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THE BOILER MAKER

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Note—Illustrated articles are marked with an (*) asterisk.

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THE BOILER MAKER

JANUARY, 1918

Revision of A. S. M. E. Boiler Code*

Proposed Revision of Boiler Code Recommended by Boiler Committee—Modification of Previous Revisions and Additional Proposals

The Council of the American Society of Mechanical Engineers directed that a hearing be conducted in accordance with the recommendation in the Boiler Code that a meeting at which all interested parties may be heard be held at least once in two years to make such revisions as may be found desirable in the Code and to modify the Code as the state of the art advances. The first of these meetings was held at the Society's headquarters in New York, December 8 and 9, 1916.

The Council also directed that the proposed revisions in the Boiler Code be published in the *Journal* of the Society, with the request that they be fully and freely discussed, so as to make it possible for anyone to suggest changes before the Rules are brought to the final form and presented to the Council for approval. Discussions should be mailed to Mr. C. W. Obert, Secretary of the Boiler Code Committee, 29 West Thirty-ninth street, New York, N. Y., and they will be presented and acted on by the Boiler Code Committee.

Revisions formulated by the Committee earlier in the year were published in the June, 1917, issue of the *Journal* of the American Society of Mechanical Engineers, pages 517 to 522, and in the August, 1917, issue, page 705. The revisions which follow are divided into two parts, namely: Part I, Modifications of the Proposed Revisions published in the June and August issues (modifications being made to conform with recommendations submitted to the Committee by those discussing the proposed revisions), and Part II, Additional Revisions proposed by the Boiler Code Committee.

PART I

Modifications of the Proposed Revisions Published in June and August Issues of the A. S. M. E. Journal

Page 50

Par. 200. Change Par. 200 to make it read as follows:

200. *Staybolts.* The ends of screwed staybolts shall be riveted over or upset by equivalent process. Staybolts must be hollow or the outside ends of solid staybolts, 8 inches and less in length, shall be drilled with a hole at least 3/16 inch diameter to a depth extending at least ½ inch beyond the inside of the plates, except on boiler having a grate area not exceeding 15 square feet, or the equivalent in gas or oil fired boilers, where the drilling of staybolts is optional. Solid staybolts over 8 inches long, and flexible staybolts of either the jointed or ball and socket type need not be drilled.

Par. 201. Add to Par. 201 the following:

If the outstanding legs of the two members are fastened together so that they act as one member in resisting the bending action produced by the load on the rivets attaching the members to the head of the boiler, and provided that the spacing of these rivets attaching the members to the head is approximately uniform, the members may be computed as a single beam uniformly loaded and supported at the points where the through braces are attached.

Par. 214. Change Par. 214 to make it read as follows:

214. *Areas of Segments of Heads to be Stayed.* The area of a segment of a head to be stayed shall be the area enclosed by lines drawn 2 inches from the tubes and a distance d from the shell as shown in Figs. 13 and 14. The value of d used shall be the larger of the following values, but not less than 3 inches.

(1) $d =$ the outer radius of the flange, not exceeding eight times the thickness of the head,

(2) $d = \dfrac{5 \times t}{\sqrt{P}}$,

Where $d =$ unstayed distance from shell in inches,
$t =$ thickness of head in sixteenths of an inch,
$P =$ maximum allowable working pressure in pounds per square inch.

Par. 215. Change Par. 215 to make it read as follows:

215. When the heads of drums of watertube boilers are 30 inches or less in diameter and the tube plate is stiffened by flanged ribs or gussets, no stays need be used if a hydrostatic test to destruction of a boiler or unit section built in accordance with the construction, shows that the factor of safety is at least five.

Page 54

Table 4. Several revisions have been made in Table 4, and it will now read as follows:

Table 4—Maximum Allowable Stresses for Stays and Staybolts

	Description of Stays.	Stresses, Pound Per Square Inch. For Lengths Between Supports Not Exceeding 120 Diameters	For Lengths Between Supports Exceeding 120 Diameters.
a	Unwelded or flexible stays less than twenty diameters long screwed through plates with ends riveted over..........	7,500	......
b	Unwelded stays and unwelded portions of welded stays, except as specified in line *a* and line *c*..........	9,500	8,500
c	Steel through stays exceeding 1½ inches diameter..........	10,400	9,000
d	Welded portions of stays..........	6,000	6,000

Page 58

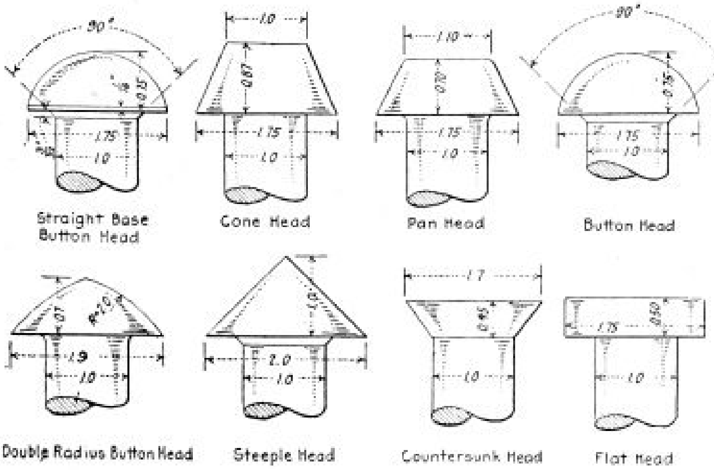
Par. 231. Change Par. 231 to make it read as follows:

231. *Maximum Allowable Working Pressure on Trun-*

* Reprinted from The Journal of the American Society of Mechanical Engineers, December, 1917.

cated Cones. a. Upper combustion chambers of vertical submerged tubular boilers made in the shape of a frustum of a cone, when not over 38 inches diameter at the large end, may be used without stays if computed by the rule for plain cylindrical furnaces (Par. 239) making *D* in the formula equal to the diameter at the large end, and provided that the longitudinal joint conforms to the requirements of Par. 239.

b. When over 38 inches in diameter at the large end, that portion which is over 30 inches in diameter shall be fully supported by staybolts or gussets to conform to the



Proportions may be larger or 1/10 smaller than those shown.

Fig. 17*a*.—Acceptable Forms of Rivet Heads

provisions for staying flat surfaces. In this case the top row of staybolts shall be at a point where the cone top is 30 inches or less in diameter.

In calculating the pressure permissible on the unstayed portion of the cone, the vertical distance between the horizontal planes passing through the centers of the rivets at the cone top and through the center of the top row of staybolts shall be used as *L* in Par. 239, and *D* in that paragraph shall be the inside diameter at the center of the top row of staybolts.

PAGE 61

Par. 239. Insert after the formula and just preceding the example in Par. 239, eliminating the present sentence:

Where the furnace has a riveted longitudinal joint, it may be of the lap type for inside diameters not exceeding 36 inches for furnaces 36 inches or less in height or length, and for inside diameters not exceeding 30 inches, irrespective of the height or length. Otherwise butt and strap construction shall be used. The efficiency of the joint shall be greater than:

$$\frac{P \times D}{1{,}250 \times T}$$

PAGE 64

Par. 246. As stated in the June issue of the *A. S. M. E. Journal,* it had been decided to change Par. 246 to Par. 246*a*, and to add Par. 347, calling it Par. 246*b*. Since the publication of the June issue of the *Journal* it has been proposed to revise this new Par. 246*b* (formerly Par. 247) to read as follows:

b. A cast-iron header, when tested to destruction, shall withstand a hydrostatic pressure of at least 1,200 pounds per square inch, and a malleable iron header, 1,500 pounds. A hydrostatic test at 400 pounds per square inch for cast iron and 500 pounds per square inch for malleable iron shall be made on all new headers with tubes attached.

This has been referred to a sub-committee of the Boiler Code Committee on Malleable Iron for consideration.

Par. 247. As it was decided to change Par. 247 to Par. 246*b*, a new Par. 247 was proposed and published in the June issue of the *A. S. M. E. Journal.* The new paragraph contained two parts, *a* and *b*. It has been decided to omit the first part, *a*, entirely, and to revise the remaining portion slightly, so that Par. 247 will read as follows:

247. Where it is impossible to calculate with a reasonable degree of safety the strength of a boiler structure or any part thereof, a full-sized sample shall be built by the manufacturer and tested to destruction in the presence of the Boiler Code Committee or one or more representatives of the Boiler Code Committee appointed to witness such test.

PAGE 65

Par. 253. Change Par. 253 to make it read as follows:

253. *Drilling of Holes.* All rivet holes and staybolt holes and holes in braces and lugs shall be drilled full size or they may be punched not to exceed ¼ inch less than full diameter for material over 5/16 inch in thickness, and ⅛ inch less than full diameter for material not exceeding 5/16 inch in thickness, and then drilled or reamed to full diameter with plates, butt straps, braces, heads and lugs bolted in position. Tack bolts for seams shall be not over 12 inches apart.

Par. 255. The illustration showing forms of rivet heads that will be acceptable is Fig. 17*a*.

PAGE 68

Par. 268. Change Par. 268 to make it read as follows:

268. *Threaded Openings.* A threaded pipe connection 1 inch in diameter or over shall have not less than the number of threads given in Table 7.

TABLE

If the thickness of the material in the boiler is not sufficient to give such number of threads, the opening shall be reinforced by a pressed steel, cast steel, or bronze

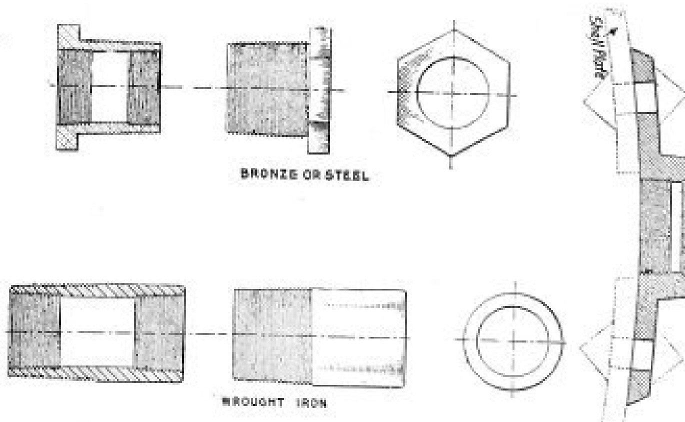


Fig. 18*a*.—Types of Boiler Flanges and Bushings

composition flange, or plate, so as to provide the required number of threads as shown in Fig. 18*a*.

When the maximum allowable working pressure exceeds 100 pounds per square inch, a flanged nozzle shall be used for all threaded pipe openings over 3-inch pipe size.

Par. 269. Change Par 269 to make it read as follows:

269. *Safety Valve Requirements.* Each boiler shall have two or more safety valves, except a boiler for which one safety valve having a relieving area of ¾ square inch or less is required by the rules.

PAGE 69

Par. 273. Change Par. 273 to make it read as follows:

273. Each safety valve shall be plainly marked by the manufacturer. The markings may be stamped on the body, cast on the body, or stamped, etched, or cast on a plate or plates riveted to the body, and shall contain the following:

a. The name or identifying trademark of the manufacturer.

b. The nominal diameter with the words "Bevel Seat" or "Flat Seat."

c. The steam pressure at which it is set to blow.

d. The lift in inches of the valve disk from its seat, measured at a pressure 3 percent higher than that at which the valve is set to blow.

e. The weight of steam discharged in pounds per hour at a pressure 3 percent higher than that for which the valve is set to blow.

f. A. S. M. E. Standard.

PAGE 74

Par. 282. Change Par. 282 to make it read as follows:

282. For the purposes of inspection and to insure the valve being free, each safety valve shall have a substantial lifting device by which the valve may be raised from its seat at least 1/16 inch when there is no pressure on the boiler.

Par. 283. Add to Par. 283 the following:

The seats and disks of safety valves shall be non-ferrous material. The seat of a safety valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

Par. 284. Add to Par. 284 the following:

284. Springs used in safety valves shall not show a permanent set exceeding 1/32 inch ten minutes after being released from a cold compression test closing the spring solid. The spring shall be so constructed that the valve can lift from its seat one-tenth the diameter of the seat before the coils are closed or before there is other interference.

Par. 286. Change Par. 286 to make it read as follows:

286. All flange dimensions shall conform to the American Standard given in Tables 15 and 16 of the Appendix for the pressures therein specified except that the faces of the safety valve flange and the nozzle to which it is attached may be flat and without the raised face for pressures up to and including 250 pounds per square inch. For higher pressures, the raised face shall be used.

PAGE 75

Par. 291. Add to Par. 291 the following:

The lowest permissible water level for various classes of boilers shall be the location of the fusible plug as given in Par. 430 of the Appendix.

Par. 292. A revision of this paragraph was published in the June issue of the *A. S. M. E. Journal*, but it has been finally decided to cancel this proposed revision and to leave Par. 292 as it stands in the 1914 edition of the Code. This matter has been referred to a special sub-committee of the Boiler Code Committee.

PAGE 76

Par. 299. Change Par. 299 to make it read as follows:

299. *Nozzles and Fittings.* Flanged cast iron pipe fittings used for boiler parts, for pressures up to and including 160 pounds per square inch, shall conform to the American Standard given in Tables 15 and 16 of the Appendix, except that the face of the flange of a safety valve, as well as that of a safety valve nozzle, may be flat and without the raised face. For pressures above 160 pounds per square inch, steel cast or wrought steel fittings shall be used for boiler parts with exceptions specified in Pars. 9 and 12. An allowable variation of 20 percent from the flange thickness required by Tables 15 and 16 may be made for steel cast and forged steel fittings, leaving the drilling of bolt holes unchanged. For pressures above 250 pounds per square inch, the flange thickness and the thickness of the bodies shall be increased to keep within the same deflection limits and to give at least the same factor of safety as the fittings specified in Tables 15 and 16. The flange of a safety valve may have a flat face for pressures up to and including 250 pounds per square inch, and shall have a raised face at higher pressures; a safety valve nozzle may have a flat face for pressures up to and including 250 pounds per square inch, and shall have a raised face at higher pressures. Tables 15 and 16 do not apply to flanges on the boiler side of steam nozzles or to flanges left by the manufacturer as part of the boiler, and do not apply to fittings designed as part of the boiler.

Par. 307. Change Par. 307 to make it read as follows:

307. *Blow-off Piping.* A surface blow-off shall not exceed 1½-inch pipe size and the internal and external pipes shall form a continuous passage, but with clearance between their ends and arranged so that the removal of either will not disturb the other. A properly designed brass or steel bushing as shown in Fig. 18A or flanged connection, shall be used.

PAGE 77

Par. 311. Change Par. 311 to make it read as follows:

311. *a.* On all boilers except those used for traction and portable purposes, when the maximum allowable working pressure exceeds 125 pounds per square inch, each bottom blow-off pipe shall have two valves, or a valve and a cock, and such valves, or a valve and cock, shall be extra heavy, except that on a boiler having multiple blow-off pipes, a single master valve may be placed on the common blow-off pipe from the boiler, in which case only one valve on each individual blow-off is required.

b. All traction and portable boilers shall have one bottom blow-off valve; when the maximum allowable working pressure exceeds 125 pounds per square inch, the blow-off valve shall be extra heavy.

Par. 315. Allow the revision to stand as it appears in the June *A. S. M. E. Journal* and add to it the following:

In Fig. 18*a* is illustrated a standard form of flange to use on boiler shells for passing through piping such as feed, surface, blow-off connections, etc., and which permits of the pipes being screwed in solid from both sides in addition to the reinforcing of the opening in the shells.

PAGE 79

Par. 325. Allow the revision to stand as it appears in the June *A. S. M. E. Journal* and add to it the following:

For traction or portable boilers, studs with pipe threads may be used.

Par. 328. Change Par. 328 to make it read as follows:

328. A watertube boiler shall have the firing door or clinker doors of the inward opening type unless such doors are provided with substantial and effective latching or fastening devices to prevent them from being blown open by pressure on the furnace side.

PAGE 82

Par. 343. Allow the revision to stand as it appears in the June issue, *A. S. M. E. Journal*, except that it is now made one paragraph, as follows:

343. In a *hot-water* boiler to be used exclusively for heating buildings or hot-water supply, when the diameter does not exceed 60 inches and the grate area does not exceed 10 square feet, or equivalent as defined in Pars. 359 and 360, longitudinal lap joints will be allowed. When the grate area exceeds 10 square feet, or equivalent, as defined in Pars. 359 and 360, and the diameter of the boiler does not exceed 60 inches, longitudinal lap joints will be allowed provided the maximum allowable working pressure does not exceed 50 pounds per square inch.

PAGE 113—APPENDIX

Par. 430. A revision of the first line of Par. 430 was published in the June issue of the *A. S. M. E. Journal*. It has now been decided to cancel this revision and let the first line stand as it appears in the 1914 edition of the Code. In the June *Journal* a proposed addition to Par. 430 was published, and it has been decided to allow this addition to remain as it appears in the *Journal*, so that the final form of Par. 430 is the same as in the 1914 edition of the Code with the addition of clause *v*, as follows:

v. Fire engine boilers are not usually supplied with fusible plugs. Unless special provision is made to keep the water above the firebox crown sheet other than by the natural water level, the lowest permissible water level shall be at least 3 inches above the top of the firebox crown sheet.

PART II

ADDITIONAL REVISIONS PROPOSED BY THE BOILER CODE COMMITTEE

PAGE 1

Title Page. Change line at bottom of page 1, which reads as follows:

Edition of 1914 with Index

to read as follows:

Edition of 1918

(New edition of Boiler Code to be copyrighted under date of 1918.)

PAGE 2

Letter to the Council. Change letter to the Council to read as follows:

To the Council of The American Society of Mechanical Engineers.

GENTLEMEN: Your Committee respectfully submits the following revised report on rules for the construction of, and allowable working pressures on stationary boilers, this report forming a part of the task that has been assigned to it. Stationary boilers as here considered are land boilers and include portable and traction boilers. The rules do not apply to boilers which are subject to federal inspection and control, such as marine boilers, boilers of steam locomotives and other self-propelled railroad apparatus.

The primary object of the rules is to secure safe boilers. The interests of boiler users and manufacturers have been carefully considered and the requirements made such that they will not entail undue hardship by departing too widely from present practice.

The Code applies only in part to certain special forms of boilers, such as those of the forced circulation or flash type. New matter has been added to state that the material for boilers of this class shall conform to the requirements of the Code, and that other requirements shall also be met except where they relate to special features of construction made necessary in boilers of this type, and to accessories that are manifestly not needed or used in connection with such boilers, such as water gages, water columns and gage cocks.

In those States and municipalities which have adopted the Boiler Code, your Committee recommends that all requests for interpretations of the Boiler Code be referred to the State authorities having jurisdiction over such matters. In order to maintain uniformity of practice it is also suggested that the authorities having jurisdiction be requested to submit all inquiries where there is any question of doubt to the Boiler Code Committee. Where there is a question respecting the interpretation of the Code, or where constructions apparently are not covered by the Code, it will be most desirable to have the matter referred to the Boiler Code Committee. Unless this procedure is followed, the aim to obtain uniformity in the application of the Code will be defeated. The Boiler Code Committee desires to co-operate to the limit of its ability in assisting in the application of the Code, and will take pleasure in considering all matters where there is any question of doubt that may be brought before it by the various States and municipalities that adopt the Code.

The committee does not pass on questions concerning specific designs of boilers or appurtenances thereto.

Your Committee recommends that a hearing be held by the Boiler Code Committee at least once in four years at which all interested parties may be heard, in order that such revisions may be made as are found to be desirable as the state of the art advances.

Yours truly,
JOHN A. STEVENS, *Chairman*.

William H. Boehm, Boiler Insurance.
Rolla C. Carpenter, Engineering Research.
Frank H. Clark, Railroad Sub-Committee, The American Society of Mechanical Engineers.
Francis W. Dean, Consulting Engineers.
Thomas E. Durban, Chairman, The American Uniform Boiler Law Society. All types of boilers.
Elbert C. Fisher, Scotch marine and other types of boilers.
Charles E. Gorton, Steel heating boilers.
Arthur M. Greene, Jr., Engineering Education.
Richard Hammond, Scotch marine and other types of boilers.
A. L. Humphrey, Railroad Sub-Committee, The American Society of Mechanical Engineers.
Charles L. Huston, Boiler plate manufacturer.
D. S. Jacobus, Water-tube boilers.
S. F. Jeter, Boiler Insurance.
William F. Kiesel, Jr., Railroad Sub-Committee, The American Society of Mechanical Engineers.
W. F. MacGregor, National Association of Tractor and Thresher Manufacturers.
Edward F. Miller, Engineering Research.
M. F. Moore, Steel heating boilers.
I. E. Moultrop, Boiler users.
Richard D. Reed, Cast iron heating boilers.
H. H. Vaughan, Railroad Sub-Committee, The American Society of Mechanical Engineers.
C. W. Obert, Secretary to Committee.

PAGE 5

Heading: Insert above heading of p. 5 the following:

A. S. M. E. Boiler Code.

PAGE 7

Heading: Insert above heading of p. 7 the following:

A. S. M. E. Boiler Code.

PAGE 8

Par. 9. It has been proposed to add a sentence to Par. 9, as follows:

Malleable iron may be used when the maximum allowable working pressure does not exceed 200 pounds per square inch, and the maximum inside diameter or diagonal dimension does not exceed 7 inches.

This has been referred to a sub-committee of the Boiler Code Committee on Malleable Iron for consideration.

Par. 14. Insert the following at the beginning of Par. 14:

In determining the maximum allowable working pressure.

PAGE 10

Par. 21. Add to Par. 21 the following:

Specifications and maximum allowable working pressures for various gages for superheater tubes shall be the same as for watertubes.

PAGE 12

Par. 29*b*. Strike out the words "or under" from the first line.

PAGE 44

Par. 182. Modification of this paragraph is in the hands of a special sub-committee of the Boiler Code Committee of Back Pitch.

PAGE 46

Par. 192. Add new section to Par. 192, as follows:

c. The strength of those ligaments between the tube holes which are subjected to a longitudinal stress shall be at least one-half the required strength of those ligaments which come between the tube holes which are subjected to a circumferential stress.

PAGES 55-56

Par. 221. Replace Fig. 15 by revised cut.

PAGE 47

Par. 193. Modification of this paragraph is in the hands of a special sub-committee of the Boiler Code Committee on Diagonal Ligaments.

PAGE 49

Par. 198. Change Par. 198 to read as follows:

198. A manhole opening in a dished head shall be flanged to a depth of not less than three times the *required* thickness of the head measured from the outside.

Par. 199. Add the following at the end of Par. 199:

Acceptable proportions for the ends of through stays are indicated in Fig. 12a.

PAGE 59

Par. 234. Under "where" change derivation of D to read:

D = least horizontal distance between tube centers on a horizontal row, inch.

Immediately below the derivation of letters insert:

Where tubes are staggered the vertical distance between the center line of tubes in adjacent rows must be not less than $\frac{1}{2}\sqrt{(2dD + 4^2)}$.

The above formula has been referred to a special subcommittee of the Boiler Code Committee.

PAGE 64

Par. 245. It has been proposed to change Par. 245 to read as follows:

245. *Cast Iron and Malleable Iron Headers.* The pressure allowed on a watertube boiler shall not exceed 160 pounds per square inch when the tubes are secured to cast iron headers, nor 200 pounds when the tubes are secured to malleable iron headers. The form and size of the internal cross section perpendicular to the longer axis of a cast iron or malleable iron header at any point shall be such that it will fall within a 7-inch by 7-inch rectangle.

This has been referred to a sub-committee of the Boiler Code Committee on Malleable Iron for consideration.

Par. 251. Change Par. 251 to read as follows:

251. The ends of all tubes, suspension tubes and nipples shall be flared not less than ⅛ inch over the diameter of the tube hole on all watertube boilers and superheaters, or they may be flared not less than ⅛ inch, rolled and beaded, or flared, rolled and welded.

PAGE 65

Par. 254. Change Par. 254 to read as follows:

254. After drilling or reaming rivet holes the plates and butt straps shall be separated, the burrs and chips removed, the plates and butt straps reassembled metal to metal with barrel pins fitting the holes, and with tack bolts.

Par. 256. Change Par. 256 to read as follows:

256. Rivets shall be machine driven wherever possible with sufficient pressure to fill the rivet holes, and shall be allowed to cool and shrink under pressure. Barrel pins fitting the holes and tack bolts shall be used. The tack bolts shall be not over 12 inches apart, and a rivet shall be driven each side of each tack bolt before removing the tack bolt.

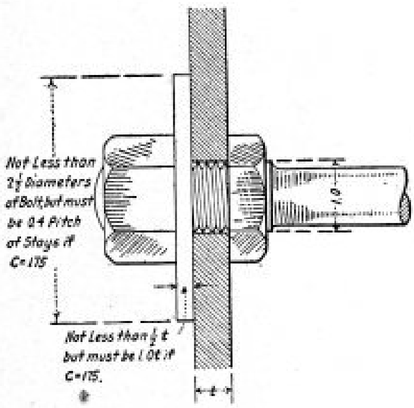


Fig. 12a.—Acceptable Proportions for Ends of Through Stays

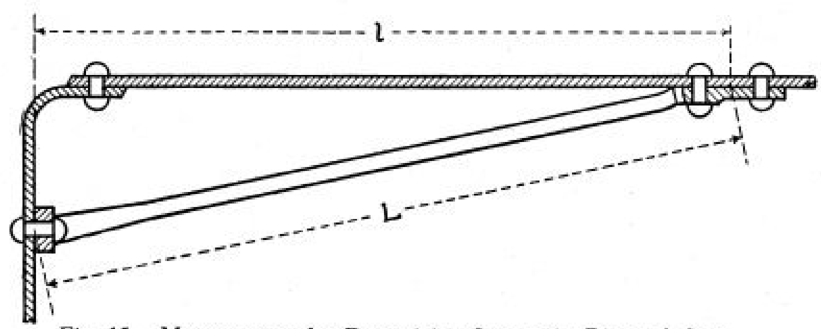


Fig. 15.—Measurements for Determining Stresses in Diagonal Stays

PAGES 65-66

Pars. 260-261:

The Executive Committee of the Boiler Code Committee will report later respecting openings that need not be reinforced and on methods of reinforcing openings that need not come under the same rules as for manholes.

PAGE 67

Par. 261. Change the two lines of Par. 261 at the top of p. 67 to read:

l = length of center line of opening in shell in direction parallel to axis of shell plus the sum of the diameters of the rivet holes that come in or adjacent to the center line of the opening, inch.

PAGE 69

Par. 272. Change Par. 272 to read as follows:

272. Safety valves shall be of the direct spring loaded pop type with seat and bearing surface of the disk inclined at any angle between 45 degrees and 90 degrees to the center line of the spindle. The valve shall be rated at a pressure 3 per cent in excess of that at which the valve is set to blow.

Safety valves may be used which are constructed with pilot valves or assistant cylinders. Such valves may give any opening up to the full discharge capacity of the area of the opening at the base of the valve, provided the opening of the valve is gradual, so as not to induce lifting of the water in the boiler.

All safety valves shall be so constructed that shocks, detrimental to the valve or boiler, are not produced.

The question of the blow-down limit has been referred back to the Executive Committee.

Par. 274. Change Par. 274 to read as follows:

274. The minimum allowable relieving capacity of the safety valve or valves required on a boiler shall be determined on the basis of 6 pounds of steam per hour per square foot of boiler heating surface for watertube boilers. For all other types of power boilers with pressure above 100 pounds the minimum allowable relieving capacity shall be determined on the basis of 5 pounds of steam per hour per square foot of boiler heating surface, and on the basis of 3 pounds with pressures at or below 100 pounds per square inch. The heating surface shall be computed for that side of the boiler surface exposed to the products of combustion, exclusive of the superheating surface. In computing the heating surface for this purpose only the tubes, fireboxes, shells, tube sheets and the projected area of headers need be considered. The minimum number of safety valves required shall be determined on the basis of the minimum allowable relieving capacity and the relieving capacity marked on the valves by the manufacturer.

PAGE 74

Par. 287. Change Par. 287 to read as follows:

287. When the valve body is marked with letters A. S. M. E. Std., as required by Par. 273, this shall be a guarantee by the manufacturer that the valve conforms with the details of construction herein specified.

Par. 288. Change Par. 288 to read as follows:

288. Every superheater shall have one or more safety valves near the outlet. The discharge capacity of the safety valve or valves on an attached superheater may be included in determining the number and size of safety valves for the boiler provided there are no intervening valves between the superheater safety valve and the boiler, and provided the discharge capacity of the safety valve or valves on the boiler as distinct from the superheater is at least 75 percent of the total valve capacity required.

PAGE 77

Par. 314. Omit the last sentence, so that Par. 314 reads as follows:

314. *Feed Piping.* The feed pipe of a boiler shall have an open end or ends inside of the boiler.

Par. 317. Add to Par. 317 the following:

Wherever globe valves are used on feed piping, the inlet shall be under the disk of the valve.

PAGE 79

Par. 332. Change Par. 332 to read as follows:

332. After obtaining the stamp to be used when boilers are to be constructed to conform with the A. S. M. E. Boiler Code, it is understood that a State inspector, municipal inspector, or an inspector employed regularly by an insurance company which is authorized to do a boiler insurance business in the State in which the boiler is built and in the State in which it is to be used, is to be notified that an inspection is to be made and shall inspect such boilers during construction and after completion. At least two inspections shall be made, one before reaming rivet holes and one at the hydrostatic test. In stamping the boiler after completion, if built in compliance with the Code, the builder shall stamp the boiler in the presence of the inspector, after the hydrostatic test, with the A. S. M. E. Code stamp, the builder's name and the serial number of the manufacturer. A data sheet shall be filled out and signed by the manufacturer and the inspector. This data sheet, together with the stamp on the boiler, shall denote that it was constructed in accordance with the A. S. M. E. Boiler Code.

The name of the State in which the boiler is built shall be stamped under and about one-half inch below the symbol. The name or initials of the manufacturer shall be stamped below the name of the State, together with the serial number of the boiler, and not over one-half inch therefrom. (Samples of data sheets appear in the Appendix, p ....)

Stamps for the official symbol shown in Fig. 19 are obtainable from The American Society of Mechanical Engineers.

PAGE 80

Fig. 20, Par. 332.

A revision of Fig. 20 was published in the June issue of *The Journal,* but it has been decided to revise it again as follows:

(Name of State)
.... STD.
(Manufacturer's number of boiler)
..............................1
(Name and location of builder)
(Installation No.) (Name of State)

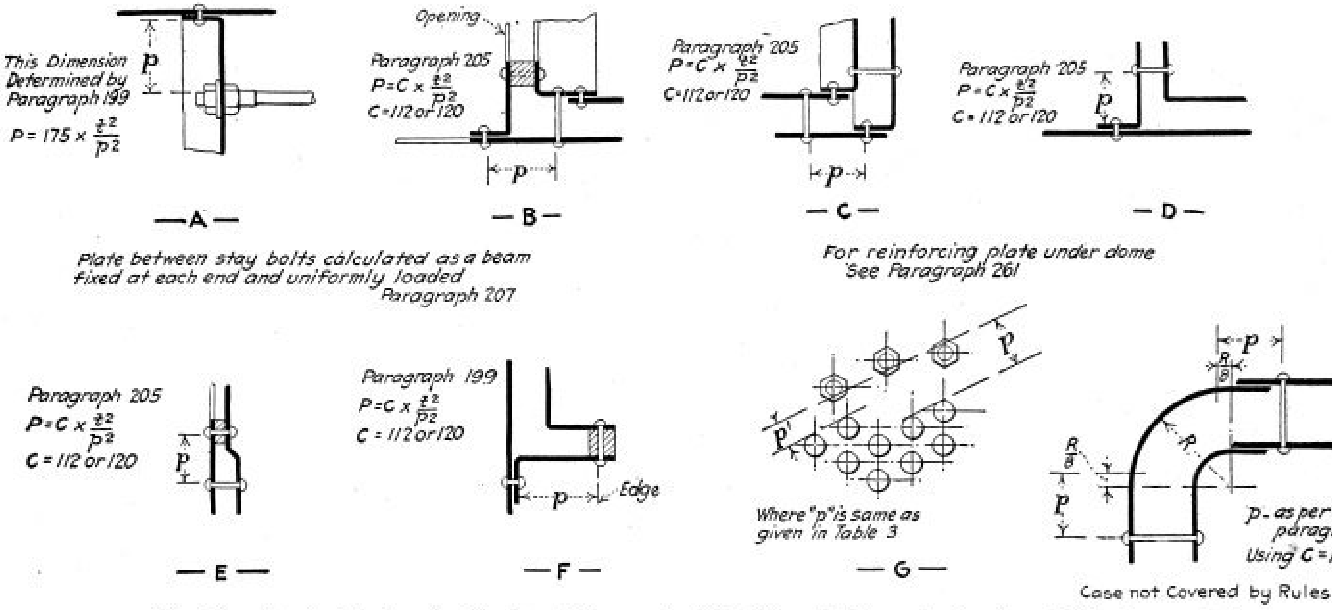


Fig. 31.—Details Showing Application of Paragraphs 205, 206 and 207 to the Staying of Wet-Bottom Boilers

MANUFACTURERS' DATA REPORT OF BOILER
As Required by the Provisions of the A.S.M.E. Rules

1. Boiler manufactured by.. at...............
2. Boiler manufactured for.. of...............
3. Type of boiler **LOCOMOTIVE** and other Internally-Fired Boilers, **STATIONARY**........................ BOTTOM Serial No................
(State if wet bottom or open bottom.)
(Alternate) HORIZONTAL RETURN TUBULAR and other Externally-Fired and Water Tube Boilers.
4. Shell plates and butt straps made by..
5. (a.) Mill test report on shell plates:........................Yield point.................... (Tensile strength. Lb. per sq. in.) (Lb. per sq. in.)
(b.) Elongation..........%. Phos....0..........%. Sul....0............%. Man....0....to 0............% (In 8 inches.)
6. Mill test report on butt straps.................................. Thickness..........in. (Brand and tensile strength.)
7. Stamps on shell plates.................................. Thickness..........in. (Brand and tensile strength.)
8. Furnace sheets made by....................Stamped.................................. Thickness..........in. (Brand and tensile strength.)
9. Heads made by......................Stamped.................................. Thickness..........in. (Brand and tensile strength.)
10. Rivets made by.. Material...................
11. Stays made by.. Material...................
12. Channel or angle irons on heads..................................Upper tubes to shell.........in. (No. and size on each head.)
13. (a.) Stays above tubes.. [No. each head, and type (through, head to head, or diagonal, welded or weldless) and net cross-sectional area of each size of each type.]
(b.) ....Area to be stayed................sq. in. (Eeach head above tubes.)
(c.) Stays below tubes.. [No. each head, and type (through, head to head, or diagonal, welded or weldless) and net cross-sectional area of each size of each type.]
(d.) ....Area to be stayed................sq. in. (Each head below tubes.)
14. (a.) Stay bolts:—Made by.........................Material........................Size..........sq. in. (Area at bottom of thread.)
(b.) Maximum pitch of.................in.×.................in. [Circumferential (or Horizontal) X Vertical.]
15. **Shell:—Diam**...............in. Length over all..............ft...............in. No. of courses........... (Inside of outside course.)
16. (a.) Longitudinal joints:—Type of.. Riveting........................ (Double, triple, quad., etc.)
Diam. rivet holes..........in. Pitch of rivets..........″×.........″×....... .″ Efficiency of joint.......% (Minimum pitch on each row.)
(b.) Circumferential joints:—Type of.. Riveting........................
Diam. rivet holes..........in. Pitch of rivets..........″×.........″×.........″ Efficiency of joint.......% (Minimum pitch on each row.)
17. Tubes—No.......Gage....... Diam.............in. Length.................ft.................in.
18. Steam outlets:—No.......... Material of nozzle or reinforcement.......................... Sizes..........in. (Cast steel or cast-iron, pressed steel or steel plate.)
19. Grate area................sq. ft.
20. Size of feed connection.......... .in. Size of bottom blow-off connection...........in.
21. Constructed for a pressure of...............lb. per sq. in. Tested to................lb. per sq. in. (Hyrostatic pressure.)
22. If boiler has a dome, send working drawing of dome, also showing connection to boiler and openings in shell under dome.

REMARKS:—..
....

We certify the above data to be correct and that all details of **MATERIAL, CONSTRUCTION** and **WORKMANSHIP** on this boiler conform to the A.S.M.E. Rules:

(Signed) .... (Manufacturer.)

..............................19 by..................................

Received ....19 Checked...................... .19 by........................ *Authorized State or Insurance Inspector*

Rules allow a max. pressure of ... lb., this being based on. ....

FIG. 32 FRONT SIDE OF DATA SHEET FORM

CERTIFICATE OF BOILER SHOP INSPECTION

Insurance Company's Serial Number.. ....
BOILER WORKS OF............ . ... at..................................

I, the undersigned, holding a certificate of competency as an inspector of steam boilers in THE STATE OF........................, and employed by the..... .... of...................., inspected internally and externally, the boiler specified in this report, on.................... ....19 , and certify that the statements made on this report are correct, corresponding with the mill test reports of material as furnished by the builders, and measurements made of the boiler when completed; and that this boiler is constructed in accordance with the A.S.M.E. Rules.

....
Inspector of Boilers for State or Boiler Insurance Company.

FIG. 33 REAR SIDE OF DATA SHEET FORM

TABLE 10—DISCHARGE CAPACITIES FOR DIRECT SPRING-LOADED POP SAFETY VALVES, WITH 45 DEGREES BEVEL SEATS.

Gage Press., Lb. Per Square Inches.		Diameter of Valve, Inches.								
		1	1¼	1½	2	2½	3	3½	4	4½
15	Lb. hr.	163	203	293	456	651	977	1,254	1,564	1,906
25	Lb. hr.	218	272	392	610	871	1,307	1,676	2,090	2,547
50	Lb. hr.	354	444	639	994	1,419	2,129	2,732	3,406	4,151
75	Lb. hr.	492	615	886	1,377	1,968	2,951	3,788	4,722	5,756
100	Lb. hr.	629	786	1,133	1,761	2,516	3,774	4,843	6,038	7,358
125	Lb. hr.	767	957	1,379	2,145	3,064	4,596	5,899	7,354	8,963
150	Lb. hr.	904	1,129	1,625	2,529	3,613	5,419	6,954	8,670	10,566
175	Lb. hr.	1,040	1,301	1,872	2,913	4,161	6,242	8,010	9,984	12,173
200	Lb. hr.	1,178	1,472	2,119	3,296	4,709	7,064	9,068	11,305	13,773
225	Lb. hr.	1,315	1,643	2,366	3,680	5,258	7,890	10,120	12,616	15,383
250	Lb. hr.	1,451	1,814	2,613	4,064	5,807	8,708	11,175	13,938	16,980
275	Lb. hr.	1,589	1,986	2,860	4,488	6,354	9,533	12,233	15,248	18,585
300	Lb. hr.	1,746	2,157	3,107	4,832	6,903	10,358	13,290	16,568	20,195

The discharge capacity of a flat seat valve of a given diameter with a given lift, may be obtained by multiplying the discharge capacity given in the table for a 45-degree bevel seat valve of same diameter and same lift by 1.4.

....................1
(Year put into service)
....

PAGE 81

Heading: Make heading of p. 81 read as follows:
A. S. M. E. Boiler Code.

PART I—SECTION II

BOILERS USED EXCLUSIVELY FOR LOW PRESSURE STEAM AND HOT WATER HEATING AND BOILERS FOR HOT WATER SUPPLY*

Par. 345. Change Par. 345 to read as follows:

345. A boiler used for low pressure steam heating or for hot water supply shall be provided with washout holes for the removal of any sediment that may accumulate therein. Steel shell boilers of the locomotive or vertical firetube type shall conform to the requirements of Pars. 265 and 266 for washout holes.

Par. 354. Change Par. 354 to read as follows:

354*a*. No shut-off of any description shall be placed between the safety or water relief valves and boilers, nor on discharge pipes between them and the atmosphere.

b. No boiler for hot water supply shall be connected to a water supply pipe fitted with a check valve or pressure reducing valve.

PAGE 86

Par. 363. Add to Par. 363 the following:

Temperature Regulator. A temperature regulator shall be applied to *hot water* supply boilers which will prevent the temperature from rising above 200 degrees F.

PAGE 89

Heading: Insert above heading of p. 89 the following:
A. S. M. E. Boiler Code.

PAGE 91

Par. 392. Change Par. 392 to read as follows:

392. In case either of the methods outlined in sections *b* or *c* of Par. 391 is employed, the safety valve capacities shall be those given in Table 10.

PAGE 95—APPENDIX

Heading: Insert above heading of page 95 the following:

A. S. M. E. Boiler Code.

PAGE 103

Par. 417. Change first sentence of Par. 417 to read as follows:

417. Figs. 28 and 29 illustrate other joints that may be used in which eccentric stresses are avoided.

Also in Appendix insert the following:

Where repairs are necessary which in any way affect the working pressure or safety of a boiler, a State inspector, municipal inspector, or an inspector employed regularly by an insurance company which is authorized to do a boiler insurance business in the State in which the boiler is used, shall be called for consultation and advice as to the best method of making such repairs; after such repairs are made they shall be subject to the approval of a State inspector, municipal inspector, or an inspector regularly employed by an insurance company which is authorized to do a boiler insurance business in the State in which the boiler is used.

Under Table 3 reference is made to Fig. 31, showing application of Pars. 205, 206 and 207.

* Domestic kitchen range boilers and their water backs, furnace heating coils and their appurtenances and domestic coil or pipe, gas or oil heaters, are not included under this Section.

JOINT MEETING OF THE SPECIAL SUB-COMMITTEE ON MATERIAL SPECIFICATIONS

A joint meeting of the special sub-committee of the Committee A-1 on Steel of the American Society for Testing Materials and the special sub-committee of The American Society of Mechanical Engineers' Boiler Code Committee, appointed to confer on the subject of material specifications, was held in the Engineering Societies Building, New York, on October 26, 1917.

Specifications for Boiler-Plate Steel.

It was agreed that 8,000-pound range for tension tests of firebox steel is too small to allow for check tests, and that in order to make check tests the range should be 10,000 pounds. It was then pointed out by those representing the Boiler Code Committee that should the range be made 10,000 pounds, the physical requirements for firebox and flange steel would be identical, with the single exception that a homogeneity test is required for firebox and not for flange steel. Those representing the Boiler Code Committee were most earnest in the belief that should the tensile requirements be made the same, something should be introduced into the specifications to further differentiate between the physical qualities of the two grades.

It was proposed that as one of the essential differences between firebox and flange steel is in the amount of discard, a test of material taken from the top of the plate might be employed to show the difference between the firebox and flange grades. The samples for the bending test in the proposed revision are specified to be taken transversely from the middle of the top of the finished rolled material, and it would seem that the requirements for these cross-bending tests could be made more exacting for firebox steel than for flange steel. After considerable discussion it was unanimously agreed that the sub-committees recommend to their respective associations that the tensile range for firebox steel be made 10,000 pounds (55,000 to 65,000 pounds) and that the requirements for the bending tests for firebox steel be made more exacting than for flange steel.

It was further agreed that a recommendation be made that the diameter of the mandrel about which a specimen is bent in the bending tests should depend on the square of the thickness of the plate.

Specifications for Steel Castings.

After consideration of the question of the sulphur requirement, it was the sense of the meeting that it would be inexpedient at the present time to make any change in the sulphur requirements for Class B steel castings.

ACTION OF BOILER CODE COMMITTEE

The minutes of the above meeting, which included a tentative rule for the diameter of mandrels to be used in the bending tests and a table of values for various thicknesses of plate, were approved as to form by the Boiler Code Committee at the meeting of November 9. At this same meeting the Boiler Code Committee directed its sub-committee to take up with the sub-committee of the American Society for Testing Materials the advisability of making homogeneity tests for firebox steel on the samples used for the bending tests, which in the proposed revision are specified to be taken transversely from the middle of the top of the finished rolled material.

High Power Feed-Water Heaters

BY FRANK C. PERKINS

Fig. 1 shows an American feed-water heater of 1,000 horsepower capacity installed at the motor cycle plant of the Hendee Manufacturing Company, Springfield, Mass., while Fig. 2 shows a 2,000 horsepower feed water heater of the American Cotton Oil Company, Cincinnati, Ohio. The largest heater, of 20,000 horsepower, or 15,000 kilowatts, is in service at the Boston Station of the Edison Electric Illuminating Company.

The coils are of seamless drawn pure copper tubing brazed solidly to special brazing metal fittings. Copper is held the best heat conductor and most durable and produces no rust in feed water and no galvanic action, and in these heaters no stuffing boxes or glands are used to leak and give trouble.

The shells can be made of sheet metal in accordance with ordinary boiler shop practice.

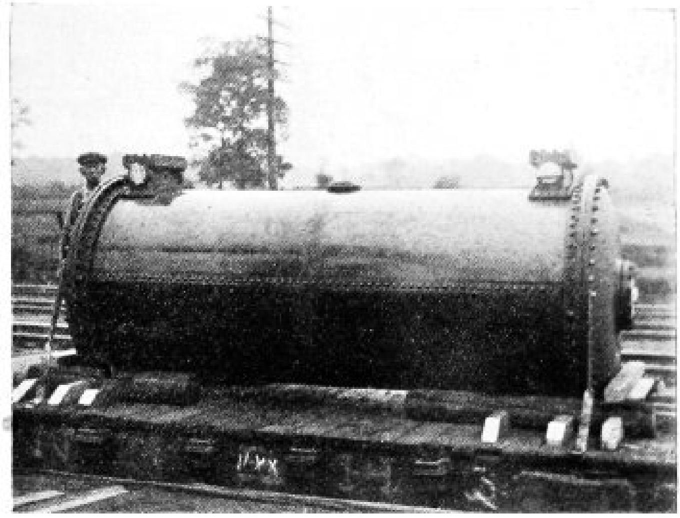


Fig. 2.—2,000-Horsepower Type B American Standard Feed Water Heater for American Cotton Oil Company, Cincinnati, Ohio

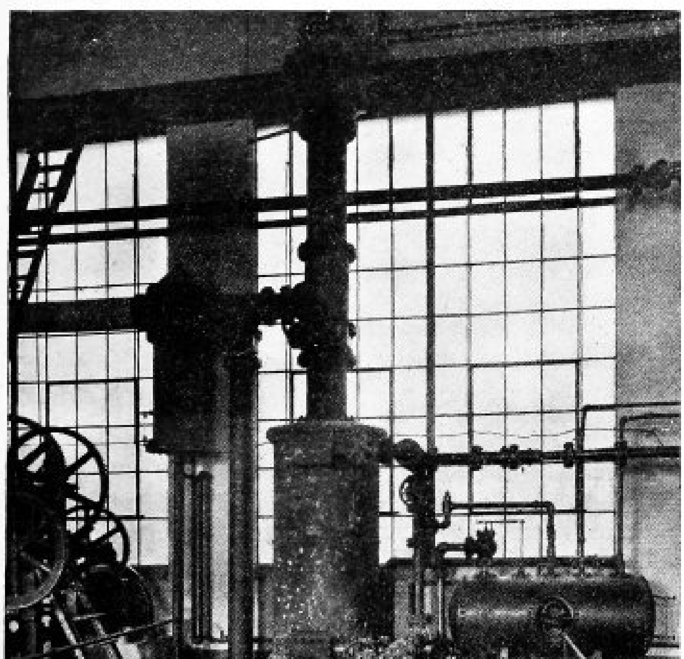


Fig. 1.—Feed Heater of 1,000-Horsepower Capacity at Hendee Manufacturing Plant, Springfield, Mass.

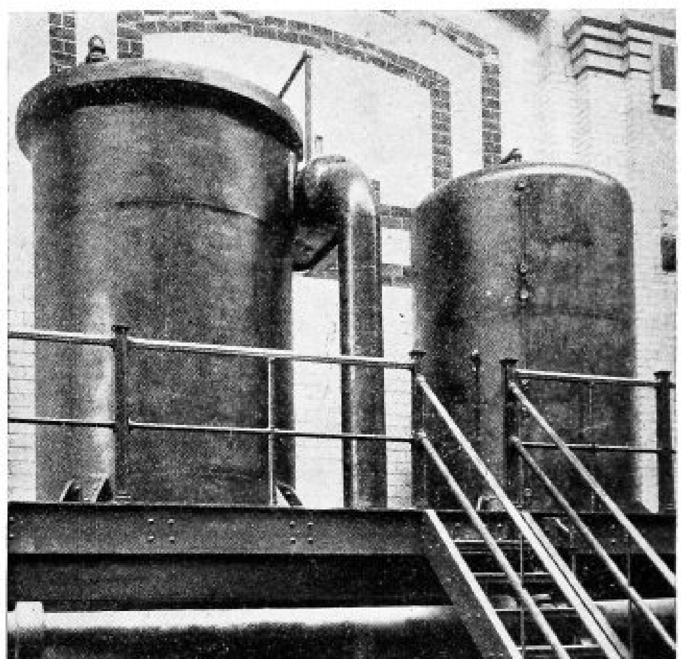


Fig. 3.—American Feed Water Heater of 20,000 Horsepower for Edison Electric Illuminating Company, Boston, Mass.

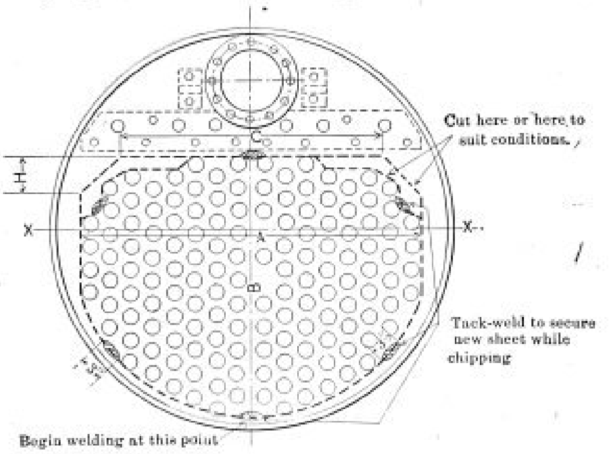
Welding Tube Sheets in Locomotive Boilers

Methods of Welding in New Front and Back Tube Sheets Adopted by Prominent Eastern Railroad

BY WM. N. ALLMAN

The subject of autogenous welding is receiving much consideration at the present time, and it is now being applied to all branches of repair and construction work.

There still seems to be considerable doubt as to the safety of autogenous welding of cylindrical vessels subjected to internal pressure, and the attitude of the Interstate Commerce Commissioner on this subject may be seen by noting the following explanation by Mr. Frank McManamy, chief inspector, who stated "some overenthusiastic friends of autogenous welding are using it for purposes which will result only in retarding its development and restricting its legitimate field. Among the uses mentioned as not meeting with approval was that of repairs to boiler sheets that are wholly in tension, without any staying to assist in their support or in the absorption



Dia. No. 1.—With Slight Modification to Suit Conditions. Cut Out Front Tube Sheet, as Shown by Heavy Dotted Lines, Clearing All Braces and Rivets

of stresses. We do not know to what extent this practice is being followed, but we have seen autogenous welding methods employed in repairing parts of locomotives which were in direct tension, and the practice would seem to have many possibilities for producing serious results. Autogenous welding processes are not a cure-all for all locomotive breakages and their use for some of the purposes indicated is likely to prove a set back to their development along legitimate lines."

Some very extensive tests with reference to autogenous welding were recently made under the direction of the Swiss Government, and some of the results are published in recent issues of the *Locomotive* published by the Hartford Steam Boiler Inspection Company.

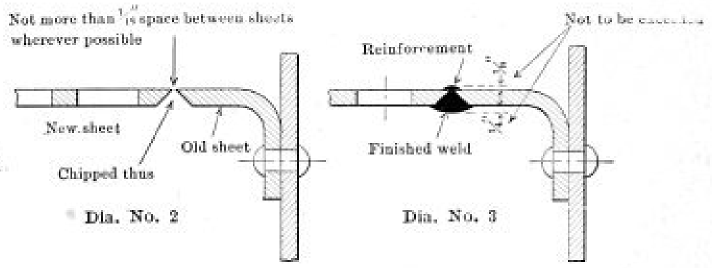
The value of autogenous welding is shown by the number of uses it is being adapted to, and at present such parts as the following are being successfully welded:

Side sheets—whole or portions.
Welding cracks in firebox sheets.
Welding cracks in bridges of tube sheets.
Eliminating all seams in fireboxes and welding joints.
Welding in tube sheets.
Welding in door sheets.
Welding mud rings.
Building up around washout holes and staybolts.
Welding up pits in tubes.

The following represents a practice to be put into effect by one of the railroads, with reference to welding in new front and back tube sheets; it will be seen that a considerable saving is effected as the stayed portion of the sheets remain intact as well as the riveted flange to the barrel of the boiler, thus saving the expenses of cutting out all the rivets in the flange and removing and renewing the stays. This also reduces the amount of new material and also results in a saving in purchase cost of material.

INSTRUCTIONS FOR WELDING IN NEW SECTION OF TUBE SHEET. FRONT TUBE SHEET

Diagram No. 1, First Operation.—Cut sheet with acetylene torch as indicated by heavy dotted lines, clearing all braces and rivets, remove old sheet and use as a templet for trimming new sheet, which is furnished without flange.



Dia. Nos. 2 and 3.—Section Through X-X, Showing Method of Chipping Old and New Sheets Before Welding

Second Operation.—Chip new and old sheet in four or more spots about 3 inches long, place new sheet in position and tack by welding, to remaining portion of old sheet in spots previously chipped, in order to hold new sheet in position while chipping.

Diagram No. 2, Third Operation.—Chip remaining portion of old sheet and new sheet, as shown.

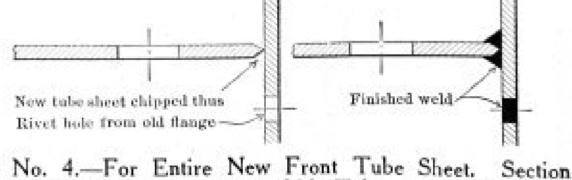
Fourth Operation.—Begin welding on smoke box side of sheet, at bottom center, and continue around to top center on either side, Diagram No. 1.

Diagram No. 3, Fourth Operation.—Reinforce weld on water side of sheet.

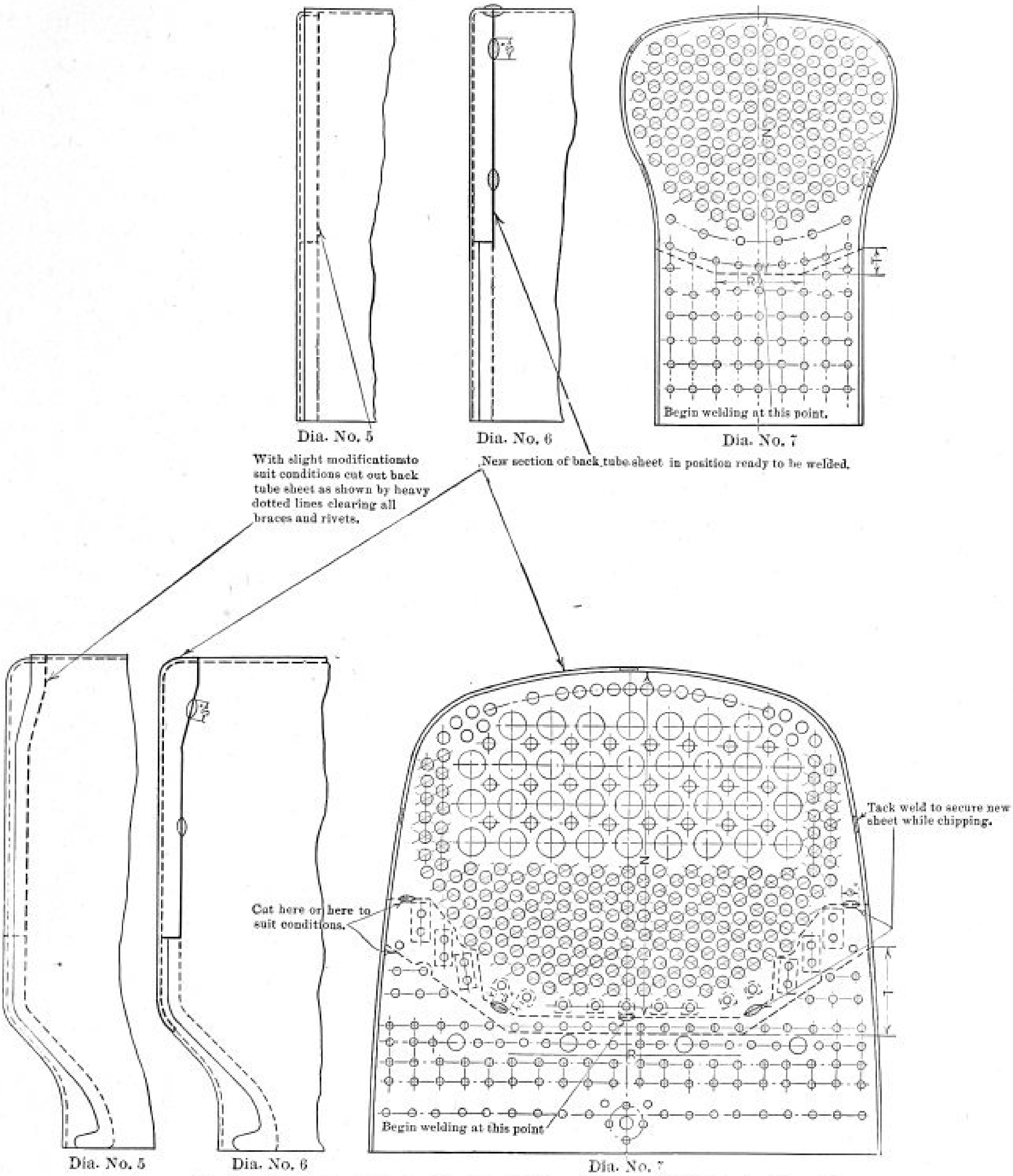
Diagram No. 4.—When entire new tube sheet is required order same without flange and chip as shown, remove old sheet including flange from boiler and use rubbing tool to clean shell where new sheet will be attached, tack by welding in four or more spots, then proceed as above.

BACK TUBE SHEET

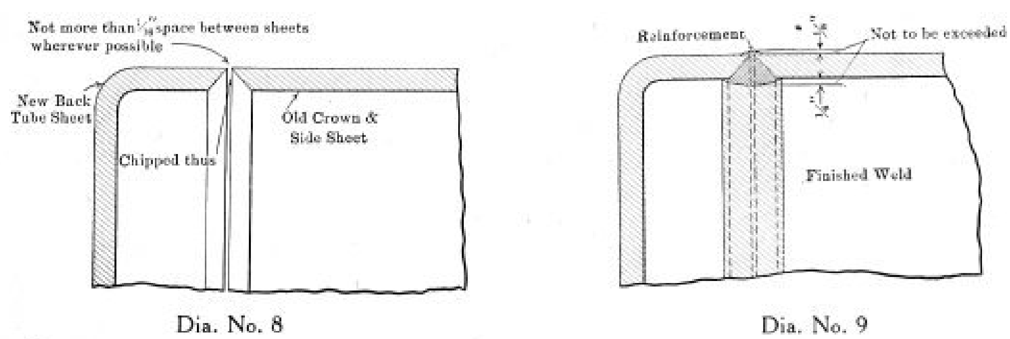
Diagram No. 5, First Operation.—Cut crown sheet and side sheets of firebox with acetylene torch as indicated by



Dia. No. 4.—For Entire New Front Tube Sheet. Section Through X-X, Showing Old Tube Sheet, Including Riveted Flange Removed and New Sheet in Place, also the Method of Chipping the Circumference of New Sheet Before Welding and the Finished Weld.



Diagrams Showing Methods of Cutting Out Back Tube Sheets and Welding in New Sheets



Section Through Center of Tube and Crown Sheets, Showing Method of Chipping Old and New Sheets, Also the Setting of Same Before Welding

heavy dotted lines at the end of flange on tube sheet and across defective portion of tube sheet in staybolt area, Diagram No. 7; remove old sheet and use as templet for trimming new sheet, which is furnished flanged, same as one removed.

Diagram No. 6, Second Operation.—Chip new and old sheets in four or more spots about 3 inches long, place new section of sheet in position, the flange butting up against crown sheet and side sheets of firebox, instead of lapping over as the old sheet, thereby eliminating the seam rivets, tack by welding to remaining portion of old sheet in spots previously chipped in order to hold new sheet in position while chipping.

Diagram No. 8, Third Operation.—Chip remaining portion of new and old sheets as shown.

Fourth Operation.—Begin welding on fireside of sheet at bottom center and continue around to top center on either side, Diagram No. 7.

Diagram No. 9, Fifth Operation.—Reinforce weld on water side of sheet if possible to reach.

Note—Dimensions as shown in Table No. 1, and as indicated by heavy dotted lines on Diagrams Nos. 1 and 7 represent maximum size of sheet and care should be used in cutting out the old sheet that these figures are not exceeded.

In order that the cut out portion of the sheets will not exceed the size of sheets carried for repairs, the table below could be extended and dimensions inserted for all the various types and classes of locomotive, sizes being indicated by the different letters on the diagrams; this will then be a guide for the workman, so that he may keep within the maximum limits when burning out the defective sheet.

TABLE NO. 1

Maximum Size Sheet Furnished, For Welding In New Tube Area

Line No.	Front Tube Sheet.					Back Tube Sheet.					
1	Class of engines..	A	B	C	H	N	R	T			

Making the Business Earn a Profit—VIII

The Trade Acceptance: Its Value, Uses and Effects on Business —Trade Acceptances Used in European Countries—Advantages

BY EDWIN L. SEABROOK

An innovation, or reform in credits, is taking place in this country with the returning use of the "trade acceptance" as a business instrument.

Since the Civil War, business in America has been conducted on the "open-account" system, although trade acceptances were in general use before the middle of the last century. During the last fifty years, however, credit inflations and money stringencies have occurred with almost methodical frequency. The possibility of another shortage of currency has been predicted by some to come within the next few months when the third Liberty Loan is floated, since about the same time the new increased income and other taxes will have to be met. In any event, the financial system of our country will probably be tested by a strain as severe as it has experienced in this generation.

It was to meet these financial strains, or the demand for more actual currency than the old method provided, that the Federal Reserve Bank was created. The Federal Reserve Bank can issue its notes (paper money) against 40 percent gold and 60 percent commercial paper. Even compared with this, the very safest form of commercial paper is the trade acceptance, because it is an acknowledgment of an indebtedness for merchandise purchased. As something of value has passed from one party to another, the indebtedness of which is acknowledged, it is considered safe by the Federal Reserve Banks to issue currency against such merchandise, which indebtedness comes to them in the form of a promise to pay by the trade acceptance. In this way money stringencies will not only be relieved but largely prevented.

The Federal Reserve Bank, and many local banks, manufacturers, wholesale houses, and credit men's organizations are at present agitating the settlement of accounts by means of the trade acceptance. When such tremendous business influences are back of this method of settling accounts, the question is surely worth study and consideration on the part of the boiler maker.

Despite all discussion in the trade and daily papers, the trade acceptance, as a method of settling accounts, seems to be far from understood by many well-to-do firms, not to say anything of those in the boiler-making business. One of the largest manufacturers, supplying a certain line in building construction work, writing on this subject, said:

"It is amusing to open a business day's mail and see the replies that are coming in from responsible firms. It is surprising to see the amount of ignorance displayed and the imaginary antagonism to this subject."

The term "trade acceptance" will be much better understood if the difference between an "open account" and one that is "closed" by some form of settlement, whereby the obligation of the buyer cannot be disputed, is recognized.

Under the open-book account there is no form of acknowledgment on the part of the buyer that he owes the account. Sales are billed thirty, sixty days, etc., but these terms of payment often mean little or nothing. It is a promise that neither party to the transaction expects to be literally fulfilled. The buyer has possession of the merchandise. He can settle a sixty-day invoice in seventy-five days, or three months, or at some other time suiting his pleasure or convenience, providing the seller is lenient with him.

Under the open-book account method the seller is practically compelled to act as banker for the buyer, either by advancing him goods on his own resources or on his own bank credit. Many boiler makers are compelled to delay

TRADE ACCEPTANCE

No. 122 New York, N. Y., August 20th 1917 $ 249.63

Forty days after date, pay to the order of RICHARDSON & BOYNTON CO.

Two hundred and forty-nine.......................63/100 Dollars

The obligation of the acceptor hereof arises out of the purchase of goods from RICHARDSON & BOYNTON CO.

ACCEPTED — DATE August 2, 1917 — PAYABLE AT Security Trust Co. (BANK) — LOCATION OF BANK Camden, N. J. — SIGNATURE James Smith

To James Smith
Camden, N. J.

RICHARDSON & BOYNTON CO.

Due September 29th 1917 By

Fig. 16.—Facsimile of Trade Acceptance

The above is a fac-simile of a trade acceptance. This is sent with the bill of goods by the seller to the buyer, the terms of payment being agreed upon in advance. The buyer "accepts" by writing across the face the name and location of the bank at which it is to be paid (generally the one in which he has an account) and his signature. The acceptance is returned to the seller, who can have it discounted if desired. It should be noted the buyer acknowledges the purchase, which places the obligation beyond dispute and a definite time is fixed for payment.

payment of their bills or borrow from the bank to meet them on time. Economically this is unsound in principle, because the buyer should finance himself. An open account is, therefore, dead capital in a certain sense, so far as the seller is concerned. This will apply with equal force to the business of the boiler maker as well as to that of the wholesaler. The result is the same, regardless of the method or name by which the merchandise or material reaches the consumer. It will be seen, therefore, that the trade acceptance will apply to the boiler maker in collecting his accounts. He can use it just the same as the manufacturer and wholesaler.

Open Accounts Indefinite

Another great defect in the open-book account is that as an asset these are too indefinite and not a sufficient tangible basis of credit standing or rating to the seller. The boiler maker going to his banker for a loan with assets chiefly represented by open-book accounts is handicapped because these are without specific acknowledgment on the part of the buyer. It is one of the easiest things in business to dispute an open account, a fact which bankers know well.

No boiler maker would care to loan money without a written acknowledgment of the specific amount due and naming a time and place of payment. In England, France and most other European countries, merchandise is sold and bought upon some such terms as one would loan money. The instrument given by the buyer acknowledges the obligation arising out of the purchase of the merchandise and fixes a definite time and place of payment. This is the trade acceptance.

Trade Acceptances Used in European Countries

In nearly all European countries there are practically no open accounts. When a merchant buys a bill of goods in Europe he never thinks of asking the seller to charge it on an open account with no other evidence to show the indebtedness. He takes it for granted that the seller will draw on him for the amount payable at a date agreed upon, and he will promptly "accept" the draft and return it at once to the seller. Unless merchandise was bought for cash the transaction would not be completed in any other way.

In France practically one-half of the paper discounted is for amounts less than $20, averaging thirty days. In that country trade acceptances are discounted at the banks in amounts as small as five francs, or one dollar. When the war broke out the Bank of France had 1,000,000 of five-franc trade acceptances, which it had discounted.

Trade Acceptances Negotiable

Trade acceptances being negotiable paper and discountable at the banks, become "live" instead of "dead" capital as represented by open accounts on the books of the seller. Representing current transactions, these furnish a circulating medium which will prevent money stringencies and panics which this country has suffered so often and so disastrously.

One of the governors of a Federal Reserve Bank is responsible for the statement that England, with her one hundred to one hundred and fifty millions in gold, is able to transact business that this country is unable to do, or afraid to do, with a billion of gold. The reason of this is that since the establishment of the Federal Reserve system it has had only about $300,000,000 of bankers' acceptances, while England always has from $1,000,000,000 to $1,500,000,000. This simply means that the English merchants are turning their transactions into currency by means of the trade acceptance.

Objections to Trade Acceptances

Many firms are hesitating about adopting or urging the use by their customers of the trade acceptance. One of the largest manufacturers, with hundreds of small firms as customers, in all parts of the country, when approached on the subject, asked: "Why should we adopt the trade acceptance? If we urge its use we will probably have to make concessions in the time of payment when a definite date is fixed by giving a written obligation." This firm looked at the proposition from the standpoint only of those who were paying promptly. It admitted, however, that when the present abnormal conditions ceased the trade acceptance would become very valuable as a stimulant to prompt payment.

The objections raised against the trade acceptance by the buyer will be perhaps more in the form of a reluctance to give a written promise to pay a definite amount of money on a certain date than anything else. It should be remembered, however, that this promise in writing is given before the bill is due and differs radically from giving a note for an overdue account, or disposing of a sight draft, which is used to secure payment of an overdue account. Both of the latter are indications of credit weakness.

Undoubtedly it will be hard to break through a practice of fifty years' standing, represented by the open-account system. This will apply to the customers of the boiler maker as well as those who buy from manufacturers and jobbers. The advantages accruing to buyer, seller and business in general will undoubtedly influence the adoption of this new form of settling accounts. These are in many respects mutual to buyer and seller, because every buyer, unless he is an ultimate consumer, is likewise a seller.

Advantages

Each transaction is in effect completed by a virtual payment upon receipt of invoice.

Open-book accounts are eliminated and in their place are bills receivable, which command a lower rediscount rate at the Federal Reserve Banks than any form of commercial paper.

It will put a stop to the practice of taking unearned discounts—a petty, unfair practice by no means uncommon.

A larger volume of business can be transacted on the same amount of capital.

It will lessen interest expense and make for economy in collections.

All orders will be legitimate, which will insure more careful buying, prevent overstocking and an accumulation of bad accounts.

It will insure prompt payment and cut down credit risks.

The giving of a trade acceptance on the part of the buyer shows his intention to pay promptly and is a good indication of the soundness of his credit. The habitual acceptance by the buyer will thoroughly establish his credit and increase his buying capacity.

It will have a tendency to assure the honest buyer that the unfair buyer shall not have unfair advantage over him through the abuses of the discount system.

It will eliminate much of the expense of collecting that is now necessary by the open-account system.

General Effect on Business

These are some of the advantages accruing to seller and buyer, but there are other advantages that will be shared by all business in general. Among these will be the stabilization of business, giving a better line of credit at the banks, increasing the lending power of banks, the scattering of bank credits, the elimination of failures due to overbuying and the accumulation of bad accounts, and giving the business of banking to bankers by eliminating the carrying of accounts by the seller.

Money stringencies will be prevented because trade acceptances can be rediscounted by the Federal Reserve Banks. William McMartin, of the Federal Reserve Bank of St. Louis, recently stated that every Federal Reserve Bank in the United States a short time ago established a rediscount rate on trade acceptances of one-half of one percent lower than on any other form of commercial paper. It is a two-name paper, which gives it a greater value in the financial market, and therefore commands a better rate of interest.

When the trade acceptances are rediscounted by the Federal Reserve Banks, Federal Reserve notes are issued against them, which really means that amount of additional money is immediately put into circulation. How much business will be quickened by converting a dead open account on the books of the seller into actual currency circulating through the community by the trade acceptance must be apparent to everyone. The minute the trade acceptance is paid the Federal Reserve notes go out of business and the obligation ceases to exist, because the trade acceptance is discharged.

How the Boiler Maker Can Use the Trade Acceptance

All the advantages claimed for the use of the trade acceptance between the wholesaler and retailer will also accrue to the boiler maker if he insists upon its use with his own customers. Building construction work, including minor contracts and jobbing, is proverbially slow pay. Probably one of the greatest reasons for this is due to those doing the work being poor collectors and not fixing a definite time for payment after the work is completed or during its performance.

It is not necessarily implied that the boiler maker should discount his trade acceptances, but the great advantage to him in having these would be to put his accounts in such liquid and definite form as to make them available for prompt use when necessary. If he secures trade acceptances he can arrange for the payment of his own accounts at a definite date and be able to meet them.

It is not to be expected that the old method of dead accounts will be quickened into a living form at a single bound. Reforms must and do come slowly. Education is necessary and time is required. Just now radical changes in business methods are taking place quickly, and there is no better time than at the beginning of this year to inaugurate the settlement of accounts by the trade acceptance system.

(To be continued.)

PERSONAL

J. S. Hardwick, formerly boiler foreman for the G. C. & S. F. Railway at Galveston, Tex., has been appointed chief planner of boiler work in the progress department at the United States Navy Yard, Norfolk, Va.

E. E. Stillwell, master mechanic at the Waters-Pierce Oil Refinery, Tampico, Mexico, resigned on December 1, 1917, to accept a position as master mechanic with the Cortez Oil Company at Tampico.

L. F. Hamilton, for the past nine years manager of the advertising and specialty department of the National Tube Company, Pittsburg, Pa., resigned on December 1, 1917, to become associated with the Walworth Manufacturing Company, Boston, Mass., as manager of sales promotion.

J. C. Bannister has been made vice-president of the Walworth Manufacturing Company, Boston, Mass. Mr. Bannister was formerly manager of the Kewanee plant of the National Tube Company at Kewanee, Ill., which has been taken over by the Walworth Manufacturing Company.

Frank A. Scott was appointed on January 1 superintendent of the Bigelow Company, New Haven, Conn.

Richard Henning, president of the Cream City Boiler Works, Milwaukee, Wis., died on November 28 at the age of fifty-five. Mr. Henning was born in Milwaukee and was one of the founders of the concern of which he was president.

Naval Watertube Boilers—II

Further Notes on Construction of Water-tube Boilers Installed on Navel Vessels

BY C. H. WILLEY

A few notes on the Niclausse boiler are given to aid those who may have to deal with this type as originally installed.

NICLAUSSE BOILERS

There is a series of double compartment headers at the front end of this boiler, one of which is shown in

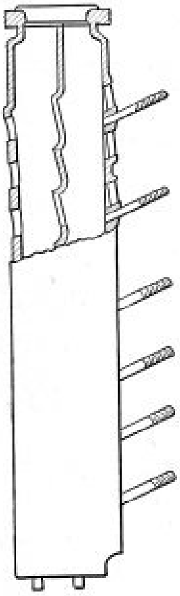


Fig. 1

Fig. 1. The field tubes are secured into these. A tube and lantern are shown in Fig. 2. The outer tubes are known as the generating tubes, the inner ones the circulators. The outer tube is closed at the rear end with a cap. The inner or circulating tube is secured at the front end to the cupped cap. A section of the tube where it is in the water chamber is cut out; the rear of this tube is open.

The joints at the front and back walls of the header are made tight by conical surfaces of the generating tube

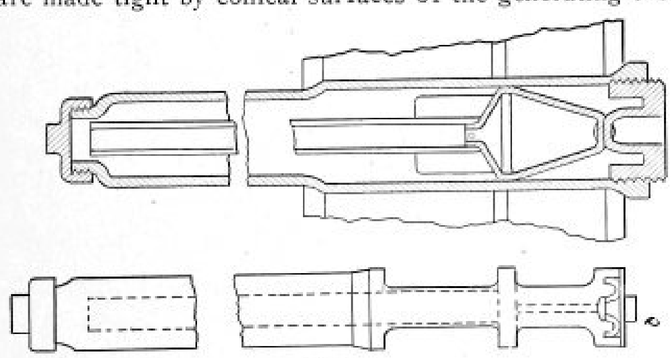


Fig. 2

and the lantern. A dog or bridge is used to secure the cap and tube. This also forces the tube and lantern home to the cone seats.

REMOVING TUBES

To take out a tube, the dog securing each pair of tubes is removed; the inner tube is unscrewed by means of a special spanner that fits into the hollow head of the tube (turning to the left). Sometimes the outer may turn while trying to turn out the inner one.

If this happens, then the two tubes should be taken out together; and after getting them out, the outer tube is gripped in a special two-part collar held in the vise, and

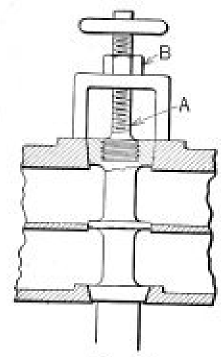


Fig. 3

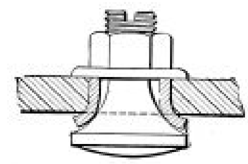


Fig. 5

the inner tube then unscrewed. Never grip the bare outer tube in the vise jaws; it is sure to be collapsed or injured.

The device shown in Fig. 3 is employed for removing the outer tubes, which are forced tightly into their cone-shaped seats. The spindle *A* screws into the threaded part where the inner tube was, and by tightening up the nut *B*, the tube is drawn out. A long rod, one that will reach into the tube clear to the rear end, is used to

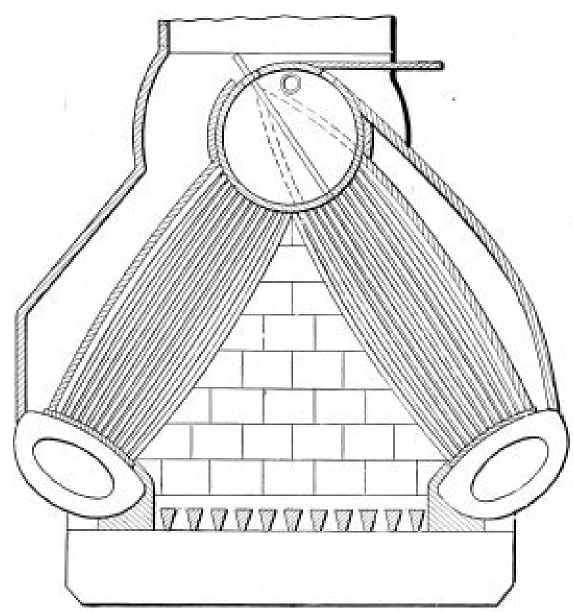


Fig. 4.—Mosher Destroyer Type Boiler

support the weight of the tube while taking it out by the head. Always revolve the tube around a little while taking it out until the lantern section is clear of the header. As soon as the tube is out, the cone seats should be greased and protected against injury.

The cap on the rear end of this tube can be unscrewed with the same spanner used on the front inner tube.

REPLACING

Inspect the machined cone seat surfaces for cleanliness and possible burrs, pitting, etc. If all is O. K., the surface is coated with grease and the tube carefully slid into the header with the assistance of the rod. There are usually some identification marks on the front of the header and tube ends to enable the proper locating of the water ways (the cut-out section of the tubes in the water space). These should all come in a vertical line.

The tubes, when in place, are rapped home on the seats with a soft copper hammer and a special plug. The inner tube is replaced, and the dogs slipped over the studs and drawn up fairly tight. It is well to remember that the seat tightness depends upon metal to metal contact of the cone surfaces; and should any foreign substance get between these when tightening up, the seat will be marred or scored.

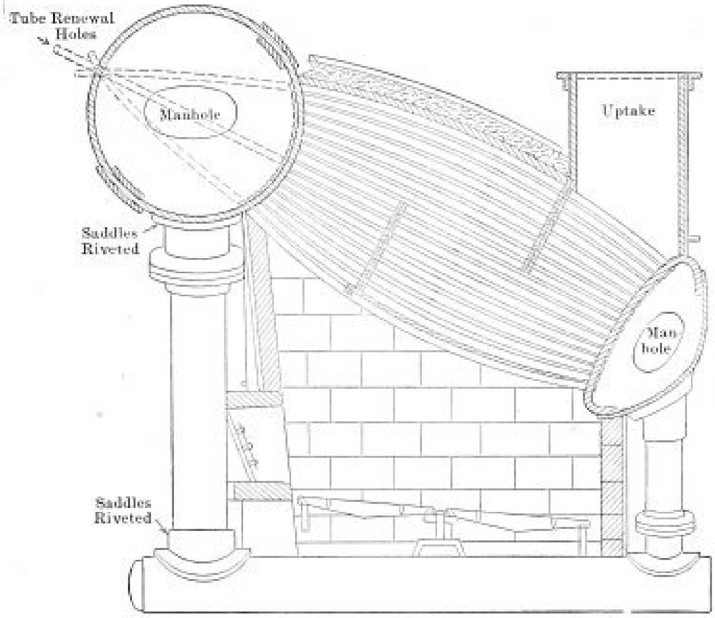


Fig. 6.—Mosher Watertube Boiler

Never take up on a leaky tube joint under steam.

MOSHER BOILERS

There are two types of this boiler. The destroyer type, as shown in Fig. 4, is fitted to the U. S. S. *Tallahassee, Samson, Nashville, Rowan* and *Smith*.

The steam drum is of cylindrical form. That part where the tube holes are is of thicker plate than the upper section. The tubes are small diameter and expand into both drums; the ends are flared. The center rows of tubes are straight, and each succeeding row is curved a small amount. The curve increases as the rows near the outside.

REMOVING AND RENEWING TUBES

There are provided on each side of the steam drum a row of holes for the purpose of inserting and removing tubes. Each of these holes is fitted with a plug, as shown in Fig. 5, the nuts being on the outside of the drum. Generally a piece of soft copper tubing is used to make these joints. The manner of removing a tube through these holes is shown in Figs. 4 and 6.

Each ship carries a supply of straight tubes which can be easily bent to a template.

The Mosher boiler of two-drum type, as fitted to the U. S. S. *Illinois, Kentucky* and *Kearsarge*, is shown in Fig. 6. There are two 8-inch vertical steel pipes or downcomers shown which connect the base of the steam drum at each end to 10-inch horizontal steel pipes, which in turn connect it to the base of the rear oval drum by the short 8-inch upflow pipes. These large steel downcomer pipes support the steam drums. The generating tubes are of 2-inch diameter. The methods of renewing and removing are the same as described for the destroyer three-drum type.

Longitudinal double butt strap joints are used on the steam drum, while the water drums are lap joints.

The tubes of this and the destroyer type do not come naturally into the tube sheets, and therefore great care must be used in expanding. Fig. 7 shows how the tube ends appear after rolling and flaring. Re-rolling after flaring insures good, tight joints.

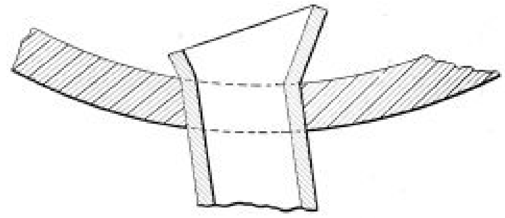


Fig. 7

THORNYCROFT BOILERS

The latest type, as fitted to the U. S. S. *Burrows, Roe, Terry, Ammen, Monaghan* and *McCall*, is shown in Fig. 8. It consists of three drums, two large downcomers, and the nest of small tubes, slightly bent at their ends to allow their entering the drums naturally. The ends of the downcomers are expanded into the drums.

There are four different types of Thornycroft boilers used in naval vessels. The others are known as the Speedy, Daring and Ohio types. All of these formerly had the upper ends of the tubes enter the steam drum above the water level. But many of them have now been changed so that the tube ends in the steam drum are below the water level.

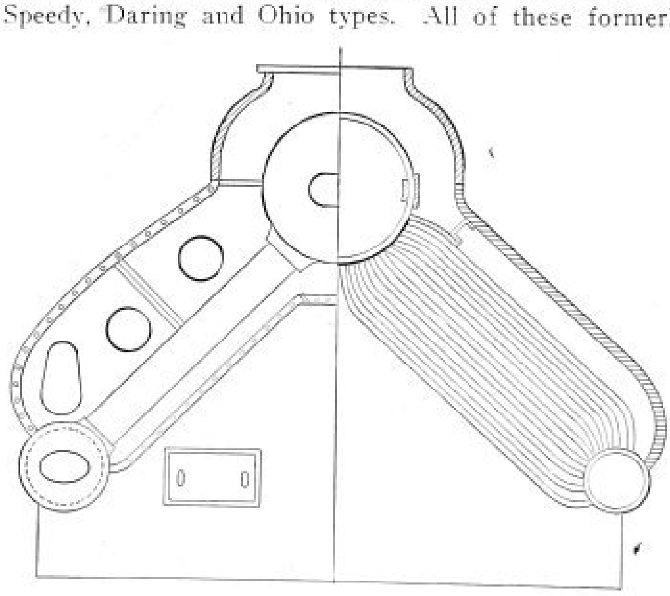


Fig. 8.—Thornycroft Boiler

The Daring type has a series of downtake pipes, or large tubes from the lower center drum connecting to the base of the steam drum.

Tubes of these bent tube type boilers, when giving trouble by leaking, have to be plugged, for to renew one generally requires taking out several others. Each ship carries spare tubes of each shape and size.

The Speedy type is installed on eleven torpedo boats, the Daring in sixteen destroyers, and the Ohio type to three battleships.

WHITE FORSTER BOILER

Two views of the boiler as fitted to the U. S. S. *Warrington, Beale, Patterson* and *Mayrant* are given in Figs. 9 and 10. It is a three-drum boiler and has rather short tubes. These tubes are all curved to the same form and

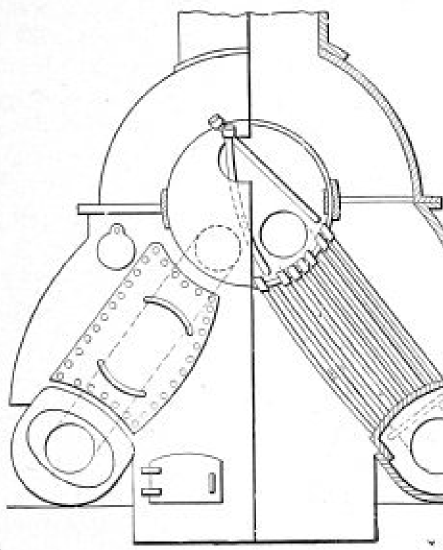


Fig. 9.—White Forster Boiler

the steam drum is larger in diameter for a short distance.

Any tube can be renewed without taking out others. They can be removed and replaced from the inside of the steam drum, the holes there being larger than the lower length of the tube permits—this being done with no undue trouble.

The manner of placing is shown in the sketch.

By twisting the tube either forwards or backwards before expanding, the curve can be placed at will, towards the rear, or to the side of the furnace.

There are two large steel downtake tubes or pipes, *A*,

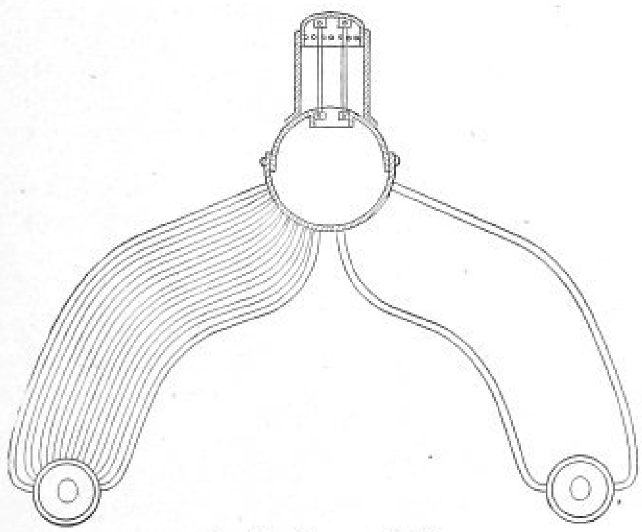


Fig. 11.—Normand Boiler

in Fig. 10, at the back of the boiler. These are secured to the rear head and to the lower water drums. There are manholes fitted to the front ends of all drums.

NORMAND BOILER

Figs. 11 and 12 serve to show the arrangement of the tubes, drums and downcomers of the Normand boiler. This boiler is installed on the *Paulding, Trippe* and *Drayton*.

The steam drum is made in two halves. The joints are lapped and triple riveted. The generating tubes are of No. 15 B. W. G. thickness, except the rows next to the fire, which are of slightly thicker gage. There are two large downcomers at the rear, and at the front ends the hollow large stays act as small downcomers.

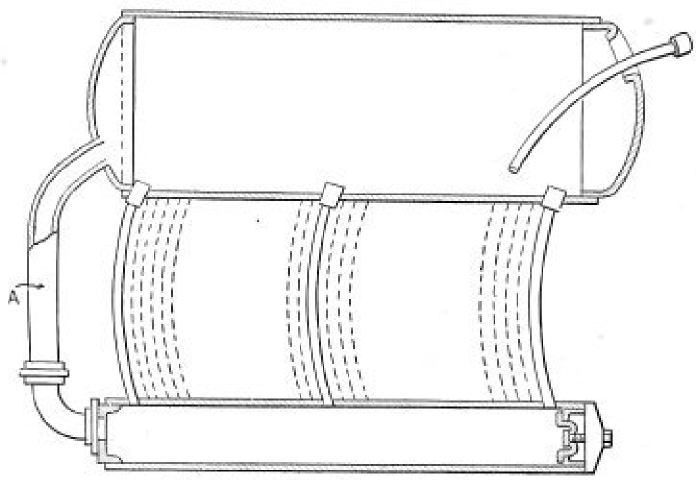


Fig. 10.—White Forster Boiler

The Normand boiler in a slightly different design is fitted to the U. S. S. *Craven, Bagly, Blakely, Porter, Morris* and others, also to the scout cruiser *Chester*. The shell joints of the latter are welded and the downcomers are at the front. The *Morris* type has no steam dome.

In the work of writing this article, the writer has consulted "Marine and Naval Boilers," published by the U. S. Naval Institute, for help in making sketches and descriptions of naval boilers.

The plant of the Tofte Boiler & Sheet Iron Works, Beaumont, Texas, which was recently destroyed by fire

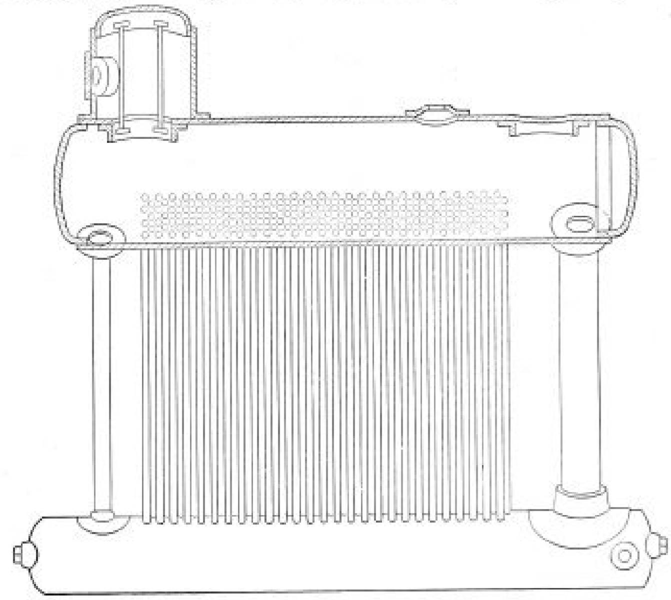


Fig. 12.—Normand Boiler

with a loss of $80,000, will be rebuilt. More than $60,000 worth of machinery will be installed.

The Milwaukee Reliance Boiler Works, Milwaukee, Wis., of which John E. Sharp is president and general manager, is building a forge and smithing shop addition 40 by 75 feet.

An Air Cooled Refuse Burner

BY FRANK C. PERKINS

The illustration shows an air-cooled refuse burner at the plant of the Onalaska Lumber Company at Onalaska, Wash. The daily capacity of the mill for 10 hours is 200,000 feet lumber and 300,000 shingles. The bottom diameter of the burner is 700 feet and the top diameter is 27 feet, while the height to the top of the dome measures 86 feet.

The superstructure of this air-cooled burner consists of a framework of structural steel and iron pipe, so designed as to provide the maximum of strength with the minimum of weight, and an outside covering, or shell, of medium weight steel plates riveted together and securely attached to framework. The lower part of the structure is conical in form, the upper part cylindrical.

The foundation consists of a concrete wall, or curb, 8 to 12 inches in thickness, about 2 feet in height above level of grates, and extending entirely around base of burner. Extending outward from this wall are pilasters, spaced about 6 feet apart, which act as a reinforcement for the wall, support the uprights of the superstructure and create uniform space for the admission of air between the wall and the outside shell of the superstructure.

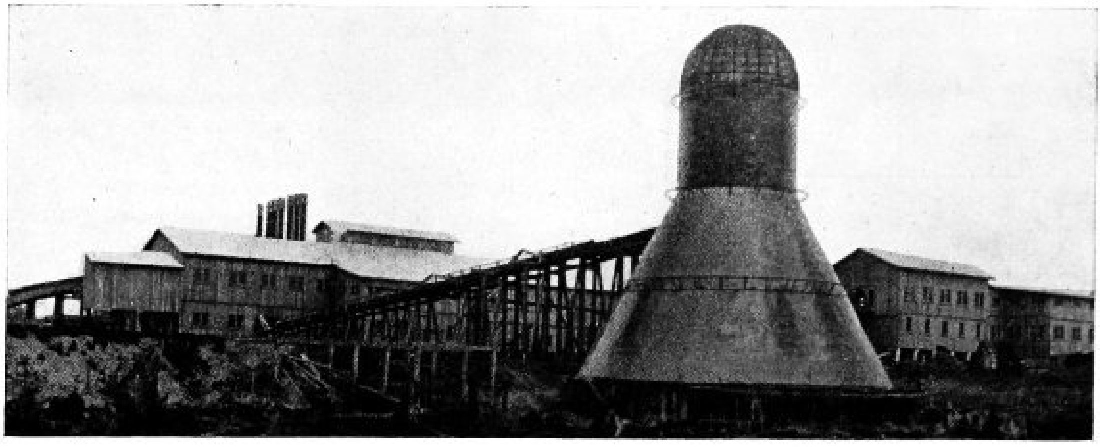
There are grates placed in center of the burner floor, the area and arrangement being governed by the amount and character of the refuse to be consumed. Tunnels are provided to supply air under the grates and to facilitate the removal of ashes. The air cooling, which is the essential feature of this burner, is brought about by the conical shape of the lower part of the structure and the admission of air in uniform quantities at all points around the base. The burner is of sufficient size at the base, so that it is impossible for refuse to come in contact with the wall, and as the cone shape conforms to the natural shape of the pile of burning refuse a uniform space for the circulation of air is maintained between the fire and the burner wall.

The heat generated by the fire causes the air in the burner to rise and pass out the top; this is replaced by air drawn in through the opening around the base, which, in turn, becomes heated and rises. The wall of the burner being conical, the air flows upward against the wall, creating a circulating air cushion between the fire and the wall. This continuous upward flow of air, automatically regulated by the intensity of the fire, prevents the burner wall from becoming overheated, and, being independent of the air supply under the grates, it absorbs and carries away a great portion of the heat generated by the fire.

It is stated that tests were recently made on an air-cooled burner, 50 feet in diameter at the base, which was consuming the refuse from a mill cutting over 100,000 feet of lumber daily. The tests were made with an electric pyrometer which was guaranteed to register within 2 percent of absolute accuracy, and the highest temperature shown at any point on the burner shell was 380 degrees F. As steel withstands 1,000 degrees without weakening, it can be readily seen that there can be no deteriorating effect on the burner from this cause.

It is pointed out that, as no part of the air-cooled burner is subjected to intense heat, neither heavy brick walls nor thick steel plates are required, consequently much less material is used in its construction than can be used in any other type of burner, and an ample factor of safety is still maintained against any contingency. The superstructure being much lighter than that of any other type of burner, no extremely heavy nor expensive foundation is required.

It is held that under normal conditions the air-cooled burner can be installed for 75 to 85 percent of the cost of an all-brick burner, 50 to 60 percent of the cost of a brick-lined steel-jacket burner, and 25 to 35 percent of the cost of a waterjacketed burner. These comparisons are not made with burners of the same diameters as the air-cooled burner, but with the sizes of each type that will consume the same amount of refuse as the air-cooled burner at the difference in cost as named, it being understood that the base diameter of the air-cooled burner is greater in proportion to its capacity than that of burners of other types.



Sheet Metal Structure Used at Lumber Mills for Burning Refuse

It is maintained that the heavy cost of maintenance in the older type of burners, caused by the necessity of renewing fire-brick linings, spark arrester screens and grates, which have been destroyed by the intense heat, is entirely eliminated in the air-cooled burner, for the reason that no fire-brick lining is used, the spark arrester screen never becomes red-hot, and there is ample air circulation underneath the grates. This air-cooled burner was developed at Chehalis, Wash.

THE DOCTRINE OF LABOR AND MATERIALS.—The present business of the United States is to win the war. The President has stated that the war can be won only if all the people of the country unite in a common purpose to defend our shores from aggression. The key to the situation, therefore, rests in the hand of the average man, woman and child in every State of the Union who can, by refraining from everything not absolutely necessary to health and efficiency, release strong arms to the production of materials of war and the support of our army and navy.

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More locomotives were ordered in 1917 than in any other year for the last seventeen years, totaling 7,642 of all kinds for domestic or foreign use. The output of locomotives as distinguished from orders placed during the year totaled 5,446, a production which has been exceeded only three times since 1899—in 1905, 1906 and 1907. These figures are compiled from official sources by *The Railway Age* and published in their annual statistical number.

The orders placed in 1917 are divided as follows: Domestic, 2,704; for the United States Government for service in France, 2,057, and for foreign countries, 2,881. While the situation as to domestic orders during the past year has been bad, due to the fact that builders and specialty manufacturers alike have been postponing orders periodically and railway men have had to be pacified with the information that deliveries have been held up for them on account of more urgent war orders, nevertheless this situation is now being remedied, so that the outlook, both for deliveries and production in 1918, looks exceedingly favorable.

War conditions, with the resulting congestion of traffic, have necessarily increased the responsibilities of the Federal locomotive inspection service. In the sixth annual report of the chief inspector, which has just been issued, it is pointed out that the problems which have confronted the Bureau in the matter of withholding locomotives from service when defective and in violation of the law, under the operating conditions which have existed since the declaration of war and during the months immediately preceding it, have been unusually difficult and have required the most careful consideration. The importance of the prompt, as well as safe, movement of trains has been constantly in mind and every privilege consistent with the purpose of the law has been granted, first, by special instructions to inspectors to exert every effort even to the extent of giving personal assistance when necessary to facilitate the prompt and safe movement of traffic, and, later, with the approval of the Commission, by means of certain modifications in the inspection rules which the representatives of the carriers claimed would be beneficial to them during the period of the war. It is to be regretted that some carriers appear to consider a congestion of traffic a legitimate excuse for operating locomotives that are known to be in an improper condition for service and in violation of the law. This is done to an extent that in the opinion of the chief inspector fully justifies the statement that, on such roads, running repairs are neglected to an extent which, if continued, will cause serious interference with the movement of traffic during the coming winter, in spite of the most diligent efforts of the limited force of Federal inspectors to enforce maintenance of locomotives, as required by the law.

The record of accidents caused by failure of locomotives or tenders, which were investigated by the Bureau, shows a total for the fiscal year 1917 of 616 accidents, with 62 killed and 721 injured. Of these accidents, 389, in which 52 persons were killed and 469 injured, were due to boiler failures. Two recommendations relating to locomotive boilers have been made by the Bureau with a view to decreasing the danger attendant upon boiler failures. The first provides for the installation of mechanically-operated firedoors. This recommendation is based on the result of hundreds of investigations of boiler failures of a character which permits the steam and water contained in the boiler to be discharged into the firebox resulting in injuries to the men in the cab. The second recommendation provides that holes for plugs or studs in boiler sheets should have a good thread the full thickness of the sheet in which they are applied, and all plugs and studs and other fittings should be screwed through the sheet. Plugs, studs or other boiler fittings should not be repaired by calking, and under no circumstances should an attempt be made to tighten them while there is steam pressure on the boiler.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, 461 *Eighth avenue, New York city.*

Riveted Joints

Q.—As an apprentice, I have studied that there are seven methods of failure in a riveted seam. However, my instructor says that in shop work all that is necessary in figuring efficiency of a riveted joint in a boiler is the formula

$$\frac{\text{Pitch} - \text{Diameter of Riveted Hole}}{\text{Pitch}}$$

Will you please explain why this is so? Is it because in well-designed seams the smallest efficiency is generally found to be due to the tearing of plate between the rivets?

A.—Riveted joints are liable to fail in different ways: by breaking the net section of plate between the rivets, by shearing the rivets, by crushing the plate in front of the rivets or by a combination of the causes stated.

A riveted joint should be designed to give a maximum efficiency for both rivets and plate. This is a problem

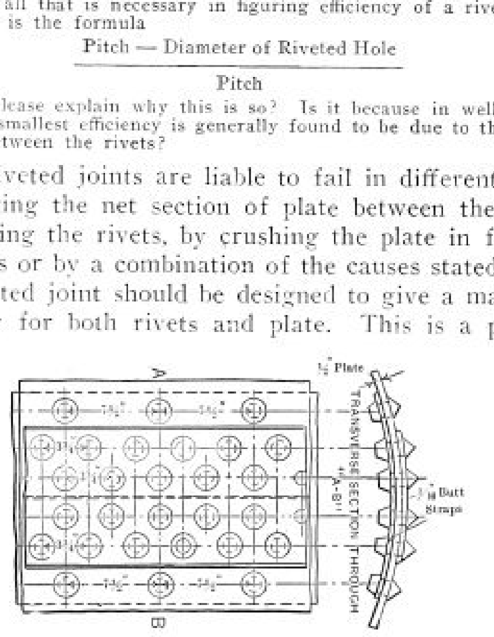


Fig. 1.—Riveted Joint

requiring very often several trial calculations before a high efficiency joint can be designed.

Owing to the corroding effect of water on boiler plate some authorities prefer to make the resistance of the net section of plate between the rivets greater than the shearing resistance of the rivets. On the other hand, some designers require the resistance of the rivets to shear to be greater than the resistance of the net section of plate to tensile stress.

The formula,

$$\frac{\text{Pitch} - \text{Diameter of Rivet Hole}}{\text{Pitch}}$$

gives the efficiency of the net section of plate between rivets as compared with the solid plate. It pertains to only one condition, if the plate efficiency is greater than the rivet efficiency, then the joint efficiency or its strength is figured from the rivet efficiency, which is the weakest part.

Rivet efficiency as compared with the solid plate may be determined by the following rule:

Multiply the area of the rivet hole by the ultimate shearing strength of the rivet material, by the number of rivets in the pitch considered, and divide the product by the tensile strength of the solid plate in the strip considered.

In the form of a formula we have,

$$E = \frac{A^2 \times .7854 \times S \times N}{T} \times 100$$

in which E equals efficiency of rivets as compared with the strength of solid plate.

A equals diameter of rivet hole.

S equals shearing strength of rivet material.

N equals number of rivets in the strip considered.

T equals tensile strength of the solid plate in the strip considered.

The A. S. M. E. Code gives the following figures on the shearing resistance of iron and steel rivets:

38,000 pounds, shearing resistance of iron rivets in single shear.

76,000 pounds, shearing resistance of iron rivets in double shear.

44,000 pounds, shearing resistance of steel rivets in single shear.

88,000 pounds, shearing resistance of steel rivets in double shear.

The pitch of the rivets in the outer row of a triple riveted butt joint is 7½ inches and in the inner rows 3¾ inches. Rivets in outer row are in single shear and those in inner rows are in double shear. The boiler plate is ½ inch thick, having a tensile strength of 55,000 pounds per square inch. The iron rivets are 13/16 inch in diameter, and have a shearing strength of 38,000 pounds per square inch in single shear.

This joint may fail in different ways: viz., breaking of the net section of plate between the outer rows of rivets: rupture of the net section of plate at the inner rows of rivets and shearing of the rivets in the outer rows: shearing of all the rivets and breaking of the net plate section of the butt straps.

To find the weakest section of the joint we will consider first the tensile strength of the solid plate section 7½ inches wide as follows: $55{,}000 \times \frac{1}{2} \times 7\frac{1}{2} = 206{,}250$ pounds. Strength of net section within this strip equals $(7\frac{1}{2} - \frac{7}{8}) \times \frac{1}{2} \times 55{,}000 = 182{,}187.5$ pounds. Within this pitch there are five rivets, four in double shear and one in single shear. Shearing resistance of one rivet in single shear is determined as follows:

Driven size of rivet in this case equals ⅞ inch in diameter. It is the usual practice to make the rivet hole 1/16 inch larger in diameter than the rivet.

Cross sectional area of ⅞-inch circle equals

$\frac{7}{8}^2 \times .7854 = .601$ square inch.

$.601 \times 1 \times 38{,}000 = 22{,}838$ pounds, resistance to shear of one rivet in outer row.

Resistance of four rivets in double shear equals

$.601 \times 4 \times 76{,}000 = 182{,}704$ pounds.

$182{,}704 + 22{,}838 = 205{,}542$ pounds, total resistance of rivets to the shearing stress.

The combined shearing resistance of the rivets shows that they are stronger than the net section of plate. The efficiency of the plate in this case equals

$182{,}187.5 \div 206{,}250 = 88.33$ percent.

The efficiency of the rivets equals

$205{,}542 \div 206{,}250 = 99.65$ percent.

As the joint may fail by breaking the net section of plate at the 3¾-inch pitch and shear one rivet in the outer row, we must consider further its strength.

Efficiency of net section is

$$\frac{3\frac{3}{4} - \frac{7}{8}}{3\frac{3}{4}} = 76.66 \text{ percent.}$$

Efficiency of one rivet in single shear equals

$$\frac{22,838}{206,250} = 11.07 \text{ percent.}$$

77.66 + 11.07 = 87.73 percent combined efficiency of plate and one rivet in single shear.

Breaking of the two butt straps at the joint is a very uncommon mode of failure. The efficiency of the two 7/16-inch straps is found in the same manner as the net section of plate between rivets. The combined thickness of the butt straps equals 7/16 × 2 = ⅞ inch.

If the combined thickness of the butt straps were equal to the plate thickness, their efficiency would be 76.66 percent. Since their combined thickness is ⅞ inch, their net plate efficiency equals

$$\frac{\frac{7}{8} \times 76.66}{\frac{1}{2}} = 134.15 \text{ percent.}$$

Summing up the respective efficiencies, we have as follows:

88.33 percent, plate efficiency at outer row of rivets.

99.65 percent, rivet efficiency.

87.73 percent, combined efficiency of net section of plate at 3¾-inch pitch and one rivet in single shear in outer row.

134.15 percent, efficiency of butt straps.

The strength of the joint would be figured from its smallest efficiency, which in this case is 87.73 percent.

Staying Calculations for a Wet Bottom Boiler

Q.—Referring to sketches, Figs. 1 and 2, of a locomotive firebox boiler, wet bottom type; first, please give the proper formula for figuring the steam pressure that can be safely carried by the ouside plate spanning the space *A*, Fig. 1, part of which plate is curved and part straight, as shown. Also formula for figuring the load carried by staybolt *B*. Second, in the water bottom, Fig. 2, what is the proper formula for figuring the load that can be safely carried by the bottom plate spanning the space *E*; also if *E* is 5½ inches and *F* 4½ inches by 4½ inches, how much more will staybolt *G* have to carry than staybolt *H*? H. C. H.

A.—The roof sheet being semi-cylindrical in form, it is self-supporting—that is, the steam pressure tends to maintain the semi-cylindrical shape and hinders distortion instead of producing it. On the other hand, the crown sheet is subject to pressure tending to collapse it. For this reason the crown sheet is stayed.

The center line *m-n*, Fig. 1, is the division line between the curved surface *x* and the flat surface *y* of plate A. Since *x* is a part of the circular section, this portion of the plate need not be considered. The section *y*, however, being a flat surface, the stay *B* must be so placed and of such a size as to support the flat plate section *y* and prevent it from bulging; also the section of plate *w*, which is midway between the staybolt *B* and the bolt below it. According to the A. S. M. E. Code, Article 199, page 49, the following is given concerning the allowable pressure:

199. The maximum allowable working pressure for various thicknesses of braced and stayed flat plates, and those which by these rules require staying as flat surfaces with braces or staybolts of uniform diameter symmetrically spaced, shall be calculated by the formula:

$$P = C \times \frac{t^2}{p^2}$$

Where P = maximum allowable working pressure in pounds per square inch,

t = thickness of plate in sixteenths of an inch,

p = maximum pitch measured between straight lines passing through the centers of the staybolts in the different rows, which lines may be horizontal, vertical or inclined.

C = 112 for stays screwed through plates not over 7/16 inch thick with ends riveted over,

C = 120 for stays screwed through plates over 7/16 inch thick and ends riveted over,

C = 135 for stays screwed through plates and fitted with single nuts outside of the plate,

C = 175 for stays fitted with inside and outside nuts and outside washers, where the diameter of washers is not less than 0.4 p and thickness not less than t.

If flat plates not less than ⅜ inch thick are strengthened with doubling plates securely riveted thereto, and

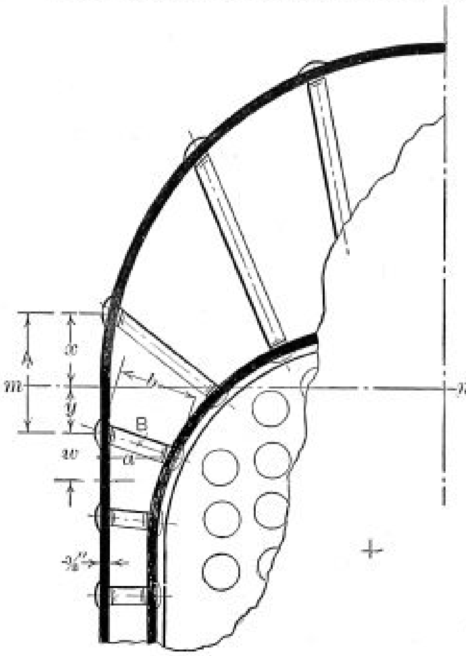


Fig. 1

having a thickness of not less than two-thirds t, not more than t, then the value of t in the formula shall be three-fourths of the combined thickness of the plates, and the value of C given above may also be increased 15 percent.

The designer in distributing stays in radial stayed boilers of this kind should aim to have each stay placed

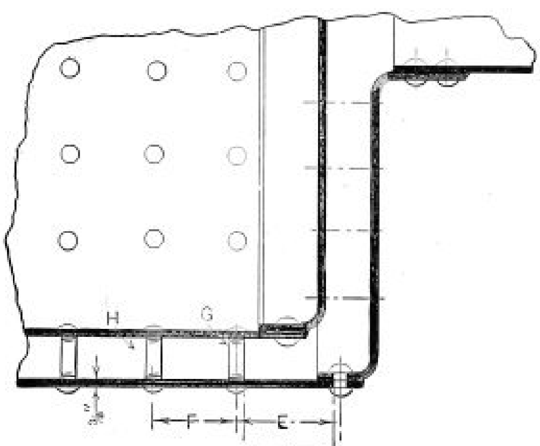


Fig. 2

so as to carry as nearly as possible a uniform load. However, conditions often arise where stays cannot be placed so as to be subjected to a direct pull. Stays which are inclined to the direction of the pull on them are not as efficient as those subjected to a direct pull. Therefore the load an indirect stay can carry varies with the angle it makes with the direction of stress placed on it, and will be less than that which a direct stay of the same size and ultimate strength per square inch of section can carry.

In calculating the stress on the radial staybolts the greatest area in the crown sheet end that they support should be employed. The load on staybolt *B* may be determined in several ways. We will consider two methods of finding the load, either of which will serve as a check or proof of the result. The load on the surface supported by the stay is found by multiplying the greatest area supported by the stay by the maximum steam pressure. Thus, for example, the area equals 4 × 4, or 16 square inches. Steam pressure equals 125 pounds per square inch, then 16 × 125 equals 2,000 pounds total pressure on the surface. The stay *B* being inclined to the horizontal, has as a result a greater pull on it than if it were at right angles to the surface it supports. Assume that the horizontal distance *a*, Fig. 1, equals 8 inches, and the diagonal distance *b*, 8½ inches, then the load on the stay is found as follows:

$$\frac{2{,}000 \times 8.5}{8} = 2{,}125 \text{ pounds.}$$

By laying off a diagram of forces, Fig. 3, the load on the stay can be quickly and accurately determined. In this

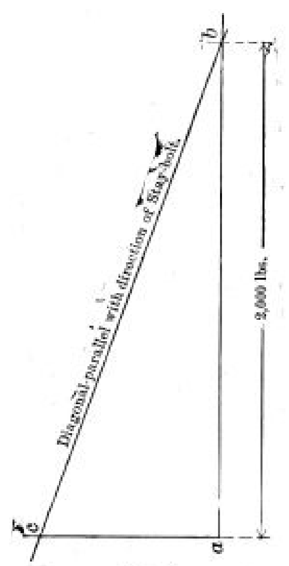


Fig. 3

case distance *a-b* is 4 inches in length and is laid off to a scale representing 500 pounds to the inch, the diagonal *c-b* is drawn parallel with the axis of the diagonal staybolt; *a-c* is perpendicular to *ab* and intersects *cb* in point *c*. Line *cb* in this case measures 4¼ inches. By multiplying the length of *cb* by the load 500 pounds to the inch we have 4¼ × 500 = 2,125 pounds, thus proving that the foregoing calculations are correct.

The formula for determining the load on sections *F* and *E*, Fig. 2, is the same as that given for Fig. 1. However, in the case of *E* the area supported is figured from the pitch indicated at *X*, according to Art. 205 of the A. S. M. E. Code, which follows:

205. The distance from the edge of a staybolt hole to a straight line tangent to the edges of the rivet holes may be substituted for *p* for staybolts adjacent to the riveted edges bounding a stayed surface when the edge of a stayed plate is flanged, *p* shall be measured from the inner surface of the flange, at about the line of rivets to the edge of the staybolts or to the projected edge of the staybolts. The load on staybolts *H* and *G* may vary and it is difficult to state *practically* the difference in the loads they carry. Theoretically we can calculate it by assuming certain conditions to exist. For example, diameter of staybolts at root of thread equals ¾ inch. Working pressure equals 125 pounds per square inch and diameter of rivets driven size equals ¾ inch.

Area of section supported by staybolt *H* = 4½ × 4½ = 20¼ square inches. From this area should be subtracted the area of staybolt hole. In practice, however, this is not usually done. The load the stay carries equals 20¼ × 125 = 2,531¼ pounds.

Area supported by staybolt *G* equals *X* × 4½ = 4½ × 4½ = 20¼ inches. *X* = 5½ — (⅜ + ⅜) = 4½ inches.

So according to the calculations, both stays in this case carry the same load.

Tests of Oxyacetylene Welded Joints in Steel Plates

A series of tests of the strength of oxyacetylene welded joints in mild steel plates has been completed by the Engineering Experiment Station of the University of Illinois under the direction of H. F. Moore, Research Professor of Engineering Materials. Specimens were supplied by the Oxweld Acetylene Company of Chicago and tests were made in the laboratories of the station at Urbana under three conditions of loading: (*a*) static load in tension (in a testing machine), (*b*) repeated load (bending), and (*c*) impact in tension (in a drop testing machine).

For joints made with no subsequent treatment after welding, the joint efficiency for static tension was found to be about 100 percent for plates one-half inch in thickness or less, and to decrease for thicker plates. For static tension tests, the efficiency of the material in the joints welded with no subsequent treatment was found to be not greater than 75 percent. The joints were strengthened by working the metal after welding and were weakened by annealing at 800 degrees C. For static tests and for repeated stress tests, the joint efficiency sometimes reaches 100 percent; the efficiency of the material in the joint is always less. This indicates the necessity of building up the weld to a thickness greater than that of the plate. The impact tests show that oxyacetylene welded joints are decidedly weaker under shock than is the original material; for joints welded with no subsequent treatment, the strength under impact seems to be about half that of the material.

In general, the test results tend to increase confidence in the static strength and in the strength under repeated stress of carefully made oxyacetylene welded joints in mild steel plates.

The results of these tests have been published as Bulletin No. 98 of the Engineering Experiment Station, copies of which may be obtained without cost by addressing C. R. Richards, Director, Urbana, Ill.

Rushing Work on Boilers for Emergency Fleet

The DePere Mfg. Company, DePere, Wis., has increased its day and night shifts to the limit of capacity of its boiler and structural shops in order to rush work on an order for fifty-five 200-horsepower high pressure boilers for the Emergency Fleet Corporation. The plant has been operating day and night shifts since early in December on private contracts and has so much business on its books that the company is contemplating the erection of a shop addition next spring. The company is affiliated with the Joliet Bridge & Steel Company, and occupies the former Lyons Boiler Works at DePere, Wis. Ward Clark is general manager.

The Oldman Boiler Works, Illinois Street and the Lackawanna Railroad, Buffalo, N. Y., is having plans completed for a one-story addition, 50 by 100 feet.

Letters from Practical Boiler Makers

This Department is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

Boiler Shop Work Horses

During a visit to a boiler shop, the writer noticed two types of boiler shop work horses. Fig. 1 shows a type made from old scrap boiler tubes, is very durable, and

Fig. 1.—Work Horse Made from Old Boiler Tubes

stands much abuse, and is easily constructed. The tubes at the joints are simply flattened and riveted.

Fig. 2 shows a type of adjustable height work horse

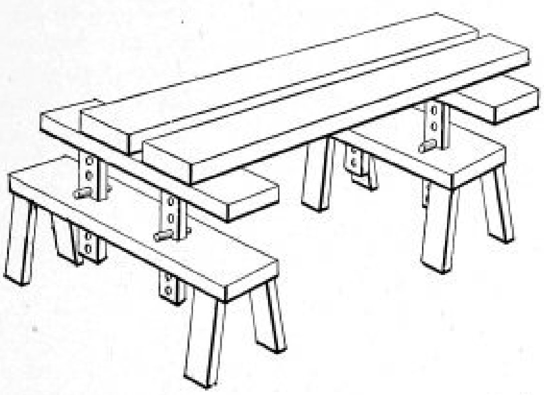


Fig. 2.—Adjustable Height Work Horse

which is extremely handy for construction work. It is made from heavy planking, and presents a good platform for a number of workmen.

JOURNEYMAN.

Impatience or Ambition?

An article in the October issue, entitled "The Impatience of Modern Youth," is one which will be read with a great deal of interest, and the writer has voiced a very pertinent question when he asks, "Why are not skilled mechanics more plentiful?"

The fault lies not so much in the impatience of youth, but rather in the system which permits a boy to flit from one job to another. The advisability of instituting an apprenticeship system similar to that in vogue in Europe might well be given the consideration of employers and employees alike. That raises the question, How long an apprenticeship is necessary?

The example quoted by your correspondent of a lad of seventeen applying for a position as a boiler maker is rather unusual, but, on the other hand, there are many young fellows who are better qualified to receive a higher rate of pay than an older man. The writer has in mind numerous instances of men who have been twenty years and longer at the business and have neither the ambition nor the qualifications to rise above a helper's salary; in comparison to this, the youth of to-day who, after four or five years at the trade aspires to a full-fledged boiler makers' salary, might well be called impatient. Some people are apt to confuse age with experience.

As our friend from Concord recently wrote, "It's not so much what you know that counts, but it's what you practice will tell."

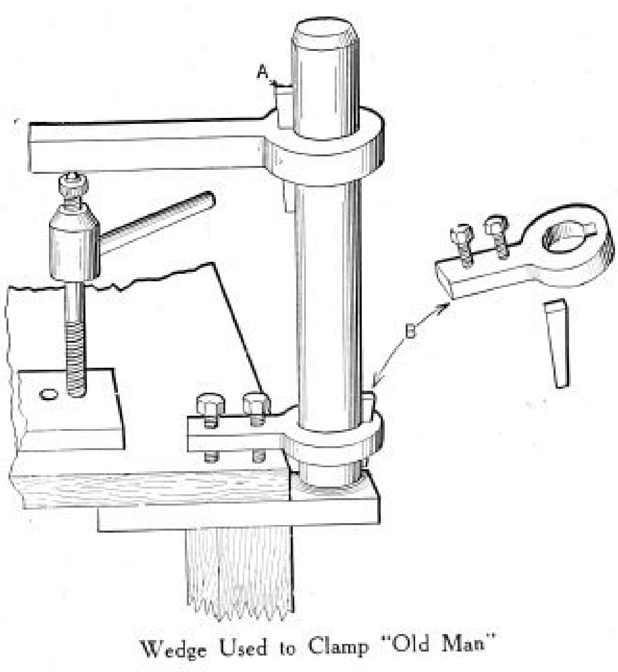
One point that the writer of the article mentioned appears to have overlooked is the advantages the present generation have in the way of education, both primary and technical; this is an important requisite of the boiler maker of to-day, as many of the older men realize as they are outstripped in the race by the "impatient youth." This, perhaps, is one reason for the lack of skilled mechanics—they don't remain at the tools very long.

Up to the outbreak of war the uncertainty of employment was perhaps another big factor in deterring many from taking up this line of work and has caused many good mechanics to enter some other field of employment. The lack of skilled mechanics is a serious problem at this time, and the opinions of other readers on this subject might be of general interest.

Brooklyn, N. Y. A. G. R.

Old Man Clamping Device

The sketch plainly shows a couple of kinks applicable to the old type of ratchet drill post. The wedge at *A* serves far better than a set screw for gripping the mov-



Wedge Used to Clamp "Old Man"

able arm, and does not burr the post. The clamp attachment shown at *B* is very handy, making it possible to use the "old man" on the bench and many other places where it could not be used for lack of bolt holes for the foot.

C. H. W.

Leisure and the Boiler Maker

It has been the privilege of the present writer on various occasions, both verbally and in print, to defend the manual worker from various accusations leveled by people who were unacquainted with him.

The superior person is now nearly extinct and the elegant idler has been transformed into the diligent worker owing to natural exigencies. On several occasions in the technical press I have pointed out that large earnings did not compensate for the sacrifice of virtually all leisure time, also that the reward of toil consisted of two parts, the freedom won to devote to personal interests, as well as the more understood financial gain.

Recently two prominent English publicists—Lord Leverhume, a soap magnate, and Mr. John Hill, the secretary of the Boiler Makers' Union—have voiced as a practical matter a conviction of the writers that a six-hour day was possible in industry, work proceeding the twenty-four hours through.

Before dismissing the matter as mere idealism, the advantages of the proposal should be seriously studied. It provides two shifts without mealtime in a twelve-hour day, or four continuous shifts in twenty-four—all machines, tools, plant and shops utilized to their full capacity right through the entire week. It would at least treble the output of any plant operating a nine-hour day and enable larger returns upon capital with equal wages or even increased returns upon increased wages. So long as capital gets dividends it matters little what wages or hours are common.

Apart from the writer's convictions that leisure is pay as well as wages, the matter is having serious attention as a policy of reconstruction after the war.

A coment by "Londoner"—the causerie essayist of the *London Evening News*—in issue of October 15, 1917, deals with the proposal as it affects the boiler maker in a manner complimentary to the trade. The comments deserve a wider venue in a strictly trade sense, and it is hoped that publication in the only journal exclusively devoted to the trade will enhance the value of the remarks and bring the article under the notice of those most interested. He says:

"Freedom," said the old poet, "is a noble thing." The more I think of freedom, the more I incline to believe that Mr. John Hill, secretary of the Boiler Makers' Society, is on the right trail for it.

"I have been reading what he said to the boiler makers, and I find a deal of wisdom in it. If I understand him rightly, he has come to the opinion that freedom is leisure, and that we might have it if we really wanted it.

"He appealed to science, that mysterious wisdom which has already given me many things that I do not want and a few things for which I am grateful. We might, I think, live happily without the higher explosives. I do not spend my evenings with the cinematograph. I would rather hear the lark sing, or a child, than listen to the bellowing of a gramophone. Nevertheless, the electric light was a very pretty miracle, and lucifer matches light my pipe without putting me to the trouble of rubbing two sticks together or hammering sparks from a flint.

"But Mr. Hill told the boiler makers that science has even better things in hand for us. Science can give us that most precious gift of leisure, and leisure, I think, is freedom. Because of science and her handy little tricks, there is no need for a man to work more than six hours a day for his living. After his fiftieth birthday a man may put down his tools; his living should be secure. He will have done his share of the world's work. So Mr. Hill says, and I am sure that he knows more about science than I do.

"If I were a boiler maker, and heard Mr. Hill's words, I should rise up and shout praises of science and of Mr. Hill. There may be duller jobs than boiler making. I figure it as a hearty job, done with much banging and clanging of hammers. There is pleasure in such labor, when a man's arms are strong, when he works with good mates about him. I have seen poets making sonnets and they did not seem happy at that delicate work; I dare say that some of them would have been happier as boiler makers.

"All sorts of men go to a world. Some of us must be boiler makers in grain, with a liking for work that is clanging, strenuous, the sort of work that a man leaves at the day's end feeling that a pipe and a pint of ale are good things, that rest after toil is sweet. There must be people also who love boilers for themselves, who have the joy of creation when they and their mates see before them the beautiful, the perfect boiler, the work of their hands. Mr. Hill must know many such. Yet he knows also that man is something more than a boiler maker.

"A free man wants more out of life than his work upon the boilers. I do not know what that is, for one free man is not the same as another free man; our souls are not all the same shape. But I know that a man can only get that something more if you give him leisure to look for it.

"Leisure is not idleness. This is my warning to certain superior people. They are fewer than they were, those superior persons. There were very many of them, I fancy, in the middle Victorian age, when tall hats were very tall, when respectable shirt collars were very stiff. Then it was the belief of a respectable sect that the working man should be kept stiffly at work for his soul's sake. If he had any leisure he would only drink more beer than was good for him. So the working hours were very long, and the working man was wont to justify the respectable theory by taking more beer than was good for him whenever he had his rare holiday.

"There is more leisure now, more holidays, shorter hours. And the more leisure that this working man has, the less he inclines to waste it in loafing beerily. The more holiday he has in his life, the more he shows himself to be a man very like other men. It is my belief that, if science and Mr. Hill can give him this light day's work, that six-hour spell in which a man can toil cheerfully and be pleased to feel his wits and his muscles at work, that bogey figure of the bad, beery man in unclean corduroy will vanish away.

"I have good hope for an age of leisure. I have no fear of an age of idleness. For I myself have leisure enough to find life a delightful journey past all manner of wonderful things. From the sight of the world itself—and that was a pleasant sight this morning with the sun on the changing leaves—to books and talk and love and even to a fair measure of beer, we shall never want toys for the leisure of a full life. I do not say that science will give each of us a Rolls Royce car and a cellarful of curious wines. But these are not the things that matter. The thing that matters is freedom, and freedom is leisure to look about us."—*The Londoner.*

London, Eng. A. L. HAAS.

Renewing Mud Drum Nipples

Mr. G. B. Longstreet, on page 349 of the December issue of The Boiler Maker, writes that he doubts very much whether a better job can be done in regard to belling or flaring a nipple with a tapered mandrel than can be obtained by use of the rolls of the expander.

Perhaps Mr. Longstreet is right. I cannot claim to be an authority on the subject, and the method I set forth for flaring one end of the nipple before putting it into place is not of my origination, but during ten years of service on various classes of naval vessels, spent in the care, repair and operation of engines and boilers, I have found this method used by the service boiler makers. The results have always been very good, for the flare or bell made gave a larger conical-shaped mouth to the nipple and tubes. We used the method on the front ends of all tubes. The wide flaring performed by the mandrel, in addition to better holding qualities, has aided the longer life of the tube end and lessened the water friction.

The idea, as I understand, originated with a lieutenant engineer in the Navy. He ordered that all tubes be belled as described on the front end, advancing as his reason that better circulation could be obtained. As I recall, his illustration of it was about as follows:

When the water from the steam drum flows down through the header and enters a tube, as shown in Fig. 1,

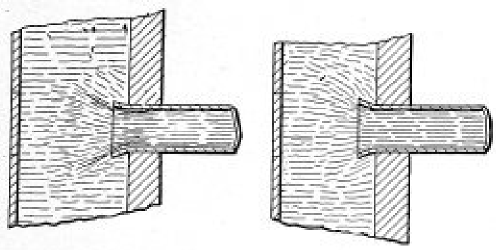


Fig. 1.—Roll Flared Fig. 2.—Mandrel Flared

there is a contraction of its volume, which has the effect of reducing free flow into the tube. The amount of consequent reduction of flow depends, of course, on the velocity with which the water enters the tube. Now by belling or making the tube or nipple, when possible, larger at the mouth, as shown in Fig. 2, the flow or circulation is improved and the contraction of volume of water is reduced. So much for the lieutenant's explanation. It sounds like a good reason to the writer for making the flare larger by the mandrel than is possible to obtain with the rolls. However, it may all be theory—I cannot here prove that it is not.

The real reason that I am partial to the mandrel flaring for nipples and tubes is that I have in my experience found that a well-flared tube or nipple end does not waste away as rapidly as those slightly belled by the rolls.

I have never experienced any trouble in rolling a joint tight on a pre-flared nipple, and will add that they have seemed easier to expand.

Mr. Longstreet speaks of having always found the first-hand information of the makers the best. While this in some instances is true, and I do not dispute that in this case it may or may not be, I have noted many improvements can be and have been made to manufacturers' products in our line by those who are daily associated with their operation and repair.

The satisfaction that we have obtained in flaring or belling of the mud drum and other nipples, as mentioned, has led us to feel the method is best. Perhaps a discussion of the subject would do a bit of good in the pages of The Boiler Maker, for if the practice is considered wrong, I would like more than one reader to condemn it, and if it has merits I would would like other champions of it to come to my aid and support my lone statement that it is better.

Concord, N. H. Chas. H. Willey.

Repairing Air Hose

The market offers many and varied devices and tools for clamping air or pneumatic tool hose to the nipples and coupling, yet many of them fall short of meeting approval from the point of simplicity and durability. When a fellow's driving rivets, and the leader and hose part company, or a joint blows out where the hose has been spliced, it's aggravating, but after putting things together again with a brass band and a couple of screws, only to have the thing re-occur—then it becomes a goat-

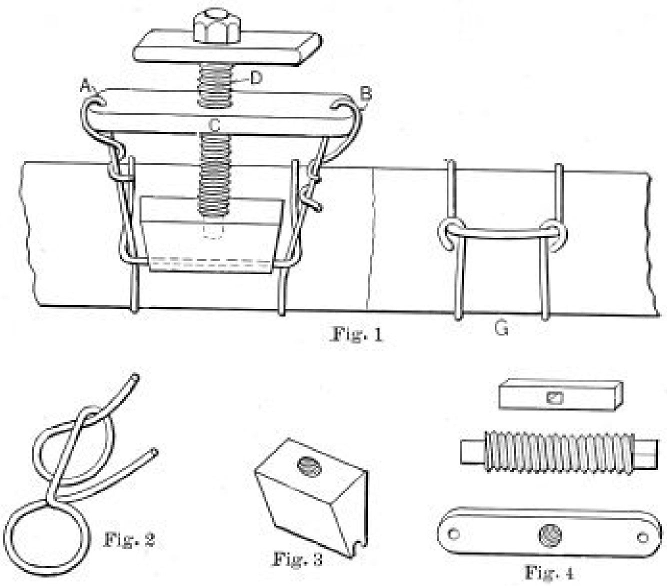


Fig. 1 Fig. 2 Fig. 3 Fig. 4

getter and causes some cussin'. The simple wire binding or clamping tool shown in Fig. 1 is used by the writer, with a bit of No. 14 gage soft steel wire, and it does the work excellently. The sketches are self-explanatory, but a word may aid some to more readily understand its use.

The wire is double looped (Fig. 2) around the section of hose where the repair nipple or coupling is to be secured, and the ends of the wire are secured through the holes *A-B* of the crosshead *C* by twisting, as shown. The screw, *D*, is turned back to receive the grooved face block shown in Fig. 3. When this block is in place, the horizontal part of the wire fits in the groove. Now by screwing down the bolt *D* the wire bands are tightened.

When the operator feels that the wire clinches the hose to the nipple tight enough, the device is then swung downward in a half-circle, which bends the wire at the points *E-F* to the position shown in *G*, Fig. 1. Care should be taken not to tighten the wire excessively and cut and ruin the hose. One ought to be able to judge how tight to make it.

After the tool has clinched the wires, it is released and they are cut short and pinched into the hook form, as shown. This tool is of simple construction and can be easily made by any mechanic.

Pleasant Contrast.—"Mike."

"Phwat?"

"I was just thinkin'. After we get out of the trenches an' back home again how nice an' peaceful that old boiler-factory will sound to us."—*Detroit Free Press.*

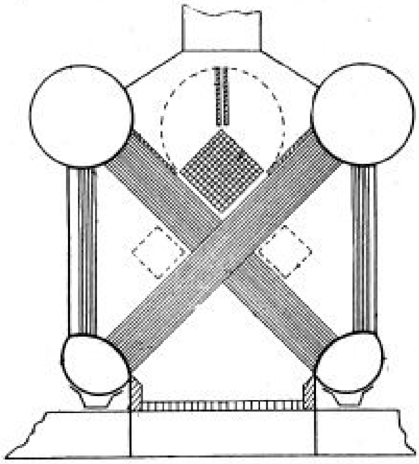
Selected Boiler Patents

Compiled by
DELBERT H. DECKER, ESQ., Patent Attorney,
Millerton, N. Y.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Decker.

1,241,356. WATERTUBE STEAM GENERATOR WITH SUPERHEATER. JAMES DORNAN, OF DALMUIR, SCOTLAND.

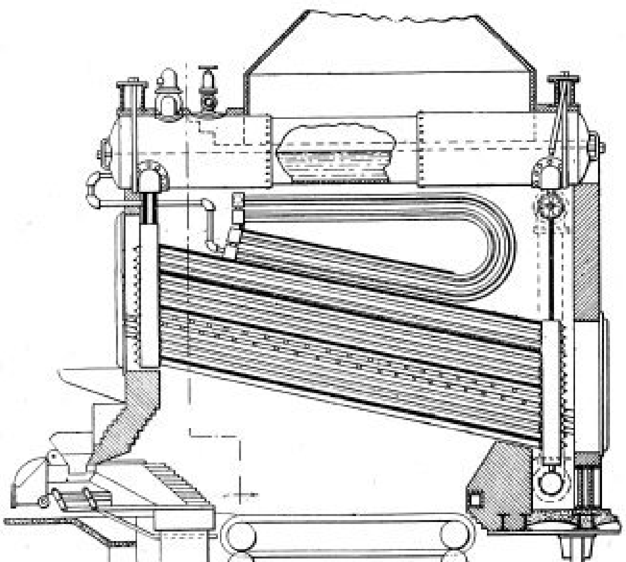
Claim 1.—In a watertube steam generator the combination with a casing, a firegrate, and four drums with horizontal axes arranged in quadrilateral fashion, two at the sides of the firegrate and the other two above these two, of four banks of tubes which connect each lower drum



with each upper drum, two of said banks thus intersecting, a superheater consisting of a block of limbs located in the angular space immediately above the intersection of the said intersecting banks of tubes, said superheater block being capable of being withdrawn laterally from the generator, dampers, and means for causing said dampers to cover or uncover the faces of the said superheater block. Nine claims.

1,242,438. STEAM GENERATOR. HERMAN C. HEATON, OF CHICAGO, ILL., ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, N. J., A CORPORATION OF NEW JERSEY.

Claim 1.—A watertube boiler having a bank of horizontally extending water tubes, superheater tubes extending transversely between rows of water tubes, a superheater box at one side of the setting protected from



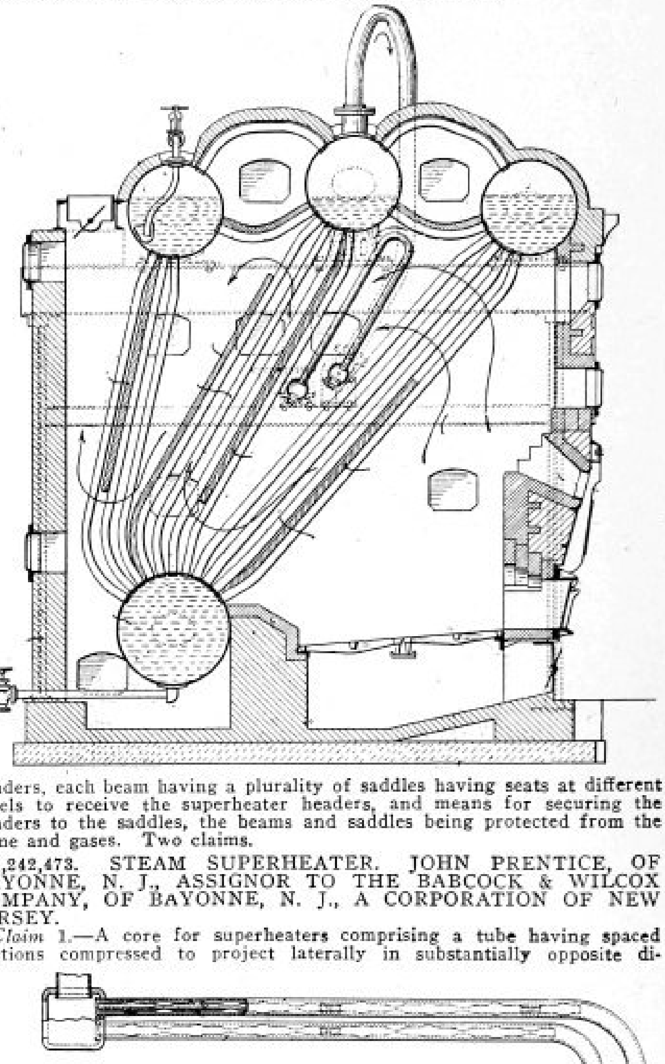
the flame and gases, a superheater box at the opposite side of the setting also protected from the flame and gases, the transverse superheater tubes being spaced apart to allow passage of the gases between the same, and connected into said boxes, the superheater tubes being formed with bends to compensate for expansion and contraction. Two claims.

1,239,918. PULVERIZED COAL BURNING MEANS FOR LOCOMOTIVES. AUGUST KIRCHHOFER, OF NASHVILLE, TENN., ASSIGNOR OF ONE-HALF TO THOMAS A. CLARKSON, OF NASHVILLE, TENN.

Claim 1.—A means for burning pulverized coal in boiler furnaces, comprising a burner with two superposed outlets, means common to both outlets for directing air under pressure thereto, means for feeding pulverized coal to the upper burner outlet by the air stream directed thereto, and means in the air directing means common to both outlets of the burner for simultaneously controlling the air to both outlets by and in accordance with the boiler pressure. Three claims.

1,242,447. SUPERHEATER BOILER. WILLIAM A. JONES, OF WEST NEW BRIGHTON, N. Y., ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, N. J., A CORPORATION OF NEW JERSEY.

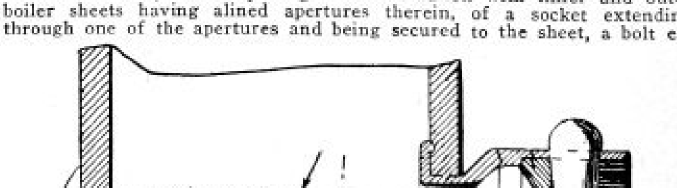
Claim 1.—A superheater boiler having transverse superheater headers between the upper and lower boiler drums and provided with upwardly projecting tubes, beams in the side walls extending underneath said



headers, each beam having a plurality of saddles having seats at different levels to receive the superheater headers, and means for securing the headers to the saddles, the beams and saddles being protected from the flame and gases. Two claims.

1,242,473. STEAM SUPERHEATER. JOHN PRENTICE, OF BAYONNE, N. J., ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, N. J., A CORPORATION OF NEW JERSEY.

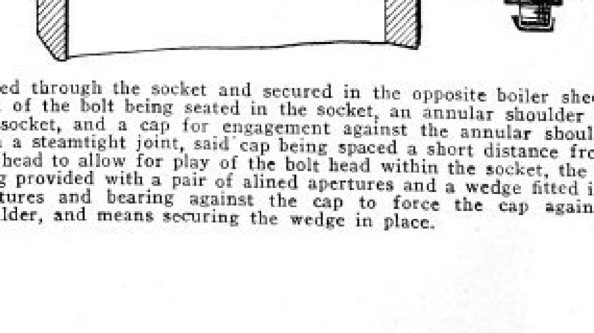
Claim 1.—A core for superheaters comprising a tube having spaced portions compressed to project laterally in substantially opposite di-



rections and adapted to hold the core in position by frictional engagement with the inner wall of the superheater tube. Four claims.

1,244,308. STAYBOLT. JOHN FOTHERINGILL, OF FORT SCOTT, KAN.

Claim.—A staybolt comprising the combination with inner and outer boiler sheets having alined apertures therein, of a socket extending through one of the apertures and being secured to the sheet, a bolt ex-



tended through the socket and secured in the opposite boiler sheet, the head of the bolt being seated in the socket, an annular shoulder within the socket, and a cap for engagement against the annular shoulder to form a steamtight joint, said cap being spaced a short distance from the bolt head to allow for play of the bolt head within the socket, the socket being provided with a pair of alined apertures and a wedge fitted in said apertures and bearing against the cap to force the cap against the shoulder, and means securing the wedge in place.

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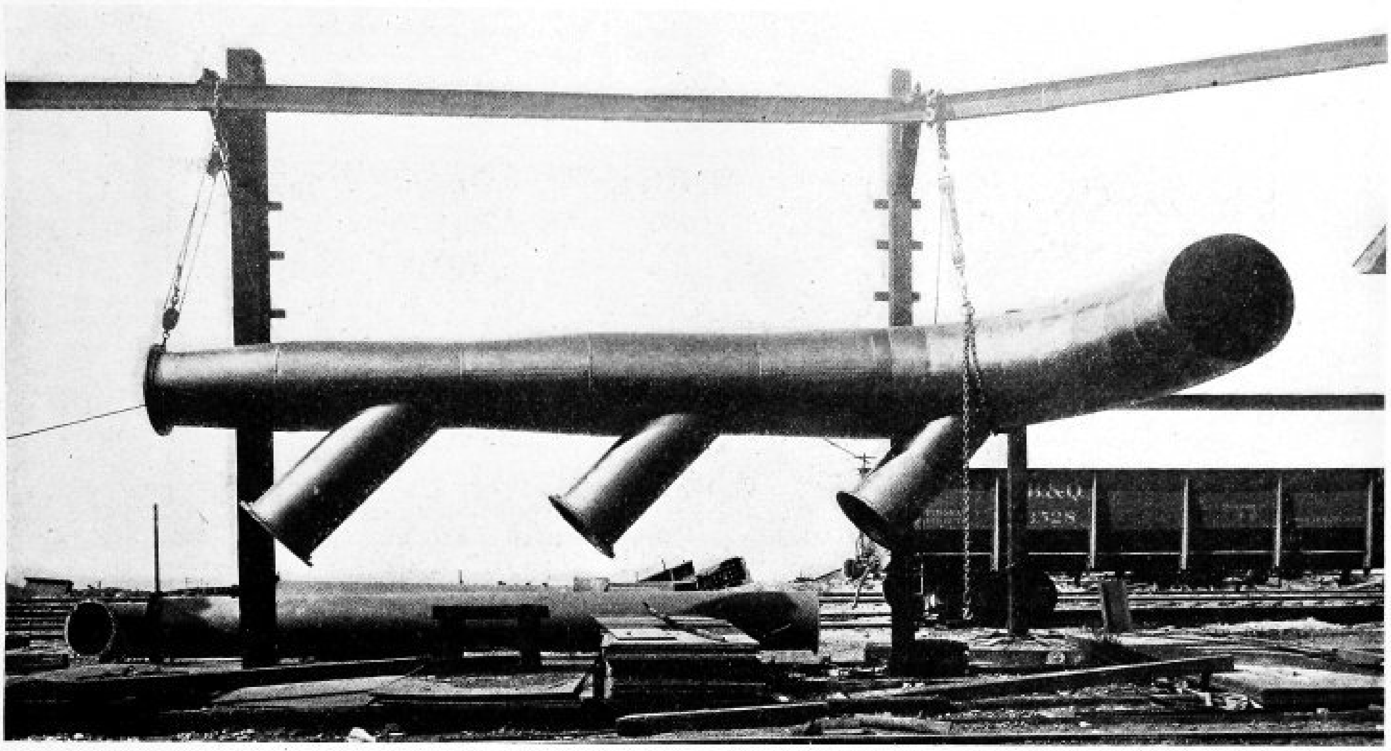


Fig. 1.—Elbow Made Up of Welded Sections Which Connects with 40-Inch Blast Main

Oxy-Acetylene Welding and Cutting

Large Elbow for 40-Inch Blast Line Successfully Welded with Oxy-Acetylene Torch—Other Welded Work

BY T. E. JAMESON*

I have read the articles on oxy-acetylene welding and cutting in THE BOILER MAKER with a great deal of interest. Perhaps other readers will be interested in what we are doing in the line of welding here.

Fig. 1 shows a photograph of an elbow we have just finished. It is 40 inches in diameter, reduced to 36 inches, 34 inches and 24 inches and goes on to a 40-inch blast main 400 feet long. This blast main is to be used for conveying powdered coal to the reverberatory furnaces. The main pipe was made in 40-foot lengths in the shop and then put in place in the field and the field connections welded.

This pipe has a spiral of 3/16 by 1¼ inches, with a 10-foot pitch the entire length of the pipe. The ends of the spirals are all welded together and attached to the pipe with angle iron lugs. The pipe is made of No. 10 iron.

We finished a water line a short time ago 2,200 feet long and 24 inches in diameter. The pipe was of No. 10 iron and was sent out in 40-foot lengths and welded in the field. When we tested this pipe a number of pin holes showed up, and it took a man with a center punch about three hours to calk them. This pipe carries 80 pounds pressure.

About two years ago we put in an air pipe of No. 10 iron 26 inches in diameter, 3,600 feet long, from the power house to the concentrator, welded the entire length. We had trouble with this line on account of expansion and contraction, and finally had to put in three double slip expansion joints. This line has not given us any trouble since putting them in.

In this case we went through some pretty crooked ditches and over some rough ground. In several places we had to make bends up to 15 degrees. Instead of making special pieces for these bends, we would cut the pipe on the proper angle where the bend would come, and turn the piece half over and weld it up. Anyone that has put in a pipe line

* Boiler shop foreman, McGill, Nev.

over rough ground will realize how much time can be saved by making a bend in this manner.

I find that I can make welded pipe up to ¼-inch material much cheaper than riveted pipe. We do all classes of repair work. Any amount of cast iron machine parts that it would be impossible to patch up and that would require three or four days to get patterns made for, cast and machined, can be made as good as new in a very few hours, and sometimes in a few moments, with the oxy-acetylene process.

We have made quite a lot of high pressure pipe from 18 to 24 inches in diameter of 3/16 iron with cast iron riveted flanges. These pipes were tested at 250 pounds cold water pressure. There was less touching up on these than there usually is on riveted pipe.

We have had some failures in all classes of work, but the percentage is small, and from every failure we have learned something. We have not used the torch very much on locomotive repairs. The only work so far has been to weld up fire cracks in the flanges of the flue sheets and the cracks from the top flue holes in the knuckle of the flange. We have had very good success on this class of work.

The cutting torch is just as valuable as the welding torch, and we would not be able to keep house without both of them.

Boiler Explosion on Michigan Upper Peninsula

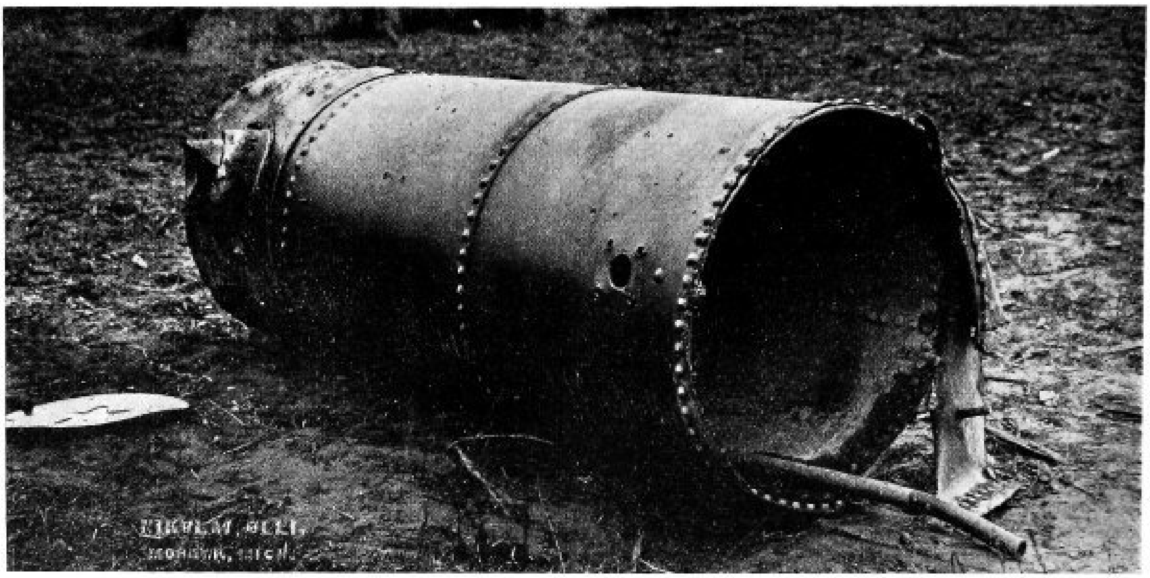
BY R. E. MC NAMARA

In the explosion of a 40-horsepower boiler near Mohawk, Mich., about the middle of last November the property damage was comparatively slight, but several unusual features connected with this disaster are deserving of attention.

The boiler was of the locomotive firebox type with a wrought iron mud ring and single riveted lap joints. It was designed for a working pressure of 85 pounds per square inch, but at times 100 pounds per square inch pressure was carried. It was stated, however, that the boiler blew up when the pressure was only 75 pounds per square inch.

The explosion occurred at about 7 A. M. while the boiler was surrounded by a number of men warming up just before the whistle was blown which would have called them to their regular work at some distance from the boiler. The firebox was blown completely out of the shell, turned inside out, and, together with the wrought iron mud ring, was so twisted and scattered that all of the portions could not be assembled for photographing.

It will be noted from the illustration that the boiler had single-riveted longitudinal seams. It is interesting to note, however, that the boiler did not rupture along the longitudinal seam, but apparently ruptured around the seam at the junction of the throat sheet and wagon top with the barrel. No rivets were sheared, the net section



Shell of Exploded Boiler

of the plate having parted all the way around—apparently even in spite of the sustaining power of the tubes and braces which are supposed to give this portion of the boiler greater strength than even a butt joint would contribute to the longitudinal seams. The crown sheet was not burned at all, as the soft plug still remained in place.

When the writer investigated the explosion a few days after it occurred he was informed that the explosion was due to "gas being in the water," which apparently was the unprofessional knowledge or belief of the layman.

The shell of the boiler was built of iron plate of the kind that we frequently find in the possession of some old patriarch who would not trade his boiler for a new one because "they do not make such materials for the boilers nowadays."

The surface water used for boiler feed in this locality is, as a rule, heavily impregnated with sulphates, mineral and various corrosive elements. The corrosives are frequently of a volatile nature, for steam pipes and smaller pipe connections are sometimes found pitted and eaten away internally to an extraordinary degree. As this boiler could not be entered for internal inspection, doubtless the absence of handholes in this case allowed the pitting to reach a dangerous degree without detection.

The boiler was not subject to regular inspection. The owner, however, did carry what is known as liability insurance, but, remarkable as it may seem, considering the number of men grouped around the boiler when it exploded and the violence of the initial explosion (the shell was blown to a distance 683 feet), no one was seriously injured by the explosion.

Among Railroad Boiler Shops—IV

More "Long Island" Kinks—Tube-Welding Machinery—Tube Trestle—Handling Boiler Tubes—Some Fine Flanging Forms

BY JAMES F. HOBART

The Long Island Railroad is surely one "kinky" place. I stayed there the most of one day, and it has taken me three months to tell THE BOILER MAKER of what I saw there! And then, there's lots of good kinks which cannot even be mentioned in all the space the editor will give me. There is a whole "bag of tricks" in the tube cleaning and welding department which are worth while, and the manner of making and using forms for head flanging would be valuable to many a boiler maker outside of railroad shops.

TESTING SUSPICIOUS TUBES

It was noticed that the "tube man" took no chances which he could possibly avoid. Whenever he got hold of a tube which to him looked suspicious he tested out that tube before either heating or welding it. The pneumatic tube tester was located right handy to the welding machine, and whenever a doubtful-looking tube came to hand the welder slipped that tube "between centers" of the test machine.

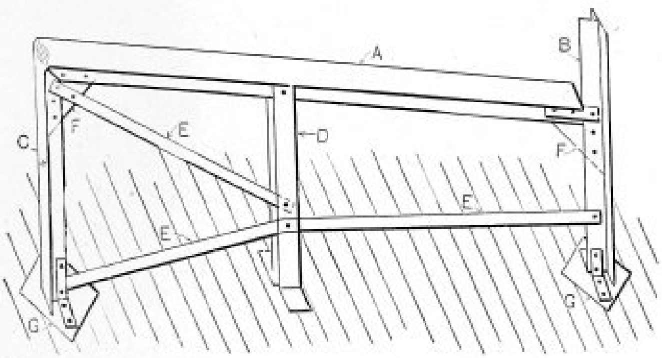


Fig. 1.—Trestle for Boiler Tubes

The tube-testing machine consisted of a long, shallow and narrow trough nearly full of water. It was long enough to take any tube which would ever come into the shop. A long shaft was hung to one side, and above the trough and hand levers attached to this shaft were used to give it a quarter revolution.

Two large conical centers of rubber or some similar material were adjustably mounted upon brackets or arms carried by the shaft above described. One of these arms was stationary and made hollow and a hose from the air service of the shop was permanently connected to the hollow center.

The other center was fixed upon an adjustable arm which could be moved along the shaft to accommodate any length of tube to be tested. The adjustable arm having been fastened, a tube was placed between the two centers and by means of a hand lever the rubber centers were clamped air tight against the ends of the tube to be tested, after which, by giving the long shaft a quarter turn by means of one of the handles mentioned in a preceding paragraph, the tube was lowered bodily and horizontally into the trough of water. Then air was turned into the tube up to, if necessary, a pressure of 100 pounds to the square inch, and if any leaks existed in the tube they were pretty apt to show themselves, the air bubbles arising from the tube in the water proving a sure "give-away." I saw the welder test in this manner several tubes which did not look quite right to him, and in nearly every instance his suspicions were justified by the bubbles which came up from the submerged tube.

By thus taking a very little time for testing, the tube man was able to save quite a bit of time, material and fuel which would have been wasted were he to weld each and every tube which came to him, no matter what its appearance might be to his experienced eyes. This method of "testing by the wayside" is surely to be commended and recommended to each and every man who ever has a boiler tube to cut off and weld a new end thereto.

TUBE-WELDING MACHINERY

In addition to the usual tube-cleaning and end-cutting-off machines, there is a gas heating furnace, a set of double rolls for working down the weld, an upsetting or expanding machine and a swage which brings the end of the tube down to proper dimensions.

The operation is as follows: The tube having been cut to proper length and the piece to be welded on also brought to exact required length, the end of the long piece is heated and expanded, and with the same heat the short piece is driven inside the expanded end. Then the tube is placed in the gas furnace, which is double, with room for two tubes.

The workman rolled the tubes over while they were heating; but it is a question as to whether this was necessary or merely a habit, for while he was rolling the weld in one heated tube the other tube seemd to heat well enough all by "its lonesome." A bit of swaging and annealing the ends of the tube completed the business save for the inevitable testing, which in this shop seems to be done all the time, in season and out. But they are pretty sure of tubes that don't leak in the welds or anywhere else after so much testing.

A TUBE TRESTLE

Permanent trestles are used to handle tubes upon, the trestles being given a slight inclination in order that the tubes might always work toward the low side of the trestle, which is next to the operator as he stands at his machine. One of these trestles is shown herewith by Fig. 1. The trestles are, of course, arranged in pairs, so that the "backbones" *A* of the two trestles form a regular skidway for the tubes to roll upon, which they did very promptly and at once gravitated toward the high post, *B*, at the low side of the trestle.

The trestles are made from seven to eight feet in length and provide ample room to accommodate all the tubes of a boiler, which may be piled pretty high in the middle of the trestle and against the post *B*, which arises to a height equal to that of *A* at the far end of the trestle.

The backbone *A* is also continued, to form leg *C* of the trestle, the T-shape being placed as shown, with the wide web upward and a notch of 95 degrees being cut out of the flange so that the shape may be bent over upon itself and form the vertical leg *C*, while the backbone *A* is inclined about five degrees.

The middle post *D* is made from two pieces of flat bar steel, riveted as shown to *A* and to the several braces, which are also of smaller, thinner black bar steel. The bottom ends of post-pieces *D* are turned out as shown, to form feet for the middle leg. Legs *B* and *C* are each fitted with a foot consisting of a square piece of waste boiler plate, butted against the bottom end of each leg and securely fastened thereto by means of the usual corner clips and rivets, bits of angles being used for the corner clips in the regulation architectural manner.

Handling Boiler Tubes

It was noticed that very little "main strength handling" of boiler tubes was done by any of the workmen in this shop. The several skidways and machines were usually so arranged that a tube could be picked up by one end and then pivoted upon some convenient support and the far end swung into position for the next operation, be it the fire, machine or the piling upon a rack as described above. Several benches or "bearing posts," as the lumber men call these things—and lumbermen use them and these methods largely—had been located at places where they came just right for pivoting tubes from one place or machine to another.

One of the favorite stands used in this shop is shown by Fig. 2. It is a very clever utilization of a waste product

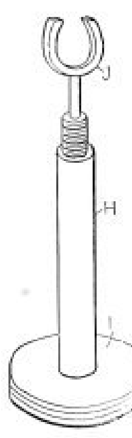


Fig. 2.—Piston Floor Stand

of the shop, for the stand is merely an old piston and rod which has been thrown away during the repair of some locomotive. The rod *H* is left in place in piston *I*, and nothing whatever has been done to either save to drill and tap a hole in the top end of the piston rod and to screw therein the stirrup *J*, which has been forged by the shop smith to a shape which resembles more than anything else an exaggerated "row-lock" as used in small boats for holding an oar in position.

Several of these stands were noticed standing around the shop, and it was further noticed that nearly each one had been carefully placed where it was in just the right position for swinging a tube from one required position to another. The few exceptions to stands thus placed were those where one of the devices had been permanently located before some machine in such a manner as to hold the far end of a tube at exactly the right height while the other end was being acted upon in the machine or in the fire.

And, by the way, the stand which was placed in front of the heating furnace and the welding machine was large enough to accommodate two tubes at the same time. And the stand had been so placed and the rolls and heating furnace so located in connection with the stand that a tube with one end resting in the "stirrup" of the stand could have its other end—of the tube—swung either into the heating furnace or into the rolling machine without removing the far end of the tube from the stirrup on the stand in question. This arrangement proved to be very handy and a time-saver indeed!

Some Fine Flanging Forms

Scattered all around this boiler shop I saw fine forms for flanging all sorts and sizes of heads, locomotive front shapes and everything between those and the front ends

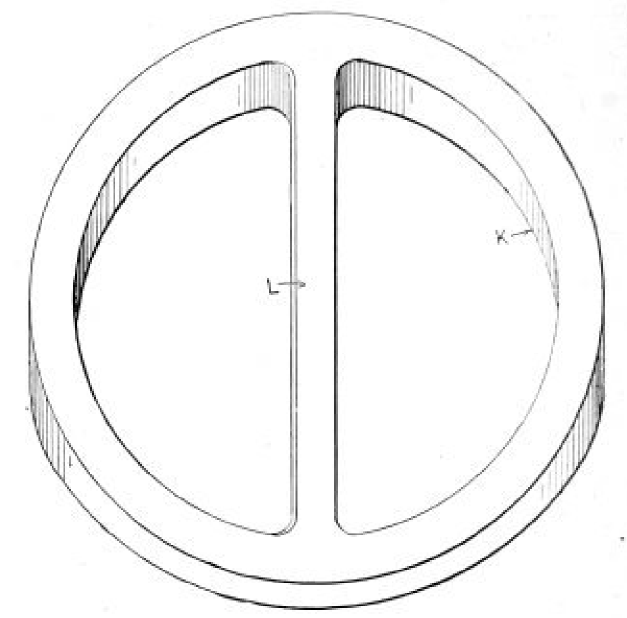


Fig. 3.—Round Flanging Form

of boilers, which were plain circles, as shown by Fig. 3. Nearly all of these forms seemed to have been finished in some manner. It may have been by many years of continual use, but nearly every form in the shop was as smooth as though it had at some day been machined "all over."

Out back of the flange shop I found a pile of forms almost as big as a boiler. Am sure that had all the forms in and around this shop been piled together that it would have made a pile considerably larger than an ordinary locomotive boiler.

The small, round, plain flanging form shown by Fig. 3 was found in almost endless variety as to diameter, and evidently several forms of this character had been made up for each size of required circular head. These forms were very simple indeed, just the ring *K*, with a brace *L*, across the diameter in one way only, the designer of the form doubtless considering a single diameter brace all that was necessary to withstand either sledge blows or the stress of the flanging machine.

There was also to be seen a large number of sectional forms, as shown by Fig. 4. These forms had evidently been designed to fill a wide range of requirements, and the writer was utterly unable to even estimate the number of pieces or sections which had been so designed and made that they could be bolted together, thus forming almost any required shape of form upon which a head could be formed to exact size, as well as flanged.

Several sizes or diameters were observed which consisted of three and sometimes of more than that number of pieces of form-sections. The form shown by Fig. 4 consisted of three pieces, but how many more there might be around the shop was not in evidence, and the writer, I am sorry to say, omitted to ask this information from the foreman boiler maker.

The writer is very certain that the "set" of forms comprises at least two like that shown by Fig. 4 at *M*, and that when two of these pieces are bolted together they form a simple round head. There were also more than one piece like that shown at *M*, and when a regular locomotive head was required it was only necessary to bolt to piece *M* as many pieces like *N* as would make up the required height of the water leg.

By means of the elliptical or parabolic piece *O*, it was possible to use this shape at will either in connection with the circular piece *M* or with one or more square shapes *N*, or, if it should ever be desirable from some cause or other, piece *O* could be used in connection with piece *M*, and even with one or more of forms *N*, in between. Thus the possibilities of a serially designed lot of sectional forms is very great. Doubtless the shop draftsman worked out the matter very fully before he commenced to lay out a lot of expensive—although time-saving—sectional forms for the flanging of boiler heads.

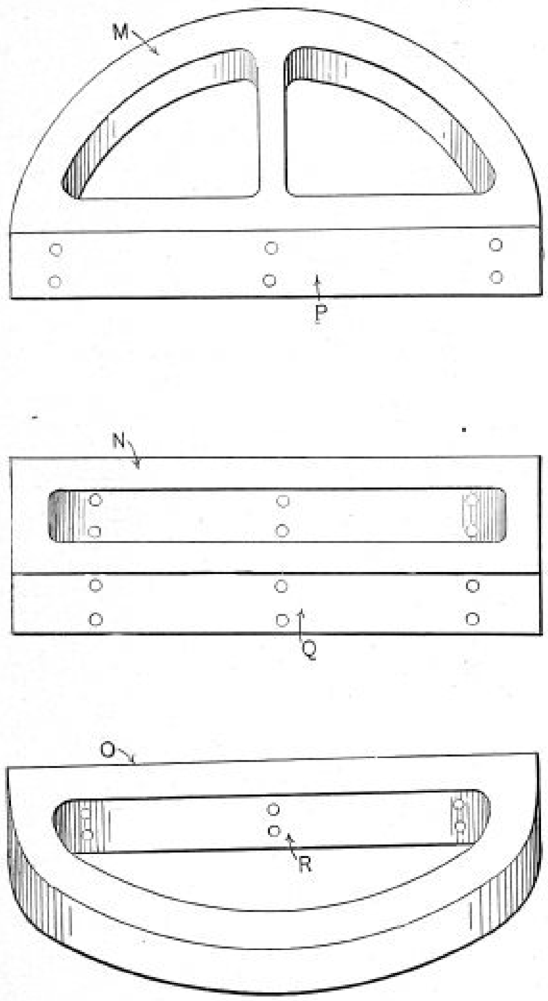


Fig. 4.—Sectional Forms

In these sectional pieces there were three sets of two each of holes for the introduction of one-inch bolts, by means of which any two or more of the sections could be firmly and securely bolted together. These bolt holes are shown at *P*, *Q* and *R* in the three sections shown respectively at *M*, *N* and *O* in Fig. 4.

Large Sectional Forms

The writer also noticed some larger sectional forms made very heavy, something as shown by Fig. 5. Owing to lack of time—for night overtook ye scribe before he had seen nearly all there was to behold in this big shop—he was unable to obtain any data regarding these large forms.

But there were several in the series, according to the evidence offered by the eight 1¼-inch holes at *S S*, by means of which the sections could be fastened together in a pretty stiff manner.

The purpose of the smaller circles, *T T*, was not apparent, but the inner edges of these bore unmistakable evidence of having been used for flanging purposes, the corner having been neatly removed and rounded over, as also were the outside working edges and corners of this

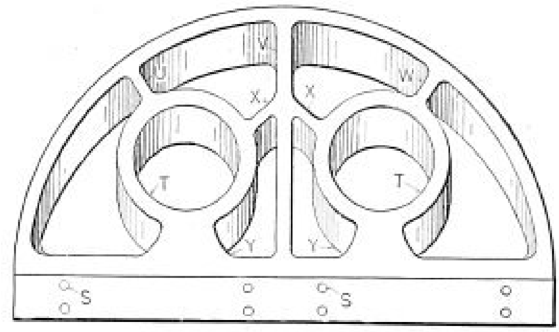


Fig. 5.—Large Sectional Form

and the other series-sectional forms here shown and described.

The disposition of the braces was evidently the result of considerable calculation on the part of the designer of forms. As in most of the other forms, there was the straight axial brace *V*, direct from diameter to circumference. And then there was the peculiar arrangement of the three braces *U* and *W*, which, in connection with the other braces *X X* and *Y Y*, evidently permitted the form to be cast without being subjected to cooling strains which might possibly distort or even break the form.

Like all the other forms, this one also was so smooth all over that it presented the appearance of having been machined some time or other.

A Face-Plate Floor Block

A very handy bit of apparatus was observed in use in the smith shop, and it was nothing more or less than the face plate from a defunct wheel lathe which had gone the way of all wornout machines. The big face plate, with all its holes and T-slots, had been blocked up a few inches from the floor on timbers, which, as they rotted away, were to be replaced, so the writer was informed, by concrete blocks which would support the old face plate for as long as the present shops might endure.

All manner of work was done on this old face plate; forms, small ones, were bolted to it and worked from. "Sick" flanges were doctored there by being heated with the kerosene oil torch, and in one or two instances the oil torch was reinforced by air and acetylene used in a welding torch. A large tip was used, and the obstinate flanges soon became hot enough to be hammered into shape.

When steel angles and other structural shapes were to be worked, bent, etc., the old face-plate came into use very handily. A steel shape would be clamped by means of a strap and a few bolts, a form fastened where the bend was to come, then a few minutes with kerosene torch and perhaps the air-acetylene and the steel shape was quickly heated and knocked into shape without resource to the very expensive forge fire.

In this shop they don't hesitate about doing a little cutting with the electric arc when occasion demands. Probably it is more of a melting out than real "cutting," but it gets there just the same.

Care and Maintenance of Locomotive Boilers and Their Appurtenances—IV

Washing Out Locomotive Boilers and Their Preservation—Rules and Regulations Governing Electric Arc Welding

BY WILLIAM N. ALLMAN

WASHING BOILERS

Time of Washing.—All boilers in service must be thoroughly washed not less frequently than once each thirty days, or more often where the water, weather or mileage conditions justify.

Metal tag to be applied in accordance with Figs. 28 and 29 to the front of the smoke box, showing the date of the boiler washing.

Plugs to be Removed.—When boilers are washed, all washout arch and water bar plugs and handholes plate must be removed.

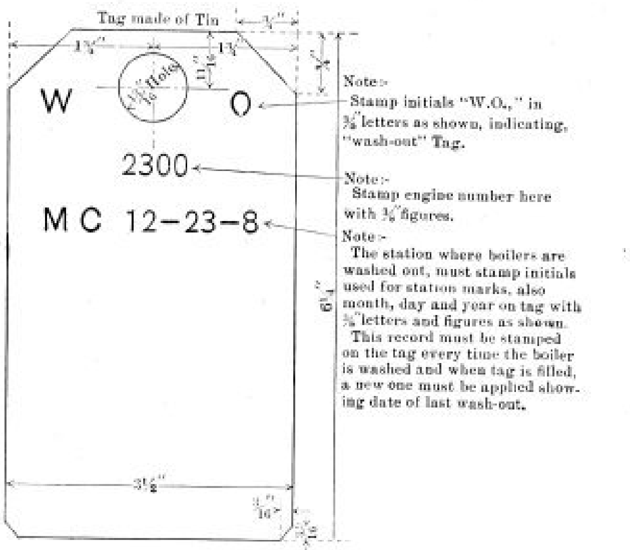


Fig. 28.—Metal Tag Showing Date of Washing

Water Tubes.—Special attention must be given to arch and water bar tubes to see that they are free from scale and sediment.

Recording Washouts.—A record of all locomotive boiler washouts must be kept on Form 5, and in addition must be reported on Forms 1 and 3.

PRECAUTIONS AGAINST EXPLOSIONS IN SHOP REPAIR AND INSPECTION WORK

Prohibiting the Use of Gas for Illuminating, Heating and Drying.—With a view to protection to employes and prevent damage to property, gas should not be used for illuminating, heating or drying the interior of boilers, or in any place where there is not sufficient ventilation to prevent an accumulation of gas and cause explosions.

In cases where it is necessary to repair or inspect the interior of boilers, electric or electric flash lights should be used.

INSTRUCTIONS FOR THE WASHING OUT OF LOCOMOTIVE BOILERS

1. The boiler inspector at each station must keep a book record of the date of washing out each locomotive boiler, in addition to the individual record kept on the smoke box front tags.

2. Locomotive boilers, as a rule, should be washed at least once during the following periods.

Passenger and freight locomotives, once every ten days.

Switching and helping locomotives, once every fifteen days.

These periods to be lengthened or shortened wherever advisable and the weather, servic or mileage conditions justify.

3. Where locomotives assigned to one division may be in temporary service on another division, the master mechanic of the division to which the locomotive is as-

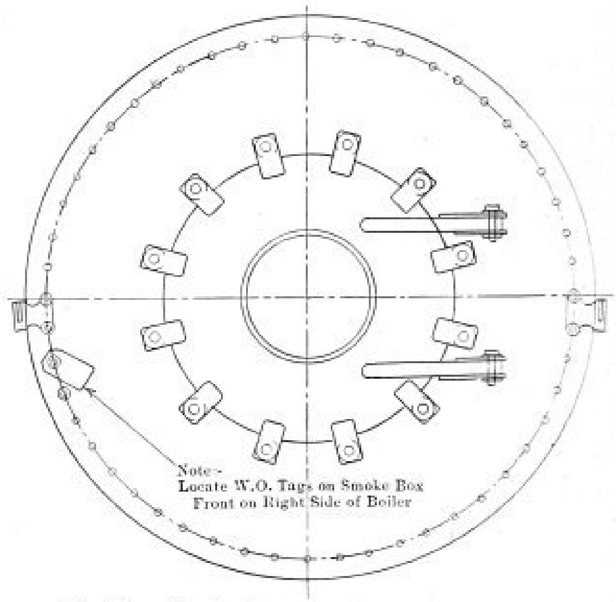


Fig. 29.—Showing Location of Tags on Smokebox

signed should take up with the master mechanic of the division on which the locomotive is in service, in order to see that the washing out is performed at the proper time.

4. The boiler inspector at each station should make up daily a list of locomotives that are due for washing out. These lists should be brought to the attention of the engine dispatchers, leading hostlers, boiler washers and all others concerned. The leading hostlers and others employed at the ashpits should also make examination of the tag record on the smoke box fronts of each incoming locomotive and keep informed as to whether the fires should be knocked on account of washout being required. They should also notify the boiler inspector and others concerned when they find home or foreign division locomotives for which washout is due.

The following methods will be adhered to when washing out locomotive type boilers.

5. Blow out boiler through the blow-off cock until water has been relieved, after which the blow-off cock should be closed in order to retain the remaining steam pressure until staybolts have been tested. After the staybolt test the blow-off cock should again be opened to let out the remaining steam and water.

6. When all water and steam has been blown out, the washout plugs and handhole plates should be removed.

7. Wash out all water legs as well as around firebox flue sheet and furnace door opening.

8. Wash off crown sheet.

9. Wash off top of flues.

10. Wash out cylindrical portion of the boiler, beginning at the smoke box end and following back by washing through the holes in the sides and at the bottom of the shell.

11. Repeat the washing out of the boiler legs and over the fire door next to remove the scale that has been washed down from the top of the crown sheet and flues.

12. Coat the threaded portion of washout plugs with a mixture of graphite and black oil and reapply the washout plugs and handhole plates and fill the boiler.

13. Wherever possible, heated water should be made use of for washing out and filling up boilers.

14. Under no circumstances shall crown sheet be washed before the boiler legs have been washed.

15. The washing and blowing out of water gages.

The boiler inspector must see that the water gage is washed and cleaned at each boiler washing; this should be done before reducing the boiler pressure; by opening the drain cock in bottom of gage, and allowing first the water and then the steam to blow, which, as a general rule, will accomplish the cleaning of gage; but to insure perfect condition of gage, after steam and water pressure has been reduced, the drain cock, water and steam valves should be removed and a wire run through the openings; this can be done without disturbing the glass. After the cleaning of boiler and pressure is again applied, the water gage should have drain cock opened and the water and steam allowed to blow through the fittings to note if gage is thoroughly cleaned. Master mechanics and road foreman should insist on the engineers blowing out the gage at the beginning of each trip.

Preservation of Locomotives, Boilers and Appurtenances

In order to comply with the rules issued by the Division of Locomotive Inspection of the Interstate Commerce Commission, in case of an accident resulting from failure from any cause of a locomotive boiler or its appurtenances, which results in serious injury to one or more persons, the gage cocks, water glass cocks, injectors, safety valves and all other parts which may or may not have been contributing factors to such accident are not to be removed for any cause until after the arrival of a Federal Inspector.

There will be no objection to having the locomotive picked up in case of such an accident and remove it to some place where it will not be in the way, though care must be taken that the appurtenances referred to shall not be disturbed pending arrival of the Inspector.

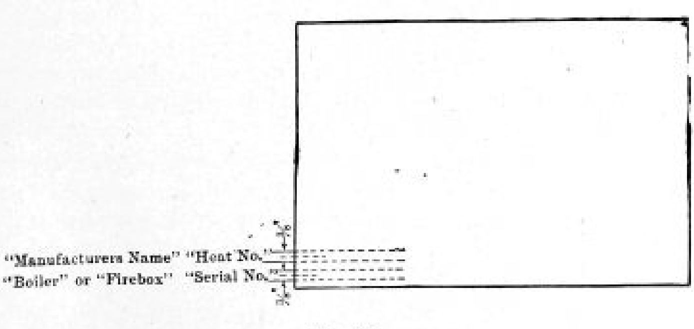


Fig. 30

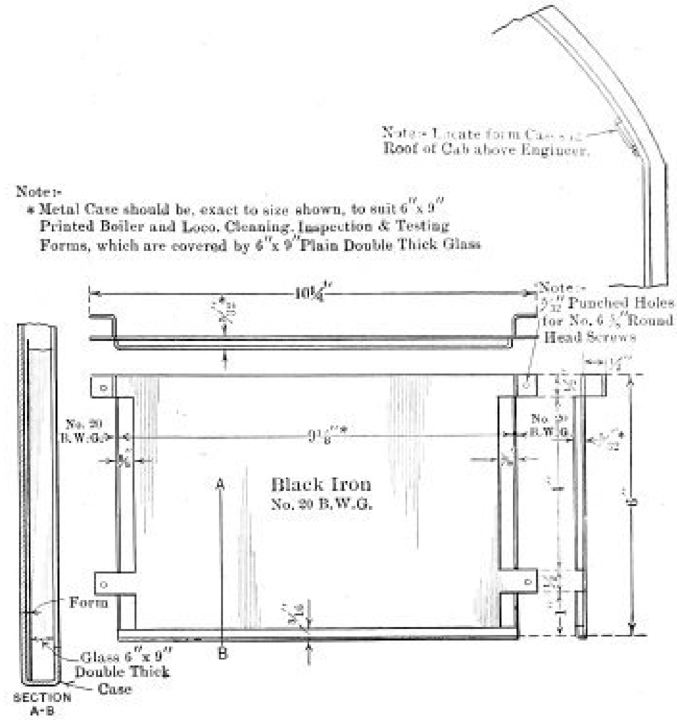


Fig. 31.—Metal Case for Holding Forms

Maintaining Identification Marks on Boiler and Firebox Steel

Fig. 30 covers diagram showing stenciling of boiler and firebox sheets for identification.

The shops are to maintain the original marking on all plates in accordance with instructions shown on the above-mentioned print, in order that proper identification can be made at any time.

When it becomes necessary to report the tensile strength of the plates to comply with the requirements of the Interstate Commerce Commission, it will be necessary to refer to test reports bearing the heat and serial numbers as stamped on the individual plates, and such test reports should be filed in the office of the superintendent of shops, master mechanic or general foreman, at the point where repairs are made, these reports being furnished by the various storekeepers after the material is properly checked on receipt of same.

Metal Case for Holding Forms in Locomotive Cabs

Fig. 31 covers metal case for holding boiler and locomotive cleaning, inspection and testing forms, to be placed in all locomotive cabs. Each locomotive cab is to be fitted with one of these metal cases for the boiler inspection certificates, Forms No. 1 and No. 3.

Boiler, Serial and Builder's Numbers

The boiler, serial and builder's numbers should be stamped on the domes of all locomotive boilers in the location shown in Fig. 32.

Lagging for Locomotive Fireboxes

Plastic lagging should not be applied on sides, back head or throat of locomotive boilers which have stays in which telltale holes have been drilled; or over hollow stays, as it is liable to close the holes and prevent the detection of broken stays. Plastic lagging applied as above also conflicts with I. C. C. requirements.

Standard Boiler Patch Bolts

Fig. 33 covers design of standard boiler patch bolt.

Rules, Regulations and Instructions Governing Electric Arc Welding

Satisfactory electric welding can only be accomplished by following the instructions as hereinafter noted, which have been found to be good practice. The heat required will depend upon the character of the weld being made.

Adjustment of Heat at Weld.—The heat at the weld should be adjusted to suit the class of weld to be made.

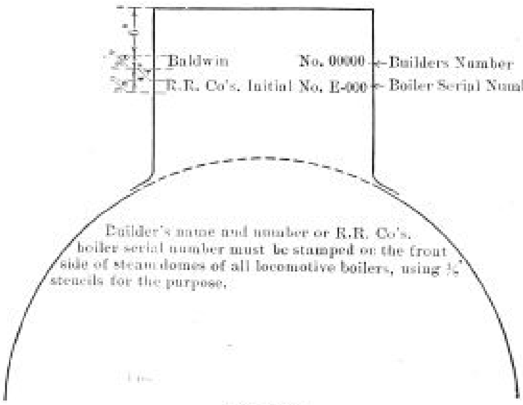


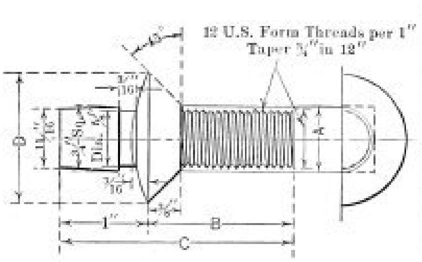
Fig. 32

This adjustment of heat can be accomplished by adjusting the switches or dial on the welding panel.

Current or Heat Adjustment.—Adjustment of switches or dial at welding panel for the various classes of welds should be made in position as indicated on *adjustment schedule* located on the panel.

Method of Handling.—The arc should be kept at a constant and uniform length, so as to heat as large an area as possible, and as few applications of the arc as is possible should be made.

Preparing Parts for Welding.—The parts to be welded should be free from dirt, grease or slag. Just before the welding is started, it should be either sand blasted or cleaned with roughing tools.



A	B	C	D
¾"	1¼"	2¼"	1½"
13/16"	1¼"	2¼"	1 9/16"
⅞"	1⅜"	2⅜"	1⅝"
15/16"	1⅜"	2⅜"	1 11/16"
1"	1⅜"	2⅝"	1¾"
1 1/16"	1⅜"	2⅝"	1 13/16"
1⅛"	1¾"	2¾"	1⅞"
1 3/16"	1¾"	2¾"	1 15/16"
1¼"	1¾"	2¾"	2"

Fig. 33.—Standard Boiler Patch Bolt

Locomotive Fireboxes.—Cracks in side sheets should be chipped "V" shape to an angle of 45 degrees clear through the sheet with 3/16 inch opening. The parts welded should not be more than ⅛ inch thicker after the welding is finished than the original sheet. When welding cracks in side sheets, the welding should be continued until same is finished, thus to prevent the weld from cracking due to contraction. Cracks in side sheets 15 inches or over should never be welded.

Application of Patches to Side Sheets.—All patches applied in side sheets should be either oval or round, and in applying patch, all old metal should be removed and patch made ⅜ inch smaller than the hole in which it will be applied. Side sheets as well as patch should be beveled to an angle of 45 degrees. The patch should be set in position in the sheet with all bolts applied, allowing 3/16 inch opening all around patch. Weld should be started at lower side and welded one-half way up, and then started at lower opposite and welded one-half way up, then started again on the opposite side and continue the weld to the top. This is necessary in order to provide for expansion and contraction of the metal. After patch is welded flushed, it should have at least 3/16 inch reinforcement extending ⅛ inch on each side of the weld.

Mud Ring Corners.—In welding mud ring corners, same should be thoroughly cleaned from oil and grease. This can be accomplished by either sand blasting or with roughing tools and then calked before the weld is started. Metal applied should extend at *least* six inches beyond the corner of the ring. All mud ring welds should be roughened down and thoroughly calked after weld is finished. This to be applied to both inside and outside corners.

Truck Frames.—In repairing truck frames, cracks should be "V" from both sides one-half way through to angle of 45 degrees, leaving a 3/16 inch opening. (Iron plates should be placed on the bottom of frame to retain metal when starting the welding.) Fill in one-half thickness of frame on one side and then fill in opposite side one-half thickness, finishing weld by continuing first side and then filling in the balance of the opposite side of frame.

Flues and Superheating Flues.—Care must be exercised to see that the copper ferrule is set back in the head at least 1/32 inch, thus to prevent copper from working towards fire side of flue sheet and under head of flue. Before welding is started, it is necessary that all oil and grease be removed between the flue head and flue sheet. This can be accomplished by heating engine in shop to steam pressure or running engine one trip. Before welding is started flue must be sand blasted.

In welding, the operator should begin welding at the bottom of flue and work up one side to top center, then return to bottom and work up on the opposite side and meet at top (never begin at the top and work to the bottom), this to apply to both superheater and smaller flues.

In applying metal on beads, it should never exceed the height of bead or extend from top of bead to flue corner in which fire cracks will develop.

Equal amount of metal should be applied on bead and flue head. See Fig. 35.

Spring Hanger Rubs or Worn Frames.—Frame must be free from rust and grease. When rub is ¼ inch deep or more, it is advisable to place copper plate at bottom of rub, this to prevent metal from running. Always see that copper plate is knocked away after weld is finished.

Smoke Box and Tee Iron Holes.—It is permissible to plug holes with boiler punchings, leaving a space of 3/16 inch or more to apply electric weld on each side of the Tee iron and inside and outside of the smoke box holes.

Cracks in Top of Flue Heads.—Cracks in top of flue sheet should be chipped to an angle of 45 degrees and an opening of 3/16 inch made through sheet and welded from inside of boiler and reinforced from the firebox side.

Washout Plug Holes.—In reinforcing washout plug holes, it is advisable to allow plug to remain in holes and apply electric weld around the plug to the desired thickness, removing the plug and retap the holes. The weld will not adhere to copper plug.

Slid Flat and Shelled Out Places on Wheels and Tires.—Should be sand blasted to absorb oil and grease, and while the weld is hot it should be hammered so as to make weld flush with tire. It is also advisable to use small emery wheel to grind weld down to uniformity of tread.

Castings and Malleable Iron Parts.—Castings and malleable iron parts to be welded must be thoroughly cleaned.

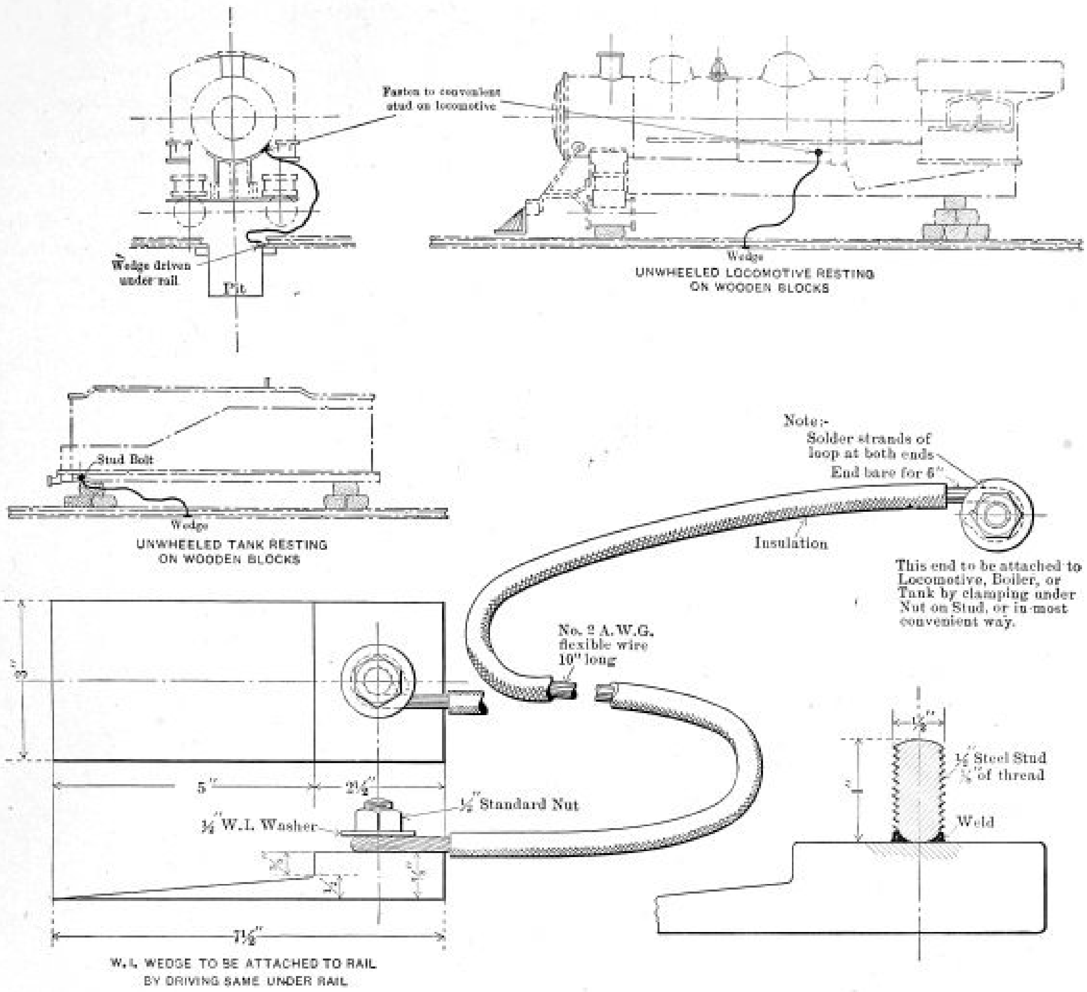


Fig. 34

removing all rust, grease and dirt, preparing weld by chipping castings, after which parts are to be clamped in position, and before the weld is started, parts should be heated from some external source. After the weld is completed, the clamps should be allowed to remain on the casting until metal is thoroughly cooled. This to prevent cracking from expansion.

Miscellaneous.—In welding castings or worn places in sheets where it is desirable to preserve a hole, a copper rod should be inserted in the hole and weld applied around rod, rod to be removed from hole while the weld is still hot. Electric welding will not adhere to a copper rod.

It is permissible to weld over and around rivet heads.

Never watch the operation of welding with the naked eye.

Never weld over or around a staybolt head.

Never weld around a crown bolt head.

Never apply a weld to the barrel of the boiler.

Grounding of Unwheeled Locomotives, Etc., When Resting on Wooden Supports

When unwheeled locomotives, boilers, tanks, or other metal parts are supported on wooden blocks and where electric welding or electric lighting circuits are used, *"ground wires"* shall be applied as indicated in Fig. 34.

Electric Welding of Boiler Flues in Back Flue Sheets

Locomotive boiler flues, including the superheater flues, after properly applied, can be electric welded in the back flue sheets. Special care to be given in the setting of copper ferrules so that when working flues the copper will not be forced outside of flue bead and prevent proper welding.

Before welding the flues, the boiler must be fired to the testing pressure, fire then drawn from firebox and water released or engine must make two or three trips before welding, to insure oil and grease being burned out from between the head and the flue sheet; in either case it is necessary that the edge of the bead and the flue sheet,

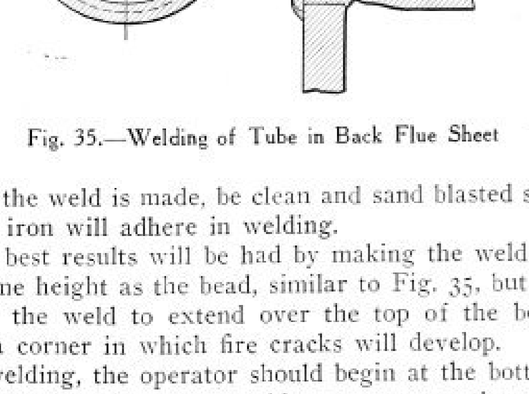


Fig. 35.—Welding of Tube in Back Flue Sheet

where the weld is made, be clean and sand blasted so that fusing iron will adhere in welding.

The best results will be had by making the weld about the same height as the bead, similar to Fig. 35, but never permit the weld to extend over the top of the bead to form a corner in which fire cracks will develop.

In welding, the operator should begin at the bottom of the flue and work up on one side to top center, then return to the bottom and work up on the opposite side and meet at the top. Never begin at the top and work to the bottom.

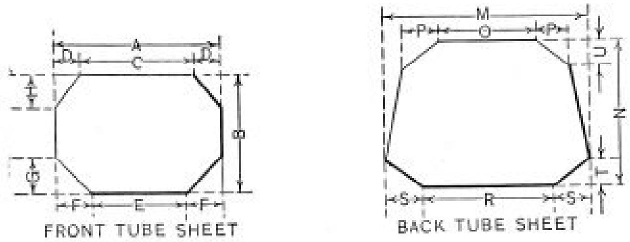


Fig. 36

Welding in New Front and Back Tube Sheets

Considerable saving in material may be realized by use of the electric welding of new portions of tube sheet—that is, that portion confined to the tube area. By culling out this area it is possible to save that portion of the sheet beyond. The diagrams in Fig. 36 serve as an illustration whereby, with the addition of a table, it is possible to cover a large percentage of power.

Welding Up Cracks at Staybolt Holes in Locomotive Firebox

Fig. 37 covers diagram showing method of welding up cracks at staybolt holes in locomotive firebox, which print, together with the instructions thereon, is to be followed in this regard.

Particular attention is called to the reference, to the effect that oxy-acetylene welding process must generally be used for welding up cracks in sheets at staybolts, and that the electric process only be used where the oxy-acetylene welding outfit is not installed.

Staybolts must be removed when a cracked sheet is to be welded.

After staybolt is removed, metal around crack is to be chipped out with a "V" or round-nose tool, as shown in view No. 2. Metal to be welded or fused in "V" space, building it up and beyond hole to be reamed and tapped and staybolt applied as shown in view No. 4.

Oxy-acetylene welding process must generally be used for welding up cracks in sheets at staybolt holes. The electric welding process is only permitted to be used at those shops where the oxy-acetylene welding outfit is not installed.

In welding a tube in the tube sheet, before weld is made, be sure that all oil and grease has been burned out from flue sheet and bead, also that ferrule does not extend outside of edge of bead, and that bead and sheet is clean, sand-blasting, if necessary, to insure adherence of fusing iron.

Weld should never be higher than bead, but be similar to the diagram above. Operator should begin welding at bottom of flue and work up on one side, then return to bottom and work up on opposite side and meet at top.

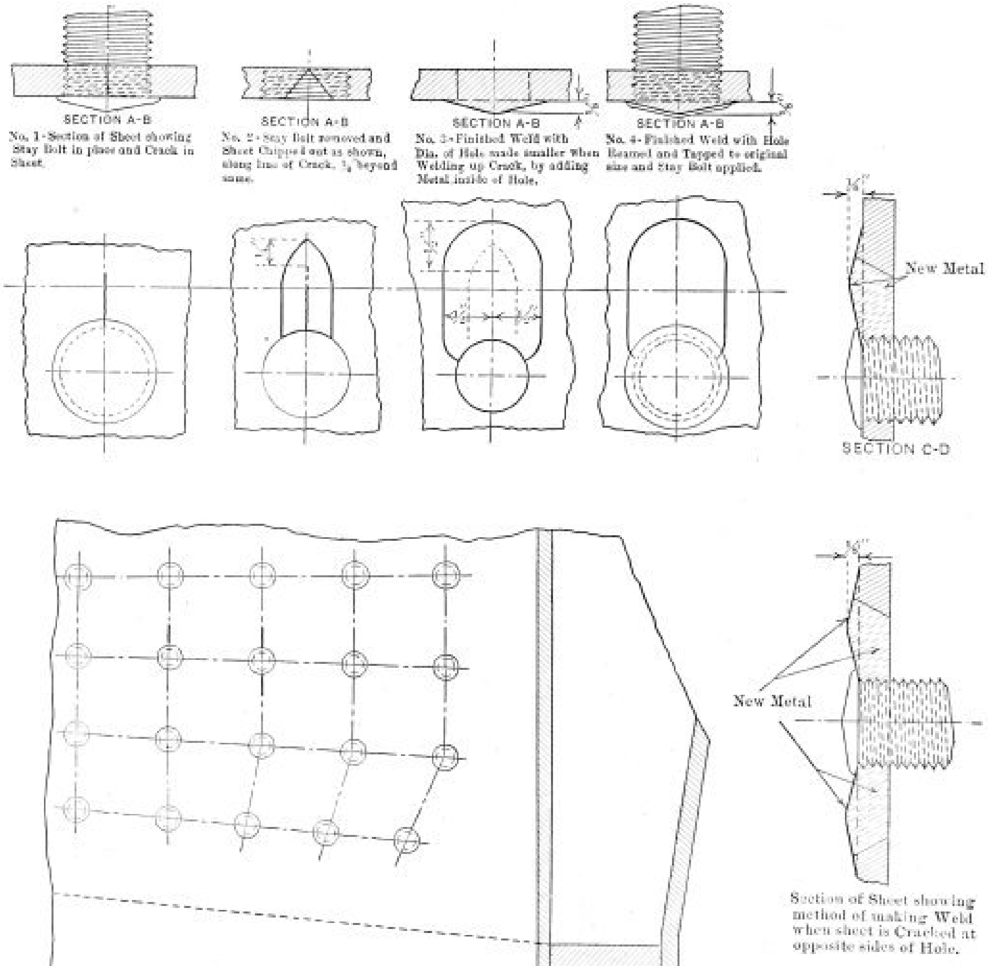


Fig. 37.—Diagram Showing Method of Welding Up Cracks at Staybolt Holes in Firebox

(To be continued.)

Naval Watertube Boilers—III

Description of Yarrow and Launch Boilers—
Repairs—Instructions for Overhauling and Care

BY C. H. WILLEY

Yarrow Boilers

The Yarrow watertube boiler, an outline sketch of which is given in Fig. 1, is of the small, straight tube type. It is installed in several of our destroyers, and in some of our small gunboats. This boiler is used extensively by the British Navy. As will be noted in the sketch, there are two water or mud drums of oval shape. These are connected to the horizontal circular steam drum by seamless drawn steel tubes. The tubes are expanded at both ends.

The shell of the steam drum is of two sections, but jointed with double straps.

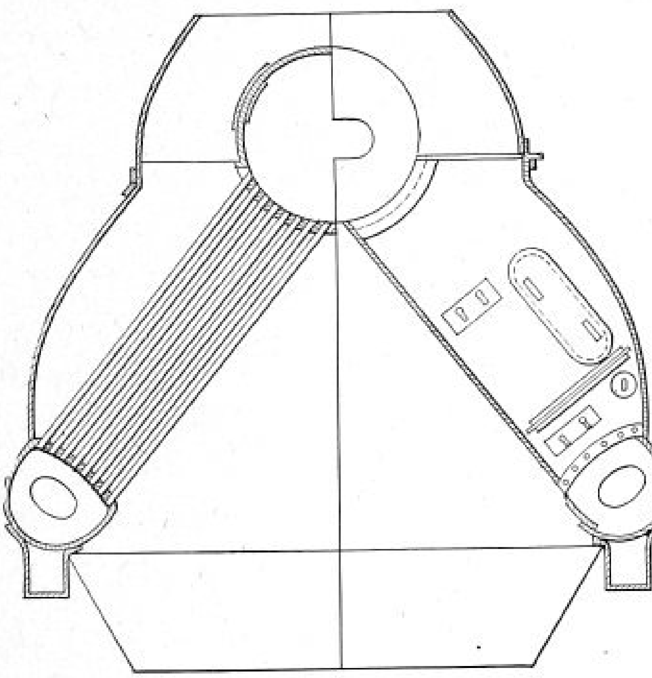


Fig. 1.—Yarrow Boiler

Launch Boilers

While the gasoline engine is doing much towards forcing the steam boiler out of use in navy launches, it will probably never entirely displace it, and at present the greater percentage of our naval launches are boilered with the Ward boiler, there being two types in general use, round and square design, as shown in Figs. 2 and 3.

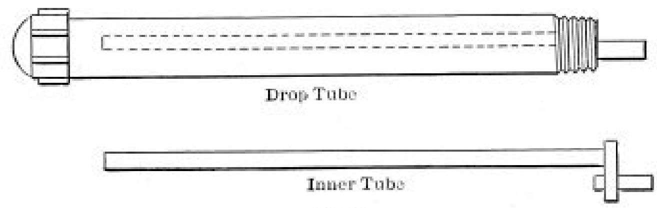


Fig. 4

These boilers are quite simple in construction and easy to repair. All ships carry a plentiful supply of spare tubes and the special spanner wrenches with which to remove and replace the tube ferrule. The shape of the outside generating tubes is plainly shown in Fig. 2. Each end is equipped with special tapered screw couplings or ferrules; these screw into the cast steel manifold at the lower end and into the vertical steam dome at the upper end.

As will be noted in the sketch, the tubes are of two lengths. All tubes are bent to right angles at the upper ends, and of a sufficiently generous radius to permit easy flow. The lower section of the steam dome that receives the tubes is of cast steel.

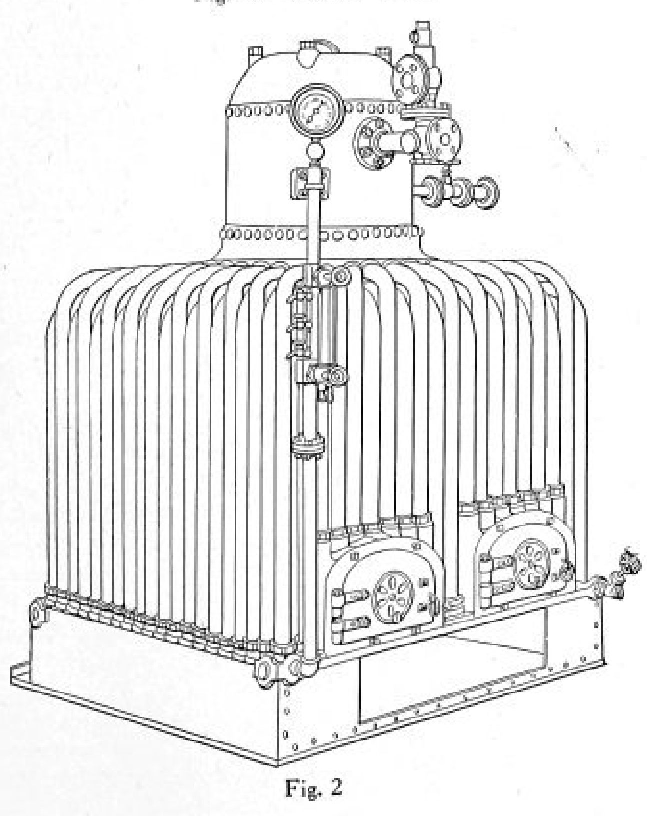


Fig. 2

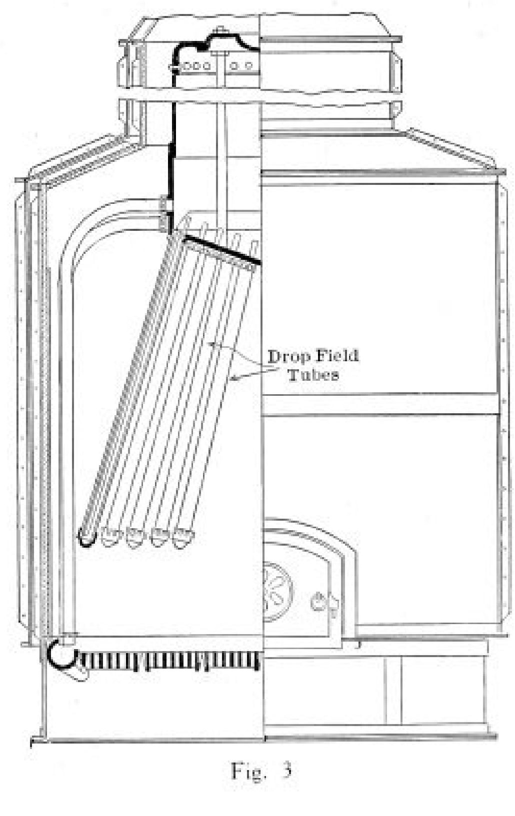


Fig. 3

The base of the steam dome is conical-shaped, and into it are screwed the Field drop tubes, one of which is shown in Fig. 4 with its inner tube. The lower end of these tubes is closed by a left-handed screw cap. The inner tubes are of brass and are heavily tinned.

The manhole plates are secured in place by studs and nuts. Packing grummits are used under the steel washer and nuts. No dogs or bridges are used. The manhole is shown in Fig. 5.

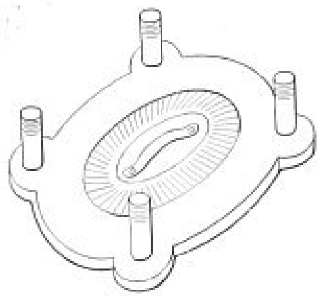


Fig. 5

Repairs

These consist mainly of renewing worn or defective tubes and calking leaky seams.

When it becomes necessary to make repairs, the boiler has to be hoisted out of the launch, for it is impossible to make them without removing the entire boiler casing. The machinist's mates will strip the boiler trimmings and fittings, and the boiler maker will take out the manhole plate and put in a strong back inside the manhole by which to hoist the boiler out. There are four lugs on the base of the ash pan through which studs pass to secure the boiler to the bilge of the launch; these are freed and the boiler is then ready to come out.

When setting the boiler on deck, there should be a large tarpaulin spread under it to save marring or dirtying the deck while working. To remove the casing, it is but necessary to take out the steel nipples of the boiler fittings where they pass through the casing and screw into the pads on the steam dome, then take out the four bolts inside the walls of the ash pans that hold the casing to it, and the casing will then be free to lift clear. Next, the boiler is lifted off the ash pan, and it is then entirely accessible.

Set the boiler on two blocks and, with the necessary pipe plugs to close up all the openings in the drum and water legs or tube manifolds, fill the boiler with water. Replace the manhole plate, and with a force pump apply a hydrostatic pressure and locate the defective tube or couplings.

If the trouble is leaky ferrules, they can be made tight by setting them up with the special spanner provided, or by the use of a blunt chisel and a hand hammer. The latter method should only be used when impossible to grip the coupling with the spanner. To renew a tube requires but the unscrewing of the two tapered couplings. The threads of the holes in the shell and in the manifold are cleaned, and the new tube is put in place and its couplings tightened. In the case of a drop tube, the work is even more simple—it requires but the unscrewing of the tube from the base of the steam dome, that end of the tube being threaded and making the joint.

Type W, Launch Boiler

This boiler is a purely naval product. It was designed by the Bureau of Steam Engineering of the Navy Department, and is manufactured by the Navy Yard in New York. A sketch of it is given in Fig. 6. The tubes are small diameter and bent to easy curves. These are expanded into both steam and mud drums. All tubes enter the drums naturally and have their ends flared. A manhole is fitted in the front, convexed or bumped head; this is secured by two dogs or bridges. There are large-sized oval handholes fitted in both ends of the mud or lower water drums. These provide accessibility for expanding the lower ends of the tubes. It is necessary to lift this boiler out of the launch when making repairs. There are two special hoisting lugs riveted to the drum for this purpose. A special 90 degrees bevel gear operated expander is used on the lower ends of these tubes.

Overhauling and Care of Boilers

The following instructions issued by the Navy Department, Bureau of Steam Engineering, for 1917 are selected by the writer as being of real importance to the navy boiler maker, as they in a measure form a large part of his duties. They apply to all Babcock & Wilcox boilers and to all other boilers except in details where difference in design makes them inapplicable.

Furnace Doors, Etc.—Examine and repair or renew as required door jambs, lintels and dead plates.

Deflection of Tubes.—Test the lower row of tubes with a straight edge and examine with a gage for evidence of bulging or sweating. Bulged or blistered tubes should invariably be renewed. In straight-tube boilers any tube which is found deflected more than three-quarters of an inch should be renewed at the first opportunity. Tubes should never be straightened in place, as joints are liable to be strained, causing leaks and possible permanent injury to headers.

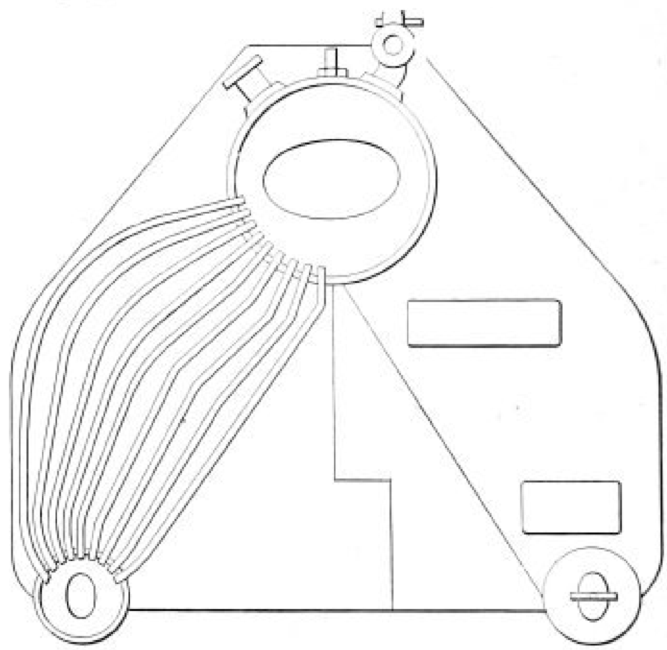


Fig. 6.—Type W Naval Launch Boiler

Inspection of Distorted Tubes.—Distortion of tubes is a sign of overheating, which may be due to internal fouling. Even a very thin film of oil may cause considerable distortion. If the distortion is not such as to cause their immediate renewal, as directed above, their internal condition must be examined with especial care when the handhole plates are taken off.

Ash-Pit Doors.—If the ash-pit doors are warped, straighten them; scale and paint them if necessary, and replace them and the furnace doors.

Inspection for Leaky Tubes.—Before running water out of boilers, inspect with an electric light from furnace and from sides of boiler for any leaks around tube ends or nipples. Mark any that are detected, and noted for repairs when boilers are empty.

Tubes With Worn Ends.—In examining watertube boilers, especially those of small bent-tube type, in which, owing to the shape of the tubes, the pressure tends to force the tubes out of the plates, particular attention shall be paid to the attachment of the ends of the tubes. When the projecting end of a tube becomes worn away to such an extent that the wear extends into the rolled part of the tube, or when it becomes materially thinned in the rolled part, it shall be renewed.

Precautions in Renewing Tubes.—When renewing tubes that are secured by expanding, each tube hole shall be carefully examined to see that it is truly cylindrical and to the correct diameter. After the expanding is done, each tube end shall be inspected to see not only that it has been well done on the inside, and also that it is expanded close to the edge of the hole on the outside.

Care in Use of Expanding Tools.—Renew defective and re-expand leaky tubes or nipples. In using the expanding tool, care must be taken to avoid the use of an undue pressure, as such may cause distortion of the header. A drawing showing the proper placing of expanding tools for expanding of tubes and nipples is usually furnished with the machinery drawings of the vessel.

Flaring Tubes, Etc.—All tubes of watertube boilers should be flared at the ends. The flaring is accomplished by a taper mandrel, with a taper of about 15 degrees each side of the axis for small tubes, decreasing for larger sizes. The flaring is done after the tube has been expanded, but rerolling is sometimes necessary. The flaring of all boiler tubes should be accomplished to such an extent that the outside diameter of the flare is materially greater than the diameter of the hole into which the tube or nipple is expanded, whether in header or drum. This does not apply to field tubes. In flaring tubes, care must be taken to apply the pressure evenly and slowly to avoid splitting the tubes.

Examination Side Boxes, Etc.—The lower side casings should be taken off annually, and the side boxes, uprights and rear headers should be examined. Defective parts must be renewed.

Cleaning Gasket Seatings.—Remove the old gaskets from handhole plates that have been taken off. It is usually inadvisable to attempt to refit used gaskets. Thoroughly clean the gasket seats on both headers and plates. Most of the apparent effect of boiler compound on gaskets is in reality the decomposition of rust and scale on gaskets' seats, causing steam leaks which result in blowing out of sections of the gasket. For this reason the seatings should be scraped down to bright metal.

New Gaskets on Handhole Plates.—Fit new gaskets before replacing the handhole plates. New gaskets must be examined carefully for defects, particularly at corners. Where either the seat or the handhole plate are all corroded, thicker gaskets must be used than otherwise. It is sometimes practicable to make the rough parts smooth by using Smooth-on cement.

Repair of Handhole Plates.—Handhole plates are faced true with the threads turned on the studs. This is done to insure a tight joint when a pressure is put on the stud in setting up handhole plates. When studs have become damaged so as to become unfit for use, and the defective handhole plates are repaired on board ship, great care must be taken to make the stud thread true with the face of the handhole plate.

Handhole Plate Studs and Nuts.—Much damage to studs is caused by frozen nuts. In all cases oil or graphite should be used on the studs of handhole plates when the nuts are put on. This facilitates the removal of the nuts. When the threads of the studs project through the nuts, the studs should be shortened slightly, so that the nut cannot become rust-bound.

Clean Steam Drum.—Clean the steam drum, after which wipe it out with kerosene oil. Inspect steam drum carefully for signs of pitting, especially about the water line and near the projecting ends of the 4-inch nipples and tubes.

Treatment of Pitting.—Whenever a pit in a boiler drum, tube or nipple is discovered, it may be prevented from becoming serious by carefully cleaning the pit, taking care to get down to bare metal. The pit should then be washed with a strong alkaline solution (lye, for instance) and filled with cement or Smooth-on paste.

Inspectors in Drum.—See that the openings in the drum to the water columns and trycocks are clear, and that the nuts on the flange bolts of the internal feed pipes are set up and the flanges drawn together tightly. Leaks in internal feed piping frequently cause pitting of the adjacent boiler metal.

Swash Plates.—Inspect the swash plates to see that they are secured, and that they have ample free openings beneath them for the passage of water.

Scum Pan.—Examine the scum pan or scum pipe to see that it is properly located about 2 inches below the normal water level.

Hydrostatic Test for Tightness.—Close valve connections and all openings except the air cock on the top of the boiler drum, and pump the boiler full of fresh water. When the boiler is full of water and free of air, close the air cock and give it a hydrostatic test as follows:

Apply to the valve a pressure of 10 pounds below that at which the safety valves are set. After applying this pressure and closing all boiler connections, including feed stop and check valves, note the drop in pressure during a considerable number of hours.

If the test is made with cold water, the drop in pressure should not exceed 20 pounds in twenty-four hours. If there is no leaks in the boiler or in the boiler fittings, there will be no change in the boiler pressure other than that due to changes in temperature of boiler or of boiler water, or both.

Too great importance cannot be given to this test. Boiler leaks that do not appear serious under a cold-water test may become very considerable when the boiler is in use, while with a properly designed boiler there is little danger that if it is absolutely tight under this cold hydrostatic test any serious leak will develop in use.

The use of warm water is not recommended for this test. Perhaps warm water searches out leaks with more facility than cold water, but the time element included in this test involves opportunity for the water to cool, with considerable contraction in volume and reduction in pressure, giving an appearance of leaks that really may not exist. Water should be used for this test as nearly as possible the temperature of the boiler and of the fireroom.

In making this test for boiler tightness, leaky check valves will give false results. Care must be taken to see that boilers are entirely free from air at the commencement of this test. Boilers must be made tight after being overhauled.

Boiler Seating, Lagging and Casing.—Examine the boiler seating, lagging and casing, and repair any defects that may be found. All radiating surfaces or steam-containing parts must be efficiently lagged with non-conducting material.

Packing Between Headers.—The asbestos packing between headers must be tight to prevent air leaks.

Boiler Casing Doors.—Special care must be taken to see that the boiler casing doors fit tight, and that the chocks securing them are efficient.

Dampers.—See that the dampers work freely and that they close tight. Straighten them if warped. Overhaul damper operating gear.

Test Under Steam; Set Safety Valves.—After the entire cleaning and overhauling has been completed, put a steam pressure on the boiler to test gaskets. At this time, adjust the setting of the safety valves.

Set Up Handhole Plates.—Tighten nuts on the manhole and handhole plates while steam is being raised. Do not put more leverage on nuts than that due to the use of the wrench itself.

Test of Boiler Casings.—The boiler casings should be gone over completely and tested with a lighted candle for leaks. *This test should be repeated daily when boilers are in use.* In the case of any leak, the flame of the candle will be drawn into the casing. Special care should be taken to see that all doors, peepholes, etc., are closed and tight. A good mixture for calking leaky seams of boiler casings is one of asbestos and fireclay; on small seams, asbestos roping and red lead. A hard Smooth-on wash or a cement wash will sometimes stop leaks in casings. A pine stick dipped in alcohol furnishes an excellent flame for discovering air leaks.

Precautions While Raising Steam.—While steam is being raised, attention should be given to all the boiler fittings and feed arrangements to insure that they are in good working order, and special care should be taken in setting up, with spanner provided for that purpose, any manhole or handhole fitting which may have been taken off for examination or cleaning.

Use of Spanners.—The boiler maker should always be present when raising steam to attend to this work, and under no condition should any greater leverage than the spanner itself be applied to manhole nuts and dogs.

Idle Boilers Full of Water.—Boilers, when not under steam or open for examination, should be kept quite full of fresh water made slightly alkaline. The boiler should be pumped full within twenty-four hours of completion of steaming, and should be kept so until twenty-four hours before being required for steaming purposes. Even if the boiler is to be examined within a few days of completion of steaming, the water should not be allowed to remain at working height, but the boiler should be pumped full.

Idle Boilers Laid Up Dry.—(*a*) When it is not practicable to keep idle boilers full of fresh water, and generally when it is known that certain boilers will be kept idle for a considerable length of time, they should be emptied and their interiors thoroughly dried out, and open trays of as large capacity as practicable, and filled to about half their height with quicklime, introduced through the manhole into the upper and lower parts of each boiler. The boilers must then be closed air-tight, and special precautions taken to prevent any moisture entering the interiors while they are being thus treated. If necessary, joints of the feed and blow systems shall be broken and adjacent sections of steam piping shall be shut off and their drains left open.

Laying Up Express Type Boilers.—(*b*) Whenever water-tube boilers of the express type (Normand, Thornycroft, Yarrow, White, Forster, etc.) are not to be used for a considerable length of time, they shall be laid up as described in paragraph (*a*). In addition to the precautions stated, the fire sides of such boilers shall be thoroughly cleaned and wire-brushed, and the fire sides of such boilers shall be thoroughly cleaned and wire-brushed, and the *fire side* of the tubes where they enter the tube sheets of lower drums shall be sprayed with fuel oil for preservation.

Making the Income Tax Return

How the Income Tax is Computed—Typical Case of Boiler Manufacturer Earning $3,000 a Year

BY EDWIN L. SEABROOK

If you are a citizen of the United States, or reside therein, unmarried, and your income for 1917 was over $1,000; or, if married, and your earnings or income, together with that of your wife, exceeded $2,000, a report must be made to the United States Government and an income tax paid on the excess of these respective amounts.

This is quite a simple statement, but the tax law is somewhat complicated. Many persons, even in business, have never been required to make out an income tax report to the Government, and no doubt will be perplexed when looking over the somewhat voluminous report blank with its numerous questions and instructions.

This law is of personal interest to everyone, because it more generally distributes the burden of taxation than any internal revenue maker in the history of our country. It touches more nearly every phase of industry, decreasing as it does the exemptions on the personal income tax, will reach over 6,000,000 of persons who have heretofore not made returns. This number includes many farmers, a vast number of retail merchants, those engaged in every line of construction, such as boiler making, etc.; also salaried employees, wage earners and laborers.

In addition there is an estate tax, a capital stock tax on corporations, an excess profits' tax on individuals, partnerships and corporations, and a variety of other taxes, so that the man who escapes the provisions of the War Revenue Act is indeed an inconsequential member of his community.

It is impossible to cover in a short article the whole scope of the income tax as it applies to individuals, partnerships, corporations and the various incomes ranging from $1,000 to $2,000, upward. There are report blanks to fit these different cases. What it is desired to present in this brief article are the requirements of an ordinary boiler business, earning, we will say, about $3,000 per year for its owner, in making the report, what can be deducted from the gross receipts and how the income subject to the tax is to be computed.

The Government is quite exacting in its requiring a correct report, and that it shall show the exact status and earnings of the business. The writer was recently told of a case where, months after the report had been filed and remittances made for the income tax, the Government found an error of 13 cents and was quite insistent

B. INCOME FROM BUSINESS, FARM, OR PROFESSION.			
Kind of business, etc.: Boiler Making Business address: 17 Broadway			
Total cash received from sale of merchandise, farm products, or professional or business services	$18,000.00		
Less expenses paid and losses:			
Labor $6,000 Merchandise or live stock bought for sale $			
Materials and supplies $7,000 Wear, tear, and repairs $			
Rent $360 Losses by fire, storm, other casualties, or theft $			
Other expenses (Mention principal items.) $1,740			
Total expenses and losses	$15,100.00		
Net income from business, farm, or profession (total cash received minus total expenses and losses)		$2,900.00	
[Business or farm property (if owned): Construction of buildings Cost of buildings, $ Cost of business equipment, $]			

Fig. 1.—The above is a reproduction of a part of the Income Tax Report blank and must be filled in by giving the gross receipts from the business, the amount spent for labor, material, the cost of conducting business, wear, tear and repairs, and some other losses. This part of the report must show the net income from the business.

that this amount should be paid. It is well, therefore, that the boiler maker should very carefully study the necessary items that go in the report and have them correct.

In passing, it might be well to suggest that everyone having an income approximating the $1,000 or $2,000 limit, to file a return with the Revenue Collector, even though the income is not subject to the tax. This might avoid embarrassment later on if the Revenue Collector should call around and insist on going over the books.

The income tax blank must be filled in, sworn to and placed in the hands of the Internal Revenue Collector not later than March 1.

A Typical Case

Let us assume that a boiler maker did a gross business of $18,000 in 1917; that he spent $7,000 for material; $6,000 for productive labor; expense of conducting business, $2,100; leaving a balance, which may be termed "Profit" or "Income," under the law, of $2,900. The boiler maker has paid interest on borrowed money, taxes, and made some contributions to religious and charitable organizations, amounting in all to $140. These can be deducted from the total income, but will be disposed of in another portion of the report. The boiler maker is a married man, how shall he proceed to fill out the report; what items can be included under "Other expenses," rent, losses, wear and tear, etc.?

First question: "Total cash received from the sale of merchandise, etc." This must include amount of orders, contracts, merchandise sold, or total amount of business for the year, which in this case is $18,000.

Second question: "Amount expended for labor," which is $6,000.

Third question: "For materials and supplies," which is $7,000.

Fourth question: "Rent," which we will assume is $360.

Fifth question: "For other expenses." It is at this point that many will experience the difficulty in compiling the report. This calls for the mention of the principal items of expense. What are these items, also what losses, if any, can be included?

There is one important item—the salary of the boiler maker—that cannot be included as a part of the expense, because the law very properly considers this a part of the income. Neither can the amounts paid to members of the family under twenty-one years of age, even though employed in the business of the boiler maker, be included in the expense item.

Interest on the investment in the business must not be included in the expense.

Bad Debts.—These must not be included unless the amount of such sales was included in the total amount of business in this or a previous report. If a bad debt is to be deducted it must be definitely ascertained to be worthless and uncollectible during the year for which the exemption is claimed. It must be charged off the books within the year and no longer considered an asset or carried as such on the books.

Depreciation, Wear and Tear.—A reasonable allowance may be claimed for these items. In claiming this allowance no deduction can be made for "repairs." Depreciation should not exceed the cost of equipment divided by its probable life in years. If the depreciation of equipment is $400 per year and $300 is spent in repairs, the exemption of $400 may be claimed as wear and tear, or $100 wear and tear and $300 for repairs.

Repairs to Property.—Ordinary repairs required to keep property in usable condition are deductible. This applies to property used for business purposes only.

Permanent Improvements.—Nothing can be deducted

G. GENERAL DEDUCTIONS NOT INCLUDED ABOVE. (See instructions on page 2.)		
Interest paid on indebtedness	$60.00	
Taxes paid	40.00	
Other deductions, if any, except contributions (explain)		
Total		$100.00
[Contributions (State here names of organizations to which made. Enter amount on lines 12 and 15, page 4.)]		
H. Total net income from above sources minus general deductions except contributions (F minus G)		$2,800.00

Fig. 2.—In this portion of the return the amounts paid for interest, taxes and other deductions are entered

CALCULATION OF TAX DUE.			
14. **Net Income Shown on Page 3** (Item H)	$ 2	800	00
15. **Less Contributions** (see line 12 above)		40	00
16. **Balance of Net Income**	$ 2	760	00
17. **Less Personal Exemption** (see instructions on page 1, under "Personal Exemption")	2	000	00
18. **Balance** (income taxable at 2% under War Revenue Act)	$	760	00
19. **Tax Due** (2% of above amount)	$	15	20

Fig. 3.—Questions 14 to 19 make a summary of the preceding parts of the return and show the balance of the net income, the portion that is taxable and the amount of the tax.

for permanent improvements, business equipment, machinery, etc. These are considered as investments. Small tools that wear out during the year can be deducted.

Contributions.—These may be included if made to organizations operated exclusively for religious, charitable, scientific or educational purposes, provided the total does not exceed 15 percent of the net income.

Expenses Allowed.—In addition to rent, space for which is provided in the report, all the overhead, or cost of conducting business charges, may be included in "Other expenses" item in the report. These items will be made up of office help and other non-productive labor, telephone, printing, postage, advertising, light and heat; in fact, every item of expense necessary to the proper conduct of the business.

Space is provided for other deductions, but an explanation of these is required.

Inventory.—If the inventory is greater on January 1, 1918, than on January 1, 1917, the increase should be added to the amount of business for 1917. If the inventory is less the decrease should be added to "Expenses" and "Losses."

Interest on money borrowed for business purposes and taxes can be deducted but not be included in "Other expense" items.

Discount taken may be deducted from the gross amount of business.

From the above hypothetical business it will be seen that this boiler maker had an income of $2,760 and can claim an exemption of $2,000, leaving $760 of taxable income at 2 percent, making $15.20, which must be paid to the Internal Revenue Collector, to whom the return is sent on or before June 15.

There are several other items affecting the business, income, etc., which it is very proper to consider.

Incomplete Contracts.—Amounts expended for labor, material, etc., for contracts commenced but not completed by December 31, 1917, need not be included in the return. In other words, incomplete contracts may be disregarded entirely, but must be reported in the return of 1918.

Income of Minor Children.—Income from children under twenty-one years of age, even though employed in the business of the parent, must be included in the income of the parent.

Accidents.—Sums paid for accident to others, or damages to property, cannot be deducted as a loss. These are not losses incurred in the conduct of the business or trade, or resulting from a transaction entered into for profit.

Losses by fire, storm, theft or other casualties may be deducted only to the extent that they are not covered by insurance, or made good by repairs reported as "Expense."

Partnerships.—Annual returns are not required of a partnership, but the District Collector is authorized to request at any time an accurate return of a partnership earnings. Each partner must file his return individually and include cash received for services or profits and his proportionate increase of the inventory. The income of the individual partner accrues at the time his distribution is determined and reducible to possession.

Corporations.—Many small businesses are conducted under what is termed a "close corporation"; that is, one or two individuals own practically all the stock and control the company. In such cases the corporation must file a return. The officers or employees of such corporation whose income is taxable must file an individual return on the forms illustrated above.

Exempt Income

Certain incomes are exempt from taxation, such as: The proceeds of life insurance policies paid to individual beneficiaries by death, return premiums, endowments, annuities, or surrender of the policy. In case of an endowment life insurance policy, maturing during the year, only the premiums paid during the life of the policy are exempt. The difference between the aggregate amount of premium paid and the amount received upon maturity of the policy should be reported.

The value of property acquired by gift, bequest, devise or descent. All interest on the 3½ percent Liberty Loan Bonds. The interest on $5,000 principal of 4 percent Liberty Loan Bonds. Interest on additional principal subject to tax.

An exemption of $200 is allowed for each dependent child under eighteen years of age, or over that age if incapable of self-support because of mental or physical defects.

Husband and Wife.—If the combined income equals or exceeds $2,000, a joint return should be rendered.

Calendar-Fiscal Year.—The return for the individual must be made for the calendar year—i. e., from January 1 to December 31—and not on the fiscal year of the individual.

Extension of Time.—If, on account of illness or absence, the return cannot be filed by March 1, an extension of thirty days may be secured by request to the District Revenue Collector, if filed before the date of return. Reasons for such extension must be stated.

Return by Agent.—If for any reason the taxpayer cannot make the return, he may appoint an agent, who must make affidavit that he has sufficient knowledge to make the return and assume responsibility therefor.

In compiling the return the need of proper bookkeeping is apparent. In the absence of good bookkeeping, how is the inspector from the Internal Revenue Department, if he should call to verify the return (which is by no means improbable) to be satisfied that the return as made is correct? The books of the boiler maker should show the total volume of his business, what he spent for merchandise, productive labor and every other item of expense.

Next to proper bookkeeping is the need of a correct inventory. A careful study of the items that make up the report will show that the inventory has a most important part. If the stock decreased during the year the boiler maker, in justice to himself, is entitled to this deduction. If the stock has increased, he is that much ahead and his statements ought to show just what this increase amounts to.

Business houses until recently looked upon taxes as a small part of their expenses. Government is becoming more complex and more expensive. Taxes hereafter must be reckoned as an important factor in the cost of carrying on business. It is important that business men should be thoroughly informed on this subject.

Little Things Sometimes Overlooked

Fitting Together Smoke Stack Sections—Painting the Stack—Wire Patterns—Trestles Made from Old Tubes

BY JAMES FRANCIS

Putting together small smoke stack sections, especially when well fitted so that one may be almost watertight inside another, is no joke, and to make much headway requires a bit of careful work. It is assumed that when the sheets are laid out they are marked—or at least when they are rolled up—so that corresponding marks placed together upon connecting sections will bring the spacing of the holes right, if there be any difference, and also bring the several sections and the guy-eyes into their proper positions.

After several sections have been connected and riveted, it is easy to lose a lot of time in entering succeeding sections unless a bit of horse sense is used in doing that work.

Making Up Smoke Stacks

Recently I watched a couple of men who were connecting up stack sections, and they seemed to work together in a way worthy of being followed by some other men who are doing similar work. The portion of stack already connected was brought to lie fair upon the floor of the shop, particularly at the upper end where the next section was to be connected.

To take care of any inequality which might exist in the shop floor, these men raised the far end of the stack by placing underneath a bit of plank or an old freight car stake until, judging by the eye, the work end of the stack laid fair with the floor upon which the new section must lie.

While the helper was bringing up the new section, the workmen secured the small drift used upon the stack and also gathered up one small bolt and a nut to fit and a tool

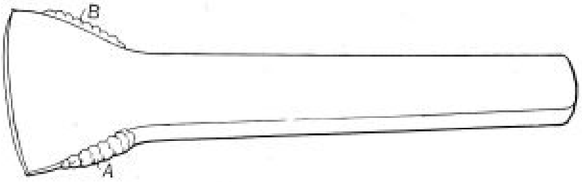


Fig. 1.—Stack Chisel

made of thin flat steel about as shown by Fig. 1, 3/8 inch to 1/2 inch thick, 1 1/2 inches wide and 12 to 14 inches long. The business end was flatted out to about 2 inches wide. The metal at *A* and *B*, which had been swaged up by hammer blows, showed that the tool was quite soft. Indeed, some of these chisels in use in the shop in question looked remarkably as though they had been made up from worn-out wagon tires from a nearby smithshop.

With the tools at hand the workman received the section brought up by the helper, having first placed the finished portion of the stack so that the marked hole was upon one side, about midway between top and bottom. The new section was placed with the marked hole outside of and over the marked hole in main portion of stack. The little drift was passed through both holes and the helper at once crawled inside and passed the bolt through the marked holes, it following the drift when withdrawn.

The helper at once came out of the stack, and, taking hold of the free end of the new section, at *J*, Fig. 2,

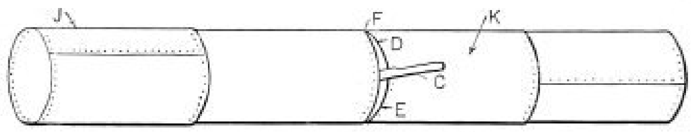


Fig. 2.—Stack Chisel in Use

exerted pressure to bring the section into line with the rest of the stack, hinging upon the little bolt just placed in position. Then the stack was rolled over, so as to bring the bolt directly underneath, and forcing the stack to lie "neck and heels" with the unjointed place uppermost at *F*.

The stack chisel was then inserted in the gap and used as a lever to force the edge of the inner sheet past the edge of the outside one, as shown at *C*, Fig. 2. The weight of the stack, of course, helped to enter the sections, the chisel slides the sharp section edges past each other, and lusty hammer blows at *D* and at *E* serve to bring the inner section home.

The chisel *C* is driven sidewise from place to place, as the resistance to entering of the inner section demands, and this side-driving is what battered up the tool at *A* and *B*, Fig. 1. As the inner section gradually draws into place, the stack chisel is withdrawn, and while hammering it from one place to another, it can be made to gradually withdraw, accordingly as the chisel is inclined to one side or the other while the side blows are being struck. Indeed, the chisel may be quickly driven entirely out of the joint by tilting it crosswise the stack to a considerable angle and then striking upon the side of the chisel nearest to the open joint.

As the last bit of inner section finally enters the outer one, the chisel, of course, is driven entirely out of the lap and its work is done for that section. The workman promptly sits upon the stack at *K*, while his helper adds his own weight just the other side of the joint *F*. Both men then get busy with their hammers and work around the joint, driving every inch of the circumference and gradually working the inner section into place so the holes will come fair with each other.

At this time many workmen make a mistake. Instead of working away with the hammers until the holes match each other perfectly, the usual workman will snatch up a drift pin as soon as one hole appears slightly under

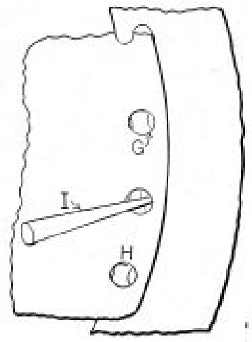


Fig. 3.—Bad Drift Pin Practice

another, as shown at *G* or *H*, Fig. 3. The drift pin *I* will be thrust into a hole as shown, and if it will not go in readily the workman is all ready to land hard on the drift with his hammer, battering the inner hole out of shape, and in more than one instance I have seen the drift broken short off.

Don't do this. Never drive a drift into a seam with the idea of forcing the section farther into place. To be sure, the wedging action of the pin will do a little toward helping the inside section get home, but the drift thus applied does far more toward distorting a hole in the stack, and later this forms a fine place for rust to attack the sheet, besides making the holding power of the rivet in that distorted hole almost nothing.

It is well to use a drift—two of them, in fact, as soon as the holes lap each other enough so that the point of a small drift can be inserted. Let the helper take both drifts, insert the points, then, using them as levers, pull upon the extreme ends of the drifts and do it as the workman strikes around the joint with his hammer. A heavy pressure will be exerted by the drifts, the leverage being tremendous, and the hammer blows, while this pressure is being exerted, loosens the plates so they slide past each other very readily under the pressure and the holes are brought fair with each other without any danger of distorting a hole or of breaking a drift or two.

Sometimes, lifting the free end of the stack, *I*, and letting it fall a foot or two upon a plank or a block, will do a good deal toward bringing the lap home so the holes will be fair with each other. But persistent light hammering of the joint at *D* and at *E*, Fig. 2, is what must be depended upon to bring the holes fair, the stack, of course, being kept "neck and heels" during the hammering.

Painting New Smoke Stacks

As soon as a stack has been finished, I like to see a coat of smoke stack paint go upon it. Stacks always look more business-like after they are painted. A finished stack, before the paint has been applied, always reminds me of a woman with her hair in curl papers and with her mouth full of hairpins—kind of unfinished, you know.

But painting a stack on a cold, blustering winter or autumn day is slow work, and if done in the shop more dust adheres to the fresh paint than looks well; therefore, out into the yard with the stacks as soon as they are fully riveted, and finish them there.

Don't, however, throw the stacks down upon snowy ground before they are painted. Before a stack section is carried into the shop yard, send out the helpers and have some scantlings or old car stakes laid down to receive each section of stack. Some shops keep car stakes piled under a convenient shed and see that they are never used for anything which will break them up. Thus, bearing strips are always at hand whenever stack sections go to the yard, and no time is ever lost hunting scantlings or old car stakes for this purpose.

After a little training a helper can be taught to place sets of skids to receive all the stack sections which are ready to go out of the shop. Each set of skids should be long enough that the stack section can be rolled over upon the skids, at least one-half a revolution. This is in order that the entire circumference of the stack may be readily gotten at for painting.

Stack paint don't spread easily or well in cold weather upon icy steel plate, therefore a whole lot of time and paint can be saved by warming the stack sections and painting them while warm. To do this, note which way the wind is blowing and select that end of a stack section into which the breeze finds its way. Even if a stack section be placed almost square with the direction of the wind, there will be a slight draft through the section, one way or the other.

Having found at which end the air draws into the section, proceed to build a small wood fire in that end of the stack section. Nothing is better for this purpose than the staves of a rivet keg, and I always make it a point to have each defunct keg placed in the yard shed adjacent to the stack skids all ready for the next stack painting job. It pays to get things ready before they are needed. That's the way to save time, to do things ahead and put in otherwise waste time in making ready little things which mean a whole lot when you are in a hurry and haven't time enough to do all that must be accomplished. Then, if things are all ready to lay hands upon, you are a whole lot ahead. And sometimes this kind of "preparedness" makes all the difference between profit on a job and a considerable loss upon the contract.

To build the fire in a stack, procure a bit of oily waste from the galvanized steel "safe" beside the drill press. Put this bit of waste just inside the in-draft end of a stack section, then throw a piece of 2-inch pipe, an old grate bar, some piece of old iron, or, failing that, a piece of 2-inch scantling, into the stack section, beside the bit of greasy waste. The object of the iron or wood thus placed is to keep the firewood far enough from the steel shell that the wood may ignite and burn readily. If the wood be thrown flat upon the inner surface of the stack section, the fire will be a long time in catching and igniting the wood.

But, with something lengthwise of the stack to keep the keg staves off the surface of the stack, the fire picks up strength very quickly. Smash a stave or two against a corner of the stack, pile the splinters carefully over the ignited bit of greasy waste, and in a very few seconds a fine blaze will be going in the stack section and the steel will be warmed to a point where the stack paint can be spread easily, quickly and over far more area than is possible when the metal is very cold.

Don't heat the stack too hot. Never let it get hot enough so that the paint will smoke. If the paint smokes as it is being applied, stop the painting on that section of stack until it has cooled off a bit. Transfer most of the fire to another section, and by the time that has been done, the too-hot section will have cooled enough that it may be painted properly.

If you have two helpers who are to paint, you need start a fire in only two stack sections at a time. As soon as these two sections have become warm enough to paint, and this requires but a very few minutes, then grasp a lot of the burning wood between two whole keg-staves and you can readily transfer the burning wood to the next stack section to be warmed.

Should there be no burning wood that can be spared for a transfer of fire, then place two fresh keg-staves upon the coals and as soon as one end of each is blazing, scrape up between the stave-ends a few of the live coals, then press the ends of the staves together upon the coals and carry them in that position carefully to the next section to be heated.

With the piece of iron placed in the stack section and the fire built beside thereof, the stack sections may be rolled over at will and the fire will slide around inside without being put out. But, be sure, before starting the fire, that the stack section is at one end of the supporting skids before the blaze is started. Then it is only necessary to roll the stack once, in one direction only, in order to paint the entire surface. But should the stack be near the middle of the skids, it will be necessary to roll it in one direction, then in the other, in order to paint the entire circumference.

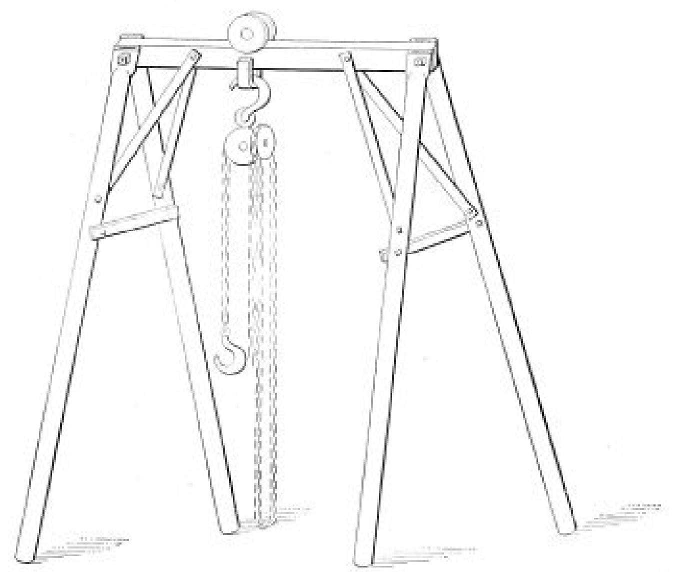


Fig. 4.—Old Tube Unloading Trestle

Should a fire be started, with the stack section near the middle of the skids, then roll the stack to one end before starting the painting, or cut the stack along, without rolling it, until it is at the ends of he skids or far enough that the section can be rolled halfway over without getting into the snow or the dirt.

Wire Patterns for Bending

It goes without saying that the best way of getting a brace or a stay bent to the proper angle, without a whole lot of fitting and rebending, is to make a pattern of light iron or steel, to the exact angle required in the bend. In some shops they use steel ¼ inch by ¼ inch square. In other shops I have seen round rods, about 5/16 inch in diameter made use of for this purpose. But I have found that the best of all material for bending pattern work, and for forging patterns as well, are small steel bars, wider one way than the other.

Light steel rods, 3/16 inch by 5/16 inch, or ¼ inch by ⅝ inch, are much better than either square or round rods, for the reason that it enables a smith to distinguish between the side and the edge of the piece to be bent. In particular is this differentiation in size of value when the part is to be bent in two directions. Then the flat pattern readily indicates the proper position of the bend in the flat stay or brace and prevents confusion and possible mistake in making the bend. Make a trial order of this thin stuff for your men to use around the shop. You will find it appreciated by both the workman and the smith.

Old Tube, Unloading Trestle

It's all right loading and unloading teams in the shop, or just outside, where the big crane can reach and handle heavy stuff, and it is a very good plan to run the shop crane track on posts, clear across the yard outside of the shop. But there are lots of shops where this is not done, and there are many small shops where there is no overhead crane, save a hand-operated affair which requires a deal of time and labor to operate.

I was in a shop recently where they had made several unloading trestles from old boiler tubes and had three or four of these outfits scattered around the yard. There was also one of them—a pretty large one, too—right in front of the shop, standing over the gutter, two legs on the sidewalk and two in the street. A team came along with a little vertical boiler on board which was to be repaired. The dray was backed under the trestle, the chain tackle made fast to the boiler, which was raised from the dray, then the team was started ahead and the little boiler lowered to the ground and rolled right into the shop.

This trestle was made of old 4-inch boiler tubes, flatted at the top and bolted to a heavy flat bar upon which a little trolley was placed and a chain hoist attached. The tubes were braced as shown. Originally there were "low water braces" around three sides of the trestle near the bottom, but drays and hard usage had knocked them all off and the trestle worked very well without the lower stays.

I noticed a lighter, smaller trestle, made of 3-inch tubes, which was readily carried around the yard by four men, one at each leg. The large trestle was laid down upon its side when it was moved, then five or six men carried it easily and had no trouble in setting it up again. This trestle was made of full-length tubes, 16 feet long. The 3-inch tube trestle was about 12 feet high. I noticed the small trestle in use handling small vertical boilers.

Criticism

Do you resent being criticised, or can you take and give it with due sense of proportion? The spirit of criticism ought to be less of the destructive and more of the constructive. He who cultivates the tactful habit of criticising fairly and constructively will find that his criticisms are always welcomed. Do you know an executive or shop foreman who fails to inspire his men, who does not seem to get their co-operation—instead it seems easy for him to arouse their antagonism? If so, size him up closely and you will no doubt discover that he is one who criticises harshly and unsympathetically.

The type of leader whose men listen with respect and attention to his admonitions, and openly admit their mistakes and faults when proved to their satisfaction, or plainly but in good humor rebut the criticisms if they are undeserved or unjust, and finally, in either case, after having listened and presented their side, yield harmoniously to the decision, and in this spirit return to their tasks is the one the men swear by. He is the kind that induces results—his cheerfulness puts the right sort of fair play feeling into the organization.

The Boiler Maker

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NOTICE TO ADVERTISERS

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 25th of the month, to insure the carrying out of such instructions in the issue of the month following.

Shortage of motive power has been one of the main factors in the recent congestion of traffic. Last year large shipments of locomotives were sent to the American railroads in France, and also to Russia. To remedy the situation thus created by the neglect to supply our own roads with new motive power, the locomotive shops have now been placed under the control of the Director-General of Railroads and their entire output is subject to his orders. Material for locomotives is now receiving priority orders along with that for the shipyards and other important government work. Every effort is being made to obtain maximum production. Of the two largest locomotive builders, the Baldwin Locomotive Works is now building a new erecting shop which will enable the company materially to increase its maximum output and the American Locomotive Company is converting its Richmond and Montreal shops, which, since 1915, have been doing munition work, to the manufacture of locomotives. So great is the shortage of locomotives on nearly all roads, however, that it will probably take all of this year to catch up with the demand created by the tremendous volume of freight now being offered to the railroads.

As far as commercial work is concerned, American boiler manufacturers are facing a situation for which it is difficult to suggest a remedy. A questionnaire was recently sent to members of the Boiler Manufacturers' Association by its secretary, in regard to 1918 contracts for plates and tubes. Thirty-seven replies were received, and of this number eight were unable to fill out the questionnaire, the main reasons being either that they were engaged in Government work or that material could not be obtained unless it was for war work.

Eleven concerns have been unable to secure any contracts for 1918 for boiler plates. Fifteen concerns have not applied for contracts. One concern applied for contracts to two mills and was refused by one. Two concerns advised that they are securing all the material required, but one qualified this condition by stating that they anticipated their requirements and carry a large stock. The general tenor of replies from the mills which refuse to fill contracts is that the mills are filled to their capacity on Government contracts. Only in exceptional cases have the mills quoted a higher price on materials for 1918 requirements than those fixed by the Government.

In general the same condition applies to boiler tubes, as well as to plates, and in the opinion of the executive committee of the Boiler Manufacturers' Association, the situation, as far as commercial work is concerned, is extremely serious. Any members who can throw any light on the subject or make any suggestions which would be of value are requested to send them to the secretary without delay.

The American Uniform Boiler Law Society, which was organized to promote the legal adoption of the A. S. M. E. Boiler Code, is to make a special effort this year to secure boiler legislation in the States of Georgia, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, Rhode Island, South Carolina and Virginia, where the legislatures will be convened. Up to date the A. S. M. E. Code has been adopted by New York, Pennsylvania, New Jersey, Ohio, Indiana, Michigan, Wisconsin, Minnesota and California, and also by the cities of Chicago, St. Louis, Kansas City and St. Joseph.

In Georgia, the support has been secured of the Georgia Manufacturers' Association. The prominent boiler manufacturers and many of the large users of boilers in this State are also in favor of boiler legislation. In Kentucky the movement has the active support of Prof. F. Paul Anderson, of the University of Kentucky, Houston, Stanwood & Gamble, Henry Vogt Machine Company, the Lunkenheimer Company and C. J. Walton & Company. In Louisiana a committee appointed a year ago by the governor, it is understood, will unanimously report the desirability of the legislation proposed and recommend the passage of the bill. In Maryland the Merchants' and Manufacturers' Association of Baltimore are actively supporting the cause.

The situation in Massachusetts appears to be a deadlock over the relative merits of the Massachusetts Boiler Code and the A. S. M. E. Code. In Mississippi the governor of the State has been won over to the cause, and it is believed that favorable action will be taken by the legislature this year. Good results are also expected in Rhode Island, but complications or disinterestedness appear likely to defeat any boiler legislation in South Carolina and Virginia.

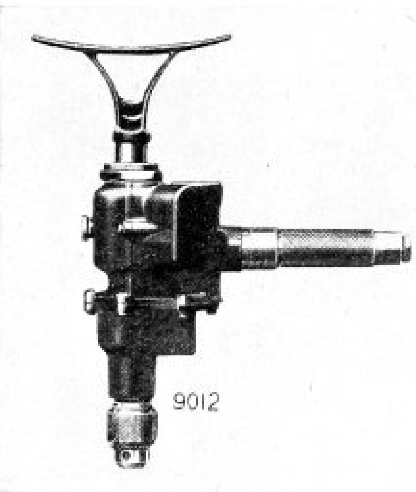
The work of the American Uniform Boiler Law Society has necessarily been educational. Immediate results in all cases, therefore, cannot be expected.

Engineering Specialties for Boiler Making

New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

A New "Little David" Drill for Light Work

The Ingersoll-Rand Company, 11 Broadway, New York, has added to its line of "Little David" pneumatic tools a new light weight, high power, non-reversible drill especially adapted to that class of drilling and reaming work which may come within its capacity limits of reaming up to 5/16 inch and drilling up to 9/16 inch. This new drill has been designated No. 5 "Little David." It weighs 15 pounds and develops a free spindle speed of 1,000 revolutions per minute. With drill chuck its over-all length is



No. 5 "Little David" Drill

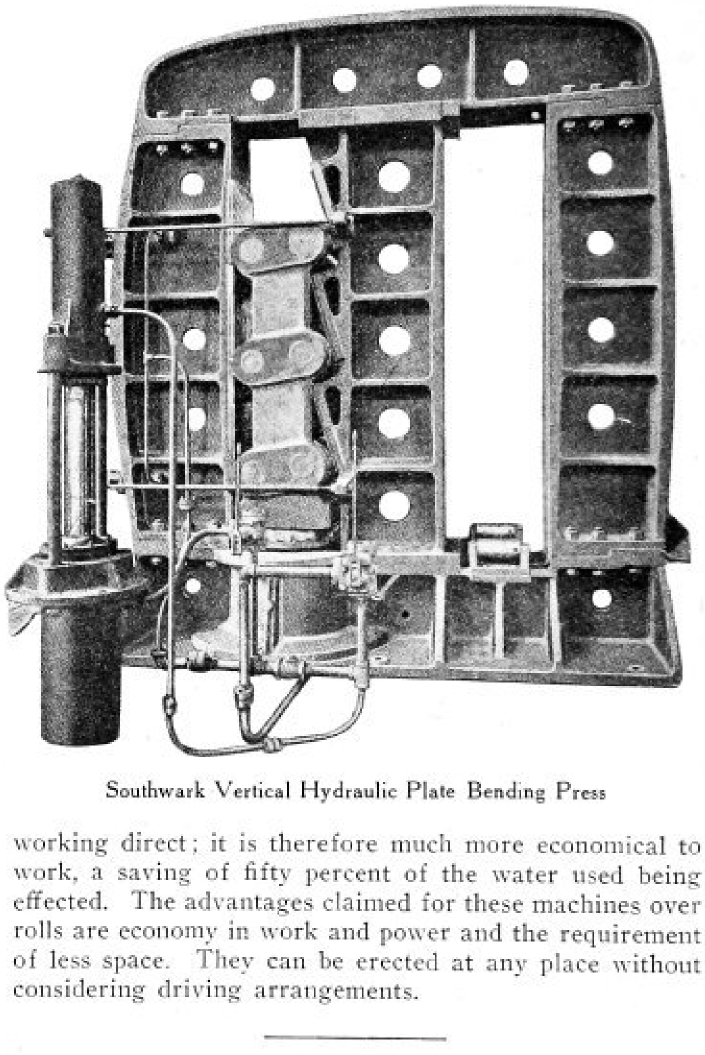
14⅝ inches and the distance from the side of the drill to center of spindle is but 1½ inches, which facilitates its operation in unhandy places. The spindle is threaded to accommodate either a No. 1 M. T. socket or drill chuck, and these may be readily interchanged as desired.

The four-piston motor is very simple and the convenient accessibility of the reciprocating parts is pointed out to be of advantage. It is stated that the removal of five cap screws permits the crank shaft assembly to be withdrawn in its entirety. The valve is of the rotary type and is gear-driven. Roller bearings are used on the connecting rods and ball bearings on the crank shaft. The No. 5 "Little David" may be had with either breast plate spads handle or telescoping feed screw. In the latter case the length of feed measured 2½ inches.

Southwark Plate Bending Press

The accompanying illustration shows an improved vertical hydraulic plate bending press built by the Southwark Foundry & Machine Company, Philadelphia, Pa. These presses are now being used by many of the leading marine and stationary boiler makers for bending boiler shells and similar work, and especially when thick plates have to be operated upon, as they bend plates completely up to the end, which cannot be done by rolls; they can also be used for bending the butt straps. These machines will bend plates to a complete circle, as the top tension member can be arranged with a swinging bolt so that the shells can be drawn up from the top. Plates can be bent to a given radius by once passing through the machine, and unskilled labor can be used, as when the stroke of the ram is once adjusted the required curve will be given independently of the operator.

One of these machines having an inclined plane and roller arrangement needs a much smaller ram than if



Southwark Vertical Hydraulic Plate Bending Press

working direct; it is therefore much more economical to work, a saving of fifty percent of the water used being effected. The advantages claimed for these machines over rolls are economy in work and power and the requirement of less space. They can be erected at any place without considering driving arrangements.

Improvements to Badenhausen Boiler Shop

The Badenhausen Company, of Philadelphia, manufacturers of boilers and engines, has received a contract from the United States Shipping Board Emergency Fleet Corporation for eighteen triple expansion marine engines, of 1,400 horsepower each, which they are building at their plant at Bound Brook, N. J., called "Bound Brook Engine & Manufacturing Company." The improvements necessary in the Bound Brook plant will consist of the installation of two Badenhausen boilers and superheaters, 200 horsepower each. a new brick stack, 125 feet high, and machine tools, which have all been purchased.

The Badenhausen Company is also extending its plants located at Norristown and Bridgeport, Pa. The Bridgeport plant is having an extension built 180 feet by 80 feet wide. Punches and shears, air compressors, plate planers and sundry other boiler equipment, including one new riveting machine, have been purchased and are being installed. Some other tools remain to be bought, for which negotiations are now pending.

The Badenhausen Company is also building an entirely new plant at Cornwells, Pa., sixteen miles from the Philadelphia City Hall. The real estate consists of 73 acres, and upon this is being erected an entirely new boiler shop, the first building being 200 by 275 feet, now being erected. The power plant will contain two Badenhausen boilers of 400 horsepower each.

The engine room will contain two Bound Brook Engine & Manufacturing Company compound engines, direct connected to two-stage Sullivan air compressors; also one Bound Brook Engine & Manufacturing Company compound engine, direct connected to 175 K. V. A. generator. A new brick chimney has been purchased, contract for which has been awarded to the Alphons Custodis Chimney Company. The main shop will contain four traveling cranes, order for which has been placed with the Maris Craning Company, of Philadelphia.

It is estimated that all improvements will total about $300,000. There is enough marine boiler business on hand to keep this shop busy for the next fifteen months.

NEW BOOKS

Finding and Stopping Waste in Modern Boiler Rooms. By engineers of the Harrison Safety Boiler Works. Size, 9 by 7 inches. Pages, 276. Illustrations, 213. Philadelphia, 1918: Harrison Safety Boiler Works. Price, $1.

The saving of coal is the purpose of this practical handbook, which is addressed to power plant owners, managers, engineers and firemen. The preface states that such statements, tables, charts, etc., have been selected as were supported by experiments and tests, references being given wherever possible to the original authorities. The latter include many well-known engineers and writers in technical periodicals, also authors of papers before engineering societies, while the excellent bulletins on the utilization of fuel issued during recent years by the United States Bureau of Mines have been freely drawn upon. Pains have been taken to compare statements and to check each source of information against others.

The work is divided into five sections, the first of which is about "Fuels," under which are considered the coals of the United States and their classifications, size of coal, coal sampling, proximate analysis, ultimate analysis, heating value of coal, ash and clinker, value of coal for steaming purposes, purchase of coal under specification, washing of coal, storage and weathering of coal, coal measurement, oil fuels and gaseous fuels.

The second section is on "Combustion," taking up the chemistry of combustion, air theoretically required, grates and grate surface, hand firing methods, thickness of fire, mechanical stokers and their operation, furnace temperature, furnace gases, clinker, draft, flue and stack proportions, draft required by stokers, mechanical stokers, draft gages, dampers, flue gas temperatures, flue gas analyses, CO_2 recorders, what CO_2 indicates, what CO indicates air requirements and supply, preventing excess air, smoke and smoke prevention, burning oil fuel, burning gaseous fuels, and burning powdered coal.

The third section treats of "Heat Absorption," including heat transmission by conduction, convection and radiation, heat transfer from a fluid in a channel, heat transfer in economizers, air heaters and superheaters, improving heat absorption, relation between heating surface and boiler capacity, boiler setting, refractories and fire brick, soot, scale, softening feed water, and feed water heating.

The fourth section on "Boiler Efficiency and Boiler Testing" covers heat balance, heat absorbed by boiler, heat losses due to moisture in the coal, hydrogen, chimney gases, CO, combustible in the ash, moisture in the air, and unaccounted-for loss, efficiencies, efficiencies with different coals, boiler capacity and efficiency, and boiler trials.

The fifth section on "Boiler Plant Proportioning and Management" discusses various arrangements of auxiliaries with regard to their effect upon feed heating, and also describes the Polakov functional system of boiler room management.

The book has been compiled by George H. Gibson, Member American Society Mechanical Engineers, assisted by Percy S. Lyon, now Captain of Coast Artillery. The proofs were read by Mr. Henry Kreisinger, who conducted for the U. S. Bureau of Mines many of the investigations quoted in the text.

Eye Hazards in Industrial Occupations. By Gordon L. Berry, Field Secretary National Committee for the Prevention of Blindness, with the co-operation of Lieutenant Thomas P. Bradshaw, U. S. Army, formerly technical assistant to the Director of the American Museum of Safety. Pages, 150. Numerous illustrations. New York, 1918: National Committee for the Prevention of Blindness, 130 East Twenty-second street. Price, 50 cents.

In this volume the author reviews the chief industrial hazards to eyesight in the industries of the United States. Case reports illustrate each section, the special dangers are described and recommendations made for such changes of working conditions, or installations of protective devices, as have been found suitable for protecting workers. The book is most completely illustrated.

The following section headings indicate the scope of the book: Statistics of Eye Accidents, Chipping Operations, Machine Operations, Abrasive Wheels, Sand-blasting, "Mushroomed" Tools, Riveting, Radiations from Intense Light and Heat Sources, Ultra-Violet Rays in Illuminants, Radiant Energy in Arc Welding and in Molten Metal, Metallurgic Operations, Glassblowers' Cataract, Infections, Gage Glasses, Acids and Chemicals, Treatment of Acid Burns, Industrial Poisons, Removal of Dangerous Fumes, Vapors and Gases, Spray Process Hazards, Methyl Alcohol, Bottling Accidents, Mining and Quarrying, Agricultural Hazards, Goggles, Garment Trade Hazards, Industrial Lighting, the Safety Movement.

These subjects have been treated not so much in the way of a technical manual for safety engineers, but rather in a general informative way for the information of the average manufacturer or layman who is seeking information of this nature. Descriptions of many of these hazards have been included heretofore in publications covering the complete field of industrial accident prevention, and where discussion of preventive measure would be repetition, the author has referred his reader to the chief of those sources where such detailed information might be secured, if desired.

Much of the "laboratory work" in the preparation of this book was accomplished in Buffalo, N. Y., where, at the invitation of a large group of leading citizens, a study was made of the eye hazards and methods in vogue for accident prevention in representative industries of that typical manufacturing city.

The book is the most complete compilation of material relating solely to the prevention of eye accidents that has been published in this country. Inasmuch as there occur annually, in the United States alone, nearly 200,000 eye accidents, from which many cases of total blindness result, it would seem that there is need for further attention to this important subject. Boiler makers are by no means immune from such accidents.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, 461 *Eighth avenue, New York city.*

Three-Way Pipe Development

Q.—Kindly show me a method of drawing the patterns for a three-way pipe joint that also connects with a cylindrical pipe. I have tried to work this problem by projection. L. O.

A.—This connection is shown quite clearly in the general view accompanying this explanation. The pipes *A* and *B* are sections of *scalene* cones and *C* is a tapering connection joining *A* and *B*. The three pipes are mitered to join the cylindrical pipe *D*. Projection drawing commonly called the parallel method of development cannot

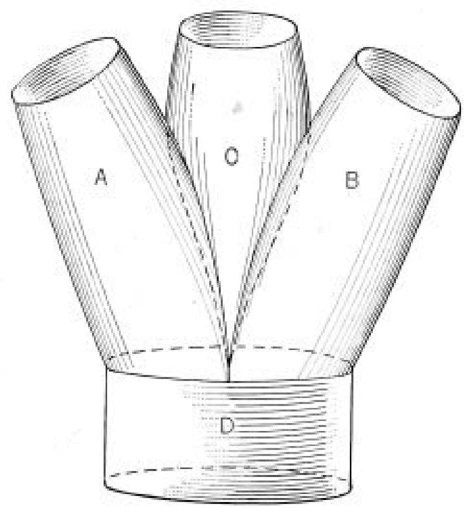


Fig. 1.—General View of Three-Way Connection

be applied successfully to this layout. A combination of the radial and triangulation systems may be used. To illustrate the procedure in applying these principles, note the three layouts, Figs. 2, 3 and 4.

CONSTRUCTION OF FIG. 2

Locate and draw the center lines for the three prongs of the connection, about which draw the outlines of the pipes. The miter *a-b-c* 4′ shown between sections *B* and *C* is drawn between the intersections shown at points *a* and 4′. In the plan, the large circle representing the cylindrical pipe is divided into a number of equal parts, and radial lines drawn therefrom to point *x*′. The corresponding lines are also projected in the elevation. Where the lines 2′-*x* and 3′-*x* cross the miter *a*-4′ locates points *b* and *c*. Vertical projection lines are drawn from these points to intersect the radial lines 2-*x*′ and 3-*x*′ respectively, thus fixing the horizontal projection of points *b* and *c* at *b*′ and *c*′ in the plan. A curved line connecting *a*′-*b*′-*c*′-4 in the plan shows the shape of a section of the miter in that view.

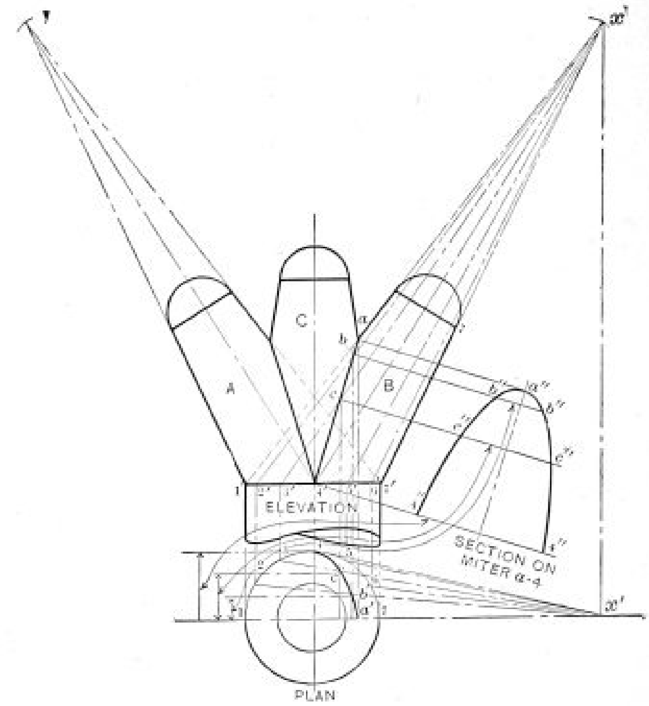
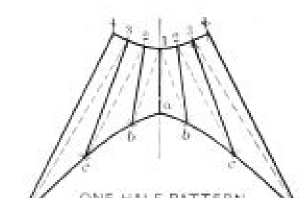


Fig. 2

The full view of the miter taken on plane *a*-4′ of the elevation is produced in this manner. At right of *a*-4′ draw projectors from *a-b-c* and 4′ indefinitely. Draw a line at right angles to 4′-4″. From this line as a center lay off the distance obtained in the plan which shows how



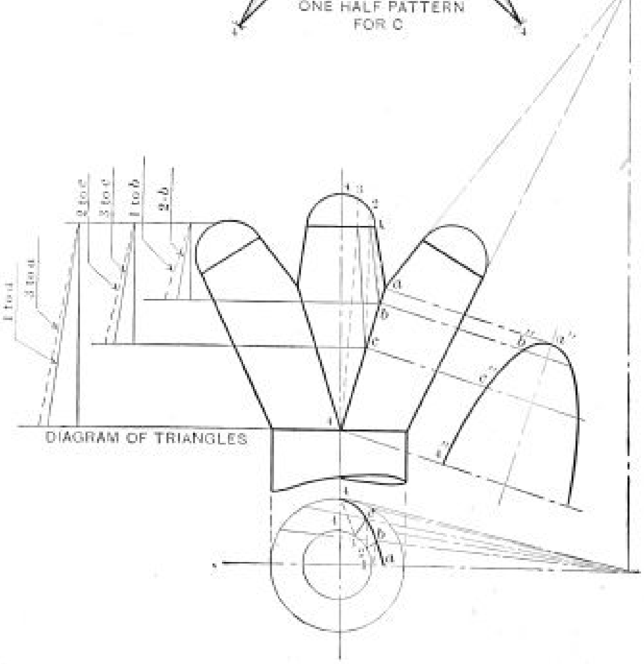


Fig. 3

far points 4-c' and b' are from the horizontal center line when measured at right to it. Through a''-b''-c'' and 4'' draw the curved line. This view must be drawn in order to get the arc lengths for the base of pattern *C*.

CONSTRUCTION OF FIG. 3

This figure is the same as Fig. 2, excepting that additional construction lines are indicated for the development of the upper base of *C*. Divide the one-half profile of the upper base of *C* into three equal parts and project them to the upper base line. Connect these points with *b*, *c* and 4, as shown. The plan view section is developed similarly. Find the true lengths of these triangulation lines as shown to the left of the elevation; the bases of these triangles are taken from the plan. A one-half pattern is laid off by using the true lengths so found. The arc lengths at the top of the pattern are equal to the lengths 1-2, 2-3, 3-4 of the profile view in the elevation. Those between 4-*c*, *c*-*b* and *a*-*b* are equal respectively to 4''-c'', c''-b'' and a''-b'' of the view taken on the miter line.

CONSTRUCTION OF FIG. 4

This development is for patterns *A* and *B*. The true lengths of the radial lines are produced by swinging their

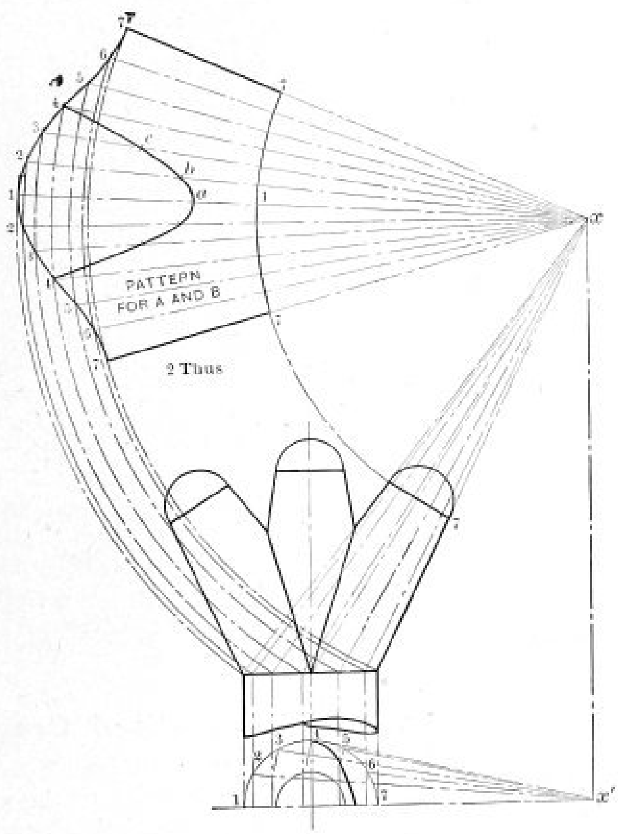


Fig. 4

horizontal projectors x'-2, x'-3, x'-4, etc., to the horizontal line x'-1. Then draw their projections in the elevation as shown. A full view of the pattern is now drawn for the scalene cone as at *x*-7-7. The arc lengths between 1-2-3-4, etc., in the pattern are equal to the corresponding ones 1-2, 2-3, etc., of the plan. The shape of the miter line on *a*-*b*-*c*-4 is found by spacing off distance 4-*c* equal to 4''-c'', *c*-*b* equal to c''-b'' and *b*-*a* equal to b''-a'' of Fig. 2. Allow for laps in both patterns and space off rivet holes.

A man in charge of a boiler went out of the room to see a parade go by. In a later parade he was at the front end of it—in a box! Moral: Stay on your job.

Flue Problem

Q.—It is required to divide the area of a given flue into three equal areas by division plates, as shown in the sketch. The only data given is the inside diameter of the flue (10 feet). It is required to find the height of *a* and the distance *b* between divisions to give the required flue areas. G. R. H.

A.—This problem can be satisfactorily solved by an approximate solution, which may require a number of trial calculations before close results can be secured. According to this method, first determine the area of the flue area as follows:

$10 \times 10 \times .7854 = 78.54$ square feet.

$78.54 \div 3 = 26.18$ square feet, the area that each section of the flue should contain.

It is evident from Fig. 1 that the total area of the rectangle *A B C D* in the center of the circular section

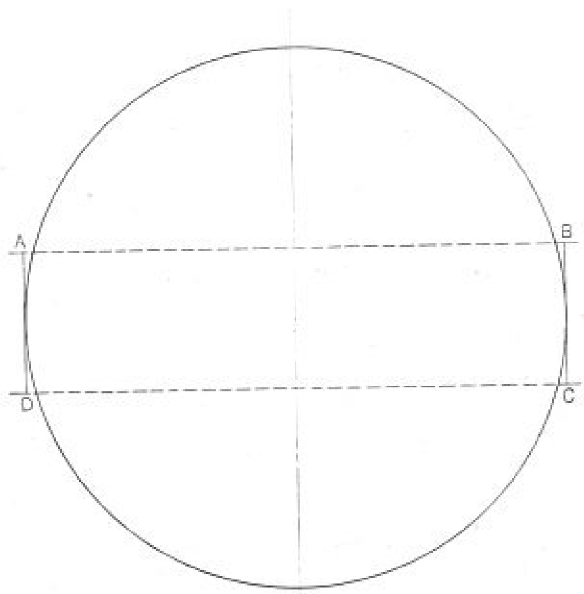


Fig. 1

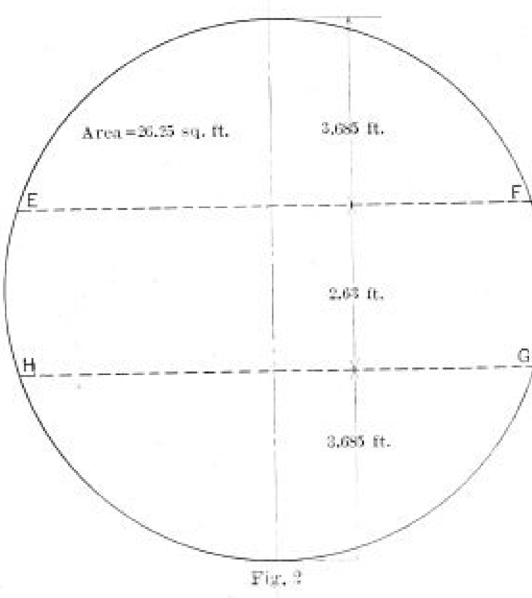


Fig. 2

equals $2.618 \times 10 = 26.18$ square feet. But, as the sides *A D* and *B C* are outside the section, the distance between the sides *E F* and *G H* must be made greater, in order to have the required area in the middle section of the flue. In Fig. 2 the width of the section equals 2.63 feet and the height of the segments equal 3.685 feet.

The area of segments may be determined approximately by this formula:

Let A = area of segment; D = diameter of circle; H = depth of segment. Then

$$A = \frac{H \times H \times 4}{3} \sqrt{\frac{D}{H} - .608}.$$

Using the value given in your problem, and substituting them in the formula, we find that

$$A = \frac{3.685 \times 3.685 \times 4}{3} \sqrt{\frac{10}{3.685} - .608} = 26.25 \text{ square feet.}$$

Hence, the calculations show that the proportions given for the three sections, Fig. 2, give approximately, but close enough for most practical purposes, the area for each section.

Laying Out Problems

Q.—Kindly describe a quick method of squaring a sheet, no matter how badly bent and buckled. What method is used in developing patterns of cones? W. J. K.

A.—Sheet metal plates that are badly bent or buckled should be straightened before laying off patterns on them, otherwise accurate developments cannot be made.

To Square Up a Sheet

Along one of the longest edges of the sheet *ABCD*, as in Fig. 1, draw the rivet line *a-a*. If the plate is to be

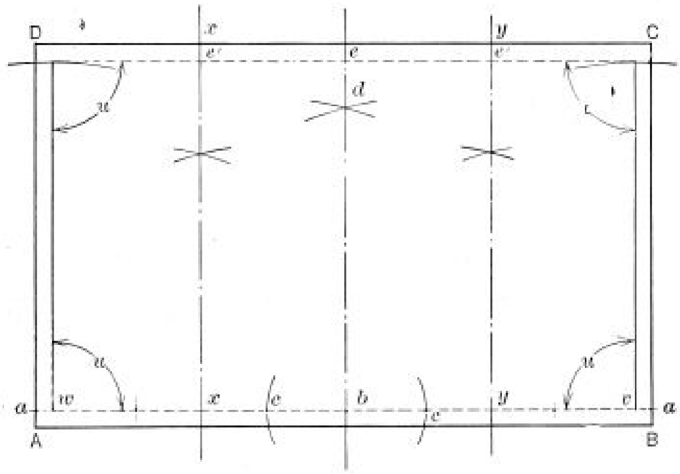


Fig. 1.—Showing Method of Squaring a Sheet

planed, add 1/16 inch to the required lap, otherwise no allowance is needed. Locate the point *b* in the center of the sheet and on line *a-a*. From *b* as a center and with a pair of large dividers draw arcs cutting line *a-a* in points *c-c*. With points *c-c* as centers and with the trammel points set to a convenient length, draw arcs intersecting at *d*. From *b* lay off distance *b-e* equal to the width of the pattern between rivet lines. Locate distances *bv* and *bw* equal respectively to one-half stretchout of the pattern. Bisect *b-v* and *bw*, locating points *x* and *y*. Draw *x-x* and *y-y* parallel with *b-e*. Line *xe'* and *ye'* are equal in length to *b-e*. Through the points *e' e e'* draw a straight line, and from points *v* and *w* draw lines parallel with *x-x* and *y-y*. If the construction is accurately done, the angles at *u* equal 90 degrees.

Development of Cones

The pattern layouts for cones, conic sections and frustums of cones require a simple construction, known as the radial method. Fig. 2 illustrates its use in the development of a one-half pattern for the frustum *A-B-C-D*. Construct an elevation of the cone, or at least a one-half view of the elevation. With *x-D* as a radius describe an arc of indefinite length. With *x-B* as a radius draw another arc for the upper base, *A-B*. From any convenient point as 1 of the arc for the lower base draw a radial line connecting with point *x*. On the lower arc and from point 1 lay off the stretchout for the lower base of the

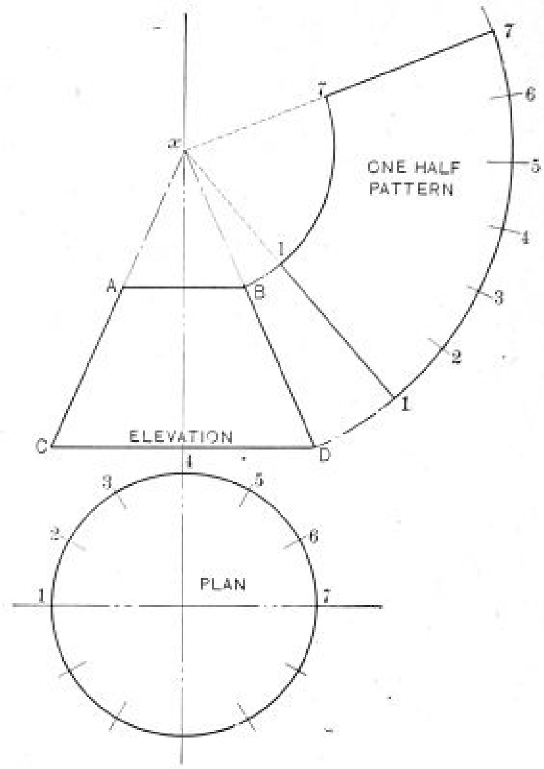


Fig. 2

frustum. This may be done with a graduated traveling wheel, or by spacing the arc as shown. These division lengths should equal the arc lengths of the plan. The circumference of the lower base *C-D* equals the product of its diameter multiplied by 3.1416. For example, if the base *C D* equals 10 inches in diameter, its circumference equals 3.1416 × 10 = 31.416 inches. This length is called the stretchout in pattern work. Having located the point 7, connect it with *x* by the radial line *x-7-7*. Where this radial line cuts the upper arc in point 7, the stretchout for the upper base is determined.

Old Tracings Asked For by Red Cross

The American Red Cross requests manufacturers and others using tracing cloth to donate discarded tracings to the Red Cross. The tracings are washed and the material —linen or cotton—is employed for the making of surgical dressings to be used in the field hospitals. The Red Cross has made arrangements with large laundries in all cities to collect material of this kind, and any manufacturer who wishes to aid should call up the local Laundry Owners' Association or one of the large laundries in his city, who will send for such material as he will give them.

If you have two men for your fire and engine room, put the man with the most brains in the fire room. It will pay.

The best engine ever built is useless without steam. The steam comes from the boilers and a cheap man in charge of them is proof that a fool is at the head of the plant.

Letters from Practical Boiler Makers

This Department is Open to All Readers of the Magazine —All Letters Published are Paid for at Regular Rates

Layout of Lip for Foundry Ladle

Set up the elevation of the ladle and lip, then just above the lip set out half plan of same. Various shapes are used; in this case an oval. Divide the plan into equal parts and number as shown. Now drop lines from the points to top of lip.

Set a square along the line *I-I* on the elevation until it strikes the top of the lip at point *O*. Draw a line across,

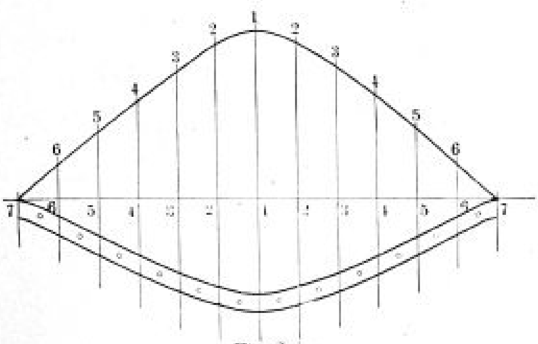


Fig. 2

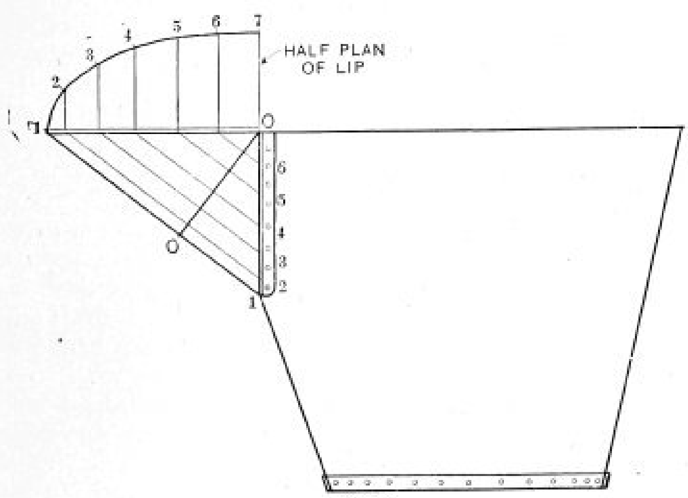


Fig. 1

Development of Ladle Lip

and on this line set the square, and draw lines on the elevation as shown.

Set off line 7-7 at Fig. 2 and mark off the same number of spaces on each side of the center as are found in the plan. Number and erect lines *I-I*, 2-2, and so on. Now set dividers to the distance *O-I* on the elevation and transfer to line *I-I*, Fig. 2. Repeat until all lengths are transferred; connect up the points found, and the pattern is complete. Flange to be allowed as shown

Layout of Offset Connection for Hot Air Pipe in One Piece

Figs. 3 and 4 present a very interesting problem, as at first glance it would seem impossible to construct this offset in less than two pieces.

Fig. 3 shows the elevation of a rectangular offset connection. To lay off the pattern take the height at *O-O* and set out as on Fig. 5. At these points erect perpendiculars, and on these set off the length and breadth of rectangle. Draw in the line connecting the points. On this line set the square and draw up lines *H-H*. On lines *H-H* set off the length and breadth of the rectangle, alternately as shown. Connect up with lines. Set the square along line *O-O* at bottom, intersecting points *H-H* at top. Draw up lines and set off another breadth and length of rectangle. This completes pattern.

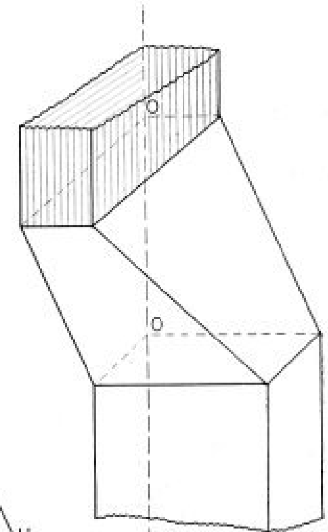


Fig. 3

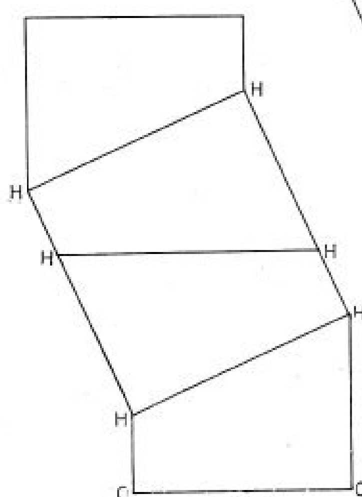


Fig. 5

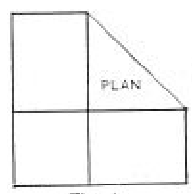


Fig. 4

Offset Connection for Hot Air Pipe

Bending lines are the diagonal lines between points *H-H*. Bending along the lines will bring the joint to one corner. A little study will show that the joint can be located in the center of back if so required.

Why Should Butt Straps Be Removed and Cleaned?

In the December issue of The Boiler Maker, Mr. James Crombie asked the above question, with the request that readers of this magazine give their experiences on the subject.

In work of this kind all plates are planed off for calking and to insure a close fit when butted. The plates are then rolled to form, and here is where the trouble starts. Should the plates be put in the rolls without first binding the edges there will be formed a flat place for two or three inches back from the edge, the entire length of the top.

This is partly overcome by first putting in the rolls plates that have been previously rolled to the proper radius, then the plate put in the rolls on top of this and the rolls run back and forth, until the flat place is removed or nearly so. As it will be found a hard matter to get the edges of heavy sheets to form a true circle, to try and overcome this trouble we had cast steel formers made to fit the hydraulic riveter and all shell and covering strips were subjected to a good pressing and much of the flat places was removed.

Here again another trouble showed up. Not having formers of the proper radius for shells and in and outside covering straps, they were all pressed to the one radius, and of course when fitted in place there was quite a lot of spring in the covering strips that had to be knocked out by the fitter up. When fitting up, ordinary fitting up bolts were used until some of the holes were reamed, when bolts machined with a body fit were applied, the others removed and the holes reamed.

After the operation of reaming was finished and the straps were removed it was found that there were still a lot of flat spots, which formed a receptacle for cuttings. Using sharp reamers, only small burrs remained on the holes and were removed with a file.

In refitting the straps, we never met with any trouble in getting straps back to their place, and having fair holes; for with the shells rolled to a tight fit there could not be any springing apart when the straps were removed, and, should there remain any spring in either the inside or outside straps, this was overcome by bolting up along the center holes in the straps, and working outwards.

The above differs very little, if any, from the method used by Mr. Crombie, and it is quite possible that the same results could be obtained if, as he says, the bolts were merely loosened up and the cuttings blown out, allowing the hydraulic riveter to take care of the little burr remaining.

Although the above has been my experience, I know that there are shops whose practice it is to remove all straps and grind all burrs off to insure a clean and close fit. To do so requires extra labor and expense, but if by doing so it is possible to make a boiler more safe, let us not consider the cost, regardless of how urgent the case may be.

Pittsburgh, Pa. FLEX IBLE.

Your Thinker

"I didn't think!" These words are uttered many times by those who fill the commonplace jobs. A boiler shop foreman issued certain orders to one of his subordinates, and the man made a bull in carrying them out. When checked up about it, the subordinate offered the lame excuse of, "I didn't think it was necessary to do it just that way." Just as long as such a man continues to fail to think for himself, he will be known as a failure.

Thinking is a habit and a faculty that can be developed and improved by will. The more you use your thinker, the better it works. Thoughts are among the few things that replenish faster, the faster they are given out. Your thinker has been given you to make use of as much as your hands. Failure to think for yourself necessitates someone else doing your share towards progress. Failure to think for yourself marks you as an imitator of others. We can all learn much from our fellows, but when we fail to develop and use our own thinker, remaining content to always have the other fellow plan and show us how, they soon lose their interest in us.

James J. Hill once sent out an order by one of his young subordinates, and this young man, after receiving it, told him it was wrong. After re-reading the order, Mr. Hill said, "I believe you'll do, young man—you think."

There are many things in this world that will provoke you when your thinker is not on the job, is when you say and do things that you many times afterwards wish you could recall or remake. Learn to master your thinker—make it earn your income. Contribute your share of intelligent thought to the movement of progress. Avoid the paid-for-strength class—there is no limit to your thinking capacity. Watch your shop mates and fellow people sit up and take notice when you begin to attain results of careful thought in your work.

Every big act has its birth in big thought. The mind is a creator of material results. Great inventions are the results of continued improved thinking. One man gets an idea and works it out—his fellow men study it and think up ways to improve and better perfect it. Many of our foremost executives of industry owe a large measure of their progress and success to surrounding themselves with careful thinking men.

It is hard to conceive a place where there exists no chance to show your ability to think and do better than your mates. Thinkers can make their own opportunity. The world has an abundant supply of workmen—it is urgently in need of better trained thinkers. Why not fill one of these places and reap the honor and reward?

A. THINKER.

Loyalty

Loyalty on the part of the assistants to the superintendent, loyalty of the superintendent to his assistants—this is the composite opinion of several prominent men of the industrial field as to the relations which should exist between the superintendent and his assistants.

The leading executive's success is largely the outgrowth of his ability to perceive in the character of his men that which distinguishes between the sincere and the pretentious, and to aid in the development of the former.

This loyalty should consist of nothing less upon the part of the subordinates than to keep forever before their minds that part of the responsibility for the best and efficient operation of the plant that is allotted to their keeping. Sidestepping of duties, shedding of responsibility onto the workmen, mental and physical lassitude, and the "that's not up to me, the super is responsible for that" attitude, are not in the least of the many failings which may be listed under the head of loyalty upon the part of subordinates for the executive head.

When the efforts of a given number of persons are to be brought to bear in the most effective manner on a given task, there must be specific leadership to give orders for the others to obey, and those who decline to render obedience and loyalty to the leader are dismissed. But in the issuance of orders, there is opportunity to systematically foster loyalty on the part of the subordinates in a way to maintain discipline and build up a spirit of co-operation—a sort of diplomatic code. Specifically, this method can be more fully interpreted by quoting from the remarks of a highly successful superintendent: "I never order a subordinate to do his work or a task in such or such a manner, but rather test out his worth by asking, 'Can yon do it in that way?' "

This is what is called, in football parlance, team work, and this applied to industrial works, relations, operation and management, means a co-operation of both mental and physical efforts on the part of every man who constitutes a unit of the executive and working force, from the sweeper and clerk to the superintendent and general manager, who struggle with their problems in the private office.

In many cases there is a tendency towards unfair criticism of the superintendent because he has a supposedly keen sense of observation, and notices many things that his subordinates would like to have passed unnoticed.

There are times when an assistant has turned a deaf ear to the complaint of a machine hand or worker, or a blind eye to something wrong or untidy, because of the fear that if it were called to the attention of the superintendent an additional task would have to be done. It is, indeed, unfortunate for any young assistant to form this lax habit. Those who take a long look into the future and aspire to fill the higher executive positions will do well to cultivate and develop the power of observation. It is a valuable asset, but must be combined with thought. To some it comes inherently, but to the less fortunate it must be acquired by self-training.

The man who can see things—he who can anticipate a source of possible trouble, and tries to provide a means of prevention or correction—is at all times a valuable acquisition to any industrial organization, and when advancements are to be made this type of man is quickly recognized as the one fitted for such reward and honor—other conditions being equal.

EXECUTIVE.

Ideas and Initiative

It is wrong for an executive to call down or bawl out a subordinate for having gone ahead and performed a task on his own initiative and judgment, even though the subordinate has done wrong in so doing. The better plan, and most conducive to harmony, would be for the executive to point out to the subordinate that he is glad to note the willingness to assume the initiative and desire to get things done, and then tell him that another time he will expect him to be guided by the present mistake, and that he will hesitate assuming the initiative until he is sure that it is right to go ahead without orders.

Willingness of leaders to aid and encourage their men to think for themselves, and to take the initiative at such times as they consider right, will develop a type of men that can be pointed to as assets to the organization.

It is a good plan for a boss to weigh a man's good qualities against his poorer ones before grumbling over some blunder he has made, and crippling the man's ambition by a severe berating. The average workman or subordinate has so many good points to his credit that will outweigh the poor ones that it behooves a leader to restrain his desire to vent displeasure over a bonehead play until the better side of the man makes him forget it.

Taking the initiative means that one must go ahead without being guided and ordered. Whoever does this must use his thinker to reason out what the results are to be. A mental survey of the plan, the work, the result, must be made. Going ahead blindly, stumbling, and without thought, is in no sense initiative—that is plain bullheadedness, and deserves condemnation in a measure commensurate with the results of such action.

There are a few executives that deliberately discourage any attempt on the part of their subordinates to go ahead with their ideas or plans for the shop's betterment, for the reason that they may appear too brilliant or successful in the eyes of the manager. Generally this type of boss steals the credit for such plans or work his subordinates do manage to put into effect.

After any length of such attitude and narrowness, the subordinate will assume a hostile attitude, and as a consequence the organization gradually goes to pieces until the owners or general manager dig up the cause, and put a more open-minded and fair executive over the men.

One of the foremost shops devoted to boiler and steel work goes to considerable expense each year trying out such suggestions as come from their men that contain the slightest bit of hope for better conditions of maintenance, always rewarding each employee by some means, varying from a letter of commendation for their efforts to develop something worth while to a promotion or substantial financial reward to those whose ideas materialize.

There is enough discouragement facing the ordinary man these days without our crippling their ambitions by jumping on them when they happen to make a mistake in taking what they thought was a step in the right direction. While in these times of stress and strain perhaps but few shops can afford to tinker or try out all sorts of suggestions and uncertain plans, etc., there must be at least one man in the plant who can find some plan to go over the promising ones and explain the fallacy of the others to their originators. It would seem poor policy to tell a man you are too busy to bother. Should a man be treated in such a manner, and he really had a worthwhile plan, you may rest assured that he will not perfect it for the benefit of that type of boss.

PROGRESSIVE.

Get Started

Do you dread to tackle your job to-day?
Do you think of it only with dismay?
Just take this advice—no longer delay,
But just—get started.

Do you shrink from a task which seems too great,
And think that hard work is always your fate?
The hardest part of it all is, I state,
To just—get started.

Don't parley and question and moments waste
By viewing your work with thoughts of distaste—
Resolve to attack it with all due haste,
And just—get started.

Have no thought of failure or of defeat,
From opportunity do not retreat,
Make a resolve that you will not be beat,
And just—get started.

Remember that if, every time you fall,
You rise up and listen to duty's call,
Some day you will rise up to stay, that's all.
Now just—get started.

Concord, N. H. C. H. WILLEY.

BOILER EFFICIENCY.—The ordinary cylindrical marine boiler burning coal under natural draft may be considered as working well if the efficiency works out at 60 percent, but actual trials with boilers burning fuel oil under forced draft have given efficiencies of about 80 percent. According to Lieut.-Commander H. C. Dinger, of the United States Navy, these performances can be improved upon by a more careful design of baffling and by the more scientific utilization of improved boiler lagging. The baffling should be arranged so as to secure the most efficient relation between the path of the gases and the circulation of the water, and also, the area of the gas passages should be varied in proportion to the density of the gases, so that the velocity of the gases over the heating surface may be maintained as uniform as possible throughout the boiler.

Selected Boiler Patents

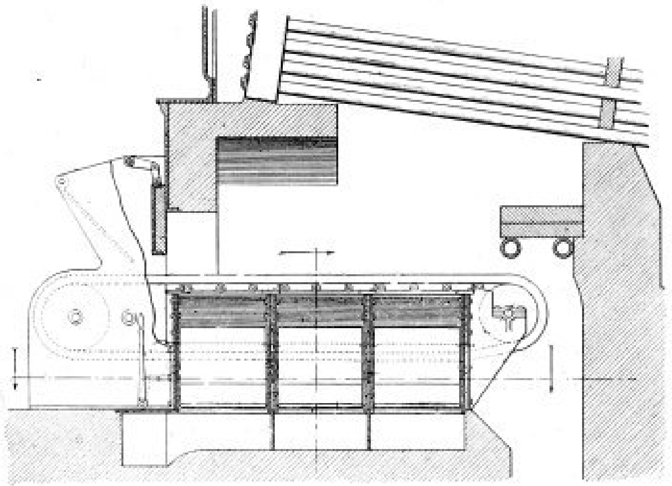
Compiled by

DELBERT H. DECKER, ESQ., Patent Attorney,
Millerton, N. Y.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Decker.

1,243,868. FURNACE. HERMAN A. POPPENHUSEN, OF HAMMOND, IND., ASSIGNOR TO GREEN ENGINEERING COMPANY, OF EAST CHICAGO, IND., A CORPORATION OF ILLLINOIS.

Claim 1.—In a furnace, the combination of a grate, a deflecting plate mounted beneath said grate and inclined downwardly toward the edge of



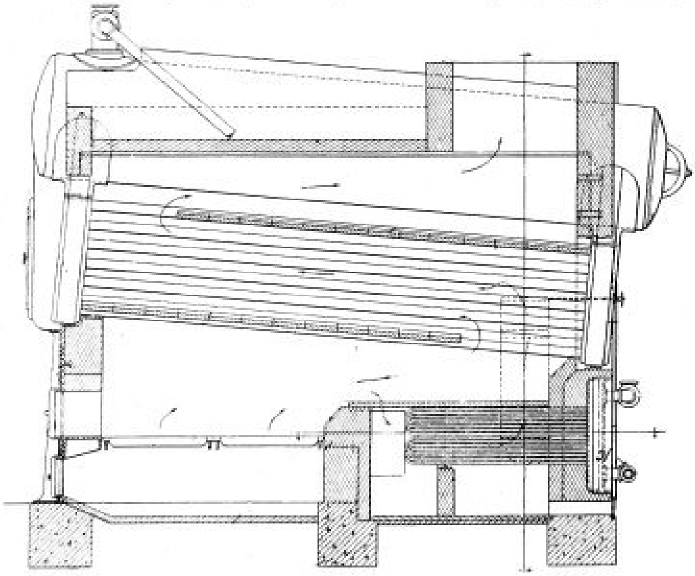
said grate, a movable plate extending transversely of said deflecting plate above and below the same, and adapted to be moved into and out of contact with the margin of said deflecting plate. Five claims.

1,240,926. SOOT BLOWER FOR BOILERS. GORDON C. BENNETT AND JAMES C. BENNETT, OF DETROIT, MICH.

Claim 1.—In a soot blower, a boiler setting, tubes, permanent interiorly screw-threaded blower holders in said boiler setting, rotary exteriorly screw-threaded tube blowers in said holders adapted for reciprocation by reason of the threaded connection between said holders and the blowers to move in proximity to said tubes, internal nozzles carried by said blowers to discharge steam between said tubes, and permit of said blowers being bodily withdrawn through said holders. Three claims.

1,244,530. SUPERHEATER FOR BOILERS. EDWARD C. MEIER, OF PHŒNIXVILLE, PA.

Claim 1.—The combination with a boiler, of a superheater construction including means providing an elongated horizontally extending chamber



aranged below the steam generating elements of the boiler and substantially on a level with the fire box thereof, said means including a side wall having an inlet opening for laterally admitting products of combustion into said chamber, said means also having an outlet opening for said products of combustion leading from said chamber, and a superheater extending within said chamber. Twenty-one claims.

1,243,055. AUTOMATIC STOKER. JOHN R. FORTUNE, OF DETROIT, MICH., ASSIGNOR TO MURPHY IRON WORKS, OF DETROIT, MICH., A CORPORATION OF MICHIGAN.

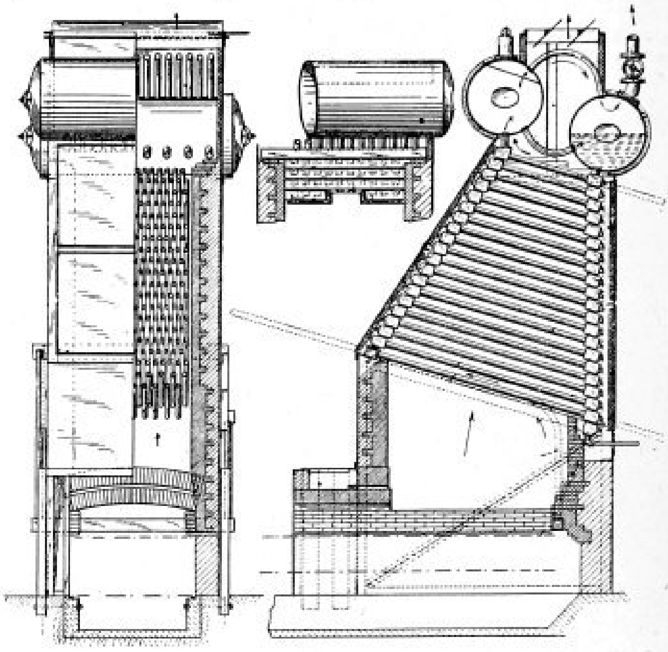
Claim 1.—In a stoker-construction, the combination of a fuel retort, means to underfeed fuel thereto, an inclined grate adjacent to said retort adapted to receive the fuel overflowing from said retort, said grate being composed of stationary and sliding grate-bars, the stationary bars having supporting feet at their lower ends, the movable grate-bars being each accommodated between a pair of stationary grate-bars and having feet slidable on the stationary bar feet, and means to reciprocate said sliding grate-bars. Three claims.

1,243,186. AUTOMATIC FURNACE STOKER. GEORGE A. KOHOUT, OF CHICAGO, ILL., ASSIGNOR TO KERSTO CORPORATION, OF CHICAGO, ILL.

Claim 1.—An automatic stoker having a fuel reservoir, a charge receptacle, means for feeding fuel from said reservoir to said charge receptacle, means for discharging said fuel from said charge receptacle, a deflector in the path of the discharged fuel, means for supplying steam associated with said deflector, a drive shaft for controlling said two first aforesaid means, and means conjointly with said drive shaft to control said steam supply. Eight claims.

1,244,603. STEAM BOILER. ISAAC HARTER, JR., OF NEW YORK, N. Y., ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, N. J., A CORPORATION OF NEW JERSEY.

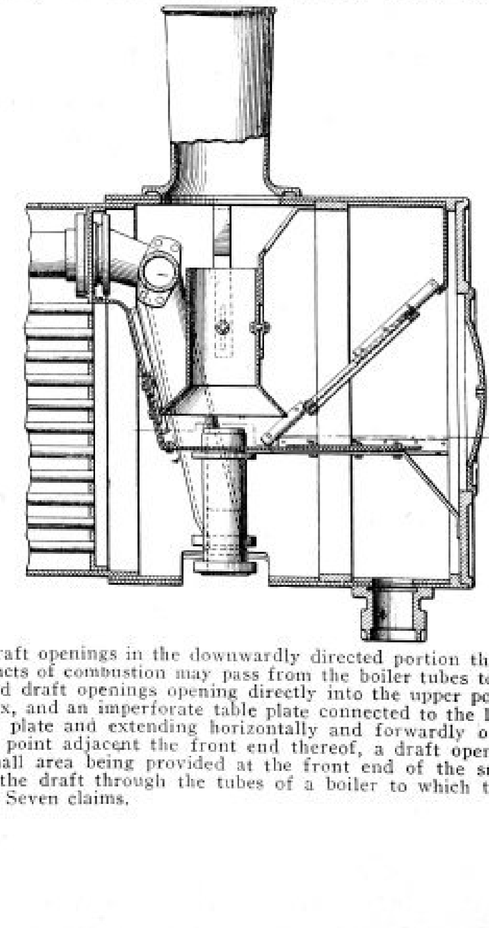
Claim.—A boiler comprising a bank of substantially parallel tubes arranged in rows at substantially equal distances apart, the tubes of a given row being staggered with respect to the tubes of adjacent rows, the length of the tubes of a given row being the same and the lengths of the



tubes of successive rows from the furnace toward the gas outlet decreasing, headers to which the ends of the tubes are connected, drums connected to said headers, a furnace discharging between the longer tubes, and a setting which, with the above arrangement of tubes, causes the gases to flow through the boiler in one direction through regularly decreasing flow areas.

1,245,284. DRAFT REGULATOR AND SPARK ARRESTER. JOSEPH H. STANNARD, OF COLUMBIA, S. C., ASSIGNOR TO JOSEPHINE STANNARD, OF COLUMBIA, S. C.

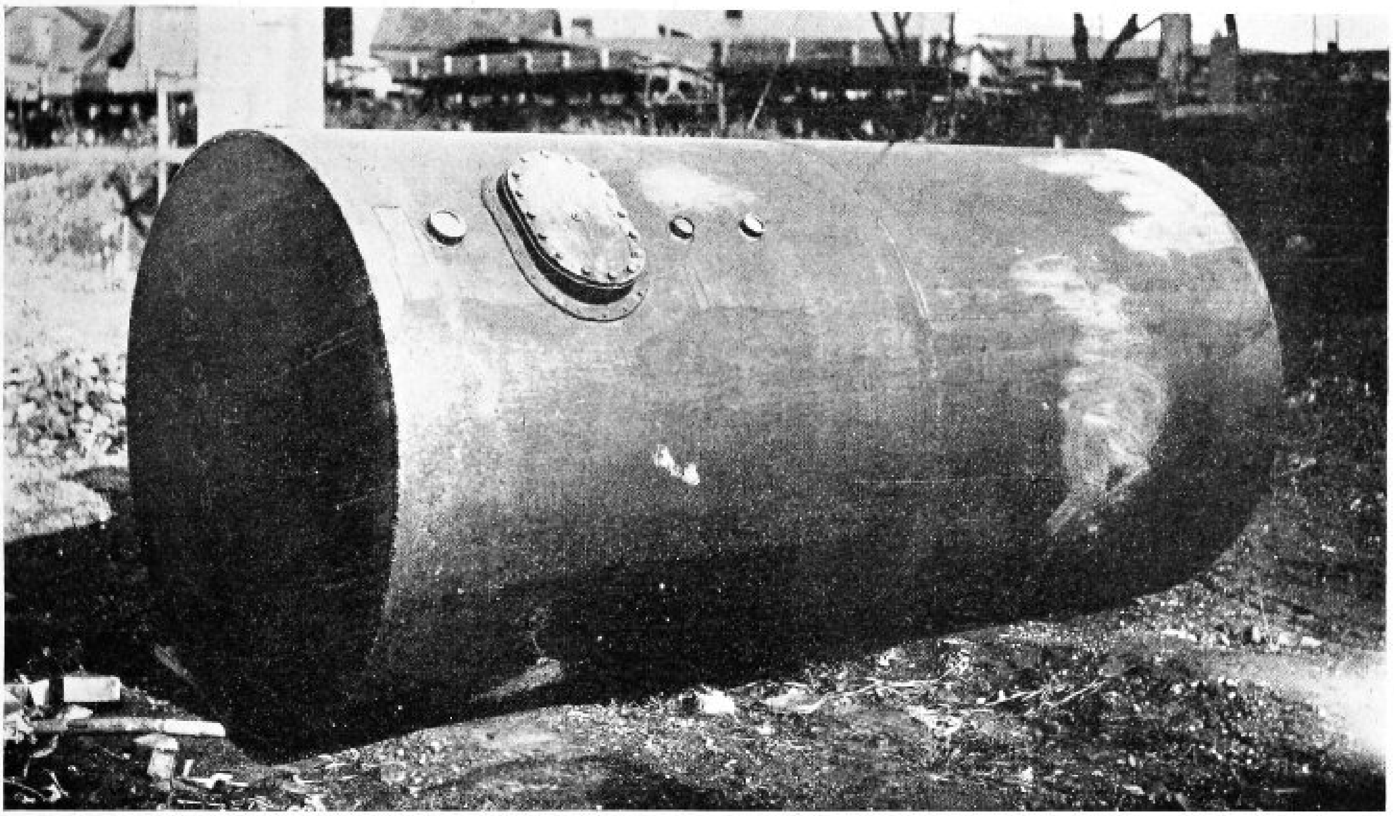
Claim 1.—The combination with a smoke box, of a baffle plate extending forwardly and then depending downwardly of the smoke box and



having draft openings in the downwardly directed portion through which the products of combustion may pass from the boiler tubes to the smokestack, said draft openings opening directly into the upper portion of the smoke box, and an imperforate table plate connected to the lower end of the baffle plate and extending horizontally and forwardly of the smoke box to a point adjacent the front end thereof, a draft opening of relatively small area being provided at the front end of the smoke box to regulate the draft through the tubes of a boiler to which the device is applied. Seven claims.

THE BOILER MAKER

MARCH, 1918



2,000-Gallon 3/16-Inch Storage Tank

The Welding of Large Storage Tanks by the Oxy-Acetylene Process

Single Beveled Butt Joint Most Satisfactory for Ordinary Tank Work—Double Beveled Butt Joint Used Only for Heavy Plates and Pressure Work

By C. W. R. Eichhoff

Large tanks for the storage of gasoline, oil and other fluids, not being subjected to any pressure other than that of the liquid contained therein, are mostly built of material from 3/16 to 3/8 inches thick, according to size. The plates of such tanks are either riveted or welded together. The latter can be performed by the oxy-acetylene or by the electrical welding process. Small tanks up to 1,000 gallons capacity can be fabricated just as cheaply and even cheaper welded than riveted, but when large welded tanks of, say, 6,000 to 12,000 gallons capacity have to be constructed, the manufacturer is confronted with problems which do not enter into the process of building such riveted tanks.

In the first place, only such welded joints should be used as are recommended for heavy plates. We have, before all, the single beveled butt-joint, Fig. 1, which is the most satisfactory to use on the thickness of plates mentioned for storage tanks, in fact on any tank. The double beveled welded joint, Fig. 2, is only used on heavier plates and pressure work. In the latter construction a saving of material is realized on very heavy plates, but it is questionable if the joint is as efficient as a single beveled butt-joint. In the writer's opinion welding from both sides introduces strains which are detrimental to the efficiency of the joint. Besides, there is a great tendency to overheat the side welded first. At any rate, in welding these two joints, it is essential that the metal be completely fused throughout the entire thickness of plate.

The beveling of the plate should be done on a plate planer. The use of a hand grinder or the bevel shears is not to be recommended, as it is important that the beveled edges be perfectly straight. The width of the "V" groove should be about equal to the thickness of plate.

When two sheets or plates of the thicknesses before mentioned, or less, are to be welded together, they should be laid on supports which facilitate a free movement in all directions, to allow for the effects of expansion and contraction. Besides, they should be laid on these supports as level as possible. The sheets should not be laid parallel with the beveled edges close together and then tacked at intervals, but should be set at an angle as shown in Fig. 3. This sketch shows an illustration of an actual performance. The material was ¼ inch thick, 21 feet 8 inches long and 30 inches respectively, 72 inches wide. Twelve of such plates have been successfully welded together with a divergence of 6½ inches at the

them without burning his fingers, but he can lay his hands on the steel plate close behind the bars and hold them there for an indefinite time without fear of having his hands injured. The application of these copper bars prevents much of the objectionable warping of the thinner gages of heavier plates. On very heavy plates this precaution is less necessary.

As said before, laying the plates parallel and close together with their beveled edges should be resorted to, as the creeping action of the plates during the process of welding leads to failure. When two sheets are laid parallel with the edges practically touching each other, they will diverge when welding is commenced, then they will come together, remain parallel for a while and when the welding is continued they will begin to overlap.

To prevent such overlapping some inexperienced welders resort to the mentioned tacking of the plates at in-

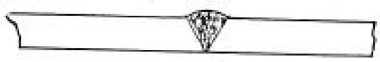


Fig 1.
Single Bevelled Butt Joint

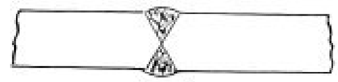


Fig 2.
Double Bevelled Butt Joint

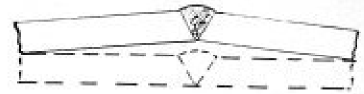
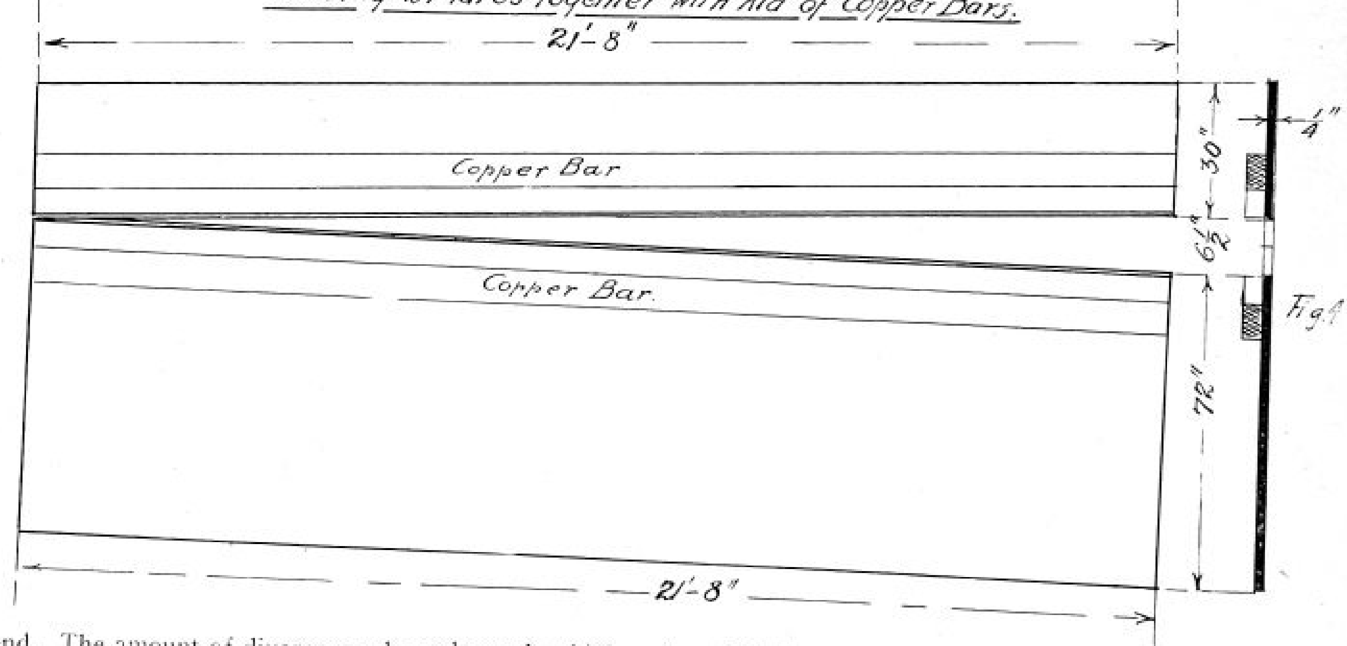


Fig 5.
Result of Wrong Welding.

Fig 3. & 4.
Welding 2 Plates together with Aid of Copper Bars.



tail-end. The amount of divergence depends on the thickness of plate and should amount to 2½ percent and more of the length of seam to be welded. Experience is the best teacher here; the amount to be allowed depends on the skill and speed of the welder.

After the plates were laid in this divergent position, two heavy copper bars, the heavier the better, were placed parallel to the beveled edges of the plates, just far enough away from the edges to allow an unobstructed handling of the welding torch (Fig. 4.). These bars should be clamped down tight to the plates, no air space should be between the bar and plates. Inasmuch as copper has a greater heat conductivity than steel, these bars will absorb the greater part of the heat developed by the torch and concentrate it at the place of welding. Only a small amount of heat will be conducted further into the steel plate.

To the inexperienced operator it will be surprising to find that the copper bars are so hot that he cannot touch

tervals before commencing the real welding, with the result that these tacked spots crack and when the joint is finished it will look at the tail-end somewhat like Fig. 5.

When such distorted plates are afterward passed through the straightening or bending rolls, they will invariably crack in the weld.

The lap joint, Fig. 6, should not be used on these thicknesses of plates, as the plates are in shear. In the process of welding if possible no weld should be subjected to a shearing or bending action; if so, the result may be breaking in the joint when contraction in cooling takes place.

Other joints which have been used are the flanged or ridge joint, Fig. 7, the inside joggle joint, Fig. 8, and the outside joggle joint, Fig. 9. The latter is in shear and therefore objectionable. It is nothing but a joggled lap joint. Such flanging and joggling can be done on sectional flanging presses and joggling machines.

Flanged joints are simply tacked together at intervals

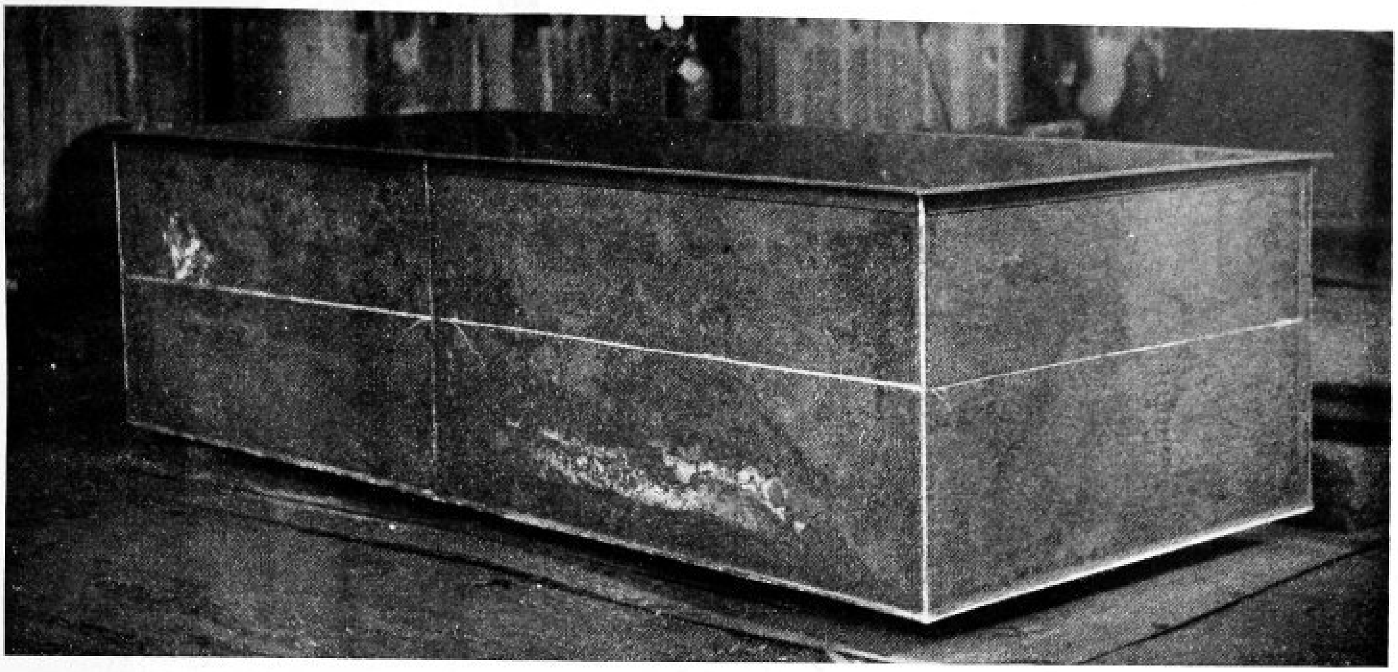
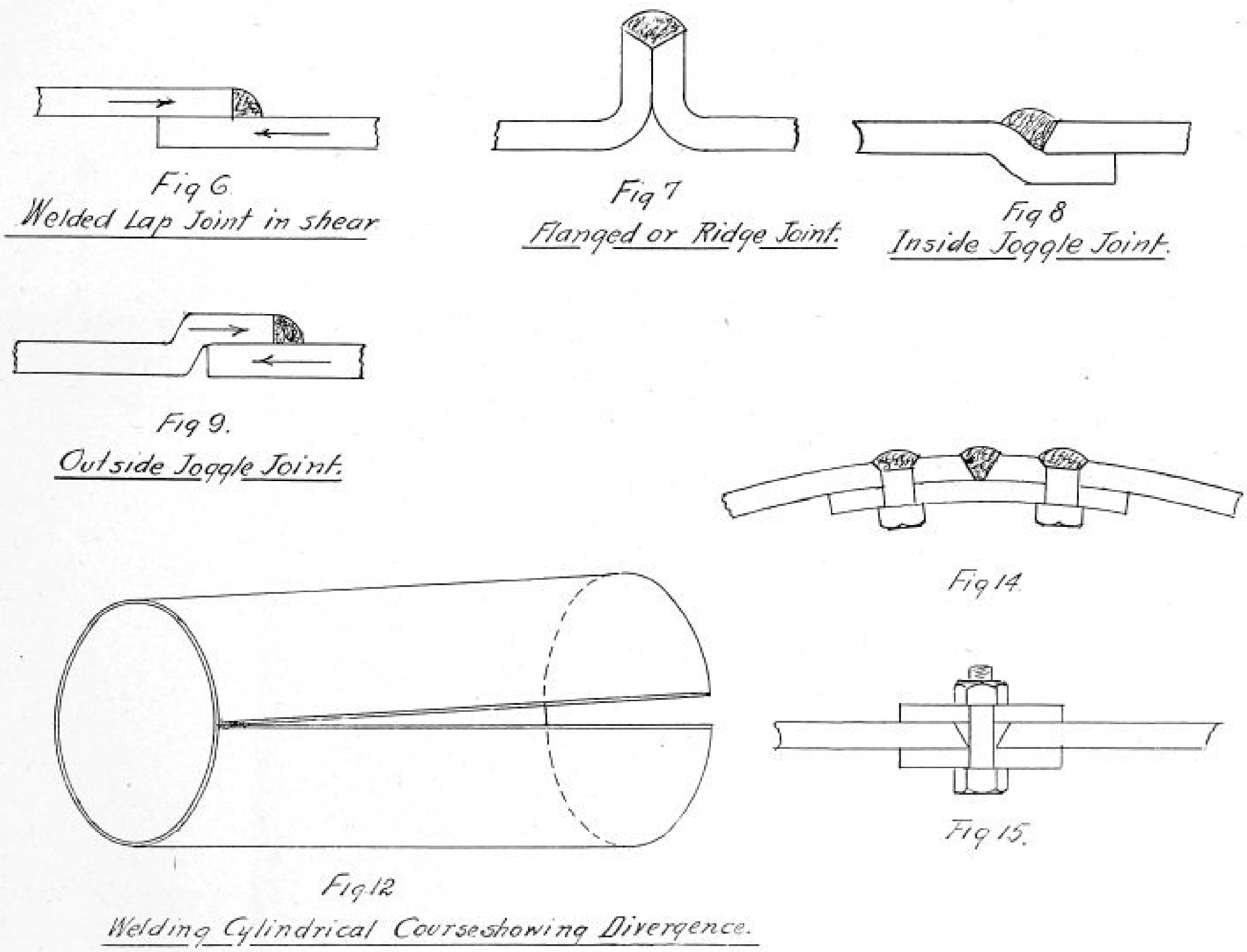


Fig. 10.—3,000-Gallon ¼-Inch Tank; Welded Ridge Joints

of 10 or 12 inches and then afterwards welded together. The flange takes care of expansion and contraction. These flanges can be either on the inside or on the outside, according to requirements. A rectangular tank constructed of such joints with a capacity of 3,000 gallons, ¼ inch material, is shown in Fig. 10.

This tank has proved to be a success. The flanged joints acting as stiffeners give the sides strength and the tank a good appearance. In this smaller unit no extra bracing was necessary. It is constructed of flanged panels and any number of such panels can be welded together. In large tanks it will be necessary to brace



Lap, Flanged and Joggle Joints

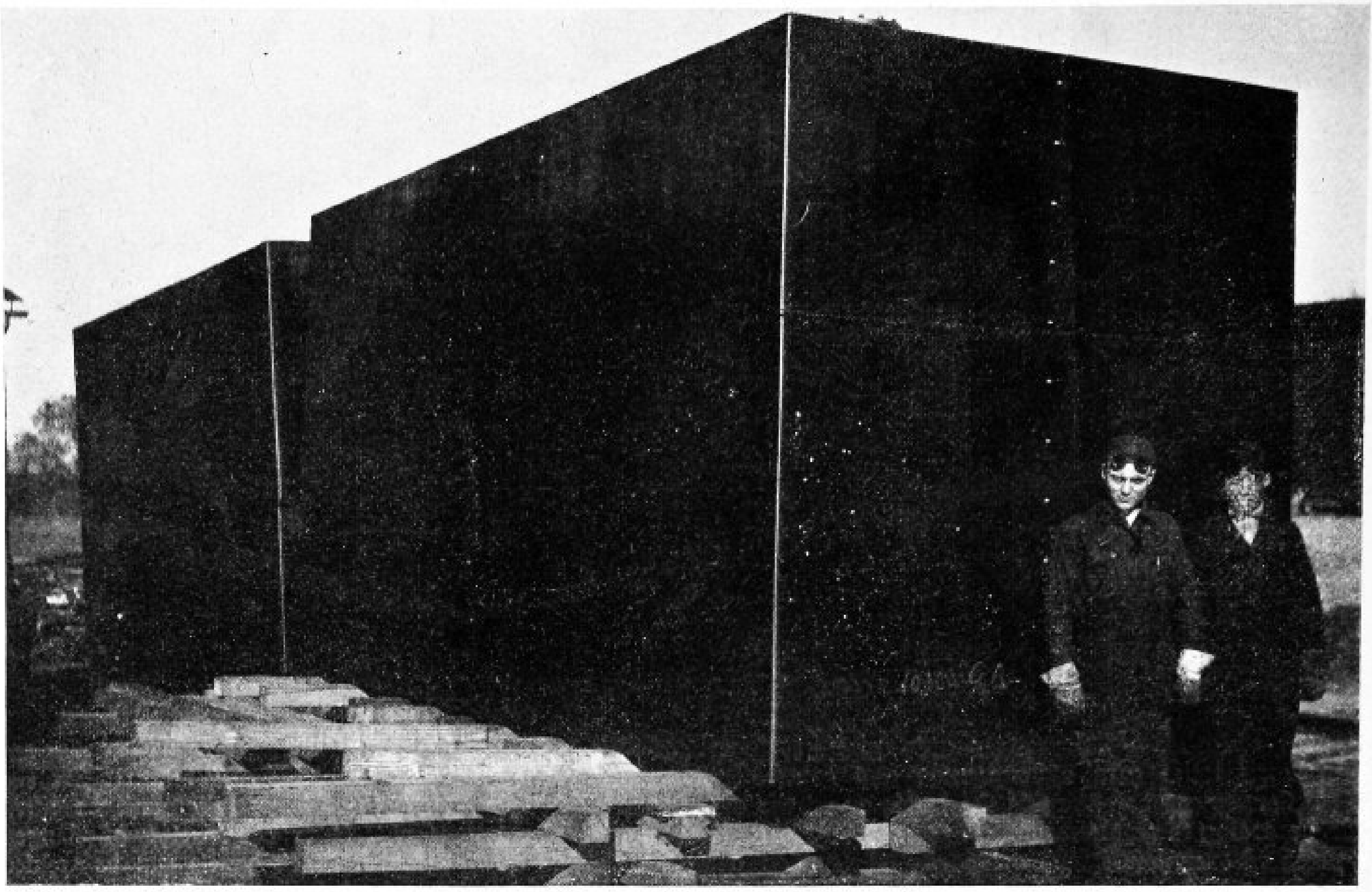


Fig. 11.—Two 10,000-Gallon Butt Welded Tanks

same, which can be done directly through the welded joint or close by in the customary way by flat irons welded in the joint or by angles and rods. It is also advisable to break the joints as much as possible. A great advantage in welding such flanged panels lies in the cheapness of construction and the prevention of buckling or warping, as the flanges take care of the effects of expansion and contraction.

Referring to tanks with joggle joints, the writer cannot say much, as such constructions have so far been out of the scope of his experience. To his knowledge one concern has built such tanks, but the result is unknown to the writer. This much is sure, that the outside joggle construction is not recommendable for reasons explained, but there is no reason why tanks, where the inside joggle joint is used, should not be satisfactory.

The photographs, Figs. 10, 11 and 13 show rectangular and cylindrical tanks which were built under the

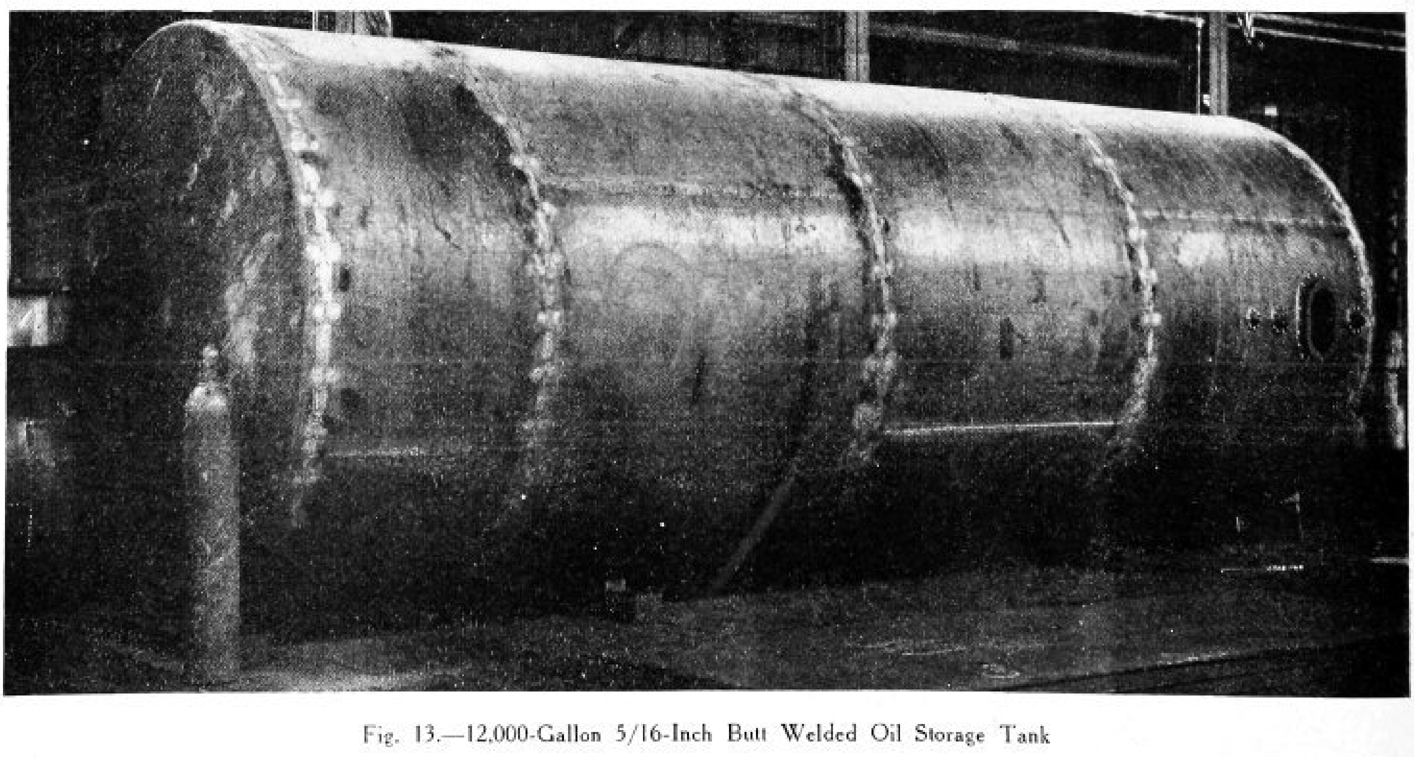


Fig. 13.—12,000-Gallon 5/16-Inch Butt Welded Oil Storage Tank

writer's supervision. In the last three years quite a number of such tanks have been built. They are all in actual service and no complaint has ever come to the writer's ear. If properly built, the welded tank, for storage purposes, is far superior to the riveted one with single riveted joints. The only objection is the higher cost of construction, and this is caused, first of all, by the lack of proper equipment and then the scarcity of skillful and conscientious welders.

To be successful and manufacture a tank economically, a shop should have, besides the regular complete welding plant outfit, the usual boiler shop equipment with a large planer, large boring mill, a sectional flanger with its accessories, first class cranes, etc. Such equipment is rather expensive.

To come back to the photographs, Fig. 11 shows two 10,000 gallon tanks 5/16-inch material, dimensions 8 feet by 9 feet by 18 feet 6 inches. All seams were butt-welded. The bracing consists of 3 inches by 3 inches by 5/16 inch angles riveted to the shell and through-rods with turnbuckles. Five of these tanks have been built for a railroad company. The two boys shown in the cut welded these tanks, one of them now serving this country in France.

Welding Cylindrical Tanks

So far we have considered the welding of flat surfaces and tanks with such surfaces. In the welding of circular tanks or courses, the same precaution as regards divergence of the edges to be welded has to be taken, as illustrated on page 63. After a circular course for large tanks is welded along the longitudinal seam, the welded ring should be passed through the bending rolls again to obtain a practically true circle.

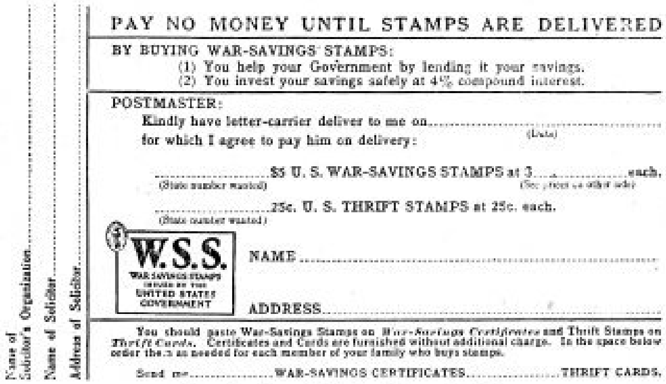
On page 61 is shown a 2,000-gallon cylindrical tank, also butt-welded with the exception of the heads, which are corner-welded, not to be recommended on large work.

Fig. 13 shows a 12,000 gallon 5/16-inch cylindrical tank. Regarding this tank the writer wishes to make a few remarks, as it represents a very successful construction. The tank has a diameter of 108 inches and is 25 feet 3 inches long. There are four courses, each course consisting of one plate only. The four rings were provided with tack holes spaced about 12 inches apart. Five fish-bands made of ¼ inch scrap bent to the inside curvature and punched corresponding to the tack-holes in the shell serve to hold the rings in alinement and together. The courses were naturally butt-welded separately in the longitudinal seams. These four courses and heads were fitted up and jointed by the above mentioned bands with ½-inch tack bolts. A space of 3/16 inch was left between each course to allow for free expansion and contraction. With the tack bolts in place the courses were butt-welded together. Afterwards the nuts outside on the tack bolts were removed and the bolts simply welded shut in place. The fish-bands remained in the tank fastened to the shell with the welded bolts. The details are shown in Fig. 14. The tank was tested with the usual test pressure of 5 pounds of air and soap suds, subjected to rough treatment, raised with the crane and dropped 6 feet on the floor, retested and found perfectly sound. It stood the rough treatment last spring, and has given guaranteed satisfaction.

Another method to butt-weld girth seams is accomplished by securing the sheets with clamps at intervals so as to keep the correct alinement of the heads and courses, as shown in Fig. 15. The seam is tack welded between these clamps, then the clamps are removed and the tank seam finished by welding between the tack welds. This latter method of fitting up is more elaborate and the joint not as strong as the former, but considerable material is saved.

Buying War Savings Stamps

A letter has been sent to the chairmen of the 150 commercial, industrial and professional committees of the War-Savings Committee by W. Ward Smith, vice-chairman of the Trades Division, stating that the sale of War-Savings and Thrift Stamps has been made much easier and missionary work much more effective by the use of the blue return post card, Form WS-138. The blue post


PAY NO MONEY UNTIL STAMPS ARE DELIVERED

BY BUYING WAR-SAVINGS STAMPS:
(1) You help your Government by lending it your savings.
(2) You invest your savings safely at 4% compound interest.

POSTMASTER:
Kindly have letter-carrier deliver to me on.................. (Date)
for which I agree to pay him on delivery:

..................$5 U. S. WAR-SAVINGS STAMPS at $.................each. (State number wanted) (See prices on other side)

..................25c. U. S. THRIFT STAMPS at 25c. each. (State number wanted)

W.S.S. War Savings Stamps issued by the United States Government

NAME..................

ADDRESS..................

You should paste War-Savings Stamps on *War-Savings Certificates* and Thrift Stamps on *Thrift Cards*. Certificates and Cards are furnished without additional charge. In the space below order them as needed for each member of your family who buys stamps.

Send me..................WAR-SAVINGS CERTIFICATES..................THRIFT CARDS.

Name of Solicitor's Organization.................. Name of Solicitor.................. Address of Solicitor..................

Fac-Simile of Blue Post Card

card is an order for War-Savings and Thrift Stamps to be delivered at your door C. O. D.

In Mr. Smith's letter, he states that the blue card provides the simplest, easiest, safest and least objectionable way of obtaining a pledge to buy stamps and that the utilization of the card permits a vast amount of better patriotic campaigning. Special emphasis was laid on the convenience of the blue card for trade agents when ordering supplies.

The card explains its utility to all who can read. It does away with uncertainty, difficulty and delay in securing stamps, for Uncle Sam's letter-carriers will fill all blue post card orders in the earliest mail, thus eliminating both bother and risk.

This blue post card, a fac-simile of which appears on this page, can be obtained free in large quantities at almost any post-office, bank and from the letter-carriers. In addition, a shipment of ten million of these cards has just arrived at headquarters and are now ready for distribution.

Loyalty of Labor

Recent events have shown the steady trend of the public mind in the direction and enforcement of loyalty from labor as well as from everyone else. The Government is apparently tired of being a plaything for labor unions. The Ship Commission has reached a point where labor must work. Congress is recognizing that it is now to be a case of how many rivets will be driven in a day instead of how many speeches professing verbal loyalty can be made by trained orators.

Course in Laying Out

A class in laying out for boiler makers, taught by Mr. Daniel T. Dale, is a new feature in the Bayonne Vocational School, West Eighth street, Bayonne, N. J., this year. Twenty-two young men employed in the boiler and sheet metal shops of Bayonne have received technical instruction of practical and immediate value in this class, and its success assures continuing the class another year.

Oxy-Acetylene and Electric Welding*

Both Methods Essential in Shop Equipment—Class of Work to Which Each Method is Especially Adapted—Economies

BY A. F. DYER

At the present price of material, scarcity of labor and difficulty of obtaining steel and iron, welding and cutting by both the oxy-acetylene and the electric processes has proved a great boon and an almost indispensable factor in railroad repair shops. Seven years ago we on the Grand Trunk employed one man as an acetylene welder and owing to failures through his lack of experience the process was nearly condemned, but as we gathered experience both gas and electric welding developed, so that now instead of one man we employ eighteen and have often to work them overtime. The low pressure acetylene gas system is used and the whole shops are piped for the acetylene, every other repair pit has a drop connection, in roundhouses we use Prest-O-Lite dissolved acetylene in cylinders, which saves the expenses of a generator and piping where the process is only in use occasionally.

The principal factor that made us decide on the low pressure outfit was the fact that our main supply pipes are carried overhead throughout the shops; and as nearly all, if not all, oil, steam and water pipes are overhead, we had to consider the factor of "safety first," for if a man was working overhead and by mistake broke a joint of the gas pipe, his torch or candle might cause an explosion which might wreck the shop. Although we have been using the acetylene gas for eight years, we have never had an explosion of any sort yet. Our low pressure generator went through a big fire two years ago, and we were enabled to repair it and use it for several weeks till we received our new outfit.

Autogenous welding processes have proved themselves fitly to be ranked among the greatest time and labor savers, and also, we may safely say, money savers, introduced for a long period.

Welded Boiler Work

In regard to boiler work, most of the welding is done with the iron electrode using a mild steel or Swedish iron as a filler. It is found that the electric process localizes the heat more so than the gas, though it is the writer's opinion that the gas makes a closer and neater weld, as all welds made by the electrode are more or less porous unless hammered up. It pays better whenever possible to do so to put quarter or half sides, in order to get out of the fire line, in preference to putting in a patch, for, as a rule, however, well the patch is welded, it generally gives out in from twelve to eighteen months' service, and the same applies to cracks, whereas the half or quarter side should last as long as the firebox.

When a nest of small cracks is found round the staybolts, the bolts are removed and the holes countersunk and welded up. This method has been found to be very successful. Corner patches are welded in by running the patch into the tube or back sheets, as the case may be, at the same time removing the flanges. If it is decided to do away with a number of tubes, plugs are welded in the holes, first countersinking the holes and haying the plugs punched by a countersunk die, which gives the proper bevel for welding. A great deal of trouble was experienced when welding in the superheater flues and tubes when this was first started, but after a little experience much better success was arrived at. Some operators prefer the tubes belled and others prefer them beaded; some prefer the water in the boiler and others do not.

The operators on the Grand Trunk Railway like the belled methods best and with the water in the boiler. This keeps the tube sheet from heating, especially round the smaller tubes. Tubes are set in with copper ferrules set back 1/32 inch and the flues are belled out 3/16 inch to 7/32 and the small tubes 3/16 inch. The sheet is roughened all around the tubes and flues, and the oil is then burnt off with the oxy-acetylene flame and tubes and flues welded in with electrode, using 1/8-inch mild steel or Swedish iron; the latter is preferred if calking is needed.

Average Day's Work

A sample of an average day's work is as follows, for a gang of 12 men: Fourteen rivet holes in smokebox and four peg holes in foundation ring; ten tube holes in upper portion of firebox tube sheet; two air pipes which were worn through; one ratchet for jack (two teeth replaced); one gear spindle built up; one chuck screw, key end built up; one boring shaft built up from 2½ to 2⅞ inches; two tool holders, rebuilt; one air hammer handle repaired; six teeth in lathe gear, built in; one cone, small end filled up solid; tool holders, rebuilt; two 1¼ inch holes in top rail of frame filled up; four cracks 18 inches long in right side sheet welded; fourteen bottom tube holes welded up; two washout plug holes built up for re-tapping in round head; cut out frame for welding and started welding same; welded bushes in pony truck stays; cut out three sets of boiler tubes; cut out one set of superheater flues; built up calking edge of fire hole; heated corners of tube sheet for closing; welded broken superheater damper bracket; built up reversing lever where worn; built up two side rods where worn; cut out 48 flexible staybolts in firebox; welded two cracks in throat sheet; and one broken flange of air brake cylinder. In addition to this list two men are engaged continuously on cutting around the shops.

Cutting Steel and Iron

For cutting steel and wrought iron, the oxy-acetylene process has practically no competitor, it being impossible with the carbon point to cut as fast or as fine and neatly as with the gas torch, although for scrapping fireboxes and frames the carbon point is cheaper if time is no object and labor cheap.

The foregoing examples enumerated only a very small fraction of the uses to which the two methods of welding and cutting are being put to in locomotive repairing and machine shops and new uses are being found for it every day. No roundhouse should be without an oxy-acetylene outfit, both for repair work and as a part of the wrecking outfit; many days are lost by engines being tied up through parts having to be sent to the nearest big

* Paper read before the December meeting of the Canadian Railway Club.

shops for repair, which could be repaired on the spot with a welding and cutting outfit. All large roundhouses should have both processes, as they would pay for themselves over and over again.

Though there are many different opinions as to which is the best process, no shop is complete unless it has both equipments, although the gas has really the widest range, but, on the other hand, a heavy piece of steel or iron needs no pre-heating with the electrode, but welding can be commenced as soon as your arc is drawn. Ninety-five percent of the failures which occur instead of being laid on the process, as is so often the case, should be placed on the shoulders of the operators who cause them.

Welding should not be treated as a side line of the machinists' or boiler makers' business, but should be treated as a trade in itself, as it really is, for it needs the entire concentration of a man's mind, careful study, plenty of practice and a conscientious man to make a welder. Wherever possible a separate building or suitable space should be provided for bench work, and should be equipped with a suitable furnace for heating and annealing castings, and also have plenty of floor room to allow of charcoal fires being built for pre-heating cast iron jobs for welding.

Hermann Gives a Few Pointers on Riveting

Tanks for Storing Gasoline Under Pressure Develop Leaks Under Test—Trouble Due to Method of Riveting

BY J. L. LANE

"You seem to be having a lot of trouble with those tanks, what's the matter?"

Hermann, who had been pensioned a couple of years back on account of his health, had dropped in, as he frequently did, for a chat with the boys and to have a look around. The tanks in question were stacked up against the wall of the testing room, chalk marked to show where more testing was to be done.

The foreman nodded. "You bet I am!" he said. "They are the worst lot we've had in the shop since I took hold of things. It just seems impossible to get them tight. They are for storing gasoline under pressure, you know, and that's about the meanest stuff there is to hold."

CALKING GASOLINE TANKS PROVES DIFFICULT

"Pete and his helper," he continued, "have been calking on that one all the forenoon and it won't stand inspection yet. There are fifty of them to be made, and, at this rate, we stand to lose a bunch of money on the job."

"I thought," he continued, "that I knew pretty near all there was to be known when it came to simple drum work like that, but the thing has me going."

"Seems to be mostly in the riveting," commented the Old Man. "What are you doing about it?"

"Well, I weighted down the accumulator to get more pressure on the line, if that's what you mean," said the foreman. "They are being riveted on the bull and I figured maybe we were not driving them hard enough. But it doesn't help."

Hermann studied a minute. Then—"Just what happens when you drive a rivet, anyway?" he queried.

RIVETING NOT SO SIMPLE, AFTER ALL

The foreman scratched his head. "Say! What to blank," he exploded. "Any kid knows that."

"I'm not so sure," answered the older man reflectively. "Anyway, just what does happen?"

"Well, after the hot rivet is shoved into place the bull squeezes up the body until it completely fills the hole and then upsets the end to form the head. Afterwards when the pressure is released and it begins to cool off, the body contracts and draws the plates together."

"Good!" said the older man, "but you've overlooked one thing, and it's mighty important on tight work."

"I don't believe I understand."

Hermann went over to the forge, pulled a rivet out of the fire with the tongs and held it up. "It's that scale you see forming," he said. "The minute your rivet comes in contact with the air it starts to oxidize, and when the head is upset against the cold plate a thin layer of this scale, as brittle as glass, keeps the parts from making a perfect metal to metal contact. Afterward, when the work cools, the contraction cracks this brittle film, leaving tiny passages for the water to seep through."

"I never thought of that," said the foreman. "I guess you're right, though. The question is, how to get rid of it."

"Simple enough," replied Hermann. "When you work steel in the forge shop you have the same thing to contend with, so you put flux on the parts to be welded. This dissolves the scale, so that when the parts are butted together it flows out."

"You mean that, before driving, the rivets ought to be dipped in flux?"

THE REMEDY

"Well, that would be one way," was the reply. "But I've found that the simplest method is to make a thick solution of flux and water, with a little sugar for a binder, and to apply this to the rivet holes with a brush, giving it plenty of time to dry on. If there doesn't happen to be any flux handy you might try common salt instead—that's what they use in the steel mills as a solvent."

"Half the difficulty," he reflected, "is in finding out just what causes all the trouble in the first place. After that it's a plain case of using the best tool a boiler maker has in his shop—his noodle."

Join the Civic Ranks as a Technical Guildsman

In connection with or in response to the call of the President for volunteers, the attention of all technical men is especially invited to the need of the army for men between the ages of eighteen and forty in sundry branches of technical troops. Technical men who are exempt, or who from any cause cannot volunteer, can yet efficiently co-operate by forming technical patriotic educational guilds in their several industries or home neighborhoods. For information, write to Major J. E. Bloom, U. S. A., 266 Market street, Newark, N. J.

Care and Maintenance of Locomotive Boilers and Their Appurtenances—V

Locomotive Superheater Instructions for Installation, Maintenance, Inspection and Repair—Reports Covering Boiler Failures and Repairs

BY WILLIAM N. ALLMAN

INSTALLATION AND INSPECTION FOR SHOP

For installation of superheater in either new or old locomotives, be governed by the following instructions:

Flue Setting.—Fig. 38 covers application of superheater flues, and refers to tools required in setting, beading, rolling and prossering. This print also covers the safe-ending of these flues.

Flues expanded, beaded and prossered at firebox end, but not rolled; copper ferrule used at this end but may be omitted when flues are welded in flue sheet; however, this will require excessive expanding of flue, which is not necessary when ferrule is used.

All flues rolled and beaded at front flue sheet or smokebox end; also bead all small boiler flues above superheater damper.

Headers.—Should have face and joints protected by boards at all times, special care being taken not to score or cut faces with crane slings or jacks, etc., in lifting in or out of smokebox.

In placing, header should be so set by jacks and blocking to line up with dry pipe connections, and have face parallel to center line of top row of flues, each end being same distance from center line of outside flue in top row; this being checked by placing long, straight edges in these two flues to furnish measuring point to face of header.

After header has been properly located and supported, push back to dry pipe joint and tighten up securely with the nuts on dry pipe studs, screwing up gradually and evenly all around; jacks and blocking not to be removed until supports are located in position.

Header Supports.—Header supports or brackets are designed to carry the weight of the header and relieve the strain that would otherwise fall on the neck and dry pipe joint.

After header has been properly located, bolted in position and still supported by blocking, carefully fit the supports, securing them to the lower face of header by means of the studs, then drill holes through support and smokebox sheet, ream same and fit with tight fitting turned bolts, which will insure weight of header being carried by the supports.

Units.—See that each unit is provided with necessary supports and bands, in good condition, and are properly located, before unit is installed. Allow wooden protection blocks to remain on units until after inserted in flues. To slide in flues freely, without twisting, care being taken to see that spacer feet on units are resting properly in the flue and in proper relation to the adjacent pipes.

After units are in place remove wooden protection blocks, wipe off clean the joint on unit and in header and secure together with unit bolts. Do not use compound, such as varnish, plumbago, red lead, etc., on these joints, but make metal to metal joints. If ends of unit pipes do not pull up true with seat in header they should be sprung into place, with a bar, and not be allowed to drag into position by tightening the bolts. Units properly located, after tightened, should be central in the upper part of the flue, but should not bind against the top.

Testing.—After units are in place and tightened to header, apply water test, before the steam pipes are in position; this test to be 25 per cent above working pressure and to include the boiler. (Steam pipe connections blanked for this test.)

While superheater and boiler are under pressure inspect all joint connections, return bends, dry pipe connections and flue sheets, and stop any leaks that may appear.

After boiler has been steamed and superheater tested again, with steam, the bolts should be inspected and

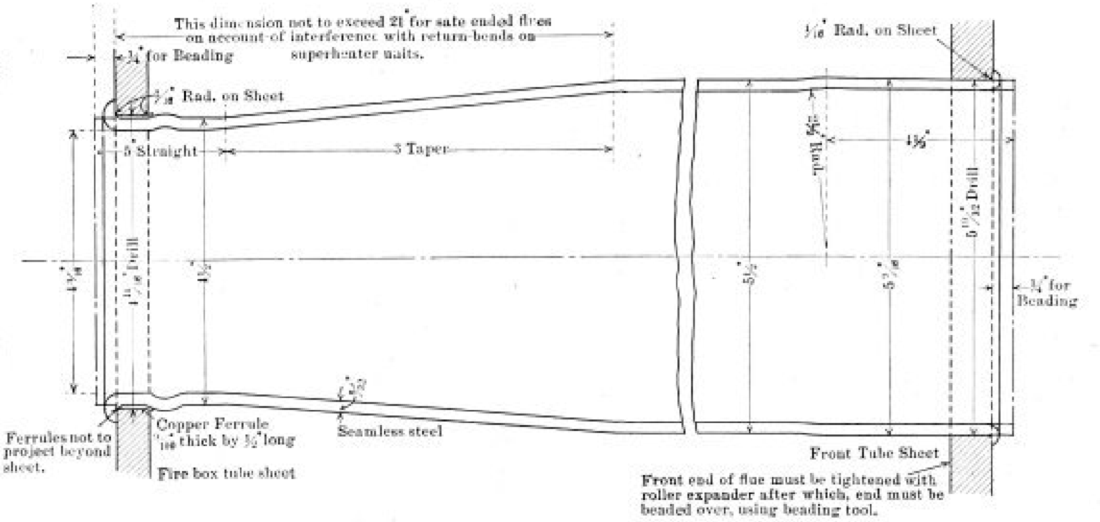


Fig. 38.—Method of Setting Superheater Flue

tightened finally, after which the jam nuts may be set up tight.

After locomotive has gone into service and made several trips, the unit bolts should be gone over and any slack that may exist taken up.

Wrenches.—Convenient socket wrenches to be provided, to fit unit bolt nuts and be deep enough to take two nuts, and be of a length and design that will not necessitate removal of table plate or damper.

Hand Holes.—Not less than 3 inches diameter, to be placed in each side of smokebox, slightly below the face of header and directly opposite each other. To permit the inspection of units without the removal of damper or baffle plates.

Baffle Plates.—Made to fit tight and so constructed to permit their removal through smokebox door. In fitting central portion of baffle plate, arrange so that it can be easily removed by lifting up and pulling forward to clear the clamps at top and bottom; adjust this by reducing or increasing size of clamps.

Damper.—When connected to the steam pipes or steam chest, the damper to be adjusted so that when weight is down it will be closed and when up it will be open. (When connected to blower, the operation is reversed, the weight being up when damper is closed and down when open.) Determine these positions by holding weight in the position that it would have when damper is closed, and with this decided, drill the damper shaft and weight arm and fasten by means of dowel pin. As a final inspection, see that the damper opens and closes freely after it is connected.

Damper Cylinder Connection.—Use ½-inch copper pipe for connecting the damper cylinder to steam chest, steam pipes (or blower). See that this connection in the steam chest, steam pipes or blower is below one in damper cylinder and that pipe has a gradual drop to insure drainage towards the steam chest, steam pipes or blower; also that it is free from pockets and protected by lagging.

Lubricator.—Care to be taken that all lubricator sights and pipes are properly identified and marked, so that those leading to the steam chest, air pump, or in cases where directed to the cylinder, they may be readily recognized.

All lubricator oil pipes should have a gradual drop and be without pockets, and be carried under jacketing to protect them from the weather. At points where exposed they should be lagged.

Lubricator connections and atomizers to conform to standard prints.

Repairs and Maintenance for Shop

Units.—Remove from the flues in reverse manner from which installed; as each unit is disconnected from header, ball seat should be covered by protection block, which block should be kept on seat from the time unit is removed until put back in position. Care should be taken not to bend or twist units in removing from boiler.

Repairing units consists of grinding ball joints, also replacing bands and supports that have been damaged and see that they are properly located. On units 18 feet long or over use two supports, the first about 60 inches from the back end, and the second midway between the first and front end of straight portion of unit; each unit to have one pipe band near front return bend. Examine and replace all unit bolts not in good condition. Test units for leaks, repairing where necessary. Units should be tested individually with hydraulic pressure, by laying horizontally on side and permitting water to enter through the lower pipe until it discharges through pet cock connected to upper pipe, which should be closed and pressure applied.

Install units in accordance with previous instructions.

Header.—After units have been removed, protect face of header with a board of sufficient size to completely cover; this being done before header is removed from boiler. After header is suitably located on floor, remove protection board, clean and ream joint seats, after which replace board and keep same on face of header until connected up in smokebox.

Install header in accordance with previous instructions.

Flues.—Remove superheater flues from boiler in regular way, by cutting off ends inside of back and front flue sheets, cutting off as little as possible.

Rattling.—In cleaning flues care should be taken to see that rattler is free from rivet heads, projections or old safe ends, which might damage flues; these flues being heavier than the smaller boiler flues, consequently require more care to prevent damage, and if dented will cause difficulty in inserting units. Any projections in rattler might cause ends of flues to split, necessitating more waste of flue in squaring up.

Safe Ending.—To be done in accordance with Fig. 38. In applying safe ends, bell the end of flue and scarf the safe end about ⅝ inch, making weld with as little obstruction as possible on the inside so as not to interfere with insertion of units. Anneal safe ends after applied, by permitting to be cooled off by atmosphere, not with water.

Care of Superheater, for Roundhouse, Dispatchers and Engine Crew

High Water.—Hostlers, dispatchers and engine crews, in handling superheater locomotives, should see that they are not filled above top of water glass or gage cock, as the overfilling of boilers is responsible, to a great extent, for failure of cylinder packing and heads, etc., and is liable to start superheater joint connections leaking.

Flue Cleaning.—At intervals, found necessary by operating conditions and kind of fuel used, superheater flues should be cleaned and return bends at firebox end be freed of any clinkers or honeycomb. Use ⅜-inch gas pipe for this purpose, long enough to extend through entire flue, being connected to air line using pressure of 80 to 100 pounds. The pipe should be inserted at firebox end and gradually worked forward under unit to blow dirt out of front end of flue. Damper should be closed while flues are being cleaned.

Damper.—Should be closed while locomotive is being fired to prevent units from becoming overheated when no steam is passing through them.

Inspection.—Every 30 days, or if convenient at regular monthly staybolt test, the superheater, steam and exhaust pipes should be tested with warm water pressure of about 100 pounds, this test including the boiler. While under pressure inspect all joints in superheater, steam pipe, exhaust and dry pipe rings, as also seams in flue sheets, not overlooking the return bends, which may be inspected from the firebox. The appearance of water in flue will indicate a leak in unit or return bend. All leaks should be repaired before locomotive goes into service.

Maintenance of Seat Joints.—If joints between units and header are found leaking, tighten them; if this does not prevent leaking, disconnect, regrind the unit and ream the header. When units are removed from boiler, replace damaged supports and bands. Units 18 feet long or over to have two supports, the first one about 60 inches from back end, and the second midway between the first one and front end of straight portion of unit. Keep supply of standard supports and bands at hand for repairs.

In making repairs, all defective superheater material should be replaced.

Maintenance of Pipe Supports and Bands.—Unless pipe supports and bands are properly maintained, the unit pipes will sag in flue, causing improper circulation of gases through flue and more difficulty in keeping flue clean. It is also possible that this sagging will permit sufficient vibration of units to cause return bend lugs to wear into flue. Therefore, it is very essential that pipe supports and bends should be in good condition and properly located before units are reapplied.

Reporting Personal Injuries to Interstate Commerce Commission Resulting from Boiler Failures or their Appurtenances

Attention is directed to paragraph 55 of the Rules and Instructions for inspection and testing of locomotive boilers and their appurtenances as issued by the Interstate Commerce Commission, which provides that:

"In the case of an accident resulting from failure, from any cause, of a locomotive boiler or any of its appurtenances resulting in serious injury or death to one or more persons, the carrier owning or operating such locomotive shall immediately transmit by wire to the Chief Inspector of Locomotive Boilers, at his office at Washington, D. C., a report of such accident, stating the nature of the accident, the place at which it occurred as well as where the locomotive may be inspected, which wire shall be immediately confirmed by mail, giving a full detailed report of such accident, stating, so far as may be known, the causes and giving a complete list of the killed or injured."

Record of Boiler and Firebox Sheets

Builder .... Date .... Works ....

Results of Physical and Chemical Tests of ....

Entering into the Construction of ....

For Locomotive No. .... Class ....

Location	Mark	Maker	Section	Area in Sq. In.	Elongation Percent / inches	Elastic Limit Lbs. per sq. in.	Ultimate Strength Lbs. per sq. in.	Chemical Analysis: Carbon	Manganese	Phosphorus	Sulphur	Silicon	Copper

Material Manufactured by ....

Signed ....

Form No. 2

In order to meet these requirements, it will be necessary to wire headquarters, so that the Chief Inspector of the Interstate Commerce Commission may be advised by wire. See that this wire is filed immediately after the accident. Let a full letter report follow by first mail, and in the event a full report cannot be obtained, send at once a written preliminary report, and follow as soon as possible with a full detailed report.

The locomotive and the parts responsible for the accident, account of defects or otherwise, must be held subject to orders from this office.

Reports

Forms Nos. 1 and 3 must be made out monthly and annually as called for and filled out complete in each instance, properly signed and attested to by a Notary.

Time out of service must be properly covered by out of service reports, and notation showing the months out of service on account of which the extension is claimed made on the back of the inspection reports and cab cards.

No extension of time as provided above will be allowed for portions of a month.

If a locomotive is out of service when any of the above work is due, it need not be performed until just prior to the time the locomotive is returned to service.

Reports of all alterations, such as application of patches, new boiler sheets, change in size of backhead or front tube sheet stays, change in size of safety valves, etc., should be reported on Form No. 19.

Record of Boiler and Firebox Sheets.

Form No. 2 to be used for recording data concerning all of the plates entering into the construction of the boiler, both for the original boiler and for renewals of sheets. This form may also be used for recording data on new border plates purchased and held in stock for repair purposes.

Record of Plates Used in the Construction or Repairs of Boilers

Form No. 4 to be used for reporting the application of all new plates applied to the boiler, as well as removal of old plates and cause for removal.

Note for Setting

Holes in sheets to be carefully cleaned.

Ends of flues to have scale removed by filing.

Copper ferrule to be set in flue hole and seated with sectional expander, after which tube is to be set in place, care being taken not to injure or misplace ferrule; then straight expander is to be used to seat flue against copper ferrule; after this the prossering expander is to be used and then flue be beaded over.

In expanding flues with sectional expanders, the expander pin or mandrel to be driven into expander until flue is solid against sheet, then slacked off and expander turned slightly in flue and driven in again. This to be done at least three times or until flue is properly set, and evenly expanded all the way around.

Before prosser expanding flue, the end of the flue should be flared to permit the prossering tool entering to its proper depth.

For hot work, use straight sectional expander for tightening flues in back flue sheets; no roller expander used at this end.

All superheater flues in service should be re-prossered about once every fifteen days, this being regulated by the service.

System of Safe-Ending Superheater Flues

Safe-ends purchased in 6, 8 and 12-inch lengths by 4½-inch outside diameter for firebox end of flue, and in 6, 8 and 12-inch lengths by 5½-inch diameter for the smoke box end of flue.

1st Application;		New tube, without safe-ends.
2nd	"	Use 6-inch safe-end, firebox end.
3rd	"	Cut off first safe-end and use 8-inch length, firebox end.

4th Application:	Cut off second safe-end and use 12-inch length, firebox end.
5th "	Cut off ragged end and apply 6 or 8-inch safe-end, to suit, at firebox end.
6th "	Cut off at front end, apply 6-inch safe-end, smoke box end.
7th "	Cut off first safe-end, apply 8-inch safe-end, smoke box end.
8th "	Cut off second safe-end, apply 12-inch safe-end, smoke box end.
9th "	Commence again at firebox end of flue, and repeat from 2nd to 8th applications until full life of flue has been obtained.

Not more than one weld to be in smokebox end of flue at one time and not more than two in firebox end of flue, the least number of welds possible, being desirable.

Flues purchased new should be ordered for longest boilers, and old flues removed from longer boilers beused in shorter ones.

Note.—If rear or firebox end of flue is welded in flue sheet, copper ferrule may be either used or omitted as desired, but as flue is swaged down to fit in ferrule it will require less expanding of flue if ferrule is used.

Standard Watertube Boilers

The specification drawings and details which appear in the November issue have been perused closely by me with the greatest interest. As at times I have been subject to hostile criticism in contending for first-class practice fairly common in the United Kingdom, I would invite those who disagree with me to give close scrutiny to the provisions of the document and realize that with few exceptions they correspond to my own ideas and may be taken to represent a model worth imitation.

If the specification is carried out with thoroughness and the construction supervised by competent men, the boilers so made can be expected to give every satisfaction. The specification is practical, is free from ambiguity and contains nearly every essential prohibition and provision making for first-class product.

It is, perhaps, bold to criticise a standard specification drawn by an associated authority and endorsed by the United States Government, but as there are debatable points it is worth while detailing these.

Drum

The term open hearth used to describe the material is scarcely as specific as could be wished. This would preferably be Siemen's acid open hearth steel.

The prohibition common to first-class specifications, that the shell shall be rolled perfectly round in the rolls and hammering the extreme ends of the plates specifically disallowed, is absent. This is an important provision and should have been incorporated.

Another important omission is that plates wholly or partially worked hot (as the heads) shall be subsequently heated all over to cherry red in a proper annealing furnace and allowed to cool out. The importance of this provision cannot be overrated. The question of holes to the front header should state that these are to be trepanned by machinery—the specification says cut, which may mean anything.

Drilling, Riveting and Calking

Experience has shown that punching in any shape or form is best avoided, that the permission to punch pilot holes is one which the present writer thinks could just as well have been omitted. Those most conversant with the different interpretation put upon reaming in the machine shop and boiler shop, respectively, have reason to regard the permission to punch 75 percent diameter and then ream with dismay.

To attain the most perfect job, holes should be drilled 1/32 inch under size and all holes machine reamed. This, however, is a refinement not yet practiced in boiler making, but worth consideration for excessive pressures.

The term calking is better omitted and substituted by the term fullering. Although criticised at length for my belief, hydraulic riveting should have been specified, and also the minimum closure pressure on the ram.

With the foregoing exceptions, the specification has much to recommend it; obviously a good deal depends upon its due interpretation by the supervising inspectors.

Why the criticism above is furnished is that a first-class opportunity is presented to raise the quality of workmanship at no inordinate cost and form an object lesson in good boiler building, as the quantities made will be distributed, and being standard it will be easy enough to insure identical supply from diverse sources.

Attention is invited to the question of position drilling; this is specified; to the pressed butt straps, pressed steel pads and mountings for the fittings; to the prohibition of drift pins, the machinery of plate edges; to the taking apart of plates to dress burrs after position drilling; to the insistence upon full rivet heads and their corresponding adequate length. Also the preference exhibited to machine riveting. It will also be noticed that calking is only mentioned in connection with plate edges, nothing is said about calking rivets. Indeed, if the provisions of the specification are honestly met no rivet should need calking.

One other prohibition is worth while. Screwed stays should not be cut to length either by hand or pneumatic chisel. They should be dead length to rivet up as supplied for building in, and if necessary to be shortened in position this should be done by trepanning and special tools or by sawing. The use of a fine taper drift in the telltale holes before hammering down is the only place where a drift should be permitted. Moreover, in riveting over the screwed stays too neat a job is undesirable, because enfoliation is often thereby produced or commenced. Most boiler makers are too keen to make screw stay ends look pretty. It must be remembered that a screwed stay is in effect a notched bar, with the disadvantage in further manipulation well known to those versed in testing materials.

It is hoped that the matter of first-class fittings, such as water gages, stop valves, scum valves, safety valves, blowdown valves, will receive the consideration then due. There are only about three makers of first-class fittings in the United Kingdom, and cheap fittings are to be avoided like the plague. In some respects it would be better if the fittings were a separate contract and supplied to the makers of the boilers. Otherwise troubles may result and good boilers fall into disrepute solely owing to the troubles due to fittings.

However, with the foregoing reservation and taking into due account articles which have appeared in this journal, which seemed to show American boiler workmanship in a poor light, it is pretty certain that, granted proper supervision, the standard boilers outlined should be a creditable job, and the results of their manufacture and test, as also their subsequent performance, will in due time make interesting reading.

A. L. Haas.

The Boiler Maker as a Credit Man

The Relation of Credit to Collections—Definite Policy Should Be Followed—Credit the Greatest Asset

BY EDWIN L. SEABROOK

Every boiler maker in his business conduct must deal with three elements—material, men, methods. In a broader sense it may be said that methods are linked in his dealings with material and men. If his methods on the drawing board, fabricating in the shop, or erecting the work in a building are faulty, the result is evident to the eye in poor work. If his methods in handling men are not correct, this is evidenced by the amount and quality of work produced. These come under his observation, are quickly discerned, because they can be seen.

There is, however, another application of methods, the results of which may not be apparent to the eye, as in the case of poorly constructed work, but are just as vital to the business conduct as the others are to the mechanical. Method is just as essential to business conduct as it is in laying a piece of complicated work.

In the boiler making business, credit in some form is almost a necessity for ninety-five percent of the business transacted. There is very little cash over the counter in the boiler making trade. Credit being a necessity it is well to look into some of the methods by which this credit is conducted on the part of the boiler maker and the reflex action on himself by these methods.

Every business beyond the vest pocket stage must have and give credit. Credit is one of the most essential factors in business; if not a positive necessity, it is at least one of the greatest conveniences. In order to get credit it is necessary to pay, and to pay it is necessary to collect. Very few business men maintain good credit and neglect collections. Many have poor credit, because they are poor collectors. The best business asset is credit. Not the credit that is given because it is felt the bill will be paid some time, but the credit that compels a business house to put itself to extra trouble when necessary to serve; to give its best to hold high credit custom. This class of credit is secured and maintained only by paying—and, inversely, getting the money in to pay out.

Capital is not the only thing that enables prompt payment of bills. Efficiency counts for much, good business methods, promptness is rendering bills, and following up collections. More profit can be made on a small volume of business, properly conducted, than on a large volume where efficiency is lacking in office methods.

Working capital should always be kept a little ahead of the business. This may be cash or credit; the latter is equal to cash, but to be maintained must be taken care of the same as cash. Any business, however small can secure all the credit that is needed, provided that credit is taken care of and the obligations met at maturity. Many a business does not have the credit it ought to have, because its obligations are not met with any degree of promptness. The failure to do this can in many instances be traced to the poor credit management of the owner of the business. He does the work, but his own lax business methods do not get in the money to maintain his credit. He spends lots of time rushing around getting work, looking after it, directing his men and leaves his daily mail unopened, unanswered, and his books are in such confusion as to be utterly unintelligible to any one except himself.

Sluggish and lax bookkeeping methods retard the growth of a business, despite the oft-repeated excuse: "Too busy to get the bills out." If a piece of work is never too small to be well done, no business item is too small to have its accounting well done, and it will not be well done if it is not done on time. There is no use doing work and selling goods unless they are to be paid for, not sometime, but within the limits usual to sound business practice.

The first step in a credit system is proper bookkeeping and that kept up to date. The items for which bills are to be rendered should be entered on the books at once. Time slips showing amounts of labor and material should be charged and not allowed to accumulate. So far as it is possible to get in form for charging, each day's business should go on the books the following day, put there in shape to bill at once.

The second step is sending the bill promptly. If the work is finished today, send the bill tomorrow. Don't expect the customer to be over-anxious to pay when dilatoriness has been the rule in getting the bill to him. The customer has a right to the bill when the work is done. Good business practice demands that it be sent.

Bills rendered promptly will facilitate the adjustment of misunderstandings or disputes. These are more easily cleared up forty hours after the work is done than forty days. There is absolutely no good reason for holding repair bills, etc., until the end of the month.

Do not underestimate the reflex influence of habits and methods of the boiler maker upon his customer. If it takes him a month to make out the bill, like will beget like. The customer will take his own good time in making payment. The customer who knows that "Jones will want his money when the work is done" will be more prompt in paying Jones than he will the one who takes a month to get the bill to him. Therefore, get the bill to the customer as soon as possible after the work is done. "Haven't time" is no excuse. It will save time to attend to business details in their proper order and time.

Terms of Payment

The terms of payment should be very definitely given in the bills. A stated time should be named. How many invoices does the boiler maker get from his supply house in which the terms of payment are not clearly and definitely stated? Have as little printing on the bill head as possible. Attention needs to be riveted on the bill, its terms, and not its typographical make-up. After the word "terms" should be written when payment is expected. Let the customer see that these terms apply to him personally, and not to everybody generally. The words "net cash," "interest will be charged on all overdue accounts," etc., when made a part of the bill are of doubtful value. If the bill is to be paid within ten, twenty or thirty days, or if two percent is allowed if paid within a certain time, state it clearly, and make it personal to the individual customer.

Prompt Collections Retain Business

All bills will not be paid when due, therefore some kind of a collection system is absolutely necessary, no matter how small the business. It is at this point that the element of methods mentioned above becomes absolutely essential. Some men hesitate to ask for a settlement when the account is due, because of a fear of giving offense and losing future business. Nothing is farther from the truth. More business is lost than gained by easy-going collection methods. Insisting upon payment when the bill is due will retain business rather than drive it away. The firms most insistent on accounts being paid promptly hold their customers best. There is absolutely nothing in the theory that persons will not continue to deal with the firms insisting upon prompt settlements of accounts. Experience proves the reverse to be true. If a person wants to buy on credit, which dealer will be more likely to get the order—the one to whom he owes an overdue account or the one to whom he owes nothing?

A Definite Policy

No collection system can be successful without a definite policy. The haphazard plan will produce like returns. To send the bill on time immediately after the work is done, and at another, allow a month to elapse before doing so, will produce the same kind of response from many of the customers. To be insistent one month and lax the next is not following a definite plan.

With a definite system must go persistence. Whatever plan you adopt must be followed regularly, month in and month out. To go after the slow pays, overdues, etc., for a month, and then drop them for a time, is in the lost motion class. The force of the previous efforts is lost by the delay in following up, and the intermittent method has given the presumption that any effort to collect would be spasmodic.

Keeping everlastingly at it is the price of successful collection. The haphazard, irregular methods fail largely because these fit in with the nature of the debtor. A let-up is what he is hoping for; he is matching his patience against your persistency.

Make out a list of delinquents at the beginning of each month. Ten days or two weeks is long enough time for any one to make some kind of a response. Nine-tenths of the effort will be lost if there is a let-up, or this part of the clerical work is done to suit the convenience of everything else.

Someone raises the question of time: "Haven't time to do all this," he says. Which is the most important part of the business—getting work, doing work, or getting in the money to keep the business going? It is a business mistake to neglect collections on the plea of lack of time. The man who has money with which to do business can generally get the business to do. Overdue accounts on the books do not pay bills.

Settlement Demands

Some people offer all sorts of excuses in asking for payment, as though they were doing something that demanded an apology. There should be but one reason given for demanding payment on an account that has reached maturity. *The account is due*. That reason alone is sufficient; in fact, no other reason ought to be given. The creditor has fulfilled his part of the obligation, the time has come for the debtor to do his part. Don't base the plea on "short of funds," "need the money," "have heavy payment to make," etc. These may be true, but why advertise it? After all, the case-hardened debtor generally takes these as a subterfuge to arouse his sympathy.

No credit system is infallible. Some losses are bound to occur, but much that is lost might be avoided by persistent collection methods. In every system, however, some kind of notice or letter is generally necessary.

Most of these put the debtor in a general class, whereas he ought to be singled out and made to feel that he is receiving personal attention. Of course, he knows that there are others in his class, but why tell him so by sending him a printed form letter? In all letters keep away entirely from even the appearance of form letters, and make them personal.

Certain stereotyped expressions should be avoided, as these mean little or nothing to the debtor. "No doubt this has escaped your attention," stamped on an overdue bill, is hardly believed by either party to the transaction. In follow-up letters it is well to lay out a series, making each one a little stronger than the preceding. There are a number of form letters that have brought splendid returns. In composing these keep close to your debtor. Men neglect, or overlook, at long range. The debtor always feels safe in a crowd. Bear in mind that just as men are moved in salesmanship to buy or not to buy, there are motives by which the debtor can be moved to pay, if he has anything with which to pay. Study the things that influence other people to action. Discourtesy, bluffing, threatening, are entirely out of place, and will not produce results. Let the debtor understand that you are after him, and that you are going to keep after him until he pays up. Don't threaten in one letter and repent in the next. If forced to say that you will bring suit on a certain day, do it. The debtor will have a wholesome respect for the creditor that keeps his word. Abusing the debtor has no effect. It irritates the honest man and rolls off the dead beat.

Let the debtor understand that you keep your collection promises and expect him to do likewise. If he promises to pay on a certain day, there must be some reasonable response on that date. Courtesy, common sense, and persistency are the greatest factors in successful collecting. A good collection system will seek to make sales along with its collection efforts.

Many overlook the fact that outstanding bills are a part of their capital, and that capital, to earn a profit, must be kept moving. Dead capital earns no profit and overdue accounts, while probably not in the dead capital class, are certainly in the non-earning class. Much is made to-day of quick turnovers in business. How many times a year can the merchant turn his capital? Has the boiler maker ever considered how many times a year it is possible for him to turn over his capital? The more turnovers, the quicker and larger the ultimate profit.

In an article in the March, 1917, *System*, J. Ogden Armour says that one test of business is the quick turnover. He makes the remarkable statement that if his company could shorten its average credits but a single day, they could make an additional profit of $100,000 in the year. The writer of that article is too conservative to overstate. How much more business might the average boiler maker do if he would make himself a better credit man in handling not only the accounts due him, but those due others. The turnover problem may be somewhat of a new doctrine for the boiler making trade, but it is none the less pertinent to that industry than to the hardware, clothing, or any other merchant. For his own credit with others the boiler maker must be careful in extending credit to his own customers and in making collections promptly.

Somewhere I came across the following, relative to credit, and it is applicable in closing this article:

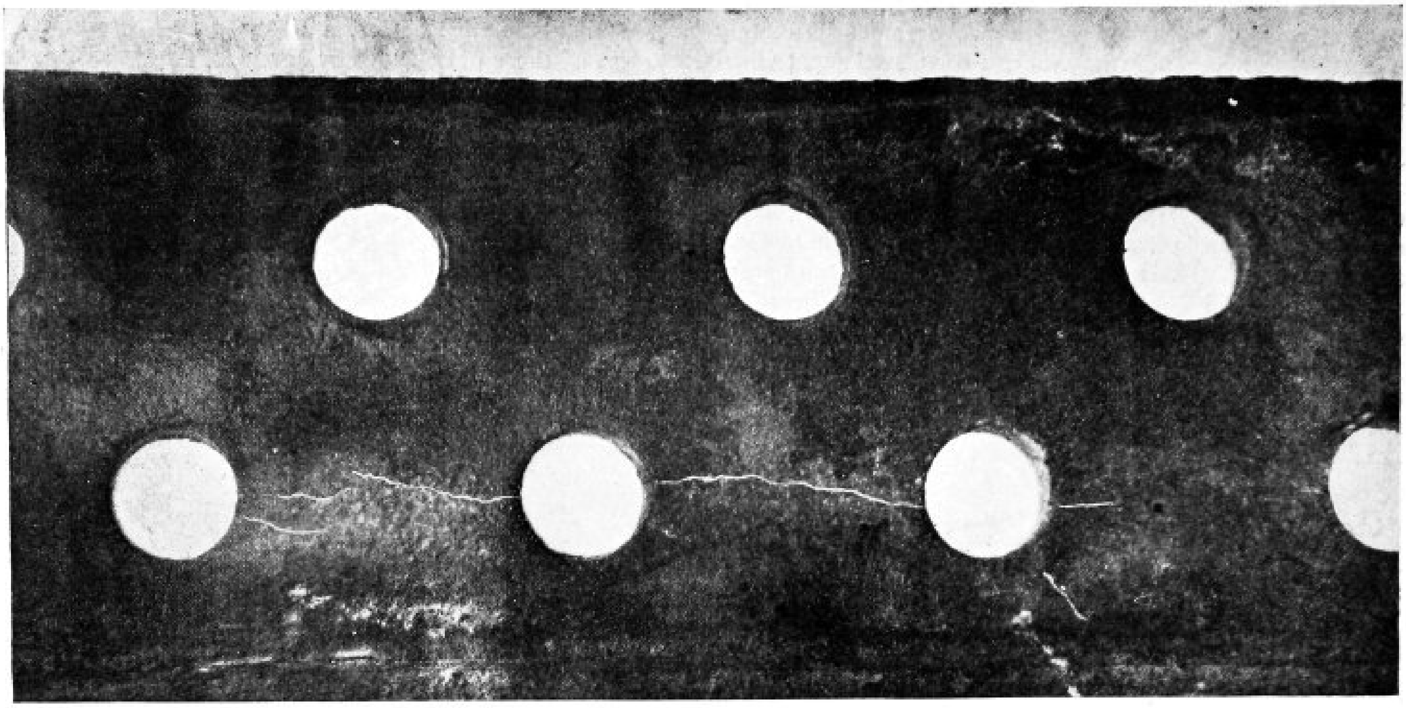


Fig. 1.—Fracture Through Rivet Holes in Longitudinal Seam of Locomotive Boiler, South Australian Railway

THE GREATEST ASSET

The greatest of assets, business or personal, is credit; it cannot be locked in a vault, nor insured against loss. It is a part of the individual; he cannot create it, yet he may destroy it.

Credit is something apart from what a man is worth in money. His property statement does not create his credit; it merely settles the question of "how much."

Honor and truthfulness are two cornerstones of credit. They mark the reliable man; one who may be trusted with that which is another's. That is the essence of credit.

Individual capacity is an important factor in extending credit. Many honest, reliable men lack capacity. The capable man grasps opportunities; he forges ahead.

Here, then, is credit; Honor, word, capacity—these three make it. The holding of this world's goods simply measures it.

Credit can be easily destroyed. One obligation wantonly disregarded, one statement proven false, and the fabric crumbles. Built in a lifetime, it may vanish in a day. The most valuable of assets is the individual's only so long as he carefully conserves it.

Development of Fractures in Boiler Plates

BY JOHN O'TOOLE

The boiler of a "P" class engine, South Australian Railways, gave way at the longitudinal seam at the

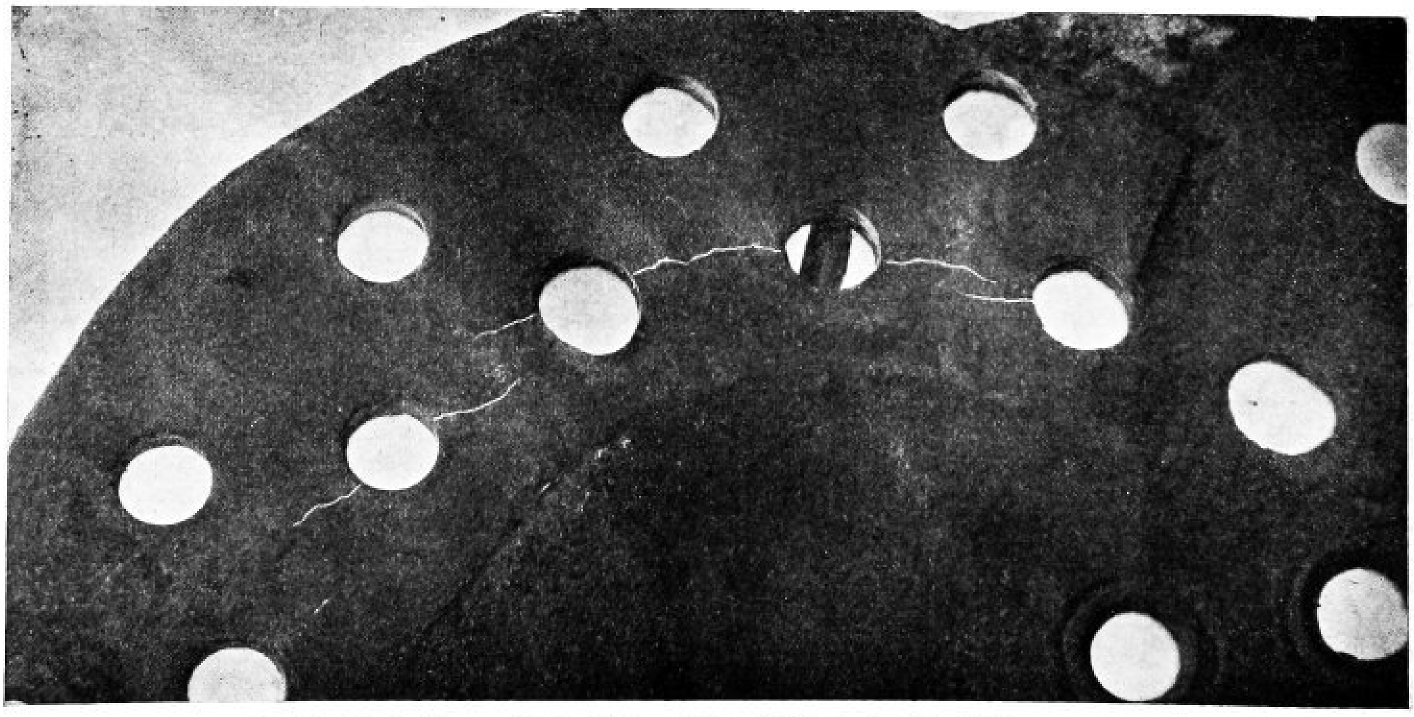


Fig. 2.—Cracks Due to "Drifting" Rivet Holes While Boiler Was Under Construction

Are Fire Box Sheets Welded With The Oxwelding Process Efficient?

Answer:

The tensile strength of a single lap riveted seam is approximately 52% to 60% of the strength of the metal itself.

By tests, it has been proven that the tensile strength of a seam welded by the Oxwelding Process is from 80% to 85% of the metal itself.

Why not submit your boiler repair problems to our staff of experts, who are constantly in touch with the application of the Oxwelding Process to the special needs of the steam railroad field?

OXWELD RAILROAD SERVICE COMPANY

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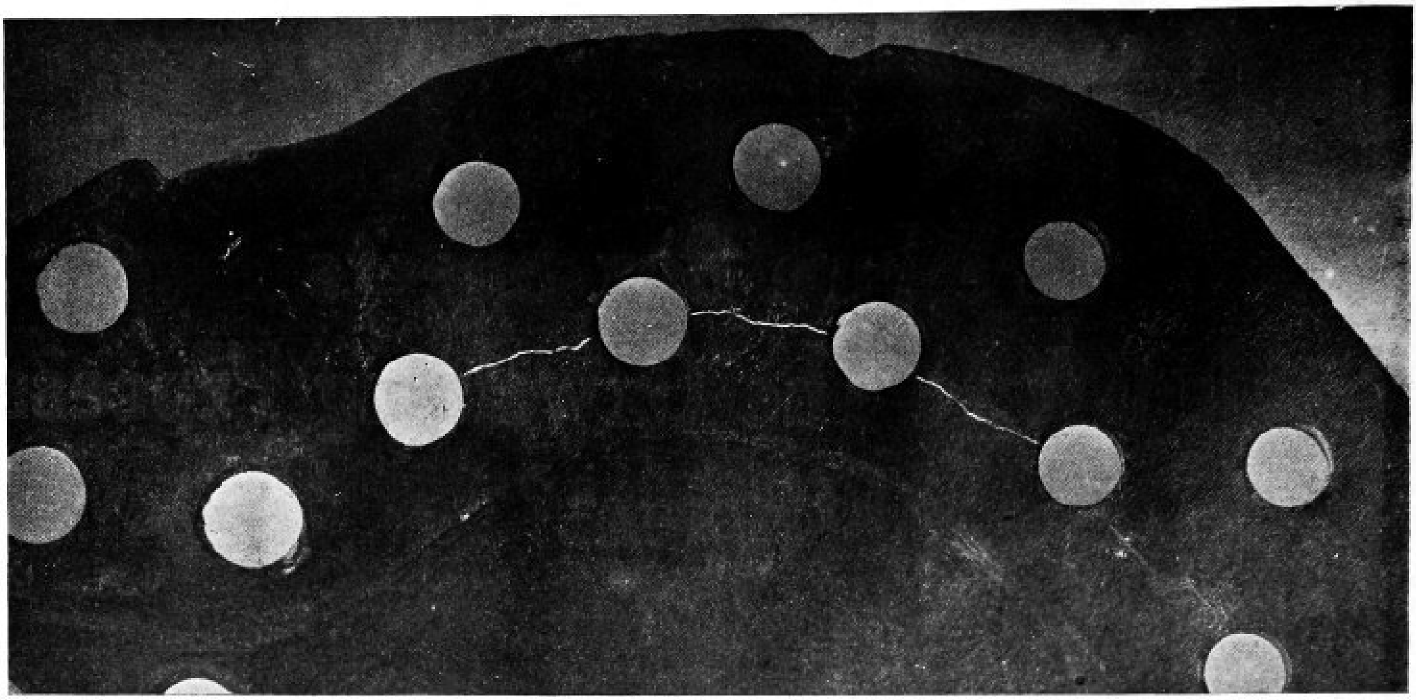

Fig. 3.—Reverse of Fig. 2 (page 74)

third course on the barrel on the right side, being a clean fracture running the length of the seam longitudinally through the rivet holes (see Figs. 1 and 2). Being covered by the lap, the cracks between the plates could not be seen, but had evidently been extending for years. After cutting out the rivets and springing the other plates back for examination, similar fractures were seen. The cracks may easily be seen on the three plates herewith.

Fig. 3 plate shows the reverse side of Fig. 2 plate. The official report expressed the view that the cracks shown in the illustrations were due to "drifting" holes while under construction.

A Modern Water Works Tank

The illustration shows a water tank recently constructed for the water system of Maryville, Mo. This water system was owned and operated by a private corporation until 1912, when it was purchased by the city. The city officials found the water supply insufficient, the water of poor quality and the pumping machinery antiquated and inefficient.

The original brick water tower was an edifice of beauty and a credit to the architect and builders, but the engineering features were not all that was desired, as the structure had a fault that prevented its full use as originally intended. It may be stated that at a height of 100 feet above the base was a semi-spherical masonry slab. On this slab was placed a steel tank 18 feet 6 inches in diameter by 60 feet high, and the brick walls were continued until the tank was enclosed. When an attempt was made to fill the tank the load on the supporting slab caused an action entirely unexpected. Immediately below the supporting deck several large cracks developed which ran down some 50 feet to the lower windows. The structure, however, was kept in service a great many years, the tank being filled to about one-half of its capacity.

It is pointed out that the officials were confronted with a problem that caused them considerable worry. They wished to keep the tower on account of its beauty, but were unable to devise an economical means of reconstruction that would permit the storing of the required quantity of water, and, at the same time, keep their water tower with its original lines. After two attempts at letting this work on designs prepared by the engineer, the committee became convinced that it would be necessary to sacrifice the brick tower.

It is of interest to note that the new tank has a capacity of 150,000 gallons and a diameter of 27 feet. The brick tower was taken down to a point that would permit the use of vertical posts. At this point was cast a reinforced concrete roof. There were no particular difficulties encountered during the dismantling of the old tower.

Steel Water Tank, 27 Feet Diameter, 150,000 Gallons Capacity, Built on Brick Tower

Locomotive Design and Construction from the Maintenance Standpoint*

Lines Along Which Locomotive Boilers Can Be Improved to Increase Service and Efficiency and Decrease Maintenance

BY W. H. WINTERROWD†

It is a question if there has ever existed an engine-house foreman who has not, at some time or other, had the feeling that if some part of a locomotive had been designed a little differently he could make repairs more quickly, more easily and at less expense. While in many instances he may have been justified in this feeling, there are, however, cases influenced by other factors which may have been of greater importance from the standpoint of ultimate economy of operation.

The type and size of a locomotive have an important bearing on certain details of design. A discussion of the factors relating to the selection of the desired type and size is far beyond the scope of this paper, as it would involve a thorough consideration of the economics of railway operation. Some of these factors, usually considered from the standpoint of both present and future, are grades, track curvature, train speeds, train resistance, kind and nature of business, size and type of existing locomotives, transportation expenses, maintenance of equipment and physical conditions such as clearances, bridges, turntables, engine houses, repair shops, terminal and water facilities, etc. Occasionally certain of these factors may be such that some detail of the resulting design, while undesirable from a maintenance standpoint, is unavoidable. However, the majority of the locomotive details are free from other than purely local restrictions and may be designed almost entirely from a maintenance standpoint.

It should not be inferred from what follows that mechanical and operating men, as well as locomotive builders, have not given a great deal of consideration to the points mentioned. Very many locomotives in service to-day bear witness of such consideration. However, there are at present justifiable reasons for emphasizing and reviewing the importance of locomotive design from a maintenance standpoint. To-day, under changed conditions, the railroads are being called upon to render greater service than ever before. But little new equipment is available other than that which the railroads may build in their own shops. Repair shops are being worked to capacity. Skilled railway mechanics are scarce. Material of all kinds is difficult to obtain; all of which means that maximum service must be obtained from every bit of existing equipment. It is, therefore, essential to consider every legitimate means whereby the "out of service period" of a locomotive may be decreased and the "in service period" increased.

All new locomotives should be constructed to give maximum service with minimum maintenance. All locomotives being rebuilt or modernized should be turned out of the shops prepared to give similar results. Any improvement that can be made to any locomotive, new, modernized, or under repairs, which will result in increased service, increased efficiency, or decreased maintenance, will help to increase the capacity of the railroads. The following covers briefly a few of the points worthy of consideration:

Boiler

It seems hardly necessary to state that a well-designed boiler of ample capacity is easier and cheaper to maintain than one of smaller capacity and which has to be forced continually. The importance of ample capacity can scarcely be over-emphasized, either from a maintenance or operating standpoint. Within its limits of weight and size a boiler should be designed to have a capacity as large as possible consistent with other governing factors. In this connection, the values of the superheater, the brick arch and the feed water heater are unquestionable. These values have been practically demonstrated from the standpoint of economy as well as locomotive capacity.

The maintenance of locomotive boilers is an important factor, the greatest difficulties being leaky flues, leaky mud rings, broken staybolts and cracks in firebox sheets. Knowing that firebox heating surface does a great deal more work per square foot than flue heating surface, boiler capacity does not depend upon long flues. Short flues are the easiest to maintain. Flue location and spacing should be carefully considered so as to permit easy maintenance, proper distribution of stresses with a minimum amount of staying, and also to facilitate washing out, particularly in bad water districts.

Many failures are the result of crowding in too many flues, placing them too close to the heel of the flue sheet flange, and the use of too small a bridge. The flue sheet flange radius should be carefully considered in relation to the flue layout. Too small a radius with flues located close to the heel will not give as much flexibility as may be desired and will make the top flues difficult to maintain. Continued expanding of the flues will cause the sheet to flow, often resulting in flange cracks. The bead on the flues adjacent to the flanges should always rest on the flat surface of the sheet and never on the curved inside surface of the heel. With two and one-quarter inch or greater diameter flues, it is best that the width of bridges be not less than three-quarters of an inch.

Assuming that the above points have been taken into consideration, it is important to see that the shop layer-out and the driller follow the design. There have been cases where a layer-out has located flues incorrectly and also added one or more. It is also important that the flue sheet holes be drilled the proper diameter, as it is almost impossible to keep flues tight in holes that are too large.

The radii of the door and back head sheet flanges should be studied in relation to the staybolt stresses. A moderately large back head sheet radius will reduce the stress in the outer rows of bolts by transferring a portion of the load to the wrapper sheet. Too small a door radius will frequently result in cracking of the sheet at this point because of insufficient provision for expansion.

Mud ring corners of ample radius will be easy to construct and maintain. Trouble due to small radius has, in

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* Paper read before Canadian Railway Club.

† Chief Mechanical Engineer, Canadian Pacific Railway, Montreal Quebec.

many instances, been overcome by electric or acetylene welding the bottom edges of the sheets at this point to the mud ring.

Flexible staybolts reduce staybolt breakage. A careful investigation will indicate the zones of maximum staybolt stress and sheet movement. In these zones the flexible bolts will give good results and reduce staybolt renewals.

Washout plugs should be so located that all points of the firebox and barrel can be easily reached with standard washout equipment.

Grates should have sufficient air space, be free as possible from dead spots and be easy to remove. Where certain kinds of fuel are used, properly designed dump grates may be a means of reducing the time the engine is in the ash pit.

As far as possible, all brackets, clamps or fitting applied on the boiler or firebox should be so located that staybolts, rivets or portion of calking edges will be accessible with a minimum of labor.

In connection with the barrel of the boiler, points which may be mentioned are—throttle and dome arrangement which will permit interior inspection of the boiler without the removal of the standpipe; also the elimination, as far as possible, of all small studs. The latter will apply equally to all parts of the boiler under pressure.

Expansion sides, instead of an expansion sheet, under the front of the mud ring, will eliminate the maintenance of a considerable number of bolts and rivets. Proper consideration of all other expansion sheets will further reduce maintenance of many bolts and rivets and tend to eliminate the many resulting troubles as well.

The front end, or smoke box, should be arranged to permit of access to all parts with the least possible work.

MISCELLANEOUS

Ash pans should be as simple as possible, and the sides should have sufficient slope to prevent the accumulation of ash under the grates. Swing doors can be suspended so that their own weight helps to keep them closed. This results in less strain on the door operating rigging.

Easy inspection and maintenance results from placing main reservoirs in an accessible location. Where this is impossible and drain cocks are hard to reach, an extension handle, the end of which is easily accessible, makes the reservoir easy to drain.

Pilots made of scrap boiler flues cost less to maintain than those of wood.

Boiler jacketing should be applied in sections so that panels can be removed with a minimum of labor.

In conclusion, simplicity co-related with efficiency, should be one of the keynotes of locomotive design. This principle, which in other words is simply good judgment, will make for that degree of efficiency which will be reflected, not only in reduced maintenance costs, but also in the increased capacity of the locomotive plant as a whole.

Electric Welding Instructions*

BY E. WANAMAKER†

Some of the equipment now on the market assures the practicability of electric welding and the perfectness of the job, provided the person doing the welding has thoroughly learned his trade.

Contrary to the opinions held by many, it is far from a simple process and it will take an operator approximately one year to become a fairly proficient welder on all classes of work, such as would ordinarily be found on a railroad and only at the end of approximately three years will he become expert, and then not unless he has studied and worked under the direction of a competent instructor and demonstrator.

The choosing of electric welding equipment should only be entrusted to some person thoroughly familiar with electrical principles, welding and general boiler and machine designs. This done, and the equipment properly installed, the next step is the instruction and breaking in of welding operators. The following are the vital points which it is necessary to master before really successful welding can be accomplished:

1. The operator should be taught all the details of preparing different kinds of work for welding.

2. The proper current strength and size of electrode for the job in hand should be selected. This automatically regulates the speed to that which is most desirable for that particular class of work. Also, special electrodes are necessary for a few certain classes of work and are well worth the extra or additional price necessary to obtain same; however, the special jobs would probably not exceed 2 percent of all welding done.

3. The study of strains and stresses is the most interesting as well as the most important of all steps connected with the welding art. The preparation of the part for welding and the proper flowing of the metal are comparatively easy to learn; provided good equipment and welding electrodes are used. It is, however, self-evident that if the problem of strains and stresses is not properly taken care of, failure will occur either in the weld itself or at some weaker point or part of the object welded. It is to be hoped that much attention will be given this point by those interested in electric welding in order that we may benefit by the enormous savings than can be effected by the intelligent use of the electric welding arc.

OPERATING AND MAINTENANCE

Installations of electric welding equipment on the Rock Island are designed and made by the electrical department. The division electricians at the point where welding installations have been made are given sufficient instruction to enable them properly to operate and maintain the equipment, being supplied with references for ordering any repair parts that would eventually be required. As soon as possible after the installation has been completed, the supervisor of electric equipment, accompanied by an expert demonstrator from the manufacturer, visits the point and instructs as many men as deemed necessary in the use of the electric arc. As is evident, these instructions are only preliminary and it is intended to continue giving instruction as frequently as possible in order to realize the full benefit from the equipments.

A complete set of instructions for electric welding has been issued. These begin with an explanation of the electric arc itself, continuing with the proper polarity for different classes of work. The next point covered is the amount of heat used, the kinds and sizes of electrodes and the current and voltage for the different classes of work. Immediately following are the instructions for all kinds of fire-box welding, including the proper use of protective shields. This in turn is followed with complete instructions on the proper methods to use in welding frames and cylinders, and in all building-up operations.

The proper preparation of the work is fully as important as the welding operation, if not even more so. The instruction book supplies detailed sketches showing the proper method of preparing work for welding.

* From *Railway Mechanical Engineer*.
† Electrical Engineer, Chicago, Rock Island & Pacific.

The Boiler Maker

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NOTICE TO ADVERTISERS

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 25th of the month, to insure the carrying out of such instructions in the issue of the month following.

The thirtieth annual convention of the American Boiler Manufacturers' Association will be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., on June 17 and 18.

In the organization of his staff, Secretary McAdoo, Director-General of Railroads, has created five separate divisions, covering transportation, traffic, finance and purchases, labor, public service and accounting. In the division of transportation a section dealing with locomotives has been established, the manager of which is Mr. Frank McManamy, chief inspector of locomotives, Interstate Commerce Commission. Mr. McManamy is well known to railroad boiler makers throughout the country, and has been intimately associated with them in their work. Needless to say, he can rely on the co-operation of railroad boiler makers in his new work, as he will continue in office at the same time as chief inspector of locomotives.

The Bureau of Mines, Department of the Interior, recently asked the advice of a number of prominent fuel engineers throughout the country as to the best way to conserve in the use of coal during the period of the war. Martin A. Rooney, of Detroit, Mich., has the following to say:

In every train load of coal laboriously hauled from the mines to our coal bins, *one* carload out of *every five* is going *nowhere* and worse. In a train of forty cars the last eight are dead load that might better have been left in the bowels of the earth.

Every fifth shovelful of coal that the average fireman throws into his furnace serves no more useful purpose than to decorate the *atmosphere* with a long black stream of *precious* soot. These are not meaningless statistics nor a "goblin" story, but *cold facts* on a *warm subject*. At best, *one-fifth of all our coal is wasted*.

And it is shamelessly and needlessly wasted. Instruments and machinery for getting out all of the heat there is in it are not nearly so complicated nor expensive as the cash register which you use to keep tab on your cash receipts or the truck which you operate to clip a few cents off of your delivery costs.

Carbon dioxide *temperature and draft* are easier subjects to comprehend than bank discount or freight rates.

The moral is, get busy and learn what they are and how to use them. The time is coming when the Government is going to *limit* the amount of *our coal* that is dumped down your chutes; and in the name of fairness, when we must deny fuel to some manufacturer, let it be to him who cannot show that he is going to use it efficiently. In the name of fairness to the miner who digs it, in fairness to the heavily burdened railroad which transports it, in fairness to a number of our people whose very existence and whose future happiness depend absolutely on the use we make of this most precious of our resources, let us *make efficiency the criterion to judge by* when we come to determine which shall survive.

And in fairness to the manufacturer who is patriotically operating his properties at nearly to the breaking speed and who is giving up a large part of his profits for the general good, let the Government *show him how to conserve* this most important of his raw materials.

Let us send in to our furnace and boiler rooms *men* who can show our engineers and firemen how to burn their fuel with the least waste, as we have sent them among our fields and orchards to show the farmer how to increase the productivity of his soil.

One of the biggest problems of industry at the present time is that of the alien employe and the excessive labor turn-over resulting from unsettled war conditions. No graver problem faces the employer to-day than the unfriendly employe alien or disloyal citizen. Boiler manufacturers cannot avoid the responsibility which this problem places upon them, and should immediately devise a practical method of dealing with it. First, determine if aliens are among your employes; if so, keep them away from the vulnerable spots in the plant where damage can be done. A satisfactory method of handling this problem can be more easily obtained if our readers will send us reports telling what they have done to meet this situation. Send in your report now and we will gladly publish in our next issue practical plans and tested methods.

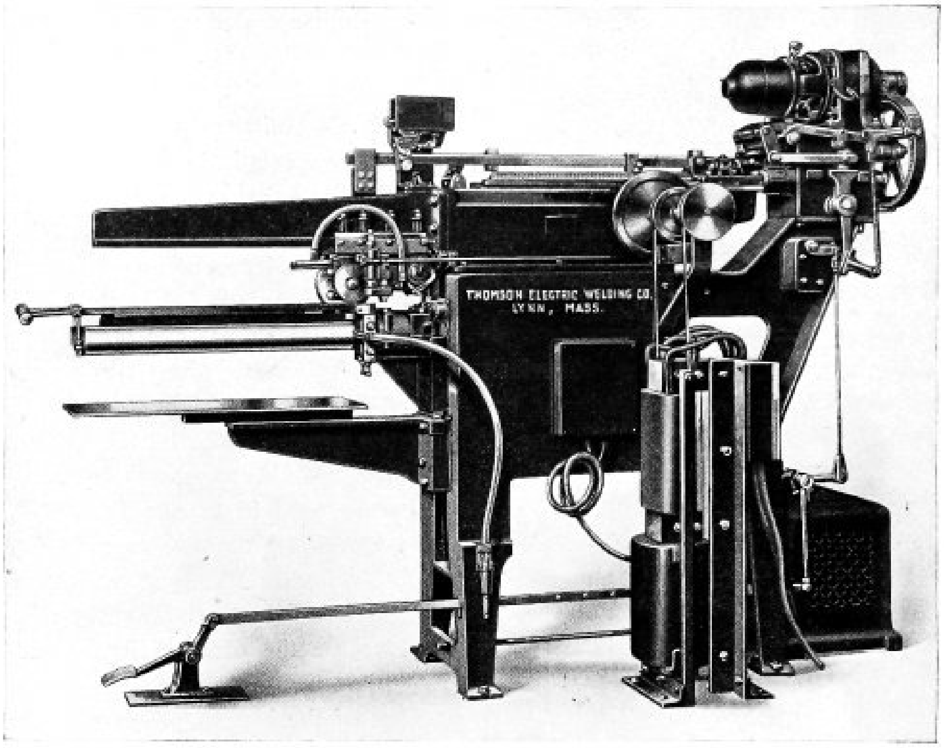
That some form of autogenous welding apparatus is indispensable in the equipment of an up-to-date boiler shop, whether it be for railroad, contract or marine work, is shown by the articles on oxy-acetylene and electric welding published elsewhere in this issue. New applications are continually being made, and we suggest that readers send to THE BOILER MAKER descriptions of any unusual jobs or new methods that come to their notice.

Engineering Specialties for Boiler Making

New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

Electric Seam Welder

A line of machines for welding seams in sheet iron and steel by the electric resistance process has been developed by the Thomson Electric Welding Company, Lynn, Mass. It consists of two distinct types, the one that is illustrated being driven through a motor, toothed clutch and worm, while the other is supplied with a speed reducer and crank mechanism. Both machines are equipped with traveling upper dies, while practically any form of lower die and jig necessary for handling any variety of can, cylinder or cone can be supplied.



Thomson Electric Welding Machine

The machine illustrated is intended primarily for welding the longitudinal seams on pieces such as cans, stove parts, flat pieces, and rectangular shapes such as metal boxes where the material does not exceed No. 16 gage in thickness and the length of the seam is not more than 24 inches. The limits between which work can be handled range from 3½ to 20 inches in diameter and 8 to 24 inches in length. In operation, the piece to be welded is secured in a specially designed jig on the lower horn or arbor and pressure applied to the treadle. This engages the clutch of the driving mechanism and causes the welding roller on the upper horn, which is actuated by the movement of a screw, to come forward. The current is automatically turned on when the welding roller makes contact with the stock and passes through the material to be welded to the lower copper horn and thence to the transformer, thus completing the circuit. The resistance of the metal being welded is relied upon to generate a welding heat so that the pressure caused by the roller gives a continuous weld for the entire length of the seam. The current is automatically turned off when the roller reaches the end of the seam and the roller is returned to its original position, thus permitting the welded piece to be removed from the jig and replaced by another.

The machine is equipped with an adjustable-speed motor which provides a range equivalent to from 7 to 13 strokes every minute. An hourly output of as high as 200 24-inch welds has been obtained, and where the seam is not so long this figure can be increased, depending upon the character, thickness and shape of the stock and the speed of the operator.

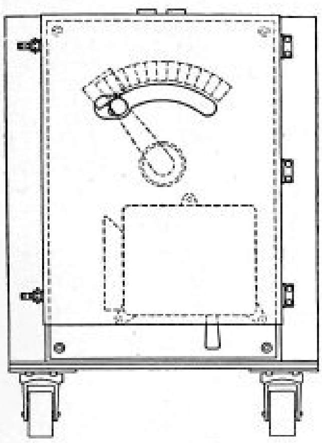
The other machine operates in exactly the same way and is designed for small sheet metal pieces such as cans, stove burners, flat pieces, match boxes and revolver magazines, where the length of the seam does not exceed 8 inches. As high an hourly output as 700 welds has been secured from one of these machines, but this figure is governed by the character, thickness and shape of the stock, the speed of the operator and the number of jigs that can be loaded by the helper.

Portable Outlet Panels for Electric Welding Service

For an electric welding outfit to be of its maximum service it must be so arranged that it can be taken to the work, no matter where that may be located. For instance, in a railroad shop there should be outlets adjacent to each stall in the roundhouse, one or more on the washing tracks outside, and others in places through the shop. In a boiler shop there should be an outlet on every other column, and in a large machine shop there should be an outlet adjacent to each of the larger machines, in order that work may be done in filling up blow holes and other defects on large castings with the minimum amount of crane handling.

One solution of the problem would, of course, be to locate a panel outlet of a suitable type wherever it is anticipated that electric welding might be desired. However, this is rather an expensive proposition and many electrical engineers would prefer to accomplish the same result in a more simple manner. A recently developed portable outlet panel manufactured by the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa., takes care of this situation with a minimum of expense with all the simplicity of the familiar distributing system for storage battery charging.

Two types of portable outlet panels are furnished, both being mounted on light trucks. They consist of a control panel mounting a handle trip railway type circuit breaker having overload release with magnetic blowout, and a



Portable Outlet Panel to Control Current for Electric Welding

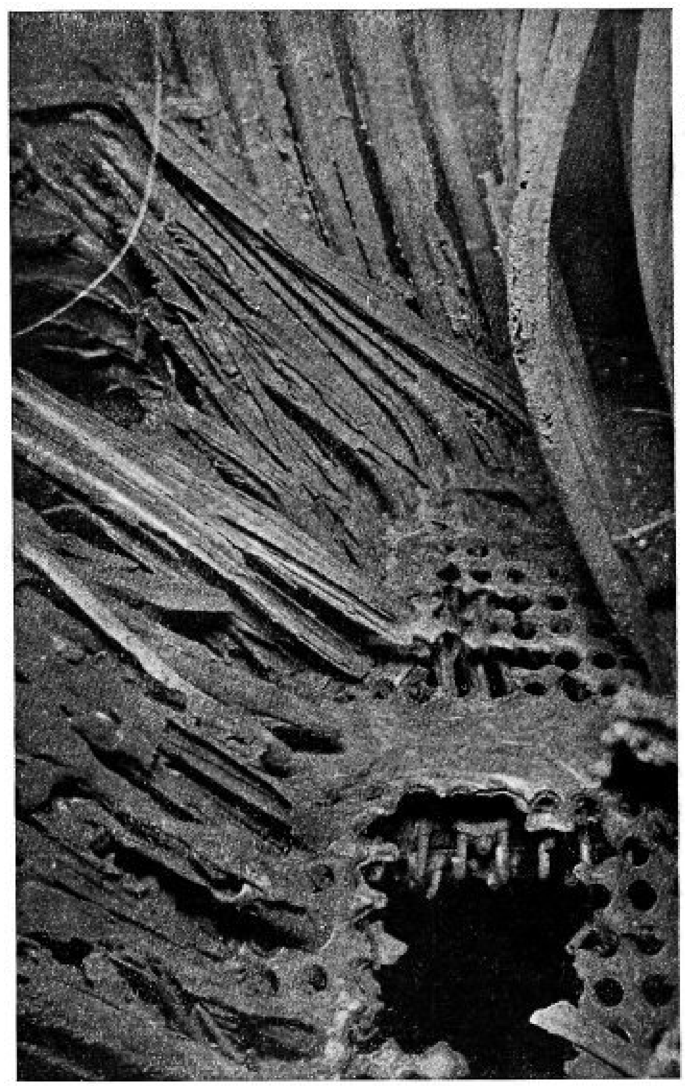
13-point face plate connected to a resistor mounted in the rear of the panel. The face of the panel is protected by a metal cover through which the handles of the rheostat and circuit breaker project. The resistor is made up of grids and is protected by a cage of expanded metal. Type E panel is intended for metal electrode welding only, having a capacity of from 80 to 170 amperes. With this outfit one metal electrode holder and one shield are supplied. For a wider range of work a Type F panel should be used. This will handle metal electrode work from 80 to 160 amperes, and light graphite electrode work up to 300 amperes. The outfit includes one metal electrode holder, one graphite electrode holder and one mask.

In installing an electric welding system using these portable panels the best method is to place a Westinghouse arc welding motor generator set at some central point. Where suitable low resistance ground connection can readily be made throughout the shop, as, for instance, where metal floors or cast iron bedplates are in general use, or in a railway shop where the track system can be used, only one connector need be extended to the various receptacles. The iron floor plates may be arc-welded to each other and isolated sections tied together by an iron rod or heavy copper cable, while the track rails may be bonded by arc-welding the fish plates to the rails. Receptacles should then be provided at suitable points throughout the shop of a capacity appropriate for the service for which they are intended. These receptacles may readily be mounted out of doors if they are provided with protection from the weather. Only single pole receptacles and a single wire cable to the portable panel need be provided. This cable should be of sufficient length so that the panel may be placed as near as possible to the work, in order to save steps and valuable time for the welding operator. The flexible cable leading from the panel to the electrode holder should be as short as is consistent to the class of work to be done.

Where metal floors or tracks are not available the ordinary two-wire system of distribution with double-pole outlets and two-wire cables should be provided.

German Vandalism Wrecks Boilers of Interned Steamship

Among the German steamships interned in United States ports at the outbreak of war, on nearly all of which the machinery was disabled by the ship's crews when the United States entered the war, the S. S. *Pommern*, now the *Rappahannock*, received the worst damage to her boilers. A survey of the vessel (interned



Damage to Steamship *Pommern's* Boilers

at San Francisco), by naval officers developed the fact that of four Scotch boilers on the vessel but one could be repaired. It was necessary to renew the other three.

The accompanying photograph, reproduced from the *Journal of the American Society of Naval Engineers*, gives some idea of the nature of the damage. The boilers were ruined by dry firing. Not satisfied with the results of this treatment, it appears that thermit or some kindred agent was employed to complete the vandalism.

The net result, however, was negligible. Considering the military value of the vessel, the cost and time required to effect the necessary boiler repairs and replacement would surprise the agents that so carefully thought out the campaign of vandalism on the German vessels seized in this country.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, 461 *Eighth avenue, New York city.*

Arrangement of Machinery in a Boiler Shop

Q.—Kindly give me a suggestion as to the arrangement of the machinery in a new boiler shop. The shop is 40 by 80 feet, with a narrow gage track through it, as per the following drawing. The list of machinery to go in the shop embraces one plate bending roll 18 feet over all and 10 feet 6 inches between housings; one power punch with a base 3 feet by 6 feet; one shears having a throat of 48 inches; one flange forge 5 feet by 7 feet; one flanging clamp 3 feet by 10 feet; one radial drill press; one hydraulic press large enough to form a charging pan, which is about 18 inches high, 24 inches wide and 84 inches long, of ¾-inch plate; one heating furnace for these plates; two laying-out tables, and one power saw. Any advice that you can give will be appreciated. J. M. R.

A.—The size of your boiler shop seems to be roomy enough for the proposed machinery, though there are other practical considerations, which you do not mention, that influence the arrangement and floor space of the machines. However, we have located the equipment on your sketch, Fig. 1, and trust that the plan will prove helpful to you. The layout tables have been placed along the sides, where it is assumed that the light will be the best; also, these tables are next to the office, not only for convenience, but to locate the more noisy operations farther away. The active stock pile is unloaded from the car between the tables, and the shear is close at hand for sizing the plates. The work is assumed to flow north through the shop.

Passing from the laying-out tables, the plate goes to the punch and bending roll, and it may also go to the radial drill press. Then the rolled plate goes to the erecting shop. The other circuit is from the laying-out table to the furnace either for the hydraulic press or the flanging clamp. Then from these the route is to the erecting shop. The power saw is located next to the entrance from the blacksmith shop, as the trimming of forgings is assumed to be most of its work. The two furnaces are placed together and in the corner of the shop for the convenience of piping them; but they stand clear of the walls. Thus every unit is set so that it is clear all around, and any form of work can be reached.

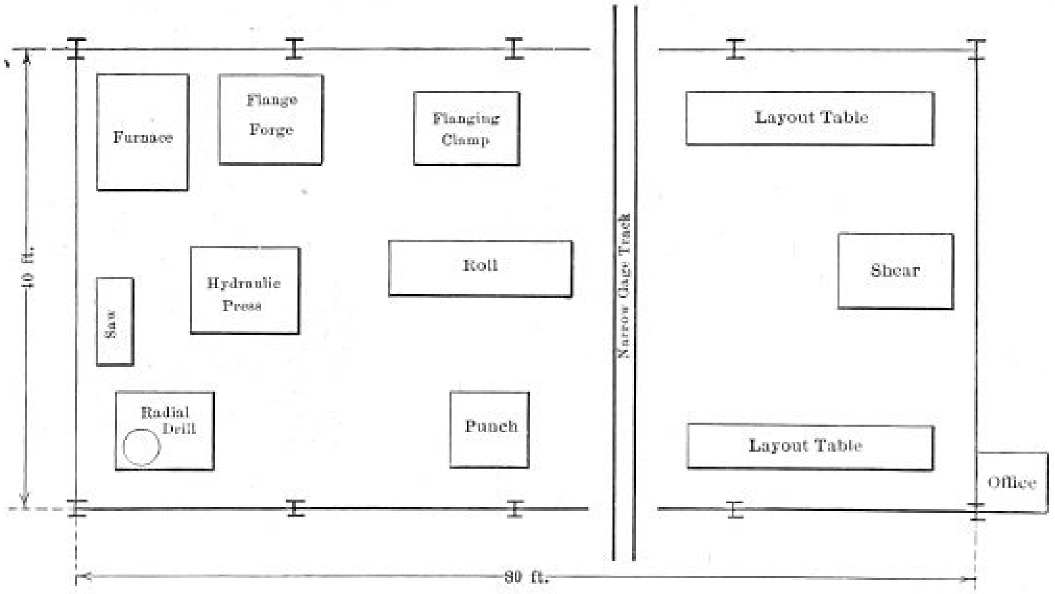


Fig. 1.—Diagram Showing Location of Machinery in Boiler Shop

Malleable Iron

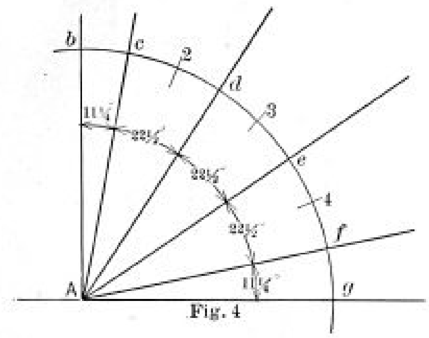
Q.—Will you please let me know whether or not a process of tempering malleable iron, bringing it to the apparent nature of steel by a heating and immersion method would be commercially useful? The cost per ton would be something less than two dollars. Eighty percent of the time now required to machine steel would be saved provided malleable iron were first machined and then processed to a state exactly the same as that of steel. The process will not produce a metal which will take the place of Stubbs, Mushet or any of the self-hardening, high-speed tool steels, but will be suitable for all machine parts where steel is now used. The process will not require skilled labor to use and all of the ingredients are obtained in unlimited quantities within a reasonable distance of any steel mill in this country. M. H.

A.—At the present time malleable iron is used commercially in place of steel in the cheaper grades of tools and appliances. If your method of tempering and refining is such that it will produce a stronger iron and equal to some of the cheaper grades of tool steel, I would advise you to place your proposition before some of the leading manufacturers. I would suggest that you write to the Cleveland Punch and Shear Company, Cleveland, Ohio; Joseph T. Ryerson & Son, Chicago, Ill.; Scully Steel & Iron Company, Chicago, Ill.; Ingersoll, Rand Company, New York. These concerns can advise you definitely on all your questions providing you furnish them with samples of your material and what you claim it can be used for.

Elbow Layout

Q.—Please explain the layout of an elbow.

A.—The construction in Fig. 3 is a method that can be applied in development of any plain 90 degrees cylindrical elbow. Draw lines A b and A f at right angles to each other. Locate the center of the elbow on either of these lines, and with A b as a radius describe an arc. Divide this arc into equal divisions, one less than the



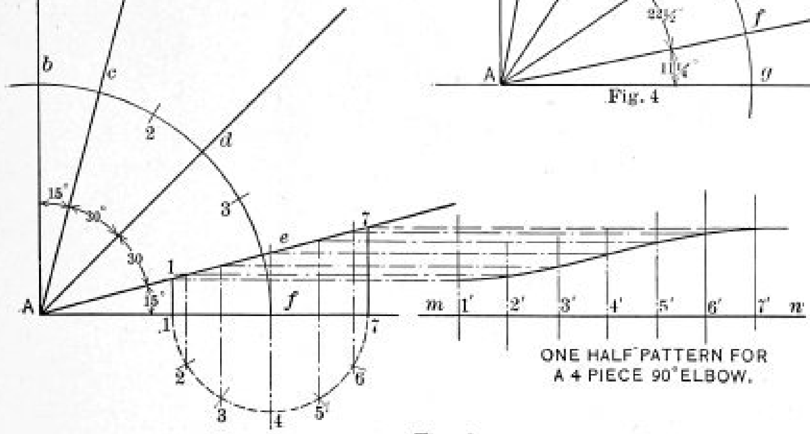


Fig. 3

number of sections required in the elbow, in this case 3, as from *b* to 2, 2 to 3, and 3 to *f*. Bisect the end divisions with radial lines *A c* and *A e*. From point *f* as a center draw a semicircle representing a one-half plan of the lower section. Divide the semicircle into equal parts and project lines from the points of division to the miter line 1-*e*-7, at right angles to the axis *e f*, if convenient to do so, draw the stretchout line *m*-*n* in the pattern. This line equals the circumference of the semicircle and is divided into the same number of equal spaces. On the construction lines drawn from 1′2′3′, etc., in the one-half pattern locate the lengths of the corresponding lines of the elevation. This part of the development is shown by projecting these distances from the elevation to the pattern. The other half of the pattern is identically the same as the one shown. With a pattern of the section given, the patterns for the other sections may be marked off, thereby saving a great amount of time.

The solution just explained is applicable to elbows having any number of sections. The difference, for example, in layouts of this kind for elbows having 3, 5, 6 sections, etc., is simply in the position of their miter lines. As an illustration, an elbow with five sections will have miter lines making in the center sections angles of 22½ degrees and 11¼ degrees for the end sections, as shown in Fig. 4.

Elongated Tube Holes

Q.—(1) What is the cause of the tube holes (Fig. 1) becoming elliptical, as shown at (a)? (2) What means will prevent the holes from becoming elliptical? (3) What is the most practical means of getting over this difficulty in expanding the tubes in the holes after the boiler has been repaired? Also, is it possible to repair these holes and make them sound and not weaken the bridge? (4) What is the reason why the internal steam pipe in a locomotive boiler always flattens on top and bottom when it collapses, and not on the sides?

A.—From your sketch, Fig. 1, the tube openings are distorted in a horizontal direction. This condition indicates that the tube plate was subjected to an excessive compressive load (due to steam pressure) which forced the tube plate downward, thus partially crushing the copper tube plate and distorting the tube holes. This condition may be brought about by improper staying or lack of staying of the crown sheet.

One of the usual English methods of staying firebox crown sheets with girder stays is shown in Fig. 2, which method has the disadvantage of placing a heavy load on parts of the tube sheet. To avoid this, the girder stays are sometimes arranged transversely—that is, across the firebox crown sheet—so that the ends of the girder bars rest on the edge of the inside firebox wrapper sheet.

When tube holes in copper plates are so distorted that they become oval or oblong in shape, it is impossible to make them circular without increasing their size, which will also decrease the bridge

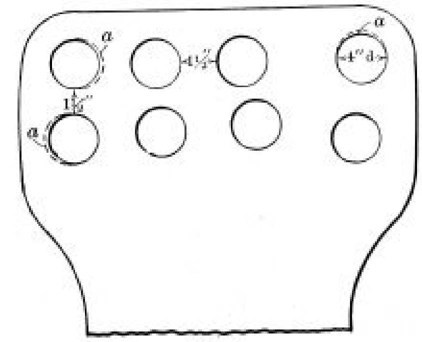


Fig. 1

of metal between them. A tapering mandrel is used in rounding out oblong holes.

It is practically impossible for us to give the exact causes that produce collapse of an internal steam pipe, as stated. The pipe is used to carry steam from the dome to connections joining the steam chest of a locomotive. The steam pressure acts on it internally and externally,

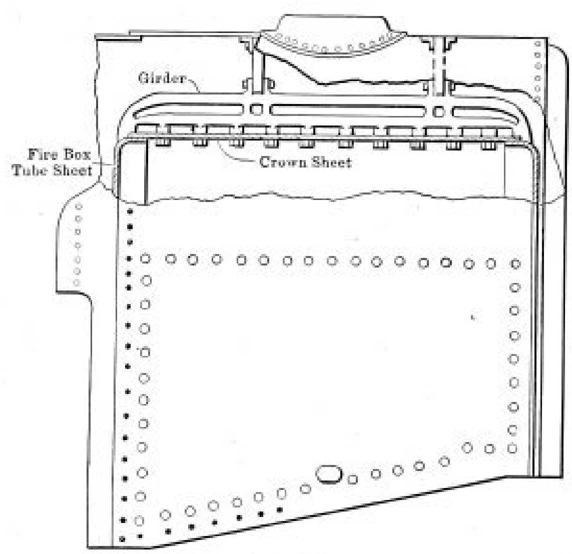


Fig. 2

hence if there is any general weakness in the pipe due to defects in the material, or if it has worn thin from corrosion, a collapse is liable to occur.

Layout of Spiral Chute

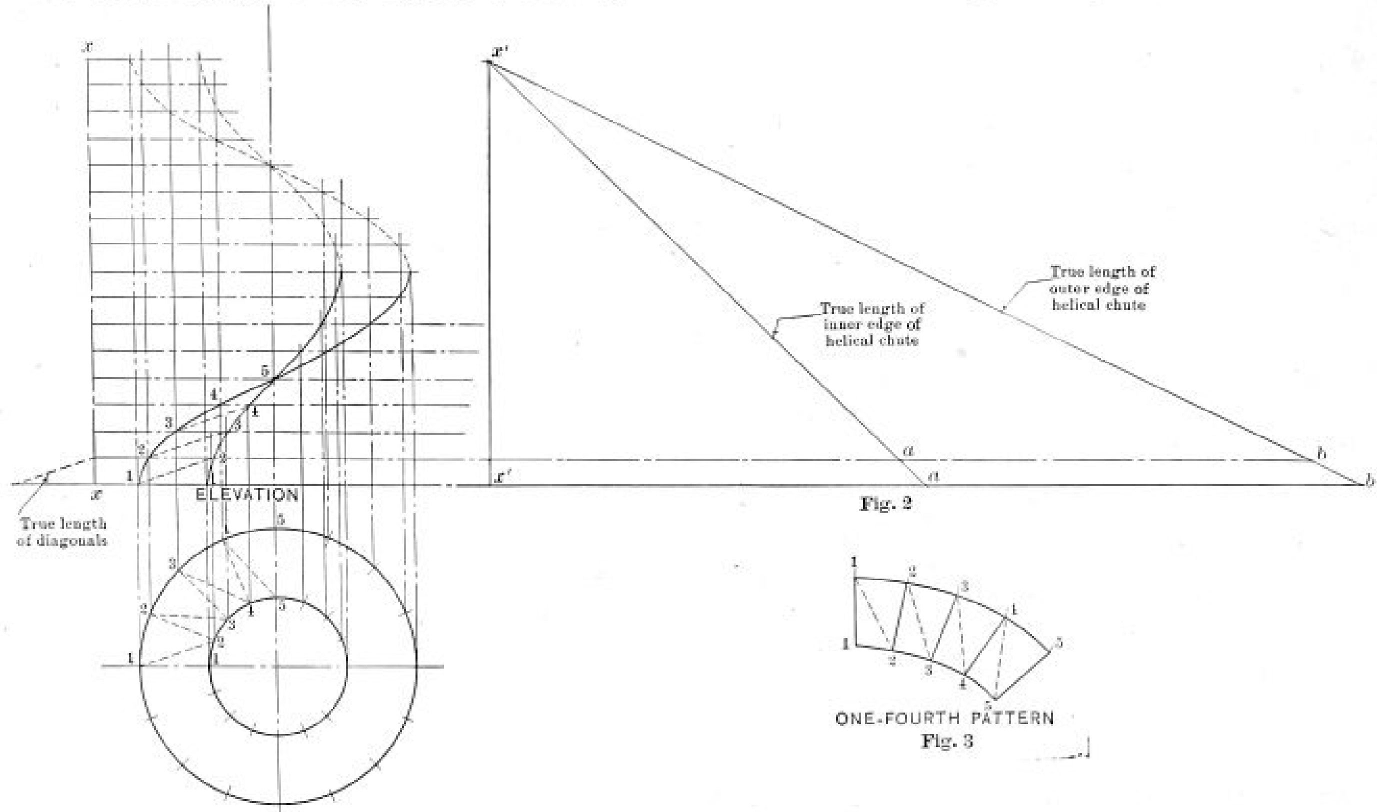
Q.—Inclosed please find sketch for a straight spiral chute, of which I would like you to send me the method of laying out same. A chute of this kind is used for conveying parcels from the top floor to the basement of the company. What would be the best way to connect the spiral plates to the outer shell, by flange or angle iron? F. E.

A.—This problem involves first the construction of the helical curves on the inner and outer edges of the chute. Fig. 1 shows the development. Describe in the plan view two circles; one for the inner edge of the chute, and the larger for the outer edge. Divide them into the same number of equal parts and connect the division points with solid and dotted lines. In the elevation lay off the vertical line x-x equal in height to the pitch for one complete turn of the chute around the shaft. Divide x-x into the same number of parts as there are in the plan view, and from these points draw horizontal lines. The intersections between the vertical projectors drawn from the plan and the horizontal projectors drawn in the elevation as at 1, 2, 3, 4 and 5, etc., in the elevation are points lying in the helical curves.

The true length of all the solid lines equal the length of the line 1-1, and the true length of the dotted lines is found by constructing the right angled triangle shown to the left of the elevation. The base of this triangle is equal to the dotted length 1-2 of the plan, and the height equals the vertical distance between the lines 1-1 and 2-2 shown in the elevtion; the hypotenuse is the true length required. As the twist of the chute is uniform, the construction lines will all be of the same length when equally spaced.

Before the pattern can be laid off it is necessary to determine the true lengths between the points 1-2, 2-3, etc. This may be done by constructing first two right angled triangles for finding the length of the helical curves on the inner and outer edges, as in Fig. 2. The base of the larger triangle equals the circumference of the large circle plan view, and the base of the smaller equals the circumference of the inner circle, and x'-x' equals x-x, the pitch of the chute. The hypotenuses are the lengths of the helixes if they were stretched out in a straight line. The distance b-b is the true length of the arcs on the outer helix, and distance a-a for the arcs on the inner helix.

In Fig. 3 is a development of a 1/4 section of the chute, the solid lines all being equal to lines 1-1 and the dotted lengths to the true length of the diagonal drawn to the left of the elevation; and the arc lengths to a-a and b-b of Fig. 2, the pattern can be readily drawn. Light angle irons can be used to advantage in attaching the chute to the shell.



PLAN Fig. 1 — Fig. 2 — Fig. 3

Development of Pattern for Spiral Chute

Listing the Boilers

Heinrich, the systematic little German, in "Mr. Britling Sees It Through," insists that the first essential to organization is a card index. The war has demonstrated, in a way that years of talking and writing would not so convincingly have driven home, the value of system and organization, the advantage possessed by him who knows what he has, what condition it is in and how it can most promptly and effectively be applied to a given purpose.

In years to come it will be difficult to realize in what a chaotic, unorganized condition the boiler situation in the United States has dragged along for years. Except in a few of the States, anybody can put up any old kind of a boiler, put any amount of pressure upon it and trust it to the care of anybody that he can get to run it. Nobody knows how many boilers there are in existence or turned out in a year. If a boiler explodes, there is no official record of its history and no official investigation of its cause, except it be that of a coroner's jury.

It is time that this condition was analyzed, systematized, and the boilers of the country card-indexed, the dangerous among them weeded out, intelligent supervision instituted over the rest, and a standard adopted which will insure that new installations are adequate for the strenuous conditions of modern practice. Some of the states are doing this. More are going to do it, and eventually we shall know how many boilers we have, how long each has been in use, and, when one explodes, why it happened and what should be done to prevent the frequent recurrence of such disasters.—*Power*.

BOILER BY EXPRESS.—Probably one of the biggest express shipments ever received in Indianapolis arrived recently from Philadelphia for the Merchants Heat and Light Company in the shape of a 1,600-horsepower boiler weighing 18 tons.

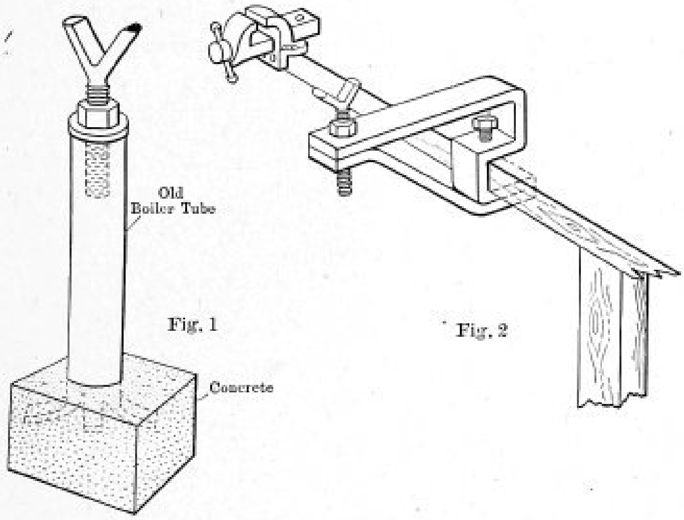
Letters from Practical Boiler Makers

This Department is Open to All Readers of the Magazine —All Letters Published are Paid for at Regular Rates

Two Shop Kinks

On Page 34 of the February issue of THE BOILER MAKER, James F. Hobart illustrates and describes a type of floor stand for supporting boiler tubes while working on one end of them. While no doubt the piston stands are O. K. and didn't cost much, I believe that the kind we have in use are far cheaper and better adapted to the work (in that they are adjustable to various heights).

Fig. 1 illustrates the floor stand. It is made from an old boiler tube, a large bolt split at the upper end in halves for sufficient length to give the V jaws, a nut and washer, and some concrete. The lower end of the tube is split in four sections, and the tabs or feet bent out, as indicated in the dotted lines, to make anchors for the



Floor Stand and Tube Support

concrete. The form of the base shown is square, but if it is desired to roll the stands about the shop the concrete should be molded in a round form. Such a form is easily made from an old wooden pail. In these days of high prices for old scrap-steel, it would pay to collect those old piston rods, and use the old boiler stand here described. Another form of tube support for use in connection with the bench vise is shown in Fig. 2. This is quite simple and easy to make.

The whole thing is made from one length of flat stock, bent as shown. A screw is used for clamping it to the edge of the bench, and a hole drilled for the Y bolt, as at *A*; a nut is used on both sides of this.

These kinks are considered to be money savers, and are the result of allowing shop men to suggest ideas to the management. No doubt many of the boys in other shops have many worth-while ideas or kinks that are lying dormant in their brains, and which would be forthcoming under slight encouragement. The writer has for many years always endeavored to encourage men to develop their thoughts along such lines.

When a suggestion or an idea advanced by one of the men proves successful, one should always be sure to reward the individual in some befitting way, even if the reward can be but word of commendation, and to those who have tried, but failed, one should give aid by pointing out the faults and assisting them to continue thinking of their plans and ideas. C. H. W.

Tools for Pneumatic Hammer

In Fig. 1 are shown punches for pneumatic hammers. These are used in riveting hammers, and often rivets that cannot be driven out with a sledge can be backed out with the air hammer.

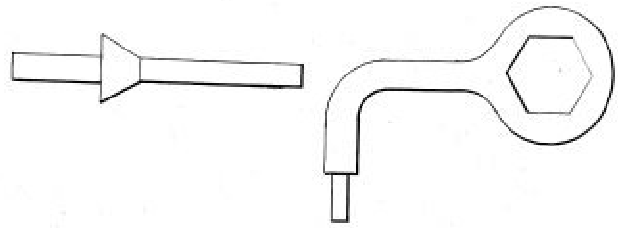


Fig. 1 Fig. 2

Fig. 2 is a wrench to take the caps off flexible staybolts. One end is turned up to fit the chipping hammer.

Caps can very easily be started with this wrench and an air hammer without much danger of breaking them or the bushings. Chisels and side sets for the riveting hammer are also very useful and easily made.

Denver, Col. ARTHUR MALET.

Three Tested Ideas

These ideas may not be of interest or value to all who read the pages of THE BOILER MAKER, but there are some of the boys who like to see the kinks and ideas that others have thought up and tested, so with that view I am sending along the following, two of which originated in a small shop in which I, at one time, spent considerable time. The other is one that was picked up by one shop as a means of saving the wear and tear on the air hose.

Fig. 1 illustrates a foot operated tube clamp used on the end of the bench to clamp the tube, while working on it, such as when removing the mill scale, or leveling the edges, taking off burrs, etc.

The bolt vise in Fig. 2 is unique, but a labor saver when one has a considerable number of bolts to cut down

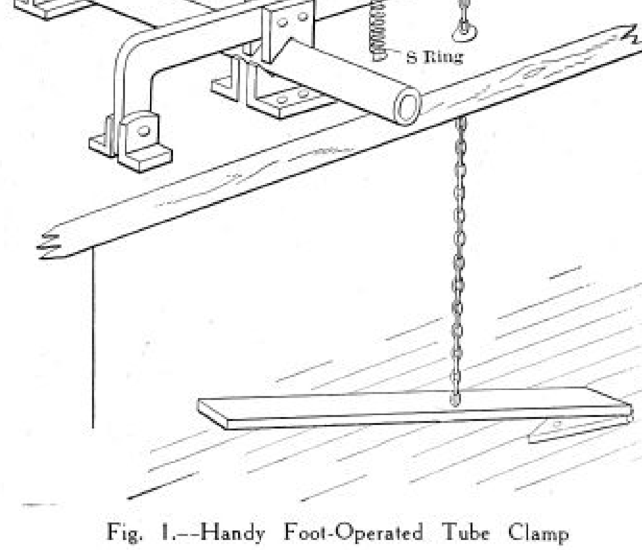


Fig. 1.—Handy Foot-Operated Tube Clamp

the thread. Once we had several hundred bolts of ¾-inch diameter which had to have the thread run down an inch farther, and the job was given to a couple of apprentices to do. The vise, in a few minutes, made the work easy, and at the same time it left the regular bench vise free for the shop work. A piece of flat stock and a wedge are the main requirements in material needed to make them. The hose reel in Fig. 3 is made from an empty rivet keg, a couple of boards, and a piece of tubing. No description is needed. These reels are excellent means for preserving the air hose.

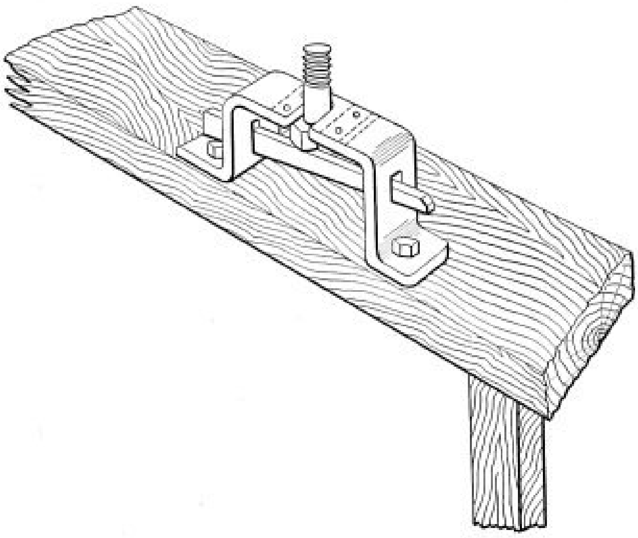


Fig. 2.—Bolt Vise

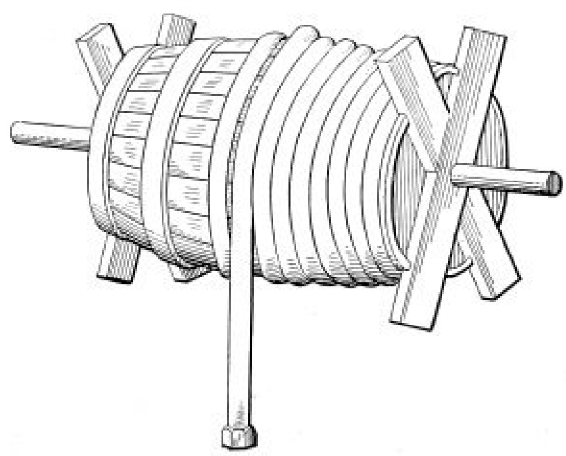


Fig. 3.—Home Made Hose Reel

Concord, N. H. CHARLES H. WILLEY.

Two Old-Timers

A few years ago, while on a trip in the mountains, I passed by an old mine. The shaft house had long since been torn down, but the boilers still stood there half on their foundation and half on the ground. They were the only thing that remained except the dump and shaft, which was badly caved in around the top.

Each boiler was about 18 or 20 feet long and had two flues about 2 feet in diameter.

About a week ago, while going through one of the railroad yards, I saw two boilers of the same type on a car. I learned afterward they were the same boilers and had been bought by a junk dealer.

Denver, Col. ARTHUR MALET.

Water Column Connections

In the September issue appears a line cut showing gage glass connections to a boiler. The design is probably given as diagrammatic, but is so far from good practice that comment is invited.

In the first place, the column connections are of screwed tube, and the fittings (crosses and elbow) of malleable iron. This is assuredly bad practice. Screwing tube directly to boiler shell is indefensible and no boiler authority should allow such a design. Screw down valves are shown at each end of gage glass, a most objectionable feature, and the bottom blow through cock is conspicuous by its absence.

The intersection of tube and fittings at a right angle invite choking, as upon reflection it is obvious that such connection must give a rough and undesirable lodgment for scale. Premising that the tube is also screwed into column direct, an extended screw or connector and back nut is required—a very bad feature—otherwise assembly is impossible. Altogether, for instructional purposes, the illustration is worse than poor, it is misleading, and if given in answer in an examination it would fail the candidate for want of practical knowledge.

The gage glass itself should have three cocks with full throughways, and the water column connected to boiler by properly bent tube flanged at either end. After all, the reason for a water column is to provide such a large flow and return pipe that choking up is virtually impossible, if cleaning is done annually. There is little need to point out the advantage of flanges in this connection over attachment by screwed tube. The gage glass fittings themselves are always provided with screw plugs to clean passages, which cannot be large owing to the limitation in the diameter of the glass itself.

All boiler fittings carry large responsibilities, but the greatest relative importance must be given to the water gage. Expense should be a secondary consideration, for human life depends more upon this fitting than any other. Records of casualty prove the contention that false water indication is responsible for more disasters than any other single thing in the operation of boilers.

London, Eng. A. L. HAAS.

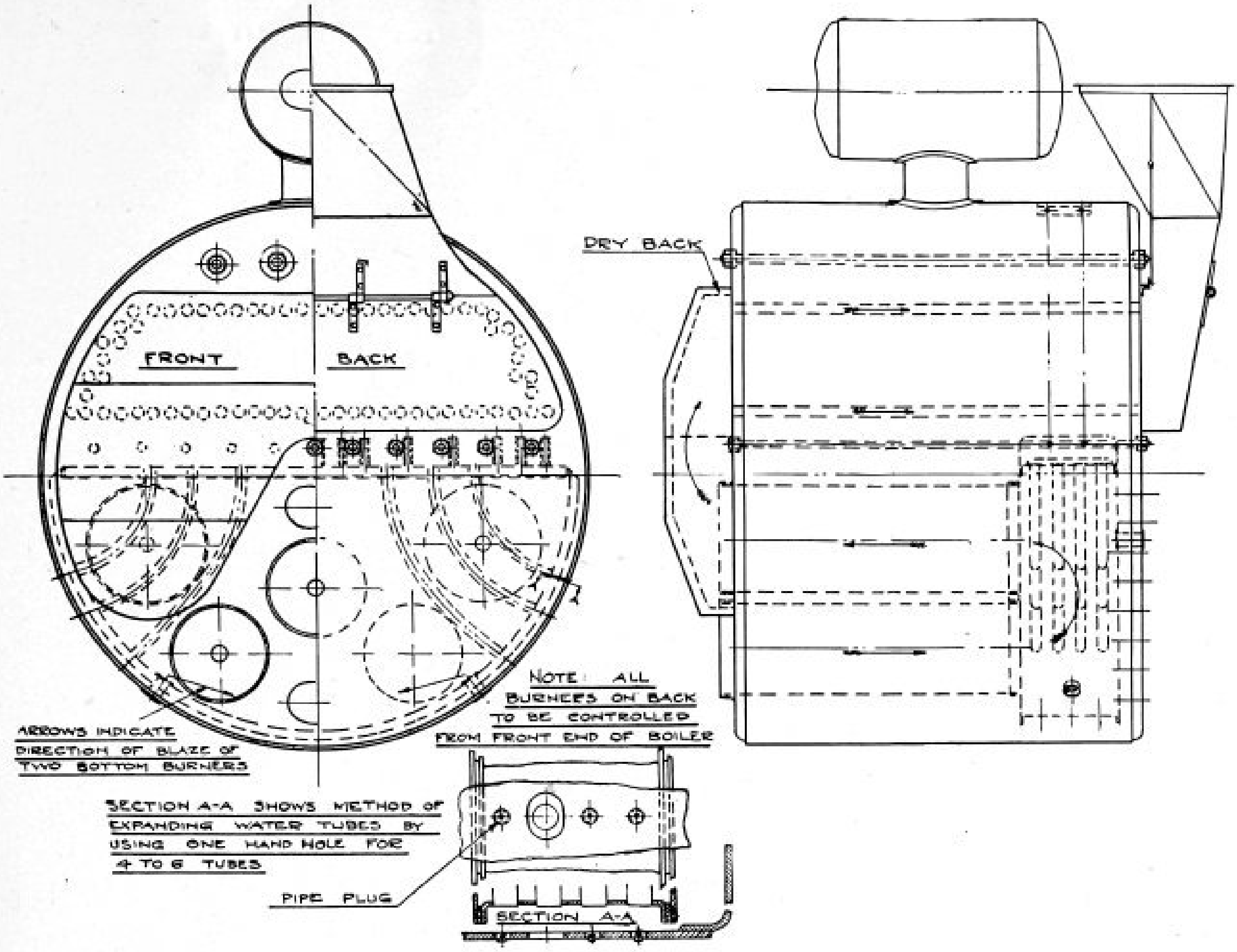
New Design for Scotch Boiler

In answer to Mr. Willey's suggestion to THE BOILER MAKER's readers to "come across" if they think that they have something worth while, I submit the following drawing of an up-to-date Scotch boiler for any purpose, either on land or sea.

The front view shows three small and two large furnaces, which lead to a common combustion chamber. The three small ones contain the burners, and the large ones are the return flues from the back to the front, or dry, combustion chamber, where the flame comes in contact with the tubes (which reach the full length of the boiler), and then pass through the uptake and around the steam drum to the stack.

The side view explains this further. The flame goes in through the small and back through the large furnaces, then in again through the tubes and up around the steam drum, that is, three times through the boiler before it becomes a superheater of the steam in the drum. The uptake is at the back end of the boiler. The dry-back combustion chamber which connects the return furnaces to the tubes is at the front of the boiler.

Engineers tell us that the bottom of a combustion chamber in a Scotch boiler does not generate any steam. I claim that if it is properly constructed it will stand more



Grant's Economy Oil-Burning Scotch Boiler

heat and generate more steam than the top of the combustion chamber. Section *A-A* shows that I flange the wrapper sheet instead of the front and back combustion heads, and place a calking strap between them. This plan places the rivets (both heads and points) in the water. I would rivet the staybolts, as nuts would burn off quickly.

We know that if we heat the water at the bottom of a boiler we get a good circulation and an equal expansion. The arrows at back end of the boiler show how this is done. A burner is placed on each side at the back end, which passes through the shell and wrapper sheet; the flame from these burners meets at the bottom center of the combustion. This will heat the water at the bottom of the boiler and give the desired circulation. It also strikes the flame of the furnaces on both flanks, thereby causing a whirling mass of heat in the combustion chamber and the return furnaces. The modern high pressure burner creates its own draft.

Water tubes are also shown in this combustion chamber, bent to conform to the line of the crown and its wrapper sheet. These tubes may be of any desired size (3 inches is a good proportion) expanded in the crown and wrapper sheets, as shown in the drawing.

This boiler permits a variable water line—for instance, where the space over the boiler will not permit a steam drum the water may be lowered and the two top rows of tubes used as superheaters—without injury to the boiler.

J. S. Grant.

The Harrisburg Manufacturing & Boiler Company, Harrisburg, Pa., will enlarge its plant and install new equipment to handle a government contract for gun carriages. The contract totals about $1,000,000. Samuel F. Dunkle is president of the company.

Why Should Butt Straps Be Taken Off and Cleaned?

The subject discussed by Mr. Crombie on page 349 of the December issue is a sore point between the responsible inspector and the boiler maker.

Practically the entire trade hold the views expounded in the December article, and no single provision of a specification is viewed with so much hostility or so frequently contravened as this dismantling and taking apart for the removal of burrs. The objection from the shop point of view is easily understood and ably expounded by Mr. Crombie.

As in every mechanism or mechanical product there are two viewpoints, that of production and operation—if there does not exist also a third viewpoint which both criticise, that of design—so in boiler making there are certain precautions essential from one viewpoint which are troublesome in manufacture.

In the older days, when rivet holes were punched, it was the practice to make both punched sides meet with the bolster side outside. This practice had the merit of making the burred edges of holes from the punch visible, and if these were bad they were easily dressed in position. Still, the fact remains that all decent work had to be positioned and the holes marked off through one holed side and the blank side then punched. When space punching became usual, plates were always holed in the flat before rolling up. The consequence was that the plates were flat or slightly depressed around the hole where they touched. Rough reaming was required to restore the holes to parallel and make them round if the boiler makers were conscientious enough to do this. Where holes are punched ¼ inch small and then reamed, the production of a fine specimen burr is facilitated. It will always make a perceptible burr unless the reamer is razor sharp, a condition not usual in the boiler shop.

Now a little common sense experimenting is worth while. This subject cannot be too closely analyzed, for it is the small refinements which represent the difference between first class work and the near enough which is not good enough.

Take a piece of boiler plate, hole it with a punch, punch and ream a second hole and drill a third. Now examine the results closely. Make a second series of holes in the same manner with tools just dulled or those in ordinary shop use just before grinding becomes necessary. Examine the results again. Perform the entire series of holes with sharp and dull tools, laying strips of ordinary paper at intervals of, say, 1 inch between two pieces of plate, and clamping both together before starting operations. The necessity of taking apart plates to dress surface clear of burrs is self-evident. The experiments represent conditions of practice, and it is upon practical results that all boiler specifications with their prohibitory and mandatory clauses are founded.

The best possible case is that of two pieces of metal with machined faces clamped together and drilled through, and, if fancied, reamed with a high grade machine shop reamer. If these are taken apart there is always sufficient roughness at edge of hole to position them exactly together again—in fact, the pieces can be reset as certainly, using the imperceptible burrs as a guide, as by the use of a plug gage.

The conclusions arrived at are:

1. If two plates are in *absolute and intimate contact* when holed by drilling and reaming with sharp tools, the burr is almost imperceptible.

2. A drill in ordinary shop condition will raise a burr even when the plates contact well.

3. If the plates are very slightly apart, the burr thrown even by sharp tools is perceptible and obviously requires dressing.

4. That in the normal condition of shop tools, especially with punched and reamed holes, the slight want of correspondence between the plates and the other practical factors make dressing the plates a necessity.

It is admitted that dismantling for this purpose is inconvenient and that most boiler makers object strongly to so doing, but it is a very necessary provision and one well worth while. The writer would even go further and sand blast or grind the mill scale from the contact surfaces, and utilize hydraulic actuated clamps in place of bolts.

It must be remembered that when the head is on the rivet, the edge of plate fullered and the seam completed, all traces of bad workmanship are out of sight. Even the hydraulic test, valuable though it be, does not sometimes reveal shoddy work. The hydraulic closure by the Tweedy system used two plungers, one inside the other, and why the practice is not more evident it would be difficult to say. When pressure was applied, it first moved the annular plunger to bring the plate adjacent to the rivet in intimate contact, then the inner ram moved forward and completed the head. It is one objection to the pneumatic hammer that its operation tends to jar the plates open.

Really the cost involved by first-class practice, position drilling, subsequent dressing of the plate faces, hydraulic closure, smallest tolerance to position rivet in hole, planed plate edges, and all the small factors which go to make a modern high pressure boiler, are not relatively expensive when all things are considered. There is the pleasure of working with the certainty that a boiler so made will fill any specification, remain tight and really give the designed factor of safety. After all, a boiler maker trades in high explosives, and he cannot object to have his product closely supervised in the interests of safety.

Finally, I do not agree that the provisions considered necessary to defeat bad workmanship and inferior boilers impede production. If the plant is adequate, the shop properly organized, it is probable that the overall cost is cheapened and production increased. It is never necessary to retrace one's steps nor to tinker with the finished job. It stays put, is tight under hydraulic pressure, is a credit to its manufacturer, and a pride to its actual builder. Better to be sure than sorry is a maxim of no small significance and a rule worth remembrance.

London, England. A. L. HAAS.

Ferrule Extractor

The two devices for pulling ferrules, shown in Figs. 1-2, are of the writer's own design, and have been found very satisfactory and useful. They can be made in various sizes suitable to the needs. The one shown in Fig. 1

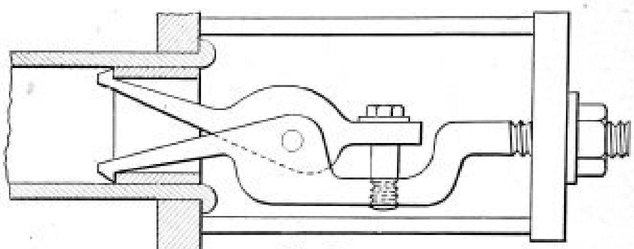
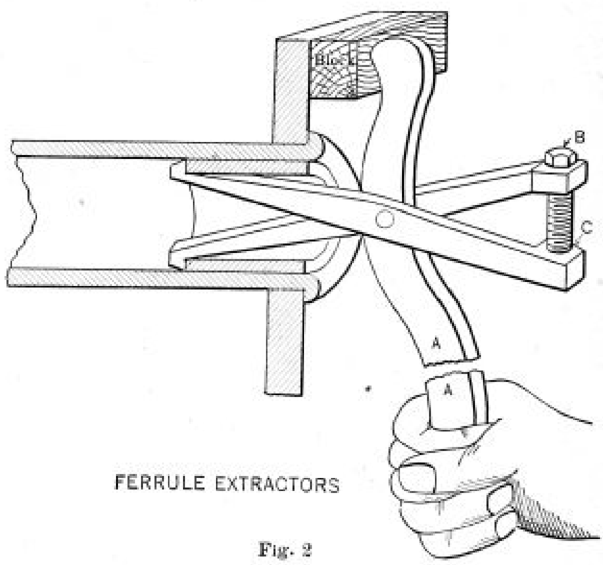


Fig. 1



FERRULE EXTRACTORS

Fig. 2

calls for a fair degree of skill at the forge, while that in Fig. 2 is quite simple, and the average handy fellow can make it.

The sketches require little description, but it may be well to say that the handle *A* in Fig. 2 should be long enough to give good leverage. The adjusting screw *B* is screwed in one arm, and its point forces the other arm at *C*. These devices should be made from a good grade of machine steel to give strength.

C. H. WILLEY.

Boilers for installation with the American Expeditionary Force in France are being built in France from materials shipped from this country.

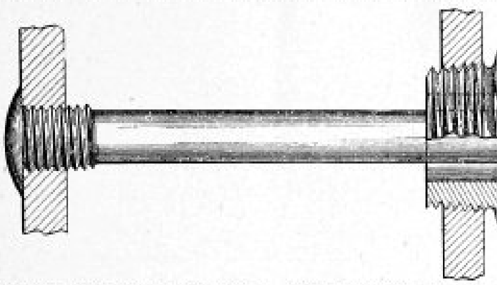
Selected Boiler Patents

Compiled by
GEORGE A. HUTCHINSON, ESQ., Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Hr. Hutchinson.

1,244,916. STAYBOLT CONNECTION FOR BOILERS. BENJAMIN E. D. STAFFORD, OF PITTSBURG, PA., ASSIGNOR TO FLANNERY BOLT COMPANY, OF PITTSBURG, PA.

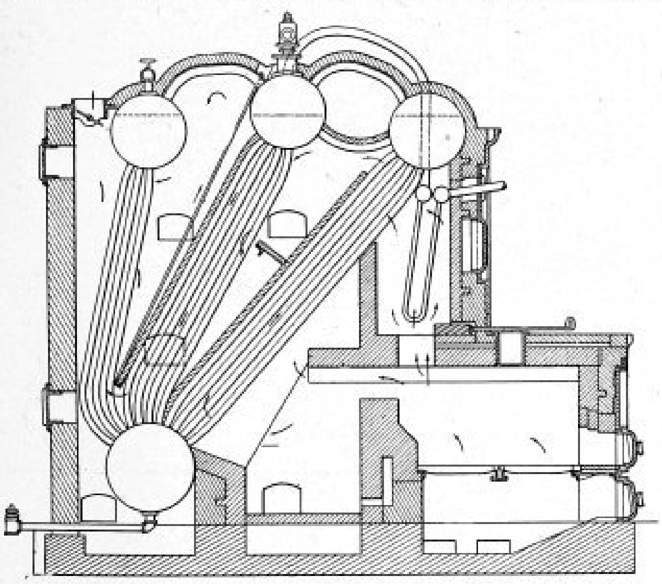
Claim 1.—In staybolt connection for boilers, the combination of a boiler plate having an opening for the passage of a bolt, a sleeve bearing against the outer face of said plate around the opening therein and



secured to said plate by welding, and a staybolt having a screw threaded connection with said sleeve. Two claims.

1,245,005. BOILER. EDWARD C. MEIER, OF PHŒNIXVILLE, PA.

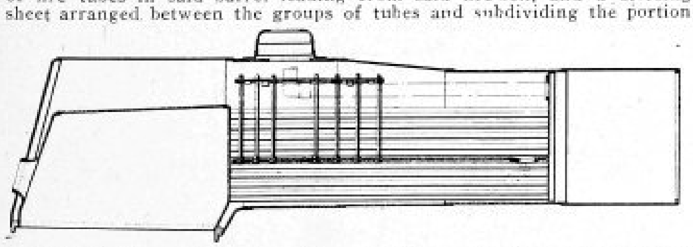
Claim 1.—The combination with a boiler casing, of a boiler unit having angularly disposed watertubes, means providing a fire box, an arched wall directly above said fire box, a baffle wall leading directly to said tubes at



its upper end and joining the arch wall at its lower end to provide a chamber, a superheater extending into said chamber, said arch wall having a passage directly above the fire box and communicating with the latter and the superheater chamber. Eleven claims.

1,249,079. STEAM BOILER. CHARLES HARTER, OF ST. LOUIS, MO., ASSIGNOR OF ONE-HALF TO JOHN E. O'BRIEN, OF ST. LOUIS, MO.

Claim 1.—The combination, in a boiler, of a boiler barrel, a fire-box at one end of said boiler barrel partially surrounded by said barrel, groups of fire tubes in said barrel leading from said fire-box, and a dividing sheet arranged between the groups of tubes and subdividing the portion



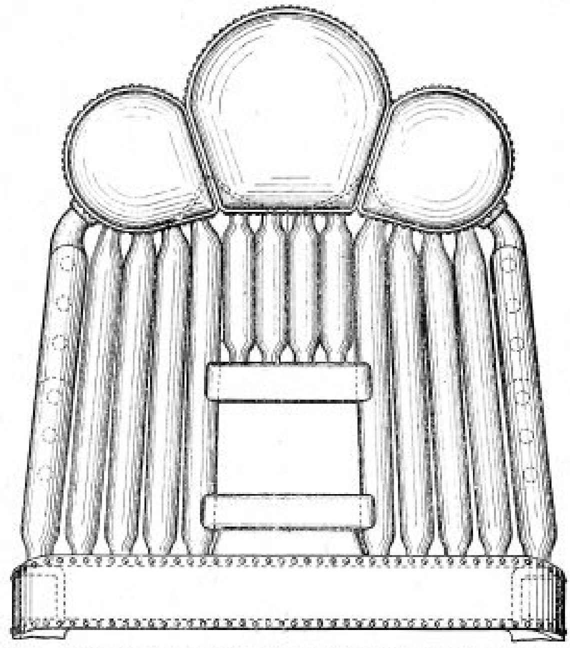
of said boiler barrel through which said tubes extend into a plurality of channels permitting circulation of water longitudinally of the boiler barrel to and from said fire-box, said dividing sheet being thus combined with the boiler barrel and fire-box to provide a continuous endless passageway through which the water, rising at the fire-box, is forcibly circulated toward the opposite end of the boiler and then back to the fire-box. Eight claims.

1,243,464. BLOWER FOR BOILERS. GLENN W. WATSON, OF DETROIT, MICH., ASSIGNOR TO DIAMOND POWER SPECIALTY COMPANY, OF DETROIT, MICH., A CORPORATION OF MICHIGAN.

Claim.—A blower for watertube boilers, comprising a conduit longitudinally adjustable through a furnace wall, a laterally extending hollow arm swiveled in the inner end of said conduit and provided with a series of jet apertures, a rod extending through said wall parallel and adjacent to said conduit, a connection between the inner end of said rod and said hollow arm for rotating the latter upon longitudinal displacement of the former, a collar having threaded engagement with the outer end of said rod, a member extending from said adjustable conduit outwardly in proximity to said rod and carrying said collar, a spring acting outwardly upon said collar, and means for normally rotating said rod to longitudinally adjust the same through its engagement with said collar.

1,248,356. BOILER. JAMES M. McCLELLON, OF EVERETT, MASS.

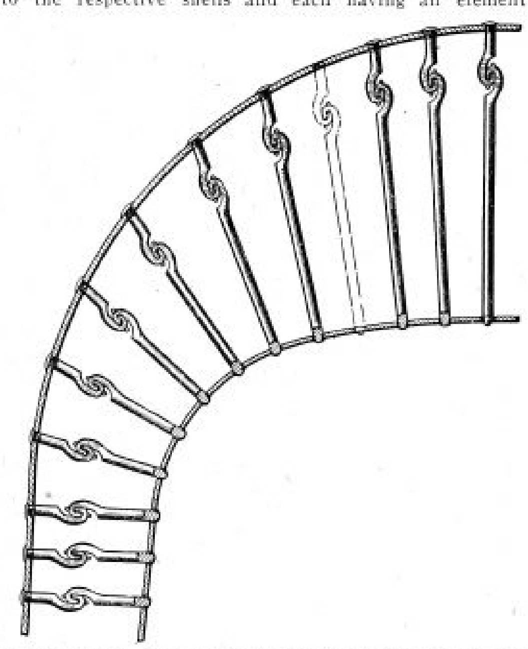
Claim 6.—In a boiler a barrel cut away to provide a segmental extension, crown drums fitting the cut-away portion and communicating with



the barrel, a flue sheet adjacent the ends of said drums, said drums and extension defining a combustion chamber rearwardly of the flue sheet, said chamber being provided with water containing walls. Fifteen claims.

1,249,958. RADIAL STAY FOR LOCOMOTIVE BOILERS. ALLAN R. HODGES, OF MEMPHIS, TENN., ASSIGNOR OF ONE-HALF TO CYRUS A. McALLISTER, OF MEMPHIS, TENN.

Claim 1.—A radial stay for the fire-box shell and outer shell of locomotive boilers comprising a pair of rigid sections adapted to be connected to the respective shells and each having an element for its



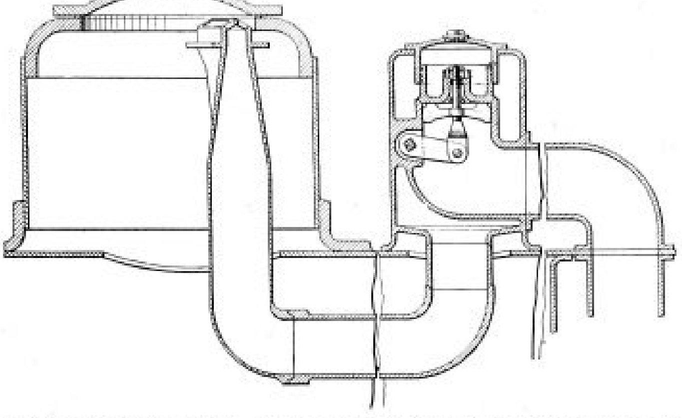
jointure to the other, the said elements being adapted for interlocking engagement by an initial transverse relative movement and by a subsequent relative outward longitudinal movement and when interlockingly engaged having a measure of longitudinal loose play to enable said shells to expand and contract independently of one another. Eight claims.

1,246,928. STEAM-GENERATING PLANT. JOSEPH L. HOFFMAN, OF PORTLAND, OREGON.

Claim 1.—In a steam generating plant, in combination, walls of double construction to provide water spaces therein, water pipes arranged crosswise within said structure and communicating with the water spaces in said walls, a boiler mounted in the upper part of said structure and in communication with said wall water chambers, whereby water can circulate through said pipes, said walls and said boiler, some of said water pipes being covered with fire brick, or the like, whereby to form two combustion chambers one above the other and communicating with each other in the rear of the structure, an oil burner extension mounted on said structure and opening into the upper combustion chamber, an oil supply pipe arranged in the wall of said extension, and an oil burner set within said extension and connected to said oil supply pipe. Five claims.

1,250,091. STEAM BOILER. JOHN S. CHAMBERS, OF NEW YORK, N. Y., ASSIGNOR TO CHAMBERS VALVE COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

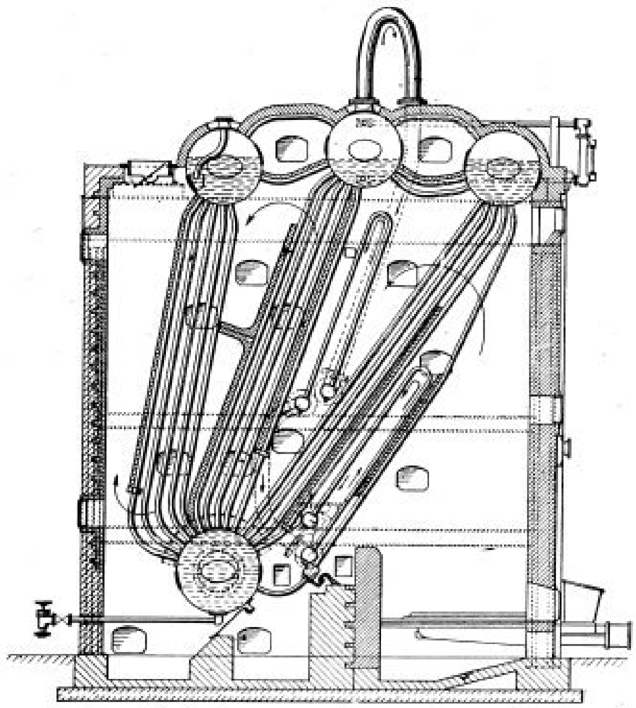
Claim 1.—The combination with a steam boiler, of a steam dome provided with a removable cap having a piston chamber therein, a stand-



pipe and a throttle-valve of the piston type therefor slidable in said piston chamber. Nine claims.

1,250,181. STEAM BOILER. DAVID S. JACOBUS, OF JERSEY CITY, N. J., ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, N. J., A CORPORATION OF NEW JERSEY.

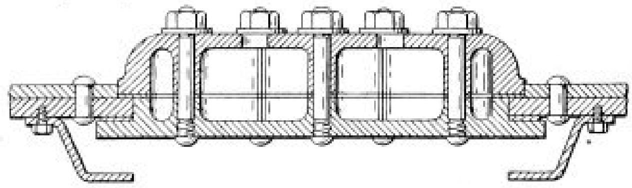
Claim 1.—A watertube boiler having a plurality of transverse steam and water drums, a mud drum, banks of tubes connecting the steam and water drums with the mud drum, additional water tubes connecting



the mud drum with the first steam and water drum and in front of the first bank of tubes and separated therefrom, a superheater in the space between said additional watertubes and the first bank of tubes, and baffling arranged to give an upflow of gases over the superheater. Fourteen claims.

1,250,629. DOOR FOR STEAM BOILERS. HUGH T. NOBLE, OF SEACOME, ENGLAND.

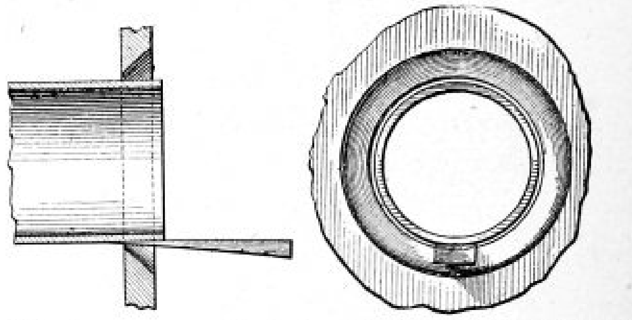
Claim.—The combination with a steam boiler having a shell provided with an opening, an inner annular reinforcing member projecting within



said opening, and supports spaced apart from said member, of a door comprising an inner section having a marginal flange engaging a lateral surface of said member, and a tubular portion fitting closely within the opening of said member, a plurality of tubular projections, and strengthening ribs connecting said tubular projections with said tubular portion, an outer section having perforations leading to the outer air, a marginal flange fitting closely within the opening of said shell and engaging the other lateral surface of said member, a tubular portion in alinement with and of greater thickness than that of the tubular portion of said inner section and overlapping said reinforcing member, a plurality of tubular projections in alinement with the projections of said inner section, and strengthening ribs connecting said tubular projections with said tubular portion, transverse bolts engaging the tubular projections of said sections and having removable nuts threaded thereon, annular washers located between the marginal flanges of said sections and the lateral surfaces of said reinforcing member, and annular washers located between the tubular projections of said sections.

1,250,881. CONNECTION OF THE ENDS OF TUBES AND TUBE-SHEETS. ALLAN R. HODGES, OF MEMPHIS, TENN., ASSIGNOR OF ONE-HALF TO CYRUS A. McALLISTER, OF MEMPHIS, TENN.

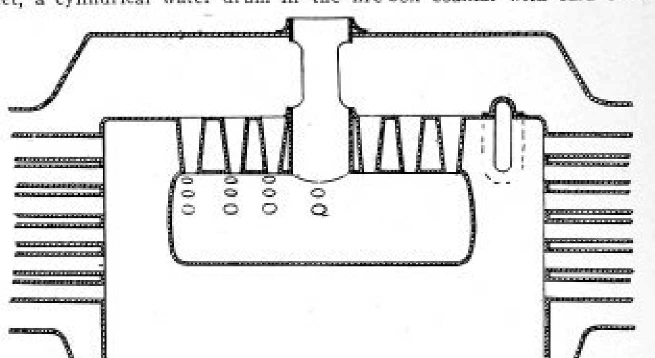
Claim 1.—A method of connecting the ends of tubes to their supporting sheets which consists in forming a conical opening between the flat faces of the sheet whose minimum diameter is substantially greater than the external diameter of the tube to be secured, thereby to provide an



appreciable clearance concentric to the tube, in centering the tube in said opening and in welding the tube to the sheet by wholly filling the space between said tube and the wall of said opening and between the flat faces of said sheet with metal which becomes homogeneously fused to the sheet and to the tube, thereby to establish a homogeneous connection between the sheet and the portion of the tube inserted therein. Two claims.

1,250,979. BOILER. PIERO CROSTI, OF MILAN, ITALY.

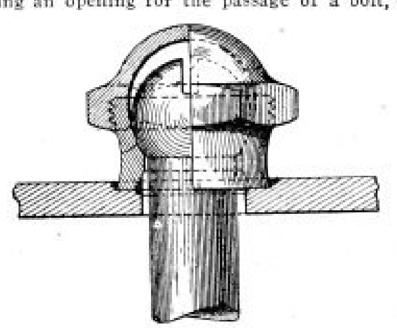
Claim 1.—In a steam boiler having a double wall portion surrounding the fire-box, the combination of a substantially cylindrical fire-box crown sheet, a cylindrical water drum in the fire-box coaxial with said crown



sheet and having a portion of its surface substantially parallel to the surface of the crown sheet, and a plurality of rows of watertubes extending radially between said parallel surfaces and rigidly connecting them together, whereby the drum is freely suspended in the fire-box. Four claims.

1,250,240. FLEXIBLE STAYBOLT CONNECTION FOR BOILERS. BENJAMIN E. D. STAFFORD, OF PITTSBURG, PA., ASSIGNOR TO FLANNERY BOLT COMPANY, OF PITTSBURG, PA.

Claim 1.—In staybolt connection for a boiler, the combination of a boiler plate having an opening for the passage of a bolt, and a counter-



bore around and in communication with said opening, and a support for the head of the bolt seated in said counterbore and secured therein by welding. Four claims.

1,243,237. CONTROLLING VALVE MECHANISM FOR FURNACE STOKERS. GEORGE W. WOOD, OF CAMDEN, N. J.

Claim 1.—The combination with a plurality of stokers, each having independently operative fuel actuating means, of a valve casing having a plurality of distributing passages therein respectively connected to said actuating means, a valve having a port successively movable into register with said passages, means for supplying pressure fluid to said valve and to successively enter said passages through the port when the valve is actuated, and means for actuating said valve. Six claims.

THE BOILER MAKER

APRIL, 1918

Boiler Maker Foremen Attached to Russian Railway Service Corps, Now in Foreign Service

The above photograph, sent to THE BOILER MAKER from Nagasaki, Japan, by B. C. King, of the Russian Railway Service Corps, shows the following boiler maker foremen attached to the Russian Railway Service Corps, now in foreign service: From left to right, standing—M. S. Van Dresser, C., St. P. M. & O. Ry.; Peter Eck, C., R. I. & P. Ry.; B. C. King, N. P. Ry.; B. F. Fisher, S. P. & S. Ry., and James Vining, S. P. Ry. From left to right, sitting—Martin Guiry, G. N. Ry.; J. V. Mathews, C., St. P., M. & O. Ry.; E. A. Dixon, Wabash Ry., and J. W. Holt, C. & N. W. Ry.

Design and Construction of Boilers to Meet A. S. M. E. Code Requirements

How to Determine the Principal Dimensions and Relative Proportions of the Boiler—Ordering the Material

BY GEORGE E. DAVIS*

Aside from the A. S. M. E. Code feature, this subject has been dealt with equally as much, if not more, than any other subject in connection with the boiler making industry, and by men more capable to handle the subject than the undersigned, so that I feel it my duty at the outset to state that my remarks are intended to be of benefit to the apprentices and young boiler makers who have, figuratively speaking, gone over their heads in an endeavor to master the subject too quickly, and, as a result, overlooked some of the small, though essential, details, these details frequently being omitted by the best authorities when writing on the subject. When first starting at boiler making I distinctly recall having read articles that I now realize were excellent authority on the subject in

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all respects, but at that time a more liberal explanation of certain details, a knowledge of which the writers generously conceded to their readers, would have bridged the chasm between a thorough understanding and a partial one.

I have selected the horizontal return tubular type of boiler to write about for the reason that it is about the best known generally, and because the A. S. M. E. code rules thoroughly cover its construction, whereas specific rules are not embraced in the "code" for the construction of some other designs.

It does not seem necessary to deal at great length with the subject of designing a boiler of the return tubular type, from the fact that the design is practically standardized throughout the country. However, a few remarks concerning the "whyfore" of the subject may be of some benefit to the beginner.

Proportions

A comparison of the designs of several different sizes of boilers of this type will reveal the fact that an approximately uniform ratio of dimensions and areas is maintained with respect to length and diameter, number and size of tubes and area of surface above the tubes. This uniformity is the result of years of experience and study by the varied interests connected with the manufacture and use of steam boilers, and in approximate terms may be summed up about as follows: Length equals three diameters; tubes equal in area to 85 percent of total heating surface; grate area at the ratio of one square foot of grate surface to 45 square feet of heating surface. The thickness of material, design of riveted joints and staying of surface are matters apart from the horsepower rating and are governed by the amount of working pressure desired.

Assume that it is desired to construct a boiler to have a horsepower rating of 150 and a working pressure of 150 pounds. As the usual practice is to consider 10 square feet of heating surface as the equivalent of one boiler horsepower, then for a total horsepower of 150 the total heating surface would be 150 × 10, or 1,500. As we have assumed that 85 percent of the total heating surface is to be comprised of tubes, the tubes will then represent 85 percent of 1,500, or 1,275. The next step is to determine the size of boiler that will contain the relative amount of heating surfaces stipulated above, these surfaces to be allotted as follows: All of the tube area, one-half the area of the shell and two-thirds of the area of the rear head minus the combined cross sectional area of the tubes.

Approximate Calculations

To predetermine all of these areas by direct calculation and without assuming some one of them would be a rather difficult job; however, a rough basis for the calculation may be arrived at by the use of the following formula: Length in feet × diameter in feet × 1½ = horsepower. It is understood, of course, that this formula makes no pretense to being absolutely accurate, but it is near enough to establish a basis on which the accurate calculations can be made. For use in this case we have in the formula two known quantities, consisting of the desired horsepower (150) and the constant 1½, so that by dividing 150 by 1½ we obtain 100, and this 100 is the combined value of the remaining portion of the formula, or length in feet × diameter in feet, and, as stated at the beginning, these dimensions are at a ratio of 3 to 1; therefore, the amount 100 is the sum of two numbers whose value to each other is at the ratio stated above, which, expressed in figures, are 17.4 and 5.8. These figures are, of course, unreasonable in so far as representing actual boiler dimensions are concerned, but they do suggest reasonable dimensions, which in this case would be an 18- by 16-foot boiler. The formula worked out with the dimensions just stated would be 18 × 6 × 1½ = 162, which is more than the amount of horsepower desired in this case, but, as stated above, the formula is suggested merely to obtain some figures that can be used as a basis for calculation. It is understood, of course, that the number and diameter of tubes used in a boiler would render the formula valueless in so far as absolute accuracy is concerned.

Deciding that the boiler in question is to be 18 feet in length and 6 feet in diameter, and remembering that the tubes are to constitute 85 percent of the heating surface, or 1,275 square feet, it now remains to determine the number and diameter of the tubes that will give this surface, the length of the tubes being determined, of course, by the length of the boiler.

It is the general practice with respect to boilers of the horizontal return tubular type to use tubes of either 3 inches, 3½ inches or 4 inches diameter, and, as the length of the tubes for the boiler in question will be 18 feet, we must decide on the number and diameter of tubes that will give the amount of heating surface desired, namely 1,275; the present price of boiler tubes will warrant accurate calculation with respect to the desired number of tubes; at least, no more tubes will be used than are really needed.

Number of Tubes

The number of tubes that cau be properly installed in a boiler head is, of course, governed by the diameter of the head and the amount of steam space desired; however, our present interest in the case in hand is to determine some tube diameter the total number of which will give us the 1,275 square feet of heating surface. A 3-inch tube has one square foot of heating surface for each 1.373 feet in length; an 18-foot tube would then contain 13.1 square feet, and, as the usual tube layout of 3-inch tubes in a 72-inch boiler is 124, then 124 × 13.1 = 1,624, which is considerably more than we need, so that we will try the 3½-inch tubes, which contain one square foot of heating surface for each 1.171 feet in length. An 18-foot tube would then contain 15.37 square feet. Eighty-six tubes make a good layout for a boiler of this size, and 86 × 15.37 = 1,321, which is sufficiently near the desired amount, it being understood that it would not be practical to put in the exact number of tubes to equal the 1,275 square feet unless the number figured out evenly and consistent with a good layout.

We can now determine the exact amount of heating surface contained in the boiler. As just stated, we have 1,321 square feet in the tubes, and as the practice is to consider one-half of the shell as heating surface, this amount can be determined by estimating the entire surface of the shell and dividing by 2, or in the following manner: Multiply the diameter in inches by the constant 3.1416, and then by the length in inches; the product is then divided by 144, and this quotient divided by 2. Expressed in a formula, the example would be

$$\frac{72 \times 3.1416 \times 216}{\dfrac{144}{2}} = 169 \text{ square feet.}$$

As stated before, two-thirds of the rear head, minus the combined cross-sectional area of the tubes, is considered as heating surface, and to determine this amount we will calculate the area of the head in the usual manner. This is found to be 4,071 square inches (72 × 72 × .7854 = 4,071); the total cross-sectional area of the tubes is 827 square inches (area of one tube equals 9.62, and 86 × 9.62 = 827); then 4,071 — 827 = 3,144, two-thirds of which equals 2,096, and this amount divided by 144 equals 13, the number of square feet of heating surface to be considered in the head. The total is now, tubes 1,321, shell 169, head 13, a total of 1,503, and this divided by 10 (usual commercial rating) equals 150.3, or, say, 150, which would be the horsepower rating of the boiler.

The foregoing remarks are undoubtedly a crude way in which to treat the design of a boiler, but, as stated at the outset, the object was to present the subject in as practical a manner as possible.

With this load off our minds, we will now attempt to order the material, layout and construct the boiler, all in accordance with the A. S. M. E. Code rules.

Quality of Material

The code rules stipulate in Part 1, Section 1, paragraph 2: "Steel plates for any part of a boiler, when exposed to the fire or products of combustion and under pressure, shall be of firebox quality, etc." This would mean that the shell plates and heads must be of firebox grade; the butt straps could be of flange grade, but the average boiler manufacturer would not take advantage of this technicality, so we will order all the material firebox grade.

The number of courses in boilers of this size depends on the opinion of the interested parties; the prevailing practice for some years has been to use three courses. However, a large number of boilers are built in which only two courses are used; the advocates of the two-course type advance the theory that in boilers constructed in this manner the circumferential seams are placed at the greatest possible distance from direct contact with the flames, thereby eliminating the likelihood of fire cracks. The advocates of the three-course type assert that the additional circumferential seam acts as a stiffening ring and that the boiler is benefited by such construction. The three-course type will be selected for the boiler in question, and an explanation of the layout of the two-course type will also be given.

The quality of the material and the number of plates being determined, the next step is to determine the thickness of material necessary to sustain the desired working pressure.

Thickness of Plates

The formula used to determine the safe working pressure for a boiler is

$$\frac{TS \times t \times \%}{R \times FS} = S\,W\,P,$$

in which TS = tensile strength, t = thickness of shell plates, % = efficiency of weakest longitudinal joint, R = radius of boiler (inside of weakest course), FS = factor of safety = 5, SWP = safe working pressure.

In the present case the values of the several parts of the formula have been established, except the plate thickness and the efficiency of the longitudinal joint (provided it is to be the weakest unit in the construction). The type of riveted joint for a boiler carrying 150 pounds pressure would, no doubt, be of the double butt strap design, either triple or quadruple riveted, and designed to give the highest efficiency.

This information is easily obtained by reference to tables containing the efficiency percentages and other data of riveted joints. For instance, we will refer to a table giving the efficiencies of double butt strapped and triple riveted seams, and find that the highest percentage obtainable is around .87; it now remains to slightly transpose the formula given above, to find out what plate thickness would be required; the transposed formula would be

$$\frac{R \times FS \times SWP}{FS \times \%} = t,$$

or, using the actual values,

$$\frac{36 \times 5 \times 150}{55{,}000 \times .87} = .565, \text{ nearly.}$$

This would mean a plate thickness of over 9/16 inch; so that we will try the value of a quadruple riveted joint and see if a thinner plate can be used. The tables will show that a percentage of .94 ranks among the best designed joints, and, using the formula in the same manner as before, we have

$$\frac{36 \times 5 \times 150}{55{,}000 \times .94} = .522, \text{ say } 17/32 \text{ inch,}$$

and the consensus of opinion would no doubt favor the thinner plate, the extra cost of the last-named type of joint being more than offset by the difference in cost of the plates.

Thickness of Heads

It is customary to use slightly thicker material in the heads of a boiler of this type than is required for the shell plates, the reason for this being that the heads are not self-supporting in the manner that the shell plates are, and also to obtain a sufficient bearing surface at the point where the tubes are expanded. With plates of 17/32 inch, the usual practice is to use heads of 9/16-inch material and butt straps of 7/16 inch (see page 9, paragraphs 19 and 20, of the Code rules). In a properly designed joint no benefit would be gained by using straps of excessive thickness, as the crushing of the strap in front of the rivets is the only way in which the strap affects the joint efficiency, and this section of the joint is invariably stronger than the other sections. However, the necessity of establishing a minimum thickness of butt straps allowed for certain thickness of plate is readily understood; the average boiler maker would easily imagine the result of riveting up a joint in which heavy plates and relatively thin straps were used.

Size of Plates

Getting back to our job again, we have now decided that our material will consist of the following: 17/32-inch plate, 7/16-inch butt straps and 9/16-inch heads. The heads will be ordered to measure, 72 inches in diameter; this will mean a circumference of 226¼ inches (226.195 inches would be the correct circumference, but heads usually measure 226¼ inches when ordered 72 inches diameter, unless, as is done in some shops, 71½-inch diameter heads are used, and the boiler rated as 72 inches diameter). The two-end courses would, therefore, be required to be of sufficient length to encircle ... heads, and the center, or small, course, to fit inside of the end courses. A convenient rule for finding the length of plate necessary to fit a given circumference is to lay off the given circumference; then add three plate thicknesses plus ¼ inch for an outside fit, and for an inside fit deduct three plate thicknesses plus ¼ inch from the given circumference. In this case three plate thicknesses plus ¼ inch would be 1 27/32 inches, so that we have 226¼ inches plus 1 27/32 inches = 228 3/32 inches, the actual length of plate necessary to make the two-end courses, and to this length should be added a sufficient amount to insure a perfect squaring up of the plate; in this case a plate ordered 228½ inches would be correct. For the small course we would have 226¼ inches — 1 27/32 inches, or 224 13/32 inches, and a plate ordered 224¾ inches would be correct.

The actual overall dimensions from outside to outside of heads should be 17 feet 11¼ inches. This allows for ⅜ inch on each end of the tubes for beading when 18-foot tubes are used. The heads usually have sufficient flange to allow a 4-inch gage (distance from back of head to center of rivet line), so the three courses would be required to have an overall length of 17 feet 11¼ inches minus 8 inches, or 17 feet 3¼ inches from center to center of head seams. As there are three courses, we have 17 feet 3¼ inches ÷ 3 = 69 3/32 inches (practically), the distance from center to center of girth seams for each course. To each course should be added a sufficient amount for lap and planing. This would require each end plate to be 72¼ inches wide; the center course should be 72 inches wide, as no planing is required. (See paragraphs 183 and 257 of Code.) The dimensions of the butt straps would be as shown in the following list, an explanation of which will be given later:

Two plates, 72¼ inches by 228½ inches by 17/32 inch.
One plate, 72 inches by 224¾ inches by 17/32 inch.
Two plates, 66 inches by 20⅝ inches by 7/16 inch.
One plate, 72 inches by 20⅝ inches by 7/16 inch.
Two plates, 72¼ inches by 10⅜ inches by 7/16 inch.
One plate, 66½ inches by 10⅜ inches by 7/16 inch.
Two flanged heads, 72 inches diameter by 9/16 inch by 5½-inch flange.

(To be continued.)

Among Missouri Boiler Shops—I

Some Unusual Kinks—How the Shop Was Heated—Angle and Pipe Ladders—Rope Tackle

BY JAMES FRANCIS

It surely is a long cry from a New Jersey boiler shop to one in "Ole Misso'ri," rather farther than it was on Long Island, from Native's house to his neighbor's, which he said, was: "Two looks and a holler"!

The first shop I came to was one of those little concerns where they make stacks for Mississippi River steamboats, do little odd jobs, and rely upon chance work to keep them agoing.

"Yes," said the owner of the little shop, "there used to be a good bit of business here, but it's all gone to Cairo or Memphis now. The boats lay up for the winter down there. The river rarely freezes over down there, so the boats can lie at the boiler shops all winter and be overhauled and everything put in shape. Then, all the work we get up here is usually little things which were forgotten down there, or some little changes which are to be made. But all the big boiler work is done in Cairo or Memphis."

Just then the shop owner and the writer were "shooed" off the sidewalk in front of the shop by three workmen who came out of the shop, en route for the boat of a customer, and they "came a-flying" with some steel plates on a wheelbarrow, one man trying to manage the handles, and two lusty helpers, each hauling like mad upon a bight of rope, the ends of which were attached to the wheelbarrow at points close to the axles of the wheel.

But they certainly delivered the plates "a-runnin'" and swept the sidewalk clear of chance pedestrians in a hurry. Half the time the barrow was down to the two brace legs sliding over the ground, with the man at the handles trying his best to keep up with the procession, even if to do so he rode the barrow handles nearly all the way.

An "Automobile Power Punch"

There was no power in the shop. All hand tools were used, and very light ones at that, as little work was done save upon stacks and light tanks. But there was one power tool in the shop. It was a little belt-power punch for not over a half inch punch through ¼-inch steel at the most. An old shaft was in evidence overhead just inside the door of the shop and the little power punch could be belted from the shaft.

I tried in vain to figure out how they drove the little punch, and had to ask for information. "Why," said one of the workmen, "they only use that punch on large stack jobs and then the Old Man backs his auto up to the door, blocks under the rear axle until the wheels are clear of the ground, then he slips a belt on each rear wheel to the pulleys you see on the shaft, we put on the old punch bent, and Boss starts the auto. Then we punch plates in a hurry!"

A "Smoke-Stack" Stove

The little boiler shop here described was merely a long narrow space in a store building, but there was a vacant

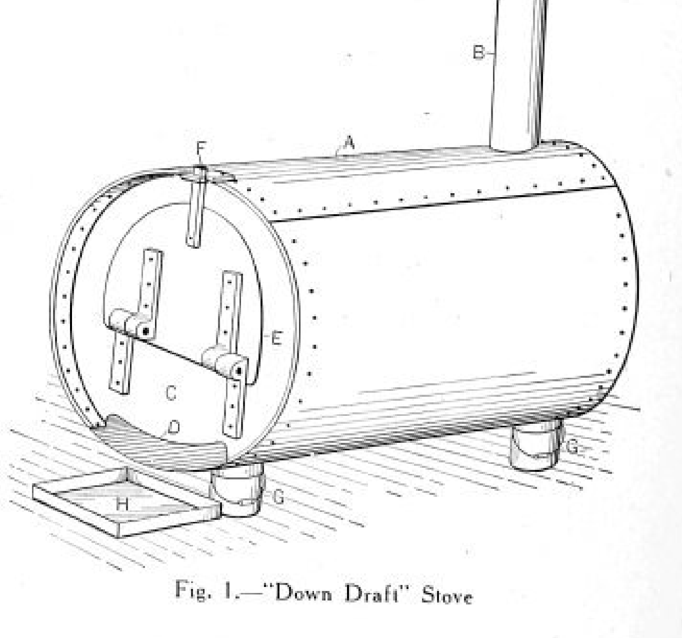


Fig. 1.—"Down Draft" Stove

lot adjoining and almost everything except tools and new stock had overflowed upon the lot in question. The shop was heated—sometimes—for even in Missouri a fire is decidedly comfortable at times—by a singular-looking stove, made from an abandoned section of smoke-stack, about 36 inches in diameter, which was placed horizontally as shown by Fig. 1.

Noticing that the writer was looking closely at the stove, the shop owner said laughingly: "What d'ye think of our 'down-draft' stove?"

"Down-draft!" was the reply. "Why do you call it by that name?"

"Well, Stranger, if you were ever here when the wind was sou'-east, I reckon you'd call it a 'down-draft' affair, all right!"

And it was. The stove pipe *B* went out right through the wall of the building and terminated horizontally toward the south, not even an elbow having been added to give the smoke a start in the proper direction. No wonder that it was "down-draft" occasionally!

The shell, *A*, had been fitted with heads, one of which is shown at *C*. The lower edge of this, the front head, was cut away at *D* to provide a draft-space, then an opening was cut for throwing in wood, which was the fuel used. A door, *E*, had been fitted as shown, with home-made strap hinges and a latch *F*, which, standing vertically, didn't seem to care a rap whether or not it stayed latched.

The erection of this stove was simplicity indeed. Two metal pails or water buckets, *G*, *G*, had been filled with sand, placed upon the floor of the shop, and the "Smoke-stack-Down-Draft-Stove" placed upon the buckets—and the work of erection was done.

The pan, *H*, had been bent up and placed where the ashes would fall into it. Most of the ashes were removed by pulling them out through the narrow opening *D* with a poker. But, should so many ashes accumulate inside that "poking out" failed, then a long handled shovel and an open door at *E* did the business.

Very Strong Rolls

I saw some mighty good rolls, belonging to this little shop, in use on the levee (call it "levy" and you'll say it right). The rolls were abandoned gas tanks, same as are used for containing oxygen for welding outfits.

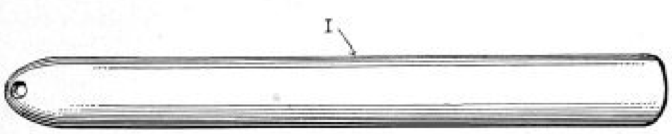


Fig. 2.—Gas Tank Roll

For some reason which the writer could not determine, the tanks had passed their periods of usefulness, had been stripped of all fittings as shown at *I*, Fig. 2, and then had been relegated to the scrap heap from which, with a keen eye for the fitness of things, the owner of this little shop had rescued the abandoned tanks and had found that no better or more convenient rolls, for heavy duty, had ever been made. They were far stronger than pipe rolls, would never split at the weld under heavy loads and it was found almost impossible to flatten them, no matter how heavily the rolls should be loaded. The conical end also proved a great advantage upon several occasions.

At the time the writer saw these rolls, they were in use on the levee, having been run directly upon the granite paving thereof, and were in use under one of the—at one time—famous Mexican power boats which were sunk in the Mississippi during the late "unpleasantness with Mexico."

Two of these boats were sunk, as the papers graphically described at the time. One of the boats was raised and repaired, but the one seen by the writer had been torn in two and the entire stern portion was missing. The forward part of the boat had been hauled on the gas-rolls upon the levee in front of the boiler shop and workmen therefrom were stripping the wreck of all machinery and metal available.

The shop owner very graphically related the happenings when these boats were wrecked. The one he was at

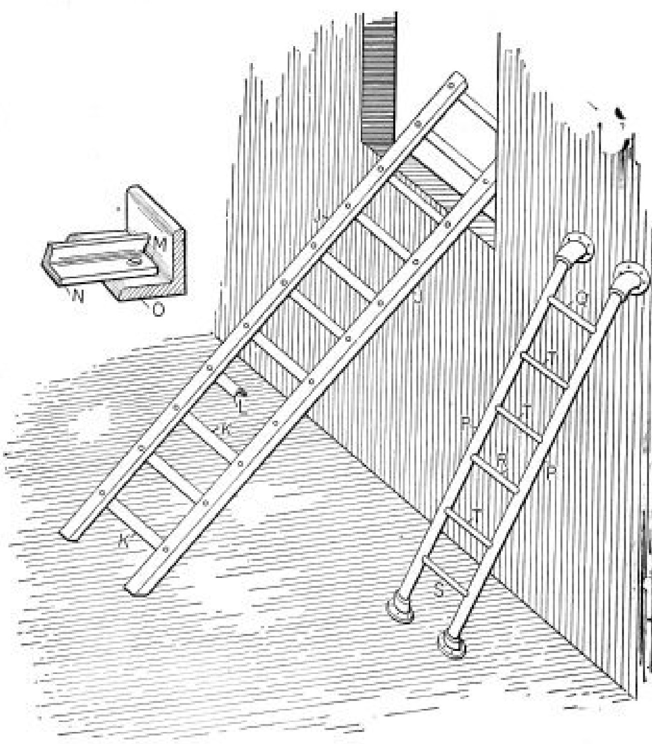


Fig. 3.—Some Steamboat Boiler Ladders

work upon, he said, had sustained two internal explosions. The Mexicans of the crew, being inveterate smokers, were unable to refrain from lighting their cigarettes, even when on board boat with gasoline at hand. By some means, a carelessly thrown match got in its work and a heavy explosion tore things up and wrecked the boat.

The wreck was finally hauled ashore and the firemen were trying to extinguish the flames, when a second explosion took place, tearing the boat to pieces, and throwing many of the firemen into the river, and only the twisted battered forward portion of the boat lies upon the rolls as a witness of the exciting times during the Mexican troubles.

Angle and Pipe Boiler Ladders

Steamboat work calls for a good many metal ladders, and it usually falls to the lot of the boiler maker to set up these ladders. Particularly is the "Stack-Shop" called upon to manufacture ladders. Two types of metal ladders are largely in evidence, and some were seen going through the shop above described. The size of the angle steel used was in accordance with the unsupported length of ladder necessary. But, as on board boat, it is possible to support ladders at short intervals, very light section of 1½-inch steel channels were used for the ladder rails and 1-inch angles for the treads.

The manner in which these ladders were constructed is shown by Fig. 3, where *J*, *J* represent the rails, and treads are shown at *K*, *K*, etc. One of the treads, *L*, is shown broken away in order that the manner of placing the flange uppermost may be visible. This disposition of the angle makes it necessary to always place the ladder with a certain end uppermost, in order that the foot may have an inch of tread instead of a mere line, as would be the case were the ladder placed the other end uppermost, or the treads disposed otherwise than as shown.

In making up these ladders, it was noticed that the treads were all very carefully punched, a jig being used to ensure their being all of the same length and each hole at exactly the same distance from the end of each tread. Then the holes in the ladder rails were so punched that the tread would not lie quite flat upon the inside of the rail flange, but would lie "neck and heels" to a slight extent, as is shown at *N*, where the end *M*, of the tread is drawn up upon the fillet of angle *O* far enough so that after the rivet has been driven the flange of the tread *N* is drawn down a very little by the rivet, thus causing the end *M* to "bite" into the fillet of rail *O*, thereby clamping the two parts of the ladder so firmly together that the tread-rounds can never work loose and allow the ladder to become "shackly" or capable of being moved back and forth a bit, same as an old ricketty lattice work. The "bite" of the tread-ends against the rail fillets will never allow any looseness or lost motion to exist, and these steel ladders are always stiff and tight. They *never* get loose or "shackley"!

Fig. 3 also presents a form of pipe ladder which is made use of around steamboat boilers and engines to a considerable extent. While the pipe ladder has very excellent points of its own, there are also one or two which ladder users do not like and are apt to condemn the pipe ladder therefor.

One of these points is: the tendency of one or more rounds of the pipe ladder to get loose and roll under the foot of the man who may be using the ladder. The rolling of a round, or "rung," as perhaps it would be more proper to designate the ladder-treads, is always a very uncomfortable and frequently a dangerous thing. It upsets the "nerve" of the man under whose foot the rolling takes place and sometimes a heavy fall is the result of a rung rolling under foot.

But it is possible to make up pipe ladders in such a manner that the rungs will be immovable, under either the heaviest or the lightest loads. In Fig. 3, the pipe rails are of about one inch pipe, the rungs, one-half inch. The rails *P, P* are screwed into the proper fitting to give the required angle. Usually, these fittings are standard, as certain angles are much used in steamboat ladders and the fittings therefor are carried in stock by hardware dealers along the river. Still, many fittings have to be made "special" and to fit the required ladder angle.

In the pipe ladder shown by Fig. 3, it may be noted that the rungs *Q, R* and *S* are screwed into the rails *P, P*, but that the remaining rungs, *T, T, T*, are merely driven into the ladder rails in holes barely large enough for the "bare-foot" rungs to be forced into.

To further tighten the rungs which are not threaded, they are cut a little longer than the threaded rungs, so that when the latter are screwed into the rails the threaded rungs will never "bottom," but will force the bare-foot rungs very tightly against the walls of the ladder rungs, so that when the threaded rungs are screwed tight they not only hold themselves against the possibility of turning in the ladder rails, but also jamb the loose rungs so tightly that these never can turn under the foot, no matter how heavy or how loaded the passer-by may chance to be.

The writer asked the shop owner why he did not weld the rungs to the pipe rails and thus make everything safe and solid. The owner replied that "He didn't have any welding outfit" or he surely would do so. Such method of putting together pipe ladders would make a very neat, very strong and low-cost job which could not be approached for value by any other known methods of construction. The arc method of welding would lend itself particularly well to ladder making, and a careful oxy-acetylene welder would turn out work of adequate strength and stiffness.

CARE OF ROPE TACKLE

Boiler stack work on the Mississippi River calls for comparatively light hoisting tackle, but lines of considerable length are required for many jobs. In this shop they kept on hand at least half a dozen lines made of ¾-inch rope, and each was about 600 feet long. When rove into four-fold blocks, this would give a comfortable hoist of over 100 feet, and strong enough to handle any section of boiler stack likely to be called for on the river, where two or three sets of tackle are usually employed for handling a large stack.

But it is found that the long lines do not wear evenly. They show far more wear near one or both ends than

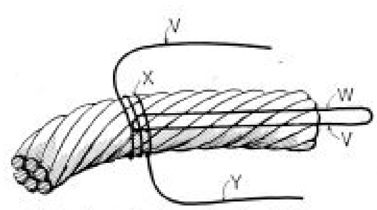


Fig. 4.—Sewing End of Rope

at the middle, for the reason that short hoists are made far more often than long ones, and the ends of the line become far more worn than the middle. The writer saw one line, which had been used almost entirely at one end, and not quite one-half the line had been reduced from its original size, so that instead of being ¾-inch rope it was only about ⅝ inch in diameter.

While the writer was present, the shop owner got at a couple of the long lines and cut them into shorter ones so as not to be bothered with 600 feet of rope when making a 30-foot lift. For inspection and cutting, the line was stretched out double, both ends being carried along the levee by one man, while another workman deftly "split" the big coil of 600 feet of rope, turning half of the coils to one side and letting the ends of the line pay off from both coils.

By a little care to not let the coils draw, the line was stretched out and one end found to be worn and reduced far more than the other end, but not to the middle of the line. All of the worn part was then cut off and made into a shorter line, while the remaining portion was made into a longer, newer and better line.

Before cutting the rope apart, the portions which were to form the ends of the new lines were served with twine, then the cut was made between the two served places.

The workman served the line in a manner different from what the writer was accustomed to seeing done. He simply lapped the middle of a piece of twine around the rope, and then kept lapping both ends until he had wound with string an inch or so of the rope. Then a knot was tied in the twine, the ends were cut off, and the rope cut in two between the two served places.

The writer, when he has a line to serve, prefers to proceed as shown by Fig. 4, the twine, *V*, being brought out along the end of the rope in a loop, *V*, *W*, then wound tightly around the rope in a coil *X*, after which the twine end *Y*, is wound tightly and closely around the rope until sufficient length of serving has been put on. Then the end *Y* is passed through the loop *V W*, pulled tight, and end *U* drawn back, loop *V W* disappearing underneath the coils of twine and pulling end *Y* in also. When the end of the loop has been pulled about halfway through, under the coils, both free ends of the twine are cut off and the serving is complete without a knot or a visible lap.

Aliens in American Industries

Industry Faces Grave Problem in Unfriendly Employee, Alien or Disloyal Citizen—Method of Solution

First of all, take a census of all employees and divide them into four classes: native born, naturalized citizens, friendly aliens, alien enemies. If they are naturalized citizens of enemy alien descent they had better be classed industrially with alien enemies until something of their history and record is known. Let us insist frankly that a man born on another soil has to *prove* himself for America. A certificate of naturalization granted under our inadequate requirements, where often a job is the goal, is not enough to class him with a native American.

Second, make an analysis or a map of your plant, showing its vulnerable spots. Where will a fire do the greatest damage; where is waste accumulated; what hydrant is most vital in extinguishing a fire; where is the control of your lighting system; and how accessible is your surtax bond; where will an explosion cause the most damage; what machines are most vital or difficult to replace; where can goods in transit be tampered with easiest? A dozen other things have already suggested themselves to you.

Loyal Americans Must Be in Charge

Now find out what kind of workmen are in charge of these vulnerable points. If they are enemy aliens, transfer them at once. Don't wait to have them prove their loyalty. Some other point in the shop will not decrease their efficiency and it may increase your safety. The fire brigade and the man who can reach the hydrant the quickest ought to be loyal American workmen—just as men in the boiler room and at delicate machines should also be. What are you paying men at these points, and what do you know about them?

Surveillance and guards and sentinels are the next most important considerations. The number and location of these should be determined by the numbers and location of alien enemies and persons of doubtful loyalty, and, second, by the strategic points to be guarded. *Both systems are necessary*—one for men; the other for places. They check each other and insure safety. With only the one method there will at various times be exposed points. One agent may be diverted, but two or more are more difficult to divert simultaneously.

When fences are put up and windows barred and guards established, do you consult your factory plan to see that every vulnerable part is included, or do you do like one concern in New England—leave your transformer out in a field, fifty feet outside of the fence, where an enemy with a tin can of powder could paralyze your plant? Safeguarding is a job of engineering—not a makeshift job that anyone can do. It would be interesting for each industrial leader to find out who handled the work in his own plant.

Lighting is the next important essential. Every possible improvement should be made; vulnerable points should be especially well lighted. *Keep alien eneimes and persons of doubtful loyalty in the light all of the time.*

Keep outsiders out. This is no time for outsiders or persons without official authority or business in war plants. Verify credentials of visitors. When they get in, see that they go only to the place they are supposed to go. Don't send them alone. Escort them in, stay with them, and escort them out.

Keep Outsiders Out

One way to keep outsiders out is to reduce your labor turnover. Every time a new man is taken on who is not known, it increases the risk. After the registration of enemy aliens in February, ask every new employee if he has such a registration card. If your shop is handling war supplies of the first magnitude, try to get every alien enemy out—not by throwing him out, but by exchanging with some industry that is not manufacturing war supplies. A man thrown out of a job because he is an alien may go to another plant in bitterness of spirit and wreck it for no other reason than to get even with his first employer. You help the Government when you help another employer protect his own plant.

Permits should be required by employees to go to different parts of the plant. A general tag is not sufficient. An alien enemy in one place may be a low risk; in another a high risk.

Appoint some employee as an alien captain in the plant, and give him a committee if it is advisable. It will be his business to spot anti-American propaganda and sentiment; to make such shop plans and maps as have been suggested, supervise registrations, recommend transfers and have the guards and sentinels under his direction. Call him by any preferred name, but give him the whole job of looking after the safety of the plant from the manpower end.

Keep Tabs on the Aliens

Take a personal interest in the alien. If it is necessary, set up an information bureau to help him understand drafts and regulations and registration. If he wants to learn English and become a citizen, help him do so. See that he gets American information on bulletin boards, in pay envelopes and otherwise, to offset the anti-American material sent him or told him. (Over 140,000 sets of civic lessons in foreign languages have already been handled by industries through pay envelopes.)

When this intelligent handling of alien enemy and those of doubtful loyalty is in operation the plant is ready for another step—the systematic removal of every possible cause for unrest, dissatisfaction, disloyalty and disturbance. This will require a close contact with the workmen, and another analysis of the plant, if not a map. Is it wages, or hours, or foremen, or the employing and dismissal method, housing or substitution of women? Whatever it is, it constitutes the medium through which the German agents work, and it is their chief stock in trade next to the love for the fatherland. In dealing with German spies, a plant has to be foolproof as well as bombproof. The man who strikes may think it is bad housing or treatment; the German propagandist knows it's German efficiency playing through American negligence and carelessness.

The American Government cannot protect the plant that will not protect itself, and the invisible war being carried on in American industries must be won by American manufacturers or the visible war in Europe will be lost.

Corrosion of Boiler Plates

BY JOHN O'TOOLE*

Fig 1 shows the condition of a boiler plate removed from a portion of the barrel of engine No. 81, South Australian Railways. This demonstrates that the water not only attacks steel, but best Yorkshire iron, as will be seen from illustrations. If this engine No. 81, with best Yorkshire iron plates, had been running where good surface water for boiler use was obtainable, not half the corrosion would have been set up, as indicated in the photograph, and before the deterioration shown had taken place, anything up to half a million miles' service would have been secured, and it is doubtful even then if the pitting would have been anything like so severe as in the case in connection with the boiler No. 81 with a mileage of only 238,900 miles.

This result would not have been attained were it not for the fact that engine No. 81 has been working in districts where the water is very much better, as will be seen from the other illustration in connection with engine No. 4, having best mild steel plates. This engine has used exclusively water obtained from the Metropolitan district, and after being in traffic only three years and five months and running 27,000 miles the casing plates had to be renewed, and if the boiler inspection and examination had not been of the most drastic kind, trouble would have resulted. The scaling salts in this water are so bad that they eat steel plates away in the manner indicated in the illustration.

* Australian representative of THE BOILER MAKER.

The Cost in Coal of Avoidable Belt Slip

Avoidable losses are the ones to stop always, especially if they can be stopped at small expense.

Never before have we understood the strategic and money value of coal as thoroughly as we do now. Never before has it been so necessary for us to save, even though considerable money must be spent in order to effect the saving.

One of the very simplest losses to overcome, however, and at small expense, is belt slip, and since belts are used

Fig. 1.—Engine No. 81. Portion of Barrel Plate. New Best Yorkshire Iron Plate Six Years in Traffic. Deepest Pit at C, 3/16 Inch, Leaving 1/4 Inch Solid Plate. Total mileage 238,980 Miles

Lower picture shows a lead casting taken off the above plate, showing the pitting in reverse

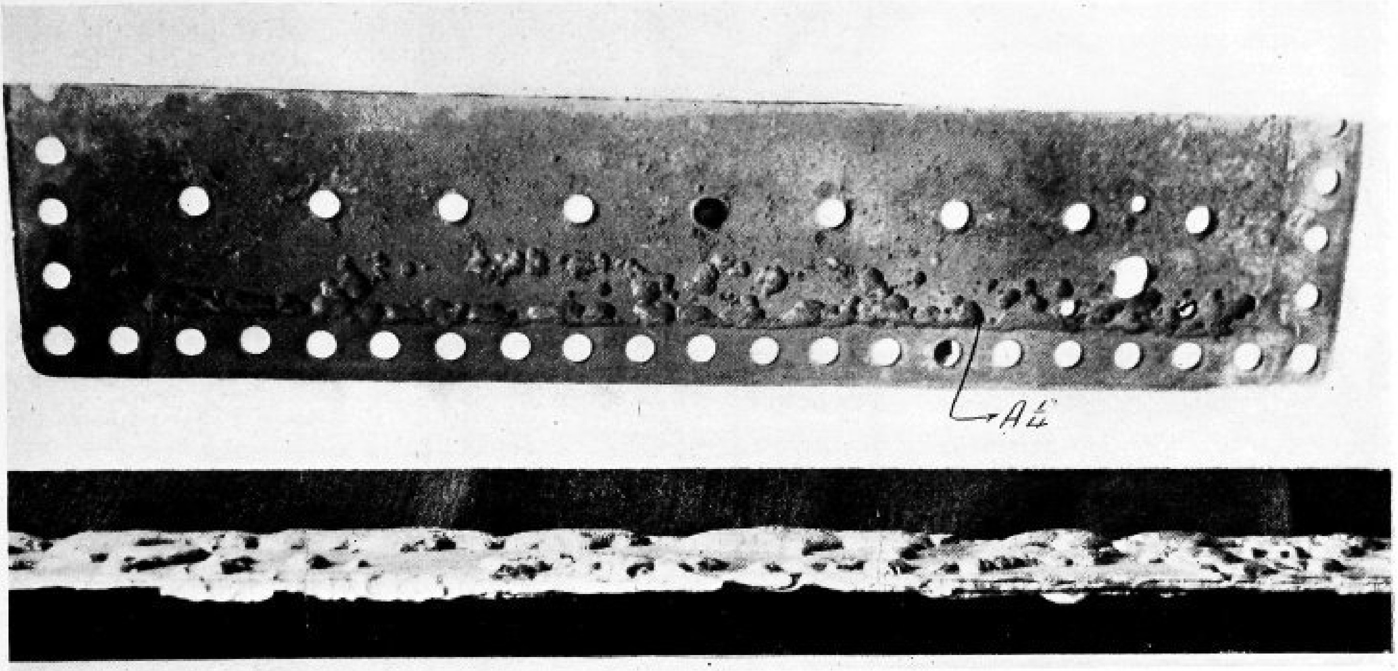


Fig. 2.—Engine No. 4. Side Casing Plate at Foundation Ring. New Plate 3 Years 5 Months in Traffic. Deepest Pit at *A*, ¼ Inch, Leaving 3/16 Inch of Solid Plate. Total Mileage 27,101 Miles

Lower picture is a lead casting taken off of above plate, showing the pitting in reverse

to so great an extent it will pay to look into the matter with more thoroughness than has been given it in the past. To show the extent of the loss of money through slipping of the main belt alone a chart, supplied us through the courtesy of the Cling-Surface Company, Buffalo, N. Y., is shown herewith, upon which this is easily ascertained. By glancing up and down column "D" of this chart it is evident that the "Cost of Avoidable Belt Slip Per Year in Dollars" may vary all the way from the smallest sums into the thousands of dollars.

Where the power in the first place is generated by a steam engine and is then transmitted to a generator or to the main shaft through a main belt it is evident that the "entire coal pile" passes through that in the form of energy, literally speaking. If the belt slips, which it should not do, a certain portion of the coal pile does not "get through," but is lost into the atmosphere in the form of waste heat. A main belt is merely a "link" connecting the engine with the generator or with the machines themselves. In fact, every belt that transmits power is a connecting link, and the efficiency of that link depends largely upon the freedom from slippage and the avoidance of strain on the shafts. Slipless, easy-running belts are most desirable.

A Power Plant Is a Train of Links

For the moment it might be well to dwell upon this thought, as it is seldom looked at in just this light.

We have for the first link the coal on the grates, which only perfect combustion can turn into maximum heat; next the boiler shell and tubes—they must be clean to bring the heat link to the steam link; next the steam line from boiler to engine or turbine—large enough and well insulated; then the engine or turbine link, which joins heat energy and mechanical energy—only careful design, proper valve setting and much care minimize losses here.

Then, where power is distributed solely through belts and pulleys, the belts, pulleys and shafts or electrical cables to the final motors and belts are the connecting links up to the very machines themselves.

If the efficiency of every link is maintained at its highest point the power end of the plant is beyond criticism. The overall efficiency will then be very high. But if the efficiency of every link is low or indifferent the overall efficiency of the power end will be distressingly low.

Mere Matter of Detail?

Many of us talk glibly about efficiency, as though it could be acquired over night. Thus one man has stated that "Efficiency is a mere matter of detail." His definition is all right, but detail is not a "mere matter."

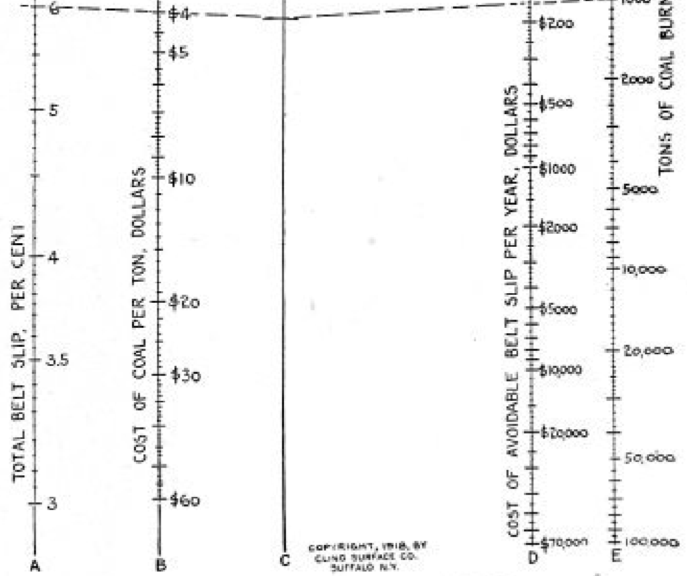


Chart Showing Loss Due to Belt Creep

Belt Slip Is Not a "Mere Matter," Either

For these various reasons, therefore, it is plain that power transmission through belting is a "detail" on which we should "plug" until all avoidable slip is eliminated. It is especially important, as stated before, where all the power passes through a single main drive belt. Each percent of slip in such a belt represents a loss of 1 percent of the coal pile.

Roughly, 2 percent of the potential power in the driving pulley of the engine is represented by "belt creep." Its loss is unavoidable because of the elasticity of the belt. This has been recognized and provided for in the chart, so the reader can go ahead and connect known values, while the intersection with column "D" gives the avoidable money loss.

Simply zigzag across the chart twice with a straightedge, as shown by the dotted lines, and the money loss is immediately found. Thus, if the total belt slip is 6 percent (column A) and the cost of coal per ton is $4.00 (column B), run a straight line through those two points and locate the intersection with column "C." Then from that point of intersection run over to the tons of coal burned per year (which in this instance has been stated as 1,000 tons), and the cost of avoidable belt slip per year is shown by column "D" as being $160.00.

For $160.00, as the makers say, one can purchase a great deal of Cling-Surface, and one can in consequence well afford to give a little time every month to the care of the belting. Yearly loss due to belt slip is often considerably greater than $160.00, for it must be remembered that this chart applies only to one belt—the main belt. If all of the distributing or secondary belts slip equally as much, the yearly loss is double, triple, or even four times as much as $160.00.

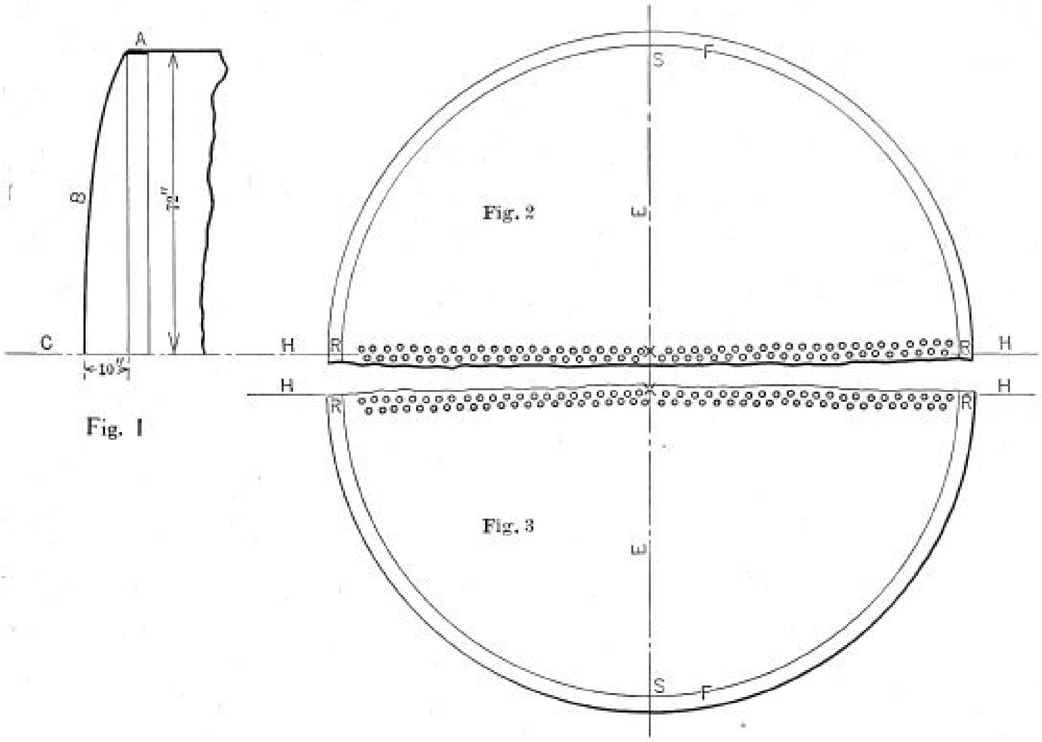
To give a clear idea as to the meaning of "total belt slip percent" let us take an example. You find by means of a revolution counter that a given driven pulley is rotating only 940 times per minute. You figure that without slip it should rotate 1,000 times per minute; 60 revolutions per minute, therefore, are absolutely lost. Dividing this 60 by the revolutions per minute that pulley should make, you get 0.060, or 6 percent, which is the "total belt slip." After having made this determination, now it is a simple matter to apply it to the chart, as has been done, and determine the money loss per year due to such slip.

Furthermore, belts which do not slip do not require tension and can be run easy or slack—every belt thus relieved of its tension reduces by that much the total plant friction load, and this means also a longer-lived belt, cool bearings, less oil used, less time of men and machines lost during repairs and more power at the machines; for friction represents lost power.

An Easy Method for Laying Out a Dished Head in Two Pieces*

BY J. G. SEYBOLDT

I have recently made in the course of my business a large number of tanks and stills varying in size from 8 to 12 feet in diameter, and the heads of these tanks were to be made in two pieces and dished 8 to 12 inches. The accompanying illustration shows the method I used for laying out these heads, and is a very simple one, and makes a good job when completed.



Layout of a Dished Head in Two Pieces

We will first draw one-half of the end elevation of the head of the still as shown in Fig. 1. In this case the half diameter is 72 inches, and the dish of the head is 10 inches. Now draw the short lines *HHHH*, Figs. 2 and 3, on the plates which were ordered to make the heads. From the lines *HH* square up the line *E* and mark the center *X*. From the center line *C*, Fig. 1, travel to *A* on line *B*, and mark this length on the lines *E* and *E*, Figs. 2 and 3, giving us the points *S* and *S*. From the point *X* with the distance *XS* as a radius, strike the circumference or flanged lines *F*. The circumference in inches corresponding to 72 inches radius is 452.4 inches. This number, divided by 4, will give us the length of one-quarter of the head, or from the point *S* to *R*, Figs. 2 and

* Reprinted from March, 1906, issue by request.

3. With a thin straight-edge held to the points *R*, *X* and *R* draw lines, which will be the rivet lines. Before we space off the rivet holes, a calculation will be necessary, as the joints are lapped and the top part of the head is put inside, so if the holes were spaced the same distance on the top and bottom half they would not match. The radius of the dish of the head in question is 24 feet, and the circumference corresponding to this is about 1,809 inches. This divided by 146 inches, the length of the head on the dish line *B*, equals about one-twelfth of the circumference. If we use a ½-inch plate, the difference in the circumference betwen the outside and the inside dished plate would be 3 inches for the whole circumference; therefore, 3 inches divided by 12 equals .25, which shows that we should have a difference of ¼ inch on the upper and lower head on the lines *HH*, or ⅛ of an inch on each side of the center line *E*. In Fig. 3 I have allowed ½ an inch on each corner, so that when the flange is turned the lap will not be short inside.

Lay off the rivet holes on both sheets and have them punched. Add the necessary lap, bevel and scarf for plates, and you are ready to dish. To dish, we laid a pair of blocks 48 inches in diameter, with a dish equal to 44 feet and dished ½-inch heads cold on an 8-foot Bement hydraulic flange press without any difficulty. No doubt many of the readers of this journal have used the above method. If not, try it, and you will find that it is all right, and that it requires very little work to lay out and to dish.

The Little Fellow in Business

Need Not Fear Big Competition—His Advantages Are Greater Than the Disadvantages

BY EDWIN L. SEABROOK

Has the little fellow in business any advantages over his big competitor? Has big business, in its process of combining and consolidating, commandeered all the sources from which business originates; are the executive and mechanical talent so entrenched that the little fellow no longer has a show? Is the big boiler plant such a menace to the little fellow that he feels like quaking a bit sometimes?

There is newspaper publicity that always gives headlines to the big thing and passes over the little with a line in an obscure corner. Big advertisers can get big reading notices. Publicity is a great factor, and the little fellow does not get many superlatives unless he does something extraordinary, and then he ceases to be little.

Purchasing capacity has its advantages. Big quantities induce lower selling prices. The large account is always sought for, while the little one is often overlooked by the selling force of supply houses. Despite the increased cost of carrying large stocks, the big establishment makes a profit on this over the smaller one because it is able to underbuy.

Is a big bank account the one essential to success and a small one a fatal defect? Is the public totally irresponsive to the ability of the little fellow? Is he practically excluded from a living portion of the public's business? In spite of the fact that the present-day tendency is toward bigness, has he a chance to grow and develop? In this day when everything from a nation to the breakfast table is going through a readjustment, these are interesting questions. Therefore, the commercial status of the small man in the business field is worth considering. Has the little fellow a chance? Suppose we reason it out?

Most businesses are small—in fact, there are more small than big ones. There are many more small communities, towns and cities than big ones. Some of these will continue to grow bigger and bigger, while others will never be much larger than they are at present, for natural reasons. It always has been this way, and probably always will be, both as to business and centers of population. It, therefore, stands to reason that many businesses must, in the very nature of things, be circumscribed or limited as to growth. Little towns cannot support big businesses unless the business is drawn from a wide territory. The size of the establishment must always be somewhat in proportion to the size of the population.

In every community that is at all progressive there is a natural increase in business. The man who starts in a small way and progresses with his community will undoubtedly share in this business increase. Here is one of the advantages for the little fellow who has made a start. On the other hand, many new businesses are starting, and many that have been operating for some time are so situated as to capital and location that they cannot be expected to make very much of an increase in size. This should not be taken as a discouragement, because there are many small businesses that are far more profitable in proportion than the big ones. The small community with moderate demands does not require a big capital, and this is again to the advantage of the small business man.

Large cities do not necessarily mean or demand exclusively large businesses. A glance over the business field in the largest cities will probably show that there are more little fellows than big ones. Many men can successfully manage a small or moderately sized business. When it gets beyond a certain size they would cease to be master of it. Some instinct seems to show this class of men their limitations and they keep within it. There are many managers of big businesses that would be total failures in running small affairs just as much as the little fellow would be if he were placed in the big one's position. Viewed from this standpoint, the little business and the big one seem to be on a par so far as stability and relative success are concerned.

Very few big concerns can exist on the business within their territory. They must go outside to secure enough business to keep the big works going. When dull times come the big concern is often hit harder than the smaller one. A rail thirty feet long is much more liable to crack in contracting than one three feet. The small shop can contract with less strain than the big one. The little fellow can reduce his overhead expense without seriously weakening his business or mechanical organization. The big concern can do this to some extent, but nowhere near in proportion to the little fellow. The large business must to a very great extent keep its sales or business-producing and mechanical organization intact. Advertising in some form must go on. The little fellow is free from much of this.

Low Prices Not Always Necessary

Has the little fellow any advantage in securing a better price than the big concern? That depends upon the field that he attempts to reach. Purchasing agents and large buyers keep well posted on prices, and, of course, endeavor to buy at the closest margin possible. In the very nature of things there are many who have no reason to follow the market closely and do not investigate prices so closely as the big buyer. There is a class of trade that can be reached by the little fellow much better than by the big concern. In many instances the little fellow, by explaining personally to his prospective customer just what he intends to do, how he intends to do it, and what his article will do for the customer when he has it, can secure a better price than his big rival. From whom purchases are to be made is often determined by something entirely distinct and separate from the price—how much—such as location, personal acquaintance, etc. If size of a business determined where purchases were to be made, the little fellow would go by the board in short order.

Service to Customers

The question of service is not to be underestimated. It might be suggested that the larger establishment can render better service than the small one; but as a matter of fact the little shop can generally put it all over the big one. The very size of the big shop, the extent of its contracts, and other classes of work, render it impossible for the owner to come in personal touch with his customer. If there is any feature where the large business falls down, compared with the small one, it is in the matter of personal supervision of work that counts so much for the good will of the customer. In many instances the proprietors of the small shops are able to wait on their customers themselves, give personal, expert attention, which is absolutely out of the question in a big establishment. They are not only able to give exact knowledge of their supplies and the uses to which these can be put, but in many cases can carefully analyze the needs of the customer better than he can do himself. Before the deal is closed the little fellow has satisfied himself of what his customer needs, and impresses the prospect accordingly.

This personal supervision, the close contact with the customer, is the biggest part of securing orders. Convenient locations and many like facilities count for much; but when it is all said and done, service is needed to accomplish definite results. This kind of service consists in giving customers what they want, in the way, and when they want it. It is very hard to imagine anyone going in raptures in having boiler work done. These lines are seldom bought for the enjoyment they alone give the possessor; but for the purpose of doing something needful and useful with them. They are just a means to an end, and that end is—*satisfaction.*

Taking away all the trimmings and non-essentials in purchases, it will be found that unless the customer gets the best possible thing that is most suited to the requirements needed, real service has not been rendered, no matter how large the establishment, nor how efficient the selling service executing the order. Here is where the small shops can have their innings and, as it were, make home runs. In many cases the proprietors of this class can give their customers personal, expert attention, which is always sought after, so much appreciated, but generally out of the question for the big establishment.

This kind of service is unbeatable, even though the shop is in the middle of a lot on a back street. It is doing good work in a merchandising sense, and if followed up means the development of personal relations between proprietor and customer that firmly establishes a business. It is human nature to desire the maintenance of pleasant and agreeable relationships wherever and whatever these may be, and the boiler maker who makes friends of his customers by giving them satisfactory service and dependable work is building a permanent trade that nobody is going to take away from him. The personal equation is a powerful factor, and the customer who learns that he can get good treatment and expert attention at a certain place is quite sure to repeat his orders, even if it is among the very small establishments in its lines.

Personal service, therefore, stands at the head of all the advantages of the small concern. This advantage is real and not theoretical. It is within the reach of every little fellow who will study the interests of his customers. He can come into personal contact with these in a manner that is well-nigh impossible for the management of big concerns. The little man in business who gives real service will neither lack for business to do, nor the profits therefrom.

The small man in business has every opportunity to develop to the limit of his capacity. The banks are looking for honest young men who are ambitious to forge ahead. They are always glad to extend credit to those who can show that they are building on a solid foundation. Banks and supply houses place probably more importance on the character of a man than the size of his business. Enough credit properly taken care of can always be secured to meet the needs of a growing business. A reputation should be acquired for doing the best kind of work. Low prices may be one form of inducement for placing the order; but it is generally the weakest. Slashing prices generally begins when every other argument is exhausted. The shop which is giving service and good work, asking only a fair margin of profit, can keep right on taking orders in the face of competition that is based solely on cut prices.

Profit

The small business man can earn a larger profit on his capital invested than his larger rival. This is due to several reasons: Close supervision can be given to the work as it passes through its various processes. Overhead expenses can be kept to the minimum with every unnecessary item lopped off.

Credit being extended almost exclusively in his own community, the customer's known personally, losses in this respect can be kept down so that they will be few, if any. The expense of collecting outstanding accounts is almost negligible compared with the big business.

Summing up the whole situation, it appears that the little fellow is an important factor in business and must be recognized as such. There are more of them than big ones, and no doubt statistics would show that they do more business than the large concerns. He is at some disadvantage, but so is the big fellow, and probably the little one has more to his credit side than disadvantages on the debit side. He can do just as good work as his big competitor, come into closer contact with his customers, give better personal service.

The little fellow in business has many advantages: He is not going to be bowled out by any means, and he has a great opportunity to make a larger profit on his capital and time than the larger business.

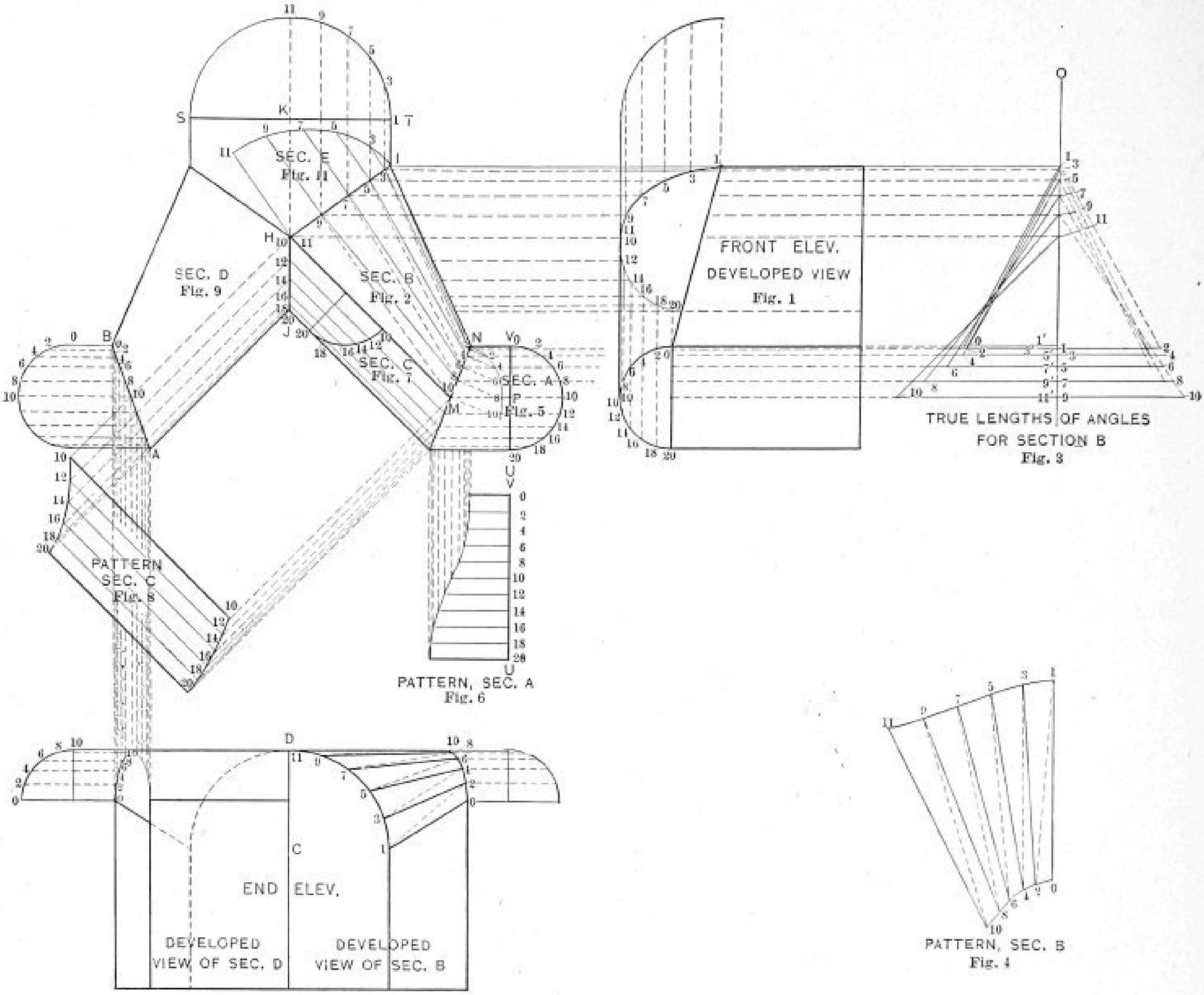


Fig. 10. Development of Patterns for Y Breeching

Layout of Irregular Y Breeching

Patterns for Section of Large Rectangular Smoke Flue with Half-Round Top Developed

BY W. MELDRUM

The following is a description of the methods used to develop patterns for a Y breeching which was built at our works recently. This was a section of a large rectangular smoke flue with a half-round top.

First, the layerout drew the plan from dimensions given on the blueprint, locating all the intersecting lines. This gave the sections A (Fig. 5), B (Fig. 2), C (Fig. 7), and E (Fig. 11), which were to be developed.

To lay out section A (Fig. 5), on the line *U-V* with *P* as a center, strike a semi-circle. Divide this into ten equal parts, numbered 0 to 20. From these points erect perpendiculars to the line *M-N*. Then draw the line *U-V* (Fig. 6). On this line lay out the stretchout of the semi-circle (Fig. 5) and divide it into ten equal parts numbered from 0 to 20. Now, from the points located on *M-N* (Fig. 5) project over to perpendiculars having corresponding numbers (Fig. 6). Draw an irregular curve through these points, which will give pattern for section A.

To lay out section B (Fig. 2), first draw the semi-circle on the line *S-T* (Fig. 11). Divide a quarter of the circle into five equal parts. Project from these points over to the line *H*-1 (Fig. 2); then from the points located on *H*-1 and at right angles to same erect perpendiculars. On these lines strike off the distances shown from the line *S-T* (Fig. 11) to 11, 9, 7, 5, 3 on the circle. Draw an irregular curve through these points, numbered 1, 3, 5, 7, 9, 11. This gives the profile through the cross-section *H*-1.

On the line *M-N*, and from the points that were located for development of section A, erect perpendiculars. On these lines strike off the distances which are shown from the line *U-V* (Fig. 5) to 0, 2, 4, 6, 8, 10 on the circle. Draw an irregular curve through these points, giving the profile through cross-section *M-N*.

Now, from the points 2, 4, 6 and 8, line *M-N*, to the points 3, 5, 7 and 9, line *H*-1, connect with solid lines, and from points 1 on the line *H*-1 to 2, on line *M-N*, connect with a dotted line, and so on with 3 to 4, 5 to 6, 7 to 8, 9 to 10. Next draw the line 0-*x* (Fig. 3). From the points 1, 3, 5, 7, 9, 11 (line *H*-1) project over to line 0-*x*, locating points 1, 3, 5, 7, 9, 11. Do the same from the line *M-N*, locating 1, 3, 5, 7, 9, 11. These are the heights of the different triangles required to develop the pattern.

We must now find the bases for these triangles; therefore, develop an end view, shown at Fig. 10. It will be noticed that one-half of this view is developed, showing section B. The other is section D, which is half of the breeching. In developing the end view through section *M-N* we must project from the points 0, 2, 4, 6, 8, 10 (line *M-N*) over to the end view, but, to avoid a confusion of lines, I have developed this view from line *A-B* (Fig. 9) to the end view of section D, locating points 0, 2, 4, 6, 8, 10. These points were located for section B in the same way. Draw an irregular curve through these points; then on the line *C-D* (Fig. 10), and with *G* as a center, strike a quarter circle. Divide this into five equal parts numbered 1, 3, 5, 7, 9, 11. Connect 0 to 1 and 2 to 3, and so on, with solid lines; also 1 to 2, 3 to 4, and so on, with dotted lines. These are the bases of the triangles for development of section B.

Next, on the line 0-*x* erect perpendiculars at the points 1, 3, 5, 7, 9, 11, and on these lines transfer the distances 0 to 1, 2 to 3, 4 to 5, 6 to 7, 8 to 9, 10 to 11, found in Fig. 10. Connect 0 to 1, 2 to 3, and so on (Fig. 3), with solid lines. These are the true lengths of the lines. Also transfer the distances 1 to 2, 3 to 4, and so on, the dotted lines found in Fig. 10, to the perpendiculars on 0-*x*. Connect 1 to 2, 3 to 4, 5 to 6, 7 to 8 and 9 to 10 with dotted lines. These are the true lengths of all the lines for development of section B.

We now continue the line 0-*x* an indefinite length, then set the trams to the distance 0-1 (Fig. 3), strike it off on the line 0-*x* (Fig. 4), set the trams again to the distance 1 to 2 (dotted line, Fig. 3), and with 1 (Fig. 4) as a center scribe an arc. With a pair of dividers pick off the space 0 to 2 on the profile of *M-N* (Fig. 2), and with 0 as a center (Fig. 4) scribe an arc, cutting the first arc. This locates point 2 (Fig. 4). Set the trams to distance 2 to 3 (solid line, Fig. 3), and with 2 (Fig. 4) as a center scribe an arc. Now, with dividers set to the distance 1 to 3 on the profile *H*-1 (Fig. 2), transfer to Fig. 4, and with 1 as a center scribe an arc intersecting the arc previously drawn, locating point 3. Proceed in the same way until all the triangles are transferred to Fig. 4.

Great care must be taken when picking off the distances on the profiles of *M-N* and *H*-1, as they are unequal. Another point for the layerout to take notice of is the way the triangles are numbered in Fig. 3, running from 0 to 1, 1 to 2, and so on, making it simple to follow and giving less chance of making mistakes when transferring the triangles.

This completes the pattern for section B. To develop section C, Fig. 7, scribe a quarter circle and divide it into five equal parts, numbered 10, 12, 14, 16, 18, 20. Through these points draw lines intersecting miter lines *H-J* and *M-N* (plan view), then to the left of the plan draw the stretchout and divide it into five equal parts numbered 10, 12, 14, 16, 18, 20. From the points located on the lines *M-N* and *H-J* project over to the lines having corresponding numbers. This gives the pattern for section C (Fig. 7).

Section E (Fig. 11) is laid out by the same methods as section A and section C. The front, *E L E*, has nothing to do with the laying out, but was drawn to show the development. All patterns were laid out to the rivet lines, and the necessary laps must be allowed.

Riveted Joints in Boilers

BY EDWARD R. WEYDERT*

All parts of a boiler in contact with the water and steam are subjected to the same pressure in boiler calculations, but in reality the pressure on the mud ring is greater than that on the dome on account of the added weight of the water.

Fig. 1 illustrates that the pressure acts on a boiler at all points from the center. Only one-half is shown, but the action on the other half is just the same.

As the seams or riveted joints in a boiler practically determine the working pressure of a boiler and nearly all

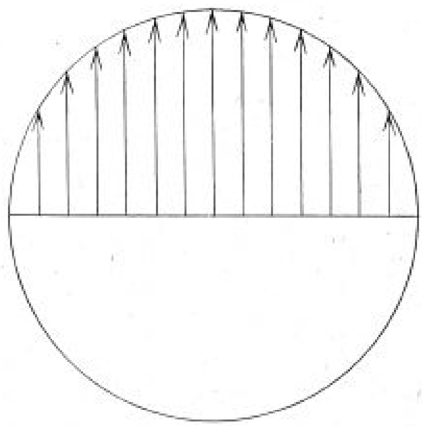


Fig. 1

depends on the joints and their efficiency, it is the object of the writer to explain the different kinds of riveted joints in such a manner as to be readily understood by the average boiler maker.

There are four kinds of riveted joints or seams commonly used in boilers. They are single riveted lap joints, double riveted lap joints, triple riveted lap joints and sextuple (six rows of rivets) riveted double welt butt joints. Before entering upon a discussion of each separately, some things necessarily have to be explained that enter into all.

In designing a riveted joint the following rules are favored by good practice and are easy to memorize:

1. The pitch of rivets for single riveting should be about two and one-half times the diameter of rivets and about three and three-fourths times the diameter of the rivets for double riveting.

2. The pitch near a calked edge must not be too great for proper calking.

3. The rivets must not be too near together.

4. The lap or distance from the center of the rivet hole to the outer edge of sheet should be at least one and one-half times the diameter of the rivets.

5. The diameter of the rivets is usually nearly twice the thickness of the sheet and should never be less than the thickness of the sheet.

6. The distance between rows for double riveting is about twice the diameter of the rivets.

7. In double butt riveting, the rivets in double shear have twice the single section.

8. The thickness of double butt straps or welt strips should not be less than five-eighths the thickness of the

* Technical and Practical Instructor of Apprentices, Erie Railroad Company, Susquehanna, Pa.

sheet, and the single straps or welts not less than one and one-eighth the thickness of the sheet.

A cylindrical boiler having the same pressure, diameter and thickness of shell is twice as strong through its diameter as along its length, therefore the greater tendency to rupture the seams running lengthwise the boiler.

Factor of safety of a boiler is the margin of safety used in designing a boiler or the ratio of the ultimate strength to the working stress. When a boiler is said to have a factor of safety of six, it means that if the boiler

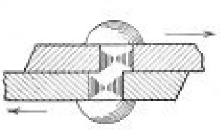


Fig. 2

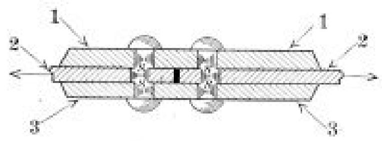


Fig. 3

was intended to carry 150 pounds pressure per square inch it is designed strong enough to carry 6 times 150, or 900 pounds per square inch. It can readily be seen that a boiler under ordinary conditions can be overloaded to a certain extent without danger of an explosion, as it is not likely that anyone will overload a boiler to any great extent. Having a liberal factor of safety insures longer life and less liability of explosions as the boiler becomes old and subjected to continual usage.

Tensile strength of a plate is the internal stresses that are developed when a load tends to pull the material apart, as is the case of the sheets in the courses of a boiler, etc. Fifty-five thousand pounds per square inch is

strength would be 38,000 plus (38,000 x .85), or 70,300 pounds for iron rivets, and 45,000 plus (45,000 x .85), or 83,000 pounds for steel rivets.

It is needless to discuss the diameter and area of the rivet holes, pitch of the rivets, etc., as they are well-known terms to everyone. In calculating riveted joints, the diameter of the rivet hole is used instead of the diameter of the rivet, as the rivets are the same diameter as the holes after being driven.

Riveted joints may fail in any of the five following ways: By shearing the rivets, as shown by *A* in Fig. 4, due to the lack of shearing strength in the rivets; by tearing the plate between the rivets, shown by *B*, Fig. 4, due to the lack of tensile strength in the plate; by tearing the plate in front of the rivets, shown by *C*, Fig. 4, due to the lack of shearing strength in the plate between the edge of the plate and the rivet hole; by crushing the plate in front of the hole, as *D*, Fig. 4, due to lack of bearing stress in the rivet; by tearing the plate along a staggered line, as *E*, Fig. 4, for the same reason as *B*. There should be no excuse for a boiler maker placing the rivets so near the edge of the sheet as to cause a condition as shown by *D*, Fig. 4, unless in a rare case of emergency and there was no other sheet near the shop and the job is a rush one, which is not very often the case. The distance from the edge of the plate to the center of the hole should never be less than one and one-half times the diameter of the hole; that is, make the distance from the edge of the plate equal to the diameter of the rivet hole and never less.

In the discussion of riveted joints the following letters

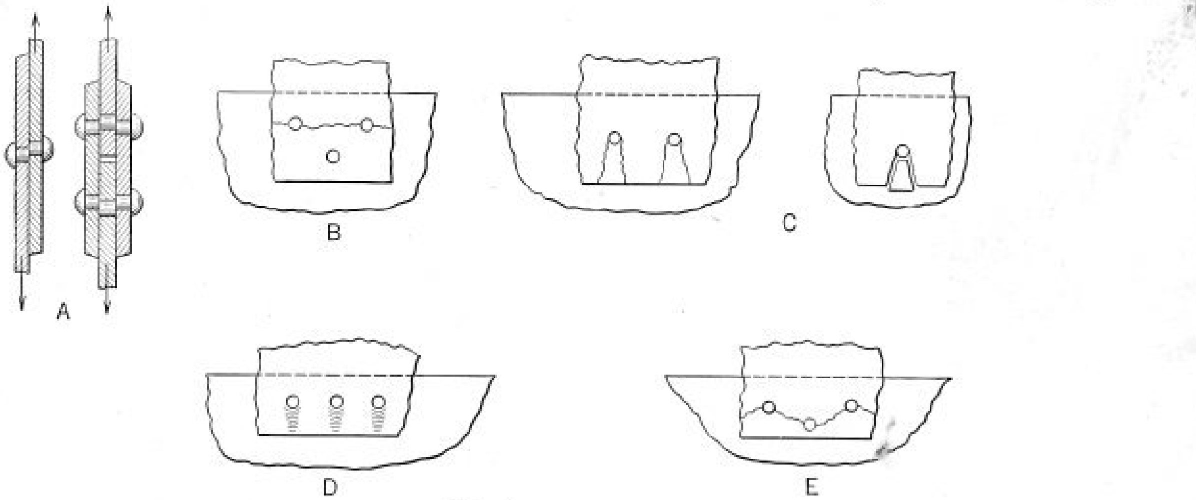


Fig. 4

usually used as the tensile strength in boiler plates. Sixty-five thousand pounds per square inch is the maximum used in boilers, as plates with a higher tensile strength are too hard and have to be annealed. Tensile strength is determined by tests.

Fig. 2 shows a rivet in single shear. It can be seen that the plates tend to shear the rivet along a straight line or in one plane, and the shearing is confined to one point. Fig. 3 shows a rivet in double shear. It is held by the two outside plates 1-1 and 3-3, and the center plate 2-2 causes the shearing, with the shearing points *s-s*, *s-s* taking place at the junction of the outside plates with the inside plate. Tests have proven that the strength of a rivet in double shear is 85 percent greater than the strength of a rivet in single shear. Thirty-eight thousand pounds per square inch for iron rivets in single shear and 45,000 pounds per square inch for steel rivets is usually used for rivets in single shear. If they were in double shear their

are given with the explanation of their meaning and use in the formulas as they are used in calculating riveted joints:

D—Diameter of boiler.
t—Thickness of plate.
L—Length of plate.
S—Tensile strength of plate.
E—Efficiency of joint as compared with the strength of solid plate.
f—Factor of safety.
a—Area of rivet hole.
d—Diameter of rivet hole.
r—Shearing resistance of rivets in single shear.
y—Shearing resistance of rivets in double shear.
P—Strength of solid plate.
N—Strength of net section of plate.
Z—Strength of rivets in double shear.
R—Strength of rivets in single shear.

The total force tending to rupture the boiler should be known first, and can be found by the solution of the formula, total force equals $p \times L \times D$, where p is the pressure in pounds per square inch and L and D as shown above. For example, take a boiler course 60 inches long and 72 inches in diameter and the working pressure 200 pounds per square inch. Then the total force is 200 x 60 x 72, or 86,400 pounds.

The total force tending to rupture a boiler across its diameter can be found by the formula $2 \times t \times L \times S$, with t, L and S the same as before. Using the same course as before and assuming the thickness of the plate to be 5/8 inch (.625 inch) and substituting the values of each in the formula, we have 2 x .625 x 60 x 65,000, or 4,875,000

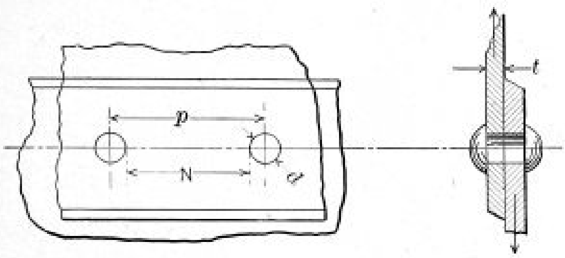


Fig. 5

pounds, which is enormous and shows plainly that all boiler work must be done with the greatest care.

In calculating the thickness of the plate without a factor of safety, use the formula

$$t = \frac{pD}{2S},$$

and with a factor of safety given, use the formula

$$t = \frac{fDp}{2SE},$$

the second formula may be used to find the safe working stresses by transposing the terms, as

$$p = \frac{2tES}{fD}.$$

All letters meaning the same as given before. As an example, take a boiler of 60 inches diameter carrying 200 pounds per square inch, and t, the tensile strength, as 60,000 pounds, and a factor of safety of 6. Assume the efficiency of the joint to be 80 percent. Later formulæ show how to calculate the efficiency of a joint. By substitution, we have

$$t = \frac{6 \times 60 \times 200}{2 \times 60{,}000 \times .8}, \text{ or } 3/4.$$

Therefore the thickness of the plate is 3/4 inch.

The efficiency of a joint is found by dividing the weakest part by the strength of the solid plate. The net section is always the weakest part, with a few exceptions, when the shearing resistance of the rivets is the weakest. If the net section is the weakest, $E = N/P$, and if the shearing resistance of the rivets is the weakest, $E = R/P$. An example of each will make it plainer. Assume the net section to be 125,000 pounds, the strength of the solid plate to be 150,000 pounds, and the shearing resistance of the rivets to be 137,000 pounds. The net section being the weakest,

$$E = \frac{125{,}000}{150{,}000}, \text{ or } 83.33 \text{ percent.}$$

Using P and N as before, and R as 120,000, then E will be

$$R/P, \text{ or } \frac{120{,}000}{150{,}000}, \text{ or } 80 \text{ percent.}$$

It can readily be seen by the foregoing that to calculate boiler joints, stresses, etc., one should have a clear understanding of the various letters given before, also those to follow, as to conditions represented and their meaning and position in the formulæ noted. It will do no harm to memorize them, but remembering at the same time that some of them have different meanings in different formulæ.

A single riveted lap joint is the most simple of all joints. Fig. 5 represents a single riveted lap joint, which is the edge of one plate overlapping the edge of another and riveted together with one row of rivets. The two edges of one plate may overlap each other and, being

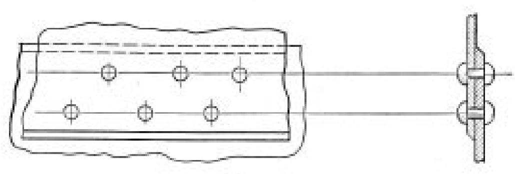


Fig. 6

riveted together with one row of rivets, would form a single riveted lap joint.

To calculate a single riveted lap joint, use the letters and their meaning as given before, with R representing one rivet in single shear, as there is one row of rivets, and assuming the following conditions: S equals 55,000 pounds per square inch, t equals 5/16 inch (.3125 inch), d equals 1 7/8 inches (1.875 inches), and r equals 38,000, using iron rivets, to find P, R, N and E.

$P = p \times t \times S$, or 1.875 x .3125 x 55,000, or 32,226 pounds.
$N = (p - d) \times t \times S$, or (1.875 — .8125) x .3125 x 55,000, or 18,262 pounds.
$R = a \times r$, or .5185 x 38,000, or 19,703 pounds.

The net section is the weakest, therefore

$$E = \frac{N}{P}, \text{ or } \frac{18{,}262}{32{,}226}, \text{ or } 56.6 \text{ percent.}$$

A double riveted lap joint is the same as a single riveted lap joint, excepting that it has two rows of rivets instead

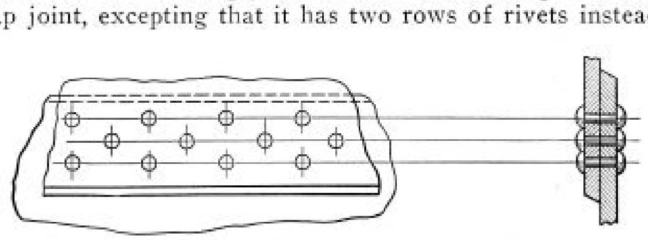


Fig. 7

of one, and the rivets are usually staggered across the sheet. Fig. 6 shows a double riveted lap joint.

Double riveted lap joints are nearly 20 percent stronger than single riveted lap joints, which is caused by the wider lap and better distribution of the material. The rivets are pitched wider and there is more rivet area to be sheared, also a larger percentage of net section of plate to be broken. Using the letters as before, excepting R, which is to be used for two rivets in single shear, as there are now two rows of rivets, and using the following conditions to calculate a double riveted lap joint, S = 55,000 pounds, t = 3/8 inch (.375 inch), d = 15/16 inch (.9375 inch), a = .69, p = 3 1/16 inches (3.0625 inches), and r = 38,000 (iron rivets), to find P, N, R and E.

$P = p \times t \times S$, or 3.0625 x .375 x 55,000 = 63,164 pounds.
$N = (p - d) \times t \times S$, or (3.0625 — .9375) x .375 x 55,000 = 43,828 pounds.
$R = a \times 2 \times r$, or .69 x 2 x 38,000 = 52,440 pounds.

The net section being the weakest,

$$E = \frac{N}{P}, \text{ or } \frac{43{,}828}{63{,}164} = 69.3 \text{ percent.}$$

Seventy percent is usually used in practice for double riveted lap joints.

Triple riveted lap joints are stronger than double riveted lap joints, for the same reasons as given for double riveted lap joints. They are the same as single and double riveted lap joints, except there are three rows of rivets instead of one or two. Fig. 7 shows a triple riveted lap joint.

Choosing the following conditions for a triple riveted lap joint and using iron rivets, with R for three rivets in single shear, as there are three rows of rivets, now S = 55,000 pounds, t = 3/8 inch (.375 inch), d = 13/16 inch (.8125), a = .5185, p = 3¼ inches (3.25 inches), and r = 38,000 pounds, to find P, N, R and E.

$P = p \times t \times S$, or 3.25 x .375 x 55,000 = 67,031 pounds.
$N = (p - d) \times t \times S$, or (3.25 — .8125) x .375 x 55,000 = 50,273 pounds.
$R = a \times 3 \times r$, or .5185 x 3 x 38,000 = 59,109 pounds.

The net section being the weakest,

$$E = \frac{N}{P} \text{ or } \frac{50{,}273}{67{,}031} = 75 \text{ percent.}$$

A sextuple (six rows of rivets) riveted double welt butt joint, which is used mostly for boilers of large diameters and high pressures and on large construction work, is the most efficient joint used. The rivets are in double shear, excepting the third or outer rows, which are

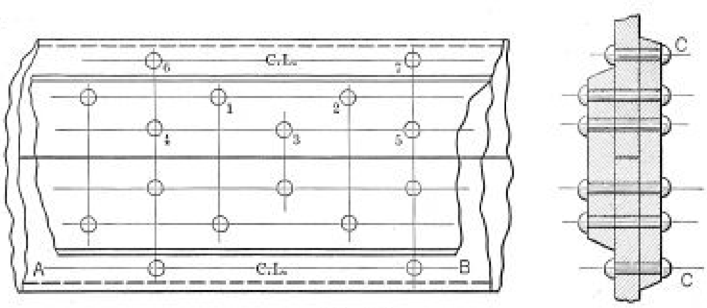


Fig. 8

in single shear, the inner welt strip being wider than the outer welt strip, extending far enough beyond the outer welt to allow a third row of rivets, as marked "*c*" in Fig. 8. The inner welt is usually made five-eighths as thick as the plate, and the outer welt the same thickness as the plate, but in figuring a joint of this kind the thickness of neither welt is considered, as all of the strain is on the plate, which is riveted to the welts, placing the rivets in double shear (excepting the outer rows, which are in single shear), which compensates for making the inner welt thinner than the plate. By putting in the outer rows the net section of the plate is increased and also adds another rivet to be sheared. By the rivets being in double shear their strength is increased 85 percent, as was stated before, and r equals 70,300 pounds for iron rivets and 83,000 pounds for steel rivets.

Assuming the following conditions and using Fig 8: One-half of rivet No. 6 and one-half of rivet No. 7 are included in taking a section of the joint as being between the two center lines marked "*c*". The halves of Nos. 6 and 7 are taken as one rivet. There are four rivets in double shear, namely, Nos. 1, 2, 3 and the halves of 4 and 5. The section *A-B* is always the weakest point in a properly designed joint of this kind. Let S = 55,000, i (pitch of rivets, inner row) = 3¼ inches (3.25 inches), o (pitch of rivets, outer row) = 6½ inches (6.5 inches), r = 38,000 pounds, y = 70,300 pounds, using iron rivets, find P, N, R, Z and E.

$P = o \times t \times S$, or 6.5 x .375 x 55,000, or 134,062 pounds.
$N = (o - d) \times t \times S$, or (6.5 — .8125) x .375 x 55,000, or 117,304 pounds.

These values for P and N give the strength of the plate at section *A-B*, which is the weakest.

$R = a \times r$, or .5185 x 38,000 = 19,703 pounds.
$Z = a \times 4 \times y$, or .5185 x 4 x 70,300 = 145,802 pounds (four rivets double shear).

To get the total shearing strength of all rivets the strength of those in single shear must be added to the strength of those in double shear; thus 19,703 plus 145,802 = 165,505 pounds, or the total strength of all rivets. The net section of plate is found the weakest, therefore the efficiency of the joint is 134,062 divided into 117,304, or 87.5 percent.

From the foregoing problems and explanations it is easy to calculate any other kind of joint.

Electric Heating of Steam Boilers

Banked boilers in an auxiliary steam plant, acting as reserve for hydro-electric generators, involve considerable fuel consumption and constant supervision. When surplus electrical energy is available, which is especially the case in summer, it may be applied usefully to keeping the reserve boilers hot. In the Letten station (Zurich municipality) two watertube boilers, each of 270 square meters heating surface, have been electrically heated since September, 1915, and with such success that the system is being applied to other boilers. Cast iron resistances are mounted on a rolled steel frame, which fits onto the grate; the furnace mouth is closed by a terminal plate with observation window.

In a double flame-tube boiler there are six sections of resistance (pairs in series) in each tube. All dampers are closed while electric heating is in progress. The maximum temperature of the resistances does not exceed 600 degrees C. A double boiler with 17 cubic meters water capacity, supplying 1,720 kilograms steam per 25 hours at 4 to 7 atmospheres for feed pumps and keeping pipes and machines hot, consumed 84 to 86 kilowatts. The three boilers heated electrically supply 5,630 kilograms steam per day, and consume on the average 1.31 kilowatt-hours per kilogram of steam.

At ordinary prices, electric heating of boilers is prohibitively costly; the system is only applicable where the power would otherwise go to waste. Working pressure of 7 atmospheres was reached 100 hours after commencing electric heating. The distribution of heat is approximately as follows: Resistance elements, 450 degrees; 10 centimeters above the heater, 315 degrees; over second row of watertubes, 185 degrees; over fifth row, 173 degrees; behind superheater, 165 degrees; over damper, 157 degrees.—*Science Abstracts.*

Removal.—The general sales office of the Vulcan Soot Cleaner Sales Company, 230 South La Salle Street, Chicago, has been transferred to Du Bois, Pa., with Mr. G. L. Simonds in charge. This is only a change in location to bring the sales, factory and engineers in immediate touch, with the idea of giving better service to all; the personnel to remain as before.

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NOTICE TO ADVERTISERS

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 25th of the month, to insure the carrying out of such instructions in the issue of the month following.

The thirtieth annual convention of the American Boiler Manufacturers' Association will be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., on June 17 and 18.

There was some difference of opinion in this country about the war until the Kaiser undertook to repeal the Declaration of Independence and to declare the Constitution of the United States null and void. That is when America decided the time had definitely come to get into the fight. No true American had any further doubts on the subject; and since then the Government has held what were, in effect, three great national referendums on the question that served to convince the Germans that it was not only the American government, but the American people, who were waging this war to maintain the independence and right of self-government given them by their fathers as an imperishable heritage.

The first referendum was the draft, and the way the millions of America answered the call was a staggering blow to the Kaiser in his power-mad belief that Americans of to-day would not fight to uphold the principles their fathers had fought and died for in 1776. The next referendums were the First and Second Liberty Loans, and again the vote overwhelmingly expressed the invincible determination of America to dedicate its treasure and its blood in a victorious war.

The Kaiser has not been stopped yet; since those three votes were taken he has murdered thousands of the flower of many nations' manhood, including America; he has overthrown self-government in Russia, and he has reduced small nations to slavery under his empire of violence.

But now another vote of confidence is to be taken in the United States. It is not to be merely a vote of confidence in the Government's conduct of the war; it is to be a vote to inspire confidence in the Allies of the United States that whatever reverses and discouragements may have come, the determination of this country to wage the war to a triumphant ending is cumulative and increasing. By voting more billions than ever to the common cause in the coming Third Liberty Loan, the people of this country will once more strike the Kaiser a staggering blow.

To those of us who think, the announcement of the third issue of Liberty Bonds at this time must be exceptionally welcome. We have read of the supreme effort launched by the Central Powers. We have trembled at the possibilities which were unfolded when for the moment the British were driven back, and we asked "What can I do?"

The answer is furnished by the Government, of which we are a part. That Government urges us to buy Liberty Bonds that those who fight for liberty, that those who uphold the dignity of America may be fitted to perform the task they have accepted and be protected in performing it.

Gladly we accept the duty; proudly we welcome the privilege. Let us not for one moment consider that we are doing anything which should entitle us to high honor or praise.

There is one feature in connection with this sale of Liberty Bonds that is often overlooked. It is this—the men who have gone into the trenches are, according to vocational averages, among the largest purchasers of these bonds. The soldiers who go to give their lives, if necessary, that America may live and that the American ideals may be more generally accepted, have given so freely of their money that they have shamed those who stay at home.

On October 18, 1917, in northern France, with the thunder of German guns in their ears, the Eleventh (Railway) Engineers of New York were paraded that they might learn that America was raising a Liberty Loan to provide money for the prosecution of the war. They were asked if any present would care to subscribe for $50 bonds. There are 185 men in a company, and this was the answer: Company A, 396 bonds; Company B, 363 bonds; Company C, 234 bonds; Company D, 240 bonds; Company E, 285 bonds, and Company F, 440 bonds. This is only a single illustration. It could be multiplied, and without doubt it could be paralleled, if not eclipsed, by the record of other units.

We who are compelled by circumstances to stay at home cannot approach this sublimity of service, but surely, as we regard it, we must be inspired to greater efforts on behalf of the country that sent such men to the front.

Bearing these things steadily in mind, let us pledge ourselves to make this loan an overwhelming success, not only by the fact of its over-subscription, but by the fact that it will be divided among twice or three times as many awakened Americans as was either of the other issues of Liberty Bonds.

Engineering Specialties for Boiler Making

New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

Dallett Boiler Shell Drill

A motor-driven boiler shell drill, designed to use high-speed steel drills, is manufactured by Thos. H. Dallett Company, Philadelphia, Pa.

This machine consists of two or more drilling heads and two horizontal bars of whatever length may be specified, the lower one being provided with a rack on the under side. This outfit may be incorporated on a housing of the purchaser's own design, in which provision can be made for raising or lowering by means of screws connected together at the top by a horizontal shaft and bevel gears, or it may be attached to the structural elements of a building by the use of yokes to hold the bars the proper distance apart. The columns of the building may be provided with a series of holes so that when a shell of a different diameter is being drilled, the whole device can be raised or lowered to the proper place and bolted fast. This latter method answers all purposes in the majority of cases, as the range of the machine within itself is such as to make unnecessary the continual raising or lowering of same in actual operation, especially if a number of boilers of the same size are being drilled.

The shell is placed in front of the machine on rollers, and, as each head has a vertical movement and the spindle can be tilted, a hole can always be drilled radially to the center of the boiler. Each drilling head has a vertical adjustment in itself of 6 inches, operated by a crank handle at the bottom, and is moved along the bars by means of a pinion and rack on the under side of the lower bar. The spindle is 2 1/16 inches in diameter and bored for a No. 4 Morse taper. It has a traverse of 16 inches and a range through an arc of 15 degrees, to permit drilling radially, as before mentioned, the latter movement being controlled by the hand wheel, which appears immediately beneath the gear reduction in Fig. 3. The motor pinion and gearing are arranged to give the proper spindle speeds to suit the work in each individual case. There are no bevel gears used in the transmission from the motor shaft to the spindle, spur gears only being used, making a very durable and efficient gear reduction.

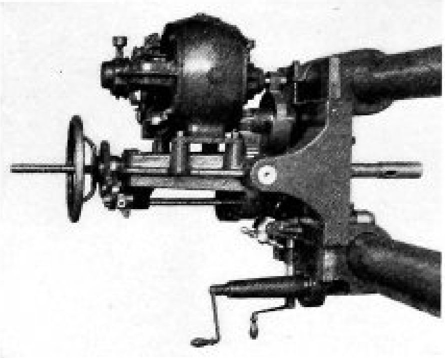


Fig. 3.—Side View

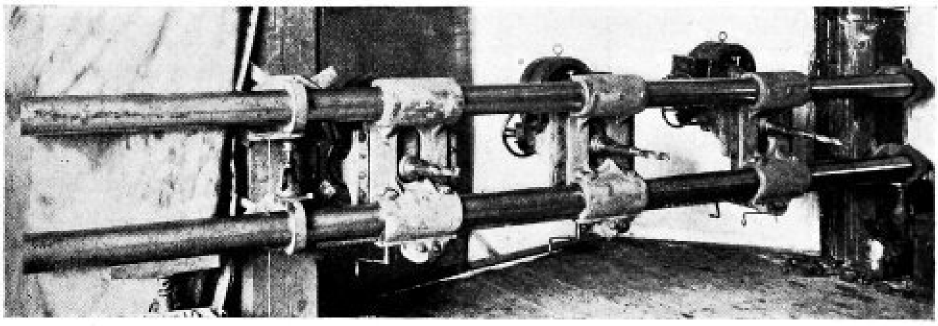


Fig. 1.—Front View of Dallett Boiler Shell Drill

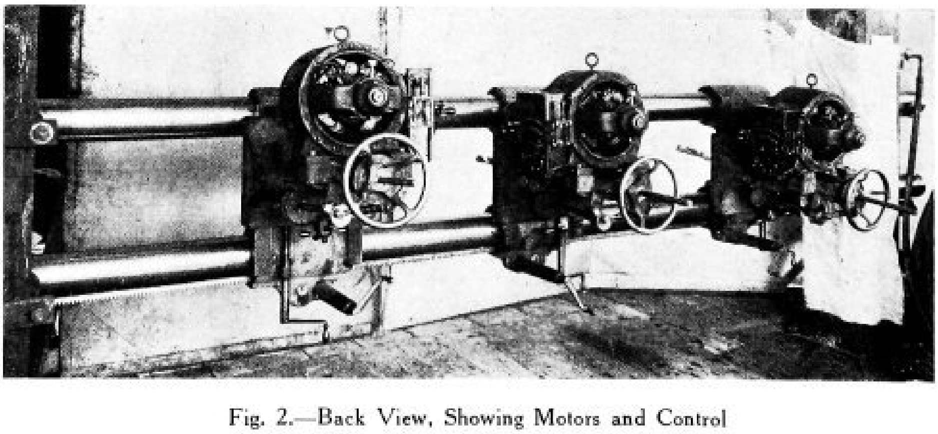


Fig. 2.—Back View, Showing Motors and Control

The feeding mechanism consists of a feed shaft, crank head, rocker pawl, ratchet wheel, feed nut and feed screw, the thrust of the latter being directly upon the back end of the spindle. The connecting rod between the crank and rocker plate is fitted with a spring, which can be set for any pressure of feed, so that it is impossible for this pressure to be exceeded, as the spring is compressed when the limit is reached and the feed ceases to operate until the pressure is reduced, thus making an automatic relief. Change of feed is effected by shifting the thumb latch around the crank head, and a range of feeds from .005 per revolution of spindle to 1/16 inch can be obtained. This range of feeds covers the entire requirements of drilling in boiler work.

An especially noteworthy feature of the machine is the central position of the spindle not only between the bearing of the drilling heads on the bars, but also between the bars, so that the pressure of the drill head against the work has no tendency to set up torsional or sidewise strains in the drill head or bearings, causing excessive friction of the drill in the hole, rapid deterioration of the drill and undue consumption of power, owing to the spindle being thrown out of alinement, as is the case where a drill spindle is not central of its support.

Each drilling head has individual motor drive, and the machine is entirely self-contained, all adjustments being effected by means of crank handles and hand wheels, no wrenches whatever being required, and the operator has all the adjustments of the head at his command from either side of said head without moving from his position.

A Plastic Refractory for Boiler Baffles

Baffles for watertube boilers have in the past consisted of tile, bricks or blocks of refractory material, fitted in between the tubes. In cross-baffled boilers these tiles are introduced between the tubes by springing the latter, and naturally do not form very tight joints with one another or with the tubes, especially after the latter have become warped or sprung, as they invariably do, in service. It is also difficult to insure that blocks will remain where they are placed and will not slip or fall, leaving large openings.

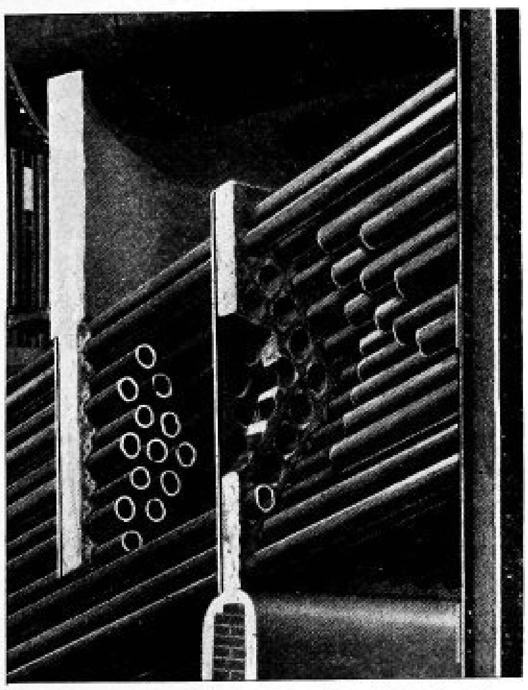


Fig. 1.—Betson Plastic Fire Brick Baffles in a B. & W. Vertical Header Boiler

Due to the manner in which baffles are inserted in boilers, it is almost impossible to cement them together, besides which the difference in expansion and contraction of the boiler and baffling would break the joints apart. Brick and blocks also warp and twist and are frequently split by the pinching effect of the tubes.

The accompanying illustrations show how jointless, and therefore gas-tight, baffles can be made by the use of a refractory known under the trade name of Plastic Fire Brick and manufactured by the Betson Plastic Fire Brick Company, of Rome, N. Y. This material was originally introduced for lining boiler furnaces, and is compounded of refractory materials so prepared as practically to eliminate expansion and contraction with changes in temperature.

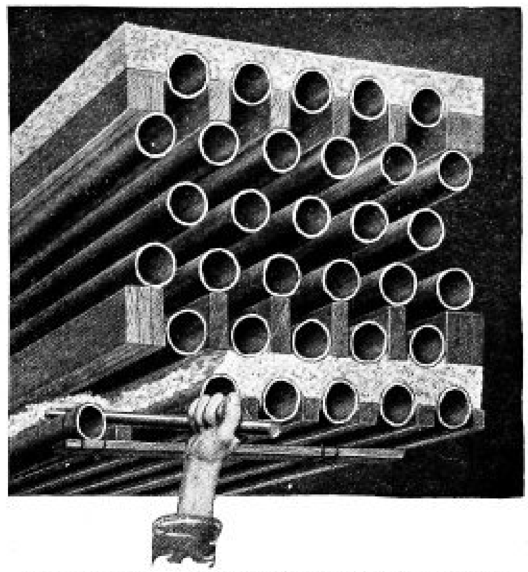


Fig. 2.—How the Material is Put in Place to Form Horizontal or Lengthwise Baffles in Watertube Boilers.

The material is shipped in barrels in a moist, plastic condition, ready for use. In forming a cross baffle for a watertube boiler of the B. & W. type the ordinary cast iron baffle plate is used as one side of the mold, while the other is made by thrusting slats in through the diagonals between the tubes. The plastic material is then poked down through the diagonals to fill the space between the cast iron baffle plate and these slats. It is sufficiently plastic so that it can be forced out sidewise around the tubes, fitting the latter snugly.

When this work has been completed the boiler is fired up slowly, the criss-cross of slats burns out and the plastic material is dried and vitrified in place. This operation occupies only a few hours, after which the full load may be put upon the boiler. Inasmuch as the boiler comes up to full steam pressure before the material is thoroughly set, the expansion of the metal pushes away the soft material to the position which it should occupy when the boiler is hot; and while the boiler will draw away from the material in cooling off again, the baffles will always fit tightly when the boiler is under steam.

In forming a longitudinal baffle, blocks of wood are placed in between the tubes, above and below the space which it is desired that the baffle shall occupy, thus confining the plastic material, which is shoved in from the side in the case of baffles in the middle of the tube bank, or from underneath or overhead, in the case of the baffles at the bottom or top of the tube bank.

Where this material is used there is no restriction upon the shape or size of the baffle, and the latter can therefore be arranged in any form desired. In cross-baffled boilers, for example, it is becoming the practice to slope or incline the baffles so that the gas passage will contract progressively from the point where the gases enter the tube to the point where they leave, in order to maintain a uniform gas velocity, in spite of the shrinkage of gas volume with cooling. This is easily accomplished with the plastic material.

Questions and Answers for Boiler Makers

Information for those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, 461 *Eighth avenue, New York city.*

Layout of a Barrel-Shaped Ore Bucket

Q.—Please give a method of developing an ore bucket which is barrel shaped in form? J. M. C. D.

A.—*Explanation:* The object in this case is to be made up of six segments in the manner as shown in Fig. 1. The segments must be raised by hammering in order to have them conform with the required curvature. After they are so shaped they are assembled so as to form a butt connection and then riveted together with butt straps as shown. Another and cheaper construction is to make lap riveted joints; or the edges along the joint may be beveled, then butted together and welded.

Construction: Lay off a plan and elevation of the ore bucket, as shown in Fig. 2. Through the elevation pass any number of planes; in this case 3 as *x-x*, *y-y* and *z-z*. Locate their position in the plan and it will be noted that each section is a true circle. Divide the plan into the required number of segments and use one to work from in producing the template. Segment (a) is, therefore, divided into a number of triangular sections by dividing the arcs in the segment as at 1, 2 and 3, respectively, and then drawing in the dotted and solid construction lines. Bear in mind that the greater the number of triangles used, greater accuracy in the layout will be had. The triangles in the plan are then projected in the elevation for convenience in following the development; this work, however, is unnecessary. Next determine the true length of the dotted lines as shown in the elevation. The bases for the triangle in each are transferred from the plan. The solid lines are shown in their true length in the elevation and equal the arc length from 1′ to 1′.

Layout of Pattern: Draw a vertical line, *m-n*, Fig. 3, then with dividers transfer the arc length 1′ to 1′ to line *m-n*, as at 1-1″. With 1 as a center and using the arc length 1 to 2 of the large circle, plan view, draw arcs on each side of point 1 in the pattern. With 1″ as a center and using arc 1-2 of the center circle plan view draw arcs as before. Set dividers to the dotted line of section *x-x*, *y-y* of the elevation, and, using point 1 as a center, draw arcs intersecting at point 2″. Continue in this manner until the pattern is completed.

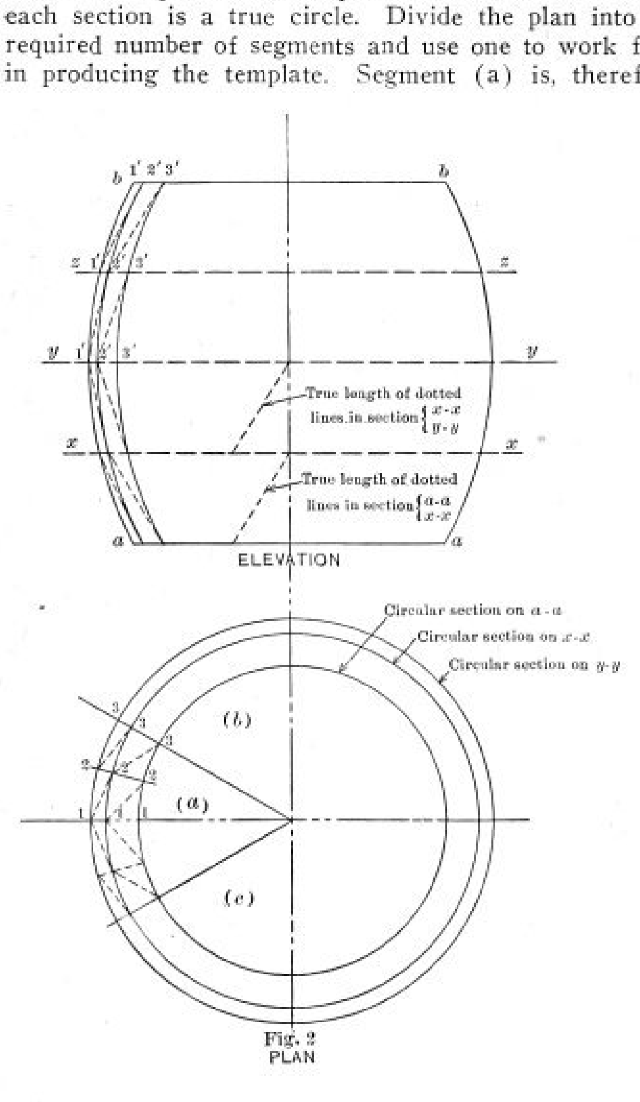
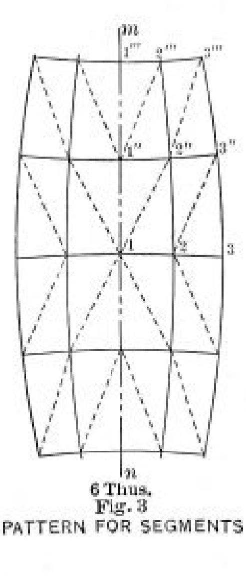


Fig. 2
PLAN

Marine Boiler Repairs

Q.—(1) Explain the construction of a furnace of a Scotch boiler. How is it secured to the boiler and how may furnaces be removed and replaced?
(2) Explain how to get out and replace a front cross box on a Babcock & Wilcox boiler.
(3) How is a leaky tube plugged in a Scotch boiler and in a water-tube boiler?
(4) Make up a bill of material to replace an evaporator shell, giving general dimensions. E. C. S.

A.—(1) A Scotch boiler is shown in Fig. 1. Boilers of this kind have a cylindrical shell containing one or more cylindrical furnaces. These furnaces are made either of short sections that have their flanged ends riveted together with stiffening rings between them, or a furnace is made of a single tube corrugated, so as to give the necessary strength to prevent collapsing. One end of the furnace is riveted to the front head of the boiler, either directly or by means of a flanged ring, and the rear end is riveted to the combustion chamber that serves


6 Thus.
Fig. 3
PATTERN FOR SEGMENTS

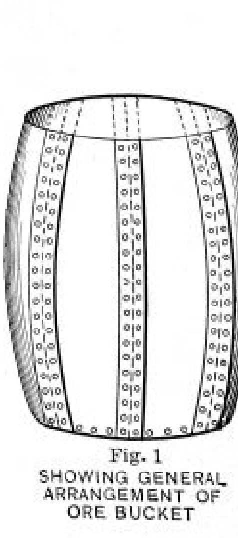


Fig. 1
SHOWING GENERAL ARRANGEMENT OF ORE BUCKET

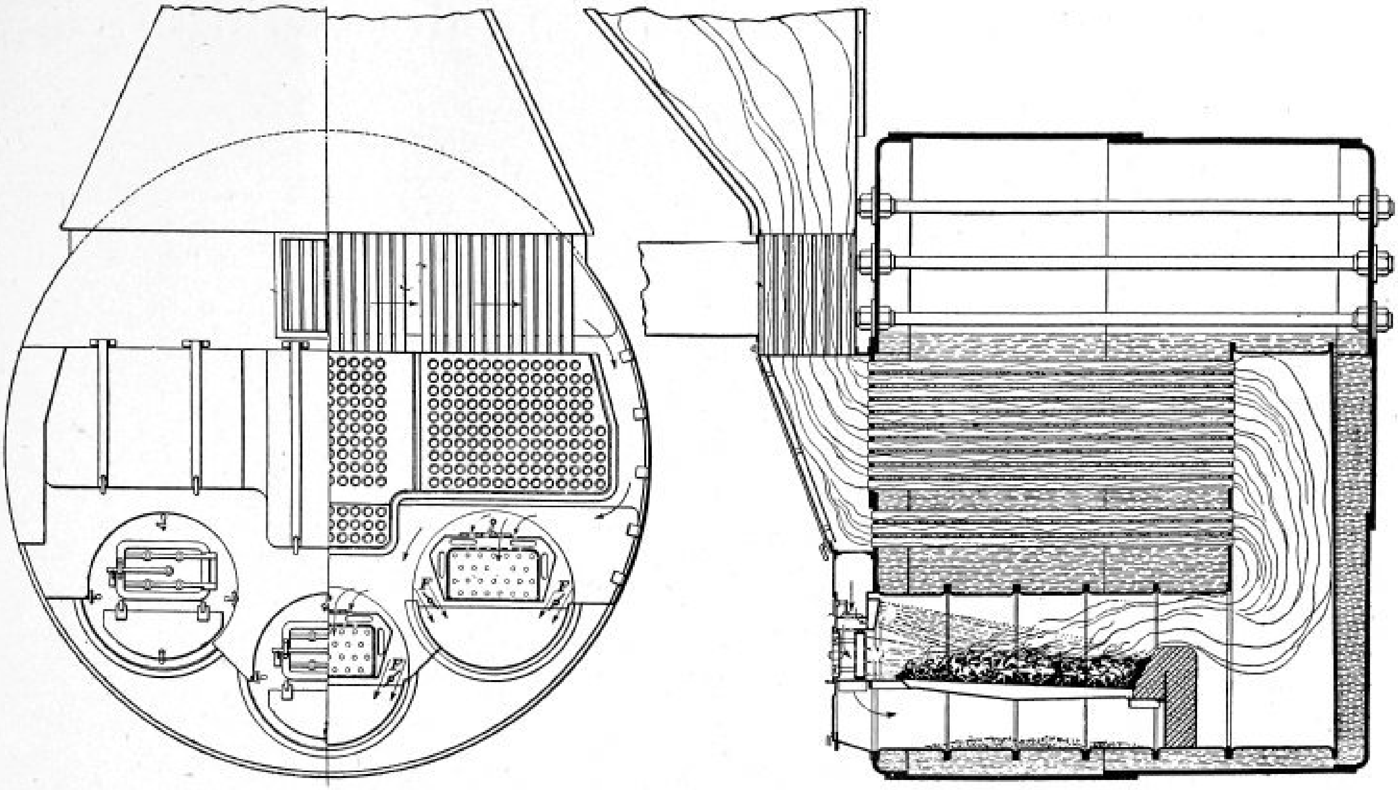


Fig. 1.—Scotch Boiler with Flanged Ring Furnaces

to carry the products of combustion from the furnace to the large number of small tubes that extend through the water space of the boiler. The method of replacing a furnace of this kind is to cut out the rivets from both ends and to draw the furnace from the front end of the boiler. A new one must be fitted to the same place and the seams riveted and calked.

(2) This question will be answered in the next issue.

(3) A leaky tube may be plugged in a Scotch boiler in either of two ways. A patented plug, as shown in Fig. 3, may be used or the old-style method of using wooden plugs may be adopted. The advantage of a patented plug is that it can be pushed through the tube from the front and tightened in place by means of a wrench and the nut on the end of the rod extending through the tube to

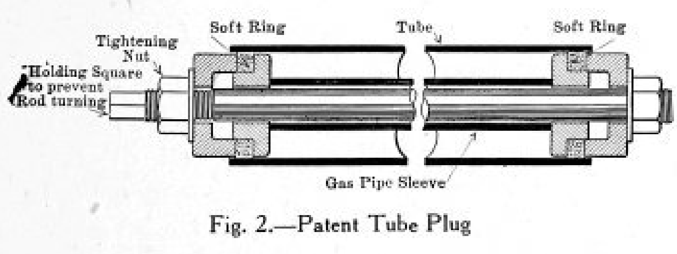


Fig. 2.—Patent Tube Plug

the plug. This tightening operation expands the soft washer in the plug, and thus makes a tight joint, the two plugs, one at the far end and one at the front of the tube, being operated on at the same time. The use of the wooden plugs, as shown in the illustration, requires that a man must go through the furnace to the combustion chamber in order to put in the rear plug and to put on a washer and nut. This work has been done by covering the fire with green fuel and placing boards over the fuel and to the full length of the furnace. The man must put on heavy clothing to protect himself from the heat when crawling through the furnace, and he must do the work in the quickest possible time. In order to plug a tube in a watertube boiler, it is necessary to drain the boiler until the water stands below the tube, so that the front hand-

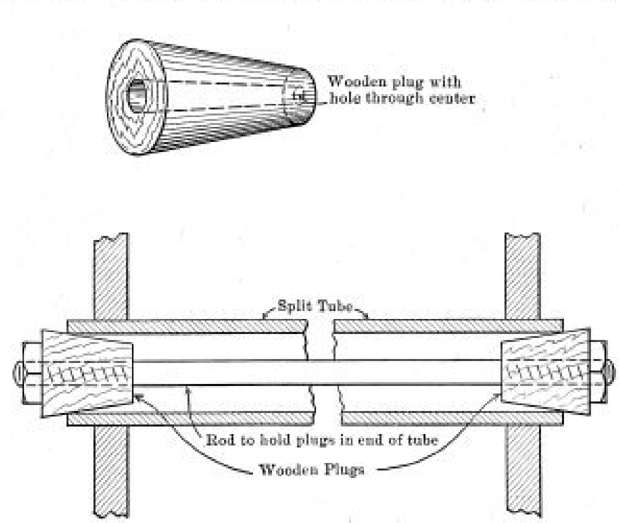


Fig. 3

hole cover may be taken off. The tube would then be plugged either with a wooden plug or a patented one.

(4) The bill of material for replacing an evaporator shell would consist of one or more plates, having the same thickness and size as the old ones, and such other fittings as may be necessary, depending upon the size and condition of the evaporator. Rivets would be needed and possibly some gaskets and other items that would be known from observing the work that must be done. If the plates are to be ordered, punched and cut, then the rivet holes should be noted and the position and sizes of the openings for the fittings. Then the plates should be rolled to the required radius. It is possible to replace a shell and to use the headers and the coils and other fittings.

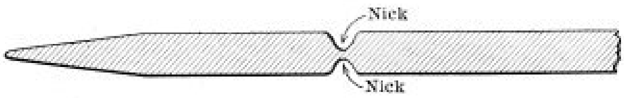
Letters from Practical Boiler Makers

This Department Is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

Making and Hardening Short Tools

I hope that the following wrinkle will prove of interest to the large number of readers of THE BOILER MAKER:

To harden short tools (such as small chisels, etc.) procure a piece of material of the required section not less than 2 feet long, and make the required article at the end. Instead of cutting off the tool, nick the chisel (or whatever tool it may be) the required length, round each of the sides, leaving a portion equal to about one-quarter of



Section of Bar Shaped and Nicked for Breaking Off Tool

the original thickness left, joining the tool to the surplus steel (see sketch).

When the tool has been nicked as shown, let the tool cool down, and after it is cold harden the point and break the chisel from the surplus steel by placing the tool in a hole, such as is found in an ordinary anvil, and place the nick in line with the surface of the said anvil, and, by bending the end of the bar, the bar will break at the nick (or where the mark was made).

Care should be taken not to break the tool from the bar by hammering, as the tool is then liable to break into a large number of small pieces, with disastrous results to the eyes.

The above wrinkle will be found very useful in a very small shop, especially when a pair of tongs cannot be had to hold the tool firmly. JAS. H. THOMAS.

Edinburgh, Scotland.

Men to Help Uncle Sam in the Shipyards and Boiler Shops

I am told that there are a good many men wanted by the Government for work in shipyards, boiler shops, etc. In these days, I believe, it would be very easy to train boiler makers; that is, men to drive rivets and calk, as in the old days it took some time to make riveters and chippers and calkers; but now this work is all done by machines. In old times I have seen young fellows learn to drive rivets with the air hammer in less than one day, but an "old fellow" stood by to see that the work was done right. Why cannot this be done again? There are a good many of the old timers who would be glad to do their bit by showing others how it is done. The Government is calling for men from 18 to 35 or 40 years old. What is the matter with those from 45 to 60? A man of 45 to 55 years is in his prime, in spite of Dr. Osler.

What I mean by making boiler makers in such a short time is training men to do the riveting, calking, etc. Punching and rolling would take a little longer, but, by having a man who understands the work stay with him for a couple of days to break him in would be all that is necessary. If the boilers are of the watertube type there is not much hand riveting to be done.

Now, I do not want it understood that a boiler maker can be made in a couple of days. A boiler maker is one who can build a boiler outright from plans and specifications; the ones who work on the boilers represent branches of the business, or what might be called skilled labor. When I was some years younger than I am now, if a shop was in need of riveters they would advertise for riveters—right or left hand, as the case might be; also for chippers and calkers. If they wanted a boiler maker he was supposed to take charge and be able to lay out, flange and rivet and calk, or, in other words, know the business; but that was in the days when decent workmanship did not exist, according to some of the later-day scientists. It riles me some when I see some of the articles written about old-time boiler makers by those who know nothing about them.

But to return to my subject: there are over half of the men drafted who have been exempted for different causes, and, in order to get help for Uncle Sam, why could not many of these be used in the shipyards and boiler shops? Over half a million of them, and all within the age limit! If they cannot be soldiers or sailors, there is nothing to keep them from being laborers or mechanics.

Springfield, Ill. JOHN COOK.

Welding Flues and Patches in Back Flue Sheet

Figs. 1 and 2 show my method of welding patches in a flue sheet through bridges, and welding flues in back flue sheets.

Fig. 1, taken from THE BOILER MAKER, will show how I have handled jobs of this kind successfully. I would

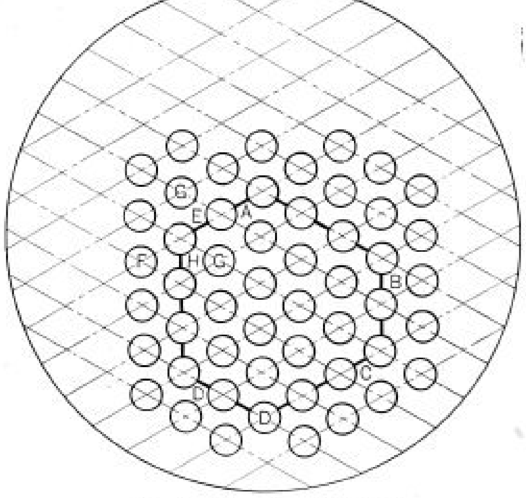


Fig. 1.—Location of Welds

begin welding as did Mr. J. G. P., at *A*; from *A* to *B*, to *C*, *C* to *D*. I would then go back to *A*, weld bridge marked *E*, and, after allowing *E* to cool a little, would roll with roller expanders, flue holes *G*, *G* lightly. In rolling these flue holes you will work against the contraction, pushing metal enough from *G*, *G*, to bridge at *E*, to take care of contraction. From *E* we will go to *H*. After welding *H* we will roll holes *F*, *G*, and so on down the line until all the bridges are welded.

Fig. 2 shows the method I am using for welding superheater flues in back flue sheet. Have written several welding supply companies of this method, but they seem to think that flues welded in this manner will not stand the test and that the vibration of flues will break the welds. Will say that I have a full set of 26 superheater

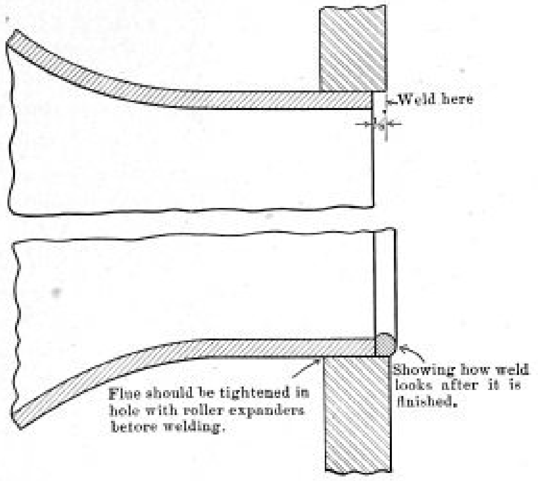


Fig. 2.—Method of Welding Superheater Flues in Back Flue Sheet

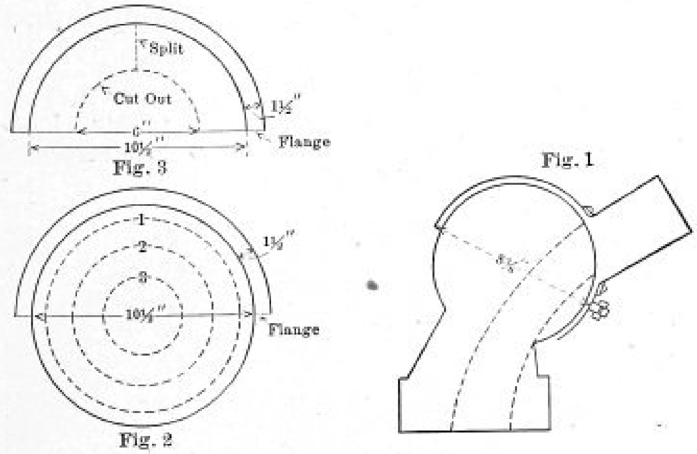
flues welded in one large passenger engine and from five to nine flues welded in other passenger engines of the same class, and, after being in service from five to six months, none of the flues has ever leaked a particle. On the other hand, all the flues put in this class engine by the old method are giving trouble by leaking around beads.

McComb, Miss. Wm. Tucker, Jr.

Unusual Layouts

Fig. 1 shows the elevation of a somewhat unusual job for a railroad shop, which was brought to us awhile ago. One-half of a ball, 8⅜ inches inside diameter, was required to fit over a casting, 8¼ inches outside diameter, with a 5½-inch pipe riveted on, material to be ¼ inch thick.

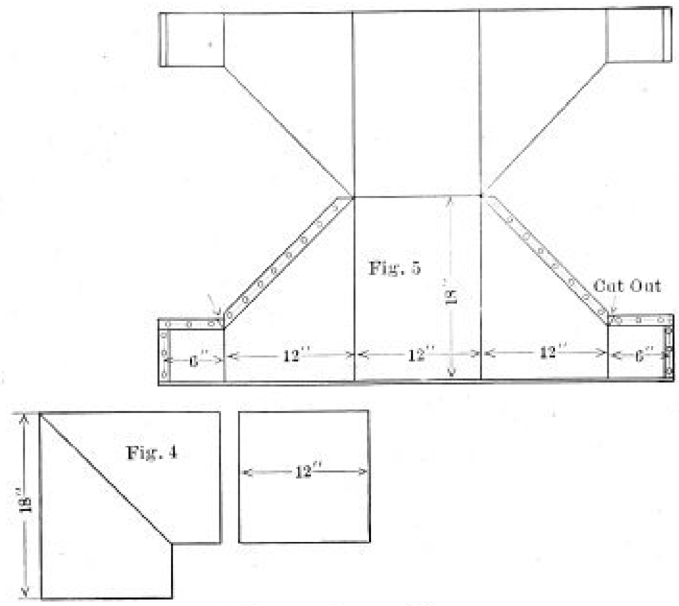
As we have no press, we had to work the metal down with a ball-faced hammer, using a casting with an in-



Layout of Ball to Fit Casting

side diameter of 8⅝ inches, slightly rounded at the edges. Heating the metal throughout, we commenced by working down on the dotted line No. 1, taking dotted line No. 2 on the second heat, and so on. When finished to proper depth and diameter, a flange was turned on one-half of circle, as shown, so that the piece in Fig. 3 could be bolted to it, and allow the sphere to revolve without falling off the casting.

Figs. 4 and 5 show elevation and pattern of a 90-degree square elbow to be made in one piece, same to be made out of light material; laps are allowed on one-half of



90-Degree Square Elbow

pattern only; holes to be punched in this half before bending, remainder drilled in position. This should be interesting to the apprentices.

Lorain, Ohio. Joseph Smith.

Why Should Butt Straps Be Taken Off and Cleaned?

As friendly criticism on this subject has been invited, I would like to offer a few remarks, and if exception is taken to the remarks of Mr. Crombie, or Mr. Haas, it is intended to be in good spirit, as both gentlemen have certainly given good views on the subject.

The rule governing this work is found in paragraph 254 of the A. S. M. E. Code Rules, and right here I will take exception to the statement in the first paragraph of Mr. Haas' article by agreeing with him that the ruling is a sore point between the inspector and the boiler maker, but wish to qualify my statement by saying that the inspector is a fool if he allows the enforcement of the rule to cause him any anxiety. The rule has become familiar to all concerned, and it is not within the province of the inspector to abrogate the rule merely because the shop objects to it; neither does he have to everlastingly insist that the rule be complied with—all that is necessary on the part of the inspector is to make sure that the work is or is not done as required and act accordingly, by either accepting or refusing to accept the completed boiler.

Mr. Crombie's assertion that the amount of burr after reaming would be negligible in a boiler constructed in accordance with the conditions he outlines is partly corroborated by Mr. Haas, but, taking a quotation from Mr. Crombie's article, we find, "Suppose we have a boiler with the heads a good tight fit and butt straps bolted close up before reaming;" right here is where the rub comes, in that Mr. Crombie's supposition is at variance with the actual general practice—instead of the heads and girth seams being a good tight fit and the butt straps bolted close up before reaming, we actually find that the heads and girth seams are assembled with about 3 or 4 drift pins, and the butt straps, containing approximately 125 holes, are assembled with from 8 to 16 bolts, ½ or ⅝-inch diameter, and loosely drawn at that. It is no wonder that burrs are collected between the metal, the wonder is that some of the shop tools are not lost in the same place.

While I have no positive knowledge of the fact, I am of the opinion that the Code Committee had in view just such conditions as I have outlined above, when formulating the rule in question, and evidently considered it necessary to correct the conditions as much as possible by imposing the rule requiring that the burrs be removed; furthermore, the boiler manufacturers were represented on the Committee and evidently concurred in the general opinion, so that if the conditions imposed by the ruling were considered unnecessary, the time to object was before the rule was enacted, and not afterward.

As Mr. Crombie suggests, under certain conditions the work could be assembled so that the amount of burr due to reaming would be negligible. However, the conditions he assumes are not in general practice, and I am inclined to agree with Mr. Haas in his statement that under the existing conditions it is very necessary to separate the plates and straps and remove the burrs, but I believe it would be possible to perform the work in the manner outlined below, so that the ultimate results would be better than that obtained by the enforcement of the present ruling.

Instead of assembling the work in the usual slip-shod manner and placing dependence on the reaming to insure fair holes and the separation of the plates for the removal of the burrs, the work should be assembled with a sufficient number of bolts, so that there would be no visible opening between the metal in any seam, then ream the holes at one side of each tack bolt and place full size bolts in these holes, bringing them up tight before doing any further reaming, then remove the small bolts and complete the reaming. In suggesting this method, I have in view the fact that even with the small bolts used in first assembling the work, a hole reamed immediately alongside of one of these bolts will show a negligible amount of burr, whereas the holes reamed at some distance from the bolts develop a large burr. For this reason I suggest that a sufficient number of bolts be used to make the work appear visibly tight and that the holes alongside of the small bolts be reamed first, then by using full size bolts, before doing any further reaming, a sufficient grip is afforded to bring the plates in good contact throughout the entire seam.

After the work has been reamed the burrs should then be removed from the inner periphery of the holes, but without disturbing the position of the plates, as it is understood that there will be considerable burr at this part of the holes, regardless of the compactness of the work when reaming. I have purposely omitted any specific distance at which the fitting up bolts should be spaced, and in place of this suggest that no visible opening between the plates be allowed when prepared for reaming, the reason for this being that some shops would space the bolts at a specified distance and then consider that the law was being complied with, regardless of the appearance of the work. When starting to drive the rivets, a tack rivet should be driven about midway between each bolt, the holes containing the bolts to be the last ones riveted; this will insure the work being held in proper contact at all times during the riveting.

In suggesting this method to replace the present one, I have in view the belief that the present method of removing the burrs, which invariably results in champhering the edges of the holes, defeats the real purpose of the code rule, my understanding being that it was the purpose of the code to obtain a joint in which the metal is in thorough contact throughout. The series of pockets formed by champhering the holes allows the rivet to flow in between the plates, forming a washer that permanently separates the plates, which, as stated above, defeats the real intent of the rule. Any doubt as to the formation of these washers will be quickly dispelled by cutting and backing out a rivet that has been driven in a hole containing these pockets.

It is my opinion that a rule properly worded to enforce the conditions suggested above would produce better results than the method now in vogue and would be the nearest practical approach to the theoretically correct condition. At least it seems reasonable to assume that this method of construction would result in giving this part of the work a factor of safety as high as that to be obtained in other parts of the boiler's construction. Until changes in the present rule are legally enacted, it should be strictly complied with; but will all the boiler makers take oath and declare that they are doing so? (Nosce teipsum.)

D. E. G.

Ability to Concentrate

If one hopes to become a master of his profession, one of the first things he must learn is to do the first things first, to think of one task or subject at a time, and to give it his concentrated attention earnestly and entirely, and when the task on hand is completed or mastered, turn to the next problem or matter with the same will and thoroughness. The best way to be ready for any task is to do the hard things first. "Do it now" is a popular, worth-while slogan. The fellow who spreads his efforts and thoughts over a number of tasks at one time never really completes one thoroughly.

Do to-day's work now—avoid forming the hold-over-until-to-morrow habit. Once started on a job, stick to it. Other men will judge you by your thoroughness. It's much easier to give a job a lick and a promise than to concentrate thoughts and energy into making it perfect, and he who takes the easy path finds that it leads to defeat.

Concord, N. H. C. H. Willey.

Flexible Die for Driving Staybolts and Rivets

I am sending you herewith a brief description, with illustrations, of a staybolt die with extra heavy long-stroke air hammer, which I think will help others who have experienced like difficulties.

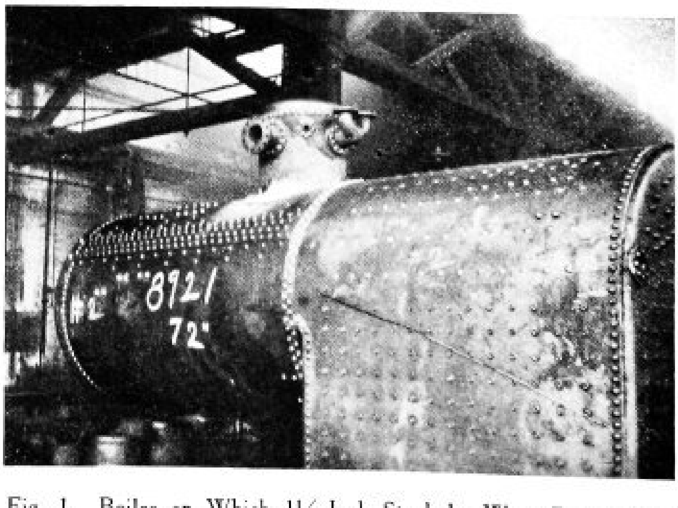


Fig. 1.—Boiler on Which 1¼-Inch Staybolts Were Driven with Flexible Die

As we lost much time while employed at the Ames Iron Works in trying to find a die to drive 1¼-inch staybolts, we finally got together and worked out a way to overcome this trouble. As a result, our machine shop foreman, Mr. Casey, had a flexible die made up for us, of which I am sending you a sketch.

This die worked splendidly, driving 3,670 1¼-inch staybolts and completing three of these boilers in the month of October. The die, however, broke on the fourth boiler, and, as we had no other dies, our output was limited to barely one boiler per month.

As the die broke in the cup, we set to work to make another die still different, as you will see by the sketch, placing a collar on the plunger. We are using this die now with good results and have completed three boilers.

These dies make a fine job, as they give a perfect head on the staybolt, and we are driving all our ⅞-inch and 1-inch staybolts with the same make of die; also 1-inch rivets are being driven with success.

I am also sending you a photograph of the boiler on which these dies are used in driving 1¼-inch staybolts.

Oswego, N. Y. John H. Harriss,
Assistant Boiler Foreman and Inspector,
Ames Iron Works.

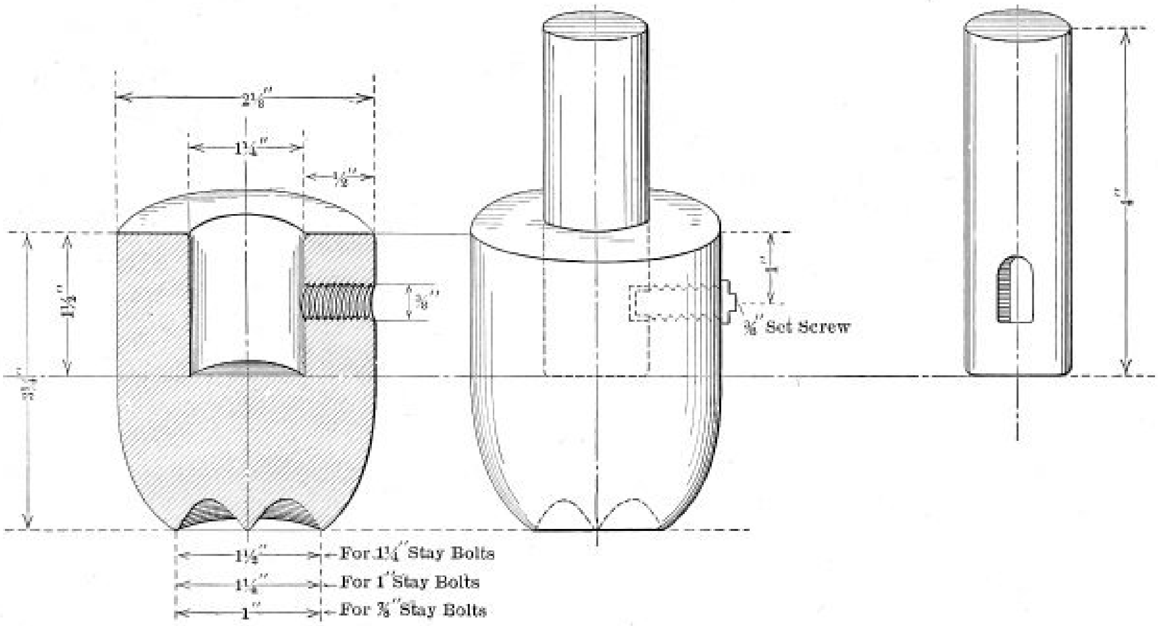


Fig. 2.—Sketch Showing Construction of First Die

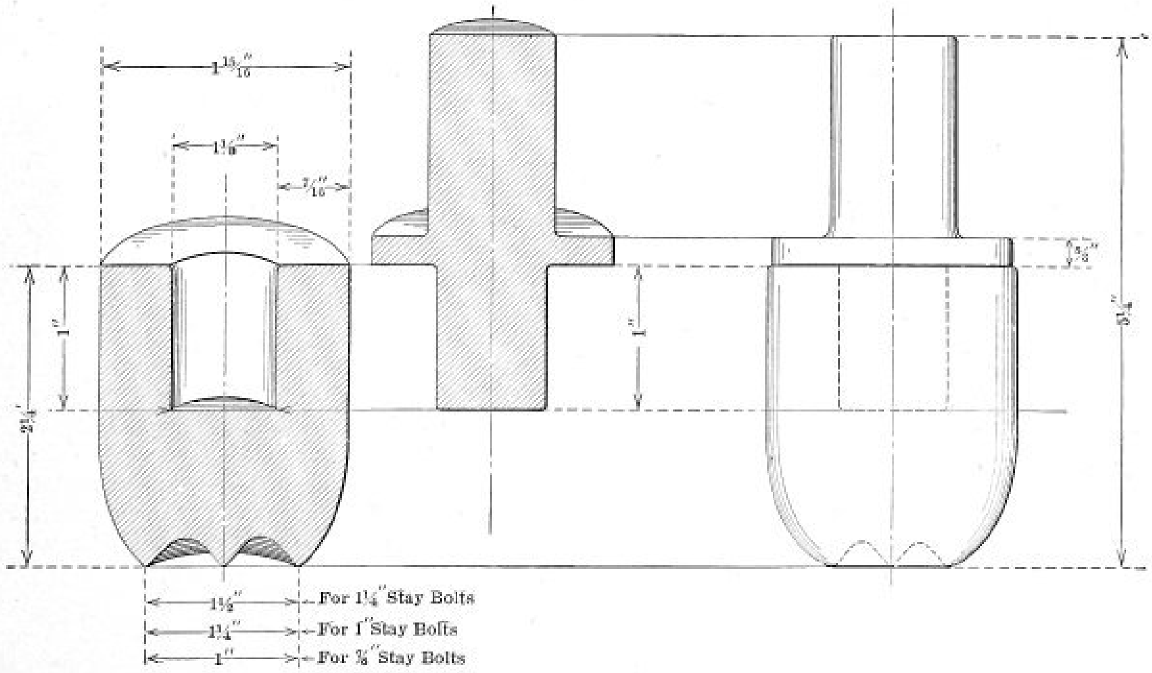


Fig. 3.—Sketch of Second Die With Collar on Plunger

Hand Versus Power Riveting

Like Mr. Harrison, the writer has the courage of his convictions, added to the evidence of experience. Careful re-perusal of the correspondence does not lead me to modify my attitude, and my adverse tone is directed in no personal sense at all; my critic, whose honesty is transparent and whose length of experience entitles him to respect, holds views the direct opposite of mine. Where we differ is in whether the conditions he describes are inevitable or not; my argument is that, so far from being inevitable or usual, they are to me incredible. If the statements made are a true picture of the majority of

American boiler shops, then there is need for missionary effort, not merely to improve the conditions but to point out that the methods in use are archaic and unworthy of American mechanical ingenuity, so evident elsewhere. Even now the writer is unconvinced, and thinks that some "counsel for the defense" with actual transatlantic experience will give locations where such conditions do not prevail. For my part, I can testify that they do not prevail in good British shops.

To comment briefly upon the article in the November, 1917, issue, early workmanship in the past days of low pressure boilers and wrought iron plates was doubtless sufficient for its purpose, but assuredly the same methods for mild steel plate and high pressures are inadequate. Moreover, if the pioneers quoted were alive to-day they would be among the first to install modern methods and better practice. The credit due to them is largely that they were in advance of their day and generation, and the same type of mind would in any time or place be progressive. Workmanship of yesterday has in all quarters been improved beyond knowledge—so much so that in many quarters, including boiler making, past practice is inferior in all respects. For instance, fuller details are yet wanted about that air compressor receiver. The writer, on the details yet afforded, can realize many reasons why it leaked under pressure test.

With regard to silence in boiler making, the difference between the writer's apprentice days and the present year of grace is so marked as to allow the use of the word "silent." Perhaps, as the matter is comparative, "quiet" would have been the better word.

As already stated, the writer does not believe in noise as a sign of energy, and, for this reason, would so far as possible do without pneumatic tools (this may be heresy), but in making new boilers, drilling, planing, gas cutting, riveting, bending, flanging, trepanning can all be done in practical silence. The one operation which involves noise is calking or, preferably, fullering, and the amount of this is conditioned by the exactitude and refinement of prior processes. It is the one location where handwork is allowable. Hours on end, a good boiler shop is as quiet as a machine shop and *there is no earthly reason why it should be like Hades.* There is no reason why a man who makes boilers should thereby be rendered stone deaf as in former days. It is worth pointing out that first-class workmanship in the boiler industry has been effected largely by outside pressure and is of recent introduction, and even to-day methods which give better results at less cost (all things considered) are still resented by the industry in general. It is always difficult to persuade the boiler maker (whether firm or individual) that up-to-date methods, involving exactitude and refinement, are necessary, but the writer will hazard his professional reputation by asserting that they pay—an argument for their introduction and practice more cogent than any other. No other industry involving metal has needed the same statutory restraints, prohibitions and close supervision by outside authority; and the need for and wisdom of these are apparent and should give everyone associated food for reflection. Since these are acknowledged necessary, it is clearly apparent that the early workmanship praised by Mr. Harrison left much to be desired.

As to the boilers of the S. S. *Mikado* and H. M. S. *Terrible*, I have no more knowledge than Mr. Harrison, but the *Terrible* is of some age now, and even in the British navy there are fashions and prejudices. The seniority rule in combatant services tends often to retain practices which junior men would see abolished. More on this head it is not possible to say, for censorship might delete my remarks.

Finally, while I do not admit the charges brought of sarcasm and ridicule, these are first-class weapons against prejudice and superstition, and if Mr. Harrison feels that my remarks were intended personally I assure him that nothing was further from my thought or intention. I ask him to remember that the audience is wider than the individual debaters in a journalistic controversy and that each side endeavors to convince the audience. My object is simple enough; it is to endeavor by every means open to raise the craft of boiler making, in one sense, the Cinderella of the metal working trades, to the level of the rest.

Great advances have been made in the past decade elsewhere; results which have increased output, diminished cost and improved the finished job are everywhere evident, and I look confidently forward to the time when similar results will be universal in the making of boilers. Retrogression will not serve the end in view, and, while looking backward has great interest, it is looking forward which aids progress.

London, Eng. A. L. Haas.

Air-Cooled Refuse Burner

The description of an air-cooled refuse burner on page 22 of the January issue is very interesting, but makes one reflect that, after all, some devices are based on misconceptions. As the burner is at a lumber mill with a huge daily capacity, the destructor is practically used to offer an oblation of burnt wood to the winds of heaven, and is really something for which to apologize. Presumably, the mill is run by steam, using lumber waste also as fuel, and the power utilized is insufficient to dispose of the wastage made in cutting. It can hardly be possible that coal is burnt to generate steam and waste wood is sacrificed without a thought. Stranger things than this, however, exist in a topsy-turvy world.

Presuming that the power is generated from a part of the wastage, and only a fraction of that, the funeral pyre of the remainder is quite unwarranted, as it is wrong with destructive distillation for industrial alcohol, pulping for paper making, extraction of turpentine or the production of charcoal, all, it would seem, being products of value in industry. Certainly, potash can be obtained from the ash, and this is now at a premium, but, burnt to destruction, is sheer perverse waste and is a severe commentary upon the human misuse of natural resources. Conservation of resources is, I believe, one of the most talked-of needs of the hour in the U. S. A. If this particular mill be multiplied by scores, the destructors being usual, there is criminal waste of the most appalling kind in daily evidence.

There will come a time when coal itself will never be burnt without prior distillation; when coke and gas will alone be used for heat. The by-products of distillation in the case of coal have enormous value. Dies, disinfectants, explosives, are all literally thrown away whenever coal is burnt neat.

Scientific re-afforestation and the conservation of timber resources are, I understand, fostered by the United States Government. The price of timber is rising higher and higher, and its need is vital in many connections. Over here, wood is more than wood; it is a commodity so scarce that packing cases, for example, are virtually unprocurable, and four cents a pound is being paid for kindling wood for household purposes.

I protest that the destructor illustrated should cause investigation to be made in the lumber industry in America by Uncle Sam, and such practices be ended.

London, England. A. L. Haas.

Selected Boiler Patents

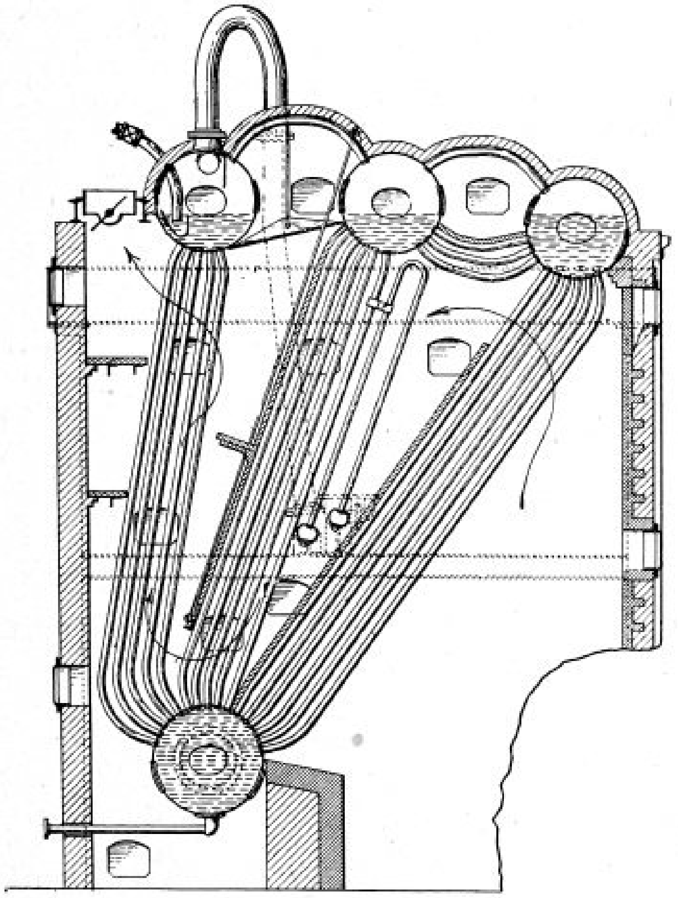
Compiled by

GEORGE A. HUTCHINSON, ESQ., Patent Attorney, Washington Loan and Trust Building, Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchinson.

1,252,444. STEAM BOILER. DAVID S. JACOBUS, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

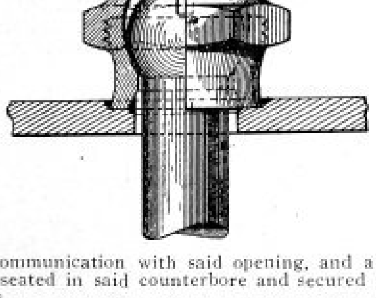
Claim 1.—A steam boiler comprising at least three upper transverse drums connected by banks of tubes to a lower water chamber, the rear upper drum being set at a higher level than the front upper drum, a feed water inlet leading into the rear upper drum, a main steam offtake leading from said rear drum, baffles for directing the gases over and



among the tubes of said banks with an up-pass in the rear bank, and a special baffle extending rearwardly from the middle upper drum and arranged to direct the gases leaving the upper part of the rear bank so as to protect the middle and rear drums from excessive heating. Seven claims.

1,250,240. FLEXIBLE STAYBOLT CONNECTION FOR BOILERS. BENJAMIN E. D. STAFFORD, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PENNSYLVANIA.

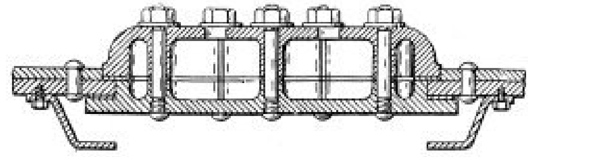
Claim 1.—In staybolt connection for a boiler, the combination of a plate having an opening for the passage of a bolt, and a counterbore



around and in communication with said opening, and a support for the head of the bolt seated in said counterbore and secured therein by welding. Four claims.

1,250,629. DOOR FOR STEAM BOILERS. HUGH T. NOBLE, OF SEACOME, ENGLAND.

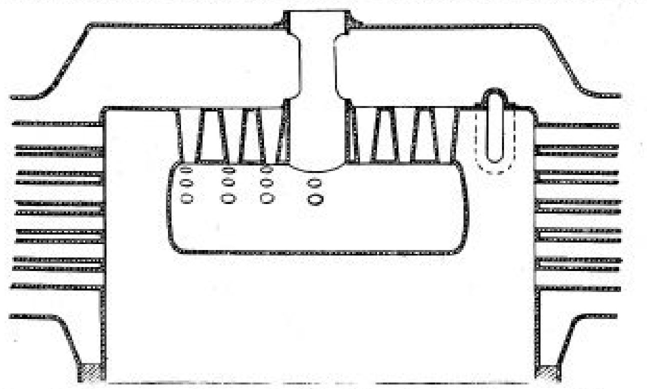
Claim.—The combination with a steam boiler having a shell provided with an opening, an inner annular reinforcing member projecting within said opening, and supports spaced apart from said member, of a door comprising an inner section having a marginal flange engaging a lateral surface of said member, and a tubular portion fitting closely within the opening of said member, a plurality of tubular projections, and strengthening ribs connecting said tubular projections with said tubular portion, an outer section having perforations leading to the outer air, a marginal flange fitting closely within the opening of said shell and engaging the other lateral surface of said member, a tubular portion in alinement with and of greater thickness than that of the tubular portion of said inner section and overlapping said reinforcing member, a plurality of



tubular projections in alinement with the projections of said inner section, and strengthening ribs connecting said tubular projections with said tubular portion, transverse bolts engaging the tubular projections of said sections and having removable nuts threaded thereon, annular washers located between the marginal flanges of said sections and the lateral surfaces of said reinforcing member, and annular washers located between the tubular projections of said sections.

1,250,979. BOILER. PIERO CROSTI, OF MILAN, ITALY.

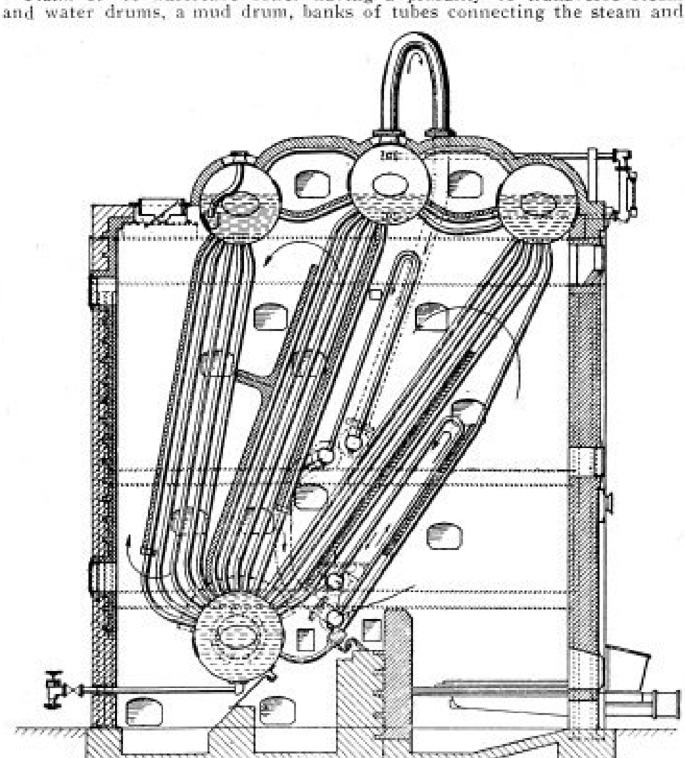
Claim 1.—In a steam boiler having a double wall portion surrounding the fire box, the combination of a substantially cylindrical fire box crown sheet, a cylindrical water drum in the fire box coaxial with said crown sheet and having a portion of its surface substantially parallel to the



surface of the crown sheet, and a plurality of rows of water tubes extending radially between said parallel surfaces and rigidly connecting them together, whereby the drum is freely suspended in the fire box. Four claims.

1,250,181. STEAM BOILER. DAVID S. JACOBUS, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

Claim 1.—A watertube boiler having a plurality of transverse steam and water drums, a mud drum, banks of tubes connecting the steam and



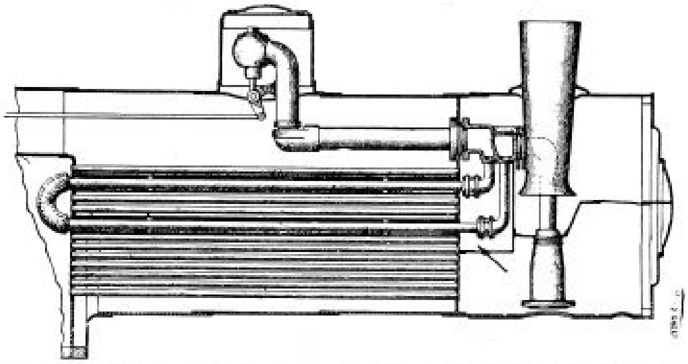
water drums with the mud drum, additional water tubes connecting the mud drum with the first steam and water drum and in front of the first bank of tubes and separated therefrom, a superheater in the space between said additional watertubes and the first bank of tubes, and baffling arranged to give an upflow of gases over the superheater. Fourteen claims.

1,250,832. MULTIPLE-UNIT BOILER CONTROL. ERNEST F. FISHER, OF PITTSBURGH PENNSYLVANIA, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

Claim 1.—The combination with a plurality of fluid pressure generators delivering fluid to a common header, of a mechanism for each generator for controlling its operation, and means for operating each controlling mechanism which is responsive to the flow of fluid from the generator to which it is appurtenant and to the total flow through the header. Seven claims.

1,256,115. LOCOMOTIVE SUPERHEATER. FREDERIC A. DELANO, OF CHICAGO, ILLINOIS.

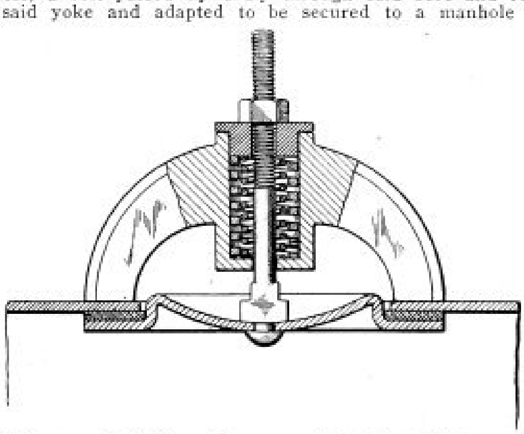
Claim 1.—In a locomotive, a fire box, a boiler, a smoke box, flues in said boiler leading from said fire box to said smoke box, a manifold comprising a wet steam chamber and a superheated steam chamber, a series of elbows depending from said wet steam chamber, a second series



of elbows depending from said superheated steam chamber, superheating tubes each detachably connected to an elbow of said first-named series and leading from one of said flues to said fire box, each of said superheating fires returning from said fire box through another of said flues and being detachably connected to an elbow of said second-named series, and fireproof material for covering said superheating tubes in said fire box. Three claims.

1,255,424. MANHOLE BRIDGE. JOHN J. IRVINE, OF PITTSBURGH, PENNSYLVANIA.

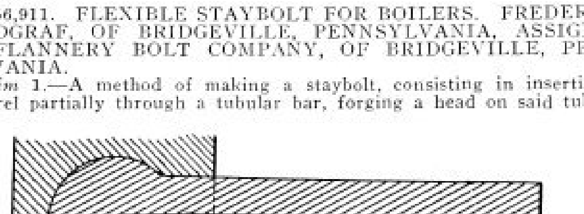
Claim.—As an article of manufacture, for use with the manhole cover of a boiler, a yoke having a recess therein and a bore at the bottom of said recess, a bolt passed upwardly through said bore and recess and beyond said yoke and adapted to be secured to a manhole cover, a



washer fitting snugly in the said recess and having a flange resting upon the yoke, said washer closing the open end of said recess and through which extends said bolt, a nut on said bolt and bearing on said washer, and a spring within said recess and engaging the washer and the bottom of the recess, said spring tending to force said washer outwardly of said recess.

1,256,911. FLEXIBLE STAYBOLT FOR BOILERS. FREDERICK LANDGRAF, OF BRIDGEVILLE, PENNSYLVANIA, ASSIGNOR TO FLANNERY BOLT COMPANY, OF BRIDGEVILLE, PENNSYLVANIA.

Claim 1.—A method of making a staybolt, consisting in inserting a mandrel partially through a tubular bar, forging a head on said tubular



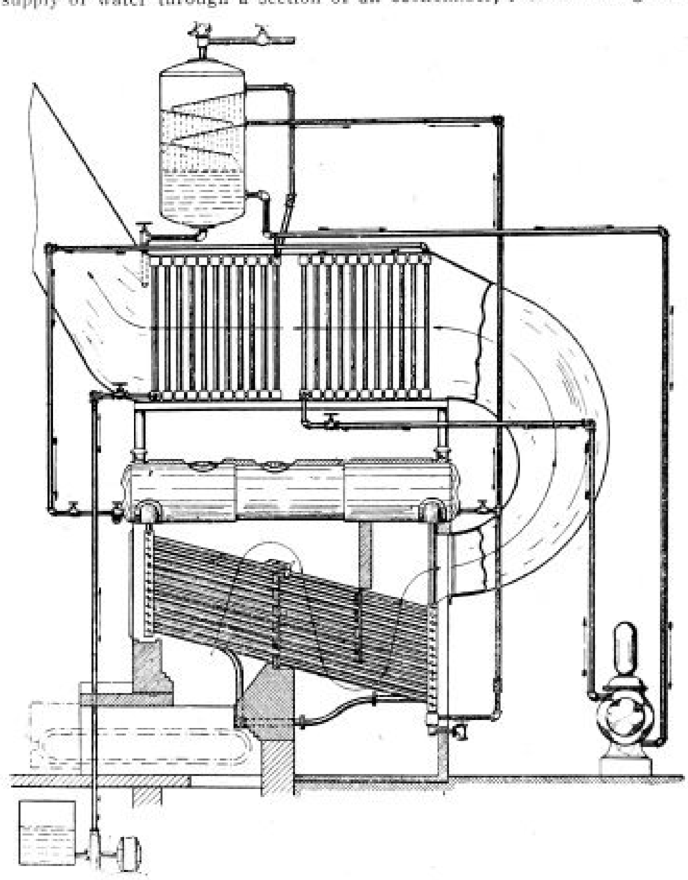
bar and then withdrawing the mandrel, leaving the bore continuous from the inner end of the bolt and extending into the headed end and closed at the outer end of the bolt within the forged head thereon. Three claims.

1,254,185. STEAM-BOILER FEEDER. BARNEY ZINDEL AND WILLIAM H. HART, OF GREEN BAY, WISCONSIN.

Claim.—In combination, a boiler having a smoke box at one end, a water heater in said box, an injector, a feed water pipe leading from said injector to said heater, a return pipe from said heater into the boiler, a second injector, a second feed water pipe leading from said second injector, a three-way valve connecting said second feed water pipe with the first, a second return pipe discharging into the boiler, a second three-way valve connecting said second return pipe with the first, a by-pass pipe leading from the first-named feed water pipe to one of said return pipes between said second three-way valve and the delivery end of said pipe, a valve for said by-pass pipe, and a valve for said first-named feed water pipe between said by-pass pipe and said heater.

1,255,170. STEAM-BOILER ECONOMIZER AND METHOD OF OPERATING THE SAME. DAVID S. JACOBUS, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

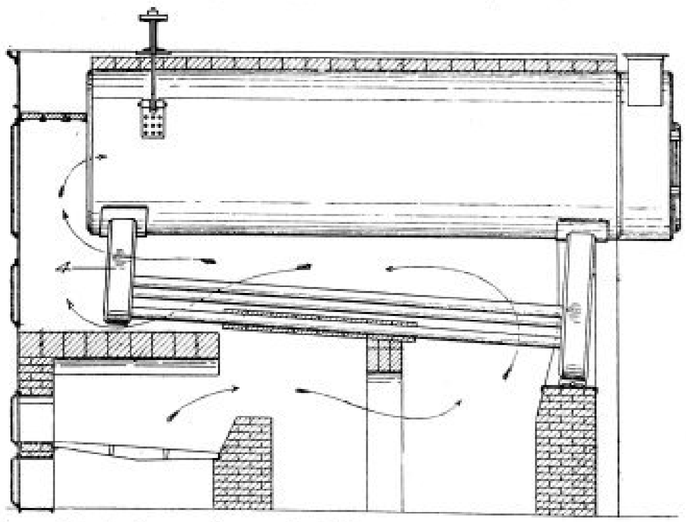
Claim 1.—In the operation of boilers with artificially softened or naturally soft water, the process which consists in passing the main supply of water through a section of an economizer, then admixing such



water with hot concentrated liquid from the boiler, and then forcing the mingled volume to another section of the economizer at a higher pressure than the first section of the economizer, and thence into a boiler. Twelve claims.

1,256,779. STEAM-GENERATING APPARATUS. JOHN F. DORNFELD, OF CHICAGO, ILLINOIS.

Claim 1.—A steam generator comprising a horizontal flue boiler, a pair of water legs depending from opposite ends thereof, watertubes connect-



ing said water legs, a furnace including a grate, an arch above the same, there being a passage for products of combustion between the upper face of the arch and the lower end of one of the water legs, a beam spanning the side walls of the furnace, and tension rods supporting one end of the boiler on said beam, the water leg at the other end of the boiler supported on the rear wall of the furnace. Three claims.

Correction.—On page 89 of our March issue the illustration shown in connection with patent No. 1,244,916 was erroneously reproduced from patent No. 1,244,915. The patent refers to staybolt connection for boilers.

THE BOILER MAKER

MAY, 1918

The Value of Heating Surface in Boilers

Recognized Proportions of Heating Surface to Other Factors in Locomotive Boiler—Boiler Efficiency—Superheating Surface

BY WM. N. ALLMAN

In order to bring about the greatest efficiency in locomotive boilers, it has been necessary to improve designs by the application of superheaters, which have been the means of producing a higher efficiency in the boiler.

Efficiency of Superheaters

The superheater units, which extend nearly through the tubes, are exposed to the combustion gases, whose temperatures range from 1,600 to 600 degrees Fahrenheit within the tubes. The saturated steam passing through the enclosed pipes and exposed to the temperature above quoted is raised from 200 to 205 degrees Fahrenheit above that of the steam in contact with the water. While there is a loss in the temperature of the superheat in passing through the pipes to the cylinders, yet there is sufficient increase over the temperature of saturated steam in the cylinders to provide against condensation. By this increased temperature in the steam, a saving in steam consumption of 30 percent per indicated horsepower and a corresponding saving of 25 percent in fuel may be realized by the use of a superheater in a locomotive boiler, as compared with a similar boiler operating under the same conditions with saturated steam.

By increasing the efficiency of the boiler under the medium of superheated steam, the same cylinder power may be derived at a lower steam-producing rate, which consequently means less evaporation of water per unit of power or work, thereby increasing their efficiency and saving in fuel. From numerous tests that have been made, it is shown that an economy of 15 to 25 percent in fuel and 20 to 30 percent in water consumption may be expected in every-day operation, through the use of superheater, with the addition of brick arch.

Table No. 1 shows the increase in tractive power derived in some tests on locomotives of the consolidation type where superheaters had been applied, the comparison being made with same locomotive class, using saturated steam.

TABLE NO. 1.

Speed Miles Per Hour.	Tractive Power.		
	Saturated Locomotive.	Superheater Locomotive.	Percent Increase For Superheat.
5	43,000	44,600	3.72
	38,500	39,300	2.00
10	37,100	40,000	8.1
	30,700	34,400	12.0
15	30,000	33,400	11.0
	23,400	27,200	17.2
20	23,900	27,400	14.0
	17,600	21,800	24.0
25	19,000	22,400	18.4
	13,000	17,300	32.0
30	15,000	18,300	21.3
	10,000	14,000	40.0

From this table it will be observed that the efficiency increased as the speed increases.

There can be no doubt by this time that the superheater is an efficient apparatus, and, while the cost of maintenance is no doubt greater than for a saturated steam locomotive, the saving in efficiency, particularly in the reduction in fuel, will more than offset the increase cost in maintenance.

Ratios

In proportioning the boiler as regards the heating surface, there have been certain ratios and practices followed by the various railroads and locomotive builders, and in the modern boilers, which have increased materially in diameter, the proportions which were considered good practice twenty years ago require some change. Table No. 2 shows the proportions which were recommended in 1897 by the Master Mechanics' Association. From recent investigations, it has been found that these ratios have been increased to the extent as shown, indicating that greater work is required of the boilers at the present time.

While a great deal has been said in the past several years concerning the proportioning of heating surface against the cylinder volume, it is still considered by some as a factor of comparison.

Modern practice involves the horsepower of the cylinders and another factor known as the "Boiler Demand Factor," or expressed as follows:*

$$\frac{TP \times D}{HS}, \text{ in which}$$

TP = tractive power,
D = diameter of drivers,
HS = heating surface.

Another comparison which is used is the ratio of total heating surface to weight of one cylinder of steam, so it will be seen that there is a great variation in practices and, under the different rules, it becomes necessary for one to familiarize himself with the various ratios and then decide what would be considered good practice under different conditions of service; as, for instance, kind of fuel used. Then again, whether the locomotive is to be used for switching, freight or passenger service.

TABLE No. 2

RATIO OF HEATING SURFACE TO CYLINDER VOLUME

(2 cylinders)

180 for large anthracite coal.
200 for small anthracite coal.
200 for bituminous coal.

* (Suggested by Mr. Lawford H. Fry.)

Modern practice indicates an average increase of 34 percent above these figures.

RATIO OF GRATE AREA IN SQUARE FEET TO CYLINDER VOLUME IN CUBIC FEET

(2 cylinders)

4 for large anthracite coal.
9 for small anthracite coal.
3 for bituminous coal.

Modern Practice indicates an increase of 23 percent above these figures.

RATIO OF HEATING SURFACE IN SQUARE FEET TO GRATE AREA IN SQUARE FEET

40 for large anthracite coal.
20 for small anthracite coal.
60 for bituminous coal.

Modern Practice indicates an increase of 28 percent above these figures.

It is now the opinion of those who have studied the design and proportion of modern locomotive boilers that some other basis of proportioning heating surface should be followed.

In 1902 another report on best proportions of heating surface and grate areas was made to the Master Mechanics' Association, and, at that time, it was stated that the ratios given in the 1897 report did not cover the recent increase in grate area, and that the basis of comparison of the previous ratios determined for the association contained only one factor, namely: the working force. This factor alone, without consideration of speed, with which the problem is so intimately connected, is of very little real value for accurately determining the correct proportions of a boiler. If, however, we combine the working force with the speed or rate of working, we then have the power. As the boiler must furnish a certain amount of power, or an amount of energy sufficient to perform a certain amount of work in a given time, it becomes apparent at once that the real basis from which the amount of heating surface should be computed is the maximum power, and that the total heating surface of any boiler is the product of a constant times the maximum power demanded by the service. Therefore, taking as the unit of power the horsepower, the formula for proportioning heating surface becomes as follows:

Total Heating Surface = (constant) × maximum horsepower.

HORSEPOWER

The formula for horsepower is:

$$(1)\ H\ P = \frac{P\ L\ A\ N}{33{,}000}, \text{ in which}$$

P_1 = boiler pressure,
P = mean effective pressure = $.85 \times P_1$,
L = length of stroke in feet = $S \div 12$,
A = area of cylinder = $\frac{1}{4}\pi d^2$ (d = diameter of cylinder).
N = number of strokes per minute, or $2 \times$ revolutions per minute for one side, or 4 times as a total = 4 (revolutions per minute).

$$\text{Also, } R\ P\ M = \frac{\text{miles per hour} \times 5{,}280}{60 \times \text{circumference of drivers in feet}},$$

where the circumference of drivers = $\pi\ D/12$.

D = diameter of drivers in inches,
S = stroke of cylinders in inches.

Substituting above values of factors in formula No. 1, we have

$$H\ P = \frac{.85 \times P \times S/12 \times \frac{1}{4}\pi d^2 \times 4\ (M\ P\ H) \times 5{,}280}{33{,}000 \times 60 \times \pi\ D/12}$$

Simplifying, we have

$$(2)\ H\ P = \frac{.85 \times d^2 \times P \times S \times (M\ P\ H)}{375 \times D}.$$

Assuming the maximum sustained speed as being equal to the diameter of the wheels (drivers) in inches, we then represent M. P. H. = D and formula No. 2 then becomes

$$(3)\ H\ P = \frac{.85 \times P \times d^2 \times S}{375}.$$

Where the M. P. H. = the diameter of drivers in inches the revolutions per minute become constant or R. P. M. = 336. The tractive power of a locomotive multiplied by the speed in miles per hour divided by 375 gives the horsepower.

RECOGNIZED PROPORTIONS

At the time the committee made its report in 1902, it was found from data taken from various locomotive boil-

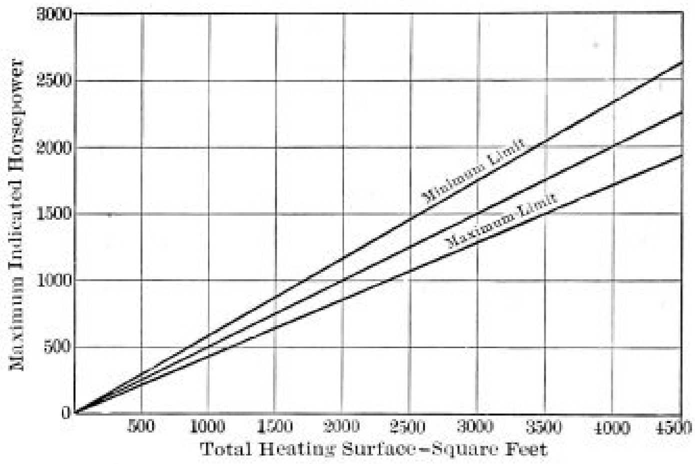


Fig. 1

ers that the ratios differed to some extent, and Table No. 3 gives the results of investigations in a number of cases where the performance was satisfactory.

TABLE NO. 3.

Ratios.	Conditions.	Simple Passenger.	Compound Passenger.	Simple Freight.	Compound Freight.
Total Heating Surface Maximum indicated horsepower or number of feet of heating surface per indicated horsepower.	Maximum	2.39	2.58	2.30	2.15
	Mean	2.00	2.13	1.71	1.80
	Minimum	1.72	1.70	1.48	1.58
Total Heating Surface Grate area or number of feet of heating surface per square foot of grate area.	Very free-burning bituminous	65 to 90	75 to 95	70 to 85	65 to 85
	Average bituminous coal	50 to 65	60 to 75	45 to 70	50 to 65
	Slow-burning bituminous or mixture of anthracite and bituminous.	40 to 50	35 to 60	35 to 45	45 to 50
	Slack bituminous mixtures of anthracite & bituminous & free burning anthracite.	35 to 40	30 to 35	30 to 35	40 to 45
	Very low grade bituminous, lignite, mixtures of anthracite & bituminous & slow-burning anthracite.	28 to 35	24 to 30	25 to 30	30 to 40
Tube Heating Surface Firebox heating surface.	Maximum	16.67	18.56	18.50	17.56
	Mean	13.42	13.42	12.75	13.58
	Minimum	10.25	10.09	9.04	11.50
Total Weight of Engine Maximum indicated horsepower.	Maximum	145.00	165.00	142.50	127.50
	Mean	127.00	135.00	115.50	113.25
	Minimum	108.00	111.00	101.25	102.25

In Table No. 3, under bituminous coal, the ratios found cover grate areas for burning nearly all grades of this coal.

TABLE NO. 4—HEATING SURFACE OF TUBES—SQ. FT. (OUTSIDE SURFACE).

Outside Diameter.	Feet.																
	1	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1½"	.3927	3.531	3.924	4.316	4.709	5.101	5.494	5.886	6.278	6.671	7.062	7.455	7.848	8.240	8.633	9.025	9.418	9.810
1¾"	.4581	4.124	4.582	5.040	5.498	5.956	6.415	6.873	7.331	7.789	8.247	8.706	9.164	9.622	10.080	10.538	10.997	11.455
2"	.5236	4.712	5.236	5.760	6.283	6.807	7.330	7.854	8.377	8.901	9.425	9.948	10.472	10.995	11.519	12.043	12.566	13.090
2¼"	.5890	5.298	5.887	6.476	7.064	7.653	8.242	8.830	9.419	10.008	10.596	11.185	11.774	12.363	12.951	13.540	14.123	14.717
2½"	.6545	5.890	6.545	7.199	7.854	8.508	9.163	9.817	10.472	11.126	11.781	12.435	13.090	13.744	14.399	15.053	15.708	16.362
3"	.7854	7.069	7.854	8.639	9.425	10.210	10.996	11.781	12.566	13.352	14.137	14.923	15.708	16.493	17.279	18.064	18.850	19.635
3½"	.9163	8.247	9.163	10.079	10.996	11.912	12.829	13.744	14.660	15.576	16.493	17.409	18.326	19.242	20.159	21.075	21.991	22.907
4"	1.0470	9.423	10.470	11.517	12.564	13.611	14.658	15.705	16.752	17.799	18.846	19.893	20.940	21.987	23.034	24.081	25.128	26.175
4½"	1.1781	10.603	11.781	12.959	14.137	15.315	16.493	17.671	18.850	20.028	21.206	22.384	23.562	24.740	25.918	27.096	28.274	29.452
5"	1.3090	11.781	13.090	14.399	15.708	17.017	18.326	19.635	20.944	22.253	23.562	24.871	26.180	27.489	28.798	30.107	31.416	32.725
5¼"	1.3744	12.369	13.744	15.118	16.493	17.867	19.242	20.616	21.990	23.365	24.739	26.114	27.488	28.862	30.236	31.610	32.984	34.358
5½"	1.4399	12.959	14.399	15.839	17.279	18.719	20.159	21.598	23.038	24.478	25.918	27.358	28.798	30.238	31.678	33.118	34.558	35.998

Outside Diameter.	Inches.											
	1	2	3	4	5	6	7	8	9	10	11	12
1½"	.033	.065	.097	.131	.164	.196	.229	.260	.294	.327	.360	.3927
1¾"	.038	.076	.114	.152	.191	.229	.267	.305	.342	.382	.418	.4581
2"	.044	.087	.131	.174	.218	.262	.305	.349	.392	.436	.479	.5236
2¼"	.049	.098	.147	.196	.245	.294	.343	.393	.442	.491	.539	.5890
2½"	.054	.119	.163	.218	.272	.327	.381	.436	.490	.540	.599	.6545
3"	.065	.131	.196	.262	.327	.393	.458	.524	.589	.654	.720	.7854
3½"	.076	.153	.229	.305	.381	.458	.534	.611	.687	.763	.839	.9163
4"	.087	.174	.262	.349	.436	.523	.610	.697	.785	.872	.959	1.0470
4½"	.098	.196	.294	.393	.491	.589	.687	.785	.883	.981	1.079	1.1781
5"	.109	.218	.327	.436	.545	.654	.763	.872	.981	1.090	1.199	1.3090
5¼"	.114	.229	.344	.458	.573	.687	.802	..916	1.031	1.145	1.260	1.370
5½"	.120	.240	.360	.480	.600	.720	.840	.960	1.080	1.200	1.320	1.4399

Outside Diameter.	Fractions of an Inch.														
	1/32	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16
1½"	.001	.002	.004	.006	.008	.010	.012	.014	.016	.018	.020	.022	.024	.026	.028	.031
1¾"	.001	.002	.005	.007	.009	.012	.014	.017	.019	.021	.024	.026	.028	.031	.033	.036
2"	.002	.003	.005	.008	.011	.013	.016	.019	.022	.024	.027	.030	.033	.035	.038	.041
2¼"	.002	.003	.006	.009	.012	.015	.018	.021	.024	.028	.031	.034	.037	.040	.043	.046
2½"	.002	.003	.007	.010	.014	.017	.020	.024	.027	.031	.034	.037	.041	.044	.048	.051
3"	.002	.004	.008	.012	.016	.020	.025	.028	.033	.037	.041	.045	.049	.053	.057	.061
3½"	.003	.005	.009	.014	.019	.024	.029	.033	.038	.043	.048	.052	.057	.062	.066	.071
4"	.003	.005	.011	.017	.022	.027	.033	.038	.044	.049	.054	.060	.065	.071	.076	.082
4½"	.003	.006	.012	.018	.024	.031	.037	.043	.049	.055	.061	.067	.073	.079	.086	.093
5"	.004	.007	.014	.020	.027	.034	.041	.048	.054	.061	.068	.075	.082	.088	.095	.102
5¼"	.004	.007	.014	.021	.029	.035	.043	.050	.057	.064	.072	.079	.087	.093	.100	.107
5½"	.004	.008	.015	.022	.030	.037	.045	.058	.060	.068	.075	.083	.090	.098	.105	.113

The maximum ratio would probably be suitable for only extremely free burning grades, and should not be exceeded. The mean ratio is probably suitable for the average quality of bituminous fuel, while the minimum limit is suitable for the power qualities. While division is made between anthracite and bituminous coal, in reality no division exists, the maximum ratios under the latter head being suitable for slack bituminous coal. The higher ratios under anthracite coal are really only suitable for low grades of bituminous coals or a mixture of ordinary bituminous coal with fine anthracite. The mean ratios under anthracite are suitable for good lump anthracite, and mixtures of bituminous and fine anthracite, while the minimum ratios are none too small for ordinary lump anthracite mixture of fine anthracite and bituminous and fine anthracite alone.

Fig. 1 represents the maximum mean and minimum ratios of total heating surface to maximum indicated horsepower, the lines on the diagram being obtained as follows: Using as ordinates the value of these two factors, a point was determined for each locomotive under consideration. A line drawn approximately through the middle of these points is an average or mean location of all points. In locating the limiting lines, it has not seemed advisable, where one point or engine comes some distance outside of the others, to allow it to have too great an influence in determining the location of the lines, so that the limiting lines are the limits of average practice.

HEATING SURFACE

Table No. 4 will be valuable in calculating the heating surface of a boiler. It gives quite a range in the diameter of tubes and the various lengths, and the heating surface can readily be obtained for any length of tube, after which it is a simple matter to get the heating surface for any number of tubes by multiplying the value of one tube by the total number of tubes in the boiler.

LATEST PRACTICES

In 1916 another report was made to the Master Mechanics' Association, and, as shown in Table No. 2, it was found that the ratios which were recommended in 1897 had been increased considerably, indicating a change brought about by a greater demand being made on the boilers at the present time, and necessitating an increase in heating surface. It will also be noted that an entirely new basis is now recommended for comparison of boilers, the basis being cylinder horsepower instead of cylinder volume, although from what information the writer has come in contact with recently, quite a few railroads still use the 1897 M. M. rules, with the modification, as previously mentioned; that is, the ratios have been somewhat increased to meet the heavy demands now being made on modern equipment.

So far as fireboxes are concerned, the improvement along this line seems to be the adoption of the combustion chamber, its use being for the purpose of reducing excessive length of tubes. Then again, its use has been considered advisable in order to bring about more complete combustion in the firebox, thus increasing firebox temperature. Although there does not appear to be much actual data at hand from tests made of boilers with combustion chambers, it is admitted by a few who have noted results that such boilers show better steaming qualities, and the consensus of opinion is that the benefits derived justifies their use on large power.

In comparing the value of boilers with regard to the firebox heating surface to tube heating surface, there seems to be a wide variation in results, namely: the minimum ranging about from 5.5 to 1 to a maximum of 12 to 1. In comparing the ratio of the firebox volume to the grate area, the results which indicate the most effective ratio are 3.6 to 8 averaging about 5.6 to 1.

JACOBS-SHUPERT TESTS

It may be interesting to note the results which were obtained in the Jacobs-Shupert tests a few years ago, during which it was found that the evaporating qualities of both the Jacobs-Shupert and the radial stay boilers were about equal. These results are shown in Table 5.

TABLE NO. 5

	Fuel.	
	Oil.	Coal.
	Pounds	Pounds
Evaporation per square foot of heating surface per hour for the whole boiler	9.78	11.77
Evaporation per square foot of heating surface per hour for the firebox	49.59	51.92
Evaporation per square foot of heating surface per hour for the tubes	6.47	8.43
Ratio of heat absorbed per foot of heating surface by the firebox to that absorbed per ft. of tube heating surface	7.6 to 1	6.15 to 1
Water evaporated per hour by firebox	16,000	11,982
Water evaporated per hour by tubes	24,000	23,423
Total water evaporated per hour	40,000	35,405
Horsepower developed in firebox	500	304
Horsepower developed in tubes	700	722
Total horsepower developed	1,200	1,026

From the above it will be seen that the evaporating qualities of the firebox is of much higher value per square foot than that of the tubes.

EVAPORATIVE VALUE

In connection with tests that have been made, it has been shown that there is a great variation in the evaporative value of the boiler tube, about one-half of the heat being transmitted to the first quarter of the tube length; the use of long tubes is, therefore, not considered to be entirely efficient. While the evaporative capacity of the boiler may be increased by their use, the rate of evaporation per unit of area is lower. There seems to be quite a variation in practice as regards the ratio of tube length to the diameter, varying from about 91 to 126 times the internal diameter, and in the recent report to the Master Mechanics' Association it is stated that a proportion of 100 times the internal diameter seems to be most satisfactory.

In arriving at the steam-producing capacity of a locomotive boiler, the following Table, No. 6, was suggested by the American Railway Engineering and Maintenance of Way Association at their 1910 meeting.

Table 6 assumes feed water at average of 60° F. and boiler pressure 200 pounds.

For 160 pounds boiler pressure approximately one-half percent greater quantity would be evaporated.

For coal of different thermal value than 15,000 B. T. U. multiply tabular amounts by following decimals:

14,500 B. T. U. × 0.967	12,000 B. T. U. × 0.800
14,000 B. T. U. × 0.933	11,500 B. T. U. × 0.767
13,500 B. T. U. × 0.900	11,000 B. T. U. × 0.733
13,000 B. T. U. × 0.867	10,500 B. T. U. × 0.700
12,500 B. T. U. × 0.833	10,000 B. T. U. × 0.667

The quantity and quality of fuel burned is a factor in the steam production, and by knowing the grate area and heating surface, the average steam production of locomotive boilers burning bituminous and other similar coals can be estimated by use of Table No. 6, assuming 4,000 pounds of coal as the maximum quantity that can be properly "fired" per hour.

Table No. 7 covers the amount of steam consumed per foot of stroke in cylinders, at pressures ranging from 160 to 220 pounds, and the maximum velocity at which full cutoff can be maintained can be found by dividing the pounds of steam produced in a minute by the quantity of steam used per revolution of the drivers. Dividing this result by the coefficient obtained from formula "A," will give the speed in miles per hour at which full cutoff can be maintained.

$$(A)\ C = \frac{336.13}{\text{Diameter of drivers}}.$$

STEAMING CAPACITY

The application of superheaters is now practically conceded by all railroad men as being an efficient device, and the proportion of superheating surface to total saturated heating surface varies from about .115 to .29, averaging about .217 for boilers without combustion chambers, and .28 for boilers with combustion chambers.

The steaming capacity of a locomotive, as ordinarily referred to, is the ratio as between the maximum evaporation of the boiler in pounds per hour to the weight of water consumed by the cylinders in the same unit of time.

It has been shown by tests made on a number of occasions that steam is drawn from the boiler at the rate of 25 to 30 pounds per horsepower per hour, and that an evaporation of 12 to 15 pounds of water per square foot of heating surface per hour is attained, these values being for saturated steam, and for superheated steam the rate of steam drawn from the boiler would be about 25 percent less than figures specified above. From these values, the efficiency of the boiler may be determined as follows: If 1,000 horsepower is continuously developed by the cylinders, the rate of steam being 27 pounds per horsepower per hour, the total evaporation of the boiler must be at the rate of 1,000 x 27 or 27,000 pounds per hour. If the boiler has 2,500 square feet of heating surface, and it is assumed that each square foot of heating surface is capable of evaporating 13.5 pounds of water per hour, then the

TABLE NO 6—AVERAGE HOURLY EVAPORATION PER 1,000 FEET OF HEATING SURFACE FOR VARIOUS RATIOS OF HEATING SURFACE TO GRATE AREA AND FOR VARIOUS RATES OF FUEL CONSUMPTION BASED ON USE OF BITUMINOUS COAL TESTING 15,000 B. T. U. PER POUND.

Ratio.	Pounds Coal Per Square Foot Grate Area Per Hour.										
	60	70	80	90	100	110	120	130	140	150	160
R = 50	8,136	8,965	9,690	10,324	10,879	11,365	11,790	12,162	12,487	12,771	13,020
R = 55	7,697	8,480	9,165	9,764	10,288	10,747	11,149	11,501	11,809	12,079	12,314
R = 60	7,295	8,037	8,686	9,254	9,751	10,186	10,567	10,900	11,191	11,446	11,669
R = 65	6,913	7,617	8,233	8,772	9,244	9,657	10,018	10,334	10,610	10,852	11,064
R = 70	6,566	7,234	7,818	8,329	8,776	9,167	9,509	9,808	10,070	10,299	10,500
R = 75	6,238	6,874	7,430	7,917	8,343	8,716	9,042	9,327	9,376	9,794	9,985
R = 80	5,939	6,542	7,070	7,532	7,936	8,289	8,598	8,868	9,104	9,311	94,942
R = 85	5,677	6,255	6,761	7,204	7,591	7,930	8,227	8,487	8,714	8,912	9,085
R = 90	5,440	5,993	6,477	6,900	7,270	7,594	7,878	8,126	8,343	8,533	9,699
R = 95	5,211	5,471	6,205	6,611	6,966	7,277	7,549	7,787	7,995	8,177	8,336

TABLE NO. 7—WEIGHT OF STEAM USED IN ONE FOOT OF STROKE IN LOCOMOTIVE CYLINDERS.
Cylinder Diameter is for High Pressure Cylinders in Compound Locomotives.

Diameter of Cylinder in Inches.	WEIGHT OF STEAM PER FOOT STROKE FOR VARIOUS GAGE PRESSURES.						
	220 Pounds.	210 Pounds.	200 Pounds.	190 Pounds.	180 Pounds.	170 Pounds.	160 Pounds.
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
12	0.405	0.389	0.370	0.354	0.337	0.321	0.304
13	0.475	0.456	0.435	0.415	0.396	0.376	0.357
14	0.551	0.529	0.504	0.482	0.459	0.436	0.414
15	0.633	0.607	0.579	0.553	0.527	0.501	0.476
15½	0.675	0.649	0.618	0.590	0.562	0.535	0.508
16	0.720	0.691	0.658	0.629	0.599	0.570	0.541
17	0.812	0.780	0.744	0.710	0.676	0.643	0.611
18	0.911	0.875	0.834	0.796	0.759	0.722	0.685
18½	0.962	0.924	0.881	0.841	0.801	0.762	0.724
19	1.015	0.975	0.928	0.887	0.845	0.804	0.763
19½	1.069	1.027	0.978	0.934	0.890	0.847	0.804
20	1.125	1.080	1.029	1.983	0.936	0.891	0.846
20½	1.181	1.134	1.081	1.032	0.984	0.936	0.888
21	1.240	1.191	1.134	1.083	1.032	0.982	0.932
22	1.361	1.307	1.245	1.189	1.133	1.078	1.023
23	1.487	1.428	1.361	1.300	1.238	1.178	1.118
28	2.204	2.117	2.017	1.926	1.835	1.745	1.657

TABLE NO. 8—WEIGHT OF STEAM IN CYLINDERS AT 180 POUNDS PRESSURE PER SQUARE INCH.
STROKE IN INCHES

Diameter	2	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
6	.01415	.05573	.06859	.08574	.9860												
7	.01929	.07717	.09431	.11575	.13290												
8	.02486	.09860	.12432	.15005	.17577	.19888											
9	.03172	.12432	.15862	.18863	.22293	.25376											
10	.03901	.15433	.19720	.23579	.27437	.30867	.34725	.38583	.42442	.46300	.50458	.54017	.57875	.62590	.66449	.70307	.74166
11	.04716			.28294	.33010	.37726	.42442	.47157	.51873	.56589	.61305	.66020	.70736	.75452	.80168	.84883	.89599
12	.05573						.50158	.55731	.61305	.66877	.72450	.78023	.83596	.89170	.94743	1.00316	1.05889
13	.06485						.58365	.64850	.71335	.77820	.84305	.90790	.97275	1.03760	1.10245	1.16730	1.23215
14	.07638						.68744	.76382	.84020	.91658	.99296	1.06934	1.14572	1.22210	1.29848	1.37486	1.45124
15	.08768						.78911	.87678	.96446	1.05214	1.13982	1.22750	1.31518	1.40286	1.49054	1.57822	1.66590
16	.09976							.99759	1.09735	1.19711	1.29687	1.39663	1.49639	1.59615	1.69591	1.79567	1.89543
17	.11253							1.12535	1.23788	1.35142	1.46295	1.57598	1.68851	1.80104	1.91357	2.02610	2.13863
18	.12604							1.26039	1.38643	1.51247	1.63851	1.76455	1.89059	2.01663	2.14267	2.26871	2.39475
19	.14062							1.40615	1.54677	1.68737	1.82800	1.96862	2.10924	2.24986	2.39048	2.53110	2.67172
20	.15587								1.71463	1.87050	2.02637	2.18224	2.33815	2.49398	2.64985	2.80572	2.96159
21	.17184									2.06206	2.23390	2.40574	2.57758	2.74942	2.92126	3.09310	3.26494
22	.18863									2.26356	2.45219	2.64082	2.82945	3.01808	3.20671	3.39534	3.58397
23	.20578										2.67512	2.88090	3.08668	3.29246	3.49824	3.70402	3.90980
24	.22424										2.91519	3.13943	3.36367	3.58791	3.81215	4.03639	4.26063
25	.24321										3.16169	3.40490	3.64811	3.89132	4.13453	4.37774	4.62095
26	.26315										3.42106	3.68421	3.94370	4.21045	4.47360	4.73675	4.99990
27	.28393										3.69114	3.97507	4.25900	4.54293	4.82686	5.11079	5.39472
28	.30545											4.27632	4.58177	4.88722	5.19267	5.49812	5.80357
29	.32765											4.58713	4.91478	5.24243	5.57008	5.89773	6.22538
30	.35062											4.90866	5.25928	5.60990	5.96052	6.31114	9.66176
31	.37444												5.61670	5.99114	6.36558	6.74002	7.11446
32	.39896													6.38340	6.78236	7.18132	7.58028
33	.42441													6.79067	7.21508	7.63949	8.06390
34	.45054													7.20866	7.65920	8.10974	8.56028
35	.47720													7.63522	8.11242	8.58962	9.06682
36	.50480													8.07678	8.58158	9.08638	9.59118
37	.53347													8.53550	9.06897	9.60244	10.13591
38	.56272													9.00364	9.56636	10.12908	10.69180
39	.59268													9.48293	10.07561	10.66829	11.26097
40	.62349													9.97594	10.59943	11.22292	11.88641

maximum capacity of the boiler is 2,500 x 13.5 or 33,750 pounds per hour. The steaming capacity under these conditions is:

$$\frac{33{,}750}{27{,}000} = 1.25,$$

or, in other words, the boiler is capable of evaporating 25 percent more water than is required by the cylinders.

It is considered desirable to proportion the values in such a manner as to obtain 100 percent boiler capacity: that is, making the boiler capacity equal to that of the cylinder horsepower. It is difficult, however, under some conditions always to obtain such a relation between the boiler and cylinders, particularly in light weight power, and, in some instances, it may be necessary to sacrifice to a small extent.

In order not to exceed the weight desired for an engine, as a rule locomotive boilers are made as large as possible; this provides for heating surface requirements, and a little excess does no harm, as there are few locomotives that have been rendered inefficient by making them a free steamer, and, therefore, the greater the boiler power the higher the speed that can be maintained. While the several parts of a boiler are more or less important in their bearing upon the generation of steam, the amount of heating surface is as a rule the most important.

Tables Nos. 8 to 11 show the weight of steam in cylinders for pressures of 180, 190, 200 and 210 pounds, and will be of use in the computation of the amount of steam used by the cylinders at certain speeds. These tables, of course, could be extended for other pressures, but modern power now is generally confined within the limits of these tables. Computations can be made on weight of steam as given in Table No. 12, which covers other pressures as well.

TABLE NO. 12—WEIGHT OF A CUBIC FOOT OF SATURATED STEAM IN POUNDS PRESSURES ABOVE THE ATMOSPHERE.

Pressure.	Weight.	Pressure.	Weight.
0	.038	110	.284
10	.063	120	.306
20	.086	130	.327
30	.109	140	.348
40	.131	150	.370
50	.154	160	.390
60	.176	170	.411
70	.198	180	.429
80	.219	190	.450
90	.241	200	.470
100	.263	210	.492

TABLE NO. 9—WEIGHT OF STEAM IN CYLINDERS AT 190 POUNDS PRESSURE PER SQUARE INCH.

STROKE IN INCHES.

Diameter.	2	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
6	.01480	.05843	.07192	.08990	.10338												
7	.02001	.08091	.09887	.12136	.13934												
8	.02611	.10338	.13035	.15732	.18429	.21040											
9	.03305	.13035	.16631	.19777	.23373	.26678											
10	.04068	.16181	.20676	.24744	.28812	.32880	.36948	.40454	.44522	.48590	.52658	.56726	.60681	.64749	.68817	.72885	.76953
11	.04944			.29666	.34610	.39554	.44498	.49442	.54388	.59332	.64276	.69220	.74164	.79108	.84052	.88996	.93940
12	.05843						.52590	.58433	.64276	.70119	.75962	.81805	.87650	.93493	.99336	1.05179	1.11022
13	.06928						.62478	.69406	.76334	.83262	.89897	.96825	1.03753	1.10681	1.17609	1.24058	1.30986
14	.08000						.71918	.79918	.87918	.95918	1.03753	1.11922	1.19922	1.27922	1.35922	1.44285	1.52285
15	.09179						.82705	.91884	1.01063	1.10242	1.19421	1.28600	1.37543	1.46722	1.55901	1.65080	1.74259
16	.10439							1.04281	1.14720	1.25159	1.35598	1.46037	1.56476	1.67209	1.77648	1.88087	1.98526
17	.11838							1.18513	1.30351	1.42189	1.54027	1.65865	1.77703	1.89541	2.00921	2.12759	2.24594
18	.13223							1.31861	1.45184	1.58509	1.71833	1.85188	1.98412	2.11635	2.25193	2.38416	2.51640
19	.14743							1.47432	1.62175	1.76918	1.91661	2.06404	2.21147	2.35890	2.50633	2.65376	2.80119
20	.16318								1.79795	1.96113	2.12431	2.28339	2.44657	2.60702	2.77020	2.93338	3.09656
21	.18013									2.16203	2.34216	2.52229	2.70142	2.88155	3.06168	3.24181	3.42194
22	.19777									2.37329	3.57106	2.76883	2.96661	3.16438	3.36215	3.55992	3.75769
23	.21575										2.80480	3.02055	3.23630	3.45205	3.66782	3.88357	4.09932
24	.23496										3.05651	3.29147	3.52643	3.76139	3.99145	4.22641	4.46137
25	.25500										3.31272	3.56772	3.82272	4.07772	4.33755	4.59255	4.84755
26	.25571										3.58691	3.84262	4.09833	4.35404	4.68366	4.93937	5.19508
27	.29758										3.86998	4.16756	4.46514	4.76272	4.05673	5.35431	5.65189
28	.33028											4.48588	4.81616	5.14644	5.47672	5.76243	6.09271
29	.34357											4.80952	5.15309	5.49666	5.84023	6.18494	6.52851
30	.36764											5.14663	5.51427	5.88191	6.24955	6.61719	6.98953
31	.39256											5.49723	5.88979	6.28235	6.67491	7.06747	7.45699
32	.41856												6.27934	6.69790	7.11646	7.53502	7.95143
33	.44526												6.67938	7.12464	7.56990	8.01516	8.45935
34	.47328													7.57252	8.04582	8.51910	8.99238
35	.50118													8.01885	8.52003	9.02121	9.52239
36	.52940													8.47033	8.99973	9.52913	10.05853
37	.55933													8.94929	9.50862	10.06795	10.62728
38	.59001													9.44013	10.03014	10.62015	11.21016
39	.62141													9.94266	10.56407	11.18548	11.80689
40	.65372													10.45957	11.11329	11.76701	12.42073

TABLE NO. 10—WEIGHT OF STEAM IN CYLINDERS AT 200 POUNDS PRESSURE PER SQUARE INCH.

STROKE IN INCHES.

Diameter.	2	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
6	.01551	.06112	.07523	.09404	.10814												
7	.02116	.08464	.10344	.12695	.14575												
8	.02727	.10814	.13635	.16456	.19277	.22004											
9	.03479	.13635	.17396	.20688	.24449	.27928											
10	.04278	.16926	.21628	.25859	.30091	.33853	.38085	.42316	.46548	.50779	.55011	.59242	.63474	.68646	.72878	.77109	.81341
11	.05172			.31032	.36204	.41376	.46548	.51720	.56892	.62064	.67236	.72407	.77580	.82751	.87923	.93096	.98267
12	.06112					.48899	.55011	.61123	.67235	.73347	.79459	.85571	.91683	.97795	1.03907	1.10019	1.16131
13	.07233						.65104	.72337	.79570	.86803	.94036	1.01269	1.08502	1.15735	1.22968	1.30201	1.37434
14	.08359						.75229	.83588	.91947	1.00306	1.08665	1.17024	1.25383	1.33742	1.42101	1.50460	1.58819
15	.09602						.86513	.95916	1.05518	1.15120	1.24722	1.34324	1.43926	1.53528	1.63130	1.72732	1.82334
16	.10904							1.09081	1.19896	1.30800	1.41704	1.52608	1.63512	1.74416	1.85320	1.96224	2.07128
17	.12383							1.24127	1.36510	1.48893	1.61276	1.73659	1.85320	1.98064	2.10467	2.22850	2.35233
18	.13823							1.38232	1.52055	1.65878	1.79701	1.93524	2.07349	2.21172	2.34995	2.48818	2.62641
19	.15425							1.54310	1.69735	1.85160	2.00585	2.16010	2.31328	2.46753	2.62178	2.77602	2.93028
20	.17105								1.88072	2.05177	2.22282	2.39387	2.56718	2.73823	2.90928	3.08033	3.25138
21	.18807									2.25686	2.44493	2.63300	2.82107	3.00914	3.19721	3.38528	3.57335
22	.20687									2.48254	2.68941	2.89628	3.10318	3.31005	3.51692	3.72379	3.93066
23	.22268										2.93391	3.15957	3.38528	3.61096	3.83664	3.06232	4.28800
24	.24573										3.19722	3.44295	3.68868	3.93441	4.18014	4.41968	4.66541
25	.26677										3.46757	3.73434	4.00111	4.26922	4.53599	4.80276	5.06953
26	.28854										3.75203	4.04057	4.32911	4.61765	4.90397	5.19251	5.48105
27	.31132										4.04824	4.35956	4.66887	4.98019	5.29151	5.60238	5.91415
28	.33503											4.69003	5.02506	5.36009	5.69622	6.03125	6.36628
29	.35902											5.03091	5.38993	5.74895	6.10797	6.46699	6.82601
30	.38452											5.38355	5.76807	6.15259	6.53711	5.92103	7.30555
31	.41059												6.16251	6.57310	6.98369	7.38651	7.79710
32	.43782													7.00567	7.44349	7.88020	8.31802
33	.46561													7.44763	7.91324	8.38329	8.84890
34	.49396													7.90371	8.39767	8.89108	9.38504
35	.52341													8.37389	8.89730	9.42239	9.94580
36	.55370													8.85817	9.41187	9.96779	10.52149
37	.58508													9.36126	9.94634	10.53142	11.11650
38	.61717													9.87470	10.49187	11.10904	11.72621
39	.65002													10.40036	11.05038	11.70040	12.35042
40	.68381													10.94106	11.62487	12.30868	12.99249

BOILER EFFICIENCY

It has also been found that the efficiency of the boiler is not altogether a question of heating surface, as, for example, a boiler may be so crowded with tubes as to hinder the circulation and the consequence is, therefore, a reduction in evaporation per square foot of heating surface in a unit of time.

The percentage of area of boiler occupied by the tubes is not only dependent upon the spacing of the tubes, but also on the relative position of the crown sheet, with regard to the top of the boiler, as, for instance, in a wagon top design, the crown sheet can be placed relatively higher than in the straight top type of boiler; consequently the wagon top type shows a larger percentage of the area covered by the tubes, and it has been found that on examining a number of boilers the percentages run as follows:

	Minimum.	Maximum.	Average.	Majority Running Between.
	Percent	Percent	Percent	Percent
Wagon top type..........	24	40	32	29 to 35
Straight..................	21	35	28	25 to 33

When speaking of the proportions of heating surface to grate area and cylinder volume or cylinder horsepower, there seems to be a number of railroads who cannot all agree on some set standard, as, for example, some roads still feel that there is no good reason for departing from the recommendations made to the Master Mechanics' Association in 1897, although these were made twenty years

TABLE NO. 11—WEIGHT OF STEAM IN CYLINDERS AT 210 POUNDS PRESSURE PER SQUARE INCH.

Stroke in Inches.

Diameter.	2	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38
6	.01641	.06401	.07877	.09847	.11324												
7	.02215	.08860	.10832	.13290	.15263												
8	.02855	.11324	.14275	.17130	.20186	.23041											
9	.03643	.14278	.18215	.21858	.25501	.29144											
10	.04450	.17725	.22648	.26880	.31360	.35810	.40260	.44312	.48762	.53212	.57662	.62036	.66486	.70936	.76315	.80765	.85215
11	.05416			.32495	.37911	.43327	.48743	.54159	.59575	.64991	.70407	.75823	.81238	.86654	.92070	.97486	1.02902
12	.06401					.51205	.57606	.64007	.70408	.76807	.83208	.89608	.96009	1.03394	1.09795	1.16196	1.22597
13	.07580						.68437	.76017	.83597	.91177	.98471	1.06051	1.13631	1.21211	1.28504	1.36084	1.43664
14	.08629						.78776	.87405	.96034	1.04871	1.13500	1.22129	1.30758	1.34321	1.42950	1.51579	1.60208
15	.10064						.90593	1.00657	1.10727	1.20791	1.30855	1.40813	1.50877	1.60941	1.71005	1.81186	1.91250
16	.11435							1.14226	1.25661	1.37096	1.48391	1.59826	1.71261	1.82696	1.94972	2.06407	2.17842
17	.12986							1.29981	1.42967	1.55953	1.68939	1.82171	1.95157	2.08143	2.20082	2.33068	2.46054
18	.14495							1.44752	1.59247	1.73742	1.88079	2.02574	2.17069	2.31898	2.46393	2.61440	2.75935
19	.16154							1.61585	1.77739	1.93893	2.10047	2.25990	2.42144	2.58298	2.74733	2.90887	3.07041
20	.17922								1.96941	2.14863	2.32785	2.51100	2.69022	2.86944	3.04767	3.22689	3.40611
21	.19716									2.36329	2.56045	2.75761	2.95412	3.15128	3.34844	3.55479	3.75195
22	.21663									2.59963	2.81626	3.03289	3.24954	3.46617	3.69265	3.90928	4.12591
23	.23663										3.07229	3.30892	3.54555	3.79112	4.02775	4.26438	4.50101
24	.25765										3.34308	3.60073	3.85838	4.12592	4.38357	4.64289	4.90054
25	.27953										3.63468	3.91421	4.19374	4.47327	4.75121	5.03074	5.31027
26	.30250										3.92898	4.23148	4.53398	4.84476	5.14726	5.44976	5.75226
27	.32635										4.23777	4.56412	4.89047	5.21682	5.55375	5.58010	5.90645
28	.35061											4.90773	5.25834	5.60895	5.95956	6.31198	6.66259
29	.37643											5.26819	5.64462	6.02105	6.40060	6.77703	7.15346
30	.40265											5.63853	6.04118	6.44383	6.84372	7.24637	7.64902
31	.42992												6.45210	6.88202	7.31194	7.73488	8.16480
32	.45788													7.32623	7.78411	8.24200	8.69988
33	.48696													7.78904	8.27600	8.76882	9.25578
34	.51738													8.27600	8.79338	9.31533	9.83271
35	.54802													8.76882	9.31533	8.86335	10.41137
36	.57981													9.27595	9.85576	10.43790	10.01771
37	.61267													9.80276	10.41543	11.02810	11.64077
38	.64627													10.34042	10.98669	11.63296	12.27923
39	.68068													10.89087	11.57155	12.25223	12.93293
40	.71607													11.45708	12.17315	12.88922	13.60529

ago, and represented good practice at that time for locomotives of much lighter construction and power, on which the demands were nothing like present-day operation. It would, therefore, seem logical to accept some modification in lieu of the numerous tests that have been conducted in later years on power representative of the present time.

We have read much on the subject of value and proportion of heating surface in locomotive boilers, and owe much to the following gentlemen for what they have contributed to the subject: Professor W. F. M. Goss; F. J. Cole; Lawford H. Fry; Geo. R. Henderson; H. H. Vaughan and others, and, with all data at hand, there are still some points to be definitely decided upon.

Rate of Combustion

As stated in chemistry, each pound of fuel is capable of giving out a certain number of heat units. It is evident, therefore, that the more rapid the combustion, the greater the amount of heat produced in a given time. In stationary boilers where the size of the grate is practically unlimited, the rate of combustion per square foot of grate area is from 15 pounds to 25 pounds per hour. In locomotives, with the limited grate area available, this rate is many times exceeded, rising at times to as much as 200 pounds per hour. This rapid combustion results in a great loss of heat and a fall in the amount of water evaporated per pound of coal. It has been shown that when coal is burned at the rate of 50 pounds per square foot of grate per hour, 8¼ pounds of water may be evaporated for each pound of coal; while if the rate of combustion is increased to 180 pounds per square foot of grate area, the evaporation will fall to about 5 pounds, a loss in water evaporation per pound of coal of nearly 40 percent. This loss may be due to a failure of the heating surface to absorb properly the increased volume of heat passing over them or to the imperfect combustion of the fuel on the grate, or it may be due to a combination of these causes.

The results of experiments show that, in general, the most efficient furnace action accompanies the lowest rates of combustion, and enforce the general conclusion that very high rates of combustion are not desirable and, consequently, that the grate of a locomotive should be made large, so that exceptionally high rates will not be necessary.

With high rates of combustion, the loss of sparks is very serious and may equal in value all the other losses occurring at the grate.

Fig. 2 is a diagram representing the losses that occur, due to an increase in the rate of combustion. The line *A-B* shows the amount of water evaporated per pound of coal for the various rates of combustion. Thus, with a rate of 50 pounds per square foot of grate per hour, 8¼ pounds of water are evaporated. When the rate of combustion is raised to 175 pounds, only about 5⅓ pounds of water are evaporated. If it could be assumed that the heat developed in the furnace would be absorbed with the same degree of completeness for all rates of combustion, the evaporation would rise to the line *A-C*. If, in addition to this, it could be assumed that there were no

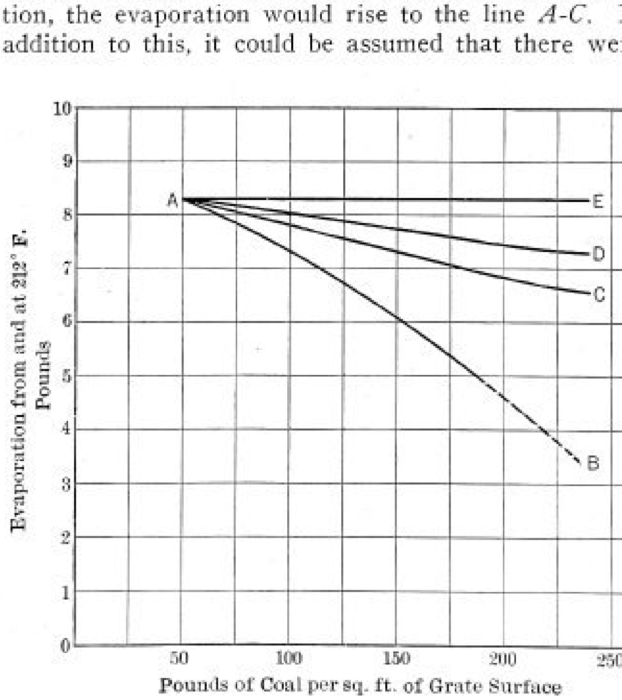


Fig. 2

spark losses, the evaporation would rise to the line *A-D*. Finally, if, in addition to these, it could be assumed that there were no losses by the excessive admission of air or incomplete combustion, then the evaporation would remain constant for all rates of combustion, and would be represented by the line *A-E*.

That is, with the boiler under normal conditions, the area *A-B-C* represents the loss occasioned by deficient heating surface, the area *A-C-D* that occasioned by spark losses and the area *A-D-E* that occasioned by excessive amounts of air and by imperfect combustion.

The efficiency of the locomotive, from the standpoint of water evaporated per pound of coal, falls off as the

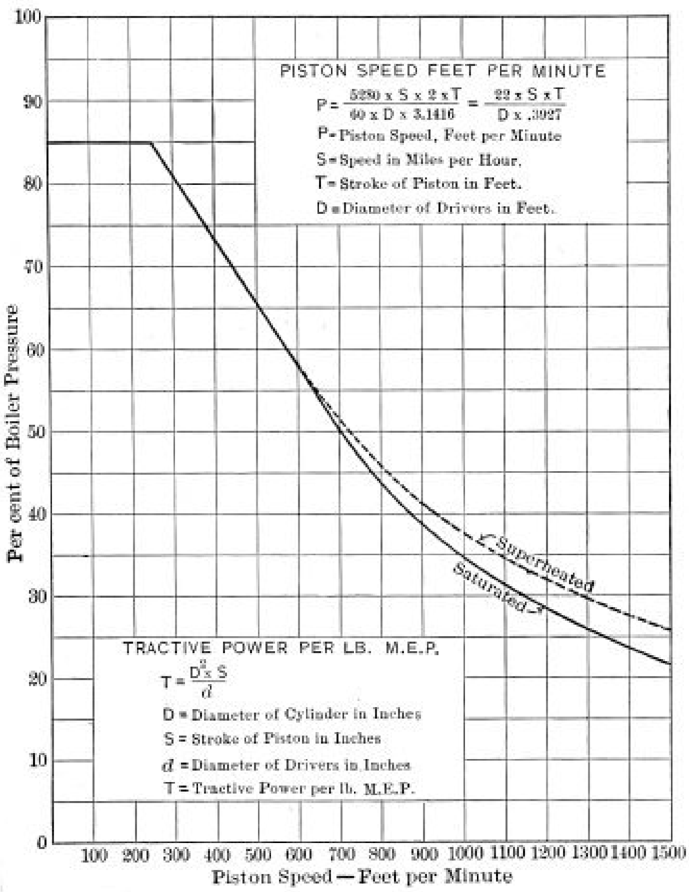


Fig. 3

rate of combustion per square foot of grate area is increased.

LOSS OF HEAT

In passing, it may not be amiss to state that there are considerable losses due to loss of heat in the products of combustion, loss of heat by external radiation and loss of heat by imperfect combustion. In order to gain an idea of what these losses amount to, the following represents the results obtained on two testing plants, one at St. Louis and the other at Altoona, Pa.

	ST. LOUIS.	ALTOONA.
The loss by CO increases.......	From a trace up to about 2 percent.	From 0.4 to 2.4 percent
Loss of heat in the gaseous products of combustion decreases.	From about 18 percent to about 11 percent.	From 18 percent to 15 percent.
Loss of unburnt coal increases.	From about 4 percent to 40 percent.	From about 10 percent to about 28 percent.
The boiler efficiency decreases.	From about 74 percent to about 43 percent.	From about 68 percent to about 52 percent.
Efficiency of absorption of heat, or absorption of heat by heating surface of heat produced by combustion	81 percent.	79 percent.

SUPERHEATERS—ECONOMIES IN

There have been quite a number of reports made with reference to the economies realized from superheaters, and from reliable data it is found that a saving of 15 to 25 percent in fuel and 20 to 30 percent in water consumption can be realized in every-day operation through the use of superheater and brick arch. While the cost of maintenance is higher with superheaters, this is offset to a large degree by saving of coal and water.

CONCLUSIONS

This subject of best proportions of boilers, particularly with regard to the heating surface and grate area, has been very much discussed in the technical press for the past twenty years, and, with the increasing demand on the power and larger boilers being constructed, it has been found necessary to depart somewhat from what was considered good practice twenty years ago and find some new basis for proportioning boilers. This problem has been undertaken by the Master Mechanics' Association and during 1897 a very elaborate report was made, involving the cylinder volume as the basis of calculations. It was not long before this basis was thought to require some further study, and it is now the opinion of those who have given the matter much study that the cylinder horsepower is the correct basis for determining the heating surface and grate area. The most recent recommendations made to the Master Mechanics' Association in 1916 are practically covered in detail in bulletin No. 1,017, issued by the American Locomotive Company, and are summarized as follows:

$$H\ P = .0212 \times P \times A = \text{saturated steam.}$$
$$H\ P = .0229 \times P \times A = \text{superheated steam.}$$

Maximum horsepower assumed to be reached at piston speeds as follows:

700 feet per minute saturated steam.
1,000 feet per minute superheated steam.

The following represents results compiled from various reports representing tests made under different conditions, in road tests and on testing plants, and represent liberal quantities:

TOTAL STEAM PER HOUR

$H\ P \times 27.0$ saturated steam.
$H\ P \times 20.8$ superheated steam.

TOTAL COAL PER HOUR

$H\ P \times 4.00$ pounds saturated steam.
$H\ P \times 3.25$ pounds superheated steam.

These figures based on coal containing 14,000 B. T. U. per pound, and for coal of better or poorer rating a percentage factor to be used.

GRATE AREA

Figuring 120 pounds of coal per square foot of grate area as the maximum consumption for economical evaporation, and basing this on coal of good quality or 14,000 B. T. U., the grate surface required will be as follows:

$$\frac{H\ P \times 4.00}{120} = \frac{H\ P}{30} \text{ saturated steam.}$$
$$\frac{H\ P \times 3.25}{120} = \frac{H\ P}{36.9} \text{ superheated steam.}$$

EVAPORATION

Some of the most recent tests, particularly those made at Coatesville, show the following evaporating value as being assigned to the firebox and tubes, and the approximate evaporation may be obtained as follows:

Heating surface of firebox in square feet × 55 = evaporation in pounds per hour.

Heating surface of tubes in square feet × 10 = evaporation in pounds per hour.

The ratio of firebox volume to grate area should be about 5.5 or 6 to 1 for bituminous coal and 4.5 or 4.85 to 1 for anthracite coal.

The ratio of tube length should be about 100 to 1 or not over 100 times the internal diameter.

The ratio of superheating surface to total saturated surface should be about .22 without combustion chamber and .29 with combustion chamber.

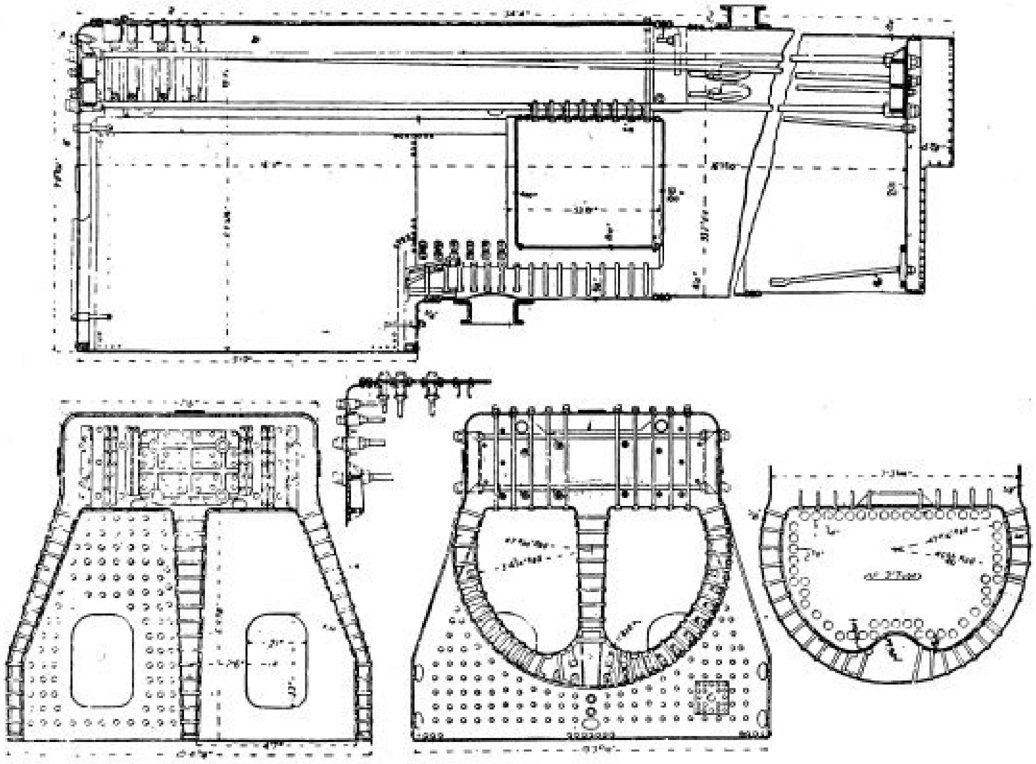
Mean Effective Pressure

Fig. 3 affords the means of finding the mean effective pressure in percent of the boiler pressure for piston speeds up to 1,500 feet per minute. This figure can be used in connection with finding the tractive power at any desired speed, from which the corresponding horsepower can readily be obtained.

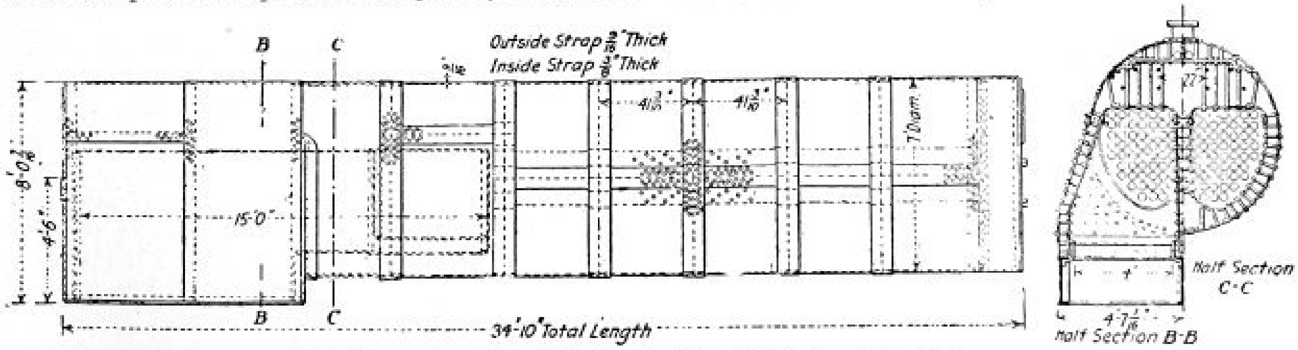
Leavitt Locomotive Type Boilers

Locomotive Type Boiler Designed by Charter Member of Mechanical Engineers' Society—Double Firebox

In a paper presented at the recent meeting of the American Society of Mechanical Engineers, in New York, F. W. Dean, a member of the society, reviewed the engineering work of Erasmus Darwin Leavitt, one of the original members of the society and its president in 1883. The death of this eminent engineer occurred in 1916, and because of the prominent position occupied by him in his day and remarkable versatility it was fitting that this review should have been presented, both as a matter of record and as a memorial to Mr. Leavitt. Briefly, E. D. Leavitt received his education in the public schools in Lowell, Mass., learned the machinist's trade in a Lowell machine shop, was assistant foreman at Harrison Loring's Works at South Boston, was chief draftsman at the



Leavitt Design of Locomotive Type Boiler with Belpaire Firebox



Locomotive Type Boiler Designed by E. D. Leavitt in 1879 works of Thurston, Gardner & Company, at Providence, entered the navy in 1861, and resigned therefrom in 1867. At this time he began the office practice of mechanical engineering, and on account of the times and his ability he achieved great success, not, however, as stated by the author of the review, without some discouragements.

Of the many mechanical designs perfected by this gentleman, his ideas on boiler construction will be of particular interest to railway men from the fact of his partiality to the locomotive type of boiler, two of his designs being illustrated herewith. Concerning his boiler experience, the author of the review states that before adopting the locomotive type he had designed some boilers for the Calumet & Hecla mines, which were a sort of "elephant" boiler, and these were failures. After this the locomotive type was always used, and these were a great success. They had fireboxes with mid-water legs, thus forming two fireboxes. The mid-water leg extended forward from the firebox and formed two so-called flues to a single combustion chamber which ended at the tube plate. The length of the flues was often 3 feet 6 inches and the combustion chamber 4 feet. At the end of the grate there was a 20-inch firebrick wall, thus making the distance from the end of the grate to the tube plate 9 feet 2 inches. In 1882, or thereabout, brick arches began to be used, as in locomotive practice.

Originally the boilers had round tops above the crown sheet, but later the Belpaire form of firebox and method of staying was adopted. Up to about this time the joints in the barrel of the boiler were butted, both longitudinal and circumferential, but Mr. Leavitt was influenced to abandon the latter for lap joints. The longitudinal butt joint was, of course, preserved, and it is interesting to know that the prevailing form of butt joint used in this country, viz., that having a narrow outside and wide inside strap, was devised by Mr. Leavitt and Edward Kendall, of Cambridge, Mass., where Mr. Leavitt also lived. This joint was then thought to be the final word in joint efficiency and the drawing of the first boiler having it was made in 1879. Why Mr. Leavitt did not adopt English practice in butt joints, with which he must have been acquainted, is not known, but it is supposed that he was seeking a joint of higher efficiency than that as then designed, which had the straps of equal widths and all rivets in double shear.

The first Belpaire boiler he designed was for 135 pounds pressure, others were designed for 185 pounds pressure. These boilers were very expensive: and as the largest had only 2,900 square feet of heating surface, the cost per square foot of heating surface was very high. It was, in fact, about $5.20 in 1887 for 90-inch boilers for 185 pounds pressure.

Data from a test of one of these boilers forming a part of the power equipment of a Boston sewage disposal plant, and made in 1885, are quoted as follows:

Duration of test, hours and minutes	24.51	24.9
Grate area, square feet	45.5	45.5
Water heating surface, square feet	1,826	1,826
Heating surface of flue economizer, square feet	934	934
Ratio of boiler heating surface to grate area	40 to 1	40 to 1
Steam pressure, pounds per square inch	99.4	98.6
Temperature of escaping gases from boiler, degrees F.	....	430
Temperature of escaping gases from economizer, degrees F.	183.5	194.2
Temperature of feed water entering economizer, degrees F.	96.5	120.7
Temperature of feed water entering boiler, degrees F.	145.1	164.1
Temperature of feed water entering building, degrees F.	38	46
Dry coal consumed, pounds	8,307	9,478
Dry refuse, pounds	432	497
Water weighed into boiler, pounds	86,783	98,780
Water evaporated per pound of dry coal, pounds	10.45	10.42
Water evaporated from and at 212 degrees by boiler per pound of dry coal, pounds	11.60	11.35
Water evaporated from and at 212 degrees by boiler and economizer per pound of dry coal, pounds	11.69	11.83
Water evaporated from and at 212 degrees by boiler per pound of combustible, pounds	12.23	11.98
Water evaporated from and at 212 degrees by boiler and economizer per pound of combustible, pounds	12.78	12.48
Dry coal consumed per square foot of grate per hour, pounds	7.35	8.62
Water evaporated by boiler per hour per square foot of heating surface from and at 212 degrees, pounds	2.12	2.44

The Layout of a Spiral Pipe

BY WILLIAM MELDRUM

While going over some of the back numbers of THE BOILER MAKER I came across a problem by Mr. J. L. Wilson, the layout of a spiral pipe, which appeared in the March, 1915, issue. Although it seems rather late to criticise, I would like to say that with the pattern Mr. Wilson has developed it would be impossible to make a spiral pipe, as I will show.

Fig. 1 is a 2-inch diameter pipe, traveling around a cylinder of the same diameter and rising one and one-half times the diameter in one complete revolution. First draw the plan, strike the line *x-y*, and with *o* as a center and a 3-inch radius strike the semi-circle *x-s-y*, then strike the inner circle with a 1-inch radius.

Now draw in the axis of the pipe, represented by *A, B, C, D, E, F*, and divide the plan into sections as shown, which looks like two 4-piece elbows joined together through section A, and is the proper construction.

From *s* through *o* extend a line to *T*, and on this line locate the pitch of the spiral; that is, the distance from center to center of the pipe, making one complete revolution, which is 3 inches. Divide this into 12 equal spaces, as there are twelve sections to the pipe, and from these points erect perpendiculars, six to the left and six to the right. Then from point *A* in the plan project up to point *A* in the elevation; from *B* in the plan to *B* in the elevation, and *C* in the plan to *C* in the elevation, and so on with *D, E, F*. Connect *A, B, C, D, E* and *F* in the elevation; this gives the axis of the spiral.

You will see that *A, B, C* in the elevation is the true length of the axis of section A, the others being foreshortened. It is around this axis that we have to develop the section.

Now go back to the plan, and on section A draw the profile and divide into eight equal spaces. Project these points to the miter line of section A, numbering 1, 2, 3, 4, and so on, to 9, and from these points erect perpendiculars. Then in the elevation extend the axis *A, B, C* to *M*; strike the profile *L, M, N*, and divide into eight equal spaces, numbering from *M* 1, 2, 3, 4, 5 and 16, 15, 14, 13. Project these points over and intersect the corresponding lines from the plan. These numbers may seem confusing, but one must remember that the other half of all profiles is drawn and the numbers run consecutively. Where the lines from the plan and elevation intersect, draw a curve. This gives the outline of section A in the elevation, and shows all lines in their true lengths.

Now draw *H-I* at right angles to the axis *A-B-C* through *B*, and on this line layout the stretchout equal to the circumference of the pipe. Divide into 16 equal spaces, erect perpendiculars from these points, numbering 1, 2, 3, 4, and so on to 16. Project these lines over from all the points 1 to 16 in the elevation to the corresponding lines in the stretchout. This gives the outline of the pattern. I have shown half the pattern with the projection lines drawn in, the other half being developed in the same manner. This concludes Fig. 1.

Now we come to Fig. 2, which is drawn just as Mr.

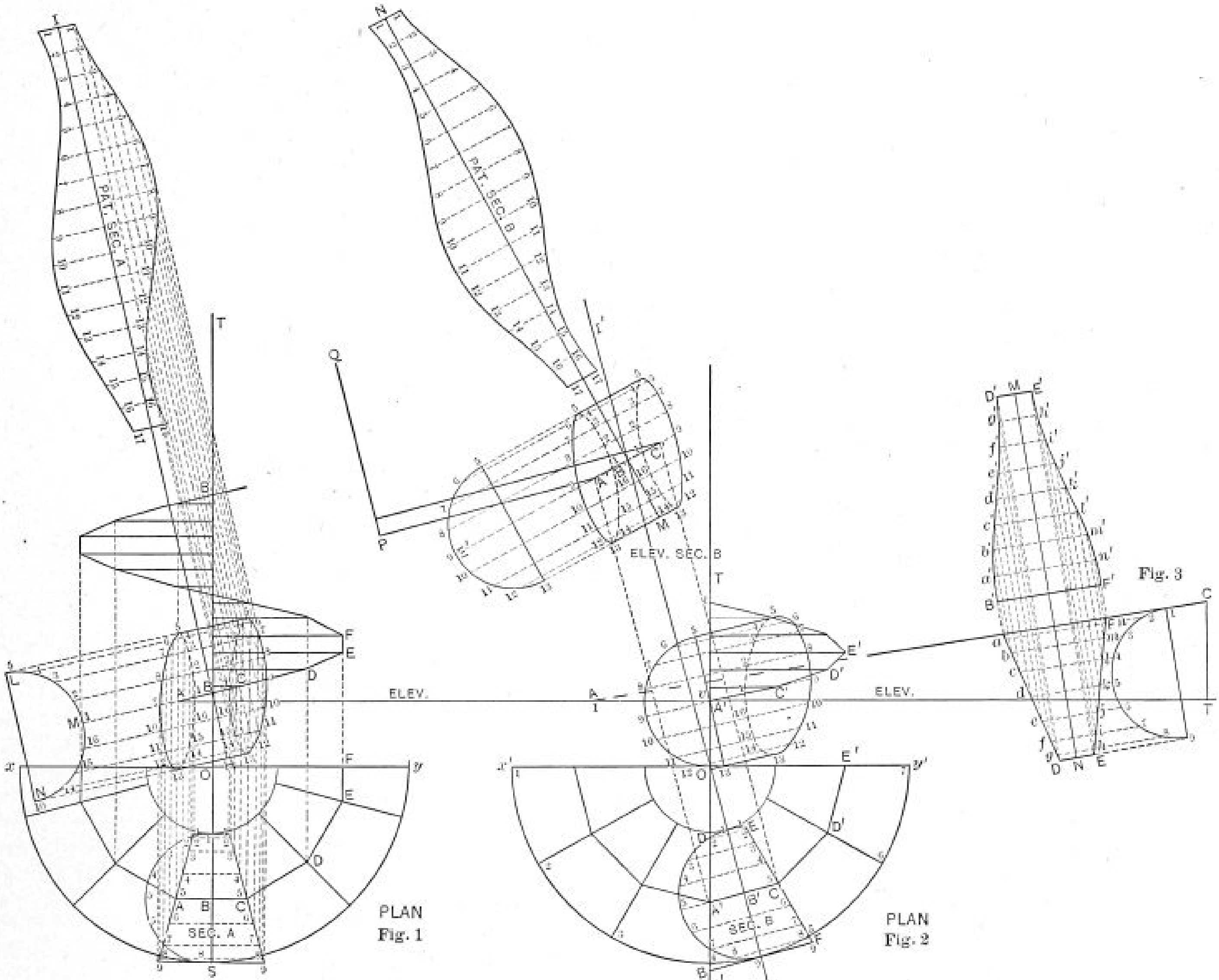
Wilson shows it, except that the rise of the spiral in this drawing is one and one-half times the diameter, and in Mr. Wilson's one and one-quarter times. Draw the plan and divide into six equal sections; then on the line *S-T* strike the points *U, V*. This is the height the spiral travels in half a revolution. Divide *U-V* into six equal spaces and erect perpendiculars, as shown. Project *A' C' D' E'* in the plan to corresponding lines in the elevation, connecting *A' C' D' E'* in the elevation, which gives the axis in the elevation of section B.

Then draw the profile on section B plan, and divide into eight equal spaces. Project over to the miter line of section and number 1, 2, 3, 4, 5, 6, 7, 8 and 9, and from these points project to elevation. Next draw the profile in the elevation and divide into eight equal spaces. Project over from these points to corresponding lines from the plan. This gives the elevation of section B. You will see from the plan and elevation that all lines are foreshortened; therefore it is necessary to develop another view.

Draw *H' I'*, and parallel to this line erect *P-Q;* then pick off one space from the line *U-V* in the elevation and transfer it to the line *P-Q*, and from these points project over and at right angles to the line *H' I'*. From the points *A' C'* in the plan project up until the lines intersect with the lines from *P-Q*. This gives the true length of the axis *A' B' C'*. Follow the same methods to develop section B and pattern, as are shown in Fig. 1. (Both patterns are ths same).

Now we come to Mr. Wilson's development, as shown at Fig. 3. He lays off 1-7 equal to the the semi-circle *x'-s'-r'*; then at 7 erects a perpendicular, and on this line marks off 7-*c*, equal to *u-v* of the elevation, Fig. 2. He then connects *c* with 1, which gives the line *A-C*, which, he states, is the true length of the longest side of the spiral, making one-half revolution. This is wrong. To get the true length of the longest side, take six times *B-F*, shown in the plan, Fig. 2, and mark off on the line 7-*C*, *F, T, C*, 3; then erect 7-*c* equal to *u, v, F*, 2; connect *c* with *I'*; this gives the line *A-c*. Then Mr. Wilson divides the line *A-C* into six equal parts, and on one of these parts draws the section *B-D-E-F*, shown in the plan, Fig. 2, and on the line *M-N*, Fig. 3, lays out half the stretchout; divides this stretchout into eight equal spaces and erects perpendiculars from these points, lettering *a, b, c, d* and so on to *n*. He now projects from all points in the profile to corresponding lines in the stretchout. This gives the outline of half the pattern.

Now, if you will compare Mr. Wilson's pattern, Fig. 3, with the patterns developed in Figs. 1 and 2 you will notice quite a difference, and had any layerout followed this method of development there would have been a number of sheets relegated to the scrap heap. Therefore, when a writer sends in a complicated job he should show all developments for the benefit of the subscribers, for there are many layerouts who look to THE BOILER MAKER as a reference book.



Development of Patterns for Spiral Pipe

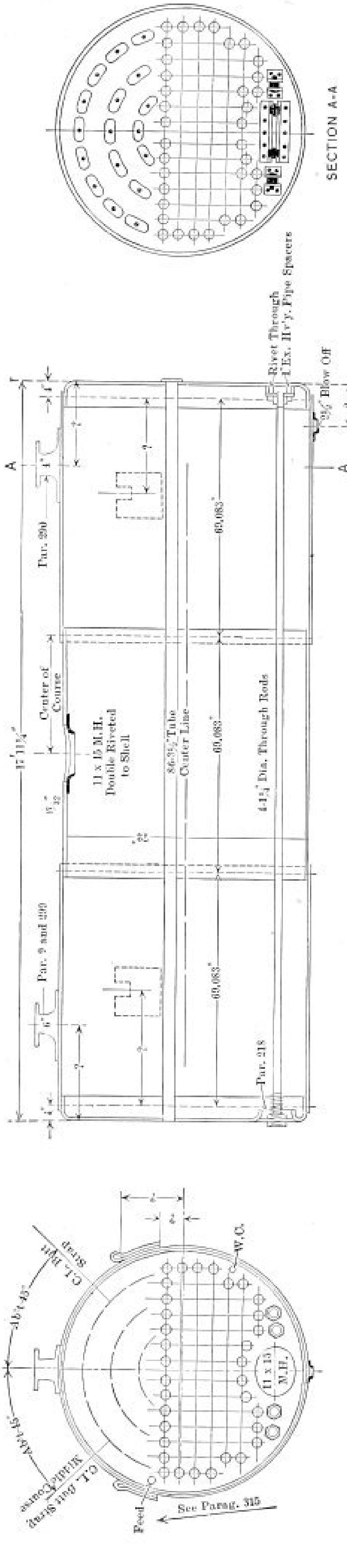


Fig. 1

Design and Construction of Boilers to Meet the A. S. M. E. Code Requirements—II

BY INSPECTOR

In laying out a boiler of this type, the work should start with the layout of the heads, for the reason that several of the measurements of the heads are practically fixed and must first be obtained before being applied to the shell plates.

The first step is to establish the center of the head, as shown in Fig. 4. This is easily accomplished with a trammel stick having pencil attached; by using the inner surface of the flange as centers and striking arcs from four places. The vertical center line should be located in such a position that the upper half of the head contains one of the plate manufacturer's stamps, as required by the Code in paragraph 331. Unless this precaution is taken, the layout may be arranged so that the stamps come within the tube layout, in which case they would be very likely to be punched out.

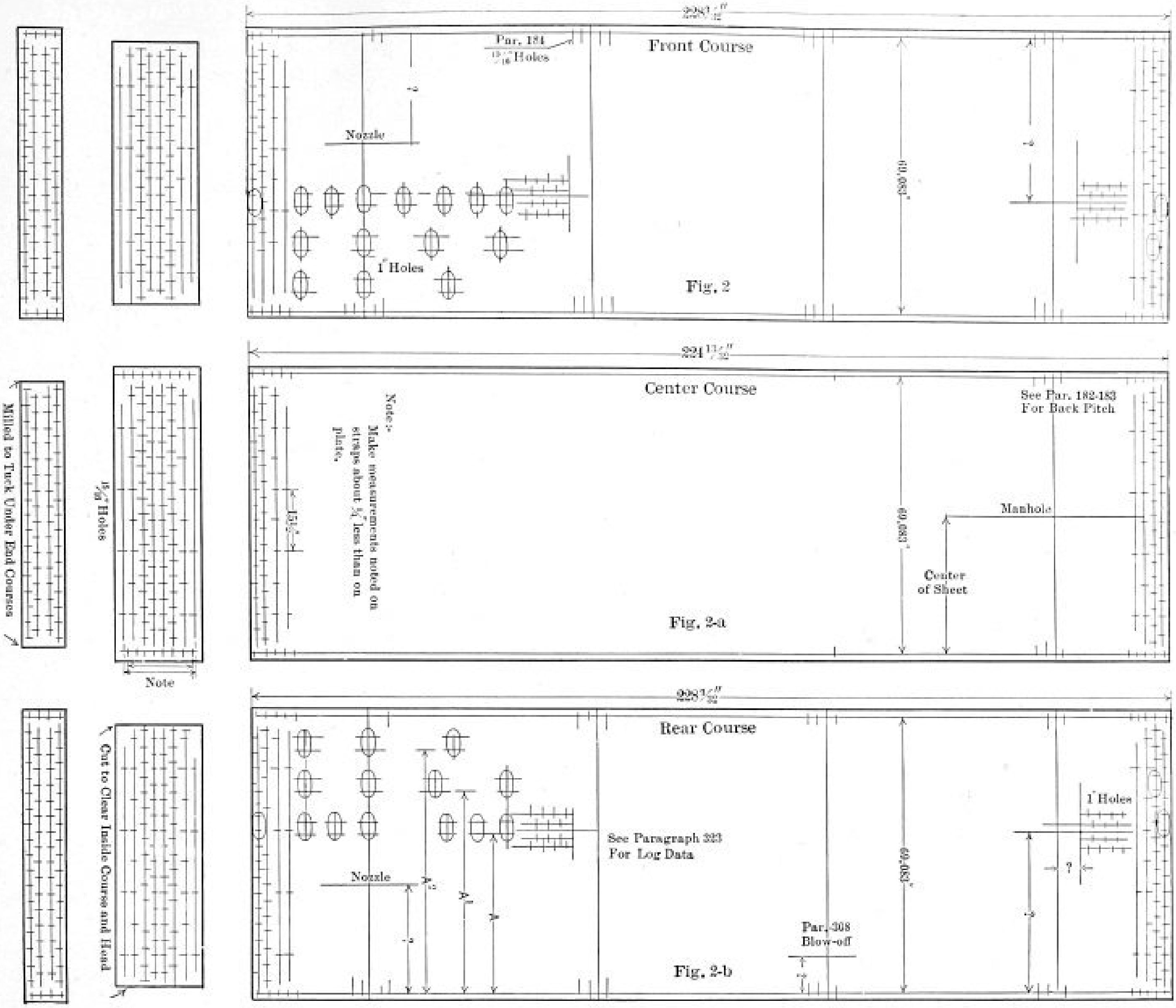
After the vertical center line has been established, the horizontal center line should then be drawn at a right angle to the vertical line, and from these two lines the layout of the head should be made. The measurements shown in Fig. 4, with respect to layout of braces, are inserted for the purpose of showing how to conform with the requirements of the Code relative to spacing of braces and brace rivets, also the measurements that must be transferred to the plate layout; the other measurements are practically standard for this design.

Laying out the tubes is a very simple matter, and is usually accomplished by means of short, straight edges, or sheet iron templates. The latter method is preferable, as greater accuracy is insured, as well as a saving in time, when the layout is a standard one. The layout of the braces should be made as shown in Fig. 4. As stated before, these measurements are made to conform with the Code rules, and will be explained later.

After the tube and brace layout has been completed, the rivet holes should then be layed out on the flange. This is accomplished by first lining off the gage or center line with a square, marks being made about every 12 inches, and then a complete line made with a thin flexible straight edge. Starting at the top center, the flange is then divided into quarters, with a tire wheel, after which the holes are layed out by means of a thin strip on which one quarter of the circumference has been layed out and on which the proportionate number of holes have been marked off. With proper facilities this method of laying out the heads may be improved, but the method described is the general practice in most shops.

We are now ready to layout the plates, and this is best accomplished by having the three plates placed side by side so that continuous measurements may be made with the work always in front of the layerout.

The circumferential seam lines are first drawn, allowance being made for lap and planing, as previously described, after which the plates are squared up in the following manner: Establish a point on one of the circumferential seams at a distance from the end of the plate equal to the distance of the inner row of rivets in the butt strap from the end of the plate, which in this case would be 1⅜ inches. Then on the same circumferential seam, establish two additional points, at, say, 48 and 96 inches, respectively, from the first point then with the two outside points as centers and with sufficient radius, strike two arcs, cutting the opposite circumferen-



Layout of Boiler Shell Plates

tial seam. From the intersection of these points measure back 48 inches toward the end of the plate. This distance will be exactly opposite the first point established, and from these points the layout may be completed.

The circumference is then layed off, starting from the end of the plate that has been squared up. The circumference is then quartered, and the holes layed out, corresponding in number with the head layout. A convenient method to use in laying out the circumferential seams is to use a straight strip of wood about one-half inch square and of sufficient length to take in one-half the length of the plate. On this strip, one-half of the circumference should be layed off, also the corresponding number of holes. The strip may then be used to lay out all the circumferential seams, provided, of course, that the dimensions are changed to suit the difference between the large and small courses.

In laying out the longitudinal or butt seam care should be taken to arrange the layout so that the end pitch in the outer row, or rather the distance between the last rivet in the outer row and the adjacent girth seam, does not exceed the distance, or pitch, of the other rivets in the same row. In the event that this last pitch did greatly exceed the other pitches, it would cause the seam to be figured as a triple instead of a quadruple riveted seam.

After the horizontal and girth seams have been layed out, lines should then be drawn across the plates representing the top, side and bottom center lines of the boiler. The line representing the top center should be drawn at a point that will bring the butt joints above the fire line, care being taken to leave sufficient space for the lugs or brackets to clear the butt joints. The layout of the nozzles, manhole, blow off, etc., are as shown and need no explanation, except that it may be well to state that the height of the brackets, or lugs, above the center line is generally indicated on drawings, as shown in the end view of Fig. 1., with the measurements filled in. Supposing the measurement filled in to be 15 inches, it must be remembered that when laying out the brackets or lugs on the shell plates, this measurement must be slightly increased, in order for the rolled plate to develop a straight height of 15 inches. The actual measurement to be layed out on the shell plate can easily be determined by sketching, full size, a profile of the bracket or lug in the position desired.

The measurements of the brace rivet holes in the shell are taken from the head, as shown in Fig. 4, and in the following manner: Hold a short straight edge with one side splitting the diametric center of the head, and midway between two brace holes, then mark the flange of the head at the point where the straight edge crosses the flange. Repeat this operation until marks have been made

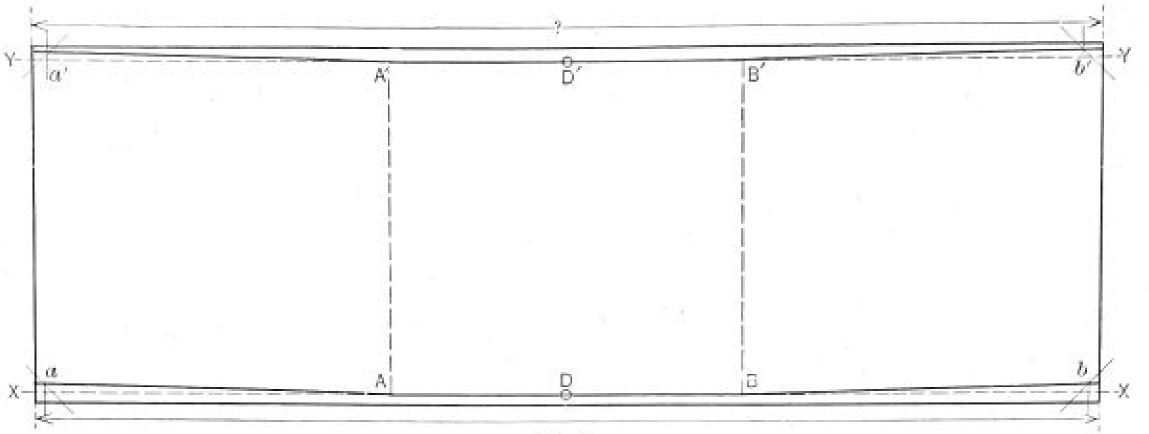


Fig. 3

Draw line X-X full length of plate, allowing sufficient lap for planing, then draw line Y-Y at a distance from X-X equivalent to desired length of course, center to center of girth seams. On line X-X, and at center of desired circumference of large end, make point D, and from this point make points A and B equidistant from D, and equal to mean diameter of course at large end. From points A and B draw arcs, cutting line Y-Y at D'; then equidistant from D' make points A' and B' equal to mean diameter of course at small end. With A as center and B' as radius, strike arc at a'; with B as center and same radius strike arc at B'; with A' as center, same radius, strike arc at a; with B' as center, same radius, strike arc at b; then with A as center and B as radius strike arc at a, cutting arc previously made; with B as center, same radius, strike arc at b; with A' as center and B' as radius strike arc at a'; with B' as center, same radius, strike arc at b'. Lines drawn from A-B, A'-B' through the arcs opposite will represent the cone development on which the girth seams will be layed out, using D and D' as the centers of circumference.

representing a brace in each row. The distance from the top center line of the head to the marks thus found represents the measurements for the respective braces to be layed out, center to center, on the shell plates.

It may be well to state here that diagonal braces are made in standard lengths, ranging from 36 inches up to and including 84 inches, each length increasing 6 inches, so that the distance of the brace holes in the shell, measured from the head, is governed by the length of brace to be used. However, it must be remembered that the length of the brace is not the actual distance in a straight line from the head to the point where the brace is attached to the shell, as the braces are placed in a diagonal position.

To obtain the actual distance of the brace holes in the shell, as measured from the head, a sketch should be made, showing one brace in each row, in position, as shown in Fig. 4, the measurements of the sketch to be made full size, or if desired the measurements may be obtained by considering the position of the shell, head, and braces, as a right angle triangle. For example, consider a brace in the No. 1 row, in which the diagonal distance from the shell to the head is 41½ inches. Call this distance (c) or the hypotenuse. The distance from the top of the head to the point where the brace is attached to the head is 7 inches. Call this distance (a) or the side opposite. The measurement to be found would then be the side adjacent. Call this (b). The geometric formula for solving this case is $a^2 + b^2 = c^2$, and as we know the value of (a) and (c) the formula can be transposed and reduced to find the value of (b) in this manner: if $a^2 + b^2 = c^2$, then $c^2 - a^2 = b^2$, and $b = \sqrt{c^2 - a^2}$. Substituting values for the letters, we have c^2 or $41\frac{1}{2} \times 41\frac{1}{2} = 1722.25$, and a^2 or $7 \times 7 = 49$, then $1722.25 - 49 = 1673.25$. This 1673.25 is then the square of (b), or b^2, and to find the actual distance or value of b, we extract the square root of b^2, or 1673.25, which is 40.9, say 41 inches. By substituting the different measurements, this formula may be used to determine the required measurements for the entire brace layout.

It will be noted in Fig. 2 that the braces, where layed out on the shell plates, are not all spaced at equal distances. The reason for this is that it is frequently necessary to draw a brace to either right or left of the equal space distance in order to avoid contact with the lugs, nozzles, etc., or to bring the brace within the close riveted part of the butt strap joint. This drawing of the brace, if properly done, does not affect its efficiency, provided, of course, that the amount drawn is within reasonable bounds. If the boiler had been equipped with a dry pipe, it would have been necessary, perhaps, to arrange the brace layout differently. However, the explanation given for the layout used would apply.

In Fig. 4, it will be noted that the area to be braced, both above and below the tubes, is shown enclosed by heavy lines, and is similar to the views shown in Figs. 13 and 14, pages 52 and 53, of the Code rules. The method of figuring the area to be braced above the tubes is explained in paragraph 217, page 54, of the Code, and using the formula given, the area on the boiler in question is found to be 1,139 square inches.

Referring to paragraphs 221, 222 and 223, pages 55 and 56, of the Code, attention is first called to Fig. 15, and paragraph 222, in which an explanation of the manner in which the diagonal position of the brace affects the load allowed on the brace, and from which the required cross sectional area of the brace may be determined, the assumption being that the allowances provided for in paragraph 222 will not be exceeded with respect to the values of the lines L and I, in Fig. 15; and it may be well to state here that these allowances will not be exceeded if the usual arrangement of braces is made.

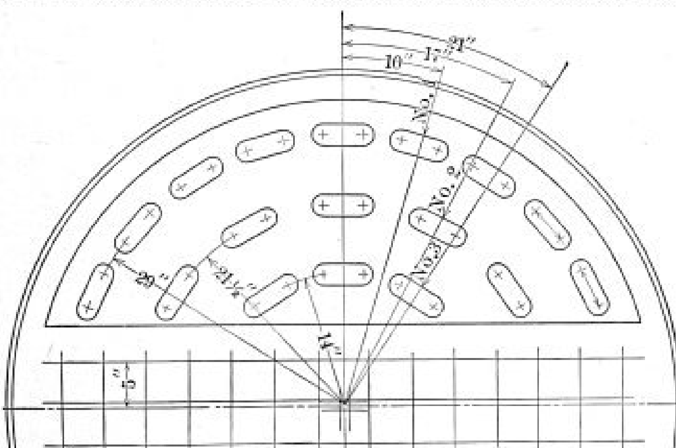
As stated above, the upper area to be braced is 1,139 square inches, which, if multiplied by the working pressure, gives a total load of 170,850 pounds. Referring to Table 4, page 54, of the Code, we find that for braces of the type suggested to be used a stress of 9,500 pounds per square inch is allowed, but as explained in paragraph 222, we are allowed only 90 percent of this amount; 90 percent of 9,500 is 8,550. By dividing the total load on the area to be braced by 8,550, we obtain 19.994 ($170{,}850 \div 8{,}550 = 19.994$), which is the total cross sectional brace area required. This total brace area must be distributed among a sufficient number of braces, the total cross sectional area of which will be at least equal to the amount just found, or 19.994. Also the number and spacing of the brace must be such that the rules prescribed in paragraphs 199 to 204, governing pitches of braces and brace rivets, will be complied with.

As stated before, diagonal braces are made in standard sizes and shapes, and of both round and rectangular cross section. For our case, we will use a round brace of 1¼ inches diameter, the cross sectional area of which would be 1.2272 square inches. As we have found that we need

19.994 square inches, then by dividing 19.994 by 1.2272, we find that it would take 16.29 braces. But as we could not use the fractional part of a brace, we would then take the next consecutive whole number, or 17.

With the number of braces determined, we can now calculate the requirements of paragraph 223, governing pins, rivets, etc., in the following manner: As previously shown, we actually needed 16.29 braces, each brace having a cross sectional area of 1.2272 square inches, or a total of 19.994, but as we are using 17 braces, each with an area of 1.2272 square inches, then we will divide 19.994 by 17, and obtain 1.1761. This figure represents the required cross sectional area of each brace, and on which the requirements of paragraph 223 are based. In other words, by using 17 braces 1¼ inches diameter, we have a total brace area slightly larger than is actually needed, or the difference between 17 and 16.29 braces. In meeting the requirements of paragraph 223, it is not necessary to base the calculation for pins, rivets, etc., on the area of braces used, but on the area of braces "required," and by using 17 braces, the actual cross sectional area required for each brace is 1.1761, instead of 1.2272, which is the area of each brace used.

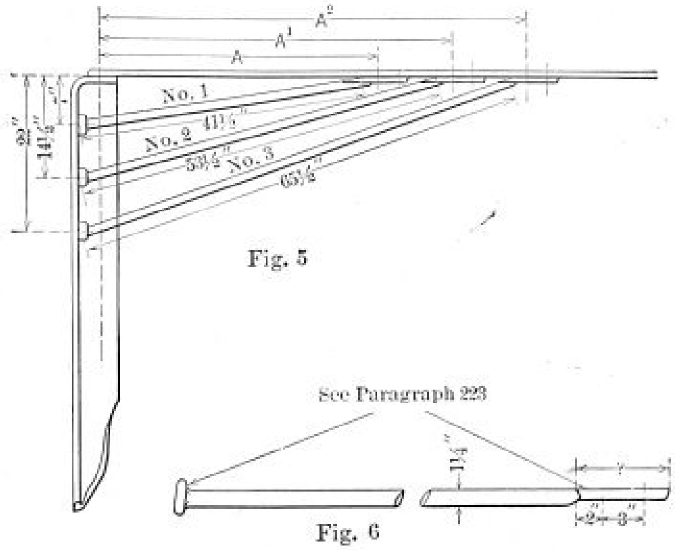
Paragraph 223 states that the combined cross sectional area of the rivets at each end of the brace must be at least 1¼ times the "required cross sectional area of the brace." As there are two rivets at each end of the brace, then the total cross section area of these two rivets must



To figure the area to be braced below tubes: first measure this distance from the bottom of head to edge of lower row of tubes, call the distance *H*, and figure same as for area above tubes; add this amount to the area of the two rectangles; the total will be the area to be braced, below tubes.

equal 1.1761 × 1¼, or 1.47 square inches. For this case it would then be necessary to use two one-inch rivets, or rather rivets driven in one-inch holes, as it is assumed that the rivet will fill the hole, after driving. A one-inch rivet has a cross sectional area of .7854 square inch, two rivets would then have 2 × .7854 or 1.5708 square inches, which amount complies with the rule, as it is in excess of the required amount, or 1.47.

Paragraph 223 also states that each branch of a crowfoot must be designed to carry two-thirds of the total load on the brace. In other words, each branch of the crowfoot should have a cross-sectional area, equal at



Diagonal Braces

least to two-thirds of the "required cross sectional area" of the brace, and as the "required brace area" is 1.1761, then two-thirds of 1.1761 equals .7840, this amount representing the "required" cross sectional area of the branch. It is also necessary to make the net sectional areas of the sides of the crowfeet, at the rivet holes, equal to the required rivet section, or 1¼ times the "required cross sectional area" of the brace. This would mean the total sectional area of the sides of the crowfeet, minus the diameter of the rivet holes. As the "required" rivet section has been calculated, it is only necessary to refer to this amount, and make the net sectional area of the sides of the crowfeet equal to that amount.

The cross sectional area through the blade of the brace, where same is attached to the shell of the boiler, should be at least equal to the "required" rivet section. As just stated, this amount has been calculated, and the explanation regarding the sides of the crowfeet would apply.

The explanation covering the diagonal braces, will apply to the through rods, except that the allowable load on the brace will be affected on account of the length of the brace, as shown in Table 4 of the Code. As the braces, or through rods, are placed on a straight horizontal plane, the full value of the brace can be used, and not 90 percent of the allowable load, as required for diagonally placed braces. When weldless through braces are used with the threaded portion upset, the upset should be sufficiently large to insure a diameter at the root of the thread, equal to the body of the brace. Should the diameter at the root of the thread be less than that of the body of the brace, it would be necessary to estimate the allowable load on the smaller diameter, and as a result a considerable amount of material in the body of the brace would be wasted.

Paragraphs 258 to and including 264 set forth plainly the requirements of manhole, openings and reinforcements, except those specified in paragraph 218 for flanged manholes. The formulæ given for use in calculating the several proportions of the manhole requirements are easily worked out, and the necessity for these requirements is readily apparent when the construction of the manhole is viewed in the same light as that of the longitudinal seam. It is simply a case of putting back in the shape of the reinforcement the amount of material cut away to form the opening, also a sufficient number and size of rivets the shearing strength of which will resist the tendency of the plate to tear apart through the longitudinal axis of the manhole. It should be remembered that the term "length of opening in shell" implies the total width of the opening in the shell, or from edge to edge of calking, and not the width of the opening in the manhole frame. This last named distance would be 11 inches, whereas the opening in the shell would be about 14½ inches.

Paragraph 274, page 69, describes the method of determining the minimum safety valve capacity to be used, based on the heating surface of the boiler. Figured according to paragraph 274, this heating surface is found to be 1,535 square feet. This amount multiplied by 5 gives 7,675, which is the theoretical amount of steam in pounds, that the boiler will generate per hour. Referring now to Table 8, on page 72, we find that at 150 pounds pressure a 4-inch safety valve should have a relieving capacity of 8,670 pounds, which would be sufficient, but paragraph 269 states that a boiler must have two or more safety valves unless one 3-inch size or smaller is large enough to meet the requirements. As the relieving capacity for a 3-inch valve does not meet the requirements of Table 8 for our boiler, then we must use two valves whose total relieving capacity is equal at least to that of a 4-inch valve. In this case it would require two 3-inch valves. This, of course, all applies to the actual valves to be placed on the boiler nozzle and not to the boiler nozzle itself, one nozzle only being sufficient, provided the nozzle has an area at least equal to that of the combined area of the safety valves.

It may be noticed that the heating surface just stated (1,535), does not correspond with the amount on which the horsepower of the boiler was determined (1,503). As previously stated, the latter amount, is figured in accordance with the accepted practice of most boiler manufacturers, and is a commercial rating only.

In connection with all of the foregoing, the Code rules affecting the construction of our boiler may be summarized as follows: The material used, such as braces, rivets, tubes, etc., should be made in accordance with the requirements of the Code, and statements, or rather mill test reports to that effect, furnished by the makers to the boiler manufacturer. Paragraphs 331 and 332, page 79, with reference to the mill stamps should be noted.

Rivet and tube holes should be drilled full size or punched and reamed in accordance with paragraphs 253 and 248. After reaming, the plates and straps could be separated, and the burrs removed, in accordance with paragraph 254.

Edges of tube holes should be cleaned as called for in paragraph 249.

Butt straps and ends of plates should be rolled or formed by pressure, as stated in paragraph 191.

Paragraphs 255 and 256 are sufficiently clear to cover the requirements for riveting. However, the Code Committee would have earned everlasting praise if they had stipulated something to the effect that boiler purchasers should place their orders with shops in which a good standard of work is maintained and let the boiler manufacturer take care of the interpretation of these two paragraphs. A tremendous amount of near information has been written in connection with the subject of riveting, ninety-nine percent of which would be termed by Webster as "fustian," but which to-day would be labeled plain "bull." To drive rivets in accordance with the ideas advanced by some of the theorists, the boiler manufacturer would need to be equipped with stop watches, thermometers, etc., the inspector enforcing the ideas would be mainly in need of a machine gun or police protection.

Calking and planing are explained in paragraph 257.

Thickness of tubes and beading of tubes are explained in paragraphs 22 and 250.

Paragraph 268, Table 7, gives sufficient data to cover "threaded" pipe openings, if used.

The rules governing fusible plugs, if used, are given in paragraphs 428, 429 and 430.

Paragraphs 308 to 322 inclusive cover the rules for blow-off, feed and water column openings and fittings.

Paragraph 329 deals with the applications of the hydrostatic test.

Rules governing the boiler appliances and fittings are thoroughly covered in the Code and should be referred to in connection with the finished installation of the boiler.

Interpretations of the Code rules are frequently made by the Boiler Code Committee and these interpretations can be obtained by writing to the Secretary of the Committee, Mr. C. W. Obert, 29 West 39th street, New York city.

American Water Pipe Made Possible the Winning of Jerusalem

In the Waterworks and Hydraulic Monthly issue, *Engineering and Contracting*, October 11, 1916, quotations from a British military report gave credit for the excellence of American water pipe (National tube) used in Egypt. Another military report gives similar credit and goes so far as to say that the recent capture of Jerusalem from the Turks was due to the conquering of the Sinai desert by the aid of an American pipe line 150 miles long. Maj.-Gen. Maurice, chief director of military operations at the British War Office, says in a report:

"In the campaign as a whole the greater accomplishment has been, not the defeat of the Turks, but the conquest of the Sinai desert. The troops which fought at Gaza drank water from Egypt pumped through an American pipe line, and were supplied over a broad-gage railroad laid clear across the 150 miles of desert, which has defeated almost everybody that tried to conquer Egypt for centuries. Every ounce of material for the pipe line, the railroad and the other works came either from Great Britain or the United States.

"All the time this conquest of the desert has been going on the official communications have been able to say only 'nothing to report,' and the public thought we were idle. The fall of Jerusalem was made possible by industry, organization and help of material from the United States."

The pipe was 12-inch steel tube laid on the surface of the desert.

STANDARD RATES FOR THE RAILROADS.—In order to provide additional revenue for the railroads, the Government intends to secure higher rates for the transportation of coal and certain other commodities. Apparently this is only the beginning of such increases under Government control. If the Government cannot pay the rates with the present revenue, that fact is a vindication of the appeals for increased rates made by the railroads and refused by the Interstate Commerce Commission prior to Government control. Although the Government has five hundred million dollars with which to make up railroad deficits, it appears more likely to resort to increased rates.

The best engine ever built is useless without steam. The steam comes from the boilers and a cheap man in charge of them is proof that a fool is at the head of the plant.

Lane's Message to Industry

Danger to Our Country from Its Foreign Population—The Remedy—Education and Fair Dealing

When Franklin K. Lane speaks the nation listens, for the Secretary of the Interior has earned the respect of the public by clear thinking and well-directed action.

His message to the men who control American industry, delivered before the Americanization Conference in Washington, states the serious condition that our country faces, due to our unassimilated foreign population.

Before an assembly comprising the governors of about one-third of our States, educators, publicists and business men of the caliber of Judge E. H. Gary, Samuel Rea, Coleman du Pont and Howard Coffin, a vigorous plea was made for the welding of our diverse races into one loyal American nation.

This paragraph is the keynote of his speech:

"Now, there are several things which we have come upon recently which seem to those of us who have not been wise to be discoveries. The first is that we have a great body of our own people, five and a half millions, who cannot read or write the language of this country. That language is English. And these are not all of foreign birth. A million and a half are native born. The second, that we are drafting into our army men who cannot understand the orders that are given them to read. The third is that our man power is deficient because our education is deficient. The fourth is that we ourselves have failed to see America through the eyes of those who have come to us. We have failed to realize why it was that they came here and what they sought. We have failed to understand their definition of liberty."

Aliens Not Yet Americanized a Danger

This, then, is our danger within—the aliens not yet Americanized. Ignorance of our language bars them from becoming loyal Americans, and the foreign language press only too often distorts the truth in the interest of some propaganda hostile to America and its institutions. It is a menace, that our industries are largely carried on by foreign laborers who care nothing for our success in this war, and are therefore not putting their best efforts into the daily work. Decreased production, labor troubles, such as strikes, or sabotage, and accidents in industry due to ignorance, all constitute a menace, for anything that curtails the supply of food or clothing or munitions to our troops is as dangerous as German bullets.

Fortunately, the remedy is in the hands of the patriotic leaders of industry. It is up to them to develop a spirit of loyalty to America among their foreign-born employees, and the employers can do it very effectively.

They can, first of all, encourage the learning of the English language among their employees. That may be through classes in the plants, such as Henry Ford developed in Detroit. Or it may be in co-operation with the local schools, enlarging their scope so that the adult foreigners can have every facility to acquire our language.

Many employers have found the knowledge of English such a valuable addition to the worker's efficiency that increased pay or promotion is given to those who learn the language. Other firms have classes in the plant on company time, and regard this measure as business efficiency—not as philanthropy.

Instruction in the duties of citizenship should go hand in hand with the teaching of English. The advantages of becoming naturalized should be brought home to the alien, and he should be encouraged to take out first papers and should be taught the legal forms for securing final papers.

Patriotism to the land of his adoption can be stimulated among foreign employees. Noon-day talks in the factories, patriotic posters, Liberty-Bond and Thrift-Stamp campaigns will develop loyalty if the employers persist in Americanization work and are not satisfied with a brief and spasmodic effort.

Patriotic literature and speeches in the native language of the immigrant will secure the attention of those who have not yet learned English.

But all the patriotic utterances will be wasted effort unless at the same time the spirit of fair play is observed in our dealings with the alien employee. Instead of discriminating against him, he should be regarded as a guest of the nation and an asset to our man power.

Other reasons for Americanization are the promotion of loyalty to the company and to the nation.

Citizens Only Promoted

Some industries are taking the stand that they will only promote men who are citizens or who have applied for their first citizenship papers. In this attitude employers are moved by two considerations—patriotism and the need for national preparedness, with a realization of their own responsibility; and, second, the need for an improved and more stable labor supply and a reduction in accidents among non-English-speaking men.

The reduction of labor turnover through such Americanizing influences as improved housing, better working conditions and fair handling of labor disputes is recognized as good business.

More than sixty big industries that have gone into model housing as a business proposition to secure efficient and contented labor are noted in the *Architectural Review* of April, 1917. Many of the concerns have developed a system of gardens to add another link to the chain of interest that holds the man to his job.

Secretary Lane addressed every American, and especially every employer of foreign labor, when he said:

"We are trying a great experiment in the United States. Can we gather together people of different races, creeds, conditions and aspirations, who can be merged into one? If we cannot do this we will fail; indeed, we have already failed. If we do this we will produce the greatest of all nations, and a new race that will long hold a compelling place in the world. It is well, therefore, that we come together at such times of stress as this, and we should have come together long since and put our heads to the problem as to what are the initial steps in bringing about that harmony within our country which will give it meaning, purpose and cohesion."

The resolutions adopted by the Americanization Conference following these words show that the practical men whom he addressed were convinced that the industries should do their share of Americanization work. They call for:

1. The adoption of the policy that the Federal Government should co-operate with States and through the States with the local communities in carrying on an

extensive, intensive and immediate programme of Americanization through education, especially for non-English-speaking, foreign-born adults.

2. That the industries employing large numbers of non-English-speaking, foreign-born persons should co-operate to the fullest extent with local communities, State and Federal governments, in carrying out this proposition.

3. That adequate appropriations should be provided by the Congress to be expended through appropriate Government agencies for the foregoing purpose.

4. That in all schools where elementary subjects are taught they should be taught in the English language only.

The Business Letter

Its Importance—What It Can Do—How It Should Be Constructed—What Elements It Should Contain

BY EDWIN L. SEABROOK

The business letter has contributed more to the growth of business than any other feature. It has made possible the transaction of an enormous amount of business at a cost which, when compared with personal handling, is insignificant. When a single firm can sell more than one hundred million dollars' worth of merchandise, entirely by mail, in a year, the influence of the business letter must be apparent.

LETTER POSSIBILITIES

The letter has dissolved distance and placed the entire relationship of business men upon a basis of courtesy and intimacy that could be accomplished by no other medium. Firms deal with one another for months and years and know each other only through the letter.

To-day the possibilities of the right kind of a letter are almost unlimited. It sells, collects, adjusts complaints; in fact, can and does do almost everything of a business nature that can be done by the business man himself. From a cost standpoint, it is the cheapest messenger that can be sent. Every letter that is written has in it the possibilities of the business touch. If the letter is to serve its purpose, however, it must be the product of thought. If it is to sell, collect, describe, or convince, it must be constructed with that end in view. The writer of the letter must aim to reach the viewpoint of the one to whom it is sent

THE STRUCTURE OF A LETTER

The good mechanic always lays out his work before executing it, the architect always plans before he does the ornamenting. Just so a good letter writer does not put his message together on a hit or miss plan. He has a pretty clear idea of what he is going to say before he begins to say it. He has a set purpose in view and the thoughts expressed in the letter are put there for the accomplishment of the purpose. If the writer of a letter has a clear idea of what he wants to say he can generally find language by which to express himself clearly. He should also consider what effect he wishes to produce on the mind of the reader. These things are necessarily acquired by practice, just the same as mechanical efficiency.

The so-called "natural gift" for writing letters comes to but very few men. Most people acquire letter writing in just about the same manner that mechanical proficiency is acquired, by training and practice. The hand and eye trained by daily practice to do mechanical work will do it with much less physical and mental effort than when done intermittently. Letter writing, or answering correspondence, will be done better and easier if done frequently

The analysis of every well written letter will show three well defined parts: the opening, main portion, closing. Consciously, or unconsciously, practically every letter is given these three parts, and they are far more important than a mere glance would indicate. If the interest of the reader is to be aroused, the opening sentences should grip his mind, and not allow it to wander through a number of words of little or no importance. Many a letter fails of its purpose because the opening sentence, instead of being snappy and gripping the attention of the reader, is lifeless.

These three portions of the letter correspond to what takes place in every straight man-to-man talk on a business proposition, where one party is endeavoring to secure action from the other. These are: arousing the interest, stating the case, appeal to action. Analyze practically every business transaction and these three parts stand out prominently. The business letter simply takes the place of the personal interview and if it is to be effective it must follow along the same lines. The opening sentences should arouse the interest of the reader and center his attention on what is to follow. The main, or statement, portion, should state the subject clearly and concisely, carrying the interest of the reader along.

It should be borne in mind that the object of writing a business letter is to secure something from the reader; action of some kind on his part is desired. Immediately after the statement of the matter in hand has been made, there should be an appeal to action. This is or should always be the closing of the letter. From this it will be seen that a letter can be weak or strong, according to how the principal parts are constructed and presented. A very strong case may be so weakly presented as to fail to interest the reader and the whole matter fall flat. Letters are, therefore, of two kinds: ink, paper, words, formal or informal—this kind goes to the waste basket because it is the product of inattention or the lack of proper preparation. The other kind grips the mind, holds attention, appeals, convinces, because it has been constructed by keen insight into the things that influence action.

THE ELEMENTS OF A LETTER

Every successful business letter must be constructed on certain fundamental essentials. It must be composed of certain elements which do not vary. It must follow a definite line of procedure, depending on the mission which prompts its sending. It must win for itself an audience, it cannot persistently force itself upon the attention of the reader, it has just one chance of riveting his attention on its contents. Getting action of some kind is its sole aim, whether it be a selling letter, collection, adjusting a complaint, or soliciting an interview. The vital point should be driven home; there are a hundred things that might be said, but only four or five are vital. One well-aimed shot is better than a dozen scattering ones; eliminate non-essentials, go direct to the point.

These fundamental essentials that should go into practically all business letters are the same. The arrangement may be different, the proportions may vary, but they must be there. These fundamentals are:

The opening: Arouse interest, grip the attention of the reader and make him go further.

Description: Get the proposition clearly and concisely before the mind of the reader, give him a mental picture of it.

Argument: Aim to create a desire for what is offered in the description.

Inducement: Give a very definite reason for accepting the offer.

Closing: Endeavor to get action at once or at a definite time.

Writing to a man is simply talking to him on paper. Take the above fundamentals and compare them with an argument in earnest appeal and see how they parallel. Separate nearly all of the business letters into their component parts and they will be found "selling letters," not necessarily merchandise; there are many other things that a business must sell. Adjust a complaint and satisfaction is sold. A collection letter that brings a check has sold a settled account.

The attention of the reader can be secured in many ways. An opening sentence that touches one of his problems or difficulties will interest him. The opening sentences must start the recipient reading or his interest in the body of the letter is lost. A wholesale paper house recently sent a sales letter to buyers of paper and used this sentence for the opening:

"You buy paper in large quantities."

This was sufficient to rivet the attention of buyers on the following sentences, which stated the proposition.

A large wholesale firm used this as the opening sentence of a follow-up letter to an inquiry:

"Just a word further about our proposition of the 25th ult."

The reader is very skillfully led to reviewing the entire proposition in the few sentences that follow.

A publishing house has sold thousands of books by the use of this opening sentence in a circular letter sent out under penny postage:

"Three lines did it."

A tool manufacturer had been using the stereotyped phrase, "Best steel on earth," for some time. He discarded this and used "It has the right stuff in it," and then went on to explain the proposition.

One firm began a number of collection letters with this sentence:

"Well, here we come again."

This attracted the attention of the reader and the next few lines told him of his overdue account.

In answering complaints promptness goes a long way to show a desire to give satisfaction. Don't argue, but explain. The customer may be wrong, but arguments will only strengthen his conviction that he is right. One firm makes a policy of opening its complaint answers something like this:

"Your complaint about ...... certainly seems justified, etc."

An offer is made to adjust the matter satisfactorily to the customer.

Let no one get the idea that a letter can be composed that will secure action in every case. The right kind of a business letter will always leave the right kind of an impression, but there may be many reasons why the recipient cannot act on the proposal. Strive by all means for a good start, because a bad one may destroy what may otherwise be a good letter.

Men Judged by their Correspondence Methods

Letter writing plays a most important part in business affairs. In the absence of personal acquaintances men are judged by their correspondence. This judgment is taken in its broadest sense: promptness, style, manner of expression, etc. The business man who is prompt in his correspondence is very apt to have his other business qualities judged accordingly. The one from whom it is almost impossible to get an answer to any important communication must necessarily be put in the negligent or incompetent class by those with whom he is dealing.

Let no business man underrate the importance of prompt attention to his correspondence. Some men are very scrupulous in this respect, answering all correspondence promptly; others throw it aside, intending to do so when they have a leisure moment, but the pile grows so large that but little of it gets attention. Orders may be secured or lost, credit maintained or impaired, a reputation for promptness and strict business methods brought into question by lax business habits, in respect to the manner by which correspondence is conducted.

Letters should be answered the same day they are received if it is possible to do so. If an important letter cannot be answered at once, because of information that must be secured, it is only courteous to acknowledge the letter at once and advise that a definite reply will be given just as soon as the information is at hand.

Letters that should be answered to-day will be all the more difficult to reach if that duty is put off until to-morrow. Failure to reply to correspondence is, in a certain sense, disrespectful. It is not considered courteous to pay no attention to a question put by word of mouth. Is the case any different because the request was put on paper?

Many persons do not read a letter carefully, nor catch its meaning. A certain request may seem very simple to the recipient, but to the sender it may be quite important. One person has put the case like this: "If anyone thinks enough of me to write on any subject, I am duty bound to give an answer if one is required."

Stationery

Good stationery should always be used no matter how small the business. Cheap stationery gives about the same impression as a shabby suit on the man who wishes to create the impression of being well dressed. Good, well-appearing letter heads and envelopes cost such a trifle more than the inferior, cheap-looking kind that no one can afford not to use the better quality.

In addition to stationery being of good quality it should be of neat appearance. A plain statement of the firm's name, location and character of business is all that is necessary. An overloading of a letter heading carries no advertising weight and is bad form. The contents of a letter heading, which can be taken in at a single glance, will rivet attention quicker than the overloading of it. Unruled paper is much more preferable than the ruled, even for handwriting.

Arrangement

The arrangement—putting the letter on paper—is not unimportant. There are certain forms and accepted standards which should be observed. Any variance from these should be with caution. Freakishness in the arrangement of a business letter is entirely out of place. Make the paragraphs short. If the letter covers a large portion of the page, have single spacing between the lines and double spacing between the paragraphs. Solid typewritten matter and extra long paragraphs tire the eyes and lessen the attention of the reader.

The Human Touch

Be natural, not artificial. Be frank, straightforward, clean-cut. Remember that letter writing is a man to man message. Get the human touch, desires, motives, inducements into the sentences. Why do ninety-nine men out of a hundred open their mail almost the instant it is received? Curiosity, interest, news. Appeal to these and you get attention.

Do not overlook the fact that the "You" feature shows up big in the letter. The reader is far more interested in himself than in the writer. "We" this; "We" that; "We," so and so, do not appeal one-twentieth as much as the "Me." Eliminate as many "We," especially at the beginning of sentences and paragraphs, as possible and substitute "You."

New Pressure Governor for Gas and Liquid Systems

In many power installations, where air, other gases or liquids must be maintained under pressure, the demand for an automatic method of doing this has arisen. As a result, the General Electric Company, Schenectady, N. Y., has developed a new pressure governor to control standard self-starters for motor operated pumps and compressors. The governor maintains a pressure between

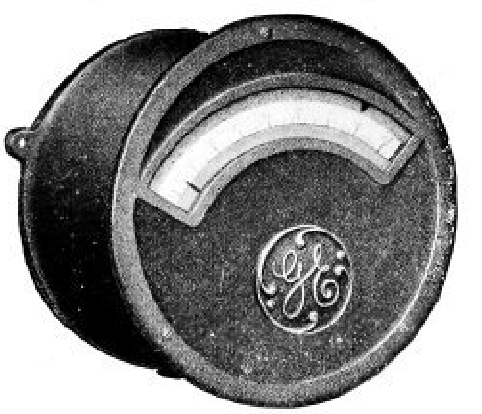


Fig. 1.—Contact Making Pressure Governor

predetermined limits on any gas or liquid systems that will not corrode the Bourdon tube.

This governor is called the CR 2,922, and can be used on any standard A. C. or D. C. circuit. It is rate for pressures of 80, 100, 160, 300, or 500 pounds and operates within settings of from 3 to 12 pounds between high and low pressures. Governors for higher pressures can be supplied if desired.

The governor consists of a Bourdon tube, an indicating needle, a graduated pressure scale, adjustable high and low pressure stops to determine the desired pressure range and a relay which actuates the contacts in the control circuit of the self-starter, all enclosed within a dust proof case, easily opened for inspection.

Action of the governor is dependent on the Bourdon tube, which should be connected to an independent discharge pipe from the pressure tank. The free end of the tube *T* (Fig. 2) is mechanically connected to the indicator needle *N*, moving it over the scale as changes of pressure affect the tube.

After the settings for the pressure range have been made, the governor will automatically maintain pressure within those limits. The operation of the pressure governor is as follows:

Assuming that the pressure is at the low value, as indicated by the left hand indicator *I*, the contact *C* on the needle *N* completes the circuit through the contact *C′* on

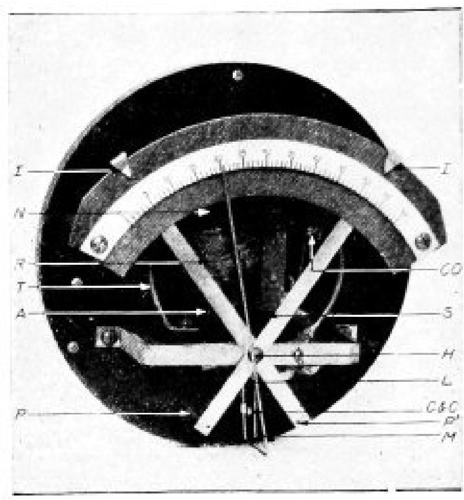


Fig. 2.—Internal Mechanism of Pressure Governor

the movable arm *M*, which at the low pressure point rests against the stop *P*. When this contact is made, the circuit is completed through the relay coil *R*, causing the armature *A* to close. Attached to this is the contact *CO*, which upon closing completes the control circuit to the self-starter, causing the motor to start.

The armature is also attached to the spring *S*, which holds the contact *C* firmly against *C′*, until contact is broken at *P*.

As the pressure increases, the needle pointer moves to the right, but its lower part, to which the contact *C* is attached, moves to the left, and is followed by the movable arm *M*. When the high pressure point is reached, the movable arm is prevented from traveling further by stop *P* and the needle continues its course, breaking the circuit by separating contacts *C* and *C′*. The instant the circuit is broken the relay *R* is de-energized, its armature falls, releasing the tension of the spring *S*, and because the movable arm *M* is counterweighted it returns to the stop post *P*.

When the pressure is decreased to the minimum value, the contact *C* again completes the relay coil circuit by engaging contact *C′* and the cycle of operation is repeated.

The case is tapped and drilled at the bottom for the pressure pipe and electrical conduit connections.

Question About Saving in War Times

Is it needed at once? Would it not be better done gradually?

England took fifteen months to wake up to it. We have not that time! If we do not begin now it may be too late to begin at all. It is the only thing most of us can do to save the lives of our men. The sooner we begin the shorter the war—the more of our men come back.

Motive Power

Inadequate Provision of Motive Power Under Government Railroad Administration—Standard Locomotives Specified

Declaring that adequate provision of motive power, like adequate provision of other rolling stock, can be assured only when Congress places on the functionary charged with the duty of regulating rates, the definite responsibility of making such rates as will yield earnings sufficient for thorough maintenance, Alba B. Johnson, president of the Baldwin Locomotive Works, put squarely up to the government the responsibility for adequate improvements and the capital necessary for providing additions and extensions, in his address before the United States Chamber of Commerce at its Sixth Annual Meeting.

Tracing briefly the development of the locomotive from the days when they weighed five tons each, to the present larger type, weighing more than 500,000 pounds, Mr. Johnson showed definitely how the spur of competition had been responsible for America's progress in handling its vast transportation problems up to its present high point of efficiency, where "American railroad men need have no fear of comparison with other countries, either in the encouragement given to improvements in engineering practice or in the reductions which have been achieved in the cost of transportation."

War Brings About New Conditions

Mr. Johnson continued, "The participation of the United States in the world-war has brought about new conditions. A mass of legislation and regulation which had accummulated during years of peace and which was predicated upon certain popular fears and prejudices resulted in the failure to allow increase in revenues corresponding to increased costs. The necessities of the war soon demonstrated that these regulations which prevented co-operation by insisting upon competition, did not make for efficiency, but prevented many measures of improved service, which the railroad managers were themselves eager to adopt but which has been made prohibitive. In order at a single stroke to untangle this situation, the Government of the United States decided that it was wise to assume control of transportation by placing all the principal lines in the control of a director general of railways, and to operate the roads as a unit during the period of the war and for a fixed time thereafter. For the first time in history of the country, all of the railroads became subject to a unity of management and to a unity of control in their purchases. For the first time it became practicable to adopt and to enforce standards to a large extent."

Describing the progress made in standardization, Mr. Johnson continued, "The work of preparing standard specifications and drawings was entrusted to a committee comprising eleven railroad officials who collaborated with the three principal locomotive builders. Twelve standard specifications have been agreed upon and recommended as follows:

Twelve Standard Specifications Adopted

"Two sizes of the Mikado type, 2-8-2, based respectively upon 55,000 and 60,000 pounds per axle. The lighter of these has a weight in working order of 290,000 pounds and the heavier 325,000 pounds.

"Two sizes of Mountain type locomotives, 4-8-2, based respectively upon 55,000 and 60,000 pounds per axle, the lighter having a total weight in working order of 320,000 and the heavier of 350,000 pounds.

"Two sizes of Pacific type locomotives, 4-6-2, based respectively upon 55,000 and 60,000 pounds per axle, the former having a weight of 270,000 pounds and the latter 300,000 pounds in working order.

"Two sizes of Santa Fe type locomotives, 2-10-2, based respectively upon 55,000 and 60,000 pounds per axle, the lighter having a weight of 360,000 pounds and the heavier 390,000 pounds in working order.

"A six-wheeled locomotive 0-6-0, with tender, 55,000 pounds per axle, weight in working order, 165,000 pounds.

"An 8-wheeled switching or hump locomotive, 0-8-0, with tender, 55,000 pounds per axle, 220,000 pounds in working order.

"A six-couples Mallet locomotive, with trucks, 2-6-6-2, based upon 60,000 pounds per axle, weight in working order, 440,000 pounds, and

"An 80-couples Mallet locomotive, with trucks, 2-8-8-2, based upon 60,000 pounds per axle, weighing in working order, 540,000 pounds.

"The tenders have been standardized with tanks of 8,000, 10,000 and 12,000 gallons respectively.

"No one railroad will be compelled to order all of these 12 standards, even the largest trunk lines may find half that number sufficient."

The whole problem of standardization Mr. Johnson discussed at length, pointing out the obvious operating advantages on the one hand and contrasting with them the possibilities of the paralysis of invention and the stagnation of new improvement on the other. Winding up this point, he said, "It would be an evil day for American engineering, for American progress in the art of transportation, which would involve a policy of discouragement to new and useful improvements in the art. We should, therefore, look carefully before we leap, to make sure that we are not giving up the substance of continued growth in efficiency and economy, to grasp the chimera of standardization. Especially should this be considered most carefully when the world-wide danger of this war is upon us."

Electric Power in Transportation

Turning to the remarkable growth and development of electric power in transportation, Mr. Johnson briefly reviewed its history from the electric locomotive ordered by the Northern Pacific in the early 90's up to the present time, when electrical engines are part of the standard equipment of such lines as the New York Central, the New York, New Haven and Hartford, the Pennsylvania, the Chicago, Milwaukee and St. Paul, the Norfolk & Western, and others.

As to the future relationship between steam and electricity, Mr. Johnson said, "Doubtless the electrification of suburban lines and the application of electricity to lines having great density of traffic will be financially justified: and as these grow in number and join themselves together, electric zones will be created in which it will be more economical to adopt electricity exclusively as the motive power.

"Any question of rivalry between the steam and electric locomotive may be set aside. The problem is wholly an economic one, the only question being as to which is the more efficient and suitable for the particular conditions, and the consequent adoption of one or the other is dependent upon the geographical or other circumstances governing each case."

PRESENT MOTIVE POWER EQUIPMENT INADEQUATE

Concluding, Mr. Johnson spoke of the admittedly inadequate motive power of our present equipment as follows:

"During the depression proceeding the war there was a small surplus of power, which, as should have been foreseen, would be absorbed in traffic with the first increase of activity. As a rule, railroads have purchased locomotives largely under the spur of excessive traffic and have abstained from purchasing during periods of reduced earnings. This is contrary to the economics of the situation. Enlargements of facilities should be made in times of depression, first, that is the cheapest time to do it; second, it is the most convenient time to do it; and third, it is the time when the managers can give most attention to doing it; and fourth, the employment of labor arising out of large railway purchases tends to mitigate the severity of a general depression. The reason the railroads have not done this since 1907 is that under the regulatory policy which went into effect at the time, railway managers have not been able to accumulate surpluses sufficient in their judgment to warrant bold construction in times of small earnings, and especially because future earnings have not been susceptible of approximate calculation even where the volume of traffic could be estimated in advance. Adequate provision of motive power, like adequate provision of other rolling-stock and other facilities, can only be assured when Congress places upon the functionary charged with the duty of regulating rates the definite responsibility of making such rates as will yield earnings sufficient for thorough maintenance, for adequate improvements and sufficient to attract the capital necessary for providing additions and extensions.

"Carry On" the Watchword of Machinery Convention

The enormous problem of manufacturing and supplying machinery and tools sufficient for the carrying out of the government programme for the production of ships, shells, guns and aircraft was the subject considered at the great "War Convention" of the machinery, tool and supply industry of the country held in Cleveland the week of May 13.

One thousand men who are bearing the brunt of the unprecedented demand for machinery gathered from all parts of the country to lay out a plan, with the aid of government officials, to keep the great munition programme going at top speed. The big war convention was a joint meeting of four great national associations—the American Supply & Machinery Manufacturers Association, the National Supply & Machinery Dealers Association, the Southern Supply & Machinery Dealers Association and the National Pipe & Supplies Association—which met together in order to co-ordinate their efforts toward one goal, "More Ships, More Shells."

"No industry has a greater responsibility at this moment than the machinery men," said H. W. Strong, president of the National Supply & Machinery Dealers Association. "We must have men, but behind the men must be ships and munitions, and behind the ships and munitions, machinery—more machinery—still more machinery. We are in this fight to a finish. The Germans have convinced us that the only way out of this war is straight through, and the American machinery industry is ready to carry on to a knock-out."

Perhaps You Can Render Valuable Service to Your Country

Important chemical and other technical engineering work necessary for the prosecution of this war is being carried on by the Bureau of Mines Experiment Station, at Washington, D. C. The services of trained men of the following classifications are urgently needed:

Bacteriologists
Biologists
Chemists, Inorganic
" Organic
" Physical
" Electro-Chemical Engineers
Chemical Engineers
Draftsmen
Electrical Engineers
Instrument Makers
Laboratory Assistants
Laborers
Machinists
Physiologists
Plumbers
Steamfitters
Stenographers
Skilled labor of various kinds

If your training fits you for any of these occupations, send to the

Bureau of Mines,
American University Experiment Station,
Washington, D. C.,

for blank forms. When properly executed and returned by you, these forms will be placed on file, and when a vacancy occurs you will be considered for it and will be notified if your services are desired.

If you are a registrant in the draft, and have not yet been ordered to camp, it may be possible to have you immediately inducted into the service for work here.

If you are *not* in the draft, but feel that you wish to serve your country in the present crisis, you can enlist, or servé as a civilian.

Serve your country where you can serve it best.

VAN H. MANNING,
Director.

Bits of Wisdom

Remember, no metal will burn if there is water behind it.

Dirty water for a boiler is no better than it is for a man.

Regular and frequent firing give better results than irregular stoking.

Potatoes, or oatmeal, or saw dust, are poor substitutes for a well-calked seam or well-driven rivet.

A fiddle string is strong, but you cannot straighten a nail on it. Trying to calk a seam or rivet under pressure is about as wise a proceeding as the fiddle and nail idea—something is likely to let go in either case.

The Boiler Maker

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4,550 copies of this issue were printed.

NOTICE TO ADVERTISERS

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 25th of the month, to insure the carrying out of such instructions in the issue of the month following.

Director-General McAdoo of the United States Railroad Administration has awarded contracts for the immediate construction of 1,025 modern locomotives. The order has been distributed approximately one-half to the American Locomotive Company and the remainder to the Baldwin Locomotive Works. Deliveries are to begin in July and to continue monthly during the remainder of the year.

The locomotives are of six standard types, one heavy and one light of each type, covering both freight and passenger service and vary in weight from 290,000 pounds to 540,000 pounds. The order involves an expenditure of approximately $60,000,000. The engines will be allotted upon completion to the various railroad systems where they are most needed.

The sixty-million-dollar-order for locomotives, just placed by the Government, begins a new era of standardization in locomotive construction. The locomotives are to be of six standard types. It is expected that eventually the standards created by the Government will supersede the many miscellaneous types and varieties of locomotives now in service, embracing over five hundred or more varying specifications. To the advocates of standardization, this action is heralded with considerable enthusiasm. It does not follow, however, that the standard designs adopted by the Government will in all cases place the railroads in the possession of motive power which will best suit their needs. To bring about the most efficient service, greater latitude should be given for the selection of special types of locomotives and where standardization is required a greater interchangeability of parts should be sought than has been the case. As far as the boilers are concerned, differences are found in the existing standards which might easily be compromised, resulting in a fewer number of standard designs for boilers but with greater latitude in the selection of engines.

Boiler manufacturers should not lose sight of the fact that the American Boiler Manufacturers' Association will hold its annual convention on June 17 and 18 at the Bellevue-Stratford hotel, Philadelphia. The secretary of the association, Mr. H. M. Covell, 191 Dikeman street, Brooklyn, N. Y., asks for suggestions as to topics for discussion and anyone who has a suggestion of this kind to make should communicate with the secretary at once. Some of the topics already suggested include the question of standard specifications for both watertube and firetube boilers, and the question of a more definite and active co-operation between boiler manufacturers. These are important subjects and have a direct bearing upon the welfare of all boiler manufacturers. Do not fail to come to the convention and give your viewpoint regarding these and other important questions.

Leakage through brickwork in boiler settings is frequently the reason for a decrease in efficiency of the boiler. As pointed out in the booklet recently issued by the Travelers' Indemnity Company of Hartford, Conn., care should be taken to keep the joints of all the brickwork about the boiler tight, so that air cannot leak in through any part of the setting and mingle with the products of combustion. Leakage of this kind chills the furnace gases so that the heat is not absorbed from them by the boiler, and it also injures the draft. The action of the air that leaks in through the setting is similar in these respects to that of the air that enters through the fire doors when they are left open too far. Leakage directly through the brickwork of boiler settings is much more common than might be supposed, and, in many cases, there is a serious loss of economy from this cause, which is not detected because its existence is not realized. These considerations show the importance of keeping the brickwork of the setting in good repair at all times.

Very few people appreciate the fact that the sum the Government is trying to raise through the sale of War Savings Stamps is but one billion dollars less than the amount it has just raised through the third Liberty Loan bond issue. Yet, while the loan was raised through subscriptions ranging from a thousand dollars to several million dollars, the War Savings campaign must gather in its quota through quarters, half dollars and other small sums. This means that everyone must chip in and lend a generous sum to the Government from every pay envelope received. The men in the trenches expect every person at home and behind the lines to keep them supplied with all the necessities, and by buying War Savings Stamps you are doing just that.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, 461 *Eighth avenue, New York city.*

Removing Front Cross Box

Q.—How do you remove and replace the front cross box of a B. & W. boiler?

A.—The front cross box of a Babcock & Wilcox boiler would be replaced by cutting out the rivets that attach the box to the shell, and also disconnect the row of nipples that joins the box to the row of vertical headers below it.

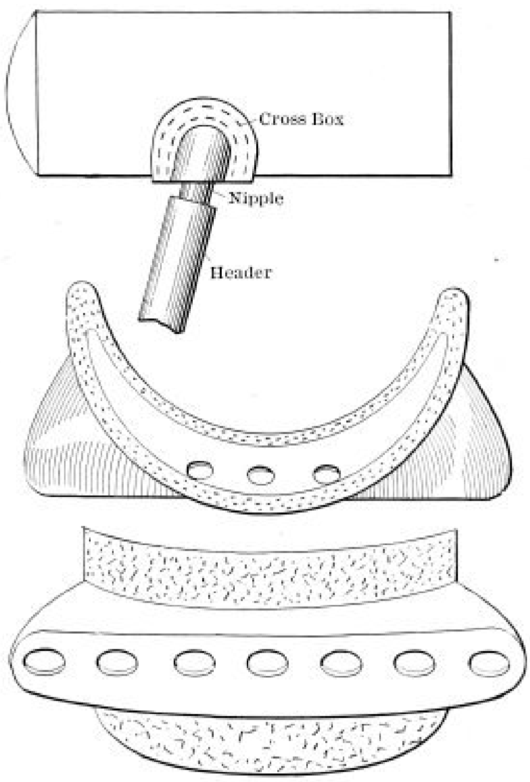


Fig. 1

A new box would be fitted into place and riveted in the usual way. In some cases it may be necessary to lower the tubes in order to make room for carrying on this work. Fig. 1 shows the form of a cross box.

Derivation of 3.1416

Q.—Please let me know how the constant 3.1416 used in finding the circumference of a circle from the diameter is originated. H. R. D.

A.—The constant 3.1416, which is the relation between the diameter and the circumference of a circle, is derived by the use of higher mathematics, such as calculus, geometry and algebra. More than elementary knowledge of these subjects is necessary in order to follow the demonstrations. The combination geometrical and arithmetical method begins by inscribing a hexagon, or six-sided figure, in a circle, and finding the length of the sides as compared with the radius. The sides are then bisected, and the lengths of the double-sided figure sides found. This process is repeated until the short length of the sides really coincides with the circumference of the circle, and the length of one multiplied by the number gives the length of the circumference.

By the series of calculations made as outlined above, the circumference on a diameter of 1 inch measures 3.14159 to five decimal places. As this is practically 3 1/7, the decimals are dropped for most practical work, and the fifth place is always dropped, making the 59 read 6.

One of the practical ways of testing the value of 3.1416 is to use a 7-inch disk and scribe a mark on its edge. Place the disk on a smooth surface with the mark in contact with one on the surface. Then roll the disk once around along a straight line and mark the closing point. A careful measurement of the length of the line will show it to be 22 inches long to the nearest hundredth of an inch. By using 3.1416 the length should be $7 \times 3.1416 = 21.9912$ inches. The practical worker need not bother himself about a derivation closer than this.

Working Pressures of Old Boilers—Horsepower of Boilers

Q.—I have tried to get a formula or some information regarding the working pressure of old boilers, and I have not been able to get it. I would be extremely pleased if you would let me have a formula or the method that you would adopt when an old boiler has been examined and it is found necessary to reduce the working pressure. The formula I want is for the working pressure of old boilers.

If you have a formula for finding the horsepower of different boilers, I would be pleased if you would supply me with same. W. F. M.

A.—Replying to your inquiry relating to formulas for the strength of old boilers, we have to say that the standard formula as used for the strength of new boilers applies.

When it is necessary to reduce the working pressure of the boiler on account of its age or some defect found by inspection, then there are three ways to figure the safe working pressure. Use the standard formula and raise the factor of safety, and decrease the allowable tension in the plate, and figure the strength of the decreased thickness of the plate.

The standard boiler formula for the maximum allowable working pressure in pounds per square inch is as follows:

$$P = \frac{TS \times t \times E}{R \times Fs}$$

In this formula TS equals the ultimate tensile strength of the shell plates in pounds per square inch, t equals the thickness of the shell plate in the weakest course, E equals the efficiency of the longitudinal joint, R equals the radius of the weakest course in the shell, and Fs equals the factor of safety.

The age limit of a horizontal boiler having a longitudinal lap joint and carrying over 50 pounds of pressure is 20 years. The factor of safety for such boilers ranges in value from 4.5 to 8, depending upon the age and condition of the boiler and the nature of the surfaces exposed to the fire. The hydrostatic test pressure allowed is 1½ times the maximum pressure as obtained by using the factors of safety.

Suppose a special case where the examination of a

36-inch boiler shows the minimum thickness of the shell to be 3/8 inch. This thickness may be found where there is pitting or grooving of the plates, or the thickness may have been caused by general deterioration. Suppose that the sheet was made of 60,000-pound steel and that the factor of safety was 5. Then, for the new calculation we had better use 55,000 pounds for the steel, and a factor of safety of 6, and a plate thickness of 3/8 inch. When we use these values in the formula we have

$$P = \frac{55{,}000 \times 3/8 \times E}{18 \times 6} = E \times 191 \text{ pounds.}$$

For an ordinary horizontal, double-riveted lap seam an efficiency of 75 percent when new would be the maximum expected. With the old boiler a pressure of 50 percent would be all that should be allowed. The correct amount should be determined from the inspection. If it is 50 percent, then the allowable working pressure is

$$191 \times 1/2 = 85 \text{ pounds.}$$

Horsepower of Steam Boilers

The term "horsepower" as applied to a steam boiler is somewhat indefinite, as the boiler does not develop the power, but it is simply a medium that receives and restores the heat so that it can be delivered to the engine. But, in order to have a basis of comparison and to establish a relationship between the boiler and the engine, the term horsepower is now applied to boilers as well as to engines.

As a matter of historical interest, it should be noted that the committee of judges in charge of the boiler trials at the Centennial Exposition in 1876, at Philadelphia, Pa., found that a good engine of the type prevailing at that time required approximately 30 pounds of steam per hour for each horsepower developed by the engine. In order to establish a relation between the engine power and the size of the boiler required to furnish the steam to the engine, this committee recommended that an evaporation of 30 pounds of water, from the initial temperature of 100 degrees F, to steam at 70 pounds per square inch gage pressure, be considered one boiler-horsepower.

It is now customary to consider the standard boiler horsepower in terms of equivalent evaporation from and at 212 degrees F. This equivalent evaporation from and at 212 degrees F. is a more logical and convenient basis to work from than that from 100 degrees. This equivalent is found by multiplying 30 pounds by the factor of evaporation for 70 pounds gage pressure, and 100 degrees temperature of the feed water. The factor of evaporation is given in steam tables, and is 1.1494. Therefore, $1.1494 \times 30 = 34.482$, or approximately 34.5 pounds. This means that in any given case and for any given steam pressure and feed-water temperature, the equivalent evaporation from and at 212 degrees F. may be found by multiplying the actual evaporation determined by trial by the factor of evaporation for that particular set of conditions.

In other countries steam boilers are ordinarily rated, not in horsepower, but by specifying the quantity of water they are capable of evaporating from and at 212 degrees F. The term from and at 212 degrees F. means making steam with water furnished to the boiler at 212 degrees F., and converting it into steam of the same temperature, which corresponds to an atmospheric pressure of 14.7 pounds per square inch. With this understanding of the term we can find the commercial horsepower of any boiler from the following formula:

First, find the equivalent evaporation from and at 212 degrees F. by this formula:

$$W = \frac{w\,(H - t + 32)}{966.1}$$

Where W equals the equivalent evaporation in pounds per hour, w equals the actual evaporation in pounds per hour, H equals the total heat of the steam at the observed pressure, and, as found from the steam table, and t equals the temperature of the feed water as it enters the boiler.

Divide the result obtained from the formula given above by 34.5 to get the horsepower. As an example, take the following:

A boiler generates 2,200 pounds of steam per hour at a pressure of 120 pounds, and the temperature of the feed water is 70 degrees F. What is the horsepower of the boiler?

Solution—The total heat H, as found from the steam table, is 1,188.64 B. T. U.; then the equivalent evaporation is:

$$W = \frac{2{,}200\,(1184.64 - 70 + 32)}{966.1} = 2{,}620 \text{ pounds}$$

of steam per hour, as compared with the 2,200 pounds given before. Therefore,

$$2{,}620 \div 34.5 = 76 \text{ horsepower.}$$

The factor 966.1, which appears in the formula, is the latent heat of steam at atmospheric pressure, and the temperature of 212 degrees F.

All the foregoing relates to the evaporation method of finding the horsepower of the steam boiler, and it is the best method to use where it can be used. But there is still another method that is somewhat more convenient to use and which may be called the buying-and-selling standard of boiler horsepower. It is based on the number of square feet of heating surface of the boiler. It has been found by careful experiment that from 10 to 15 square feet of heating surface constitute one horsepower in the boiler. When speaking in general, the horsepower depends upon how the boiler is driven, what kind of fuel is used, how it is burned, etc. The 10 to 15 range of values of the heating surface covered most all cases close enough for practical purposes.

The following example will show how to find the horsepower of a return-tube or horizontal boiler, based on a rating of 10 square feet of heating surface per horsepower:

Calculate the heating surface of a 54-inch diameter horozontal, return-tubular boiler containing 74 tubes 10 feet long and 2 inches inside diameter. Also calculate the horsepower, allowing 10 square feet of surface to one horsepower.

Circumference of shell $= 54 \times 3.1416 = 169.65$ inches.

Length of shell $= 10 \times 12 = 120$ inches.

Heating surfaces of shell $= 169.65 \times 120 \times 2/3 = 13.572$ square inches.

Circumference of tube $= 2 \times 3.1416 = 6.2832$ inches.

Heating surface of tubes $= 74 \times 120 \times 6.28 = 55.766$ square inches.

Area of one head $= 54^2 \times .7854 = 2{,}290.2$ square inches.

Two-thirds area of both heads $= 2/3 \times 2{,}290.2 = 3{,}053.6$ square inches.

Area through tubes $= 2^2 \times .7854 \times 74 = 232.48$ square inches.

$$\text{Heating surface} = \frac{13.572 + 55.766 + 3{,}053.6 - 2 \times 232.48}{144}$$

$= 499.49$ square feet.

$$\text{Horsepower} = \frac{499.49}{10} = 49.949, \text{ or 50 horsepower in round numbers.}$$

Letters from Practical Boiler Makers

This Department Is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

Removing Burrs from Plates and Butt Straps

The accompanying sketches are intended to represent two tools that were made to assist in the work of separating the butt straps from plates and removing the burrs from same, as required in the A. S. M. E. Code rules.

The burring tool shown in Fig. 1 can be made from a wornout or broken reamer. For 15/16-inch holes an

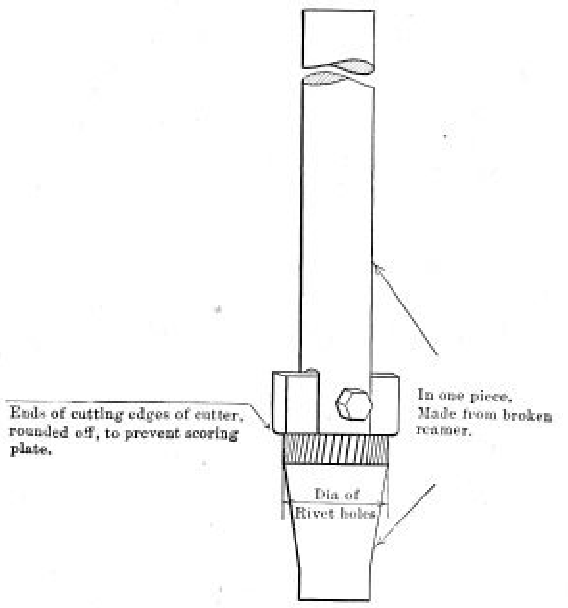


Fig. 1

old reamer of this size was used. After being annealed it was then turned down and slotted, as shown in the sketch. The provision of a reaming surface, as well as the cutter, was decided on after it was found that a tool with the cutter only had a tendency to crush part of the burr down inside the hole, requiring a subsequent operation to remove same.

This tool will give very satisfactory results, as it removes the burrs without champhering the edges of the

Fig. 2

holes, providing perfect contact between the plates, and eliminating the pockets formed by removing the burrs with a tool that champhers the holes. The ends of the cutter should be rounded off to prevent scoring the plates. The shank can be turned down to fit whatever machinè is to be used for motive power. Used in a small electric or air drill, this tool can be easily operated by one man.

The lug shown in Fig. 2 is made from a piece of 3-inch by ½-inch flat iron. Two of these are required, one for each end of a course, and are used to act as a tray to catch the inner strap when the fitting up bolts are removed, and to prevent the course from springing apart.

When bolting the lugs to a course, the lugs should be placed so that the offset will bring the bottom of the lugs toward the center of the course, this will enable the lugs to catch the short straps used on inside courses. The ends of the lugs should be shaped to a radius of about 30 inches, for work in which the diameters range from 48 inches to 72 inches, as no change in the shape will then be necessary within this range.

As will be noted, the ends of the lugs are slotted to engage holes in the girth seams; a slot 2½ inches in length will insure the engagement of the necessary holes in ordinary work. The lugs are formed so that a drop of about 6 inches is provided; at this distance the strap can be released at one end, and allowed to rest on a lug without bringing a severe strain on the remaining bolts while they are being removed; one man performing the operation without difficulty.

Used in conjunction with the burring tool, the entire operation of separating straps and removing burrs is speedily performed, and becomes a one man job. D.

Thermit Welding

Thermit consists of a mixture of aluminum and the oxide of an element—usually a metal—to be reduced. The aluminum has such an affinity for oxygen that it reduces the oxides to metals, giving a temperature of 3,000 degrees or more.

The application of the thermit weld to the repairing of heavy castings that cannot be easily replaced, or locomotive frames, etc., should appeal to those in power in our railway repair shops, especially where the motive power is limited to a certain number of engines, and, in

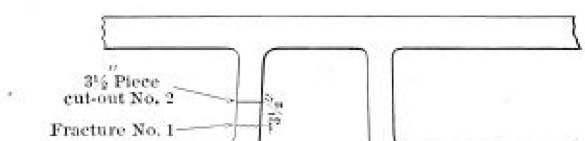


Fig. 1

the case of an engine with a broken frame, is a dead loss to the company.

Oxy-acetylene welding cannot be depended upon to give the best results in welding broken locomotive frames, for after welding, to all appearances successfully, the frame will fracture again in the same place while cooling off, on account of contraction, or some other cause unknown to the operator, with the result that a new frame has to be installed.

With the thermit process this is a very simple matter. Recently the writer saw a broken pedestal jaw welded by this process. Fig. 1 shows a section of a locomotive frame, broken through at arrow, No. 1. To repair this break, the wheels were dropped, ash pan and other braces removed, and a piece of the jaw, 3½ inches at arrow, above the fracture, burned out. Both surfaces were then chipped smooth. Into this space there was then worked melted beeswax to form a core; this was then allowed to harden in position. Around the frame was then fitted a flask, as shown in heavy lines, Fig. 2, which was of ½ inch iron bolted together. The flask was then filled with molder's sand and rammed in the usual way around the core formed by the beeswax. Just back of the beeswax core there was a hole or cavity formed in the sand. This is shown by dotted lines, Fig. 2. This cavity or hole is to take care of the surplus metal that overflows after the space to be welded is fitted up.

When the job of ramming the sand is completed, a burner is then inserted in the flask near the bottom in holes that the operator made while ramming the sand. The flame of this burner is gasoline under compression and is used for the double purpose of drying the sand

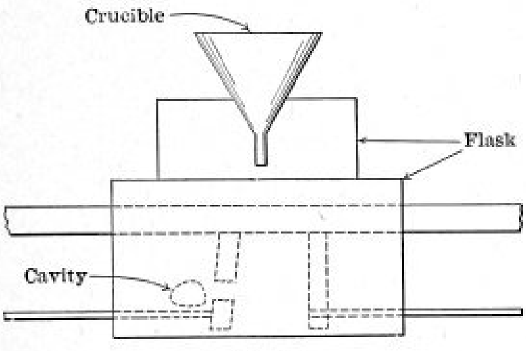


Fig. 2

and melting the beeswax, which runs out of the bottom of the hole. When the sand is quite dry, the ends of the jaw, which project through the sand about ½ inch, are heated until they are white hot, which is to form the weld at this point. The operator then orders everyone back out of the way and places a piece of magnesium ribbon in the crucible, and, at the same time, the foreman or some reliable person is requested to time the fusing of composition after the light is applied.

The time-keeper calls out in just fifty seconds after the light has been applied to the magnesium ribbon, the operator then presses on a lever at the bottom of the crucible and the molten mass is poured into the sand and the job is done. The metal is allowed to cool off usually over night. The operation of preparing for the weld takes about thirteen hours. It is then up to the machinists. The flask is now removed, and the surplus metal, which has overflowed into the cavity provided for it, is burned off. So nice and smooth is the job done that it takes very little labor to get a working surface, and, when properly done, it is impossible to tell that there has been a fracture.

Wilkinsburg, Pa. FLEX IBLE.

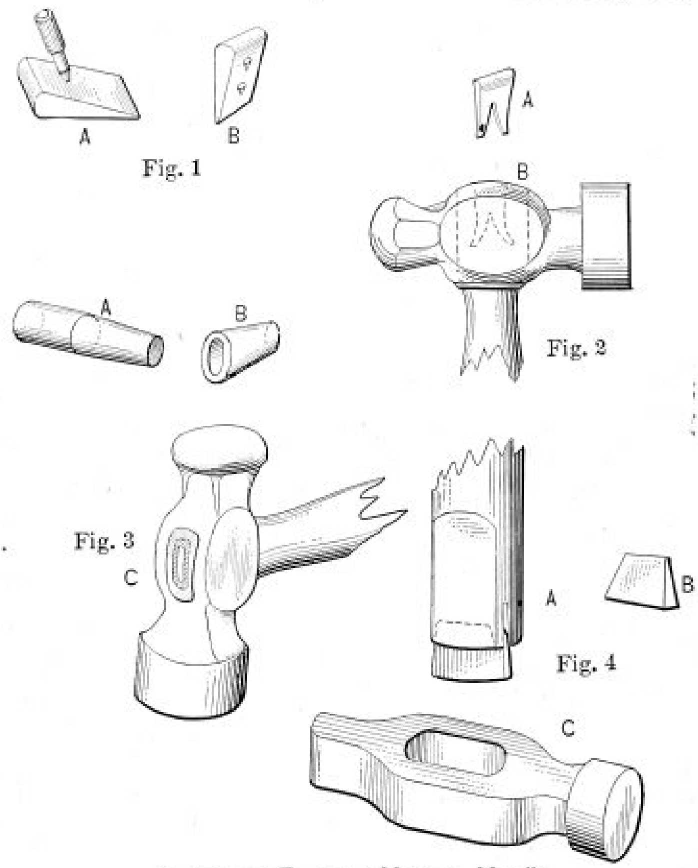
Hammer Kinks

These simple kinks are worth while passing on to the boys; they may bring forth other interesting ways of securing hammer handles so they won't come out.

Fig. 1 is the common steel wedge. It has been found that by throwing up a couple of burrs with a prick punch on each side, as indicated at *A* and *B*, the wedge, when driven in, is there to stay; the burrs, of course, take hold of the wood and prevent it backing out.

The split or V-wedge shown in Fig 2, at *A* and *B*, is another simple yet excellent sure grip wedge. The further it is driven the more it spreads and clinches. Try it out if you don't believe it.

The pipe wedge shown in Fig. 3 is a novel way to secure an old handle that has given bother by its old steel wedge working out. Take out the old wedge; plug the hole with a bit of hard wood and then make a small pipe wedge by taking a piece of ⅛-inch steel pipe; grind it, tapering on the end, as at *A*, Fig. 3; cut this section off and make it flat shape as shown in sketch *B*, then



Methods of Fastening Hammer Handles

drive it in, as at *C*, and your loose handle troubles are over.

Another trick that was passed on to me by an old shipwright is shown in Fig. 4. Before putting the handle in the hammer, it is slotted, as at *A*, and a hardwood wedge of full width at the back, but narrow at the front, as at *B*, is placed in the slot. The handle and partly started wedge is then entered into the hammer *C*, and the handle is driven in in a vertical position on an anvil or the like.

The farther the handle is driven in, the deeper the wedge is driven.

This method is excellent, for neither the handle nor wedge can work loose.

Concord, N. H. C. H. WILLEY.

The Fair Way

In the September issue Mr. C. H. Willey deals with a matter now common practice in large organizations, and commends a system that the present writer believes is open to serious criticism, and which is also justifiably resented by numbers of qualified men.

What is a man hired for? The color of his hair, his personal appearance, his religious beliefs, his social standing, the manner of his wife, or the number of his family—all these may be interesting to the curious, but it is considered that the engagement of a man is due to the fact that he is qualified to perform specified work.

Modern application forms to be filled by candidates for employment are in too many instances an impertinence and an insult, and the sooner the blanks are confined to the exact business in hand the better.

A man is not bought outright by reason of employment. He buys his freedom to live by the sacrifice of a part only of his liberty. During his hours of toil he renders willing service in return for wages, his leisure is his own in so far as it does not impair his efficiency. Employment is not bondage and payment is not a purchase price except for service of a specified kind. The present industrial system has many acute critics, and the existence of such records provide, a useful text for labor troubles. Certain records are decidedly useful, but there is always a temptation to collect data having only the remotest bearing on the subject in hand. The card index people have a mania for classification. They want to know all you know, and an applicant for employment being in a defenseless position, is legitimate prey.

As a matter of fact, the latest phase of employment bureau or agency in the most progressive firms is a severe criticism upon the application form. It consists in the substitution of a tactful and sympathetic individual to interview the candidate. There is possibly even room for a trained psychologist, but this science is too nebulous at the moment to be of great service.

There is no way to ascertain suitability save the practical method of trying out; and this in more than one capacity, for every individual is suitable somewhere, otherwise faith in human nature is a vain thing. Not that all men are equal, but that all men are useful is a maxim to be borne in mind. Proven unreliability, unstable moral qualities like insobriety, are matters of character and cannot be assessed save by actual trial. Ability is more speedily proven. This is why the average testimonial says more as to character than ability. To return to the employment application, from which starts the man's record. Think of the possible prejudice against the efficient because his religious beliefs or his political leanings differ from his superior. Neither of these have any bearing upon ability or character. To be penalized upon grounds other than merit and efficiency is surely an inherently bad thing. Again, is any real dependence to be placed upon the replies? You can't expect a man to give himself a bad character, to testify that he is not sober, so that the application form initially defeats its own object.

All pertinent facts can be elicited, and if necessary recorded, but it is behavior after engagement which really counts. Punctuality and regularity are given by the recording clock, productive ability by the time card, intelligence is a pretty obvious quality, insubordination is rather patent when it occurs, skill is shown by due performance of difficult work. When, however, we come to the intangible qualities catalogued by Mr. Willey, who is to assess them at face value, and is it possible so to do or to make a record of any value whatever concerning them? Like examination marks, they are subject to periodical revision in the light of new knowledge or practical application. Who, for example, is to assess latent ability? Certainly neither the man's foreman nor a card index clerk.

It is submitted that while the system of complete records has a fair appearance on the surface, it is by no means ideal, since it falls short in too many ways. The real reason for the system is that larger organizations cannot maintain personal touch with the entire staff. It is the weak spot of such concerns, and at one and the same time its huge size bolsters up the inefficient and penalizes the first-rate man. Methods of inquisition will always be resented by men of spirit, and of such is the pick in the basket of industrial help. The inquisition form is a wooden and inelastic means of assessment open to abuse so flagrant that its intentions are perforce suspect. What is really needed is the personal touch now to a large extent vanished from industry; its restoration is the problem of the hour. As a suggestion, a responsible official with no specified duties, able to win confidence and forming a living court of appeal in case of imperative or unrecognized merit, who can discover and stop waste of human material, is needed in every large concern. Many a good man has found it essential to break rules and get into minor trouble in order to bring himself to notice in a big firm. In no other way would he have been discovered.

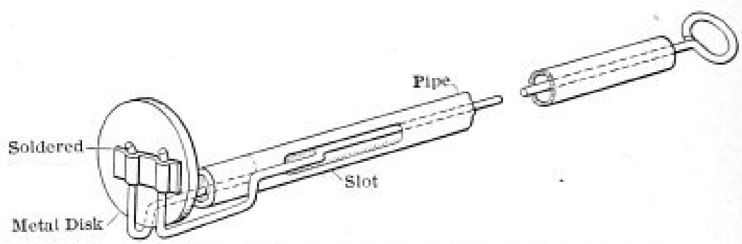
The writer has, and will always have, the greatest sympathy, founded on past personal experience with every man the victim of industry's default who is on that most tragic of all errands, "seeking a job."

London, England. A. L. HAAS.

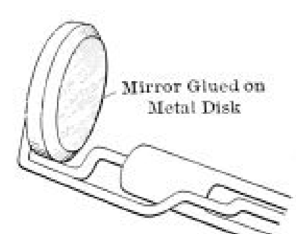
Tube Inspecting Device

This very handy device came to the writer's notice during a visit to a large boiler shop in Massachusetts, and I copied its details into my notebook, and am sending it to the pages of THE BOILER MAKER, for it may be of aid to some of the other fellows.

No dimensions are given, and the sketches are thought to be quite clear, so little need be said except that 3- or 4-inch tubes are about the smallest that the device can be used on. The main handle is of condenser tubing, and the end to which the mirror is attached is plugged with hard wood; the support for the mirror is screwed into this. By working the small wire rod inside the pipe, the mirror is moved obliquely. INSPECTOR.



INTERNAL TUBE OR PIPE INSPECTION MIRROR



Arrangement of Mirror for Inspecting Tubes

Small Shop Kinks

While visiting a neighborhood small shop, I picked up a couple of kinks that may be of interest to some of the boys.

During a dull period one of the shop hands fell to experimenting (with the permission of the boss) on the construction of an adjustable tube scraper for cleaning flue tubes, and was rewarded with a simple and inexpensive tool which proved so worth while that the foreman gave orders for him to make several of them. The shop did a deal of local boiler cleaning and repair work.

A sketch of the scraper and detail views are shown. *A* is a steel wedge with a screw stud; *B* represents the blades of the scraper made from old flat files; *C* is the cross head block to which they are secured.

Fig. 1 is the assembled tool. To adjust the blades to fit the tube it is but necessary to take up on the nut. A rod (not shown) is used for a handle, the end of which

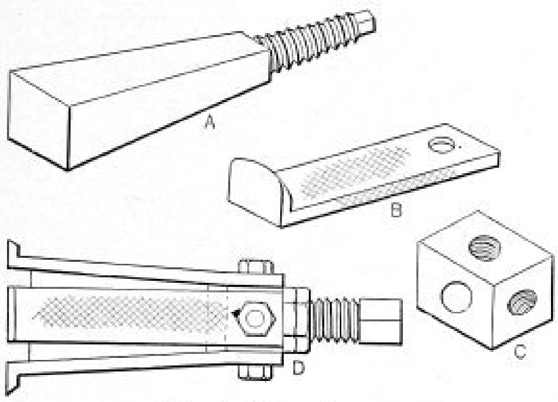


Fig. 1.—Tube Scraper

is tapped out to screw on that part of the stud coming through the nut *D*.

The tube puller shown in Fig. 2 is quite valuable on repair jobs outside the shop. Frequently the shop had call to renew one or two tubes. These had to be pulled out, and the work was made easier by the construction

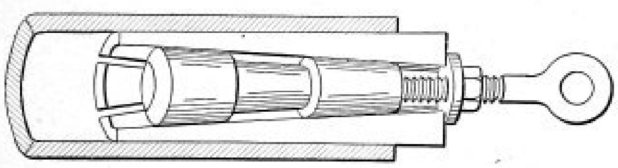


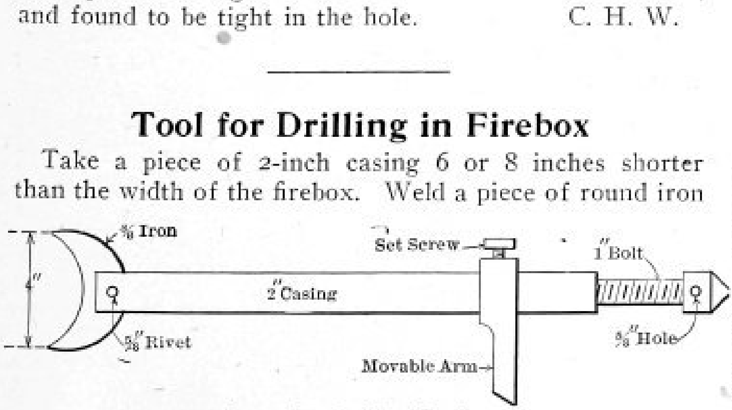
Fig. 2.—Tube Puller

of this device—a tapered mandrel and the split bushing which is turned to fit the inside diameter of the tube, then split lengthwise to three sections.

The small end of the mandrel is tapped to take the eye bolt, which is used with a nut and washer. The chain falls is hooked into the eye bolt, and as the strain is taken, the wedge expands the bushing. The harder the pull, the tighter the bushing, the nut being used to prevent slipping at the start. As soon as the tube protrudes enough to use a pipe wrench on it, one should be used to help in working it out when it is covered with scale, and found to be tight in the hole. C. H. W.

Tool for Drilling in Firebox

Take a piece of 2-inch casing 6 or 8 inches shorter than the width of the firebox. Weld a piece of round iron



Brace for Drilling Firebox

4 inches long in one end. In this end slot out a groove ½ inch wide and 1½ inches deep. Then drill an 11/16-inch hole through it halfway between the slotted place and about ¾ inch from the end.

Next take a piece of ⅜-inch flat iron, cut in a half-moon shape, drill an 11/16-inch hole in it and rivet in the slot. Tap out the other end with a 1-inch stand and tap.

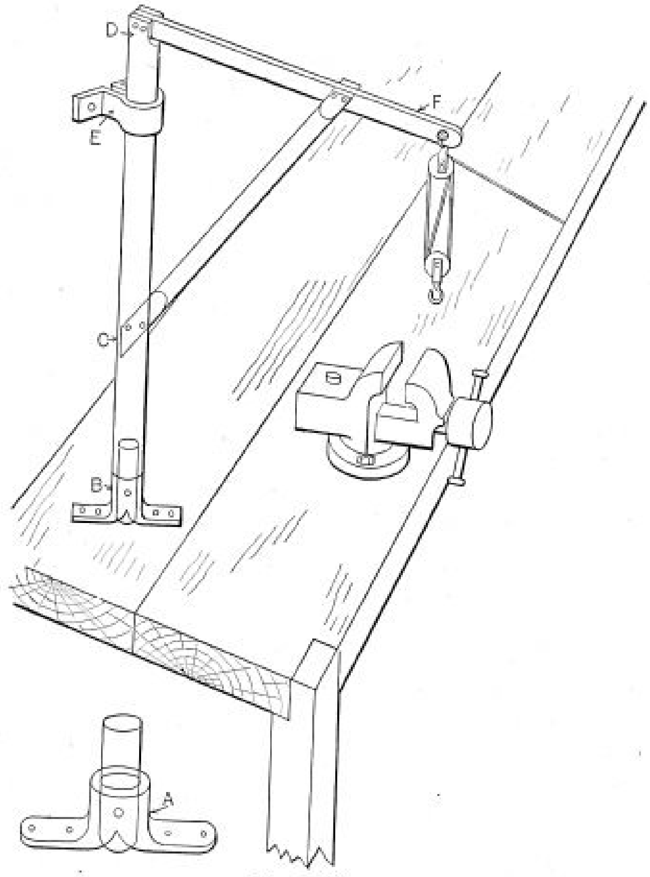
Take a piece of 1-inch round iron and make a large, pointed head on it. Drill ½-inch holes through the square sides of the head for a bar to work in, then thread the bolt the full length. The bolt should be 2 feet long to allow for different lengths in the firebox.

Take an arm that will slip easily over the casing with a set screw to fasten it in place with and you have a very useful tool to set the motor against.

Denver, Col. Arthur Malet.

Bench Crane

One good use for a few scraped boiler tubes is that shown in the sketches—a small bench crane. It's a pretty useful thing for lifting heavy castings to the bench, such as boiler stop valve saddles, safety valves, etc. The cost of making a few of these small cranes is well repaid in the convenience that they prove to the men and the



Bench Crane

time they save in not having to wait for a helper to give them a lift. Perhaps a bit of description may make the understanding of their construction clearer.

A short section of the tube is cut off and split part way to form the foot *A*, by bending back the two ears. A piece of round stock the same size as the inside diameter of the tube is used as shown in *A* to give the pivot, as indicated at *B*. The upright of the crane is split at the upper end at *D*, and a slot is drilled at *C* to receive the strong back and arm, *F* and *G*. The arm *G* is made of a smaller size tube, flattened at the end *C* to enter the slot, and split at the other end to receive the strong back *F*, which is of ½-inch by 2-inch stock. A bracket *E* to hold it to the wall is the finishing touch.

Selected Boiler Patents

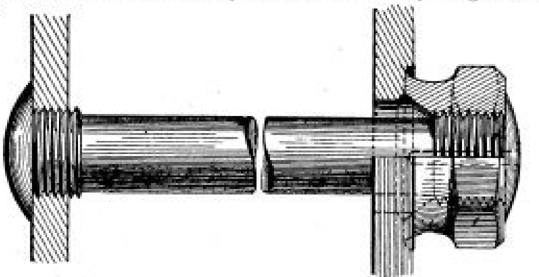
Compiled by

GEORGE A. HUTCHINSON, ESQ., Patent Attorney, Washington Loan and Trust Building, Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchinson.

1,244,916. STAYBOLT CONNECTION FOR BOILERS. BENJAMIN E. D. STAFFORD, OF PITTSBURG, PA., ASSIGNOR TO FLANNERY BOLT COMPANY, OF PITTSBURG, PA.

Claim 1.—In staybolt connection for boilers, the combination of a boiler plate having an opening for the passage of a bolt, a sleeve bearing against the outer face of said plate around the opening therein and



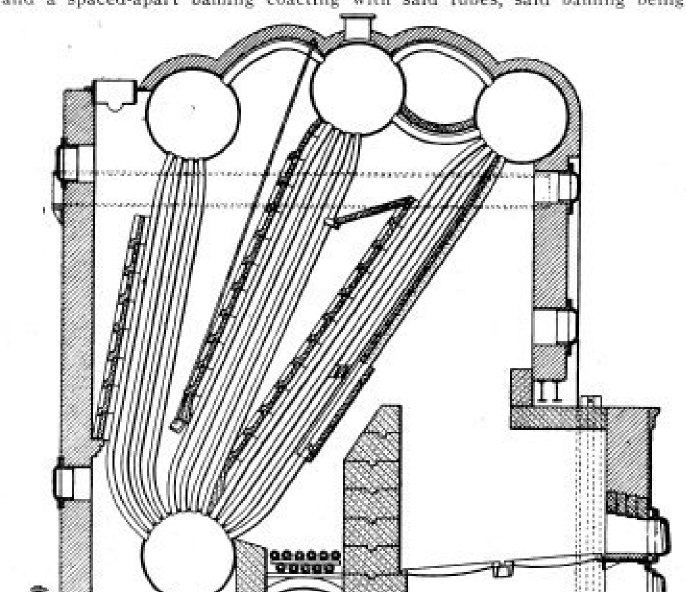
secured to said plate by welding, and a staybolt having a screw threaded connection with said sleeve. Two claims.

1,250,321. SAFETY WATER-GLASS FITTING. WILLARD A. KITTS, JR., OF MOUNTAIN LAKES, N. J.

Claim 1.—The combination with a gage-cock for steam boilers, of a normally open self-opening check-valve in the connection between said boiler and gage-cock, and adjustable means for limiting the opening movement of the check-valve to vary the degree of such opening. Five claims.

1,257,302. BOILER BAFFLING. JOHN E. BELL, OF BROOKLYN, N. Y.

Claim 1.—A boiler having a row of tubes containing fluid to be heated, and a spaced-apart baffling coacting with said tubes, said baffling being



composed of tiles, having projections longitudinally of the tubes and resting on some of the tubes, and bridging over other intermediate tubes. Four claims.

1,255,164. METHOD OF AND APPARATUS FOR TREATING BOILER FEED WATER. HERMAN C. HEATON, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

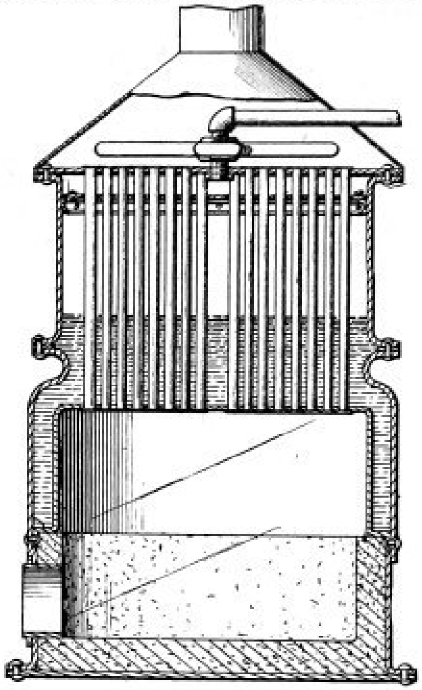
Claim 1.—The method of treating boiler feed water consisting in passing the water through the low pressure stage of a plural stage economizer, withdrawing the water and any contained air or gases from said stage and afterward allowing discharge of the air or gases therefrom, heating this water by exhaust steam and then passing the water through a high pressure stage of the economizer and then into a boiler. Four claims.

1,257,076. CHECK VALVE FOR LOCOMOTIVE BOILERS. JOHN B. GALLAGHER, OF BUTTE, MONTANA.

Claim 1.—A check valve for boiler feeds, comprising a casing having a central opening, a cap for removably closing the opening, an extension projecting through the opening and having a guide pocket therein, a valve carrying a guiding stem normally in engagement with said pocket, an extension on said casing having a smooth bore entering into said casing, a rod having a forked end arranged in said casing and extending through the bore in said extension, a stuffing box on said extension through which the rod passes, said rod adapted to slide in said bore to cause the forked end thereof to engage the valve to lift it from its seat, and means to rotate the rod when in engagement with the valve to grind the valve. Two claims.

1,257,519. STEAM GENERATOR. JOHN F. OTIS, OF OSWEGO, NEW YORK.

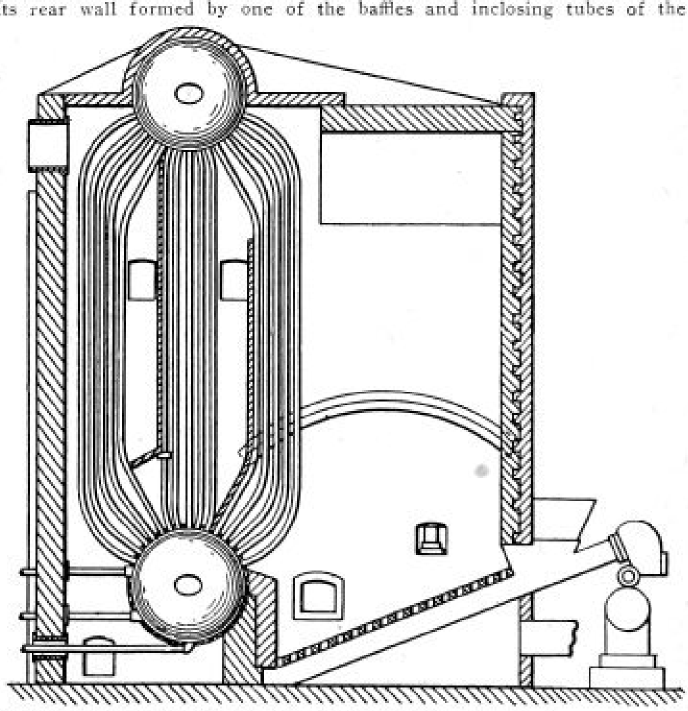
Claim 1.—A steam generator of the multiplicity of fire tube type, having a separator plate located in the steam space remote from the water level, said plate formed with perforations closely receiving the



fire tubes, said perforations being flared to produce edges surrounding the tubes to separate water from the steam passing through the plate along the tubes. Twelve claims.

1,258,248. BOILER. WILLIAM H. RITTS, OF ETNA, PENNSYLVANIA, ASSIGNOR TO GEORGE T. LADD, OF PITTSBURG, PENNSYLVANIA.

Claim 1.—The combination with a boiler consisting of an upper and a lower drum, and a plurality of sets or banks of tubes connecting said drums, baffles so arranged substantially parallel with the sets of tubes as to form a plurality of vertical and connected passes for the hot gases, a combustion chamber formed in part by the fire box and having its rear wall formed by one of the baffles and inclosing tubes of the



first set or bank, means for introducing fuel into the fire box at a point remote from the first set or bank of tubes, and means for introducing air to promote combustion, said combined fire box and combustion chamber being of substantially uniform transverse dimensions for the entire height and having such a height as will permit a practically complete combustion of the gases, etc., before the gases pass from the combustion chamber. Three claims.

1,258,843. FURNACE. RUY DIAZ WHITING, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO ALONZO A. WHITING, OF CHICAGO, ILLINOIS.

Claim.—In a furnace the combination with a fire box and combustion chamber and bridge wall therebetween, of an air heater in rear of the bridge wall comprising a plurality of passages having substantially parallel walls, baffles in said passages comprising inclined ribs projecting from the walls of said passages, the ribs on the wall of one passage being inclined reversely to those on the opposite wall of said passage, and means for conveying the air from said heater to the fire box.

THE BOILER MAKER

JUNE, 1918

Testing, Inspecting and Cleaning Stationary and Portable Boilers in Railroad Service

Methods of Internal and External Inspection—Staybolt and Firebox Tests—Location of Fusible Plugs—Reports of Tests and Inspections

BY WM. N. ALLMAN

In order to maintain boilers in a safe and suitable condition for service, it becomes necessary to establish some system of regular inspection. There are certain requirements which must be met in order to comply with municipal, state and other regulations. The rules set forth in this article are applicable to the various types of boilers in stationary service as well as portable boilers, other than those in locomotive service, for which other requirements are to be followed to meet the state and Federal laws.

Legal Requirements.—Where laws exist covering the testing and inspection of boilers, the requirements of same shall be fully complied with. Where no laws exist the following rules must be adhered to. Where laws do exist but do not require tests as rigid as the following, the necessary tests must be made to conform to these rules and the law.

Authorized Steam Pressure.—The authorized working steam pressure shall be fixed by the chief inspector of steam boilers of the insurance company by whom the boilers are insured and can be obtained at the office of the engineer in charge.

Internal Inspection

All boilers in service must have an internal inspection every six months.

Before entering a boiler connected in battery with other boilers, the utmost care should be exercised in seeing that all the valves on outlets, particularly on the steam, feed water and blowoff connections, are securely closed, so as to effectually remove all danger to inspector or others while the boiler is being cleaned or inspected.

Boilers shall be prepared for internal inspection by cooling down (blanking all connections to adjacent boilers, if necessary), removing all soot and ashes from tubes, heads, shells, mud drums, furnace, arches, bridge wall, combustion chamber, etc., and the water drawn off, handhole and manhole plates removed and grate bars removed from internally fired boilers.

The inspector shall enter the manholes and make thorough examination of the interior of the boiler. He shall also enter the firebox and combustion chamber and make thorough inspection of all parts, paying particular attention to the baffles and to the asbestos rope joints between brick work and ends of mud drum on Stirling boilers and to the asbestos packing between headers and between headers and brick work, front and rear, on B. & W. boilers. The hammer test shall be applied to all accessible parts.

All boilers in service must have an external inspection every six months.

External Inspection

The inspector shall make a thorough inspection of steam gage, water glass gage cocks, water column connections, water blowoffs and safety valve.

Fire doors, tube doors and doors in settings shall be opened so as to permit viewing as far as possible the fire surface, settings, tube ends, blowoff pipes and fusible plugs.

Boiler walls, cleaning doors, breeching and flues shall be examined to see that same are practically air tight.

Hydrostatic Pressure Test

A hydrostatic test shall be applied to boilers whenever in the judgment of the insurance company's inspector, superintendent or the master mechanic, such test is necessary or desirable.

Boilers carrying less than 100 pounds pressure per square inch must be subjected to a hydrostatic pressure of fifty percent above their authorized working pressure. Those carrying pressures ranging from 100 to 125 pounds per square inch, inclusive, must be subjected to a hydrostatic pressure of 150 pounds per square inch. Those carrying more than 125 pounds pressure per square inch must be subjected to a hydrostatic pressure of twenty percent above their authorized working pressure.

The water must be heated to about the boiling point immediately before pressure is applied.

The inspector shall make a thorough examination of every accessible part of the boiler while under hydrostatic test, and at completion of the test a thorough examination shall be made of every accessible part of the boiler, both internal and external, if necessary.

Staybolt Test

Staybolts of boilers in service must be tested once every six months. Staybolts must also be tested immediately after each hydrostatic pressure test.

When these tests are made there must not be less than fifty pounds steam pressure on the boiler which will produce sufficient strain upon the staybolts to cause separation of the parts of broken ones. If the boiler is not under steam, an examination may be made after drawing all the water from the boiler.

An inspector who is especially trained for the service must tap with a hammer each staybolt and crown sheet stay accessible on the firebox end, and those not accessible must be tapped whenever possible on the outside end and judge if any are broken. Staybolts having tell-tale holes must, in addition to the hammer test, be carefully inspected to insure that all of the tell-tale holes are open, using a drill for this purpose when necessary.

If any doubt arises during inspection as to the condition of sheets behind or below grate bearing bars, the grate bearing bars must be removed. The bottom portion of all firebox sheets below the fire line must be fairly straight, and after examination painted below and behind the bearing bars.

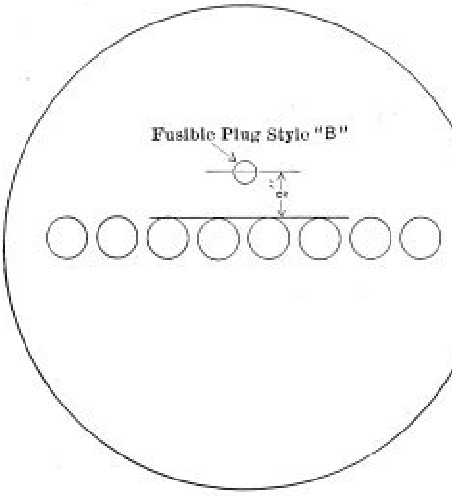


Fig. 1.—Horizontal Return Tubular Boiler

Fusible plug to be located in rear head, not less than 2 inches above the upper row of tubes, and projecting through the sheet not less than 1 inch.

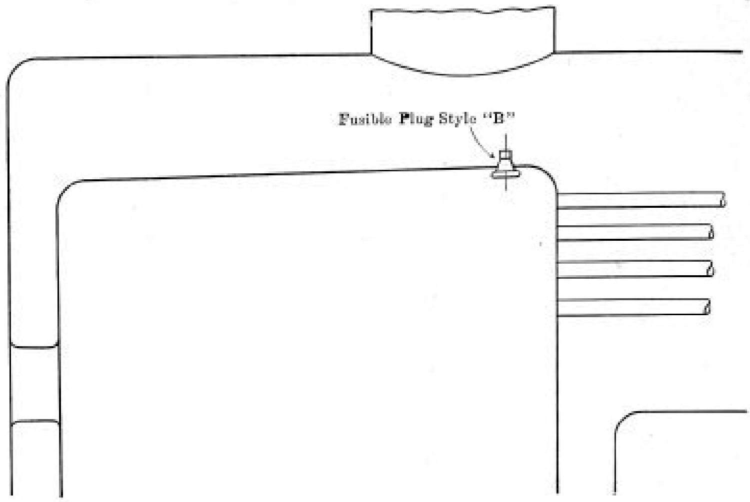


Fig. 3.—Locomotive Type or Star Watertube Boiler

Fusible plug to be located in the highest point of crown sheet, and projecting through the sheet not less than 1 inch.

No boiler must be allowed to remain in service when there are one or more staybolts broken in the top row of firebox, nor two or more adjacent broken or plugged staybolts in any part of firebox, nor three or more broken or plugged staybolts in a circle four feet in diameter, nor when five or more staybolts are broken in the entire boiler.

Precaution must be taken to insure the removal of all defective staybolts, and a careful examination made of all bolts adjacent to broken bolts.

WASHING OUT BOILERS

All boilers must be washed out every fifteen days. This period, however, may be lengthened or shortened when conditions warrant. Whenever possible, heated water should be used for washing out and filling up.

When boilers are being washed, all such fittings as check valves, injectors, blowoff cocks, gage cocks, water columns and all connections leading to or from the boiler must be thoroughly examined to see whether same are free and clear, and, if found defective, be repaired.

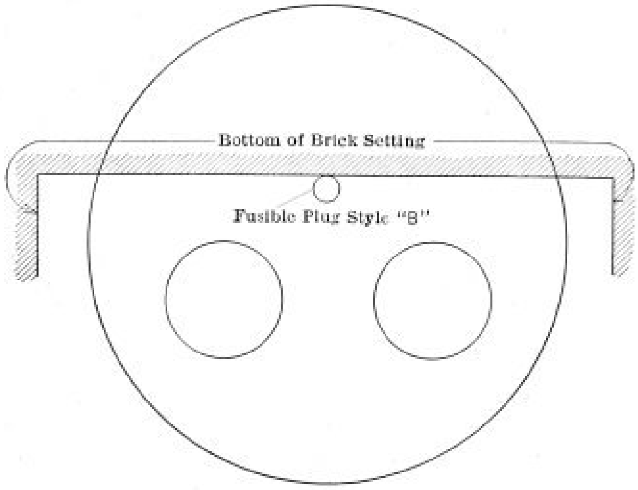


Fig. 2.—Horizontal Flue Boiler

Fusible plug to be located in rear head on a line with the highest part of boiler exposed to the products of combustion, and projecting through the sheet not less than 1 inch.

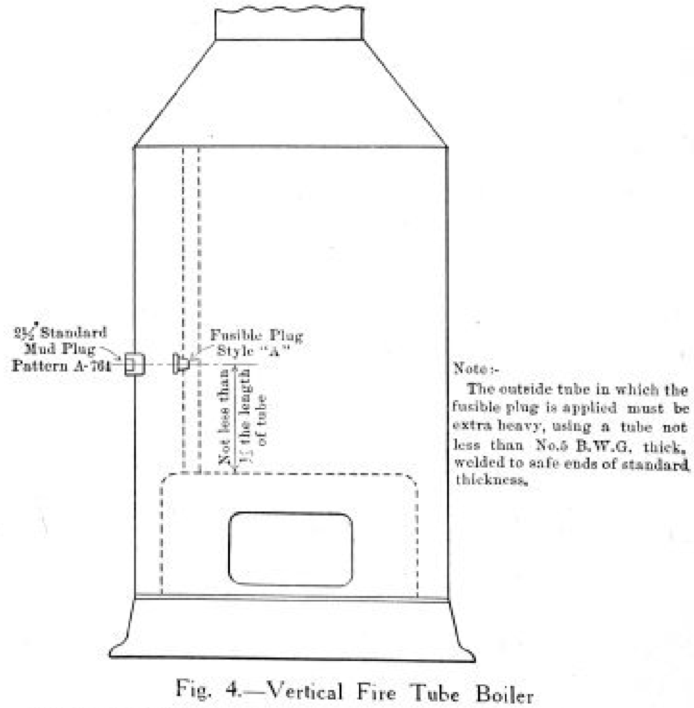


Fig. 4.—Vertical Fire Tube Boiler

Fusible plug to be located in an outside tube not less than one-third the length of the tube above the lower tube sheet.

If during the hammer test the inspector has any doubt regarding flexible staybolts, the caps must be removed and bolts examined.

FIREBOX TEST

The firebox sheets must be hammer tested and inspected once every six months for corrosion, mud burning, cracks, defective seams, patches, rivets, patchbolts, calking, riveting and tubes. A careful examination must be made to see that no sheets are sprung on account of improper staying or handling, and a hydrostatic test applied if necessary.

Water columns with high or low water alarms should receive special attention where state laws require such.

FUSIBLE PLUGS

All stationary boilers in service in the states of Ohio and Indiana and any other state where laws require them, must have fusible plugs applied in accordance with the following and located as per Figs. Nos. 1 to 10, using fusible plugs as shown in Figs. 11, 8 and 12.

The types of boilers shown in Figs. 1 to 10 represent those in general use, and fusible plugs should be placed as near as possible to the locations as indicated thereon.

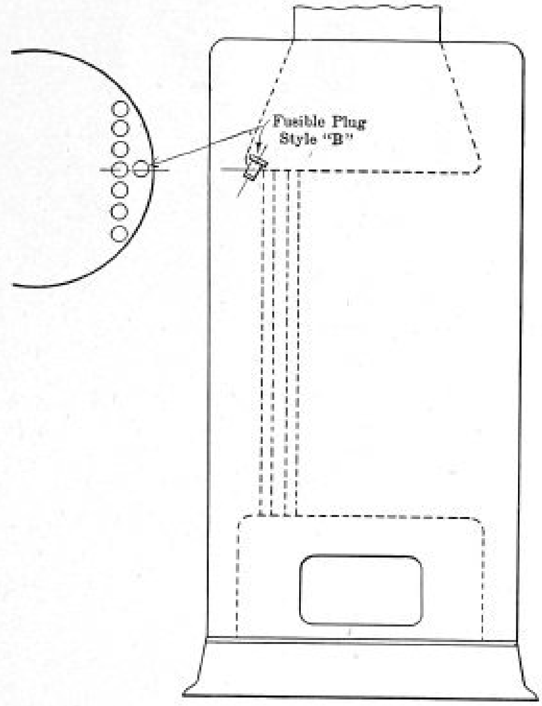


Fig. 5.—Vertical Submerged Tube Boiler
Fusible plug to be located in the upper tube sheet as shown.

Horizontal Return Tubular Boilers.—In the rear head not less than 2 inches above the upper row of tubes, measurement to be taken from the line of the upper surface of tubes to the center of the plug and projecting inside the sheet not less than 1 inch.

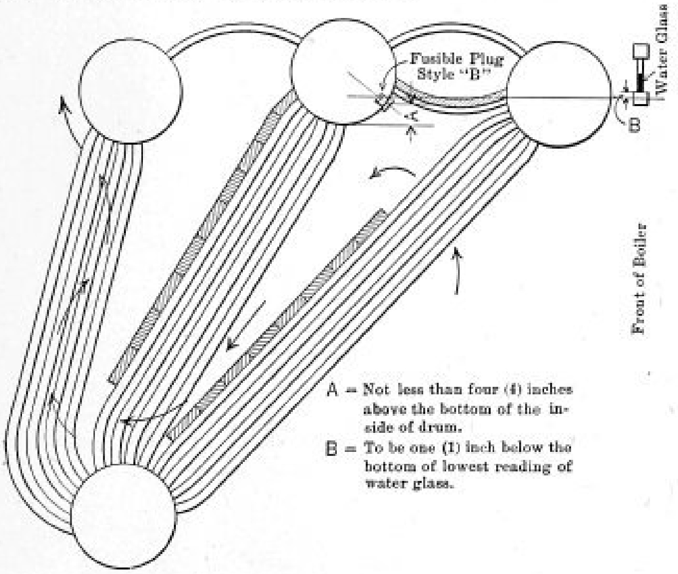


Fig. 7.—Stirling Boiler, Standard Type
Fusible plug to be located in front side of middle drum not less than 4 inches above the bottom of the drum and projecting through the sheet not less than 1 inch.

Horizontal Flue Boilers.—In the rear head on a line with the highest part of the boiler exposed to the products of combustion and projecting through the sheet not less than 1 inch.

Locomotive Type or Star Watertube Boilers.—In the highest part of the crown sheet and projecting through the sheet not less than 1 inch.

Vertical Fire Tube Boilers.—In an outside tube not less than one-third the length of the tube above the lower tube sheet. Tube in which fusible plug is placed must be extra heavy No. 5 B. W. G., which tube must have standard safe ends welded thereon in order that same may be properly swaged and beaded over the tube sheets.

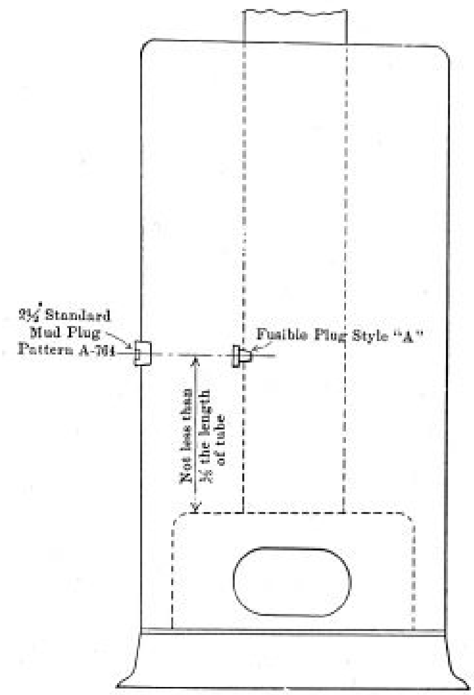


Fig. 6.—Upright Boiler
Fusible plug to be located in center flue not less than one-third the length of the flue above the lower flue sheet.

Vertical Submerged Tube Boilers.—In the upper tube sheet.

Upright Boiler.—In center flue not less than one-third the length of the flue above the lower flue sheet.

Watertube Boilers, Horizontal Drums, Babcock & Wilcox Type.—In the upper drum not less than 6 inches above the bottom of the drum over the first pass of the products of combustion and projecting through the sheet not less than 1 inch.

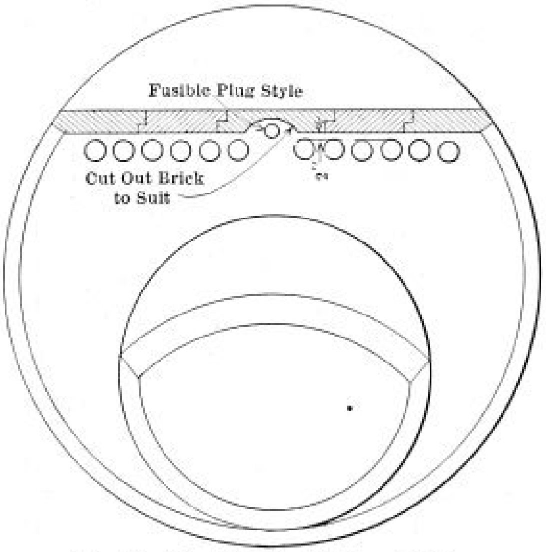


Fig. 8.—Dry Back Scotch Type Boiler
Fusible plug to be located in the rear head not less than 2 inches above the upper row of tubes and projecting through the sheet not less than 1 inch.

Stirling Boilers, Standard Type.—In the front side of the middle drum not less than 4 inches above the bottom of the drum and projecting through the sheet not less than 1 inch.

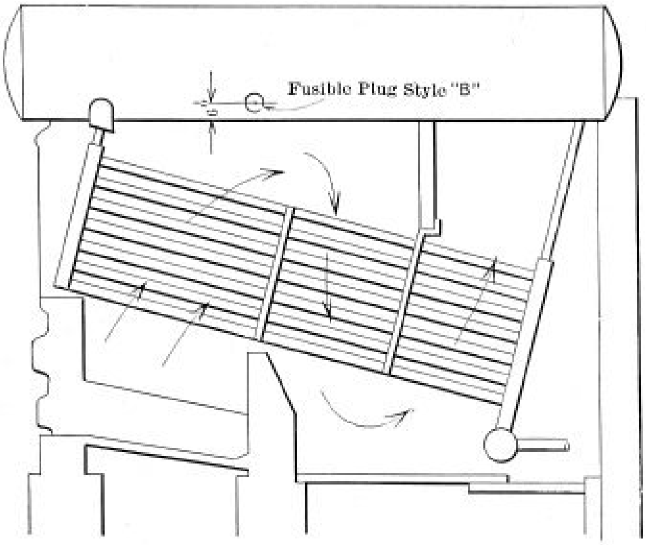


Fig. 9.—Watertube Boiler—Horizontal Drum Babcock & Wilcox Type

Fusible plug to be located in the upper drum not less than 6 inches above the bottom of the drum over the first pass of the products of combustion and projecting through the sheet not less than 1 inch.

Stirling Boilers, Superheated Type.—In the front drum not less than 6 inches above the bottom of the drum exposed to the products of combustion and projecting through the sheet not less than 1 inch.

Dry Back Scotch Type Boilers.—In rear head not less than 2 inches above the upper row of tubes and projecting through the sheet not less than 1 inch.

Economic Type Boilers.—In the rear head, above the upper row of tubes.

Vertical Fire Tube Boilers, Corliss Type.—In a tube not less than one-third the length of the tube above the lower

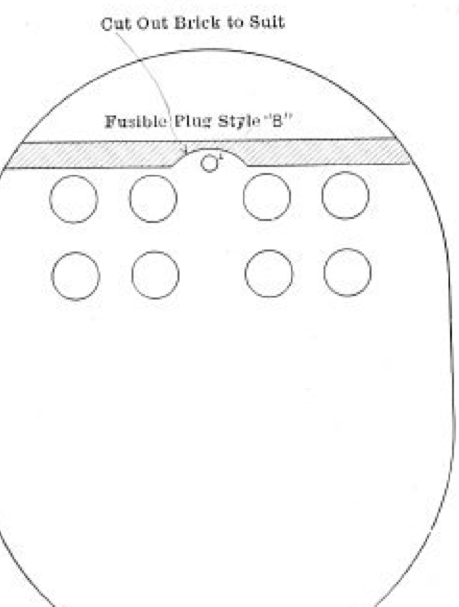


Fig. 10.—Economic Type Boiler

Fusible plug to be placed in the rear head just above the upper row of tubes.

tube sheet. Tube in which fusible plug is placed must be extra heavy No. 5 B. W. G., which tube must have standard safe ends welded thereon in order that same may be properly swaged and beaded over the tube sheets.

Watertube Boilers, Heine or Edgemoor Type.—In the front course of the drum not less than 6 inches above the bottom of the drum and projecting through the sheet not less than 1 inch.

Pipe Boilers, Almy or Roberts Type.—In a tube or fitting exposed to the products of combustion.

Vertical Boilers, Climax or Hazelton Type.—In a tube or center drum not less than one-half the height of the shell, measuring from the lowest circumferential seam. Tube in which fusible plug is placed must be extra heavy No. 5 B. W. G., which tube must have standard safe ends welded thereon in order that same may be properly swaged and beaded over the tube sheets.

Cahall Vertical Watertube Boilers.—In the inner sheet of the top drum not less than 6 inches above the upper tube sheet and projecting through the sheet not less than 1 inch.

Cast Iron Sectional Heating Boilers.—In a section over and in direct contact with the products of combustion, in the primary combustion chamber.

For other types and new designs of boilers, fusible plugs shall be placed at the lowest permissible water level, in the direct path of the products of combustion, as near the primary combustion chamber as possible.

Precautions Against Explosions in Shop Repair and Inspection Work

Prohibiting the Use of Gas for Illuminating, Heating and Drying.—With a view of protection to employers and

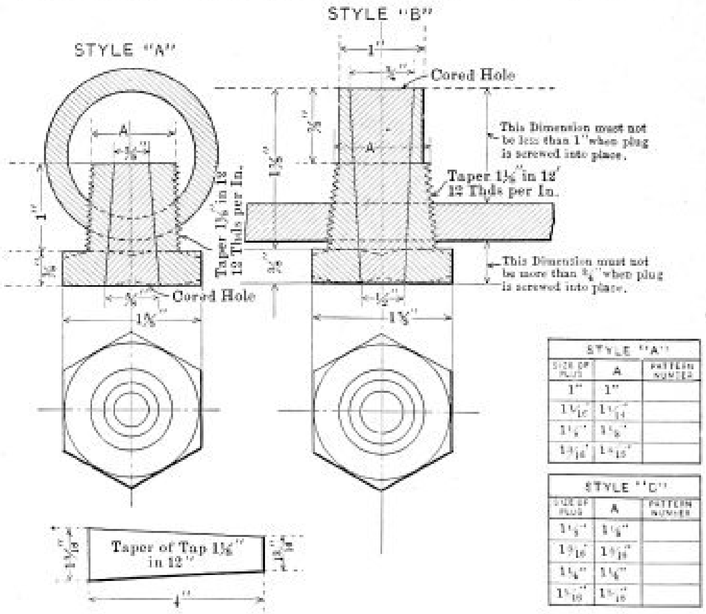


Fig. 11

Fig. 12

preventing damage to property, gas should not be used for illuminating, heating or drying the interior of boilers, or in any place where there is not sufficient ventilation to prevent an accumulation of gas and cause explosions.

In cases where it is necessary to repair or inspect the interior of boilers, electric or electric flash lights should be used.

Numbering of Stationary and Portable Boilers

All stationary and portable boilers in any service whatever, except locomotive service, marine or other boilers under the jurisdiction of the United States Government, shall be given a serial number. The name of the railroad with the number suffixed must be distinctly stamped on the boiler, using a steel die with a five-sixteenth-inch letter and figure, as shown by the following:

A-B-C No. 100.

Location of stamps to be as follows:

(*a*) On Horizontal Return Tubular Boilers—on the front head, above lower manhole.

(*b*) On Horizontal Flue Boilers—on the front head, above lower manhole.

(*c*) On Locomotive Type—on furnace end, above furnace door.

(*d*) On Vertical Fire and Vertical Submerged Tube Boilers—on the shell, above the furnace door.

(*e*) On Watertube Boilers, Babcock & Wilcox, Stirling, Heine and Edgemoor Types—on a head above the manhole opening, preferably on the flanging of the manhole opening.

(*f*) On Vertical Boilers, Climax or Hazelton Type—on the top head.

(*g*) On Cahall Vertical Watertube Boilers—on the upper drum, above the manhole opening.

(*h*) On Scotch Marine Boilers—on the front head, above the center or right hand furnace.

(*i*) On Economic Boilers—on the front head, above the central rows of tubes.

(*j*) For other types and new designs—in a location to be approved by headquarters.

Numbers assigned to boilers will remain on boilers even when same are transferred to other stations or districts, and will go out of existence when the boilers are scrapped or otherwise disposed of.

GENERAL

Baffles.—All baffles must be kept in tight condition and be inspected each time boilers are washed, as it is important that they fit the tubes closely and be in proper position.

Tubes.—When tubes are reset or renewed they should be subjected to hydrostatic test, if necessary. Watertubes, including headers, nipples and all restricted passages, must be given thorough internal cleaning once every three months, or more frequently if necessary, and the two lower rows of tubes in B. & W. boilers and the tubes connecting rear drum and mud drum in Stirling boilers should be thoroughly cleaned each thirty days, or more frequently if necessary.

Accumulations of dust must be blown off watertubes and out of firetubes once in every twenty-four hours, or more frequently if necessary. Fire tubes must be brushed or scraped at least once each fifteen days.

Steam Test.—After boilers have undergone extensive repairs and hydrostatic test applied, a steam test, raised to not less than the authorized working pressure, must immediately follow to ascertain if the boiler is thoroughly tight, and a careful examination should be made for any defects in the boilers, seams, rivets, bolts, cocks, valves and appurtenances, necessary repairs being made before placing the boilers in service.

Safety Valves.—All safety valves should be lifted each day to see that they raise freely from their seats, and must be tested and adjusted once every six months, as hereinafter specified.

Boilers equipped with one safety valve must be adjusted to relieve at the authorized working pressure; when two valves are used, one must be adjusted to relieve at the working pressure and the other at five pounds above. When adjusting the safety valves, they must be set and adjusted by a test gage or with a steam gage compared and correctly adjusted with a test gage. When a boiler is equipped with two safety valves, each time the valves are repaired the one set at the higher pressure should be changed to the lower or working pressure, in order to keep the two valves in working condition. When setting safety valves the water must not be above the highest gage cock.

Steam Gages.—All steam gages must be tested at least once every six months, and also when any irregularity is observed or reported. Gages must be removed from the boiler and set with a master gage, and all inaccuracies must be corrected before being put into service, and the syphon pipe and its connections to the boiler must be cleaned each time the gage is tested. Records should be kept of all gages tested and the date of test must be indicated on small slip and attached to the face of the gage.

Fusible Plugs.—Boilers fitted with fusible plugs must have same removed and cleaned, if necessary, every six months.

Oil.—Care should be used to prevent oil from entering the boiler, as it is liable to cause overheating of shell plates and tubes, which may result in rupture.

Report of Tests and Inspections.—Complete record on Form No. 1 must be made each time a boiler is inspected and tested. Copies shall be forwarded to the electrical engineer, superintendent of insurance, superintendent of motive power or district superintendent of motive power. Record shall also be kept in the office of the master mechanic or general foreman in whose district boilers are located.

FORM No. 1

REPORT OF TEST, INSPECTION AND CLEANING OF STATIONARY AND PORTABLE BOILERS

1. Kind of test or inspection...
2. Boiler insured by...
3. Boiler No.............located at..................date.............
4. Type and make of boiler..........authorized working pressure....
5. Date last cleaning........washing........hydrostatic test........
6. Boiler tested at a hydrostatic pressure of..................pounds
7. Date of last insurance co.'s inspection—internal......external......
8. Date of last test on steam gage............safety vales..........
9. Saftey valves set at.......................pounds working pressure
10. Did safety valves relieve at required pressure....................
11. How often soot removed from breeching and base of stack........
12. How often soot blown from tubes.............................
13. How often are tubes brushed or scraped (firetube boilers)..........
14. Method of removing scale.......................................
15. Thickness of scale in or on tubes.........circulating tubes........
16. Thickness of scale in drums...............in shell..............
17. Feed water treatment, use of soda ash or other material and how much..
18. ....
19. Condition of brick setting (cracks, etc.).........................
20. Condition of furnace lining.............bridge wall.............
21. Condition of baffles ....
22. Condition of brick arches...
23. Condition of asbestos rope joints between mud drum and brickwork ....
24. Condition of asbestos packing between headers..................
25. Condition of asbestos packing between headers and brickwork......
26. Condition of superheaters ....
27. Condition of grates.................... stokers..................
28. Condition of headers.......steam drums.......mud drums......
29. Condition of watertubes................ firetubes.................
30. Condition of manholes................ handholes................
31. Condition of breeching..............cleaning doors..............
32. Condition of inside firebox sheets..............................
33. Condition of shell..................fusible plugs.................
34. Condition of blowoff cocks.............valves and piping..........
35. Condition of water columns........gage cocks and piping........
36. Condition of pipe openings where screwed into drum or shell......
37. Condition of feed water lines, valves and checks..................
38. Condition of staybolts.................. stays.....................
39. Number of broken staybolts......number of staybolts renewed....
40. Remarks ....
41. ....
42. ....
43. ....
44. ....

....
Inspector.

....
Master Mechanic or General Foreman.

NOTE.—Under "Remarks" give recommendations and brief statement of repairs that are necessary.

PERSONAL.—Herbert H. Evans has been made district sales manager of the Coatesville Boiler Works, Philadelphia, with office in Philadelphia. From 1909 to 1912 Mr. Evans was connected with the American Bridge Company, and from 1912 to 1915 he was assistant engineer of design on the Hell Gate Arch Bridge. Since 1915 he has been engineer for the Coatesville Boiler Works.

Buy Thrift Stamps.

John Jumps Some Algebra

Explanation of Signs Used in Algebra—How They Are Used as Tools in Boiler Making

BY JAMES F. HOBART

"Say, Mr. Hobart—some of us boys are trying to study out a little algebra and we have run against some tough snags. Will you try and help us jump the tough spots a bit?"

"Sure, John. I'd like to do so and am glad of the chance. But tell me, what started you into algebra? How did you happen to start on that?"

"Why, a long time ago, if you remember, you told me that when I got up against anything I didn't understand, to go right to work and study back until I came to a place where I knew the ground, then to work ahead again until I could handle the thing I didn't understand. Now, some of us have put in together and bought some books and when we tried to read them we ran slap dash against some algebra that we could'nt get around or climb over, so we set to work to run the things down but have kinder gotten 'up against it.'"

"Just what seems to be the trouble, John? Don't you understand the signs used in algebra? If you do, about all you have to do is to twist the several quantities one way and another until you get rid of some of them and determine the value of the others."

"Yes, that's what we are trying to do, but there are certain signs which we don't seem to get next to. Of course we understand the common signs such as $+$, $-$, $\times$, $\div$, $=$, etc., but when we come to $x = a.b$, we got up against it bad. What does it mean?"

"John, the point between quantities, except where used as a decimal point, means that the quantities are to be multiplied together. Personally, I never use the point as such a sign, for it is too apt to be misleading and too easily confused with the decimal point. Then again, letters seldom need the sign of multiplication between. The equation that you present would mean the same if you stated it $x = ab$, or if you put in the real signs and wrote it $x = a \times b$. It is only necessary to use the point sign of multiplication when it is necessary to denote a quantity by two letters or symbols. As an example, where a triangle is given with letters at the angles, say in a right angle triangle with the letters a, b and c placed upon the three angles, then the three sides might be known as ab, bc, and ca, and you could make the equation $+ x = ab.ba$. But this is an awkward statement at best, and I prefer to give the angles capital letters and then designate the three sides by the three lowercase letters."

"Say, it's the same in division, isn't it? I see it now. I can write

$$x = a \div b, \text{ or } x = a \,/\, b, \text{ or } x = \frac{a}{b},$$

and all three expressions mean the same?"

"Right you are, John, you've got that all right."

"Well, sometimes we find a sign like this: $\backsim$. In one place we found

$$0.667 \backsim \frac{2}{3}.$$

What does that sign mean?"

"It means in that case, John, 'nearly equal to.' As you will see, the decimal is nearly the equal of the common fraction. But this sign $\backsim$, is sometimes used in a different manner, as $5 \backsim 7 = 2$. In this case, the sign means difference. Or we may say that it is used as a difference sign, the difference between 5 and 7 being 2. In this case, I would prefer to use the common subtraction sign, but some mathematical 'sharps' seem desirous of using that sign in the manner indicated."

"Well, there are several other signs which have been bothering us. One of them is a 'double barreled equality sign' $\equiv$. Now what does that mean? In this case, the equation was $3\ (m + n) \equiv 3m + 3n$. What does it mean?"

"In this case, John, the sign $\equiv$ means identity. If you will study the equation a bit, you will see that both members are identically equal. This sign is not used very often but they go with any sign in question, two others, $\geqq$ and $\leqq$. The first means equality or superiority, the seecond, equality or inferiority. Thus, $g \geqq 40$ and $g \leqq 40$, meaning respectively that g is greater or equal to 40, and that g is less than or equal to 40. These signs are combinations of the equality sign $=$, and the very common signs $>$ and $<$ meaning greater than, or less than. Thus, $g > 40$ means that g is greater than 40, while $g < 40$ means that g is less than 40."

"Gee whiz! But algebra is sure full of stunts which trip a man up when he isn't looking or expecting!"

"Just look at the matter another way, John. Just consider the things which 'trip you up' in another way. Instead of thinking them to be obstacles and stumbling blocks, just see if, after you come to know them better, they are not real short cuts—improved tools and methods, in fact—wherewith, after you know how to use them, you can secure results quicker and better than without the things which now 'trip you up' because you do not understand them?"

"That may the case. Guess it would be the same if an old timer, used to hand work alone, were suddenly called upon to operate a modern 'air-gun.' It surely would be a stumbling block to him, knowing nothing at all about the pneumatic tools of to-day. I think he would find that air-gun as bad a thing as we find the signs and stunts of algebra when we first meet up with them!"

"That's what, John. It's a pretty good comparison, so go to it and learn to use the new 'algebra-tools.' They will help you a whole lot when you know how to use them. Are there any more of the algebra signs which are not clear to you, John?"

"Gosh, Yes! There are lots of them. Sometimes I think I understand one of them, then it fools me when I'm not looking! That line which is sometimes written above the letters or figures in part of an equation—a vinculum—I believe they call it. That line fools me sometimes. Why can't it be dropped?"

"That's a mighty handy tool in algebra, John, and to drop the vinculum would sometimes make the work harder. You will never get caught by this line, John, if you fix in the back of your head the ironclad rule—a rule without a single exception—that the figures or letters between brackets, or under a vinculum, must be added, multiplied or divided according to the several signs preceding such numbers of letters, before these quantities are combined with or transferred to any other part of the equation."

"How is that?"

"Why, in the following equation, each set of symbols indicates exactly the same thing and shows the same operations to be performed, viz:

$$2\ (3 + 5) = 2\ [3 + 5] = 2 \times \overline{3 + 5}$$

and in each instance it means that 3 and 5 are to be added before being multiplied by 2. That's what the vinculum and the parentheses or brackets mean in algebra; and rather simple it is too, isn't it John, after you 'know how'?"

"Yes, it's simple enough after you know how, but dog-goned hard before you know just what it all means!"

"And here's another point, John. When you get to working an equation, to transposing and uniting terms, see to it that you do the adding and subtracting first, before you do any multiplying or dividing. Then, you will come out all right. But if you go to multiplying and dividing quantities before uniting them according to their plus and minus signs, then you sure will have trouble and the result obtained may not be right."

"So, that's the way is it? And does it make any difference as to addition or subtraction, where they are called for, as to which is done first?"

"Not a bit of it, John. Really, in algebra, there is no such thing as subtraction. Properly speaking, you unite similar or like qualities according to their several signs and add or take away as the case may be; therefore, 'uniting' is a much better term to employ in algebra than adding or subtracting."

"I get you, Mr. Hobart, and I have been fooled badly several times in that very matter. Working an algebra equation is surely much like sailing a boat through a crooked channel. If you miss a single sign, or a buoy or range you are up against it, either in algebra or in the boat, and a man has sure got to watch out mighty closely in either bit of work."

"Yes, John, working algebra is much like working steel in the boiler shop. In either case you must 'make your marks right and then work to them accurately' in order to obtain exact results."

"Mr. Hobart, I wish you would put me straight regarding the exponents. There are frequently found letters or figures such as 2^2, 2^3, a^2, a^3, etc., which I understand to mean the square or cube of 2 or of a, and to mean 2×2, or $a \times a \times a$, etc. But when I find 3^n, or a^n, what in Sam Hill does it mean?

"Hold on, John, don't swear. It means $3 \times 3 \times 3 \times 3$, or $a \times a \times a$ up to n times. That's just what it means."

"Yes, I suppose that's so, but how many times does 'n' mean?"

"That's what you have to find out, John, or, if you can't find out the numerical value of n, you may find some way of eliminating it or of dropping it from the equation—getting rid of the n-th power altogether."

"Oh! Then I am not obliged to find out the value of exponent n, and to raise 3 or a to that power?"

"Usually not, particularly if you can eliminate both the quantity and its exponent altogether."

"Glory be! That makes things a whole lot better. That 'n' exponent sure had me buffaloed. But there is another which is worse. Sometimes I find a quantity written 2^{-2}, or a^{-2}, or b^{-n}. Now, what is to be done with things like these and how are they worked? What is the negative power of anything, anyway?"

"There isn't any 'negative power,' John. You are a bit mixed regarding those negative exponents, that's all. When you find 2^{-2}, just consider it to mean the reciprocal of the square of 2. It is $1/2_2$, that's just what it is, with no 'negative exponent' whatever. Also, the other 'negative exponents' are simply

$$a^{-2} = \frac{1}{a^2}, \qquad \text{and } b^{-n} = \frac{1}{b^n}.$$ See, John?"

"O pshaw! that's another of the fierce-looking things which aren't anything at all when you meet up with them. Pshaw!"

"Don't worry, John, you'll have trouble enough with negative exponents before you get rid of the fractional quantities they represent—see if you don't, sometimes."

"Say, Mr. Hobart, I am not very much afraid of a thing after I know what it is. It's only the things which I don't fully understand which get my goat. But there are a couple more signs which I wish you would let me in on. One of them is i, or j. I have seen it once or twice in an equation. Once, I believe, it was:

$$\sqrt{-1} = j.$$

Now, what does that equation mean, anyway?"

"I don't wonder that puzzles you, for i or j is a sign sometimes used to represent the imaginary. In the equation given above, there is no such quantity as the 'square root of minus 1.' The square root of, as the boy said, one less than nothing, would surely be a curiosity, therefore the sign i or j is used to represent something entirely imaginary. I don't believe, John, that you will have very frequent occasion to use that sign in boiler making. But then, a mechanic of the 20th century never knows what problem he will meet up with, so you never need fear having too much knowledge. It is only too little knowledge that is bad, as the old adage says, 'A [too] little knowledge is a dangerous thing'!"

"I'm out for all I can get and hold, Mr. Hobart, and if you will show me about one more sign, I'll go home and study what you have given me."

"What is the other sign, John, which puzzles you?"

"Why, it seems to be the ordinary exclamation point '!'. Once or twice I have found it after certain quantities in an equation like this:

$$p = \frac{3! \times 4!}{7!}.$$

Now, what does such an equation and its signs mean, anyway?"

"It means, John, the Factorial. This equation is regarding the probability of something or some event taking place. The symbol p stands for probability. (Some authors use the sign L). The 3! means the product of 3 and of all the digits preceding it, viz., $3 \times 2 \times 1 = 6$. The other quantities in the equation are to be treated in the same manner. Extended in full, this equation would become:

$$p = \frac{3 \times 2 \times 1 \times 4 \times 3 \times 2 \times 1}{7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1} = \frac{6 \times 24}{5040} = \frac{144}{5040} = \frac{1}{210}.$$

This means that the probability of a certain event coming to pass was as 1 to 210."

"Rather long chances, wasn't it? Guess there isn't much chance of using that sign in the boiler shop, is there?"

"Probably not, John, but just to show you how it is worked we will fake up a chance to use it in the shop. Suppose you get four boxes and place them in a row. Then you hunt up 13 copper rivets, 13 brass rivets of as nearly the same size and shape as possible, then 13 galvanized rivets, and 13 more black rivets. Put them all in a bag, shake them well, and pick 'em out one at a time and place a rivet in each box in rotation."

"And then what?"

"We will suppose that copper rivet comes up first and is placed in the first box. Now, John, it is possible, of course, that you can distribute all those rivets into the four boxes, and have all the copper ones in the first box, isn't it?"

"Why, yes, I suppose it's possible, but it don't seem very probable."

"There you are, the probability of it! That is what the '*p*' stands for in the 'horror-mark' equation. And John, it is possible to calculate the probability of all the copper rivets falling into the first box. That is, we can calculate how many times the rivets might have to be distributed before the thing might happen, although it might still happen the first or the second or third time they were distributed."

"Well, that isn't very likely, but how in all creation is such a thing calculated?"

"The following equation, John, where '*p*' is the probability, then

$$p = \frac{13! \times 39!}{52!}.$$

"Say, must all the numbers, from 13, 39 and 52, down to 1, be multiplied together, and then reduced to a fraction, having 1 for its numerator?"

"That's the way of it, John; it will be 13 x 12 x.... 3 x 2 x 1, and the same with 39 and with 52."

"Thunder, it will take some figuring to get that answer. Wonder what it will be?"

"You can work it out, John, noons and night. Logarithims will help a whole lot, and see if you don't find that

$$p = \frac{1}{635{,}013{,}559{,}600}$$

And that means, John, that you might have to distribute those 52 rivets over 635 billion times before you got all the copper ones into the same box! Want any more algebra signs to-day, John?"

"Naw! I don't. Betcher life. That one's a corker and will last me for a month anyway!"

The First of Every Month to Be Thrift Stamp Day

The first Thrift Stamp Day went over big! It proved a tremendous boost for Uncle Sam's Thrift Stamps and War Savings Stamps campaign and for American business in general. As a result of the great success of the first Thrift Stamp Day it has been decided to make the First Day of every month Thrift Stamp Day in the U. S. A.!

This means that every branch of American business has the unusual opportunity to make the first of every month a red letter business day throughout the Nation, and a Victory day of the U. S. Government by disposing of hundreds of thousands of dollars' worth of Thrift Stamps and War Savings Stamps!

So get busy at once in preparation for these red letter business days—these monthly Thrift Stamp Days! It's up to you to help the Government and help yourselves at the same time.

Profit by your experiences of the first Thrift Stamp Day to make the succeeding Thrift Stamp Days still more of a success! Redouble your former efforts and you'll double the results! If any of you should still be unfamiliar with the working plan for Thrift Stamp Day, write for this plan to-day without fail. Address W. Ward Smith, National War Savings Committee, 51 Chambers St., New York City.

This Chart Shows the Money Lost Up a Chimney

This handy and useful chart has been developed by the Uehling Instrument Company, 71 Broadway, New York. It is of unusual interest and value at the present time, when the coal problem is so important, for it enables anyone quickly and closely to estimate the money now being lost up almost any chimney, due to low CO_2.

Simply connect the percentage of CO_2 (shown in Column C) with the money now being spent per year

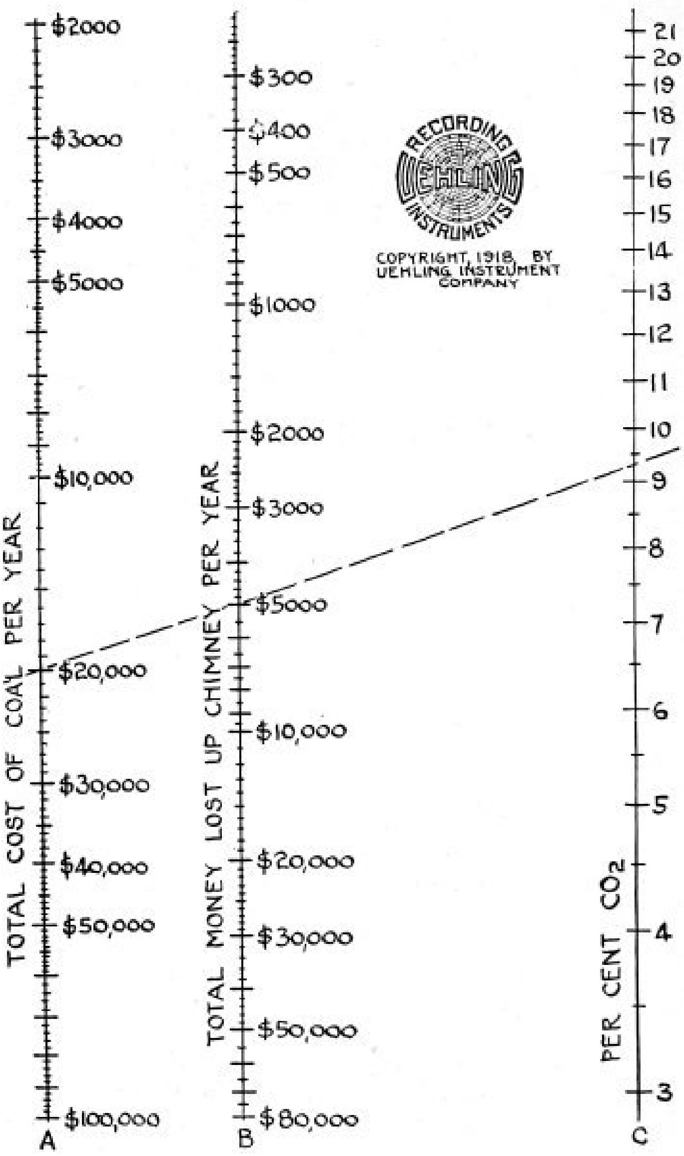


Chart Showing Money Lost Due to Low CO_2

for coal (shown in Column A), and the intersection of the connecting line with Column B immediately gives the dollars rolling out of the chimney in the form of heated gases.

Example: If $20,000 is spent per year for coal burned in a furnace, whose average CO_2 registers 9.3 percent, what is the approximate money lost up the chimney per year?

Solution: Connect the $20,000 (Column A) with the 9.3 percent (Column C), as indicated by the dotted line drawn across this chart, and the intersection with Column B shows the approximate yearly loss to be $5,000.

The object of this chart is to show that high percentage of CO_2 is most desirable. To be sure, even where the CO_2 is as high as 21 percent, the theoretical maximum, there is a loss, because, in the average power plant the flue gases leaving the boiler have a temperature as high as 500 or 600 degrees F. Loss, therefore, is inevitable unless a blower is used for exhausting the gases and some sort of interchange system is installed for either heating the feed water or preheating air and leading it under the grate.

It is well to know all about these various things, and the Uehling Instrument Company advises that its engineers will gladly co-operate in whatever way possible with responsible concerns to secure maximum returns from every dollar invested in coal. Being combustion specialists, the advice of the Uehling people will be of particular value in showing how to attain the highest possible percentage of CO_2. It should be borne in mind that combustion is a *chemical process* and for that reason should be studied from the viewpoint of the chemist.

It is significant that most of the large power plants of to-day have adopted CO_2 instruments that record automatically and continuously. The reason for this is to keep constant tab on the workers in the boiler room and the efficiency of combustion. The recorder may be placed at any convenient distance from the boiler in the office of the chief engineer, owner, manager or superintendent, while an auxiliary CO_2 indicator is placed on the boiler front in full view of the fireman. The function of the indicator is to keep the fireman constantly informed as to the efficiency of his own work. This feature is most commendable.

Coal cannot be saved by a CO_2 machine alone. If no attention is paid to the indicator or recorder, the installation of such apparatus borders on foolishness. The records should be carefully watched and studied and adjustments should constantly be made in firing methods until the best percentage of CO_2 is obtained. After the best mark is reached, fluctuation of the CO_2 line below that mark to any great extent should not be allowed.

This chart is based on a flue gas temperature of 600 degrees F., and an outside temperature of 60 degrees F. Where the flue gas temperature is higher, or the outside air temperature lower, the money loss will be correspondingly increased. On the other hand, with a higher outside air temperature and a lower flue gas temperature, the money loss is proportionately decreased. Further, in the construction of this chart, it has been assumed that the coal has a calorific value of 14,500 B. T. U. per pound of combustible.

It may also be interesting to point out that where there is only 3 percent of CO_2 in the flue gases, 76 percent of the heat value of the coal passes up the chimney as waste, under the conditions outlined above. It is impossible, however, for these gases to contain as low as 2 percent, because it would require more than the original quantity of heat in the coal to heat the enormous surplus of air to a temperature of 600 degrees F.

PERSONAL.—J. A. Kinkead, for 10 years sales representative in New York of the Parkesburg Iron Company, will become the Pacific Coast representative of that company in San Francisco after July 1, located probably in the Mills Building. He will also represent the Chicago Railway Equipment Company and a few other railroad and steamship supply companies. Mr. Kinkead was for nine years chief inspector of the Chicago & Northwestern Railroad and also for six years engineer of tests to the American Locomotive Company, Schenectady, N. Y., before coming to New York.

Fusible Plugs: Their Composition, Installation and Location

BY W. A. LAILER

Fusible plugs, sometimes called safety plugs, represent one of the most positive and foolproof guards against danger from low water in boilers, and are especially valuable in the smaller plants where the operating conditions are more lax than in larger plants, and where often a constant watch in the boiler room is not established.

The fusible plug is merely a screw plug with the center bored out in a taper form, in which hollow space is placed an alloy of some kind, which melts at a certain fixed temperature. The fusible plug is placed in the shell plate of the boiler at the lowest point to which it is desired that the water level shall ever go without notice.

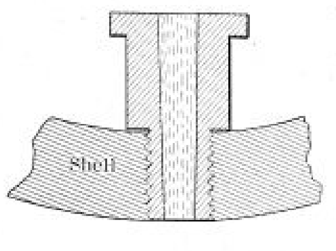


Fig. 1.—Inside Type Fusible Plug. Screwed into Boiler Shell from Inside.

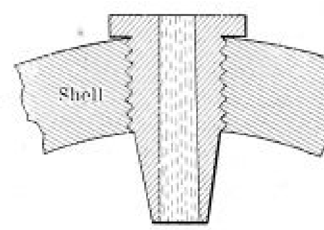


Fig. 2.—Outside Type Fusible Plug. Attached from Outside of Shell.

The principle of operation is that as long as water is present on the inner end of the plug the water will carry away the heat from the fire sufficiently fast to prevent the melting of the alloy. If, however, the water level falls below the desired point, the heat of the fire acting on the alloy, and not being conducted away by the water, melts it, and as a result, steam blows through the opening, sounding an alarm so that the fires can be drawn.

While, as stated above, the fusible plug is most useful and desirable in small plants, or where the operating force is unreliable or incompetent, or whether constant attention to the boiler is not assured, in many States and cities the placing of a fusible plug in every steam boiler is enforced by law. The fusible plug not only sounds an unmistakable alarm of low water, but it also allows the escape of steam from the boiler at a time when the pressure is bound to rise. The plug can also be so located that the steam is discharged into the fire chamber in such a manner that the fires are deadened by the discharge of steam, thus forming a positive and automatic check against explosion from low water. Also in the case of actual explosions, the condition of the fusible plug after the accident will often furnish quite conclusive evidence as to whether the explosion was actually due to low water or not.

The fusible plug can be made in either of two types, the inside type, which is screwed into the boiler from the inside, or the outside type, which is screwed into the boiler from the outside, although the latter type is the most generally used. Fig. 1 shows the inside type, while Fig. 2 shows the outside type.

The body of the plug is usually made of bronze, though brass may be used where the water is of such a nature that corrosion will not take place. Where the feed water has been chemically treated so that the soluble salts present in the boiler have a tendency to attack brass, or even bronze, then cast steel bodies should be used.

The body of the plug is provided on the outside with a standard pipe thread so that it may be screwed into the shell plate of the boiler, one end of the plug being shaped as a square or hexagon so that it can be tightened up and removed by means of a wrench. The hollow part of the plug, into which the fusible metal is placed, is usually made ½ inch in diameter at the smaller end, though for high pressures, *i. e.,* about 150 pounds, a ⅜-inch diameter is satisfactory.

Hollow Section of Plug Tapered

The hollow section or metal container is usually tapered with the smallest area end being next to the fire. Some makers use a uniform taper through the length of the plug, while others incorporate recesses or shoulders in the hollow section for the purpose of holding the softer fusible metal in place, though it has been found that if the hollow section is first tinned before the metal is placed in it, no trouble should be encountered from the blowing out of the fusible metal, unless of course, the cross section of the metal is too large. As stated above this should never be made over ½ inch in diameter.

The plugs should be filled with an alloy that has a melting point between 400 to 500 degrees F. Pure tin, with a melting point of about 450 degrees, has been found to give the most satisfactory results because of its reliability and durability, this metal having a melting point that is little affected by continued exposure to heat, and which also resists corrosion and crystallization.

Where tin is used particular attention should be given to see that pure tin is secured and used, because the presence of zinc, even in small quantities, is undesirable because of its propensity to set up electrolytic actions, and hence cause crystallization and hardening of the filler, thus nullifying its action. Where pure tin is not available, pure lead is sometimes used. Alloys of bismuth and other materials have been used, but experience has shown them to be somewhat unreliable because of the change in characteristics brought about by constant exposure to heat.

All portions of the plug should be nicely finished and smoothed off to reduce to a minimum the tendency to corrode, and for pieces of scale and grit to attach to it.

After the selection of the proper plug, the installation and location is of greatest importance, because ignorance or carelessness on these points will often prevent the desired results from being obtained.

Location of Plug

The location of the plug, of course, will vary according to the type of boiler, but in every case it should, if possible, be installed at least three inches below the normal working water line to prevent blowing due to fluctuations in the water level. Ordinarily the plug should also be placed at least two inches above the lowest water line, *i. e.,* the line where the water level is dangerously low. The plug should be installed so that its one end will be exposed to the direct heat of the products of combustion, while the other end is in contact with the water in the boiler.

An absolutely tight fit should be secured when placing the plug in position, otherwise seepage or leakage will result. Even the most minute leakage is objectionable here because the moisture in the presence of the gases in the combustion chamber will have a marked tendency to corrode, especially attacking the brass body of the plug if that material is used.

A coating of scale on the inner end of the plug will, of course, prevent the proper contact with the water, and hence reduce the efficiency of the plug, and, therefore, in order to prevent the formation of scale on it, the inner face of the plug should extend at least 1 inch beyond the inside of the boiler sheet or shell.

Once the fusible plug blows out it is, of course, necessary to draw the fires, cool down the boiler, and put in place a new plug. Some users have endeavored to prevent the shutting down of the boiler immediately after the blowing of the plug by incorporating in the plug structure a cut out valve, or by installing a valve between the fusible plug and boiler, but this practice is not to be recommended, because with its use the plug loses all its real protective features, since then it can be tampered with or cut out of service by the operators. It is inconvenient to shut down the boiler when the plug blows, but under proper operating conditions the plug should never be allowed to blow, and hence this should be an incentive to so operate the boiler that the low water mark is never reached. The use of automatic high and low water alarm on boilers also has a tendency to cause many to consider the fusible plug unnecessary, but as stated above the plug should be retained as an extra safeguard and precaution. If the automatic alarm sounds the warning during the first stages of low water, and this warning is heeded, all is well and good, but if the fusible plug is used it stands as a further positive check and safeguard. Properly made and filled fusible plugs are inexpensive and should be a source of no trouble, and hence represent a desirable extra precaution even in modern practice where other automatic alarms are used.

One Year the Length of Service

Because of deterioration of the fusible element, the plugs should not be kept in service for over a year's time, and should be carefully scraped and cleaned each time the boiler is cleaned. It is best practice to change plugs each time the boiler is inspected.

One or more fusible plugs should be set in the rear head of return tubular boilers, not less than 2 inches above the upper row of tubes, measuring this distance from the upper surface of the tubes to the center line of the plug.

In vertical firetube boilers, with dry upper sheets, the plug should be placed not less than one-third the length of the tube, above the lower sheet. For the complete submerged tube type of vertical boiler, the fusible plug should be placed in the upper sheet. Where it is necessary to place plugs in the tubes, and the large size plug is not suitable, smaller plugs can be made up on the same general lines, and these should then be placed in two or three different tubes.

For horizontal watertube boilers the plug should be placed in the upper drum, about 6 inches above the bottom of the drum. In the Stirling type, the plug should be placed in the front side of the middle drum, about 4 to 6 inches above the bottom. For Scotch marine boilers, the preferable location is in the top of the combustion chamber. For heating boilers of cast iron construction the plug is usually placed directly at the primary heating stage, just above the fire.

The Pierce, Butler & Pierce Manufacturing Company, Syracuse, manufacturer of boilers and other heating specialties, is reported negotiating for the purchase of the Ames Iron Works, Oswego, N. Y., with about $1,800,000 involved in the transaction. The plant would be used by the new owner for the manufacture of large boilers and engines heretofore made by the Ames company.

Relation of Locomotive Maintenance to Fuel Economy*

Features of Locomotive Design Which Influence Economy of Operation—Losses Due to Poor Maintenance—Boiler Cleaning and Repairs

BY FRANK MCMANAMY

Fuel economy and locomotive maintenance in practically everything that relates to efficient locomotive performance are synonymous terms.

To fully describe the relation of locomotive maintenance to fuel economy, some features that perhaps should more properly be termed locomotive design must be touched upon because, without studied well-balanced design, maintenance alone cannot effectuate either fuel economy or operating efficiency.

The locomotive of a few years ago was built with little thought for economies. The designer had in mind the creation of a machine that would haul a given load at a stated speed and whose measurements and weights were within certain prescribed limits. Fuel, in most sections of the country, was both plentiful and cheap, and the necessity for economical operation of locomotives was not so acute.

Fuel Economy of Major Importance

Within recent years the situation has completely changed. The increasing cost and scarcity of fuel have made fuel economy a question of major importance to the designer as well as to the officials in charge of locomotive maintenance. The inventor has also turned his talents in that direction, with the result that the superheater, the brick arch, the combustion chamber firebox and other fuel-saving devices are to-day parts of the equipment of every modern locomotive. The influence of these devices in effecting real fuel economy is tremendous, and their applications to many existing locomotives will result in a marked reduction in fuel consumption.

Generally speaking, the railroad officials responsible for the maintenance of locomotives have no hand in the selection, purchase or preparation of fuel, but it is their business to get the largest possible measure of performance out of that which is furnished them, and this can only be done by giving constant and careful attention to locomotive maintenance.

Fuel is potential energy. The locomotive is the medium through which this potential energy is transformed into powerful action. The sole object of putting fuel into a locomotive firebox is to develop power at the drawbar, and waste due to failure to maintain this medium through which power is developed and applied is inexcusable. Locomotive maintenance is, therefore, not only *related* to fuel economy, it *is* fuel economy.

Condition of the Locomotive

Practically every report of a fuel test and every article on fuel economy is prefaced with the statement "The locomotive must be in good condition." No other single factor is of so much consequence in obtaining the economical use of fuel.

What is meant by a locomotive in good condition?

It means a boiler which generates steam economically but freely, proper steam distribution to the cylinders and efficient mechanism for transmitting the power developed in the cylinders to the only place where the power of the locomotive can be measured—the drawbar at the rear of the tender.

For the purpose of considering locomotive maintenance and its relation to fuel economy the locomotive may be divided into the boiler, valves and cylinders, including steam passages, and the machinery.

Factors Promoting Fuel Economy

The boiler, to promote economy of fuel, must be properly designed, with ample grate and heating surface. It must be clean, the grates level and easily shaken and in good condition, the ash pan and grates must have ample air openings to aid combustion, the fire door should operate easily, and the fire tools should be in good condition. The flues must be clean, the flues and firebox free from leaks, the smoke-box must be air tight, the smokestack and nozzle in line, and the draft appliances in good condition and properly adjusted.

Too much stress cannot be laid on the necessity for keeping boilers clean, because, in addition to effecting a material saving in fuel, it increases the efficiency of the locomotive and materially prolongs the life of the flues and firebox sheets.

Frequent and thorough boiler washing is the foundation of proper boiler maintenance, and this has been recognized in all boiler inspection rules, both State and National. Authorities differ somewhat as to the exact loss due to scale on the boiler sheets, but a comparison of tests made indicate pretty conclusively that 1/16 inch of scale will increase the fuel cost approximately 15 percent and ¼-inch scale will increase the fuel cost approximately 60 percent.

Effect of Scale

It is not an exaggeration to say that on an average 40 percent of the locomotive boilers in service have scale 1/16 inch thick, or, to say it differently, due to poor boiler washing all of them have 1/16-inch scale 40 percent of the time and many have scale from ⅛ to ¼ inch in thickness; in fact, in some districts it is not unusual to find ½ inch of scale on the boiler sheets.

Let us see what this means in actual figures. The railroad fuel bill, along with other things, has been increasing by leaps and bounds. In 1915 the railroads consumed 122,000,000 tons of bituminous coal at an average cost of $1.13 per ton, or a total cost of $157,000,000.

In 1917 they consumed 154,570,000 tons, at an average cost of $2.13 per ton, or a total cost of $329,000,000.

In 1918 it is estimated that they will require 166,000,000 tons, at an average cost of $3.50 per ton, which will be a total of $581,000,000. If we add to this 48,000,000 barrels of fuel oil it will make the total fuel cost over $650,000,000.

We will pay, therefore, during 1918, more than $50,000,000 for fuel on account of the scale in locomotive

* From an address before the International Railway Fuel Association, Chicago, May, 1918.

boilers that many men do not consider of sufficient importance to warrant its removal.

But even a boiler that is clean and in the best condition can do no more than generate steam. Proper steam distribution to and from the cylinders must be had and the steam made to do effective work. If the valves are out of square or blowing, or the valve gear badly worn; if valve changes or cylinders are badly worn or out of round, if the cylinders packing is worn or broken; if leaking piston-rod packing or leaks about the steam chests or cylinders dissipate the steam that should and could be made to do work, we can expect no improvement in our fuel performance.

Assuming, however, that the boiler is in good condition, that the steam distribution is good and that there is no waste of steam through steam leaks, it remains to deliver this power at the drawbar, and this cannot be efficiently or economically done through the medium of wornout machinery. Rods in bad condition, boxes loose or journals, wedges which require adjusting, and tires badly worn which will cause excessive slipping, are poor mediums through which to transmit energy.

Repairs

Some of the repairs which will do the most toward reducing fuel consumption and improving locomotive performance, arranged in what is believed to be the relative order of their importance, are: setting the valves properly and maintaining the valve motion, washing the boilers, keeping the flues clean, eliminating steam leaks about cylinders and steam chests, and maintaining the driving boxes and rods.

It should be borne in mind that an 80 percent boiler with 80 percent steam distribution and 80 percent machinery does not make 80 per cent efficiency, but an 80 times 80 times 80, or a 51.2 percent locomotive.

Each locomotive represents a certain definite investment on which a return must be made. This can be done only by maintaining it in a condition to accomplish maximum results in the way of locomotive performance.

A locomotive can be said to represent 100 percent of values as an investment as long as it can render 100 percent service, and no longer. To allow it to deteriorate so that it cannot perform efficient service destroys a portion of that investment just as surely as though it were done by fire, flood or war.

Losses Due to Lack of Maintenance

If it were possible to calculate the aggregate loss in operating efficiency for the total number of locomotives that, due to lack of maintenance, are operating at less than their maximum efficiency, the result would be staggering, and when we add to this enormous loss of operating efficiency from 10 to 20 percent of the railroad fuel bill (which for the past year was $329,000,000 and for the current year is estimated to be $581,000,000 for bituminous coal alone) we begin to realize the price we have been paying for the privilege of operating defective locomotives and delaying traffic thereby. This being true, the question that must inevitably follow is, "What is being done by the United States Railroad Administration to remedy the conditions which have been described?"

The first step before taking action to bring about an improvement in the condition of locomotives was to make a survey of the field, and, like a good general, this was immediately done by the director general. The records of the United States Locomotive Inspection Bureau were drawn upon for information relative to the general condition of locomotives, and this was supplemented by more detailed information obtained directly from each carrier.

The next step was to speed up locomotive repairs to provide motive power to meet immediate needs, and this was done by increasing the shop hours about 16 percent for over 200,000 men and by nationalizing locomotive repairs so that a locomotive in need of repairs would be sent to the nearest available repair shop, thus utilizing to the fullest extent the total shop capacity of all railroads. The result of this soon became apparent in the increased number of locomotives turned out of the various shops, which, for the four months ended April 30, increased 6,849 over the corresponding period for last year. This not only means more locomotives but it means better locomotives, which increases operating efficiency and decreases fuel consumption.

For the future the work that has been started will be continued, and a higher standard of condition of locomotives will be required. A regular schedule for the application of superheaters and other fuel-saving appliances to locomotives not now so equipped is being prepared, and will be adopted, subject only to labor and material being available.

Next to wages the fuel bill of American railroads constitutes their largest single item of expense. Locomotive maintenance is the only method of conserving fuel that will of itself show a net profit in addition to the fuel saved. Every item of maintenance that makes for fuel economy also promotes operating efficiency and increases the life of the locomotive. Therefore the good effects of maintaining locomotives are cumulative, and the bad effects of failing to maintain them increase in the same ratio.

Fuel Tests

Many fuel tests have been made, and, as previously stated, the first requirement is that the locomotive must be in good condition, thus admitting that the relation of locomotive maintenance to fuel economy is a vital consideration.

We have gained nothing by making fuel tests to determine, for instance, the amount of fuel that can be saved by applying a superheater to a locomotive, with everything in good condition, and then, when the locomotive properly equipped is placed in regular service, to operate it with the superheater tubes stopped up, clinkers at the end of the superheater units and honeycomb on the flue sheet, thus making, in effect, a condenser out of what should be a superheater. If we add to this ⅛ inch of scale on the interior of the boiler, we have lost more in efficiency than we can possibly hope to gain by the application of the superheater. If we apply a brick arch to a locomotive to increase the length of the flameway in the firebox and to promote more perfect combustion, and then continue the locomotive in service with the flues leaking or stopped up, with the grates in poor condition and with the arch tubes coated with scale we have lost all of the efficiency which should have been gained by the application of the arch, and in addition we have increased the probability of accident and locomotive failure.

All of the foregoing applies to normal times and average conditions. To-day, with the increased demands for fuel by reason of the war and the necessity for furnishing fuel to our allies, and with the increased use of fuel in industries whose output is essential to the successful conduct of the war, the saving of fuel by better locomotive maintenance and the increased operating efficiency which will result therefrom, means more than can be expressed in terms of tons, gallons or dollars. It means *the saving of America, the saving of Democracy, the winning of the war.*

Among Missouri Boiler Shops—II

Unusual Features Observed in the Heine Safety Boiler Works—Machinery Kinks and New Methods

BY JAMES FRANCIS

On November 8, 1917, it was my good fortune to be able to spend a few hours in the St. Louis, Mo., shops of the Heine Watertube Boiler Works. There are shop kinks a-plenty in that establishment and a good bunch of them came away with the writer when he left the shop, and here are some of them for THE BOILER MAKER readers.

THE HEINE SAFETY BOILER WORKS

The first striking matter upon entering the shop was the absence of stock underfoot. In lots of shops, when stock comes in, the plates are thrown on the floor, there to lie and be walked over, until they are removed for laying out and making up.

But not so in this shop. Not a plate was to be found on the floor anywhere. All the plates in process of making were carried on trestles or were hung up in front of some machine. As soon as a sheet was punched, it was rolled up, and after that did not have any liking for spreading itself, door-mat fashion, on the floor to be walked upon or stumbled over.

There are lots of steel shapes used with Heine boilers, and these, too, were all kept off the floor. Indeed, the first thing upon entering the shop from the office was a long, high rack built upon the wall of the shop, carrying all manner of steel shapes and bar steel, up high enough that not a foot of otherwise available shop room was taken up by the angle and bar steel storage.

WALL STORAGE BRACKETS

Fig. 1 shows one of the steel brackets which had been built all along one of the shop walls for steel storage. There were several of these brackets disposed along the wall, about five or six feet apart. The vertical piece *A* of each stand was made of 2-inch by 4-inch by ¼-inch steel angle, the base *B* was made of 4-inch channel and all the stubs or arms *E*, *E*, etc., were 2-inch by 2-inch angles, spaced about 12 inches apart and of about that length each.

Each bracket stood upon a neat concrete base, *C*, to which the foot, *B*, was bolted, as shown. A bolt through the top of each bracket, as at *D*, fastens the top end securely and no ordinary stress could ever tear these brackets from their places, either while empty or when loaded with stock.

Gusset sheets or braceplates *F*, *F*, etc., were placed, one at each arm, so as to stiffen the apparatus while loaded to capacity. What said capacity might be was not told to the writer, but they said the racks had been packed mighty near full of solid bar steel, without showing any signs of distress.

HIGH PROTECTIVE FENCE

Speaking of steel storage, not all the steel, by a good deal, to be found at the Heine boiler shops was stored on the inside of the buildings, for several tons, to say the least, in the form of heavy woven wire and barbed wire, were disposed around the plant, the high fence being composed of diagonally woven wire cloth, attached to iron posts set in concrete, and the strong mesh fence thus obtained was surmounted by several strands of barbed wire, disposed upon overhanging brackets in a manner sure to make it very unpleasant indeed for any man who sought to pass via the "fence route."

A CLEAN FLOOR AND STORAGE FRAMES FOR PLATES

Upon entering the shop and passing the wall storage apparatus above described, the visitor is at once impressed by the absolute cleanliness of the shop floor, its freedom from the usual boiler shop litter—piles of sheets,

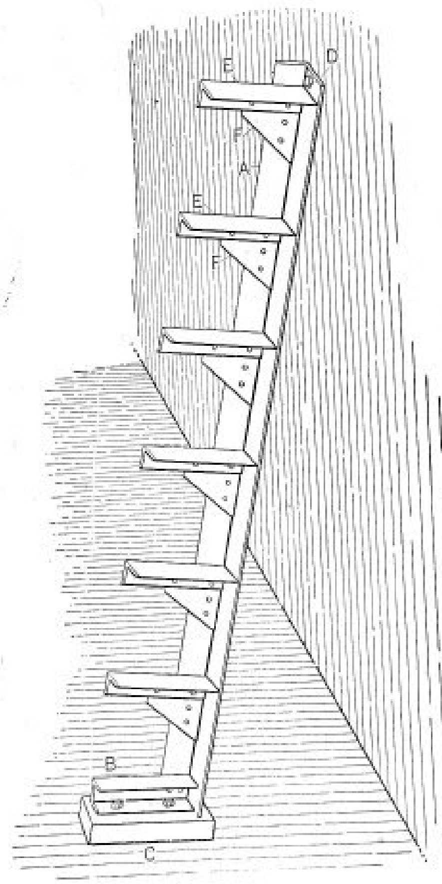


Fig. 1.—Wall Storage Bracket

bits of metal around machines, etc—and with the presence of a great number of odd stout steel trestles.

The latter may explain somewhat the absence of work from the floor of the shop, for plates which were being marked, or were waiting for machine processes, were disposed upon the steel trestles above noted, instead of upon the floor. And as for the metal cuttings, etc., a man with a barrow and shovel made it his sole and continual business to be always looking for such bits of steel, and it is wonderful the great amount which he managed to find and remove during each shop working day. "Did the barrow man store the scrap in bins for that purpose?" No, sir, not by a good deal. He wheeled each barrow load up a little inclined runway and dumped the waste metal right upon a flat car. No farther handling of the stuff in this shop.

The next "kink" which I saw in this shop was the manner in which plates were stored so that hundreds of them on hand were so placed that each or any plate in the shop could be brought out instantly without any overhauling of plates whatever. The manner in which this was done is shown in Fig. 2.

Compact Plate Storage

For a hundred feet or more down one end of the shop, right out in the open and free of walls and posts, were disposed dozens of A-frames, as shown by Fig. 2 at 1. These A-frames were made about eight feet high, of heavy hardwood timber, well bolted together, and to a pair of heavy sills, *G*, *G*, which extended along the floor of the shop the entire distance of the plate storage racks. Each A-frame—and these frames are placed in pairs—is composed of three pieces of 10 inches by 10 inches timber, two pieces, *H* and *I*, being exactly alike and the

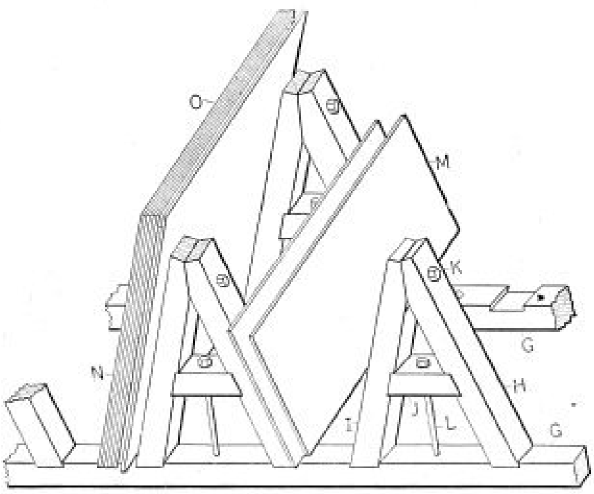


Fig. 2.—Plate Storage

third piece, *J*, being much shorter than the other two, and gained into them as shown, the whole frame being held solidly together by means of the bolt *H* and the rod *L*, which anchors the A-frame to its sill.

The bolt *K* necessarily passes through both timbers at somewhat of an angle, and the head and the nut are sunken below the inclined surface, that the bolt may always be out of the way of any plates which may be piled against the A-frames.

The manner in which plates are piled in storage is shown at *M*, *N* and *O*, the latter letters indicating several plates of the same size which chanced to pack very closely together. When one of these plates is required, it is a very short operation to pinch the top sheet or plate far enough away, using a crow-bar for that purpose, so that the plate dogs may be attached. The overhead crane does the rest very suddenly and effectively.

When one or more plates are required, of various sizes, as at *M*, thereby making it necessary to take some plate other than the top or outer one, then a single plate lifter clamp attached to whatever edge or corner may be prominent will enable the shop crane quickly to pull the required sheet out into a position where the lifting clamps may be readily adjusted in the regulation way.

Electric Lamp Placement

Same as in almost any shop, it is necessary here to do a good deal of the machine work, punching, shearing, etc., by electric light, and on several of the machines, in addition to lamps placed where they would do the most good, the writer noticed another lamp on each machine which had been attached to an armored flexible extension, with the usual lamp guard; then the lamp was hung to the starting lever or handle of the machine.

This brought the extra lamp into a position from which it could be taken without loss of an instant of time whenever anything about the work called for a little extra light. The hook by means of which the lamp was suspended from the starting lever could be used to hang the lamp in many other places, but the hook had been specially fitted to the starting lever and there the lamp was supposed to be kept at all times when not in use. And the workmen observed the rule pretty well; it is to their credit to say I saw but one machine thus fitted with an extra lamp at which the lamp was not hanging in its proper place on the starting lever of the machine.

It is a good rule, I have many times noticed, which workmen follow without trying to dodge the rule or violate it, so when they adopt readily anything new, or in the nature of an innovation—particularly along the lines of "efficiency" work—then you may be assured that the new departure is a good one and is worth while. So it seemed with the lamps on starting-lever business. Furthermore, it seems to the writer that there are several other places in boiler shops where lamps could be installed in a similar manner to very good advantage.

One of these places is on the counter shaft, just where that belt jumps off occasionally, and where it is so hard to replace the belt upon its pulley. You might do one or two things right here to your considerable advantage. One of these things would be to place an electric lamp at the point where so much trouble occurs, letting the lamp go in a guard and attached to an armored flexible same as at the starting-lever lamps. Use the same hook, too; then the workman who must needs take the risk of climbing up to replace that belt can at least have light just where he needs it, placing the lamp by its hook in the most convenient position for him to do the dangerous work of belt-throwing at the least personal risk.

"The other way of making it easier and safer for the man who must needs juggle that belt occasionally?" Why, simply fix that belt so it never would have any inducement to jump off its pulley, then there would be no need of electric lamps or of belt-throwing, either! "How to fix it?" Dead easy! All you need do is to place that belt and its pulleys in perfect alinement and then supply belt enough—either a wider belt or drive it faster—so that said belt can at all times do its required work without being strained under more than forty pounds working stress per inch of belt width! Do this and there *never* will be any more trouble with that belt, or with any other troublesome belt, which may be treated in like manner!"

Annealing and Rolling Fabricated Plates

They have one method in particular in the Heine shop which appeals tremendously to the writer. That method is the one by which they treat plates which may have been worked and made ready for assembling in a boiler. After all the work of flanging, drilling, planing, reaming, or other metal-removing operations has been completed, the sheet is sent to the annealing furnace and brought to a good, solid red heat. Then the plate is brought out of the furnace and placed flat upon an immense and very solid floor plate, said plate forming a level extension to the annealing furnace hearth.

Close beside the big floor plate is another and smaller plate on the same level and about midway of the large plate, measuring from the furnace door to the farther end of the large plate. As soon as the hot plate has been dragged out of the furnace, a huge and apparently solid iron roller, about 24 inches in diameter and of equal length, is pushed by two men by means of a long "pole" made fast to the roller axles with cross-handles attached to the pole for the use of two men. This big roller is pushed upon the hot plate and pushed all around until the plate has been well "ironed" and all the kinks and bulges have been flattened down, leaving the hot plates flat and smooth.

Then the plate is returned to the annealing furnace again, given another and, this time, the annealing heat, and is placed to cool off as slowly as may be judged necessary. In this manner is each and every plate which is to remain flat rolled and annealed; the treatment not only relieving the strains of machining but leaving the plate smooth and true, so that the connections, which may be attached later, will go in place almost as though attached to a machine surface.

Flanging Form

As a good deal of the flanging in a Heine shop is, on heads in the neighborhead of 36 inches in diameter—some smaller and some larger—stout metal cylinder forms have been prepared for this work, upon which the heads to be thus treated are directly flanged and fitted. The cylindrical forms are about as long as their diameter and the wall is apparently three to four inches thick. This gives a very strong and solid bearing for fitting a flange against and the edges of any sheet may be flatted and drawn to a thin edge in one place on the form as well as at another; so wherever the head happens to stand upon the cylindrical form—which lies upon its side—there the flange is "belted" down to a fit and finished right then and there.

In much of this kind of flanging it becomes necessary to turn one edge of rather narrow plate in one direction, the other edge in the opposite one. The cylinder form lends itself nicely to this matter and the flange-man need only take care that the head which he is working on stands properly in two directions; then he can rush the flanging rapidly and do a whole lot of it while the heat lasts.

It is absolutely necessary that the head, while being flanged, should be held exactly crosswise of the cylindrical form, also that the vertical portion of the plate, or head, as it may be, should also be supported exactly perpendicular to the side of the form cylinder—"square with it" the shop man would say! The writer noticed during several flanging operations as above, which he saw from beginning to end, that the flangeman in charge of each job paid great attention to this matter, and at all times, while his men were banging away with their sledges, kept an eye upon the squareness of the work in both directions as noted above. As a consequence no crooked or "skewangular" work ever comes from the flangers in this shop.

Flange Fires and Window Protection

But flanging practice in this shop is by no means confined to the comparatively small work noted above. Large flanging and lots of it is done, and there are two large flange fires, with an hydrostatic, three-cylinder flanging machine, located nearly between the two fires, both of which are required to keep the big flanging machine anywhere near busy. One of the two cylinders is for clamping the plate in the machine.

Of the other two cylinders, one is for delivering a downward vertical thrust, while the other cylinder delivers its force horizontally. Thus the edge of a plate may be bent downward by the action of one cylinder, through proper dies, of course, after which the horizontal cylinder delivers its thrust and smooths up and finishes the turned-down flange in short order.

These three machines, the flanger and the two fires were located along one side of the shop, and it was noticed that between the machines and the shop windows had been interposed, at a distance of a couple of feet inside the windows, a large screen of corrugated steel which very effectually prevented the breaking of window glass adjacent to the three machines and also had the result of keeping the windows a whole lot cleaner than if they had been exposed to all the dust and dirt from the two big flange fires. The screen was appreciated in summer when the window could be left open, without each gale driving cinders and dirt into the eyes of every man near the flange fires.

Exact Alinement in Setting Up

Every man who ever has had occasion to do any exact fitting work around a Heine boiler will have noticed and remarked at the great exactness and accuracy of the connecting parts. Furthermore, the distances are the same in one boiler as in all the others. In fact, these boilers are virtually built upon the "duplication of parts" scheme, and a piece from one boiler will fit any other.

A reason for this exactness is apparent as one watches the assembly of one of these boilers. The start is made with exactness, steel straight edges and accurate squaring and dimensioning being exactly carried out as exactly as it was started, thus resulting in a boiler of exactness as well as of strength and quality.

The Heating of Rivets

The interesting suggestion put forward by Mr. J. L. Lane in his little story on page 67 of the March issue, as to the adoption of flux treatment to minimize rivet scale troubles, raises some much more important questions. It calls for the overhaul of much of the present methods, that another link in the chain of improved workmanship should be made. Elsewhere in the March issue will be found some opinions of mine on the subject of intimate plate contact and suggestions as to removal of mill scale from lap of plates before assembly into a seam. The objective is precisely the same, metal to metal jointing, honored frequently in the breach by a great deal of boiler practice.

The present writer has given a deal of consideration to the subject of rivet heating, and now proposes—prompted by the storyette of Mr. Lane—to ventilate the entire question. Constructive criticism is always worth while, although occasionally it raises hostility. The conclusions advanced may be novel, but they do not lack interest or practical value. Usual rivet heating employs either a solid fuel forge or an oil-heated furnace, and the amount of scale produced is evidence of metallic wastage. Such irregular surface decay leads to variation in rivet diameter and volume; this in turn alters the effective length, and of itself may slightly vary the regularity of the heads. Other factors may have greater influence, but scale production is wastage, which is irrecoverable.

The usual methods of heating, apart altogether from the gross carelessness not uncommon, are unscientific and capable of improvement. Whatever be the means of closure employed, the consumption of rivets per interval of time must, and does, vary, hence there is a tendency to keep a maximum quantity hot, soaking in the fire to ensure supply when required. Owing to the variation in the speed of working, it is difficult, if not impossible, to avoid prolonged heating, with its attendant scaling. Against this may be set the fact that want of contact, due to inclusion of scale, is less when the scale is really heavy; because it then tends to fall at a touch, so that any remedy, such as flux, is less needed when a rivet is overheated and well scaled than when used immediately it is brought to proper temperature and quickly placed. A tap with the picking-up tongs just before handing to the holder up will in the case of a well-scaled rivet cause it to shed its entire skin of scale.

Oversize in Holes

The tolerance allowed as oversize in hole does not take the reduction due to fire wastage into account; and as the present writer pointed out in these pages some while ago,* the usual clearance is more due to variation in nominal size of rivets than to expansion by heat, addition of scale or the matter of easy placing. The wastage due to scale when this is excessive causes this tolerance to be greater than designed, especially when prolonged soaking in the usual forge has been given.

There is no commercial rivet forge on the market which takes this question of production of scale into account in a manner to lessen wastage of metal. In other words, from the point of scale there is no satisfactory forge.

Utilizing direct flame from solid or liquid fuel with an air blast necessarily in excess, results in the presentation of a large volume of oxygen to the heated rivet. The resultant is that the conditions inviting scale the same is produced. The longer the rivet stays in the furnace after the closing temperature is attained the worse the result.

Manufacture of Rivets

Before proceeding to discuss any remedies it is as well to glance elsewhere. In the manufacture of rivets two processes are employed—cold heading in automatic machines from bar or coil up to a diameter of half an inch; heading while hot above this size. As the manufacturer is never sure as to how the smaller cold headed rivets will be used (i. e., hot or cold), these are always annealed. Such structural alteration by temperature—the term is used because of micro photography, upon which the modern metallurgist lays such stress—is done without forming anything but the slightest suspicion of scale. For proof of this, examine any small cold-made rivets.

Another instance of heating, this time without any scale whatever, is that of blued wood screws, whose attractive color is produced by heating. Cold headed rivets are "pot annealed," as it is termed; heated in a crucible with a lid luted on with fire clay, and consequently apart from the atmosphere. The crucible is allowed to become stone cold before opening out the contents. Wood screws are heated in an iron chamber through which gas is passed to exclude the atmosphere and no air whatever is brought in contact with the heated screws.

Separation of Flame and Oxygen

Keeping both these precedents in mind, why not separate the flame and oxygen from the rivets during the process of heating? It needs a muffle *round* which the heat produced circulates; it would not be in contact if closed at one end and with a contracted opening at the other, which in turn could be closed when first heating up and, between service, by fire clay, brick or small door. Take such a furnace wherein four D muffles are supported, leaving good room between their exteriors and any system of combustion round them. Half an hour's heating up and then load each muffle with a couple of dozen rivets at ten minutes between; as soon as the first muffle is emptied fill it up again. It would not be impossible either to employ a cellular structure on the pattern of the honeycomb of refractory material, each pocket to hold one rivet if this is preferred. Heating would be by direct radiation, and the system would, it is believed, be economical of fuel besides. It would be easier to ensure complete combustion in the chamber for this purpose than at present in the usual design.

Regulation is now performed more by alteration of blast than by any alteration of fuel supply, and few rivet heaters are expert fuel or combustion students. Getting hot rivets as required occupies all their energies, and so long as these are forthcoming no one makes complaint. As a consequence, when the supply must be rapid, the heating is forced by excess air supply and, when there comes a temporary lull, prolonged soakage, in an actively oxygenated atmosphere is the practice. Both methods produce scale in abundance and neither is economic or scientific in character.

Modern Electric Furnace an Example

The great feature of the modern electric furnace for steel melting is the fact that the metals are melted in a reducing atmosphere, not in an active air blast, as in a Bessemer or reverberatory furnace; as a consequence, raw materials can be employed in the way of machine-shop borings and chips, which formerly had to be briquetted, and even then involved great losses in melting.

Heating rivets can hardly be done in an inert and passive atmosphere, but it would not be impossible to design a method of heating whereby the only scaling should be between the furnace and placing the rivet. However, separating the flame and combustible elements in the furnace from the rivet itself will most certainly assist matters.

There appears to be a clear opportunity open to furnace and forge makers for a rational rivet-heating furnace which will minimize scale. At present there is too much tendency to regard refractory materials like fire brick as simple protections against the collapse of the containing iron work, and not as a reservoir and distributer of heat. With a couple of dozen fire bricks, each having perforations, say, four each of one size to place rivet shank (such perforations not to come quite through the brick); rationally designed oil-fired furnace and a bucket of fire clay, any intelligent individual could construct a furnace whose scaling propensity would be 90 percent less than playing a direct flame upon the rivets themselves. The idea does not seem to have occurred to furnace specialists, who must perforce line their jobs with refractory material which attains very nearly the temperature of the flame itself in quite a short time.

Riveting

Turning aside from this phase of the subject for awhile, although what follows concerns riveting and the heating of rivets, on several occasions I have discussed the question of the perfect boiler seam, and have considered the possibilities open for improvement, and believe that we are now within measurable distance of its possibility. There is a method scarcely yet developed, but certain to be considered as pressures increase and absolutely drop dry work, entirely reliable, becomes more and more essential. The advocates of fusion welding assert that in the near future riveting will be wholly dis-

* "Oversize Allowance for Hot Rivets," January, 1916.

carded in favor of welding all plate seams. It must be remembered that such a revolution has to overcome a mass of prejudice; that insurance and statutory authorities have to be convinced; both are rightly conservative with reason. The need for individual conscience in welding operations and the catastrophe involved in the rupture of a high pressure boiler, termed an explosion, delay the substitution of welding for riveting. It will be a long time yet before fusion welding will be accepted as a universal substitute for riveting.

What, therefore, seems needed is a compromise which retains all the salient features of riveting with the advantages of absolute work (the word "absolute" is advisedly used), which would placate both parties and form a rational beginning for the more general adoption of welding in boiler production. Indeed, the introduction of the process seems overdue for very exacting work, although it has already been tentatively employed.

Taking a typical boiler seam with butt straps clamped up and position drilled; with exact size holes of any normal diameter: the clamps are removed, the burrs dressed off in accordance with good practice; sand blast the contacting faces of butt straps and plate laps; reassemble in exact position, using exact size parallel pins to locate holes in former positions; bolt up every alternate hole with full-size bolts.

It is, of course, assumed that the plate edges are perfectly fair and rolled to the radius of the boiler, and that the butt straps have been pressed to conform to the same curvature. Now choose exact size rivets, which need a two-pound hammer and a couple of blows to drive home cold which have been previously pickled, sand blasted, or tumbled brignt.

The plate and butt laps, also the rivets in the holes, are in intimate metallic contact—in fact, metal contacts with metal all over.

ELECTRIC RIVETING

Then employ a large resistance welding unit actuated by suitable means for pressure, say a hydraulic ram, grading the pressure to suit the job, as found by experiment. The rivet becomes heated throughout from end to end by localized resistance to current, and it should be possible to employ more than one welding set simultaneously.

If simple closure is required it would be found sufficient to put on full pressure at cherry red condition, the temperature of the rivet would always greatly exceed that of the surrounding plate, and so give the contractive pull peculiar to riveted construction. If the rivet be allowed, together with the adjacent portions of the plate, to attain welding temperature, local adhesion, as in spot welding, would weld surfaces (all clean of included scale) of strap, plate, rivet heads and shank into one homogeneous mass; the surfaces alone would fuse, so that the structural character of the main portions of the union would undergo no serious molecular change. Certainly a microphotograph of a series of etched sections of such a joint would be very interesting and, provided that the writer's beliefs hold good, would show no serious impediment to an extension of the practice.

The result, it is contended, would prove an ideal seam, require no calking, would be independent of human fallibility so far as anything can well be apart from this consideration.

For large vessels, thick plates, heavy pressures and penetrative fluids, the prospect opened up by the procedure outlined has much to recommend it. Where welding and the temperature incident thereto was practiced, hydraulic closure would not be needed; some more direct mechanical pressure sufficient to deform shank into head would be all that was needed. There is ground for the belief that present practice as to relative size of rivet and plate thickness could be amended, the rivets being larger and more widely spaced, so increasing the percentage strength of the seam. Under such methods there should be no question of leakage.

PLATE EDGES WELDED WITH ELECTRIC ARC

As a further safeguard, although it would probably be found that none was needed, arc welding the extreme edges of the butt straps with metal electrodes, the edges being lap beveled prior to assembly, would provide a substitute for calking silent in operation and much superior. Such fusion calking is already practiced.

It is true that the refinement outlined is considerable at every stage, and every detail must be to machine-shop exactitude, but this is no insuperable barrier where the best possible job is desired. The heating of the rivets in their final location, the holes they are designed to fill, the entire absence of scaling where contact is made, the exact correspondence of rivet and hole, the surface adhesion of the plates, straps and rivets, are all enticing advantages.

Finally, it is not considered that the expense would be prohibitive for really first-class work; probably the shop costs on the operation of making the seam would be increased 50 percent, and its economic application is dependent upon cheap electric supply.

As stated above, the adoption of the process is within the horizon of possibility.

London, England. A. L. HAAS.

A New "Old-Man"

BY W. D. FORBES

Some of the readers of this journal may take exception to the title which I have given, but in a long life I have never seen any similar design anywhere except in my own shop.

This may tend to prove that the design is not valuable for general use, yet I found it so convenient that I make bold to describe it. In my own experience I found very often that the "old-man" was either too short or too long and quite frequently was awkward to adjust directly over the point to drill.

So I designed one which was made as follows: A piece of flat steel, two inches wide, five-eighths thick and about eight inches long was slotted in the usual manner for the foot and at one end tapped for one-inch pipe. Into this tapped hole was screwed a piece of one-inch pipe, ten inches long, in the upper end of which was forced a steel plug which was pinned.

This plug was tapped for three quarter inch standard thread. A piece of tough machinery steel eight inches long was threaded its entire length and fitted to work nicely in the tapped hole in the plug. A piece of flat steel about an inch and a half wide, five-eighths thick and about four inches long was tapped at one end to meet the three-quarter thread and these were screwed together and pinned.

On the under side of this flat piece of countersunk holes were made to receive the head of the feed screw of the ratchet. These countersunk holes were drilled through with about a No. 40 drill and slightly countersunk on the upper side of the flat piece. The advantage of doing this lay in the fact that oil could be used to lubricate the head of the ratchet feed screw.

A semi-finished nut was screwed onto the threaded portion and the new "old-man" was finished. It is evident from this that the length of the "old-man" could be readily adjusted for various lengths of drill and limited space. Also, this upper abutment or shelf could be turned in a half circle, thus allowing an adjustment for the drill, which was a great convenience.

Layout of Large Transition Piece

Development of Plates for Connection Rectangular at One End and Circular at the Other

BY PHIL NESSER

When making a transition piece, such as the one shown in the accompanying sketch—that is, one which has to meet a rectangular connection at one end and a cylindrical connection at the other—we find, when we come to form it up, that we are up against quite a problem, as one end is a job for the bending rolls, while the other end is a square bend and cannot be made by the roller. The latter end, however, could be made by the flanges or in the press, but, as the flanger could not form up an 8-foot cylinder, then it could not be done up altogether at either place. Such pieces usually are sledged out by hand, and we have put in many a day beating on a fuller at such jobs in the good old past.

To overcome this difficulty, it would be a simple matter to put a seam at such point within the length of the piece as to make the rolls form up the most of the rounding part, while the flanger could handle the small amount between the seam and the square corner, and this could be attached to the first course of rectangular pipe. Anyone familiar with work of this kind can see the advantage at a glance, and one who can lay out a piece with no seam in, does not even have to lay out a side view to make a seam anywhere within the length of the piece, because one has simply to draw a line across in the diagram triangle (as the line marked 18 inches from *O* in Figs. 7 and 8) at any point where you would wish to put such seam. Then lay off the full lengths from the points thus found, as from the point *O* to each sectional point and the one marked *7a* in Fig. 7 will be the length from the corner *A* to each sectional point, as *7a* in Fig. 5, or *7a* to *A* in Fig. 6.

A man working at laying out, who takes an interest in such work, should have a set of drawing tools at home and practice with them in spare time. He could thus enable himself to make almost any problem, and it would be more pleasure than work; besides, he could do his work at

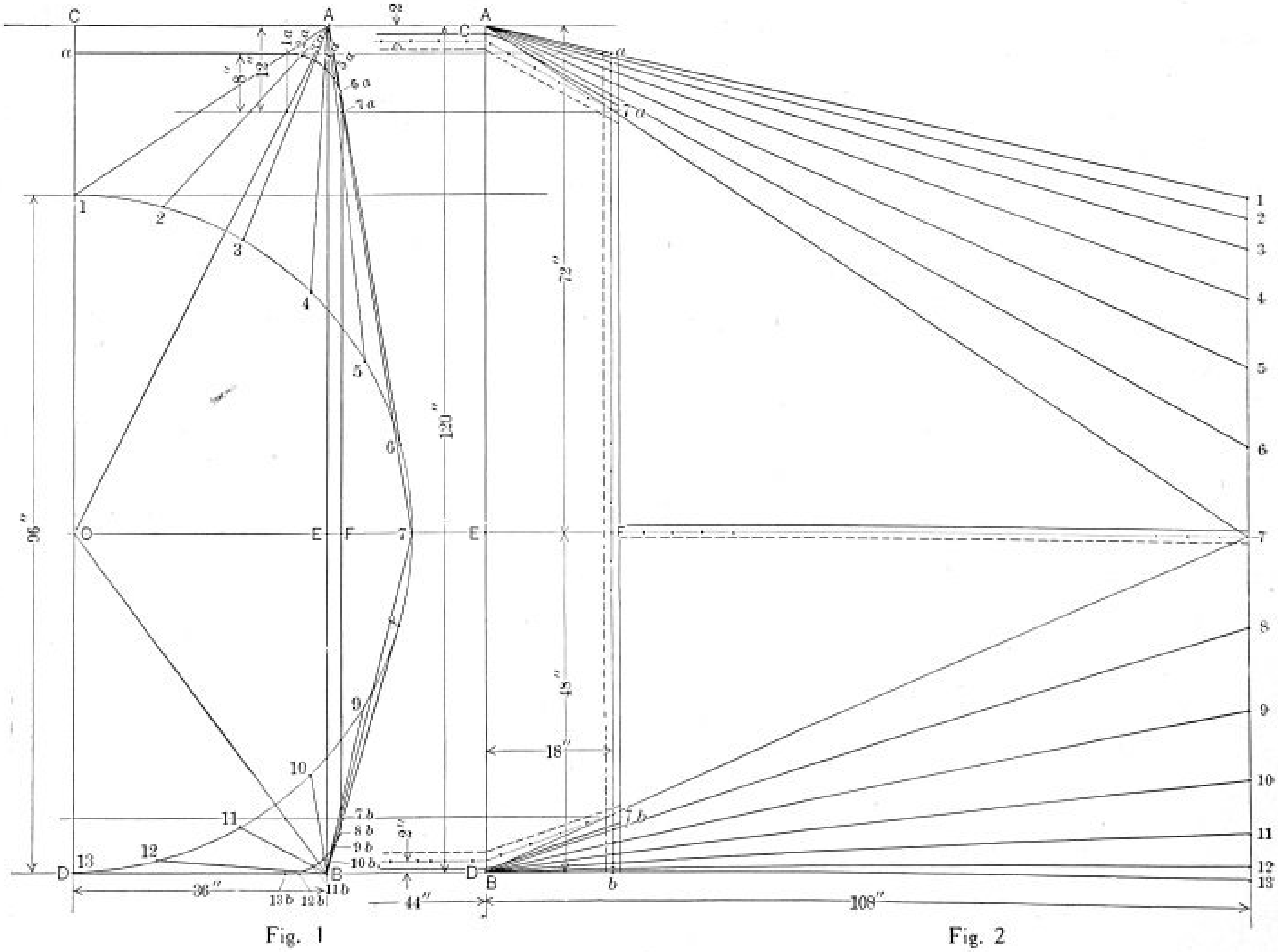


Fig. 1 Fig. 2

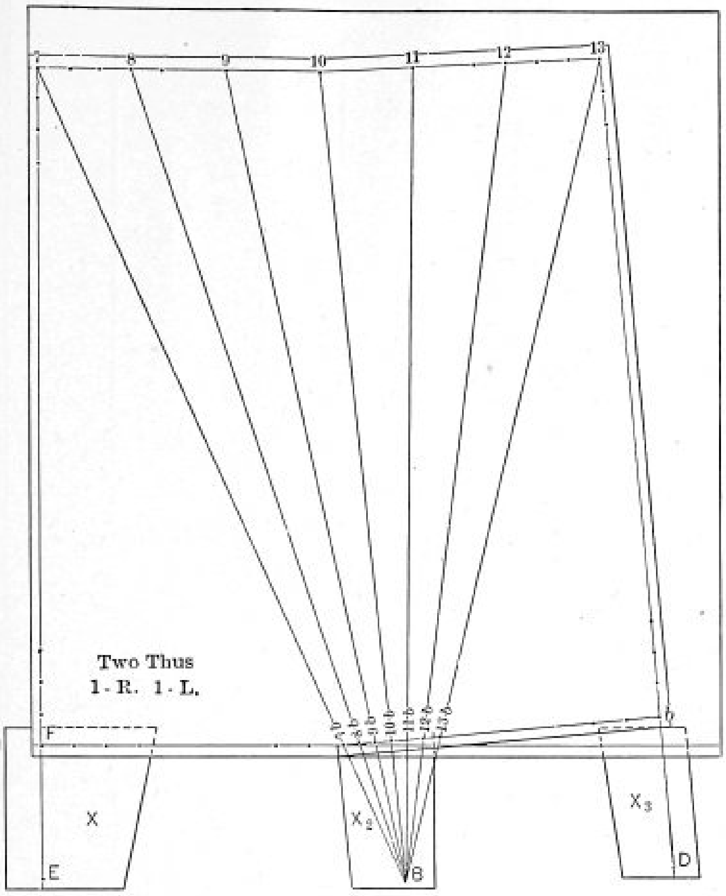


Fig. 3

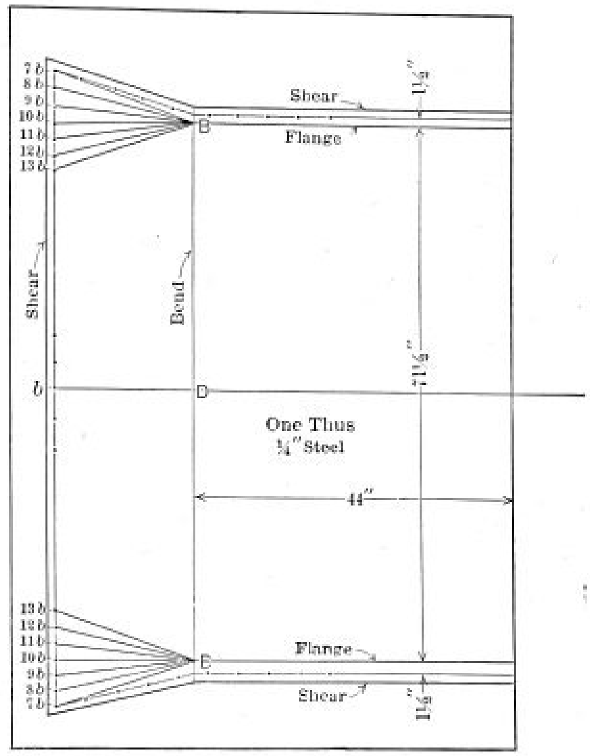


Fig. 4

the shop with much more ease and less worry. Practicing with drawing tools and drawing board, and making models of light tin in different shapes, is a very interesting pastime, besides being valuable instruction.

The section on the line of the lap, as *a-b* in Fig. 2, can be drawn on Fig. 1 with a drawing board, as it would be hard to find a surface large enough to draw this full size. By drawing it up small, you can see how the flanges and seams are going to come.

First draw a semicircle from point *O* as a center and with a four-inch radius. This would be an inch for each foot, or one-twelfth scale. Draw line *C-D* through point *O*, and set off 10 inches from *C* to *D*. Set off three inches and draw line *A-B* perpendicular to *B*, then join *C* to *A* and *D* to *B*, Fig. 1. Draw horizontal lines through into Fig. 2 from points *A* and *B*, Fig. 1, and draw *A-B*, Fig. 2, at a short distance from the semicircle. Divide the semicircle into twelve parts and connect points 1-2-3-4-5-6 and 7 by straight lines to point *A*; also connect points 7, 8, 9, 10, 11, 12 and 13 by straight lines to point *B*, as shown in Fig. 1. Draw a line from *A* to *O* and one from *B* to *O* in Fig. 1.

Set off 9 inches from *B*, Fig. 2, and draw the line *B*-13; from 13 draw a perpendicular line 8 inches to point 1. Joint 1 and *A* and complete the outline 1-*A*-*B*-13, Fig. 2.

Carry the divisions of the semicircle, as 1-2-3, Fig. 1, horizontally and spot them on the line 1-13 in Fig. 2. Join each figure or number to the letters *A* or *B* in Fig. 2, the same as in Fig. 1. Set off 1½ inches from the line *A-B* and draw the line *a-b* (at which point the seam is to come) parallel to line *A-B*, Fig. 2. Now draw a horizontal from *a*, Fig. 2, and carry it to intersect the line *C-D* at point *a* in Fig. 1. Also draw a horizontal from point 7*a*, Fig. 2, and carry it to intersect the line *O-A*, Fig. 1. With this intersection as a center and dividers set to 1*a*, draw a quarter circle, 1*a*-2*a*-3*a*, etc. To draw the quarter circle at the corner *B*, Fig. 1, the line is carried from 7*b*, the same as stated for the line from 7*a*.

By joining 7*a* and 7*b* we complete the section on the line *a-b*; that is, if Fig. 2 were cut with a saw on the line *a-b*, this saw cut would appear in Fig. 1 as the lines *a* to *a*1, thence around the quarter circle to 7*a* to 7*b*, thence around the quarter circle to 13*b* to *D*. This sectional view would not be essential to the laying out part of the article; but it would be to the forming up part, as the radius at this point would have to be known to be able to roll it to the proper shape. To figure the radius of the quarter circle is a very simple problem. When drawing up your full size end view, it is well to draw also this quarter circle, to set a template to, and tell how to bend the small corners.

Consider the triangle *B*-7-13, Fig. 2. *B*-13 is 108 inches, 13-7 is 48 inches, *B-b* is 18 inches. Then *B-b* is the same part of *B*-13 as *b*-7*b* is of 13-7, and by this we get this simple proportional, 108:48::18:*X* and, $\frac{18 \times 48}{108} = 8$ inches, the radius of the quarter circle at each corner. To find the distance from the line *A-C*, Fig. 1, to the center of the quarter circle consider the triangle *A-E*-7, Fig. 2. *A-E* is 72 inches, *E*-7 is 108 inches, the distance from the side *A-E* to 7*a* is 18 inches. By the same reasoning as before, we say 108:72::18:*X* and $\frac{72 \times 18}{108} = 12$ inches; or, by drawing a line parallel to *C-A* at a distance of 12 inches, the point of intersection of this line and line *A-O* would give the center of the quarter circle as 1*a*-2*a*-3*a*, etc., in Fig. 1, without having to draw up Fig. 2.

The writer had a job to make up recently where a

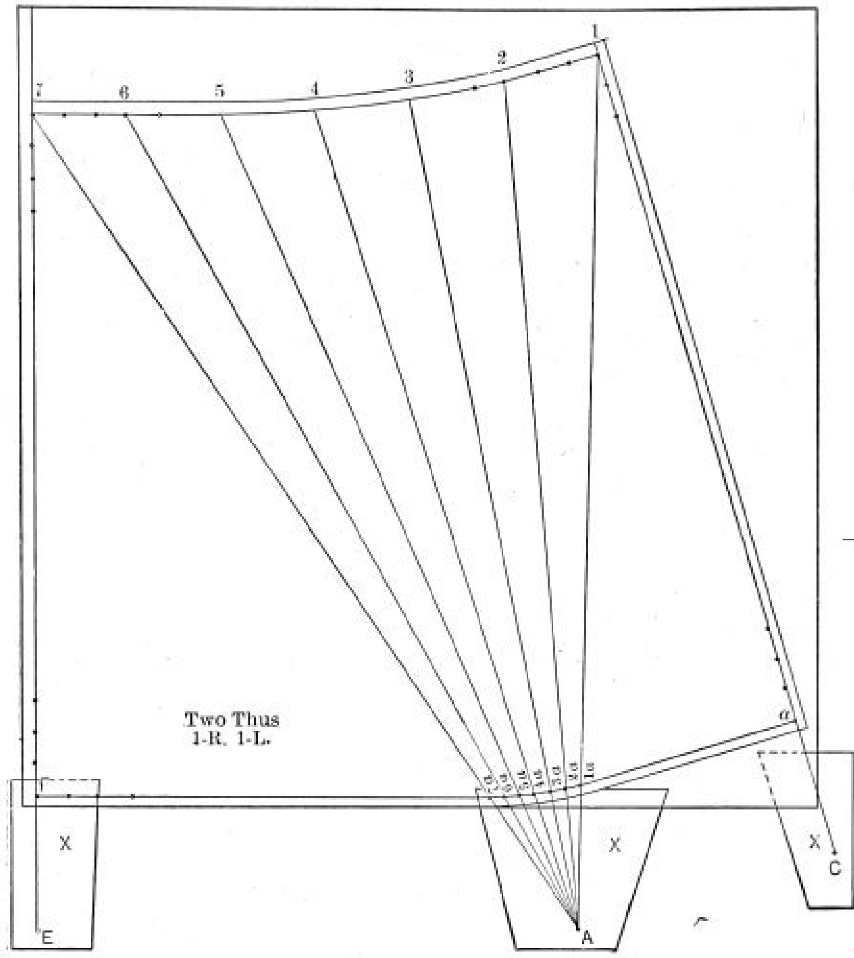


Fig. 5

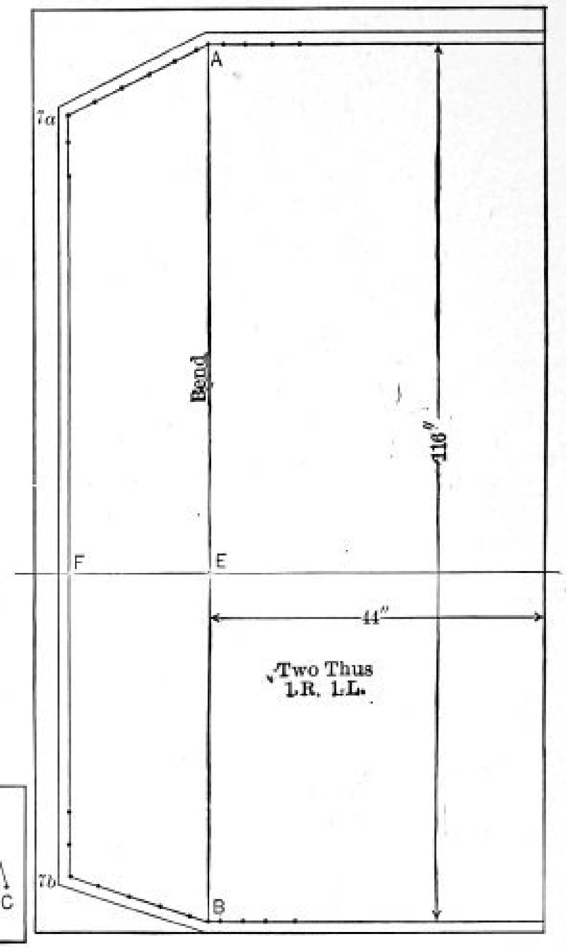


Fig. 6

brick stack had a flue opening 6 by 10 feet and the last section of round pipe was 8 feet diameter; the length of the piece was also specified as 10 feet, but in this article it is taken as 9 feet. To lay out the patterns in full size, draw up Fig. 1 to full size dimensions on neutral lines, or to center of material. Then draw up the diagram triangles, Figs. 7 and 8. Make the distance *A-O* 108 inches, then set trammels to the lengths *A*-1, *A*-2, *A*-3, etc., in Fig. 1, transferring each length respectively into Fig. 7, and numbering each length as it is spotted on line *A*-7. Then *B*-7, *B*-8, *B*-9, etc., are to be transferred from Fig. 1 into Fig. 8 and spotted and numbered on line *B*-7. Draw diagonal lines from each such number to point *O* in each triangle. Transfer also the lengths *E* to 7 and *C* to 1 in Fig. 1, to Fig. 7, and spot the points *E*-7 and *C*-1 on the line *A*-7.

We can now go ahead with the patterns. Fig. 3 is made to represent a rectangular sheet on which the pattern for one-quarter of the rounding part is to be laid out. First draw a line along each of two edges for rivets, allowing lap to suit. These lines must be right-angled at *F*. Set the trammels to the distance *E*-7 to *F*-7 in Fig. 7 and with *F*, Fig. 3, as a

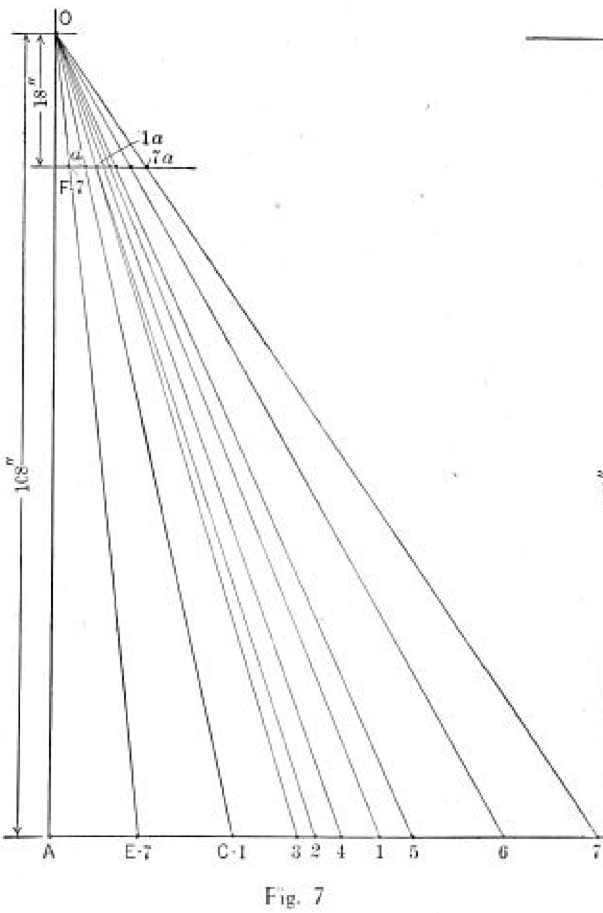


Fig. 7

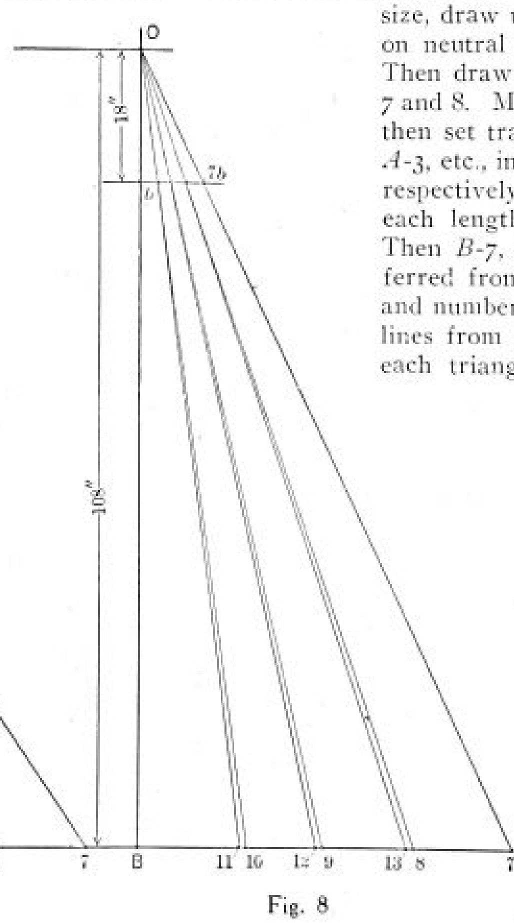


Fig. 8

center scribe point 7 on the rivet line along one edge. Set the trammels to the distance *O* to *E*-7, Fig. 7, and with 7, Fig. 3, as a center scribe point *E*. As this point is beyond the edge of the sheet, however, we must make an extension on the sheet by clamping a piece of steel, *X*, on the edge, and locating the point on this extension.

Next get *E-B* on trammels from Fig. 1, make a second extension, *X*2, on which point *B* is to be scribed from *E*, Fig. 3. The distance from 7 to *B*, Fig. 3, is taken from 7 to *O* in Fig. 8.

Now set a pair of dividers to one of the divisions in the semicircle, Fig. 1, and scribe from 7, Fig. 3, an arc on which point 8 must lie. Set trammels to *O*-8, Fig. 8, and with *B*, Fig. 3, as a center scribe an arc cutting the small arc at 8, thus locating point 8 by intersection. Continue to carry on the same operation with each of the

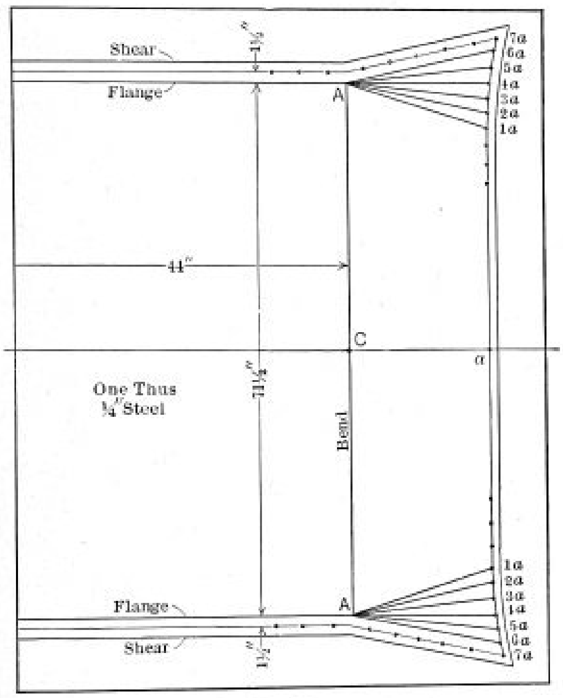


Fig. 9

divisions until the line *B*-13 has been made, then set trammels to *B-D*, Fig. 1, scribing through *D*, Fig. 3, from *B*, for which we must put on a third extension, *X*3. Then set trammels from *O* to *B*, Fig. 8, and with 13, Fig. 3, as a center scribe point *D*, intersecting the arc *B-D* at *D*. Next take *O* to 7*b*, Fig. 8, and scribe 7*b* from *B* in Fig. 3. The other points as 8*b*, 9*b*, 10*b*, etc., are obtained in Fig. 3 in the same way, but to avoid confusion the other points are not numbered in Fig. 8. Set trammels from *O* to *b* in Fig. 8 and with *D* as a center mark off point *b* in Fig. 3. This gives all lines for rivet holes, as shown. Allow lap all around to suit. The work on Fig. 5 can be done by the same method.

To lay off the rectangular part, the length of which is marked on Fig. 1, 44 inches: Fig. 4 shows a rectangular sheet on which we will start by drawing a line parallel to one edge at a distance of 44 inches. The width of the rectangular section is given as 6 feet. To make it fit loose in the stack we decreased this to 71½ inches. The flange holes are shown to be 2 inches from the back of the flange, and from experience we have learned to take off two thicknesses of the steel for flanges. In the pattern we take 1½ inches each away from this flange line for the rivet hole lines. To this we add 1 inch on each side for a lap, as shown in Fig. 4. The part from the line *B-B* to the seam, or the line *a-b*, called the seam line, can be transferred from Fig. 3 to Fig. 4; or each division can be laid out simply by having both sheets lying ready and marking Fig. 4 and Fig. 3 at one time. The letters and numbers are all the same, the only difference being that the distance from 7*b* to 13*b* in Fig. 4 should be ½ inch or twice the thickness longer than from 7*b* 13*b* in Fig. 3, so as to overcome the takeup, as Fig. 4 fits outside of Fig. 3. The thickness of the steel of which this job was made was ¼ inch.

By studying Fig. 4 and 3 one can see how these will come together. Fig. 3 has to be doubled on line *b*-13. Fig. 9 is the head which goes at the end, *A-C*, Fig. 1, and it is laid out the same way as explained in the case of Fig. 4, excepting that the lines are transferred from Fig. 5 or marked along with Fig. 5. Fig. 6 is nearly a flat sheet. It has a slight bend on the line marked "Bend." The rivet holes are marked 116 inches apart, because two flanges, gaging 2 inches each, would make 120 inches or the height of the hole in the stack. To lay off the outline, take *F-E-7a-A* from like points in Fig. 5 and take *F-E-H-B* from like points in Fig. 3. The rest can be seen easily from the dimensions that are given.

OBITUARY

Edward C. Meier, president of the Heine Safety Boiler Company, Phoenixville, Pa., died suddenly on May 7, while attending a meeting of the District Production Division of the Emergency Fleet Corporation, in Philadelphia, held for the purpose of speeding up production.

Edward C. Meier

Mr. Meier was a son of the late Colonel E. D. Meier, founder of the Heine Safety Boiler Company, former president of the American Society of Mechanical Engineers and for many years president of the American Boiler Manufacturers Association. It will be remembered that while president of the American Society of Mechanical Engineers, Colonel Meier was the leading spirit in the development of the present A. S. M. E. Boiler Code, which is now being rapidly adopted by many States and cities in this country.

Edward C. Meier received his education in the public schools of St. Louis and the St. Louis Manual Training School. When only eleven years old, he worked during vacation periods in Richard Garstang's boiler shop in St. Louis, where Heine boilers were originally made. After completing his education, he started to work for the Heine Boiler Company, which was organized by his father in 1884. Mr. Meier worked in all departments of the company and was thoroughly familiar with the construction of boilers. He was entrusted with installing the Heine Boiler Company's exhibit at the World's Fair, Chicago, and when the fair closed, he supervised the dismantling of the boilers and their shipment to San Francisco, where they were exhibited in the Mid-Winter Fair in 1894.

When the fair was over, Mr. Meier came East, entering the sales department of the company, and established offices in Philadelphia in 1895. During this time he exercised general supervision of the Eastern shops where Heine boilers were built. In 1899 the company decided to operate a shop of its own in the East and Phoenixville, Pa., was selected as the site of the industry. Although this shop was established in Phoenixville only nineteen years ago, it is now one of the chief manufacturing establishments of the city. Up to his death, Mr. Meier had been in charge of the plant, and it was due to his activity and the attention he gave to it that the development was so rapid.

Mr. Meier was a director of the Heine Safety Boiler Company and before becoming president he served for a number of years as vice-president. During the past year Mr. Meier had been very active in designing a boiler suitable for marine work, and it was through his intimate knowledge of boiler construction that he was successful in securing government contracts which are now taxing the Phoenixville shop to 100 percent capacity.

During his busy career as a manufacturer, Mr. Meier also gave considerable of his time to the upbuilding of the community and to local government in Phoenixville. He took a great interest in all movements in the town, and particularly in all the patriotic ones. He served three terms as Borough Councilman. He was also President of the Madco Foundry and a member of the board of directors of the Phoenixville Trust Company. In the death of Mr. Meier, the nation loses a progressive citizen and the workingmen a friend who spared no efforts in looking after their welfare.

PERSONAL

Edward Buker has been appointed Western representative of Rome Iron Mills, Inc., with office in the McCormick Building, Chicago. Mr. Buker brings to his new position an extensive experience that will be invaluable in his work.

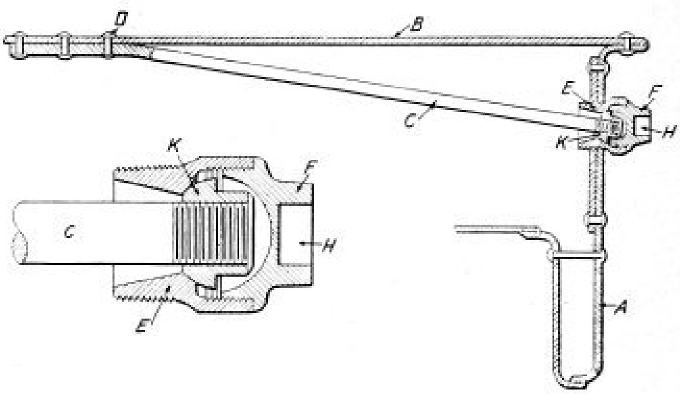
Mr. Buker was born in Chicago in 1885. He received his education in the public schools at that place and the University of Illinois, from which institution he received the degree of mechanical engineer. While at college his summer vacations were spent in South Chicago Rolling Mills.

Immediately upon graduation from college, Mr. Buker entered the service of the Pullman Company as apprentice in their car shops in Chicago. After serving his time he went as special apprentice in the locomotive shops of the Illinois Central. Two years later he accepted a position as inspector on the Chicago, Rock Island and Pacific, and was later appointed general foreman on the same road. Leaving the Rock Island, he went with the Missouri, Kansas and Texas Railway as master mechanic. During the past two years he has been with the Galena-Signal Oil Company as mechanical expert, which position he held up to the time of his recent appointment.

Boiler Brace Coupling

An improvement in the method of fastening boiler braces, recently patented by S. U. Walck, of Lansford, Pa., has been described in the *Railway Mechanical Engineer* as follows:

The device is shown in detail in the illustration, which is a vertical section through the boiler where the brace is applied. Referring to the illustration, *A* is the back head of the boiler and *B* the wrapper sheet. The brace *C*



Boiler Brace Coupling

is held by rivets to the wrapper sheet and the back head is drilled and tapped with a standard boiler tap to take the shell *E*. As indicated, this shell is chamfered and has a concave seat machined to suit the convex face of the nut *K*. *K* has a square head and may be tightened by means of a suitable wrench. The shell *E* is threaded on the outer end to receive the cap *F*, which is provided with a recess, *H*, to allow for tightening.

In applying the brace and coupling, the inner end of the brace is securely held to the wrapper sheet by riveting or otherwise and the threaded portion is passed through the shell. The nut is tightened on the brace, so that a few of the threads will project through and may be riveted over. The cap is then screwed into the shell, enclosing the nut in the manner shown and making a steam-tight joint.

If it becomes necessary to inspect the braces, the cap may be removed by a wrench inserted in the recess in the end; and should the brace and nut turn together, it will be evident that the brace is broken. In order to remove the part of the brace which is riveted to the boiler sheet the rivets holding firm may be cut, allowing the inner portion to fall down and be taken out. After the old brace is removed, a new one may be slipped into the boiler through the opening in the end of the boiler head and the inner end drawn up to the wrapper sheet. After tapping out the old holes, screw plugs may be screwed into the wrapper sheet and brace, allowing them to extend above the sheet for a distance of a few threads, which may be afterwards riveted over, the same as a staybolt, thus making a tight joint. The shell may then be screwed into the boiler head and the parts replaced, as already described.

This form of boiler brace possesses the advantages of being easily applied and readily inspected. In addition, it provides a flexible connection at one end and is much less likely to break than a rigidly riveted brace.

The Boiler Maker

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H. H. BROWN, Editor

June is the boiler maker's convention month and the big event this year is the thirtieth annual convention of the American Boiler Manufacturers' Association, which will be held at the Bellevue-Stratford Hotel, Philadelphia, on the 17th and 18th. An interesting programme has been arranged for the discussion of topics of the greatest importance and an unusual list of distinguished speakers has been provided for the banquet, which will be held on the evening of the 18th. Don't forget the time and place.

As a part of the government plan to exercise a nationwide control and direction of the labor supply, and all questions affecting industrial relations through the machinery of the War Labor Administration, a Policies Board has been appointed by the Department of Labor, the chairman of which is Felix Frankfurter, head of the Administration of War Labor Activities. All questions involving distribution of labor, wages, hours, and working conditions will be determined by this Policies Board. This will apply directly to war industries and indirectly to non-war industries. Its decisions will be executed by the various production departments of the government. In non-war industries, the board's decision will be given effect through the machinery of the War Industries Board, which controls the flow of war materials for all industries.

A recent communication from J. Derrick of Casper, Kansas, a boiler maker of twenty years' experience, who has been a subscriber to THE BOILER MAKER for many years, calls our attention to the fact that a great many readers of THE BOILER MAKER are employed in oil refineries, although very little information regarding this class of work has been published in the magazine. Mr. Derrick informs us that practically every kind of water-tube and return tube boiler is used in refineries and that some of the most difficult patching is done by the boiler makers in this industry. The difficulties can be appreciated when it is understood that the work must be calked oil-tight to stand temperatures of 600 to 775 degrees Fahrenheit and a working pressure of from 80 to 110 pounds per square inch. The joints must be "iron to iron," with no chance for corrosion, rusting or take-up.

We are sure that readers of THE BOILER MAKER will be much interested to learn some of the details of this special class of work, and we would urge those who are working at the refineries to send us descriptions of any unusual jobs they are doing, as well as of methods and kinks which they find of value in construction and repair work. Liberal payment will be made for contributions of this kind.

As a suggestion to contributors Mr. Derrick asks our readers to answer the following questions: What is the proper method of applying a patch over the firebox of a still of the high pressure type? Would it be safe to patch directly on a bottom where the blaze laps the shell of the still? How should large coke stills with expansion joints, or rather expansion rings of material lighter than the bottom, be patched? How has this work been done and what is the most satisfactory method?

These are practical questions and we hope many of our readers will send in answers before we go to press with the next issue so that the work can be fully discussed in later issues.

Our readers have been invited to "back up" our soldiers at the front by joining or forming a War Savings Society. Full information will be supplied upon addressing the War Savings Society Bureau, 51 Chambers Street, New York City, or the National War Savings Committee, Washington, D. C.

Members of War Savings Societies promise to avoid competing with the Government for labor, materials and transportation by buying only what they need and only with the next issue so that the work can be fully disweekly or monthly in Thrift or War Savings Stamps or in Liberty Bonds.

A War Savings Society may be formed within a society, class or club, or in any group of people who work together or eat together, who play together or otherwise frequently "get together." The Society will include all members of the group who are willing to sign the patriotic agreement to individually support the Government in two ways—(1) by each doing his buying thoughtfully and (2) by loaning his savings to the Government.

There will be a chairman and secretary, whose first effort will be to secure as members of the War Savings Society all members of the group, each one signing the application blank and promising to purchase a certain number of Thrift or War Savings Stamps every week or every month. From time to time, the secretary will check up the stamp purchases of the members so that none may neglect their promises. Weekly or monthly reports of the total purchases and total number of members will be sent to the National War Savings Committee.

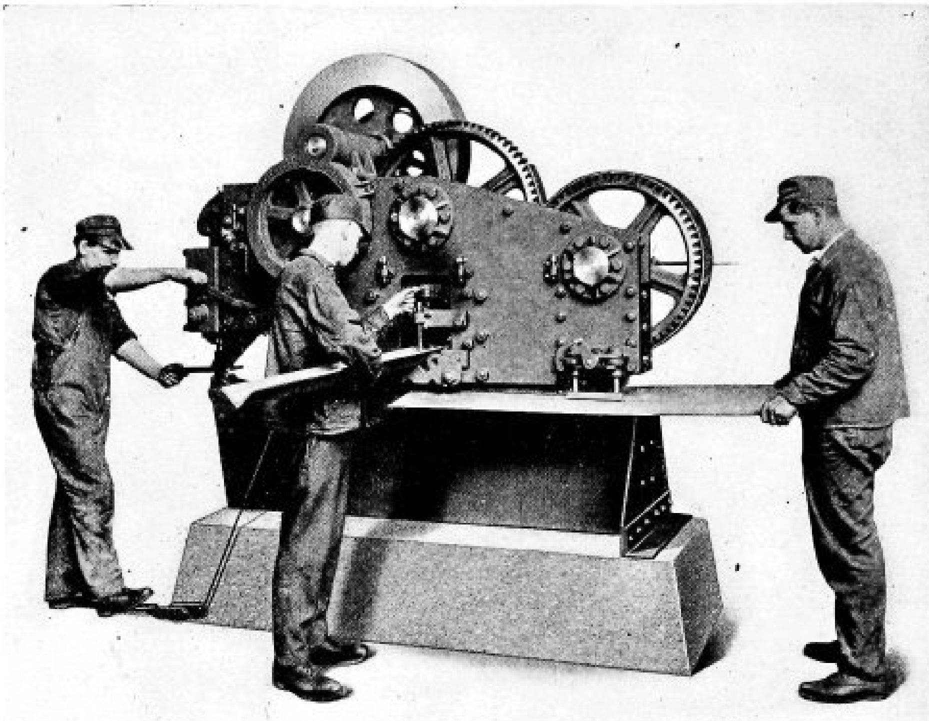
At such times as the members may determine ten minutes or more will be given to the War Savings Society of that group for war savings and other war-time discussions. In some offices or shops occasional brief, informal talks may be practicable. For these talks and the more formal meetings speakers will be suggested and material will be supplied from time to time.

Engineering Specialties for Boiler Making

New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

Universal Slitting Shear, Punch and Bar Cutter

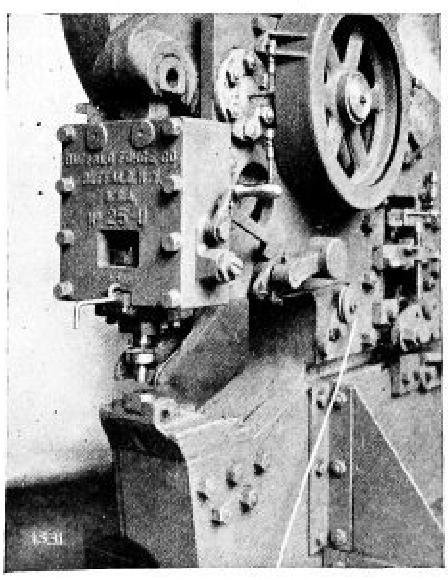
Among the developments hastened by the war, one of the most interesting is the line of punches and shears built by the Buffalo Forge Company, Buffalo, N. Y., under the trade name "Armor Plate." Small hand punches, shears and bar cutters had been built by this from Germany in competition with the much heavier cast iron machines built here. About six months prior to the beginning of the war, the Buffalo Forge Company had been preparing designs and had built a few power machines in the smaller sizes, so that they were in excellent position to supply the demand which already existed, and



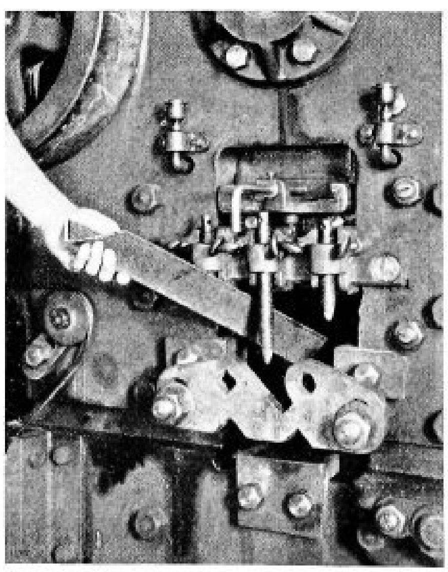
Combined Slitting Shear, Punch and Bar Cutter Built by Buffalo Forge Company

company for a number of years, superseding the old line of cast iron machines, and these indestructible armor plate tools have found much favor on account of their lightness and strength. No American manufacturers were building power punches and shears of steel plate, but a substantial number of such machines were being imported have been rapidly increasing their facilities, one entire building recently erected, being used for this line of work exclusively.

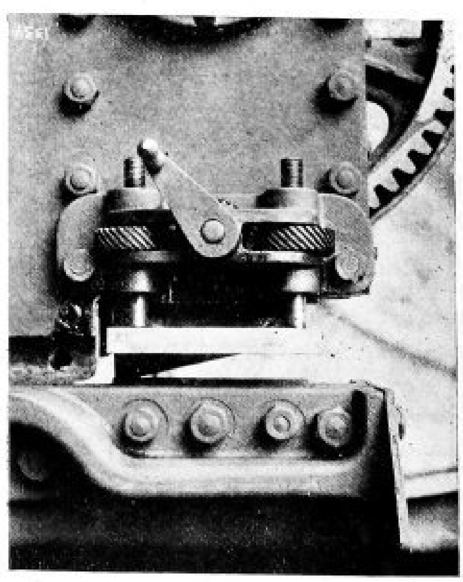
These tools have not been extensively advertised because the demand from abroad has exceeded the supply. As "Armor Plate" punches and shears weigh approxi-



Punch

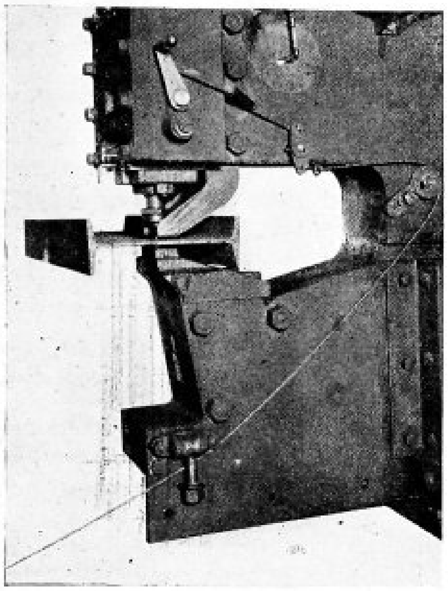


Bar Cutter



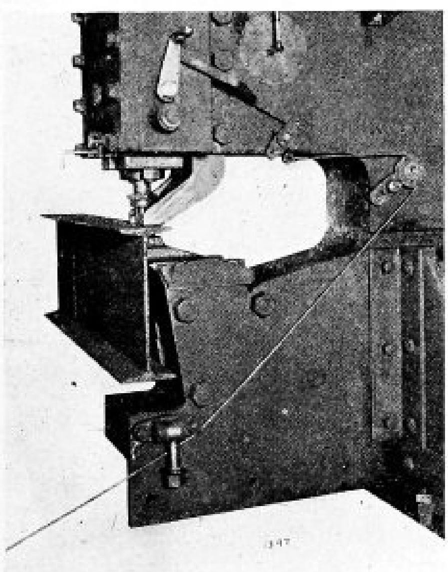
Slitting Shear

mately 1/6 as much as cast iron machines of the same capacity and of equal strength, and are very much more compact, the difference in ocean freight is marked. Moreover, the European market was more accustomed to this type of construction, so that a great many of these tools have been in very severe and continuous use in the largest munition plants of France and England.



Punching Web of Channel

A particularly interesting design, which combines unusual features, is the "Universal" slitting shear, punch and bar cutter. A slitting shear in combination with a machine for any other service is unusual, but the makers have succeeded in bringing within very small compass a shear which will slit plates of any width or length, will



Punching Flange of Channel

punch sheets, channels, "I" beams, or other special sections, cut angles and toes, either square or mitered, and by the substitution of special knives will cut channels, beams and other rolled sections. Three distinct operations can be performed without in any way interfering with each other. By reference to the illustrations, it will be seen that the nachine is operated either by foot treadle or by hand lever, and the three sets of knives can be operated independently, or may be engaged at one time.

The close-up views show details of construction of the No. 25 U Machine, which is of moderate size, as shown by the men engaged in operating it, and specifications of which are as follows:

Shear: Plates 5/8 inches thick, flats 3 inches by 3/4 inch; length of knives, 8 inches; strokes per minute, 25. *Bar Cutter:* Angles (square), 4 inches by 1/2 inch; angles (mitered), 2 1/2 inches by 5/16 inch; tee iron, 3 1/2 inches by 3/8 inch; round, 1 1/2 inches; square 1 1/4 inches; I-beams, 6 inches, 12 1/4 numbers; channels, 6 inches, 10 1/2 numbers; strokes per minute, 25. *Punch:* 1-inch hole in 5/8-inch plate; height stroke, 1 inch; strokes per minute, 25. Brake horsepower required, 5. Size motor recommended, 7 1/2. R. P. M. of high speed shaft, 350.

Built either for motor or belt drive, the gears are of steel, machine cut, and the pinions cut from solid manganese steel blanks. The bearings are ample and rigidly attached to the frame, all bronze bushed, and high speed shaft is ringoiling.

On the punch end, in addition to gag operated either by foot or by hand a second gag with handle is used in place of the customary hand wheel for bringing the punch down on the work without penetrating the material so as to locate center marks and also for setting up dies and punches. The shear engagement is by jaw clutch, and the stripper is readily adjusted in place by two spiral gears operating through a crank and pinion.

The illustration of the bar cutter sections shows the adjustment of the stops, which can be moved right or left so as to miter angles. Every provision is made for simplifying the operation of the machine and avoiding as far as possible the use of the hammer and wrench for making adjustments required in daily service.

John A. Stevens & Associated Engineers Receive Cotton Manufacturers' Medal

John A. Stevens & Associated Engineers, Lowell, Mass., have been awarded the National Association of Cotton Manufacturers' medal for contributing the most to the advancement of the cotton industry during the year and also for the large conservation of coal and men made by the people using their services during the past years. This award was made at the joint meeting of the National Association of Cotton Manufacturers and the American Cotton Manufacturers' Association, held in New York, May 1 to 3.

President Wilson Urges Nation to Invest in Government Securities

Calling on the people of the nation to buy only those things which are essential to the individual health and efficiency, thus saving materials and labor for necessary war purposes, President Wilson has just appealed to the people of the nation to volunteer on or before June 28—National War Savings Day—to invest systematically in War Savings and Thrift Stamps or other Government securities.

Thoughtless expenditure of money for non-essentials uses up the labor of men, the products of the farms, mines and factories, and overburdens transportation, all of which must be used to the utmost and at their best for war purposes.

The great results which we seek can be obtained only by the participation of every member of the nation, young and old, in a national concerted thrift movement.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, 461 *Eighth avenue, New York city.*

Factor of Safety for Air Receivers

Q.—In building air reservoirs for shop use, what factor of safety should be used for the cylinder, also for the longitudinal stays? The cylinders are to be from 24 inches diameter to 60 inches diameter, with flat heads ⅜-inch thick. The large sizes are to be reinforced to ¾-inch thick; stays to be 1-inch body with 1⅛-inch ends welded on.

In the staying of these heads, should I consider the thickness as all ⅜-inch thick or should I use a different constant for the heads that are ¾-inch thick? We now have an air reservoir 60 inches diameter with heads ¾-inch thick stayed with twelve 1-inch longitudinal stays ⅞-inch body and 1-inch ends with nuts on the outside. Do you consider this cylinder sufficiently stayed for a pressure of 100 pounds?

The cylinders from 24 inches to 60 inches diameter are to have all stays with 1⅛-inch nuts on the outside. Our chief draftsman claims that a safety factor of 2½ should be used for the shell and stays. I do not consider this is right. Kindly oblige me with this information.

G. F. L.

A.—An investigation of some of the air receivers made in the United States seems to indicate that the shells have a factor of safety of from 4 to 5. The makers claim the use of 60,000-pound steel. Lap-welded, single-riveted girth joints are used and double-riveted longitudinal ones. The working pressures range from 100 pounds to 450 pounds per square inch. Cold-water tests of from 140 pounds to 175 pounds per square inch are used for working pressures of from 100 pounds to 120 pounds per square inch.

For the factor of safety of the shells of air receivers we have

$$F = \frac{S \times E \times 2 \times T}{P \times D} = \frac{60{,}000 \times .7 \times 2 \times 5/16}{100 \times 60} = 4.$$

This factor of safety is for new work and is based on an efficiency of 70 percent for the double-riveted longitudinal joints. In the formula given above S equals 60,000, or the tensile strength of the steel used; E equals the efficiency of the joint; T equals the thickness of the plate; P equals the working pressure, and D equals the diameter.

As a general thing, the receivers are made with heads dished to a radius equal to the diameter of the shell, as this does away with the objectionable flat heads with their stay rods and fastenings. We can see no reason for making the heads with a less factor of safety than the shells, except that the lower the factor the less the cost and possibly the greater the profit. There should be some Government rules for safety of air receivers, just as there are rules for the safety of steam boilers, though, of course, the air receiver is not as dangerous as the steam boiler.

When using flat heads with stays, the actual thickness of the head should be considered, so as to find the strength between the stays. The shell is supposed to support a 3-inch ring of the head around the outer edge, this ring being, in fact, the curved part of the flange of the head. The area inside this ring must be supported by the stays. It will be interesting to calculate the bursting pressure on an unstayed flat head by the use of the formula that has been worked out by experiment.

$$P = \frac{t \times S \times 10}{A}$$

Where P is the bursting pressure, A is the area of the head, t is the thickness of the head, S is the tensile strength of the steel, and 10 is a constant that is used to make the formula agree with the experimental fact. Another and older formula is

$$P = \frac{t^2 \times 72{,}000}{R^2}$$

If we insert the data of your problem relating to the 60-inch receiver in the formula we have

$$P = \frac{3/4 \times 60{,}000}{30 \times 30 \times 22/7} = 16 \text{ pounds.}$$

This assumes that you are using 60,000-pound steel. It is readily seen that with the value of P only 16 pounds practically the whole pressure on the head must be held by the stays.

As to the use of 12 stays on a 60-inch head, the problem of the factor of safety is as follows:

A 54-inch circle must be supported by the 12 stays. The area of this circle is 2,291 square inches, or 2,291 ÷ 12 = 191 square inches for each stay to support. The working load on each stay is 191 × 100 = 19,100 pounds. The stays are ⅞ inch, with enlarged ends that probably give a net diameter of ⅞ inch, giving an area of about 6 square inches. The breaking load is 60,000 × .6 = 36,000 pounds. The pressure load being 19,100 pounds, the factor of safety is 36,000 ÷ 19,100 = 1.88. This seems to be a very narrow margin.

The formula used to find the area for each stay when the thickness of the flat surface is taken into account is as follows:

$$A = \frac{120 \times t^2}{P},$$

Where A is the maximum area in square inches for each stay to support, p is the thickness of the head in 16ths of an inch, P is the allowable working pressure, and 120 is a constant to be used where the plate is over 7/16 inch thick. If less than this thickness, 112 is used for the constant. Applying this formula to the 60-inch receiver with ¾-inch flat heads and 12 stays, we have

$$A = \frac{120 \times 12 \times 12}{100} = 173 \text{ square inches,}$$

which is considerably less than the 191 square inches actually loaded onto the stay. It would be a good plan to increase the number of stays—in fact, to double or treble the number—or to greatly increase their size.

Design of Dies for Flanging Hemispherical Heads

Q.—Kindly print the best method of making a spherically bumped and flanged head 42 inches diameter, ½-inch material, at a single heat, so that the flange shall be square with the head. The question involves the diameters of male and female formers and best method of construction, so that head will have proper circumference at heel and end of flange when ready for shell. Work to be done by hydraulic flanging machines.

M. J. M.

A.—The dies for flanging and their arrangement, as employed on a four column hydraulic press, are shown in the accompanying sketch. The clamping or female die acts as a former and also as a clamping die. The upper die is a distance block. This block, together with the female die, is bolted to the adjustable cap of the press. The grip block is fastened to the movable table of the former. Between the grip block and clamping die is a recess, which should be about 1/16 inch deeper than the plate thickness. The purpose of the recess is to prevent the plate from buckling when the male former advances in dishing the head, and to provide a space for the plate,

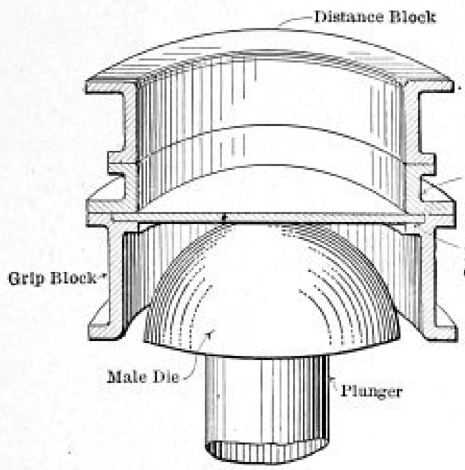


Fig. 1

as the disk or blank is larger in diameter than the finished head. All surfaces abutting together should be machine finished, so as to insure good alinement.

In the design of all castings for dies, allowances must be made for shrinkage of the plate. The inside diameter of the female die is found as follows: Add the product of .008 times the diameter of the finished head to the female die for heads up to 60 inches in diameter; and the product of .01 times the diameter of the finished head for heads that are larger than 60 inches in diameter.

For example, the inside diameter of the female die for a 42-inch head would be determined in this way:

$42 \times .008 = .336$ inch.
$42 + .336 = 42.336$ inches, inside diameter of die.

Diameter of male former should equal $42 - (\frac{1}{2} + \frac{1}{2}) = 41$ inches. A clearance of from 1/8 to 1/4 inches should

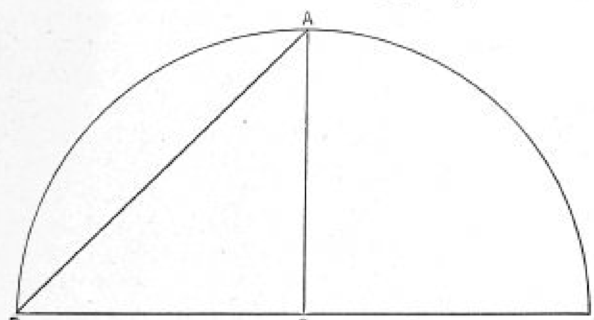


Fig. 2

also be allowed for take-up or gather of the metal, hence $42 - \frac{1}{4} = 40\frac{3}{4}$ inches outside diameter of male die. The foregoing is the general practice followed in the design of dies, but modifications may be necessary to meet special requirements.

Grey cast iron, of sufficient thickness, is suitable for this work, but the female die should be made heavier than the male die. For your work we believe a thickness of from 3 to 3½ inches is sufficient for the female die, and from 1½ to 2 inches for the male die, which also should have reinforcement ribs in the center. Wooden patterns for the dies should be designed first, and any patternmaker understands what the requirements are.

Determines Size of Blanks

For this work the calculations should be made from the neutral layer of the plate. The diameter of the blank may be found by determining first the area of a sphere along the neutral surface, and then divide the product, as found by 2, to find the area of the hemisphere which is the area of the blank. Neutral diameter of head equals 41½ inches.

Area of a sphere may be found by this formula,

$A = 3.1416 \times d^2$,
in which A = area,
d = neutral diameter;

then A in this case equals $3.1416 \times 41\frac{1}{2} \times 41\frac{1}{2} = 5410.6$ square inches. $5410.6 \div 2 = 2705.3$ square inches, area of hemisphere or blank. The diameter of the blank may be found from the following formula:

$D = 1.128 \sqrt{A}$,
in which D = diameter,
A = area of blank;

then $1.128 \sqrt{2705.3} = 58.7$ inches, diameter of blank.

A shorter method is simply to use the slant height of the triangle in Fig. 2 as a radius which may be accurately found by calculation.

$AB = \sqrt{AC^2 + CB^2} = \sqrt{(20\frac{3}{4})^2 + (20\frac{3}{4})^2} = 29.34$ inches, the required radius.

"Hiring and Firing"

"Labor turnover" is estimated on the basis of reliable facts to cost the country a billion and a half dollars every year. Every new employee costs a house $25 (£5/4/2) to $1,000 (£205), or even more. What steps are being taken to reduce this expense by first selecting employees intelligently, and, secondly, keeping and developing them?

All managers interested in this and other employment problems from the modern point of view will find a good guide in a pamphlet of sixty pages entitled "The Employment Department and Employee Relations," which is the joint work of F. C. Henderschott, of the New York Edison Company, and F. E. Weakly, employment manager of Montgomery Ward & Company, published by LaSalle Extension University, Chicago, as part of the material of its Business Administration course and service.

This book describes the organization and duties of an employment department, the function of the employment manager, his relations to other departments, the sources of the labor supply, and the scientific method of selecting people for their jobs. This last includes tests for general intelligence, special intelligence, and manual dexterity; physical examinations, and the observation of temperament. Mental capacity tests which have been found reliable are given in full.

The responsibility of the employment department does not cease when the worker is hired, but extends to his entire career with the house. Practical questions of transfers, promotions and general welfare work are all discussed. The analysis sheets for critical examinations of turnover ought to prove particularly suggestive to most concerns.

J. E. Wiese, superintendent of the Gem City Boiler Company, Dayton, Ohio, has resigned on account of ill health. Mr. Wiese was seriously injured on December 24, but returned to work after six weeks. He had only partially recovered from the effects of the injury, however, and is now forced to take several months' vacation. After September 1 Mr. Wiese will be ready to consider a new position.

Letters from Practical Boiler Makers

This Department Is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

A Corollary

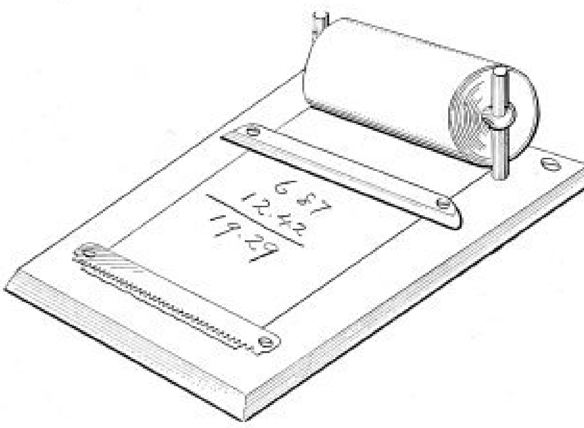
On page 136 of your May issue, at the foot, I see a remark which might as well be quoted: "The best engine ever built is useless without steam. The steam comes from the boilers, and a cheap man in charge of them is proof that a fool is at the head of the plant."

Why not apply the same thought to the locomotive boilers, which present the same conditions to the motive power heads of railroads? If construction is at fault, which is the case with rigid construction, why not remedy the evil by building a flexible boiler to save the cost of upkeep, as well as save in fuel consumption, which would be saving at both ends?

Reading, Pa. J. H. Bickley, M. E.

Scratch Pad

A very useful continuous memorandum or scratch pad can be made from a small piece of soft board, a couple of wire spikes with their heads cut off, two screw



Improvised Scratch Pad

eyes, a hacksaw blade, and a roll of small-size package paper, such as used in drug stores to wrap small bottles, etc. A sketch of the completed pad is given above.

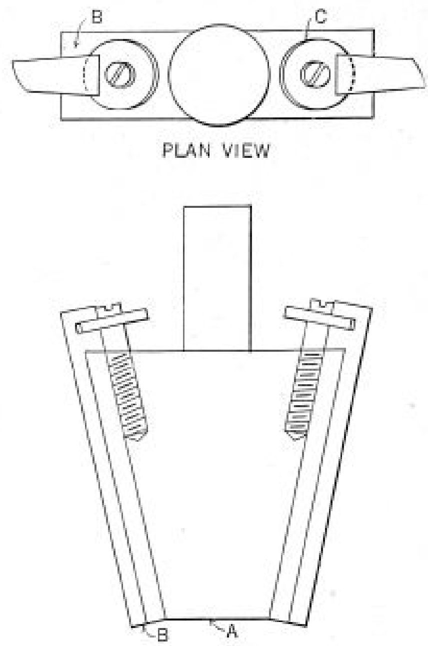
Concord, N. H. C. H. Willey.

Tool for Drilling Tube Holes in Boiler Head

The drill shown herewith is far superior to that which is commonly used in most boiler shops for drilling holes in boiler heads, etc., which are first started by punching. The ordinary drill or cutter is a one-piece forging, the shank, as well as the cutting edges, being made of expensive steel. The whole thing becomes useless when ground smaller than the required hole.

This drill consists of a holder *A* made similar to the ordinary drill, with two dovetail slots *B*, planed on a taper starting at the lower end and growing wider toward the top. The adjusting screw *C* is tapped into the top of the holder and has on it a shoulder which runs in a slot in the blade. By this screw the blade is raised or lowered until the distance across cutting edges equals the diameter of the hole to be drilled.

Care must be taken to design the adjusting screw so that it will stand the thrust of the cut. The size of the



Sketch of Special Tool for Drilling Tube Holes

blades, holder, etc., will, of course, be in proportion to the size of the hole the tool will be required to drill.

Providence, R. I. J. T. Jones.

How to Change a Firebox

In changing fireboxes much depends on what kind of a firebox it is, a radial stay supported crown sheet or a crown bar supported crown sheet. In either case the first thing to do is to remove the flues, then cut off the rivets, in the mud ring and drill the bolts deep enough to clear the sheets. Gouge the burrs out of the corner holes so that they will be rather deeper than the thickness of the sheet at the corners, and this will insure the bars from catching at the corners when the bar is ready to be removed.

When the rivets and corner bolts are out, as stated above, proceed as follows: Cut a hole about 3 or 4 inches wide at both right- and left-hand corners of both door sheet and flue sheet, and, starting about 2 inches above the mud ring, cut the pieces out, being careful that you do not cut the mud ring. When this is done in both flue and door sheet get two bars of iron about 3½ inches by 1 inch (if the holes are 4 inches wide). They should be the full length of the firebox and once the width of the mud ring. Place them in the holes cut out. Drive iron wedges on top of the bar and against the top of the holes at all four corners. This will force the mud ring down and out, by putting pieces of iron under the wedge as the wedge is driven into the head. Having removed the mud ring you can now tell if the back head must come out or not.

To get the old box out, if the firebox is wider at the top than the inside of the wrapper sheet, then the back head must come out. By measuring at both places you can tell at once. This may be done before the mud ring is out by measuring the width of the mud ring over all and the top of the firebox and allowing for thickness of the side sheet and heads of rivets. If it is a crown bar firebox, the dome will be nearly always over the firebox, so that the dome braces may be cut loose. The machinists will take out the dry pipe and the nigger head out of the dome.

After cutting the dome braces loose from the dome, leave them there until the box is out before taking them off the crown bars. Mark all the crown bars at the fire door end with some plain mark, so that they will go back on the new firebox in the same position they were in on the old one, otherwise the dome braces will not go into their proper places. Take particular notice of how the bars fit on the sheet, so that you can put them back in like manner.

Take care of all the diamond washers, also all the ferrules or bushings that come from under the crown bars. They are about 1 inch high and the hole is about 1 inch for the 7-inch crown bolts. Also mark all the braces, both on the bars and on the inside of the dome.

After this is done, turn the boiler on its side and with a long chisel bar cut out all the staybolts. A bar with a jaw is a good one to break the bolts down with, but before doing this the staybolts must be drilled on the outside about ½-inch or ⅝-inch deep. If this is done they will break down easily.

If it is a radial stayed firebox proceed in the same way as before, but there will be no braces in the dome.

If the back head must come out you need not turn the boiler on its side. Do your cutting from the back end with the exception of the flue sheet. This can be done from the inside of the boiler with a short bar.

Ashland, O. R. B. HARRISON, L. A. & S. R. R.

Hand Versus Power Riveting

In his letter to THE BOILER MAKER, of April last, on the above subject, Mr. Haas says that, like myself, he has the courage of his convictions, added to the evidence of experience, and that careful re-perusal of the correspondence does not lead him to modify his attitude.

I am not at all anxious that Mr. Haas should alter his attitude in this controversy. My contention still remains the same—that hand-driven rivets can be made tight (something that I have never seen done by any power riveting machine), and, in so contending, I simply wanted to draw the attention of the readers of this magazine to the conditions that not only exist to-day but have existed ever since the introduction of power-driven riveting machines. In all of my years of experience I have never seen a hand-driven rivet fall out of the hole when the head was cut off.

What I mean by hand-driven rivets is the method of driving and finishing a rivet with the hammer, regardless of what kind of hammer is used.

One of the chief reasons why a machine driven rivet is so hard to back out, and often has to be drilled out, is on account of the work not being fitted up close. When the rivet is driven, a collar is formed between the sheets, but this does not mean that the rivet fills the hole any better than the hand-driven rivet. I have seen sheets 13/16 inch thick, crushed, and the laps distorted by the tremendous pressure put upon the rivet, yet the rivets have not been tight.

My question as to what constitutes a leaky rivet is still unanswered. I do not know that the conditions mentioned by me are inevitable or not, but they are very evident, and the picture drawn is a true one of some of the best boiler shops in the United States.

No doubt there is room for missionary work in the boiler industry of this country. It is well known to the many thousands of boiler makers and others interested in this industry that of all the mechanical trades that of boiler making has received the least attention. To many, a boiler is simply a thing to raise steam in, and any kind of water or any kind of fuel is good enough, and, in many cases, it is a question of cost. If a second-hand boiler, well painted, catches the eye of a prospective purchaser, he will invariably say that it is just what he is looking for and the quality of material that goes into the boiler is a secondary consideration. Safety seldom or never enters into their heads.

Although improvements have been made for the last twenty-five or thirty years in material and machinery, still it is well within the last decade that boilers (locomotive especially) have received the close attention they are receiving to-day at the hands of the engineering profession.

We have here in Pennsylvania a mechanical engineer (a frequent contributor to the pages of this magazine), who has for some years past been drawing the attention of the profession to certain things in the construction of the locomotive boiler that would be real improvements, but he is not getting the deserved attention that he should.

There is a vast difference between conditions in the boiler industry in England and that of the United States. The chief one is just this, that the boiler makers' trade in England is kept strictly in the hands of qualified men, and no one not able to fill a certain position, and show that he was a fit person for that position, would be put to work on that particular job. Would an English manufacturer put a man to work installing a set of brass tubes in a copper firebox whose only claim to boiler making was that he had riveted on a hot blast stove? I think not. Yet we meet with parallel cases in this country. Men in England hold their jobs from boyhood to old age. Here, the majority of our boiler makers are floaters, and the curse of the trade in this country is the handyman—something unknown in England.

Regarding the quality of our early workmen, and the use of low pressure boilers and iron plates; let us, for the sake of argument, say that 70 pounds per square inch is low pressure, and anything above that high pressure. Such being the case, we know that there have been made (by the London & North Western Railway, England) some thousands of locomotives, the boilers of which were made of the best Lowmore and bowline iron and carrying pressures from 125 pounds to 160 pounds per square inch. Furthermore, many of these boilers were hand made—and this back in 1878, when Mr. Haas, according to his own words, was still in the nursery; for he says he has had "less than half of your [my] forty-seven years' experience." Many engineers are still of the opinion that *that* homogeneous steel is iron of a good quality, but made by a quicker process. Now remember I am not a chemist, therefore I am not able to argue on the subject for or against. Be that as it may, however, the fact remains that the high pressure boilers above mentioned called for skilled mechanics. In this case I happen to know whereof I speak, for I worked for the London & North Western Railway under the late Mr. Webb, motive power superintendent, in 1878.

Thirty-six years ago I worked on steel (Otis) boilers of high pressure, in this country, much of it hand-driven rivets and some of it snap work, but never met with any trouble from leaking rivets. Therefore I maintain that past practice is not in any way inferior to the present-day practice in boiler construction.

Mr. Haas wants further details regarding the compressed air tanks. I fail to see what fuller details are wanted other than the ones already given, and it is quite unnecessary to repeat them here.

There is no question but that there has been great improvement in the last decade, if building boilers of a size that was not dreamed of twenty-five years ago can be called improvements; but it is an open question with the profession as to the benefits derived from such improvements, for with the monster locomotive has come the monster steel car with its carrying capacity of 140,000 pounds, and with the monster engine has come also the troubles of various kinds never heard of in the time of the light locomotive. The great question that many railroads have to face to-day is, does it pay? And from the viewpoint of a workman I cannot see how it pays, when we are told on the best authority that of the power generated by one of the modern monsters 80 percent is consumed to move itself. If the cost of production is reduced in the case of one of these engines, the cost of repairs and renewals has increased far above what it was before the so-called improvements were made. So many "improvements" have been made that to-day we have in this country many hundreds of different types of locomotives, some of them freaks—the developments of a pet fad of some engineer.

Recently in conversation with some boiler inspectors the subject of leaking rivets was brought up. One of the inspectors, well known to the writer for the last seventeen years, and who is employed by one of the railroads entering Pittsburgh, was sent to a large locomotive works to inspect the building of a number of locomotive boilers. This inspector told me that the boilers in question had to be calked three and four times before they could stand up to the required test. These works have a world-wide reputation for good work, yet they cannot build a boiler in which the rivets do not leak. Another inspector, quite a stranger to me, but who was inspecting a number of boilers for the company for which I work, upon being asked the following question: "In your experience as boiler inspector how many (if any) boilers have you passed, under test pressure, that did not require calking?" replied, "D——n few."

Regarding the silent boiler shop, I have this to say. I would rather work for a life-time in a boiler shop where there were ten gangs riveting by hand than ten hours in a shop where ten men were using the pneumatic of any kind. Like Mr. Haas, I am a heretic as far as the pneumatic hammer is concerned. Of all the tools of modern invention I think the air hammer the curse of them all. An old shopmate of mine was taken sick, and, upon going to the doctor, was questioned as to the nature of his work, which he said was boiler making and that he used pneumatic hammers all day. He was told to give it up and take the machine and bury it deep and stand over it with a shot gun to prevent it coming to life again. I am of the opinion that the air hammer has racked more nerves and destroyed health more than any other tool invented. I know of but one place in which a pneumatic hammer is of real service, and that is in a granite quarry. I saw them used there to advantage; and although they made an awful racket, there was not the same recoil, for the stones, although hard, absorbed much of the shock, and with very small machines I have seen some fine carving done. In fact any of your readers who live in Boston may see this work by looking at the columns (fluted) of the Museum of Fine Arts.

I will take Mr. Haas' word for it that he did not intend to be personal and let it rest with the audience, feeling sure that they will judge impartially and render a just verdict as to who is right and who is wrong; for I am neither prejudiced nor superstitious.

In one of my former letters I made a fair offer to the readers of this magazine. That offer still stands good. I am not a wealthy man or I would gladly pay the expenses of any gentleman sent by the editor to verify my statement, although I believe my honesty is transparent. I have stated the truth; I have gone into the enemy's country and shown that my statements are true; I have given names as far as it is proper to do so, and if there are any more from Missouri still in doubt I am waiting to show them.

Wilkinsburg, Pa. G. H. HARRISON.

Collapse of Internal Steam Pipes

Arising out of the question and answer under the heading of elongated tube holes, page 83, March issue, the querist raises the question of the collapse of internal steam pipes in a locomotive. He wants to know why it always flattens on the top and bottom and not on the sides. The reply quite rightly shows that collapse depends upon the area of local weakness, with which the present writer entirely agrees.

The peculiarity of the question is that the collapsed shape indicated in the question is directly at variance with the present writer's own experience. He has seen at least eight such collapsed tubes and years ago was concerned with the actual removal of three or four.

The typical collapse is that of an irregular triangle and this shape was so pronounced in all the cases that it might be termed characteristic. The remedy for the failure was replacement with a pipe a couple of gages thicker than the original, as it was obvious that the original thickness did not allow sufficient for wastage.

Exactly why the pipe should waste sufficient to collapse was never satisfactorily determined; nor why its failure should take the particular shape it did. The removal of the pipe itself was an extremely troublesome piece of work. It was secured at the smokebox end by a flange external to the plate, to which the breeches pipe was studded. At the dome end it was secured by half clips behind an annular projection which was the same external diameter as the opening in the smokebox tube plate. Ring bolts, through the eye of each of which passed the bolts securing the clips, were by means of a threaded end and nuts secured to the regulator mounting. The difficulty was that the splitting of these nuts corroded solid down the dome and partway under the barrel plate, a most awkward place to get at with the fire tubes in the boiler—the usual condition when removal of the internal pipe is required.

If ever there was a place where dissimilar metals should have been used it was in this case: the nuts should have been bronze to facilitate withdrawal.

Once these nuts were removed, however, and the clips dismantled (splitting the nuts of the second pair of bolts holding the clips together was far the worst part of the programme, because further from the dome and prone to turn), the pipe was withdrawn from the smokebox end. The operations usually took two whole days and were the most detested job ever tackled in that railway shop.

The writer proposed the remedy of a screwed clip with two lugs and two brass nuts to the drawbolts, the internal brazed collar which made the spigot joint being externally fine threaded This would have enabled the entire pipe to be revolved by the smokebox flange after slacking two nuts, and would have spread endless trouble and given a rational chance of dismantling. As, however, an English railway is the most conservative public utility on earth, the better construction failed to win acceptance during his time in the particular shop. The collapse itself is certainly peculiar and practically closes the pipe altogether. As already stated, the specimens seen had all the one general type, a collapse from three sides giving a regular figure akin to a triangle.

London, Eng. A. L. HAAS.

Improved Hydraulic Testing

For the modern boiler shop many alternative systems of applying power to various operations are open, Hydraulic, pneumatic, electric, have each their special place in the shop economy, to say nothing of the main shop drive.

It is by no means unusual in a well-equipped shop to find at least two of the alternatives in constant use. Combinations of two systems furnish considerable mechanical interest in their application, apart from their utility, and afford the designer opportunities for special purposes where limited space or direct economy lead to their adoption.

In the case of plant, hydraulic accumulators may utilize steam or even air pressure in substitution for the usual deadweight. Air receivers may be constructed to supply a constant pressure in a somewhat similar manner. In fact it would not be impossible to design a combined hydraulic accumulator and air receiver where both air and water should balance each other for supply purposes.

Recently a simple case of combined hydraulic power and air pressure came under notice. The rig-up is simple, the convenience undoubted, and its utility deserves publicity.

In the works where the apparatus is used large quantities of complicated pipe work and coils are made in addition to difficult tank and sheet work. For bending and flanging purposes hydraulic power at low pressure, 350 pounds per square inch, provided by a boiler feed piston pump, is piped around the shop. A modern air compressor, giving supply at 200 pounds, is used for drills and riveting. The rivets used do not exceed 5/8-inch. Nearly all the pipe work is for pressure purposes and has all to be tested.

With regard to the utilization water power, few seem to consider the value of the pressure existing in the ordinary town mains. In a hilly district this may be as high as 80 pounds per square inch and is very rarely less than 30 pounds. So cheap and easy, a source of hydraulic power is often overlooked; hence this digression.

In the case of complex pipe work, involving a number of double bends (such work has come into being largely owing to the facilities afforded by modern welding), there is a difficulty in testing. This is in the disposal of the water from the jet after it has passed the test. In fact some of the work done by the shop in mind would defy ordinary methods to empty completely—only by repeated reversal and consequent waste of time and labor could many pieces be drained.

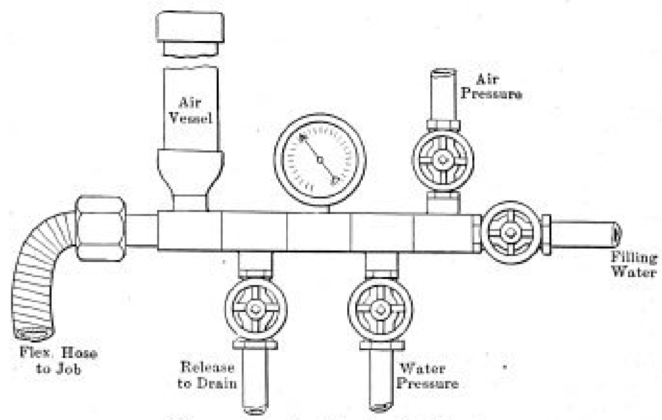
To effect the emptying promptly the shop air service is requisitioned and the test water is blown out. This used to be done by uncoupling water service hose and coupling up the air pressure.

The tester, whose condition under the circumstances was decidedly moist and unpleasant, turned his attention to a remedy where, by a simple arrangement, air and water services are connected up, used alternately, and the job of testing simplified. The atmosphere to-day is less reminiscent of the seaside and the cost of testing very much reduced. Lower cost, by the way, is a usual correlative of improved working conditions. It is gratifying to relate that the improvements made by the tester brought him a monetary recompense.

The sketch shows the device, which is made up from screwed tee pieces, and simple manipulation of the valves serves either to fill, put on pressure or blow out the contents of the job.

One point about the device calls for special notice. The closed end pipe *A* acts as an air vessel does on a pump and results in a steady pointer on the gage. The wild fluctuations of pressure usual are quite absent. This last is an idea worth some further application.

In a boiler test pump it is frequently the case that the pump fitted thereto is badly strained and unreliable after



Connections for Hydraulic Testing

short service. The severe pulsations of the adjacent pump inflict great hardship on the Bourdon tube of the gage, which is, after all, quite a delicate piece of mechanism. Two gages are often fitted for the reason alleged, one to give indication of rising pressure and the other only opened up to pressure to confirm reading. The interposition of an air vessel with its dampening effect would enable the pressure gage to retain its accuracy over a longer period. The only pertinent objection is that in testing a boiler a solid, uncushioned effect free from pocketed air is sought. While the air vessel so fitted to pump would in reality not in the least affect the desired result, it might be objected to on the grounds stated. The gage, therefore, might always be fitted direct to the boiler where the pulsations of the pump would not be felt so severely by the gage.

To ensure the release of pocketed air, the release cock should be at the highest point of the boiler and the boiler canted to ensure the desired result. Further than this a closed end W. I. tube, similar to that shown in the apparatus illustrated, might be used at the highest point of boiler shell, say on one of the mounting blocks. This would serve as a cushion and also form a positive point where pocketed air might collect.

One other matter involves the considerable amount of air in suspension in the water. The pressure when applied causes the minute bubbles to coalesce into larger amounts and these in turn may collect into a fair-sized air pocket, thus frustrating the severity of the searching hydraulic test. The foregoing are well-known phenomena and it is thought that the provision of a definite point of collection would minimize the acknowledged trouble. Moreover, if part pressure and release is performed as it should be in hydraulic testing, the air pocket under the conditions outlined would be outside the boiler shell itself, which would thus receive a more searching test.

A. L. H.

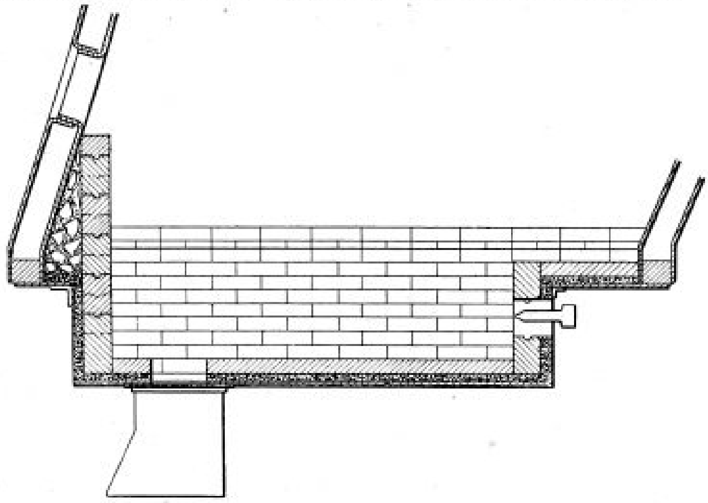
Selected Boiler Patents

Compiled by
GEORGE A. HUTCHINSON, ESQ., Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchison.

1,259,030. LOCOMOTIVE FIRE BOX CONSTRUCTION. JESSE C. MARTIN, JR., OF SAUSALITO, CALIFORNIA.

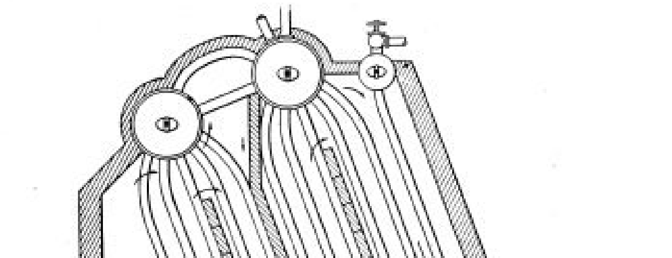
Claim.—In combination with an open bottom oil-burning locomotive type fire box, of a metallic fire pan having downwardly inclined side walls united to and depending from said box, refractory sides and bottom walls for the fire pan, a removable flash end wall and opposing end wall fitted within said pan and held in place therein intermediate



the ends thereof and the ends of the sides and bottom walls, said end walls being composed of corner tiles and an intermediate wedge tile adapted to interlock one with the other, and each consisting of a series of superimposed interlocked independent unit members having angularly disposed end walls, the angle of the outer ends of said corner tiles corresponding to the inclination of the fire pan side walls and the inner ends thereof corresponding to the taper of the side walls of said wedge member whereby a three unit construction may be employed, the flash end wall extending from the bottom of the fire pan to a point within the fire box above the mud ring thereof.

1,259,654. BAFFLE CONSTRUCTION FOR BOILERS. EDWARD C. MEIER, OF PHOENIXVILLE, PA.

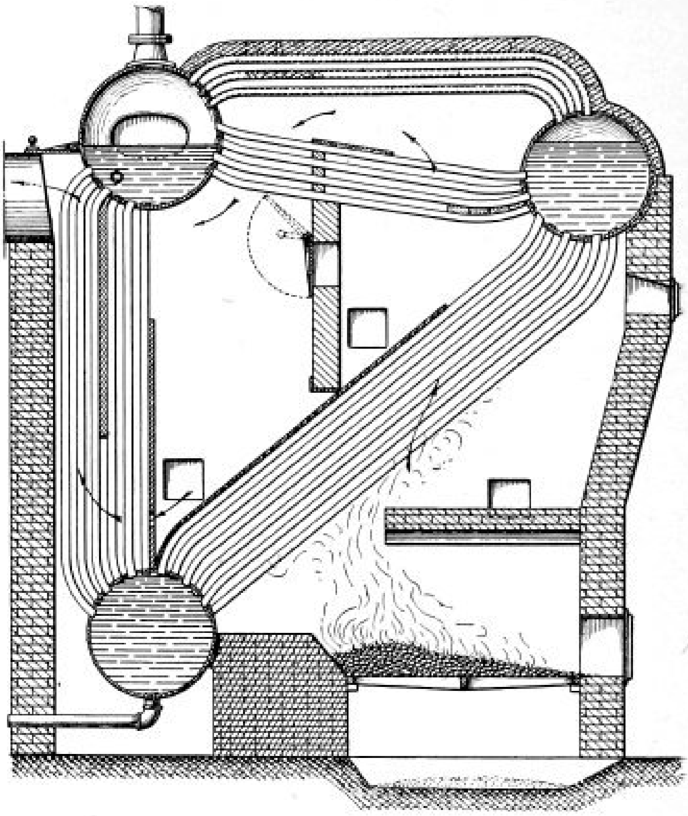
Claim 1.—The combination with a boiler having a plurality of units, each unit having an upper and a lower drum, and two sets of tubes, one set communicating with the upper and lower drums of one unit,



the other set communicating with the upper and lower drums of the other unit, of a baffle extending from the upper drum of one of the units to the lower drum of the other of the units and having a portion extending from the latter mentioned drum to the lower drum of said first mentioned unit, other baffles spaced from both sides of said first baffle to cause the products of combustion to move between them and said first baffle and to include certain of said tubes between them and said first baffle, said first baffle having an opening in alinement with said lower drums, said portion of the first baffle providing a barrier for directing the products of combustion, after they pass through said opening from one side of the first baffle, upwardly through the space between the other side of the first baffle and the adjacent one of said second mentioned baffles. Six claims.

1,259,660. STEAM BOILER. THOMAS T. PARKER, OF NEW YORK, N. Y.

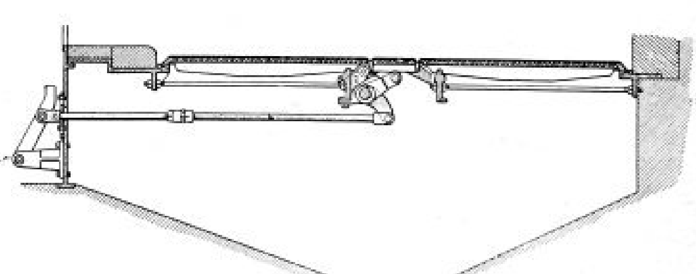
Claim.—A transverse drum watertube boiler having a lower water drum and two upper steam and water drums, the latter drums being located at the front and rear respectively of the boiler setting, three banks of watertubes whereof two banks connect the lower drum with



the upper drums respectively and whereof the remaining bank connects the two upper drums, and a bank of superheating tubes connecting the upper portions of the two upper drums, said setting having therein a firebox below the forward bank of watertubes, an outlet in rear of the rearward bank of watertubes, and a vertical wall located below the bank of connecting watertubes for the two upper drums, said wall having an opening therethrough, and a manually-operative damper for said opening, whereby the hot gases in their flow from the firebox to the said outlet can be diverted through a path below the last-named watertubes.

1,259,646. FURNACE GRATE. WILLIAM McCLAVE, OF PENNSYLVANIA, ASSIGNOR TO McCLAVE-BROOKS COMPANY, OF SCRANTON, PA., A CORPORATION OF PENNSYLVANIA.

Claim 1.—A furnace grate comprising front and rear spaced stationary grate sections, each stationary grate section being provided with an overhanging edge disposed oppositely to the overhanging edge of the other stationary section, and an intermediate dumping section adapted



normally to bridge said front and rear stationary sections, said intermediate section being adapted to engage the overhanging edges of the stationary sections, and tiltable on a transverse axis wholly beneath the fuel supporting areas of the stationary sections, and means for so tilting said intermediate dumping section. Eleven claims.

1,260,925. PRESSURE GAGE FOR STEAM BOILERS. FREDERICK H. LOVERIDGE, OF CHICAGO, ILL.

Claim 1.—The combination with a steam boiler, of a stub-tube communicating at one end with the interior of said boiler at approximately the lowest desired level of the water in said boiler, a closed tube containing a fluid, said closed tube having one of its ends inclosed by said stub-tube and having its opposite end terminating in a Bourdon tube, mechanism, responsive to the operation of said Bourdon tube, for controlling the feed of water to said boiler, and indicator mechanism, operated by said Bourdon tube, for indicating whether the water in said boiler is up to the desired level and also for indicating the pressure of steam in said boiler when the water is below said desired level. Four claims.

THE BOILER MAKER

JULY, 1918

Schwab Appeals to Boiler Manufacturers*

Director-General of Emergency Fleet Corporation Asks for Prompt Delivery of Boilers—Recognition for War Industrial Service

The situation of this great shipbuilding industry, which chance, or fortune, or what not, has placed me in connection with, is indeed a critical one. The one thing that I have discovered and have devoted practically all of my time to since coming into the corporation has been the supplying of the accessories necessary for the completion of the ship.

Ninety Ships Waiting for Machinery

A lot of people thought that the building of the ship was the building of the hull. You gentlemen, of a more practical turn, know that that is very far from the truth. To-day, I think, we have 80 or 90 hulls floating in the water waiting for the engines, boilers and other equipment, at a time when every ship that can possibly be put into commission ought to be put into commission.

I attend the war councils in Washington every Wednesday. There is never any question of any kind that comes up that does not have fundamentally, at the bottom of it, the question ot securing ships and ships and more ships. The whole question of this war, in my opinion, and its successful outcome is going to be a question of our getting ships to transport and feed the soldiers when they go over there.

I wonder how many of you realize that only twelve and a half to fifteen percent of our shipping capacity is required to ship the troops abroad, but that from 85 to 87 percent of the capacity of the shipping of the United States is required to feed and take care of them when they get over there. It is true that we are sending vast numbers of troops abroad; 250,000 went over last month. The question of ships to take care of these people over there is one of such tremendous importance that it is hard to make one not closely in touch with it realize of what vital importance it is to our country.

Hulls Built Quicker than Equipment

I have no fear of the question of hulls any more. I am satisfied that the hulls of ships will be built much more rapidly than we are going to be able to supply the accessories for them. As a result of that I have availed myself, and we are availing ourselves, of every possible facility in the United States for securing engines, boilers and everything that goes into a ship.

I do not come here in any sense, in any spirit, of criticism. I know that nearly everyone of you are interested in supplying boilers for this great fleet, but every time I look over the list of where the boilers are coming from, where they are late, how much you are back in your deliveries, I shudder, because I wonder if this Association and this great industry realize that to them belongs the necessity of giving us the ships that we want.

The Fleet Corporation in Washington has nothing much to do with this. They are the contracting party. They have placed the contracts for this work throughout the United States and the obligation for the fulfillment of this contract does not rest with the people in Washington. It rests with the people who have undertaken it, and so does the credit, if credit is due, rest with the people who have undertaken the obligation.

Credit Where Credit is Due

As far as I am concerned I am going to see that the public and the world at large place the credit where the credit is due. If misfortune overtakes us, they must know where blame for the misfortune is due. Commencing with the first of the month, through a board of which Admiral Fletcher is the head, I am going to publish to the world broadcast, in every newspaper of the United States, the relative performance of every shipyard within the United States and have the public, the public at large, know the men who have patriotically done their duty and those who have failed. I am going to have this board consider all the circumstances and place at the top of the list of 140 odd shipyards in the United States, those who have done their duty best in relative order down to the last. I do not mind saying that I should dislike very much to find any firm over which I have control that is not mighty high on the list.

Public Recognition for Unusual Services

I am also going to institute, at the same period, the giving of recognition to the people who do things for the benefit of the Government at a time like this. We are going to give to the people in the allied trades, as well as in the shipbuilding trade, the opportunity of having public recognition for unusual services. I expect to have Congress authorize us, and in the event of Congress not desiring to authorize it, I expect to issue, with the approval of the President and of the Shipping Board, gold service medals, or silver medals that shall carry just as much distinction to the people who win that honor for distinguished service as the medal given to the soldiers who win honor in the trenches

I claim that the people engaged in industrial lines of war work in the United States cut just as much figure

*From an address before the American Boiler Manufacturers' Association, Philadelphia, June 18.

and are just as patriotic in fulfilling the industrial conditions that are necessary to win this war as the men in any other branch of the service, and there ought to be, where an unusual effort is given in any branch of the public service, public aknowledgment for the distinguished service in that direction. That is one thing I intend to do and shall start immediately to do, and so it will be my pleasure, and the pleasure of the President of the United States, to confer on some of you good people in the boiler trade the distinction that ought to mark the American man as a real man for all time to his family and his friends and his community.

Red Tape Cut

I do not have any doubt at all about the ultimate outcome of this whole shipbuilding programme, if they will just leave us alone. We are business men; we are not politicians. I came away from Washington, as you men know, saying that in my opinion the real shipbuilding business cannot be done in a political atmosphere. I wanted to be in some place where the work was going on. Philadelphia was the center of the shipbuilding industry and I came to Philadelphia. I would have gone anywhere where I was the nearest to and closest in touch with the work to be performed. And I have cut loose from all the red tape conventions of manufacturing. After a couple of months I do not hesitate to say to you, you have no doubt observed that the whole industry seems to have an impetus now that I am sure is going to carry us on to a successful conclusion.

Do not feel that we are not doing a big job, because we are. Last month we placed in service one ten thousand ton ship for every working day in the month. I never expect to see less than that. I never prophesy for the future. I always say let actions that have been done in the past speak for themselves. It is but fair for me to say publicly, in line with my policy in this thing, that the credit should be given where credit is due, and I want to say that the people of the Northwest and the people of the Great Lakes district, Mr. Pessano and his friends, and Skinner and Eddy and the people in the Seattle district have set the pace that has marked the shipbuilding industry of the United States.

Pacific Coast and Great Lakes Records

If you will take the list of ship yards published last month for the best week and notice the amount of rivets driven per day, you will find that in the first ten works, eight of the first ten are in the Northwest, and the other two are at the Great Lakes. That is not a very good commentary for us shipbuilders in the East, yet the facts are true. Those people deserve credit and I want the world to know that they deserve credit, and I want the world to know that half the ships which have gone into the Emergency Fleet to-day, notwithstanding all these great plants in the East, have come from the Pacific Coast and the Lakes. I want to put the two together. I do not think they will continue to hold that position because the great yards in the East have not really come into action yet. I hope they will do so soon, I know they will soon; they have got to come into action soon or they will go out of action altogether.

I am optimistic. I have asked the people of the country to stop their criticism and stand by us. I am not one of the people who believes in criticism. I believe that the best result is accomplished by the approval of the people, by their encouragement. Napoleon once said, "Let me win the first battle and I am assured of my campaign, because" he said, "if the people once have the spirit of successful onwardness, nothing will stop them, they will go right through with it," and what was true a hundred years ago is true to-day. I have failed to find the man, however great his position, who was not susceptible to the approval of his fellow man, and who does not do better work by being told that it is well done. Now that is the principle on which I am endeavoring to carry this programme through, and we are going to carry it through with your help.

You gentlemen must realize how important your part of the work is to the completion of this task. You ought to devote every energy to it regardless of what the profits or other conditions are, because if we do not win this war, your works and your business and nothing else will be worth considering or even thinking about. Therefore we have got to go to it with every ounce of energy that we possess. We must let nothing in the world stand in the way of it. Money cuts no figure in these times at all, and if the country demands that all we make goes for the support of this Nation, and victory comes, it is victory cheaply purchased. We have got to disregard money and work entirely for patriotic motives.

Schwab Ready to Help

Now, if I, as the head of this Emergency Fleet Corporation, for whom you are all working, can help you in any way, I want to do it. Don't hesitate to write or communicate or let me know. It is not always possible to see and meet you, because Mr. Pessano knows what a crowd I have about me of various kinds, and I have to have many people to help me. Do not feel slighted if I personally cannot do so much, but be assured that I am in touch, and if there is a real necessity I will come forward.

I want to take this opportunity to say a word about Mr. Pessano, because I have never seen a more patriotic act in my life than he performed a short time ago at Cleveland. I wanted the Great Lakes people to give me a million tons of shipping for next year. I do not know whether you realize how much that is, but it is a tremendous quantity, more than double what they have ever done in the past. I had them altogether and I said, "Gentlemen, I want you to give me this shipping, I must have a million tons. I will advance you the money necessary to build your works, I will do anything you want, but I must have that amount of shipping out of the Great Lakes for the next year." I said, "Now, under what conditions are you people willing to do this?" Mr. Pessano arose in that meeting where negotiations had at times been difficult, "Mr. Schwab, I, with my works and with all the influence I have, will do any work that you ask us to do that is within our ability to do, and you shall fix the conditions." That was a question involving a couple of hundred million dollars. It was a big, and it was a fine thing to do and it enabled me to carry it through with a vim and a zest that was a great pleasure. It was a great and patriotic thing, and I like to give Mr. Pessano the credit that is due him.

I do not feel discouraged, I am just as optimistic as I ever was, I am just as happy in my work as I have ever been in my life. I love to do things of this sort when there is a real motive back of it. I feel sure that the job, to use a slang expression, is going to be put over and put over because the people are with us, because the President is with us and because the country has confidence in us and confidence in you and everybody is contributing his part. Let it be a proud history, a proud memory in the minds of every manufacturer in America, when you come to talk over this great war in the years to come that you

(Concluded on page 200)

What is Ahead in Business?

Some Basic Facts Underlying its Conduct—War Products and Non-Essentials—Profits and Opportunities

BY EDWIN L. SEABROOK

LET us face the business situation. America is at war in dead earnest. War tolerates no competition; its demands are imperious and must be satisfied. It is the most exacting despot that ever ruled. At its bidding, agricultural, mining, manufacturing, transportation, must marshal their forces. The product of the mine, factory, forest, farm—in fact all the products of the genius of men, art, science, literature—must lay their all at its feet. It will tolerate no rival, nor brook opposition. It has taken the average business man some time to awaken to this fact, but it is becoming very clear to him now. It is not business as usual—but *unusual* business.

The War Department is talking of an army of five million men. Grasp the magnitude of providing everything these men need, remembering that war does not create, but destroys! When a million shells are fired in one day, what must be the output of mine, mill and factory to make good what has been destroyed, not only in shells but in equipment?

When the war began it was generally assumed in the United States that the production of war supplies could be undertaken as an *extra*. The mines, factories and workers were to be speeded up sufficiently to meet all war demands. Experience shows that this assumption was wrong. England learned by experience that "business as usual" was impossible, but it took her business men two years to find it out, and that the non-essential must be eliminated.

Someone has said business for the year 1918 is likely to be what the business men of America *will* to make it. This is true in a large measure, but any forecast of business for months to come may be most unexpectedly set aside by military operations, or political events. Business decisions, however, must be made. Business must go on, not "as usual," but in the experience and demands of day-to-day conditions, and these may change quickly.

The first great outstanding fact is, the war must be won by the Allies. The interests of business and of the Government are one. The principal business of the Government at the present time is war. There must be an absolute unity of purpose. Anything and everything that can be done to win the war, or to shorten it, must be done. Anything that does not contribute to this sooner or later will have to be eliminated. The Government must have the first call on the resources of the nation. What the Government needs, therefore, from industry and business becomes the first question.

Materials

The enormous and urgent demands of the Government have already caused a shortage of material in many lines, and this will increase rather than decrease. In the early part of May the Government practically "commandeered" all the iron and steel of the country. It did not say "commandeered" in so many words, but the result amounts to about the same thing. Ships, cannon, machine guns, have the first call on the iron and steel from the ore in the mine, upward. If there is not enough for these and for nails, hardware, plumbing goods, furnaces, boilers, etc. then the latter must wait until there is. There is no time to think of these things.

There will also be a shortage of materials which must be imported from distant points and those of domestic production for which there are great demands at home and abroad. The business that is dependent upon these scarce materials will probably find its volume measured by the amount of such materials that can be secured. The ingenuity of the American business man will be tested to solve this problem. Either a smaller amount of the scarce material must cover more of the output, or substitutes will have to be worked out.

The Non-Essential

The war products must receive the first consideration, hence economies in material, fuel and transportation are necessary. The Priority Board was created to meet this problem. A reliable authority states that at one time it was proposed to curtail or eliminate from four hundred to six hundred industries. A little study showed the impracticability of throwing out this number at a single stroke. A large percentage of the so-called non-essentials is probably produced by small concerns and shipped in less than carload lots. A wholesale elimination of industries must naturally lead to serious if not disastrous results. The interrelation of business and industries is such that to shut down any considerable number means bankruptcy to some and an unwholesome effect on the whole financial fabric.

Neither can investments and overhead expense be reduced by the stroke of a pen 50 percent without involving credits and inviting bankruptcy. Neither can a great number of industries reduce their normal output by fifty or seventy-five percent, unless this reduction is made up from some other source. It is quite plain that if the non-essential goes the Government order must take its place. Hence it cannot be business as usual. Business must readjust itself to meet this condition. This applies to small concerns as well as the largest industry. Business that is being conducted on the basis of the year 1914 must either be readjusted or eliminated. In some sections of the country many small concerns in some lines hesitated or refused to increase the wages of their mechanics when these began to go up. Consequently these firms are left with scarcely any mechanics to take care of what business they have. What these business men did not see, when wages began to increase, was that to hold their business they must retain their mechanics, and to do this the wages would have to be increased to meet the competing conditions of the firms engaged in Government work.

Profit

Business *must* earn money. If the credit of the nation is to be maintained, if the Income Tax is to be a substantial source of revenue, if Liberty Bonds are to be subscribed to in ten figures, business must be conducted at a profit. It must be a self-evident fact, apparent to every one, that unless business itself and those employed in business and industrial establishments, earn money, there is no other source from which the Government can expect to raise the money to carry on its operations. Every one admits that conservation is necessary in all lines, but it is important that so far as possible it be effected without reducing the total volume of business. Business cannot be seriously curtailed without reducing it to a non-profit basis.

Business must be encouraged for its own sake, for the sake of the money there is invested in it, for the sake of those employed by it, but, greater still, for the sake of the Government. It must be encouraged to conduct its affairs legitimately, energetically, and in all reasonable ways to earn money. This must be in order that the Government may be supported either through its own taxes and contributions, or the contributions of the employees, owners, stockholders, or all. An alert business nation must stand back of the Government to the very limit in the greatest industrial undertaking that history has even seen. Our credit operations are great, but underneath these there must be sound business prosperity. Business men must be alert. They must not doubt, hesitate, nor shrink, for any or all of these things mean a reduced amount of national earnings.

LABOR

The most serious factor in the output of industry is the shortage of the labor supply. There is a disposition in some quarters to question this shortage, and some have gone so far as to deny it. The basis for this reasoning must result from one or more local viewpoints, rather than from looking at the nation as a unit. Those who are trying to find labor for various operations are unanimous in their opinion of its scarcity. It is not possible to take several million able-bodied men from the industries all over the country, speed up production beyond normal, without feeling its effect. There are fewer men to do more work that must be done, and some way must be found to enable these fewer men to do more work if the needs are to be met.

American ingenuity will undoubtedly solve this problem. Labor-saving devices, standardizing labor methods, organizing vacation labor of colleges, schools and teachers would give some relief.

The first aim is to win the war, but an active business of normal amount is essential. This means elimination of waste, careful management, alert to every opportunity to adapt the production of the factory or mill to meet new demands. Sound financing, no matter how small the business, is another necessity. Unusual demands must be met, therefore business cannot go on as usual. The man who tries this will see himself passed by another who meets these new conditions. The manufacturer and dealer must supply what present conditions dictate, and must educate his customers to adapt themselves to these new necessities.

CO-OPERATION

Present conditions have demonstrated that the spirit of co-operation among those in the same line of business is greater than ever before. The desire among business men to lay aside rivalry and co-operate for the common good is manifesting itself in every line. The building of cantonments called for enormous quantities of lumber from a certain city. All the lumber dealers were asked by the contractors for quotations, quantities, etc. These lumber dealers went to Washington and asked if they should all name a common price to the contractors, whether they would be considered violating the Sherman Anti-trust law. They were informed that under the circumstances the pooling of their supplies would not be considered a violation of the law. This action on the part of the lumber dealers was taken not to eliminate competition, nor increase the price, or pooling the amount of material on hand, to restrain trade, but to co-operate with each other in serving the Government.

A National Trade Organization, whose members are engaged almost entirely in a line of metal work, recently sent out a questionnaire for shop capacities and character of work that could be produced. This was to bring the purchasing departments of the Government and the shops that could make the requirements of the Government in their line together. One of the questions was whether the recipient of the Questionnaire would be willing to unite with other shops in his locality on an order if time was a factor. Of the hundreds of replies received, only one answered "no," and even this may have been a typographical error.

The members of a metal trade in one city was handicapped by the shortage of help. As the members of the organization were practical at the trade, having served time as mechanics, they seriously proposed helping each other by working themselves for one another, if orders were received too large for any one to handle under the help shortage condition.

Another firm was offered a certain order which would overload its capacity within the time required. This firm immediately asked some of its competitors, who were fellow-members of their trade organization, what help they could give.

These instances indicate the co-operative spirit, the willingness to help and a realization that while business must go on, it cannot be conducted as usual, but must be adjusted to suit conditions created by the war.

OPPORTUNITIES

No time in this generation have business conditions been so full of change. The business man never had so great an opportunity to meet present-day needs and gain permanent customers; nor have conditions demanded of the local business man such careful education of his customers. The man who shirks his business, abandons his customers, injures himself and weakens the whole business structure.

There is room for all the new Government activities and demands, and at the same time for a good portion of the normal volume of business. It must be realized, however, and if a portion of this normal amount of business is to be produced, the individual business man must adapt himself to the changed and constantly changing conditions. If he will do this he need have no fear as to the ultimate outcome, but if he will not adapt himself to present-day conditions, he must expect to be outrun in the race. The business man who has not or will not adjust his affairs, and the conduct of his business, to meet present conditions, will find himself without any business, because it will go to those who can take care of it.

Rehabilitation of War Cripples

BY DOUGLAS C. MCMURTRIE*

THE provisions which the United States Government are now making for the soldiers disabled at the front are inspired by the experience of the belligerent countries of Europe and by the new possibilities that experience has shown of utilizing as productive units what in former generations used to be so much human waste. Our policy towards our war invalids will mark a notable departure from their treatment in the past. The government will not consider the national duty toward the dis-

* Director, Red Cross Institute for Crippled and Disabled Men, New York City.

abled soldier accomplished by simply granting him a pension. The pension system has proved a failure in the past. The pension never can be enough to support the man in decency; it is usually just sufficient to act as an incentive to idleness and semi-dependence. Now every disabled soldier will, in addition to his pension, be given the opportunity of vocational training to prepare him for a useful and remunerative trade. A bill recently passed by the United States Senate has entrusted the Federal Board of Vocational Education with this task.

Training schools for crippled and disabled soldiers have been in operation in all belligerent countries since the beginning of the war. It has been found that while a cripple may be debarred by his handicap from certain occupations, there are, in most cases, a considerable number of other occupations which even a seriously crippled man could pursue, provided the occupation is chosen intelligently and he is given an adequate training. The number of trades that are being taught in the hundreds of "re-education" schools in Europe are legion. They include automobile engineering, machine tool work, different branches of electrical work, mechanical drafting, locksmithing, blacksmithing, cabinet-making, wood-carving, toy-making, printing, book-binding, shoemaking, tailoring, harnessmaking, making of artificial limbs, commercial subjects, agriculture, and so on.

With the experience of other countries before us, we should consider our work for the war cripples creditable, not by equalling, but by excelling the results accomplished abroad. But success will depend primarily upon the attitude of the public. The government will be able to successfully carry out its programme of reconstruction only if it is actively supported by citizens of all classes. In the past the attitude of the public was a hindrance rather than a help in all attempts to devise some way of constructive assistance to cripples. We were all too ready to consider the cripples as helpless and to condemn him to an ignominious existence of idleness. Crippled men testify unanimously that the "handicap of public opinion" had been to them a greater obstacle than the loss of a limb. We must rid our minds of all the old prejudices with regard to cripples, since it has been proved that the cripple is not necessarily helpless.

We must, in the first place, find for the cripple the kind of a job for which he is capable. We must not think of a charity job, but of an occupation which the man could hold on the basis of competency and in which he could grow. The duty of every employer is now to study the jobs under his jurisdiction that might be satisfactorily held by cripples and to give the cripples preference for these jobs.

If physical cripples are an unavoidable product of the war, it is up to us to spare our country the waste and the disgrace that would be involved in the existence of thousands of economic and social cripples. Give the men physically crippled work they can do.

Calculations of Sheets for Tapered Stack

Arrangement of Forms for Recording Calculations for Ordering and Laying Out Cone Sheets for Tapered Portion of Stack

BY JOHN A. COLE*

Fig. 2 represents a form for arranging in sequence the work necessary in calculating a "cone sheet" for the taper portion of a stack. These "forms" can be made in blank and reproduced in quantities and will prove a great time saver, as well as reducing to a minimum the chances for error, wherever there are self-supporting steel stacks to be "laid out." The necessary calculations, at best, are a tedious operation, but by always using the above "forms" the work is systematized, tending to greater speed and accuracy. This "form" can also be used for conical hopper bottoms or wherever it is necessary to develop the surface of a right section of a cone.

* Engineer, Pittsburg, Pa.

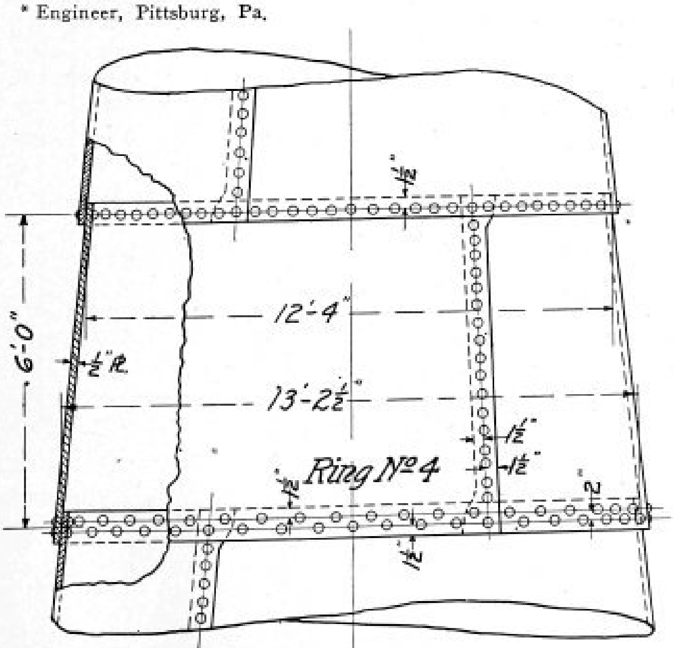


Fig. 1

Referring to Fig. 1, let this represent a portion of a steel stack, and let it be required to "lay out" the pattern for one of the sheets for the fourth ring, assuming it to be made up of four sheets to the ring.

Taking the upper row of rivets of the bottom seam of the ring as the "working line" for bottom and the rivet lines as "working lines" for the sides and top, we can "fill in" on the "form" (Fig. 2), the values of 1, 1_1 and 1_2.

From Fig. 1, we can determine the mean diameter at the top, which is 148 inches minus ½ inch or 147½ inches. The mean diameter at the bottom is 158½ inches plus ½ inch or 159 inches. Inserting these in the "form" and dividing by 2, as indicated, gives us the values of a and b, whose difference gives us the value of d (formula 1). We also obtain from Fig. 1, the value of h (Fig. 2), which is 72 inches minus 1 inch, or 71 inches.

Next, by inserting the values of d and h in the "form" and then finding their logarithms, we obtain the log tan of the angle A (formula 2). The numerical value of this angle is of no use in the calculations and is only put down as a check, but while we have our "log book" open at the log tan of this angle, we also determine the log sin and insert it in the "form" at the several places it is required. We then insert the value of n (4 for this problem), divide it into 180 and then "look up" the log of the

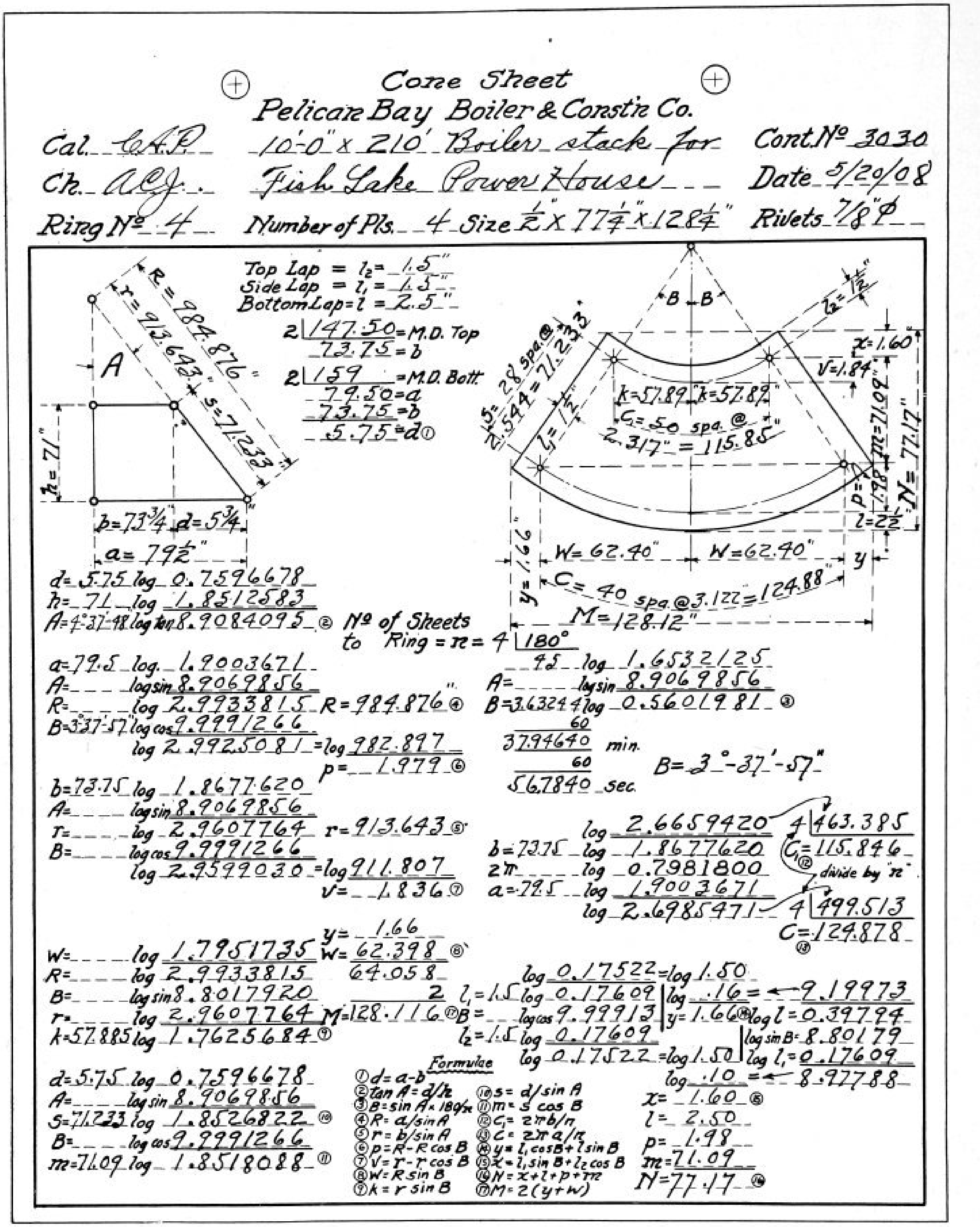


Fig. 2

quotient. To this we add the log sin of the angle A, previously put down, which sum gives us the log of the required angle B in degrees and decimal of a degree (formula 3). By multiplying successively the decimal part of the degrees and minutes by 60, as indicated, we obtain B in degrees, minutes and seconds. We next "look up" the log sin and log cos of B and insert them in the several places where required

Continuing, we determine the logs of a, b, and d, putting them in their respective places. From the log of a subtract the log sin of A, which gives the log of R (formula 4). From the log of b subtract the log sin of A, which gives the log of r (formula 5). From the log of d, subtract the log sin of A, which gives the log of s (formula 10). After determining these values from their logs we obtain a check on the work, as R should equal the sum of r and s. Insert the value of S on the sketch of "cone sheet." Assuming the pitch in this seam to be about 2½ inches, we find that 28 spaces at 2.544 inches equals 71.233 inches (or s), so we put this down. Next add the log cos of B to the log of R, and the number corresponding to this sum subtracted from R gives p (formula 6), which is set down on the sketch of the "cone sheet." Similarly we obtain V (formula 7).

We next copy the logs of R and r, respectively, above and below the log sin of B, as indicated, and then in turn add the log sin of B to each of these two logs, the upper addition giving us the log of W (formula 8), and the lower addition, the log of k (formula 9). Next add the log of s to the log cos of B, both of which are already set down, and their sum gives the log of m (formula 11). Then above and below the log of 2π we copy the logs of b and a, adding each in turn to the log of 2π. The number corresponding to the upper addition, divided by n (or 4) gives us the value of C (formula 12). Similarly, the lower addition gives the value of C (formula 13). Assuming the pitch in the top seam to be about 2⅜ inches, we find that 50 spaces at 2.317 inches equals 115.85 inches (or C). This memorandum is then transferred to the "sketch."

Assuming the pitch in the bottom seam to be about 3 inches, we find that 40 spaces at 3.122 inches equals 124.88 inches (or C). This is transferred to the "sketch" and gives the spacing in the upper row of rivets of the double riveted seam, from which the lower row can be readily located.

We now have sufficient data for completely "laying out" the sheet, but further calculation is necessary in order to determine the exact size of a rectangular sheet to be ordered for this pattern.

Proceeding, we determine the logs of 1_1 and 1_2, placing them, as indicated, above and below the log cos of B, already placed, and then in turn add each of them to the log cos of B. Looking up the numbers corresponding to these logs, we place them at the right of the logs, as indicated, both being 1.5 inches in this problem. Next, place the logs of 1 and 1 above and below the log sin of B as indicated, and add each in turn to log sin B. Looking up the numbers corresponding to these logs, we place them to the left of the logs, as indicated, directly under the values of (1_1 x cos B) and (1_2 x cos B). Adding the two values in each case gives us the value of y and x (formulas 14 and 15).

Under the value of X, copy the values of 1, p, and m, as indicated, all previously determined, and the sum of these four quantities gives the value of N (formula 16), which is inserted in the sketch.

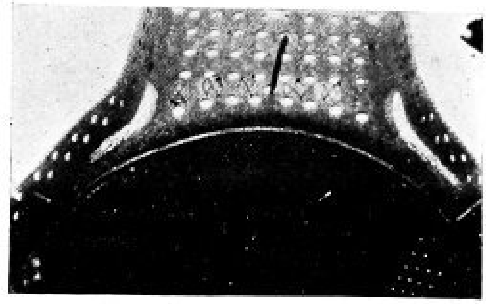
Next copy the value of y directly above the value of w, as indicated, then add these two quantities and multiply by two, which gives the value of M (formula 17), which is then inserted in the sketch, completing it. We now see that it will require a rectangular sheet 77.17 inches x 128.12 inches or say 77¼ inches x 128¼ inches. We then insert this size at the top of the sheet (Fig. 2), which completes the problem.

The "form" now contains all the data necessary for ordering the material and "laying-out" the sheet. One "form" is required for each ring of the tapered portion of the stack. They can be kept conveniently in a loose-leaf binder.

Cousins & Sons, boiler makers, Buffalo, N. Y., are building a reinforced concrete shop at Hopkins and Tifft streets and the South Buffalo Railroad, to cost about $25,000.

Welding Cracks in Throat Sheet

The illustration given herewith shows the boiler and throat sheet of an O. G. firebox turned upside down. The heel of the flange showed small cracks, so "the boss" had me cut a line down through the center with the cutting torch. The cut was then V'd out, cut and welded from



Position of Welds in Throat Sheet

the inside and smoothed up on the outside. The crosses show an extra row of staybolt holes welded by the same means. The whole job took about a day and a half and 200 cubic feet of oxygen and acetylene.

There is no limit to the jobs we do with this outfit; and the beauty of it is that we generally succeed.

Vancouver, Wash. L. J. HERTEL.

Compressed Air Terms Defined

Upon the recommendation of its technical committee the Compressed Air Society, New York, has adopted the following definitions of certain compressed air terms in order to eliminate confusion as to their exact meaning:

Displacement—The displacement of an air compressor is the volume displacement by the net area of the compressor piston.

Capacity—The capacity should be expressed in cubic feet per minute and is the actual amount of air compressed and delivered, expressed in free air at intake temperature and at the pressure of dry air at the suction.

Volumetric Efficiency—Volumetric efficiency is the ratio of the capacity to the displacement of the compressor, all as defined above.

Compression Efficiency—Compression efficiency is the ratio of the work required to compress isothermally all the air delivered by an air compressor to the work actually done within the compressor cylinder as shown by indicator cards, and may be expressed as the product of the volumetric efficiency, the intake pressure and the hyperbolic logarithm of the ratio of compression, all divided by the indicated mean effective pressure within the air cylinder or cylinders.

Mechanical Efficiency—Mechanical efficiency is the ratio of the air indicated horsepower to the steam indicated horsepower in the case of a steam-driven, and to the brake horsepower in the case of a power-driven machine.

Overall Efficiency—Overall efficiency is the product of the compression efficiency and the mechanical efficiency.

The Society further recommends that the use of other expressions of efficiency be discontinued.

THE CHICAGO PNEUMATIC TOOL COMPANY announce the appointment of L. C. Sprague as their special representative in connection with the sale of pneumatic tools to railroads. Mr. Sprague was formerly connected with the company but more recently has been connected with the railroad department of The H. W. Johns-Manville Company, New York city.

Boiler Manufacturers' Convention

Thirtieth Annual Meeting of American Boiler Manufacturers' Association, Held in Philadelphia, June 17 and 18

The thirtieth annual convention of the American Boiler Manufacturers' Association was opened at 10:30 A. M., Monday, June 17, in the Bellevue-Stratford Hotel, Philadelphia, with M. H. Broderick, president of the association, in the chair. The association and guests were welcomed to Philadelphia on behalf of the mayor and citizens by Dr. E. J. Cattell, city statistician. Following Dr. Cattell's address William H. Barr, president of the National Founders' Association, discussed informally the present industrial conditions and their relation to war work.

The next speaker introduced was D. M. Medcalf, chief inspector of steam boilers, Toronto, Ontario, Canada, who described industrial conditions in Canada, especially as relating to shell making, shipbuilding and aeroplane building. His address in part was as follows:

War Work in Canada

BY D. M. MEDCALF

Canada has been in the war for the past four years, during which time we have unstintingly contributed men, money, and war material towards its successful termination. Within two months of the outbreak of the war Canada concentrated, armed, and sent to England an expeditionary force of 33,000 men—a voluntary army; the first complete Canadian Division ever assembled, with more than half a reserve Division. This force was by far the greatest body of soldiers that ever crossed the Atlantic up to that time, and it comprised cavalry, artillery, infantry, engineers, signallers, etc., with complete equipment.

The fact of raising such a force is very remarkable when one considers that the overwhelming majority of the men who volunteered were civilians without previous experience or training, and as an example of administration rising to an emergency the effort has never been surpassed. Since those days we have put under arms nearly half a million men, and our casualties number 150,000. There are to-day in Canada 40,000 men who have been invalided home from the battlefields of Europe, and this number is being added to at the rate of 1,500 per month.

Our national debt has reached the enormous sum, for us, of $1,400,000,000, an increase of over 25 percent since the outbreak of the war, and yet, notwithstanding our great sacrifices, past and present, we know our duty is to put forth the maximum effort, irrespective of what the cost in men or money may be, or however long it may last, and we have thrown in our lot to the last man, and the last dollar if need be.

Shell Making

Last month announcement was made by a Canadian firm of the acceptance of an American order for the manufacture of 9.5 and 4.7 high explosive shells. The contract approximates an outlay of $7,000,000 and necessitates new building and equipment at a cost of $1,000,000. This company is just finishing up a large contract for the manufacture of 4.5 shells. The value of orders for munitions last year approached $800,000,000, and the value of munitions shipped to date is close to $600,000,000.

Some of our largest boiler shops are almost entirely engaged in this work, and comparatively few stationary boilers are being constructed at the present time.

Shipbuilding

Shipbuilding in Canada is an outstanding feature of our industrial achievements during the past year or so. In the year 1884, Canadian shipbuilding was at its high water mark, the tonnage shown on the registry books of the Dominion for that year being 1,253,747. Since then the years following have shown a steady decrease, and at the end of 1916 the registered tonnage totaled only 942,559, or 25 percent less than the high water mark of 1884.

The vital need for ships at this time has awakened this industry. A large number of new yards have been established, all of which, together with those of many years' standing, are working at full capacity. Those shipyards are located at most of our ports, both inland and seaboard, and great success has everywhere been achieved.

The majority of ships constructed and under construction are of standard design and some of our yards are making a specialty of wooden freighters. The tonnage of these ships ranges from 2,500 to 7,000. As yet, there is no restriction to the variety of ships that our shipbuilders may build, although the order of the day, however, is for cargo ships. According to the chairman of the Imperial Munitions Board there is under construction in Canada one-quarter of the total merchant tonnage produced by the United kingdom in 1917, and four-fifths of it will be completed this year. Several Canadian-built ships have already been delivered, and are to-day carrying the much needed food supplies to Great Britain and her Allies. The Canadian-Vickers Company, at Montreal, have just launched a 7,000-ton cargo ship; the vessel has a length of 380 feet and a beam of 49 feet. Five minutes after this ship was launched another keel was laid down, and the ship will be completed October 1.

The engines for these ships are built in Canada. A number of the larger yards have their own engineering shops, while many plants formerly specializing in stationary engines and boilers are almost entirely engaged in marine work. The engines for the cargo steamers are for the most part of the ordinary marine type and average 1,000 to 2,500 horsepower.

The boilers are of the Scotch marine and the Howden watertube types. Great difficulty has been experienced by Canadian boiler makers in obtaining corrugated furnaces, and many plain butt strap furnaces are being used, the material of which in some cases is 13/16 inch thick.

The Howden type of watertube boiler is made up of three elements, each consisting of a top and lower drum, connected together by straight tubes. The tube plates are flat and very heavy, and are counterbored for the tubes. A cross drum couples the three elements together. The fire passes underneath the lower drums and back through the tubes to the uptake. Like all watertube boilers, the casing involves a lot of work, especially when forced draft is fitted. Two hundred pounds steam pressure is carried and the boilers are credited with being rapid steam generators.

The majority of wooden freighters, of about 2,500 tons carrying capacity, are being constructed in British Columbia. The total capacity on order aggregates 115,000 tons. The wooden shipbuilding programme of our Imperial Munitions Board, however, is likely to be discontinued, although shipments of British Columbia fir are being made to the United States for shipbuilding purposes in connection with the Emergency Fleet. Conditions are such in Canada that the wooden ships have to be built out of virtually green timber, for the most part, and consequently give trouble by leaking and warping with exposure. Undoubtedly these ships are a passing fever induced by the need of tonnage of any kind, and money put into this industry may become a dead loss at a later date.

Canadian engine and boiler manufacturers have secured a large number of contracts for foreign Governments during the past year or so. One prominent firm is making locomotives for Trinidad railways. They were of a special type, with copper fireboxes and brass tubes. Several marine boilers are also under construction for the French Government.

A number of enterprising Canadian engineering firms are participating in the distribution of machinery orders for vessels on the United States Government programme, and very good progress is being made in the matter of this particular equipment output. There is little doubt that further substantial contracts will be forthcoming from the same source, and Canadian manufacturers are doing their utmost to meet this unusual demand.

As a result of the extraordinary development which has taken place in the shipbuilding industry during the last year or two, there has naturally been a corresponding increase in the imports of ship plates and other varieties of steel necessary for the work of construction. Prior to the recent development in the shipbuilding, the quantity of plates, angles, beams, etc., imported for the construction of steel vessels ran from 300,000 to 400,000 hundredweight annually. During the year ending March, 1917, the quantity increased to 530,205 hundredweight, and the imports of this material for the present year surpass all previous records. Canadian manufacturers, however, have been very much handicapped in their operations as a direct result of the United States war activities. They are dependent to a very large extent on the United States for the supply of steel, especially plates. About 99 percent of Canada's imported steel supplies is obtained from American manufacturers. There is an embargo on all such steel at the present time; and while provision is made whereby export under license may be effected, no end of inconvenience and delay have been experienced in procuring the necessary material.

In order to meet the demands of Canadian shipyards in future years, construction of a three- to five-million dollar plant for the rolling of steel plates, etc., is now in full swing at Sidney, Cape Breton. The Dominion Iron Steel Corporation are the builders of this rolling mill, which will be capable of producing 150,000 tons of ship steel annually. This plant will receive orders for its products from the Canadian Government, and will be ready for operation in from fifteen to eighteen months. No direct financial aid is being given by the Government towards the construction of the plant, but the fact that sufficient orders are guaranteed to assure the plant being run on a profitable basis allows the industry to start its career under favorable conditions. The years following the war, however, will be the testing time when in the building of steel ships the shipyards of Canada will necessarily be compelled to meet competition in the open market or go out of business.

STEEL MAKING

Although pig iron was produced in Canada 188 years ago, the making of steel is decidedly a modern enterprise. Until as recently as 1883, just thirty-five years ago, all the steel used in the Dominion was imported. In that year two plants were started, one in Nova Scotia and one in Quebec. There was, however, no increase in the furnace capacity of the country until 1900, when the first steel plant in the Province of Ontario was established, but it is within the last eighteen months that the steel industry reached a stage marked by real development. It existed before the war, but its growth was slow.

The year the production of steel began in Ontario the total output of the plants in the Dominion was only about 24,000 tons. Up to the outbreak of war the maximum production in any year was 168,993 tons. That was in 1913. But the demand for steel for munitions inaugurated a new era of development, and since then over two hundred open hearth furnaces have been installed, and the output of steel by the electric process has been permanently established, with the result that the production of steel in Canada last year reached a record total of 1,736,514 tons. This was an increase of 21.6 percent over 1916, and 109.56 percent over 1914. Of the total steel produced last year 50,000 tons were the output of electric furnaces, compared with 19,639 in 1916, and but sixty-one tons three years ago.

When the rolling mill at Sidney, Cape Breton, goes into commission a new epoch in the manufacture of steel will be established in Canada.

AEROPLANE BUILDING

Canada's newest and one of the most important wartime industries is that of aeroplane building. We have in this line one of the largest and most up-to-date factories on the American continent, covering an area of eleven acres, and employing 2,500 workers, a large percentage of whom are women.

The average number of complete aeroplanes leaving this factory is about 350 per month—eleven machines for each day in the week—and as many as 97 aeroplane wings have been manufactured in one day. Most of these machines are used for training cadets in Canada and in Texas by the Royal Air Force.

Boiler Furnace Design

Following Mr. Medcalf's address the Chairman called upon Dr. D. S. Jacobus of the Babcock & Wilcox Company, past president of the American Society of Mechanical Engineers and member of the A. S. M. E. Boiler Code Committee, for a few remarks. Dr. Jacobus discussed at length the question of boiler furnaces and boiler furnace design. Extracts from Dr. Jacobus' address will be found on page 199 of this issue.

DISCUSSION

MR. BACH: You touched on one point that I think is of great importance to watertube boiler manufacturers, particularly in the matter of guarantees as to capacity. We put in a 400 horsepower boiler that did not give the ratings they had anticipated, and I found they had cut down the stack height we had specified to 40 feet because the forced draft stoker man told them none was required. The result was a regular retort condition of the furnace that not only melted down the brickwork but did not give them capacity, because the second and third class drafts did not work. As the plant was in operation, the only suggestion I could make was to put a steam jet in the stack, and eventually we had to put on a stack. Since then I have incorporated a clause in our contracts which says that where certain capacities are demanded, at least so much draft must be provided, even with a forced draft proposition, because you get a reverberatory retort condition in your furnace and a terrific temperature, but you get no work in the second and third class passes of the boiler.

DR. JACOBUS: That is right. If you get any pressure at all in the fires, the whole tendency is for the hot gas to leak outward through any cracks in the brickwork or setting. If you get a suction, the tendency is for the cold air to leak inward, and the difference between leaking outward and leaking inward is what makes all the difference between having a lot of trouble and not having it.

A MEMBER: The balanced draft will bring you up to that.

DR. JACOBUS: Balanced draft should be called regulated draft; the draft is regulated to get a suction.

A MEMBER: Don't you find it almost impossible to get a balanced condition and hold it for any length of time under a certain set condition?

DR. JACOBUS: It is very hard, but it can be done automatically. You have got to get a suction around the hot parts of your furnace every time, otherwise you have trouble.

MR. BACH: I would like to have an opinion regarding the expanding tube pattern for high overload capacity.

DR. JACOBUS: There you are running into a point of boiler design that is a very difficult one to analyze. You have got two features on a boiler design; one is that you absorb radiant heat directly from your fire grate. You may absorb as much as a third of direct radiant heat right in your tubes. The next thing is the baffling, which comes in mainly to get out by conduction the heat left in the gases. It does not make very much difference, if you have got three passes over a boiler, how you put in those baffles. For economy, it depends more on the number of passes than on the particular form of baffle.

MONDAY AFTERNOON SESSION

Chief among the subjects which have been before the Boiler Manufacturers' Convention for many years is the question of uniform boiler inspection and construction. The work of the American Uniform Boiler Law Society in promoting the adoption of the A .S. M. E. Boiler Code was outlined by Charles E. Gorton, chairman of the American Uniform Boiler Law Society, as follows:

Report on Work of American Uniform Boiler Law Society

BY CHARLES E. GORTON

ABSTRACT

In Kentucky we have the active support of Prof. Carl Anderson, of the University of Kentucky; also the Henry Voight Machine Company, the Lacherheim Company, and also Houston, Stanhope & Gamble, in Cincinnati. These parties interested are organizing at the present time a very active campaign, and we expect to have a bill introduced in the Legislature and feel confident it will receive the proper attention. You all realize the situation.

In Louisiana legislation has been introduced and referred to the Governor with a request that he appoint a committee, said committee to report back to him as to the desirability of the State adopting uniform boiler laws. We understand that this committee will report favorably.

The activities in Maryland have been such that we have been able to interest the Merchants and Manufacturers' Association of Baltimore, and we have been advised that the matter of a uniform code will be brought before the Legislative Committee and that we will have the active support of not only Mr. Deacon, the secretary, but former Governor A. S. Goldsborough. In placing the matter before the Association as a whole, we have no doubt that this Association will take up our cause and with us have it properly introduced before the Legislature.

In Missouri, Governor Bilbo has already recognized the importance of the legislation which we wish enacted in that State, not only as a safety measure but as an efficiency measure. Governor Bilbo is a firm believer in standardization. Our bill will be introduced and we believe it will receive favorable consideration when the Legislature meets.

In South Carolina, where they are liable to take a great deal of time to consider these matters, we are taking up the work and feel that in due course of time we can interest the State officials to such an extent that they will consider the adoption of uniform boiler rules.

In Virginia we shall have a bill introduced. The bill introduced last year, owing to a local condition, did not get any further than the Legislative Committee, but with the help of Professor Randolph we are in hopes that this will be laid before the next Legislature and the bill reported out of committee.

In Montana they realize that they are in need of uniform boiler regulations. It is within the power of the Industrial Accident Commission to adopt the code in practically the same manner as it was adopted in Minnesota; that is, if the State Boiler Inspectors consider the code a good one and workable in Montana, by ruling of the Industrial Accident Board it can be put into operation. We feel confident that Montana in the very near future will adopt the code.

The same condition exists in Iowa. The Labor Commission there realizes that they are sorely in need of a uniform boiler code. They have no standard and they realize the necessity and importance of adopting the A. S. M. E. Code, not only for the sake of safety but to prevent the State from becoming the dumping ground for boilers that will not pass the requirements of other States. We believe that Iowa will give the A. S. M. E. Code favorable consideration when its Legislature meets.

The foregoing practically covers the work as I find it, up to the time that I assumed the chairmanship. I would like to report now on what I know from my own experience.

I have been to the State of Massachusetts three times and I feel satisfied that within a reasonable time you will see A. S. M. E. boilers being admitted into the State of Massachusetts.

A year ago a bill introduced in the State of Rhode Island for the adoption of the A. S. M. E. Code was defeated by certain interests. The traction interests of the State, or legislation, rather, in which the traction companies of the State were interested, was of such magnitude that they did not feel that they should pass legislation at that time other than that actually needed in the State of Rhode Island. The bill was introduced in the lower branch of the Legislature. Since that time I have had a conference with Judge Mumford and we have felt that a bill should be re-introduced, but that the bill, if possible, should be introduced in the Senate rather than in the House, which will probably be done at the next session of the Legislature. The interests allied with this organization, notably the National Trades Association, the National Electric Light Association, etc., have stood shoulder to shoulder back of this bill.

The prospects look very good so far as Vermont and New Hampshire are concerned.

The Georgia Legislature meets the latter part of this month or the forepart of next month. The Resolutions

Committee of the Georgia Manufacturers' Association has pledged not only the Association to do all they could to further the A. S, M. E. Boiler Code, but has pledged the individual members of that Association to work with us in order to have the A. S. M. E. Code placed upon the statute books of Georgia as the Code under which they will operate in the future.

Since that time I have taken up the question of the A. S. M. E. Code with those interested in the State of Alabama, with the result that I have an engagement the 28th of this month and the forepart of August to meet and deliver an address before the Alabama Technical Association of Birmingham.

DISCUSSION

MR. CONNELLY: How many States have taken the Code up since our last meeting?

MR. GORTON: Seven.

MR. CONNELLY: What is the situation in Michigan?

MR. GORTON: Michigan looked very favorable, but an unfortunate condition has arisen in that very recently the matter of revision of the Code has been injected into it. But I do not anticipate that there is going to be very serious trouble when the thing is brought to a final issue.

MR. CONNELLY: My reason for asking that question is that I got word from Ohio to-day that Ohio is going to throw out the A. S. M. E. Code and go back to the old Ohio Code on the same ground that Mr. McCabe is objecting to it in Michigan.

MR. GORTON: I do not think there is any question but what the situation in Michigan will be absolutely cleared up to the satisfaction of the Michigan authorities, so if there is any disposition on the part of Ohio to go back to the old code based on the same grounds on which the State of Michigan based theirs, the State of Ohio will still operate under the A. S. M. E. Code as well as the State of Michigan; I do not think there is any question about it.

MR. MYERS (State Boiler Inspector for Ohio): The Code will stay in Ohio, in my judgment, providing some of these things are ironed out. Up to this time they have not made very strenuous efforts toward ironing them out. One case, which has never been settled, is the track locomotive proposition. Our law requires that these locomotives be inspected and constructed according to the rules of the Board of Boiler Rules, and we find that the A. S. M. E. Code does not cover locomotives to be constructed for track use; nor does the A. S. M. E. Code cover the vertical flue boiler. Then comes the question: Are we going to stamp them A. S. M. E. standard? We have adopted your code. I have taken the stand that we should disregard the A. S. M. E. symbol and stamp them Ohio standard and permit them to be used in the State of Ohio. But there is no uniformity in a method of that kind. The result has been that the Ohio Committee has adopted the I. C. C. Code for that type of boiler.

DR. JACOBUS: This trouble started up in Michigan is clearly something that is a misapprehension. It relates to so-called revision of the boiler code. So far there has been only one boiler code published, and quite a while ago that came up for revision. The way in which the revisions were handled was a way that the boiler code committee and the council of the American Society of Mechanical Engineers felt would be the safest one. The proposed revisions are published in the Journal of the Society, with the request that they be fully and freely discussed. The idea has been to finally come down to a state where, by publishing the revisions, no one would have anything further to say about the revisions; in other words the Boiler Code Committee would hand to the council something that had been published and say that the final suggestions, as published, have not been criticised by anybody—and we believe they are all right. That is the condition in which it stands to-day.

Incidentally I might say that the Boiler Code Committee does not and cannot take final action. The final action is taken by the Council of the American Society of Mechanical Engineers.

The next speaker to address the convention was Col. F. M. Gunby, U. S. Army, who gave a lecture illustrated by films and lantern slides on the building of the cantonments for the training of the expeditionary forces which the United States is now sending to France. Col. Gunby described not only the rapid development of the construction division of the army, and the location, plans and details of the various cantonments but also the organization developed for carrying on the work and the form of contracts under which such big undertakings have been carried out successfully and in an unbelievedly short time.

The next speaker to address the convention was C. V. Kellogg of Kellogg & McKey of Chicago, Ill., vice-president of the association, who discussed present industrial conditions, not only as relating to the war but also as to the conditions in the boiler making industry.

Duties and Responsibilities of Boiler Manufacturers

BY C. V. KELLOGG

ABSTRACT

Let us pause and consider our duties and responsibilities at this hour. What is the future and what shall we do when this war ends? The Government has said to many industries to-day, you can use 50 percent of the fuel which you required in 1917, and when you have used it, you must close your places of business because we need the fuel for other purposes. And many plants to-day, having fuel in their yards, have been obliged to close down because they have used up the limit. In many lines, you cannot obtain material except for war purposes.

The Government has already issued bonds of approximately eleven billion dollars. I said in the last address which I had the pleasure of giving to you, that I thought the Government would call for twenty-five billions. Little did I know of the future and of the conditions. If I had said one hundred billion dollars I would have been nearer right. We are going to raise the money, but it will take time. The Government has got to have it from business and business men, and the question naturally arises how are they going to get it?

First, by saving. We must learn to economize; then, when we have done that, it is necessary for us to do that which we have never done before. The old way of doing business has ceased; a new evolution or condition of business has arisen. The old way of any firm, individual or corporation, no matter how strong or how little, who believes he is able to conduct his business as he formerly did in an individual capacity, is forever gone.

No matter what line of industry, no matter what business, in the future, to meet the propositions which this country will face, we must not only have co-operation but the greater word, co-ordination; that is, there must be a meeting of people who are doing business upon a line and with a common purpose, that can put their abilities, their minds, their energies and their wealth together to meet the conditions, and they must co-ordinate with those other lines.

At the close of Mr. Kellogg's address, D. J. Champion, of the Champion Rivet Company, read a paper on co-operation.

Organization and Co-Operation

BY DAVID J. CHAMPION

This paper will be published in full in the August issue.

TUESDAY MORNING SESSION

After the reading of the report of the secretary and treasurer the first topic discussed on Tuesday morning was "A Uniform Cost System."

A Uniform Cost System

BY G. S. BARNUM

This paper is printed on page 198.

DISCUSSION

MR. CONNELLY: Have you included interest on the investment as an item of overhead, that is, six percent on your investment?

MR. BARNUM: No, I have not. I think we all ought to be willing to swap estimates. What have we got to keep back? Anybody can see anything in my shop and if I can tell them anything I have got there they are welcome to it. As Mr. Champion said yesterday, we cannot all make all the money, there aren't any of us so smart that we can have something that the other fellow hasn't got.

MR. MCKEON: I notice you stated in arriving at your costs that those were actual costs of material. In arriving at an actual cost, I think you should emphasize, if material had advanced after the time you made the estimate, that you took it into consideration in arriving at your settlement price, because frequently that brings quite a variance in the prices. One may have a contract stretching over a period of months at a low price. At the time the sale was made the price was low, but since then it has increased considerably, and while it would be necessary to take that into consideration in the actual cost, it should be taken into consideration in selling.

MR. BARNUM: That is right.

MR. MCKEON: I notice you also stated that you put on 15 or 20 percent profit. That is all right for commercial work, but if you are figuring on Government work, that won't pass muster and you will have to camouflage your cost to some extent by taking in your overhead to get by, in order to show any such profit.

MR. BARNUM: That is right. Of course, when I stated that, I did not have any reference to Government work.

MR. MCKEON: I think if we are going to arrive anywhere in establishing some form of a uniform cost, that a committee should now be appointed to solicit first of all various forms that are being utilized by the various concerns, and as nearly as possible arrive at the nearest ideal cost system that will cover the condition that we have here where manufacturers are making various types of boilers; if necessary, formulate probably three or four different forms to cover each type of boiler, and then recommend that each individual member adopt something along the line, the object being to try and get each concern started on some fixed cost system, and in that view I make a motion that a committee be formed on that basis.

MR. BARNUM: What Mr. McKeon said is exactly what I would like to bring about. The only way for us to do is to say, as an organization, "Will you figure an overhead of not less than a certain percentage, say 150 percent?"

MR. MCKEON: I would like to change my motion and make it that the present committee be retained and that they request each concern to submit to them their present cost system forms and methods, and further, that they then, as nearly as possible, determine what would be the most ideal system to suggest as a cost system for the various members, and send them copies of the forms and ask them to adopt them and request a reply as to whether they will adopt them or not, and let us get somewhere.

The motion was adopted.

THE CHAIR: We have with us this morning Mr. Charles A. Howard, of Gunn, Richard & Company, who will speak to us on cost details.

Abstract of Mr. Howard's Remarks

In discussing Mr. Barnum's paper, one gentleman suggested, among other things, that we agree upon an overhead, 150 percent or something else, and he further added that, in regard to Government work, you could not get away with 25 percent profit so you should camouflage your costs. Now that is the wrong idea all the way through, in principle, for one thing, and furthermore, you could not get away with it. I have had occasion to look into some twenty-five or thirty Government contracts, and in about ten or fifteen of them that situation was going on, and it did not take more than fifteen minutes to find it.

There are really two separate parts to a cost system, one of which is what we would call a cost, and that means nothing but this, a history of the cost or of the expense of something that you have paid in the past. The other part is your estimates. Estimates are something you are going to make, and in making those estimates, you must use as a basis the information regarding what past jobs cost you. Your new job, perhaps, is the same, more likely it is not, it is a little different; you use your business judgment, taking as a basis the figures you have on past experiences to make an estimate for the future. You have certain contingencies to allow for; but remember this, that your estimate is a separate proposition from your costs.

The discussion this morning in regard to costs has been along just one line, that a cost system is a good thing because you need it to tell you how much to make your price so that there is a profit. Of course, that is very necessary. It is even more necessary for another reason. Your business involves a fairly large outlay in investments. You are not a good banking proposition; that is, a bank will take a business like yours a great deal more seriously than when it comes to lending money to a merchant whose assets are liquid. Your assets are not liquid.

A big part of it is product in process, and then you have got your plant; so when you come to borrow money, if you haven't got the information to supply, you do not get the accommodation you expect and you wonder why. Mr. Barnum's cost system is not in any way, shape or manner, tied in with the company's financial books. Mr. Barnum says it is operating very satisfactorily. That is a great credit to him, because it means simply this, that whoever in his company has been responsible for fixing those rates has been able to foresee what the expenses were going to be with efficient accuracy so that it came out without giving him a headache at the end of the year. Now, the fundamental of a controlled cost system consists in tying these records into your financial books. It is a task that requires a little study to dope out just the way to do it, but it is no more work to run after you do it.

The important thing and the thing that gives all the trouble in connection with cost is your product in process. You charge out your material, labor and expense. At the end of a month or three months, or whatever it is, you say your overhead has been so much and you say that you have absorbed so much, but how do you know how much you have absorbed on the stuff that is in process? You don't, and frequently what you have got in process is a couple of months' business. It is such a big proportion of your total that you are liable to have an awful headache some day when you wake up, and then it is too late.

I would say that even a greater advantage than knowing your costs for the purpose of knowing your profits is the advantage of being able to get a profit and loss statement every month. You cannot do that without a cost system, on account of your product in process. If you know from month to month that you are running ahead or running behind; that is what you are in business for, that is what you want to know. Of course, it is very advisable to know that you are making or losing on this job, that job or the other job, but wouldn't you a whole lot rather know that you are making ten thousand dollars a month than to think that you are making three thousand dollars on this job and twelve hundred dollars on that, etc., etc., and then at the end of the year when you take your inventory, say, "Well, somebody must have made a mistake in that inventory a year or so ago, or last year, because we have made this profit; it is on the books but it is not in the bank! Where is it?"

This idea of a uniform cost system exists pretty largely on paper. I think it is perfectly evident that the type of a system that would operate in, say, the Babcock & Wilcox Company, would be far too complex in detail than one for a shop that employed sixty-five men.

When it comes to a situation that you are facing, there are certain features that can be made uniform. The basis of estimate can be made uniform and it ought to be and it will save you lots of money if you make it so, but when it comes to putting the figures in on that estimate sheet, then what you want are your true, honest costs in there, and those are the only things that do any good. It does not do you any good to say the costs are so much. They are not anything of the kind; they are what they happen to be when you get through; you cannot tell in advance what they will be.

When it comes to fixing the selling price, there is only one basis on which you ever fix selling prices, and that is what you think you can get. If the basis of estimate can be made uniform, it is a thing you want to do. When it comes to a cost system, there are certain features of it that can be made reasonably uniform. Just like everything else in this world, a cost system is a matter of proportion, of balance. Certain things will be very important in one company for certain reasons, but will not be important in another. Different men have different ways of managing their business. You have got different temperaments and different methods of business management to consider and the uniform proposition does not do it. If one of you has a cost system that is working right, he is not going to pay very much attention to all the rest of you people who want a uniform one that is admittedly a compromise. He wouldn't do it, it wouldn't be business.

Now, if you get a little co-operation first on this estimate matter, then on what general things in connection with the installation of your cost systems can be done, the next logical development of that sort of a thing is toward the open price association that Mr. Champion alluded to, rather than described, yesterday.

Director General of the Emergency Fleet Corporation Addresses the Convention

While the subject of cost systems was under discussion Charles M. Schwab, Director-General of the United States Shipping Board Emergency Fleet Corporation, entered the hall and was received by the members of the association with applause. Mr. Schwab addressed the convention as follows:

Mr. Schwab's Address

(Mr. Schwab's address is printed on page 183.)

TUESDAY AFTERNOON SESSION

The first speaker at the afternoon session was Hon. Edwin F. Sweet, Assistant Secretary of Commerce, whose address, in part, was as follows:

Some Compensations of the War

BY HON. EDWIN F. SWEET

Over against the losses of war, the destruction of life and property, present taxation and the mortgaging of the future, there are some items of importance which we may place on the opposite side of the account. The experience through which we are now passing is sure to have a corrective influence upon national wastefulness. In the matter of production the necessities of war are causing important results. Starting with the farm, we find a larger acreage in crops. In factory production we find more time-saving machinery is being used. More care is given to its economic arrangement.

A few years ago shipbuilding in the United States seemed almost a lost art. The war has changed all this. It first compelled us to change our laws, and then it taught us to build ships. During the eleven months ending the 1st of June, 1918, American shipyards turned out more tonnage than during the entire previous four years. The art of building ships has been restored to our country, and if every ship we now own should be lost, we have the men and the materials with which to build more and to build them as well and as rapidly as they can be built anywhere.

Closely allied to shipbuilding is the building of aeroplanes—ships of the air. The same energy which is now being put into shipbuilding and is producing such magnificent results is also being put into the manufacture of aircraft.

Vitally interested as you boiler makers are in the production of American steel, you must have been shocked by the published reports of the Geological Survey stating that the supply of Connellsville coal—the only coal deemed usable for coking purposes without admixture—will probably be exhausted in twenty-five years. Steel you must have, and this statement coming from Government experts presented a sorry prospect for American boiler manufacturers. But a new kind of coke oven has been invented and constructed, in which bituminous coals from Illinois, Indiana, and many other States, wholly unused for making metallurgical coke, can be so used. An excellent quality of coke can now be made from the Illinois coals, and the by-products derived from coking these Illinois and Indiana coals are fully equal in quality and quantity to those obtained from the Connellsville coal. From these by-products aniline dyes have already been manufactured which are in no wise inferior to the best ever made in any country.

Prior to the beginning of the war in Europe, the American people gave very little attention to the value of foreign trade. The war has put an end to all this. During the past three years we have had all the foreign trade we could find ships to carry and in some lines all we could handle. After the war a new era will be ushered in, numbering among its blessings emancipation from glutted home markets and the steadying influence which naturally comes from foreign markets widely scattered. This will date from the World War and will constitute not the least of its compensations.

It has been a very common thing during the past years for Americans to give expression to the fear that sooner or later the social elements which we designate by the terms "Labor and Capital" will engage in deadly conflict one against the other. Right here at home we see, day by day, a more democratic spirit. We must win the war. The rich cannot do it alone. The poor cannot do it alone. We must pull together. Here again we find a compensation of the war which is well worth while."

The shortage of coal is giving an impetus to the development of our unused water powers. Wise public policy demands that the Government should not lose its control of the wonderful natural resources found in the numberless water courses of the United States which are suitable for such development. The transportation problem has also forced upon our attention as never before the importance of using more freely our navigable waterways and of rendering navigable such as can be made so without undue expense.

No matter how many billions the war may cost, the material compensations I have named may bring them back and many billions more. But the greatest of all our compensations will be found in the building up of our personal and national character. We have another possession which is still more fundamental, a blessing upon which all other blessings are based. We call it liberty. It is the real issue in this war. The strain, and sorrow and self-denial forced upon us by war in such a cause give us a truer conception of its value.

Report on Activities of War Service Committee, American Boiler Manufacturers' Association

Abstract

On November 14, 1917, the entire committee met in New York, outlining plans and policies, to the end that the committee could serve the Government and the members of this Association to the very best advantage. Among the various subjects taken up was that of obtaining complete data pertaining to the equipment and shop facilities of the various boiler manufacturers. A questionnaire was compiled and printed copies of same were a few days later mailed to practically all of the boiler manufacturing firms in the United States. This questionnaire met with favorable response from at least 95 percent of the firms to whom it was sent, and there is now on file with your Secretary the most complete data on the boiler manufacturing industry, both as to plant facilities, types of boilers, capacity, etc., that have ever been compiled.

The Emergency Fleet Corporation, Refrigeration Bureau, General Engineering Depot, Railway Equipment Division and Nitrate Division were notified of the results of this canvass.

Upon receipt of a request early in November for bids for about 400 watertube boilers for the American International Shipbuilding Corporation, at Philadelphia, your committee called a special meeting of approximately 15 boiler manufacturers whose activities in the past had been confined principally to the manufacture of watertube boilers. Bids for one type of boiler were submitted by each firm, as well as bids for an additional 120 boilers, but the contract was not placed with the bidders represented by your committee for the reason that the American International Ship Building Corporation had another contract with the Emergency Fleet Corporation for ships on which Babcock & Wilcox boilers were being used, and the officers of the Shipping Board, after carefully considering the matter, felt that in order to afford the shipbuilding company no excuse for delays, it would be advisable to purchase the same type of boilers for all of these ships.

It is the opinion of your Committee that this matter was thoroughly gone into by Admiral Bowles and his associates, and there can be no criticism of their action in awarding the boilers to the Babcock & Wilcox Company.

Since that time, the committee has sent out at various times additional notices of the needs of the Emergency Fleet Corporation for boilers, and the information has been communicated promptly to all members of this association, so that each one would have an opportunity of obtaining such part of the business as they felt competent to undertake.

This committee has also placed on file with the "Power & Equipment Division" of the War Industries Board a complete copy of all questionnaires pertaining to the plants and equipment of the boiler manufacturing plants, also stating which type of boiler the various plants were best equipped to build.

In addition to the work done with the Emergency Fleet Corporation, we have done some work with other departments, principally with the General Engineers Depot of the War Department, with regard to supplying a large quantity of small locomotive type boilers needed for prompt shipment to France.

This committee has also communicated with the Purchasing Department of the Pennsylvania Railroad, furnishing them with such information as they requested from time to time as to where they might obtain boilers which they needed for their work in France.

The committee was also requested by Major Long, of the Engineers Depot of the War Department at Washington, to attend a special meeting in their offices on or about December 20th, with reference to a quantity of about 1,000 boilers, which were wanted by General Pershing for shipment to France. Your committee recommended that the boilers be sent "knocked down," with punching, beveling, drilling and flanging done here, also that these boilers be made of material and in construction in accordance with the requirements of the A. S. M. E. Boiler Code, which recommendations were followed by the Engineers' Depot. Your committee has also been personally in conference (as well as by mail), with various firms, to assist them in obtaining the names of builders of Scotch marine-type boilers for tugs which they are furnishing to the Government.

On or about December 6, Mr. Barnum represented this committee at a meeting of the War-Service Committee of all industries called at Washington by the National Chamber of Commerce.

We have also furnished information to the War Trench Board, Bureau of Research, 1027 Vermont Avenue, Washington, helping them to classify the various types of boilers for their schedule of Classification of Commodities covering exports.

Information with reference to various boiler plants has also been placed on file with the Control Bureau of the Ordnance Department, Washington, in accordance with their request, and at the same time a list of builders of the various types of boilers was filed with said Bureau. Your committee has had some correspondence with the U. S. Fuel Oil Administrator with reference to obtaining materials for the builders of oil-well drilling boilers.

In view of the large amount of boilers to be purchased by the Emergency Fleet Corporation and Shipbuilding Companies—the greater part of which will be watertube boilers—your committee felt that it was advisable to bring about a standard form of contract and specifications in so far as possible, covering this type of boiler, and to submit same to all of the boiler manufacturers, requesting them in the future to use this standard specification on all proposals for marine watertube boilers. After considerable study of this subject, your committee completed a standard form of specification and contract, and printed copy of same has been mailed to about 200 firms.

As far back as September, 1917, your committee recommended to the officials of the Emergency Fleet Corporation that they avail themselves of the Inspection Departments of the well-known boiler inspection companies, like the Hartford, Fidelity & Casualty, Travelers, etc., and that the inspectors of these various companies be given Government service as boiler inspectors during the period of the war, and that an inspector in any boiler manufacturing plant, by so doing, be qualified to act as a Government inspector on all Government boilers being constructed in that plant. This would have saved the Emergency Fleet Corporation the trouble of trying to build up an entirely new organization of inspectors, and would further result in a large saving in the cost of boiler inspection, also insure the boiler manufacturers of their work being inspected by reliable and competent inspectors.

For some reason our suggestion was not acted upon favorably, and since that time we have found that the Government is taking inspectors from the Inspection Companies mentioned above, making it all the harder for these companies to handle their business. Your committee is of the opinion that it is not too late for this method to be adopted, and we suggest that the matter be given careful discussion at our meeting, and if they think advisable the Association can bring the matter before the proper officials with the view of having this method of inspection accepted.

As a summary, your committee has met very frequently since their appointment in November, has sent out in the neighborhood of 1,000 letters and telegrams, in addition to about 600 copies of the questionnaire, and have received about the same amount of correspondence in return.

W. C. CONNELLY, Chairman.

Associate Class of Membership Proposed

A resolution was adopted calling for a change in the constitution and by-laws of the Association, creating a new class of membership, known as "associates," and giving the executive committee authority upon application to elect any person, firm or corporation interested directly or indirectly in the industry represented by this association to associate membership.

This amendment will be subject to ratification by mail ballot within thirty days.

Another resolution was adopted fixing the annual dues as $30 for members and $15 for associates. This amendment will also be subject to ratification by mail ballot within thirty days.

Report of Committee on Uniform Contracts

Your committee, appointed to report a Uniform Contract at this meeting begs to recommend that this subject be postponed until the next annual meeting, and either this committee be continued or another committee appointed, for the reason that owing to the fact that the Government at the present time is requiring nearly 100 percent of all steel production, and that all business must be made subject to the necessities of the Government to win this war, and that any Uniform Contract that might be proven in practice would be subject to Government regulations.

We do, however, make a partial report of clauses which should be inserted by every member of this organization and all other manufacturers in their quotations or contracts made by them. The conditions are so abnormal that it would be unwise, from a business standpoint, for any manufacturer to make a flat contract and out of fairness to himself and the purchaser we believe that if the recommendations reported by us are adopted it will save thousands of dollars to the members of this organization, and we respectfully submit for your consideration the following recommendations or clauses.

Clause 1—On account of present unusual conditions, this quotation is made for acceptance within five (5) days from date hereof.

Clause 2—All promises of delivery are made in good faith, but are contingent upon strikes, accidents, fire, flood, inability to secure material or skilled labor, also subject to Government regulations and all other causes of delay beyond our control.

Clause 3—If prevented from shipping any material because of railroad or Government embargoes, we will invoice such material when it is ready for shipment and time of payment will be calculated from invoice date.

Clause 4—The contract price to be paid by purchaser is based upon present cost of labor and materials; and in case during the progress of the work contracted for we are obliged to pay any increased price for labor or materials, the difference in the cost to us, caused by such increase, is to be borne by the purchaser, and per contra; if there shall be a decrease in the price for labor or materials on this contract, the difference in the cost to us, caused by such decrease, is to be credited to the purchaser.

Clause 5—The freight allowance, if any, mentioned herein, is based on the existing published rate of freight, and in the event of revision of this rate, prior to the time material is shipped, the freight allowance will be adjusted accordingly to the purchaser and he will pay any excess and be credited for any deduction.

Clause 6—The Government tax charged on any shipment, is not included, and must be paid by the purchaser.

LOUIS MOHR, Chairman.

Election of Officers

The officers elected for the coming year were as follows:

President, W. C. Connelly, D. Connelly Boiler Company, Cleveland, Ohio.

Vice-President, C. V. Kellogg, Kellogg & McKay, Chicago, Ill.

Secretary and Treasurer, H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

In Charge of Power Plant Efficiency

The United States Fuel Administration announced today the appointment of Henderson W. Knott to manage the field force of engineers and inspectors which is at work among the power plants of the country, carrying out a campaign of instruction and inspection designed to bring the use of fuel for the production of power to the highest possible efficiency and economy. Mr. Knott has been the general manager of the Morgan Crucible Company of New York City.

The appointment of Mr. Knott is a part of the plan, originated by David Moffat Myers, advisory fuel engineer of the Fuel Administration, to have each of the 250,000 steam plants in the United States visited by a competent man who can make suggestions and report in connection with the questionnaire originated by Mr. Myers, working with committees from the four great engineering societies. This work will naturally require a large number of inspectors devoting their time to traveling among the steam plants.

This field force will be organized by states in order to give it greater force and efficiency. Mr. Knott will, at an early date, visit the states already organized to study the work being done by the men in the field, and to speed up the inspection programme.

Uniform Costs*

Proper Methods of Determining Costs—Figuring the Overhead

BY G. S. BARNUM†

At the annual meeting two years ago, this Association appointed Mr. Fisher, Mr. Fish and myself a committee to again bring before you the importance of properly estimating our work, as to what should be the total cost of same. On the programme it states that my report is on Uniform Costs. This is really not what I want particularly to bring out, but, as already stated, it is as to how we should arrive at this cost, which we can make uniform or not, as we may see fit.

Owing to the abnormal conditions and severe strain that we should arrive at this cost, which we can make uniform winning this war, it has not been easy to find time to give this matter the thought perhaps that it should require. The principal factor, and the one over which there has been the most controversy, is that of the overhead, as to what constitutes it, and how it should be applied to the cost of the work. We wish, therefore, to outline a simple form for your consideration, which it seems to us you can all very easily adopt. There is nothing very new about it, over and above what Mr. Connelly suggested in the paper he read to you in 1913, and I might say, before outlining it, that it is a form that has been in operation in our plant, The Bigelow Company, for a number of years and the results have been most satisfactory.

A manufacturer's cost has three phases—first, direct or productve material; second, direct or productive labor, and third, overhead, which means indirect or nonproductive labor, and all other expenditures of money that do not come, or cannot be charged, directly to the specific order or job, except such money paid out for permanent assets or investment values, commonly called betterments, such as new buildings, new machines, new tools or other new equipment, which are no part of the cost of the production of the particular job. I can anticipate a criticism that might come up by some who would say that the manufacturing expense and commercial expense should be separated, but we advise, in order to keep everything as simple as possible, not to undertake to separate these two items, as it would add more or less to the detail.

Direct material means only such material as enters into and becomes a part of the finished product, such as boiler plates, tubes, rivets, staybolts, etc. They should be positively and accurately determined and charged at the purchase cost price per pound rate directly into the job. Tickets, if possible bearing the specific number of the job or order, should be used to tabulate this material with its weight, number of pieces, etc.

Direct labor means that labor which can be positively determined and rightly charged to the specific job at the average rate per hour, which can be determined by the different amounts paid every operator, which, added together and divided by the number of men, will give the rate per hour. This labor may be obtained by a timekeeper, or made out by the operator himself, or by one of the various means of mechanical time recording devices, which is preferable, I think, to the personal timekeeping method. These individual time tickets should be collected daily, looked over by the superintendent or foreman very carefully, and then the number of hours on the tickets charged up daily to each specific job. Such time as does not appear on any job is charged to overhead, unless it is for what would be called betterments, as mentioned above.

About the overhead, which is the principal and important factor that I want to bring out, is how this should be determined. I think in nine cases out of ten anyone who has given this matter any fair amount of consideration will say that it should be based on the productive labor. We will assume that our productive labor for the year amounts to $40,000, and that the total amount of these different overhead accounts foot up $60,000; that is to say, this $60,000 is supposed to mean all money expended for the carrying on of the business outside of the productive labor, and for betterments. This being the case you can readily see that if you add to each job 150 percent of the productive labor to the exact cost of the material and labor it will give you the total cost of the job. We will assume these accounts are made up as follows:

Non-productive labor (such as handling material, oiling up, etc.)	$ 4,000
Power Heat Light & Water	8,000
Supervision	2,000
Drafting room	1,500
General factory expense	1 500
Fuel Oil for furnace and forges	1,000
Insurance	2,000
Mistake account, operating mistakes	200
No charge allowance	200
Repairs on tools	6,000
Repairs on real estate and buildings	1,500
Taxes, including city, federal and state	1,500
Interest	3,000
Office supplies	500
Catalogues	200
Postage	300
Miscellaneous expense	2,000
Salaries	11,000
Subscription account	200
Telephone and telegraph	1,000
Bad and doubtful accounts written off	500
Advertising	500
Commission account	300
Traveling	1,500
Depeciation on buildings (2½ percent)	2,000
Depreciation on patterns (25 percent)	1,500
Depreciation on office furniture and fittings (10 percent)	100
Depreciation on machinery and plant equipment (7½ percent)	5,000
	$60,000

I have not included the freight, for in figuring the cost of the material you should figure what it costs delivered at your shop; that is, the freight should be added to the mill invoice, and should you be called upon to deliver the boiler at its destination the freight on the job can be added to the estimate or cost. The commissions, however, I have included. It looks to me as if they were the same as a salary, and should be part of the commercial expense. Some may differ with me in regard to that. The principal thing to remember is that all money expended for whatsoever it may be, that is not charged to the specific job or for betterments, should be charged to overhead in some way. If the above accounts do not give everything that might come up, simply add to this list.

Some of the small concerns have what they call a drawing account. This I do not believe in. Every executive

* Report of Committee on Uniform Costs, read before the Thirtieth Annual Convention, American Boiler Manufacturers' Association, Philadelphia, June 18.

† The Bigelow Company, New Haven, Conn.

should have a salary according to his ability and what the business will warrant paying, and should be charged in the salary account as overhead.

I have here a printed form of an estimate sheet of a return tubular boiler, which form we use almost universally in New England. One advantage in having it printed is that you will not forget in making your estimates any of the items that go to make up the cost. The material on this estimate amounts to $2,500, the direct or actual labor $200, which makes $2,700. The overhead on the plan suggested, being 150 percent of the productive labor, would be $300, which would make the total cost of the job $3,000; to this should be added the profit, which should never be less than 15 percent or 20 percent, and more rightly 25 percent over and above this final cost.

The foregoing is, I think, a sufficient outline for any firm to base their estimate on. All sorts of revisions may be introduced, if you care to go into it further, but care should be taken not to make it unwieldy, or so complicated that you hesitate about adopting it. Understand, this overhead can only be obtained really at the end of the year, consequently you would use the overhead for last year for this present year's figuring. It will, of course, vary more or less, but in a period of years will average up so it will prove, I am confident, quite satisfactory. I make this statement from my own experience.

Now I do not wish, at the present time, everything being so abnormal, to try and influence anyone who now has a definite way of figuring this overhead, but I would suggest that those who are not satisfied with their present plan, or do not have any that is definite, adopt this for one year, as it is so very simple that it can be done without adding greatly to your clerical help, and I know if you will give it a trial you will be more anxious to go into the matter still further at the end of the year, and will also see that you have made some money.

I have also forms of order sheets and cost sheets such as we use in our plant with this system. First we have the general order for the office, the duplicate of same going out into the shop, together with a detail shop order. Following these are the cost sheets in forms for the different boilers, and also for special work; then the workmen's daily time card, and also special cards for detail of outside work, all of which I would be glad to send to anybody who might like to have them.

I would like to say just a word in regard to jobbing, as to the rate per hour we should charge for this work. This should be determined, in my opinion, by adding, for instance, 150 percent to the average rate per hour, plus 10 percent. In other words, if your average rate is 42 cents an hour, 150 percent of this would be 63 cents, which would make $1.05; plus 10 percent would make it $1.15 per hour, and the material should be charged at not less than 15 percent over and above the actual cost of it delivered in the shop. Of course, there are special jobs where you use your most experienced and high-priced men, and you would be warranted in charging more than this per hour, even up to $1.25 or $1.50.

Boiler Furnaces and Boiler Furnace Design*

Construction of Furnaces for Boilers Operated Above Normal Ratings—The Excess Air Problem—Burning the Ash—Oil Fuel

BY DR. D. S. JACOBUS†

When I started with the Babcock & Wilcox Company about 12 years ago, we started to make some experiments to see at what capacity boilers could be driven without resulting in any harm. At that time there were very few boilers that were ever operated under steady load conditions, or kept up day after day at very much above a rating of 125 percent of the so-called rating, or 150 percent of rating. At the peak load conditions the boilers were operated up to 200 percent of rating, which was thought to be going very well.

The first experiments that I made were to take a boiler with 20-foot tubes and mounted up over a fire, hand fired from the front, rear and sides, leaving the two lower lines of tubes entirely bare so we could get the full amount of heat into those tubes that went into a high boiler. Then we would put some blowers underneath and a reducing apparatus above, to get what capacity we could out of a hand-fired boiler at the limit. We ran the boiler 350 percent and made a number of experiments on quickly releasing the steam so the gage would go right down and shutting it up quickly to see if we could get any difference in circulation, etc. As you all know to-day, who are running boilers under higher service conditions, nothing happens to the boiler and they thought a little better about so-called high capacity.

That meant that if we ever attempted to run a boiler at that capacity, there was a very good sort of automatic safety valve, that is, the furnace would give out before you came to the limit of the boiler. At present we are still in that condition. With the ordinary kind of furnaces and the ordinary kind of boilers, the first thing that gives out on these high capacities is the furnace and not the boiler.

When I first went with the company, the setting height for horizontal tube boilers, from the floor level to the uppermost header, was 6 or 7 feet. A great many had the idea that if you got the boiler too high above the grate or above the stokers, you were going to lose something in the way of efficiency. With the development of these higher capacities, we have set the boiler higher and higher until to-day these boilers are set 10 feet, or sometimes 14 feet, above the floor to the upmost end of the tube. We get these bigger furnaces in order to get better combustion condition.

In getting that bigger furnace we are running more and more into the difficulty of holding that brickwork up because we get a lot of flat, slab-sided walls that come up to the mill limit where the brick is up to the point of melting, and that has led to certain principles of furnace design. With the underfeed stoker and forced blast or enforced blast stoker, we have got the ability of burning a great amount of coal. When the underfeed first came out, the first cry of the stoker man was, "Here, we have got a good forced blast stoker, it costs you quite a little bit, but it will save quite a lot on your stack; you don't need

* From an address before thirtieth annual convention of American Boiler Manufacturers' Association, Philadelphia, June 17.
† Babcock & Wilcox Company, New York.

so much stack." As a matter of fact, if you don't put the stack there, and a good-sized stack, you begin to get the gases leaking out through the setting on account of back pressure within the setting, with the result that you cannot hold the brickwork. To-day on these underfeed stokers, they are putting in the same size stacks and the same areas of stacks that was common practice before for lower capacity because the whole tendency of putting these modern stokers underneath is to get greater capacity, and with that you need a greater stack and a greater area to get the gases through the boiler and prevent a back pressure within the furnace. You should always figure to have a suction, even if it is only small, within the setting at all points, irrespective of how hard you drive the boiler.

The next principle you have to observe is that you don't get brickwork that is heated on two sides under too great a stress. If an arch is heated on both sides and you begin to get too much heat, the arch is bound to come down. It is the same way even with a vertical wall; if you get a vertical wall which is heated too much on both sides and soaks up the heat, the wall is bound to sag under the heat. The next thing is to get an economical furnace, and as we are going forward there is going to be more and more thought put to this economy. The boiler man to-day is in a position where he doesn't mind 2 percent difference in economy, but eventually, on account of this movement which must be made to save coal and all that sort of thing, they are going to make some real tests, and a real test is when you run along about a week or a month.

In a coal-fired furnace you have got, in the first place, to watch out for excess air. But when it comes to getting the ultimate and very maximum amount out of a given furnace, what you have got to watch out for in addition to that excess air is the carbon non-oxide, and there, unfortunately, the average analyzing rig don't show it correctly. As a rule, about half a percent, sometimes as much as one percent, of carbon non-oxide will go right through the average gas analysis apparatus and will not be caught, because they do not get their solution right. In furnace design, you have to get a furnace that will run up to, say, 13½ or 14 percent of CO_2 with only a trace of CO, if you want to get the ultimate possibility.

In a great many furnaces as soon as you get about 10 percent or 11 percent of your CO_2 and then try to cut down the excess air, you will find that you are running into the CO zone, so that practically 10 or 11 percent is the most economical point. On the other hand, if you get the furnace under certain conditions, it may be necessary to put air above the fire. It seems that in burning coal it is impossible to have an even fire bed over the bottom of the whole furnace, and with that even fire bed to have from every part of that fire bed a uniform analysis. Some part of your fire bed will give off volatile gases and CO, and other parts with the stokers, as we have them to-day, will give excess air; therefore you have got to get a furnace that has enough volume, after you get through your fire bed, to mingle the gases, and also of a shape that will tend to mingle those gases and burn them, if you want to get your very highest capacity. More and more attention will have to be given that feature by the boiler men as the art advances.

The next feature in economy is the burning out of the ash by the stokers, and in that the modern stokers are getting more and more perfected. In that, however, we have to guard against the operating engineer who lets too much excess air go through the dump place in order to clean up the carbon from the ash, but the modern stoker's art is developing to a point where they are getting with the proper furnace, as high as, say, 13½ percent of CO_2, probably an average of not over .2 percent of CO, and down to a point where they have a pretty clean ash, which will be one having about 15 percent of carbon in the ash. Fifteen percent of carbon in the ash does not mean 15 percent loss, because you have only got a small weight of ash in proportion to the total weight of your coal.

The next fuel we have to deal with is oil fuel. To-day the Government uses oil in the greater part of its war vessels, etc., where they need to get the very maximum out of a given storage capacity. When you come to marine service with oil, you are handicapped through the fact that you cannot afford to put on as big a furnace as you really would like to, and that means that you must get some sort of a burner that burns that oil quickly with a short flame. To do that they spray the oil under a heavy pressure atomizing burner and get a furnace and arrange the boilers in such a way that they burn that oil with a short flame and burn it before it hits the boiler tubes.

The same idea of quick burning and mingling is now pervading all the burning of blast furnace gas and gas of that character for boilers; in other words, they get something to bring the pressure of the gas right up to the burner and get a quick mingling action.

When you come to land practice with burning oil, where you can use steam for atomizing instead of these pressure burners, then we run to big furnaces and longer travel of the gas and all that sort of thing for our land oil-burning furnaces.

Another type of fuel you have to contend with is wet wood and dry wood. Wet wood has been burned in an extension furnace with a lot of radiating surface of brickwork to dry out the wood and then afterwards burn it. A great many people do not appreciate the fact that if you have got sawdust from a mill that has 50 percent of moisture in it, it means that each pound of dry wood has one pound of water to evaporate before it ever begins to burn. If you have got something with over 60 percent, as in a great many cases they get in these mills, where they have these sinker logs, as they call a log that sinks in the water, you have got about twice as much water to evaporate for each pound of dry material before it can ever burn, and naturally in burning that sort of stuff you have got to get the hot furnace walls to dry out the moisture first.

Schwab Appeals to Boiler Manufacturers

(Concluded from page 184)

can say to yourself and your own conscience and your children and your family and your friends that you had a part to play and did it successfully and did it in the time of the country's need.

We need the boilers, and we need them badly. If I could just impart to you but a small trifle of the enthusiasm and patriotism I feel myself, I shall feel that I have done a good morning's work in coming here to meet you. Go home and feel as I do, feel that you have this great duty, this patriotic duty. Just discard everything else and give us not ships, ships, ships, but boilers, boilers, boilers and more boilers.

You will always find the officers of the Emergency Fleet Corporation your friends, ready to co-operate with you. The question of the amount of profits does not cut much figure any more, although we will always treat you fairly. Let us have the boilers first and the conditions and other things may be settled afterwards when we get this thing right.

Let us stand together and fight the good fight as only Americans and real men can.

The Boiler Maker

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GEORGE SLATE, Vice-President
E. L. SUMNER, Secretary
H. H. BROWN, Editor

Requests for an advance in the prices of steel products were made at a recent meeting of the General Committee of the American Iron & Steel Institute with the War Industries Board in Washington. The request was coupled with the explanation that better prices must be allowed in the remaining six months of the current year or no profits will result because of rising costs, for which the increasing advance in freight rates is largely responsible. The former scale of prices expired on June 30.

Evidence of the value of the National War Labor Board and of a careful observance of the spirit of agreements with this Board is strikingly given by the recent avoidance of a threatened strike at the Schenectady plant of the General Electric Company. This plant is doing an immense amount of vital war work for the Government, but, nevertheless, a strike was threatened. Trouble in this quarter was averted, however, by the agreement of the employees to submit their differences to arbitration by former President Taft and Frank P. Walsh, the joint committee of the National War Labor Board.

It is announced unofficially that the Government, through the War Industries Board, will try to prevent the shutdown of any industry, whether essential or not. The needs of the Government come first, but the Board has ordered the departments of the Government which buy war materials to make a careful re-check of the amounts of raw materials they need. This is to be done to ascertain if they have overstated their requirements, and if such is found to be the case it is hoped that greater amounts of raw products can be released for less essential industries than is at present indicated. It has already been found that a number of Government organizations have overestimated their needs.

Industries employing more than one hundred workers will be asked after August 1 to recruit any labor through the medium of the Federal Employment Service of the Department of Labor. This is merely a beginning looking to complete Government control for the national labor supply. The step is necessary, say government officials, to overcome an existing shortage of common labor. Registration of all labor in the United States by the United States Employment Service is also contemplated by the Department of Labor.

The object of this plan is the centralizing of all labor recruiting in this one Government employment agency and the elimination of private competition for workers. Further than this the War Policies Board of the Department of Labor, which is responsible for the new rule, is now considering the standardization of wages and a survey of the needs of all war industries.

Government officials have failed in an attempt to classify industries as essential or non-essential or to define what items are luxuries and what are not. The judgment of the manufacturers themselves as to whether their production is essential to the Government war programme, it is understood, will in the future be the basis for decision.

References to pipe in technical articles, specifications and elsewhere are too frequently inaccurate and misleading. There are three proper designations for pipe: wrought pipe, wrought iron pipe and steel pipe. Wrought pipe is the generic term for steel or iron pipe and is a proper designation for either. Wrought iron pipe means just what it says and refers to the product of a pudling furnace. Steel pipe also means exactly what it says but represents about 90 percent of the present output of wrought pipe in the United States. By reason of the fact that wrought iron pipe was the original pipe manufactured, the term is still erroneously used and the chances are ten to one that the product referred to by this term is in reality steel pipe, which, in the absence of definite information, should be termed "wrought pipe" and not "wrought iron pipe."

In view of the critical situation which will result in Belgium through the disasters caused by the depredation of the enemy, his removing of tools, raw materials, manufactured products, etc., there has been created, with the co-operation of and under the control of the Belgian State, an organization having for its object the economical reconstruction of Belgium, entitled "*Comptoir National Pour La Reprise De L'Activité Economique en Belique*" (Société Co-opérative), 15, rue Louis-le-Grand, Paris (2°).

This organization, in helping industry and trade, by enabling them to purchase the tools and all necessary raw materials, will not only reconstruct the economical situation of Belgium, but will put an end to the suffering of the working classes by enabling them to start working in the reconstructed shops.

American manufacturers will certainly realize the great interest they may have in eventually becoming contractors through the Société Co-opérative. The society's interests are many, as everything in Belgium will have to be reconstructed, including: metallurgy, materials for construction of buildings, leathers, textiles, farming implements, chemical products, wood machines, electrical material, optical instruments, motor cars, vans, wagons, oils and greases of all kinds, refractory materials, etc.

In order to secure orders, manufacturers should send at once catalogues and tariffs in triplicate to the Société Co-opérative at the above address.

Engineering Specialties for Boiler Making

New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

Why Cast Iron Protects Soot Cleaner Elements Against High Temperatures

Does steel grow stronger or weaker with increase in temperature? How about wrought iron and cast iron?

Although these metals are used more than others in engineering work, there are very few engineers who can answer the above questions correctly because very little has been written or spoken on the subject. It is a very important subject, yet a search through well-known engineering text books on strength of materials reveals the incompleteness of the books and general knowledge of the facts. Tests have been made, mostly in Europe,

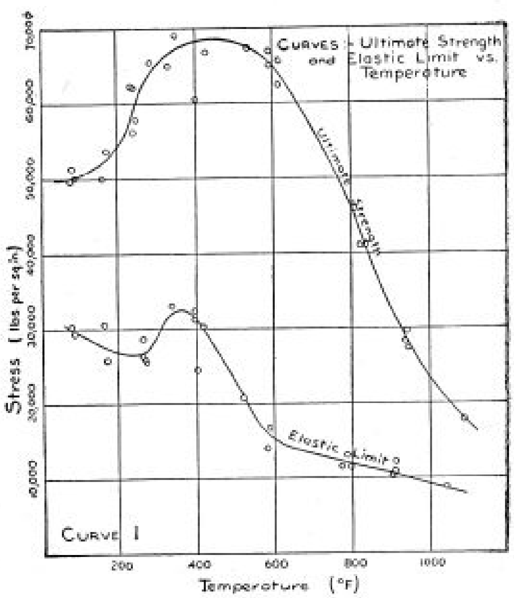


Fig. 1

but the results of those tests have been buried in dry, voluminous reports or in foreign language literature. These tests have recently been sought and collected by the Vulcan Soot Cleaner Company, of Du Bois, Pa.

Permanently installed soot cleaners must often be placed in temperatures that are comparatively high, and for that reason the above manufacturers of the well-known soot cleaner have investigated the matter with unusual thoroughness. Their study, experience and conclusions will doubtless prove of interest to all who have anything to do with steam boiler operation.

Most laymen are aware of the fact that when metal is heated to a high temperature it bends easily. When "red hot" they know it is forged easily. And when still hotter it becomes liquid. But these phenomena are not associated with decrease in tensile strength. Yet it is this decrease in tensile strength that permits the metal rod or pipe to to be bent or broken easily, and that is why tensile strength tests are so important in this discussion.

On the other hand, it is commonly believed by engineers who have given more thought to the subject that steel and wrought iron become weaker with increase in temperature. But that is not strictly true, and therein lies a point of considerable interest.

Steel and cast iron both grow stronger up to a certain point, as shown by the ultimate strength curves in Figs. 1 and 2. Thus the maximum strength of wrought iron occurs at a temperature of 450 degrees F., whereas the corresponding temperature for steel is about 525 degrees F. However, with further increase in temperature the curves show that the ultimate strength decreases rapidly.

These figures also give the elastic limits of wrought iron and steel at high temperatures and the curve relation between elastic limit and ultimate strength.

Fig. 1 shows that the ultimate strength of wrought iron drops very rapidly when the temperature is in the neighborhood of 1,000 degrees F., and Fig. 2 shows that at the same temperature, steel no longer has an elastic limit. In other words, if soot cleaner elements are made of steel alone, and if they are heated to a temperature of 1,000

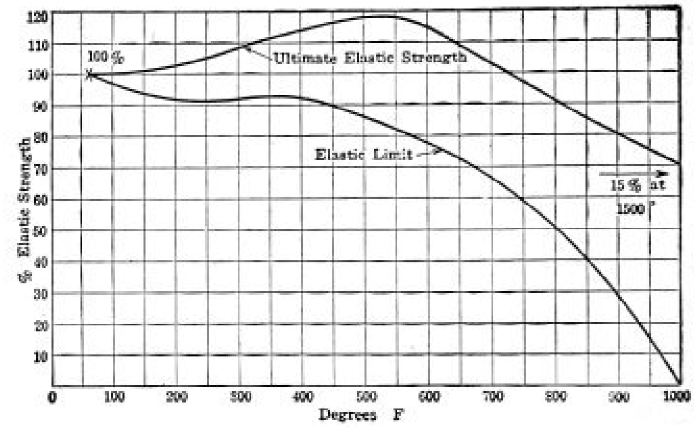


Fig. 2

degrees F., they are liable to sag, due to their own weight, and become inoperative in a short time.

The maximum temperature to which soot cleaner elements are subjected is not definitely known, but according to the experience of the Vulcan Soot Cleaner Company, it is doubtful if the temperature of the metal itself ever passes 1,000 degrees F., even though the temperature of the hot gases is 1,500 degrees F. For example, a test made by A. W. Conklin shows the temperature at the top of the first pass in a hand-blown boiler to be 954 degrees F. In the same boiler, cleaned by a permanently installed cleaner, the temperature at the same place was reduced to 934 degrees, or a difference of 20 degrees in favor of the mechanically cleaned boiler. Thus the mechanical cleaner protects itself in providing for itself a minimum temperature. Even at points close to the fire near the bottom of the first pass, there was a temperature difference which favored the mechanical cleaning method. Although it may sometimes be necessary to place soot cleaner elements in gases having a temperature of 1,500 degrees F., as for instance in the first pass of a Babcock & Wilcox boiler, the Vulcan Company has not found it difficult to maintain a temperature in their elements of less than 1,000 degrees F., by means of dead gas pockets, baffle screens, etc. Convection currents are thus warded off and by placing the elements in close proximity with the boiler tubes, which seldom, if ever, have a temperature higher than 380 degrees F., the temperature of the element is kept well within the bounds of safety by radiation.

It has been stated by such authorities as Kreisinger and Barkley that in taking temperatures of gases, surrounded by colder or hotter surfaces, there is usually an error of some 3 to 25 percent in temperature. This error is due to radiation. Quoting from "Finding and Stopping Wastes in Modern Boiler Rooms," Vol. II, by the Harrison Safety Boiler Works:

"If a temperature measuring instrument is immersed in hot gases surrounded by cooler surfaces, it absorbs heat by convection, and its temperature rises. Gases are permeable to radiation and as soon as the temperature of the instrument exceeds that of the surrounding surfaces heat passes from it to them through the gases by radiation. The temperature of the instrument continues to rise with a decreasing rate until the quantity of heat it gives off by radiation is equal to the quantity it receives by convection. The temperature then remains constant, but is below the temperature of the gases. The magnitude of the error depends mainly on:

(1) The size of the part of the instrument exposed to the gases and the radiation.

(2) The difference between the temperature of the gases and that of the surrounding surfaces.

"The smaller the exposed part and the smaller the difference of temperature, the smaller the radiation error."

Rules 1 and 2, above, are applicable to a soot cleaner element as well as to a thermometer. Thus according to

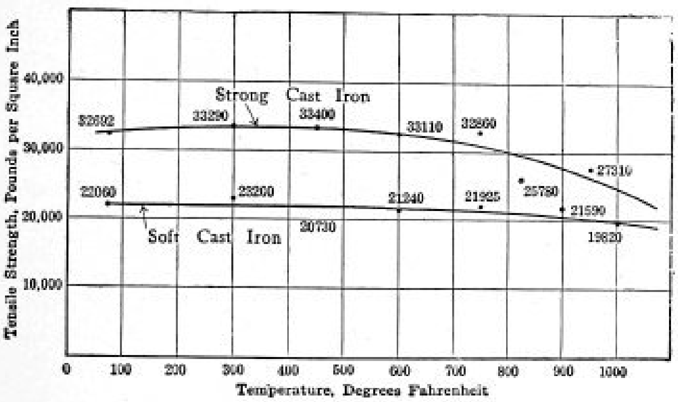


Fig. 3

Rule 1, it is advantageous to make the element large. And according to Rule 2, the difference in temperature (perhaps 600 degrees or 700 degrees F. at times) serves as a further protection.

Thus it has been found by the Vulcan Soot Cleaner Company that their elements are seldom, if ever, subjected to a higher temperature than 1,000 degrees F. However, to make assurance doubly sure, they decided to make the Vulcan cleaner still safer and longer lived by reinforcing the element with a metal sheath that is not easily influenced by heat.

A study of pages 543,544 and 545 of Marks' Mechanical Engineers' Handbook will soon convince anybody that there is no better metal for this purpose than cast iron. Among the various metals listed are aluminum, bronze, phosphor bronze, cast manganese bronze, malleable iron, cast steel, cast nickel, Monel metal, machinery steel, nickel vanadium steel and rolled Monel metal. All of these metals lose their strength very rapidly when the temperature is in the neighborhood of 1,000 degrees F., but it is shown that soft cast iron and strong cast iron both retain their strength remarkably well.

Fig. 3 is plotted from the test data given in Marks' Mechanical Engineers' Handbook for strong and soft cast iron. These curves tend to show that cast iron grows stronger up to a temperature of about 450 degrees F., and from that point on the strength reduces slightly. The strength of soft cast iron, it will be noted, is practically constant all the way from 100 degrees to 1,000 degrees F.

From these curves the conclusion may be drawn that cast iron of almost any good composition will protect soot cleaner elements sufficiently. But for the sake of absolute

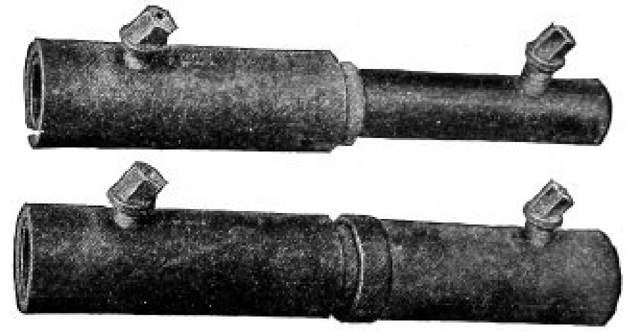


Fig. 4

safety a special tested uniform grade of cast iron has been decided upon and is now being used.

Also, inasmuch as the cast iron sheath placed over the soot cleaner element makes the element somewhat larger, it is evident that the rate of radiation will be greater, according to one of the rules quoted above. The greater size, therefore, insures lower temperature.

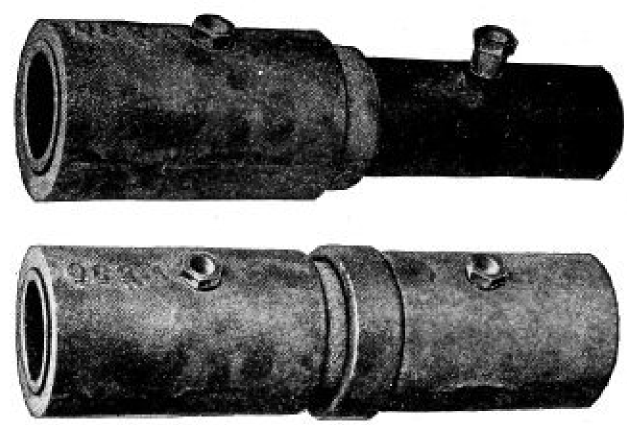


Fig. 5

Cast iron also has a high heat radiating factor. Marks' Handbook gives the following factors for the several substances:

Cast iron, rough, oxidized..........	1,570
Lamp black........................	1,540
Wrought iron, dull, oxidized.........	1,540
Lime plaster, rough white..........	1,510
Water	1,120
Wrought iron, highly polished........	467
Brass, dull.........................	362
Copper, slightly polished............	278

To further emphasize the value of cast iron for retaining its strength at high temperature, take for example the well-known, comfortable, red hot, cast iron stove. Have you ever stopped to consider the strength retained by the metal, even at the high temperature of a good cherry red (1,500 degrees F.)? Moreover, you will recall that the top of the stove does not scale or burn.

All engineers are quite familiar with the use of cast iron in grates where temperatures go very high.

In the field of steam engineering, we are all familiar with superheaters that have cast iron rings placed upon the inner tubes of steel, these being used principally to strengthen the structure at high temperatures, which prevent overheating and warping. These superheater rings do not scale or burn.

We are also told of a case in a steel foundry where certain cast steel parts for a furnace cage which was used to transfer the parts to be annealed in and out of the furnace, fell down repeatedly. The foundry employed in making castings of steel only and the parts that were

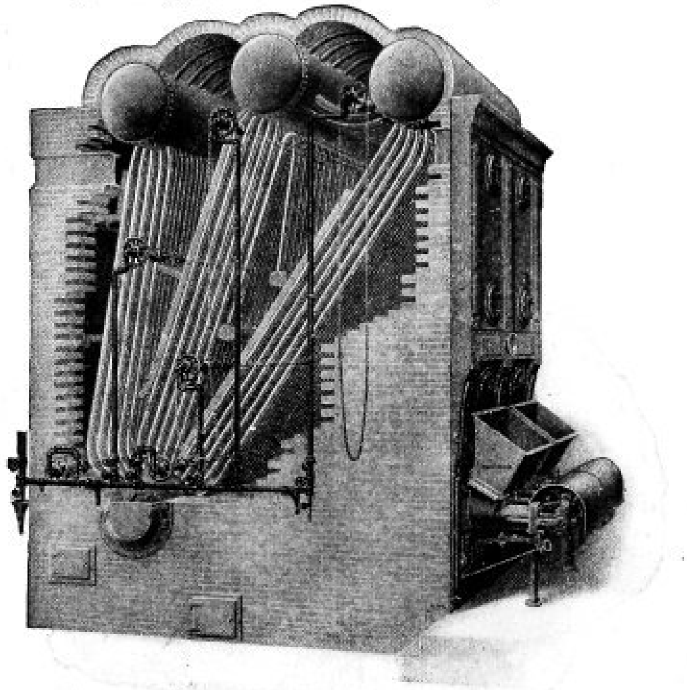


Fig. 6

failing were finally sent out to be made of cast iron and thereafter proved entirely satisfactory and resisted warping under the high temperatures to which they were necessarily exposed.

An editor of *Metallurgical & Chemical Engineering* wrote the following:

"Cast iron is better than wrought iron or steel for purposes where the material is subjected to considerable heat. Most steel is heat treated and if subjected to considerable heat in practice it will lose to some extent the properties which were given it by the heat treating. Cast iron contains a much larger percentage of carbon than either wrought iron or steel and retains its properties up to quite high temperatures."

Cast iron is used in Diesel engine cylinders, for example, where steel would not stand the strain.

Cast iron has an additional important advantage because of its resistance to corrosion. It is well known, for instance, that there are a great many cast iron economizers which have been in successful operation for 50 years. Cast iron is used for pipes under all sorts of conditions, in underground work, in water, in out-door exposures, subject to acid fumes, etc. We are all familiar with the cast iron pipe advertisements showing examples of pipes that have been in active service for some 100 to 200 years without evidence of serious corrosion. Cast iron forms a scale on its outer surface which seems to act in a protective manner, and, besides, the crystal construction of cast iron itself is effective in resisting corrosion.

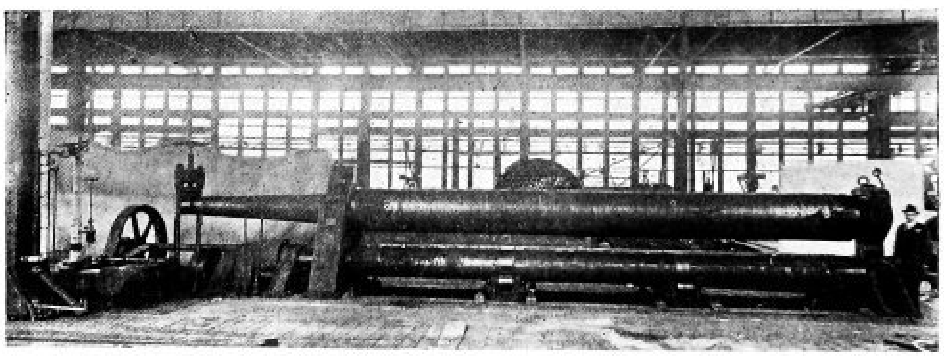
Lastly, even if these cast iron sheaths should perchance reduce in thickness because of scaling, corrosion, or other unlikely cause, they will last a good many years, because they have considerable thickness.

Figs. 4 and 5 illustrate how the problems of designing these non-warping sheathed elements have been solved. The steel inner pipes in the element are wholly encased in the heavy cast iron sheaths with a loose fit. Fig. 4 is a short length of a standard element for horizontal tube boilers. Above the assembled view is shown the same element with part of the sheath removed, exposing the inner steel tube. This photograph also shows the arrangement of nozzles for blowing down obliquely.

Fig. 5 shows a Vulcan non-warping element for vertical tube boilers. It is similiar to Fig. 4 except that its nozzles are at right angles to the element and not oblique. This element is located between the circulating tubes above the first pass in boilers of the type illustrated in Fig. 6, where the tube arrangement is such that the nozzles discharge at right angles to the element.

Large Bending Rolls

The accompanying photograph shows a plate bending roll recently installed in The D. Connelly Boiler Company shop in Cleveland, Ohio, by Wickes Brothers, Saginaw, Mich. The tool is 43 feet long over all, and has a capacity to bend a steel plate 1½ inches thick (and extending the full distance between the housings) to a 48-inch diameter. The machine is of the pyramid type, having two lower rolls, each 20 inches diameter, and one upper roll 31½ inches diameter.



Bending Rolls Recently Installed at Connelly Boiler Shop

These rolls are hammered "forgings" and machined. The top roll weighs 80,000 pounds.

The machine is fitted with a "drop-end" housing so that a plate can be rolled to a complete circle, and by lowering the "drop-end" housing the plate can be removed from the top roll. The weight of the tool is 250,000 pounds.

This tool is perhaps the largest and heaviest machine of its kind in any boiler manufacturing plant in America.

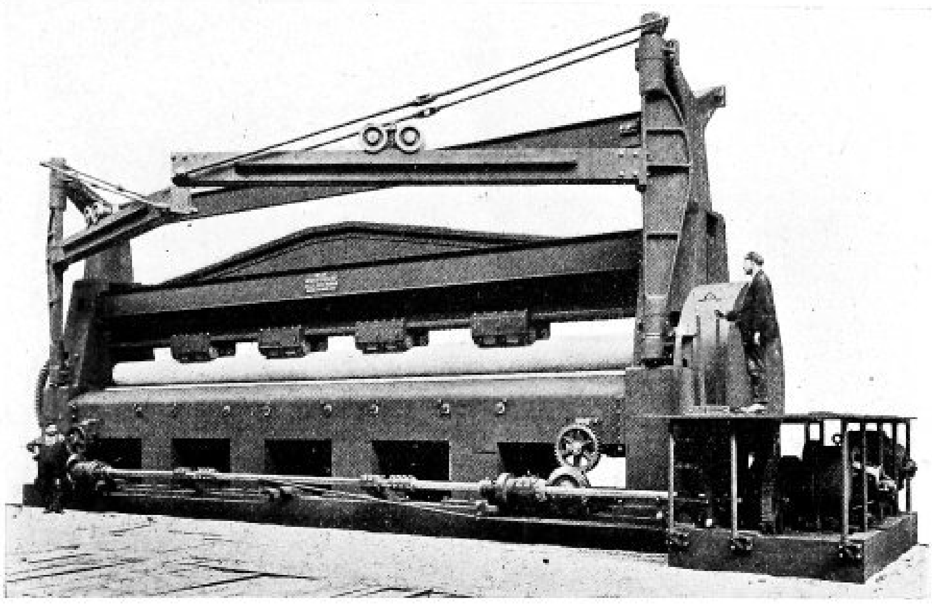
Horizontal Plate Bending Rolls—Strongback Type

The illustration shows a very large set of bending rolls recently built at the Niles Works, Hamilton, Ohio, of the

Niles-Bement-Pond Company. This machine is of the strongback type and has a capacity to roll mild steel plates 1 inch thick and 36 feet long, and plates 1¼ inches thick and 30 feet long.

The machine consists of two massive cast iron housings, united at the top by two 20-inch I-beams and below by two heavy cast iron side frames, with bearings for eight pairs of steel rollers, four pair on each side to support the lower rolls.

The three rolls are forged steel, one upper and two lower, each 36 feet 9 inches in length between the journals. The lower rolls are 16 inches in diameter. The rolls are driven by means of a 100 horsepower motor.



Strongback Type of Bending Rolls Made by Niles-Bement-Pond Company

The top roll is 19 inches in diameter and reinforced by a heavy built-up steel girder carrying on the under side four supporting roller bearings directly over those carried on the side frames. The girder and roll are raised and lowered by means of steel screws, one at each end. The elevating screws are operated by a 75 horsepower motor through a mechanism so arranged that each end of the roll may be raised or lowered independently of the other or both ends together.

The whole set of operating handles is grouped together in a convenient point at the motor end, so that the motor controllers, reversing and clutch levers can be controlled by one operator without moving from one position on the operating platform.

The machine is supplied with four top braced jib cranes, self-contained with the machine. The posts for the cranes are at the four corners of the machine.

Saves Money by Arc-Welding

Arc-welding has been brought prominently before the public through the fact that it was used to restore the broken engine castings of the interned German ships. When breaking these castings the Germans thought they could not be repaired, and that it would require a year or more to replace them. However, even before the ships could be otherwise overhauled and made ready for transport service the broken castings had all been repaired and were as good as new. This achievement has impressed the value of arc-welding upon the minds of many shop managers, and in many plants castings and other parts of apparatus which in the past would have been scrapped as hopelessly damaged are now perfectly restored by the arc-welding process at small cost and great saving of time.

One large manufacturer, working on munitions, has installed a Westinghouse arc-welding equipment for the sole purpose of making tools for turning shells.

Ordinarily these tools are made from high speed steel and cost about $12 each. This manufacturer uses high-speed steel for the tip of the tool only, welding it to a shank of carbon- or machine-steel, and in this manner the tools are produced at a cost of $2 to $4 each.

For several weeks this plant has been turning out 240 welded tools per day, the men working in shifts of four, which is the capacity of this outfit.

The equipment consists of a 500-ampere arc-welding motor-generator with standard control panel, and three outlet panels for metal-electrode welding, and one special outlet panel for the use of either metal or graphite electrodes. This special panel is intended to take care of special filling or cutting processes which may be necessary from time to time, but it is ordinarily used in the same manner as the other panels, for making tools.

These four panels are distributed about the shops at the most advantageous points for doing the work, it not being necessary to have them near the motor-generator or main control panel.

For toolmaking, which involves the hardest grades of steel, a pre-heating oven is used, not because it is necessary for making a perfect weld, but because otherwise the hard steel is likely to crack from unequal cooling, and also because pre-heating makes it easier to finish the tool after the welding process has been completed. For ordinary arc-welding operations the pre-heating oven is never used.

Internal War Loans of Belligerent Countries is the title of a book just issued by The National City Company. The methods of financing internal war loans in the different countries engaged in the world struggle are clearly described. The information has been gathered from original Government prospectuses and many foreign journals by the Foreign Department of The National City Company. In all, fifteen countries have been covered and sixty-seven loans described. The book is most comprehensive and forms a contribution to the literature on war finance.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, 461 *Eighth avenue, New York city.*

Strength of Flat Tube Sheets in Yarrow Boilers

Q.—In your issue of February you illustrate the Yarrow watertube type of boiler, showing the tube sheets of the lower drums, almost flat, but slightly cambered. There are being built in this district, for war service, watertube boilers of the Howden type, in which the tube sheets are perfectly flat. I am attaching a sketch of one of the three elements forming the completed boiler, showing the arrangement of the tube sheets. Will you please inform me what formulæ are used in determining the thickness of these tube sheets?

In the sketch referred to, the tube sheets of the upper and lower drums are 1⅜ inches thick, planed to about ⅝ inch thick on the edges before flanging. The back end of top tube sheet, forming the top of combustion chamber, is stiffened by girders and screw stays. The holes for the tubes are counterbored for a depth of ⅝ inch, the tubes being expanded into the remaining ¾ inch of thickness. It is the strength of the plate between the tubes about which I wish to obtain the information. T. T. G.

A.—It is difficult to make any definite calculations for cases of this kind. The use of a flat and unsupported surface in any boiler does not appeal very strongly to the user. However, these boilers are used for certain purposes and the flat tube sheets seem to be one of the requirements for construction reasons. In order to figure the theoretical thickness of such a tube sheet, three or four viewpoints must be considered. First, the plate must be figured in tension as being a member that holds together two edges of the drum. Second, the plate should be figured as subject to the bending stresses from the steam pressure against it. Third, the plate will be subject to bending stress due to the pull and the movement of the tubes.

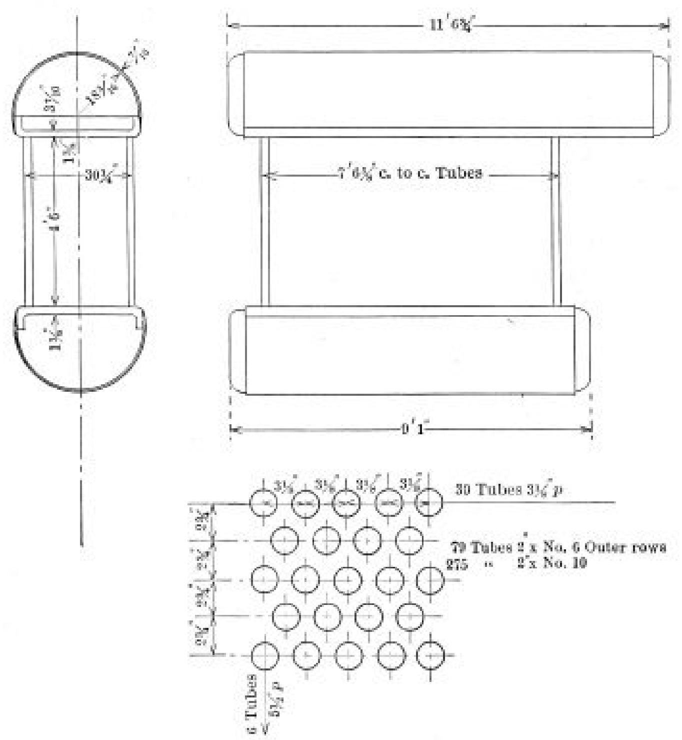


Fig. 1.—The Yarrow Boiler with Flat Tube Sheets

The theoretical thickness of the Yarrow tube sheets may be calculated for two of the stresses that are known to be set up in the sheets, and a very liberal factor of safety should be allowed. Taking the first case, we find the thickness required of the shell for the tensional stress

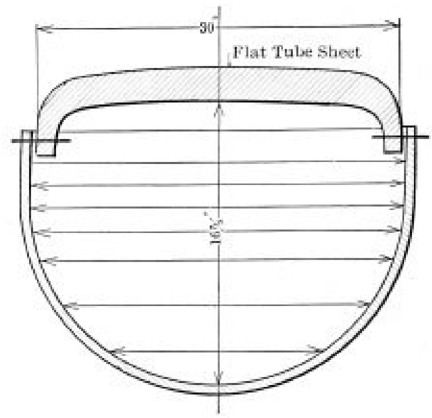


Fig. 2.—Direct Tension in Flat Tube Sheet

by the use of the formula ordinarily used for the horizontal joints in cylindrical shells,

$$t\,l = \frac{P \times L \times D}{2 \times S},$$

in which P is the pressure in pounds per square inch, D is the diameter of the shell, S is the allowable maximum stress per square inch, L is the strength, t is the thickness of the shell, and l is the length of the strip between the rivet holes, or net length.

The illustration, as modified from Fig. 1, is shown in Fig. 2. It should be noted that the distance across the drum is 16⅝ inches instead of the diameter of 30 inches. Assuming that 60,000 pounds boiler steel be used and that the maximum stress allowable be not over 9,000 or 10,000 pounds per square inch, then the factor of safety of six or more is adopted. There is a row of 2-inch holes for 30 tubes, giving a net area of the flat sheet of

$$1\tfrac{3}{8}\ (78\tfrac{5}{8} - 60) = 1\tfrac{3}{8} \times 18\tfrac{5}{8} \text{ square inches.}$$

With these data the allowable gage pressure is

$$P = \frac{1\tfrac{3}{8} \times 18\tfrac{5}{8} \times 2 \times 9{,}000}{16\tfrac{5}{8} \times 78\tfrac{5}{8}} = 353 \text{ pounds.}$$

Evidently, this tube sheet is amply strong, if it is not subject to any other than the straight tensional stress.

The transverse bending stress on this flat sheet is severe. The large number of 2-inch holes reduces its strength, but the area of these holds reduces the amount of pressure on the sheet. In Fig. 3 is shown the adaptation from Fig. 1. A strip 3⅛ inches wide is taken as the unit beam. This beam has a gross area of 3⅛ x 30 inches. It has cut from it an area equal to eleven, two-inch holes, or 11 x 3.1416 square inches. This area is made up of 12 one-half holes cut from the edges of the strip and 5 complete holes cut along its middle line. The net area of the strip is 3⅛ x 30 — 11 x 3.1416 = 59½ square inches. The total transverse load on the strip is $P \times A = 59\frac{1}{2} = W$.

There are two formulas that can be used in a case of this kind. The strip is a constrained beam because both ends are fastened. The formula for such beams is as follows:

$$f = \frac{S l^2}{48 E C}, \text{ and } f = \frac{W l^3}{384 E I}, C = \frac{S l^2}{48 E f}.$$

In this formula f is the allowable deflection, S is the maximum stress per square inch, L is the length of the beam in inches and C is one-half the thickness of the beam. E is the coefficient of elasticity, which for boiler steel is about 25,000,000. W is the total uniform load and I is the moment of inertia of the section of the plate.

We can assume any deflection, such was 1/100 inch or larger, and figure the thickness of the shell from the given data. Thus,

$$2\,C = \frac{2 \times 10{,}000 \times 30 \times 30 \times 100}{48 \times 25{,}000{,}000} = 1\frac{1}{2} \text{ inches.}$$

From this it will be seen that a sheet $1\frac{3}{8}$ inches thick would seem to be stiff enough for the work.

The most important calculation is that from the use of the last formula. In this case we will assume that considerable deflection, such as 0.1 inch, is allowed. Then,

$$W = \frac{384\,E\,I\,f}{l^3}, \text{ or}$$

$$W = \frac{384 \times 25{,}000{,}000 \times .24}{30 \times 30 \times 30 \times 10} = 8{,}530 \text{ pounds.}$$

In this computation we have figured the value of I from the minimum section of the strip, as shown at AB in Fig.

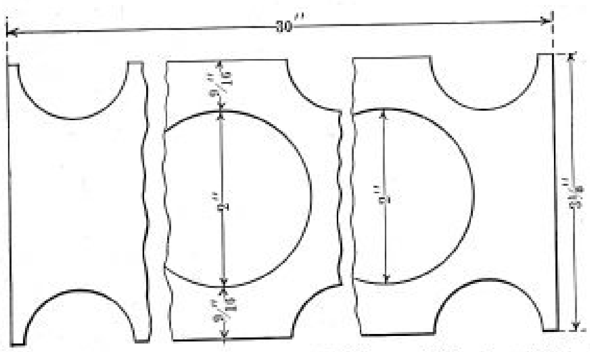


Fig. 3.—Section $A\,B$ Through the Middle and Weakest Part of the Tube Sheet

3. The net width of the plate equals $3\frac{1}{8} - 2 = 1\frac{1}{8}$. The value of I is $1/12\ bd^3$, where b is the breadth and d is the thickness of the strip. Hence,

$$I = 1/12 \times 1\frac{1}{8} \times 1\frac{3}{8} \times 1\frac{3}{8} \times 1\frac{3}{8} = .24.$$

From the computation made before we have

$$P = \frac{8{,}530}{59.5} = 143 \text{ pounds.}$$

This result is rather low for the allowable working pressure and it indicates that the sheet is the weakest along the middle row of tube holes. The bending stresses due to the pull of the tubes is rather indeterminate. Therefore, the sheets should be made extra thick and tested out in practice, which they are. A flat unstayed surface is not a desirable one for boiler construction.

A. M. Castle & Company, of Washington Asborbs the Business of the Western Hardware & Metal Company

On July 1, the business theretofore conducted by the Western Hardware & Metal Company, at Seattle, Wash., and that by A. M. Castle & Company, in the Pacific Northwest will be conducted by A. M. Castle & Company, of Washington. The entire organization and warehouse facilities of The Western Hardware & Metal Company will be taken over by the new company, which is organized with a capitalization of $1,500,000.

A. M. Castle & Company was founded in 1890 with headquarters in Chicago, and from modest beginnings has grown to be one of the important iron and steel jobbers of this country, with a very modern plant and facilities. The Western Hardware & Metal Company was established twelve years ago by Mr. George Boole, who had had a very wide range of experience in iron and steel merchandising and particularly on the Pacific Coast. The growth and success of this company have been phenomenal. Mr. Boole will be active in the new company and will be the chairman of this Board.

The new company will specialize on tank, flange and marine plates, black, galvanized and blue annealed sheets, iron and steel bars, shapes and structural material, hoops, bands, pipes, tubes, etc., besides carrying a complete line of all supplies, bolts, nuts, rivets, brass valves and fittings, blowers and forges, wheelbarrows, waste, etc.

The principal offices will be located at 1201 First Avenue South, corner Connecticut Street, Seattle, Washington.

PERSONAL

Victor J. Hartley, formerly assistant foreman boiler maker at William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has been appointed superintendent of the Badenhausen Watertube Boiler Company's plant at Cornwells, Pa. Mr. Hartley received a thorough training in marine boiler construction from Henry J. Hartley, for many years head of the boiler department of Cramp's shipyard and a past president of the American Boiler Manufacturers' Association.

N. W. Fuehrer, well known as a successful layerout and boiler shop executive, has accepted a position as superintendent of the boiler department of the Badenhausen Company's new shop at Bridgeport, Pa.

W. H. Callan, general manager of plants, and W. P. Pressinger, general manager of sales, have been elected vice-presidents of the Chicago Pneumatic Tool Company, Chicago, Ill.

George H. Crossan, formerly of the purchasing department of the General Electric Company, Lynn, Mass., is now acting in the capacity as director of purchases for the General Vehicle Company, Aeronautical Engine Corporation, and the Wright Martin Aircraft Corporation of Long Island City, New York.

P. B. Findley, technical editor in the department of publicity, Westinghouse Electric & Manufacturing Company, has resigned from that position to enter the training school at the University of Pittsburgh, where he will take a special course in radio work, with the Signal Corps. Before going to the Westinghouse Electric Company, Mr. Findley was editor of the *Electrical Age*, in which position he made a large number of friends in the electrical field who will wish him success in his military work.

Letters from Practical Boiler Makers

This Department Is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

Repair Work in Oil Refineries

As I am also a reader of THE BOILER MAKER, and have been for years, I have watched with interest the different methods and views of the numerous contributors and have made and used considerable of the information I have gleaned therefrom. I have found in a late issue where a Mr. I. Derrick asks about some patches on stills. As I have worked in refineries for a long time, I have had practically all kinds of stills to repair; but as he only asked for two kinds, I will help him as much as possible.

He has stated that in refineries several types of boilers are used. He is right, as at this point we have two kinds of watertube (Wicks and Vogt), return fire tube, flush tube, crane boilers, and several field boilers, as we call them; they are semi-portable.

But getting back to our still question, I will say it is possible to patch pressure stills. I have patched this still successfully for five years, but it is considered by some operators as an impossibility until they see a still in operation. With the coke collector, either metal plater or oscillation scraper device, you can get nothing lower than 85 percent of the actual percentage of a new still, and, if handled properly, will give 100 percent results.

In patching pressure stills of 85 to 110 pounds pressure and 725 degrees to 790 degrees F., with the double bottom coke collector, I use plain methods in repairing patching, with patch inside, all holes countersunk in patch to feather edge, rivets all staggered (as I would not trust chain-riveted seams, for reasons well known to the craft). Rivets driven with flat die with an air hammer, on account of countersunk rivets, make the still easier to clean and takes away an extra amount of steel which is of importance at this particular part of the still, calking patch inside and bottom to patch in firebox, fullering heads in firebox and finished off inside still. Stills using the oscillating or chain drag I apply patch in the same way, only instead of calking seam I oxweld the seam on the inside before driving the rivets. After patch is gotten out and all holes matched up, all burrs cleaned from between the patch and still, patch is bolted into place again and beveled with chipping machine to an angle of about 30 degrees, for when welding I have welder fill in as much as possible, as it makes the offset of the two plates less abrupt and allows chain drag to keep the coke from accumulating and causing a hot spot on bottom, as we call it. After being welded, I have rivets driven in; care should be taken, however, to caution welder not to get countersink filled in. The best way is to go over the outside row of rivet holes after the welder has finished, for countersink needs to be perfectly clear. Then drive the rivets. Care should be used in the heating of rivets and no rivets should go in that are the least bit burned. When you are patching a pressure still, you should always remember that expansion of plates will not tighten your seams, as oil will not take up like steam and there is no chance for a leak on a patch stopping for at least the first three runs, but after that, she will gradually become tight, and, if coke is kept from gathering around patch, it will run indefinitely.

In regard to coke stills having expansion strips in of lighter material than the bottom sheets, about the first that give way are the rivets on each side of the strip, and often the heads become small and pull through the holes. If the seams have not pulled too much to redrive, I cut out all rivets, knock out all coke and clean out between sheets, ream out a few bolt holes, bolt up and lay up the iron from both bottom and top. If there is sufficient lap to do so, I drive a larger rivet than was in originally.

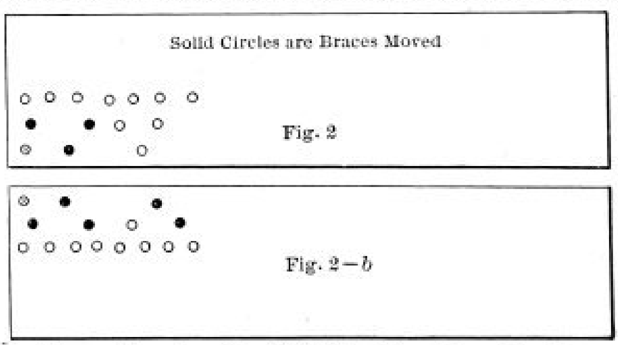
About the next repair will be thin spots in strips. Sometimes the fire sheet will have become so thin it will need a patch. If it is close to the strip, cut completely around thin place, and, if expansion strip has also got thin, cut it out. Also, there is one thing you must avoid and that is laps, as the more laps you have in the fire, the worse for wear, as there is a certain amount of plate there that is not protected by having oil on the inside.

I will be glad to hear what some of the boys think of the above and will be glad to answer anything at any time to help out any way I can. I have often wondered why some of the boys that work in oil refineries have never published anything regarding their work, as a refinery, I believe, has as much variety of work as any shops in the country. Any inquiries regarding the above will be forwarded to the author by the editor of this journal.

GENERAL FOREMAN BOILER MAKER.

Location of Diagonal Braces

Referring to pages 133 and 134 of the May issue of THE BOILER MAKER, I would like to call "Inspector's" attention to the fact that it is considered good practice in laying out diagonal braces not to put one over the other, where same are attached to the shell. On page 134, first column, last paragraph, "Inspector" notes the fact "that it is frequently necessary to draw a brace to either right or left of the equal space distance, in order to avoid contact with the lugs, nozzles, etc., or to bring the brace within the close riveted part of the butt strap joint."



Braces Moved so One Will Not Come Over the Other

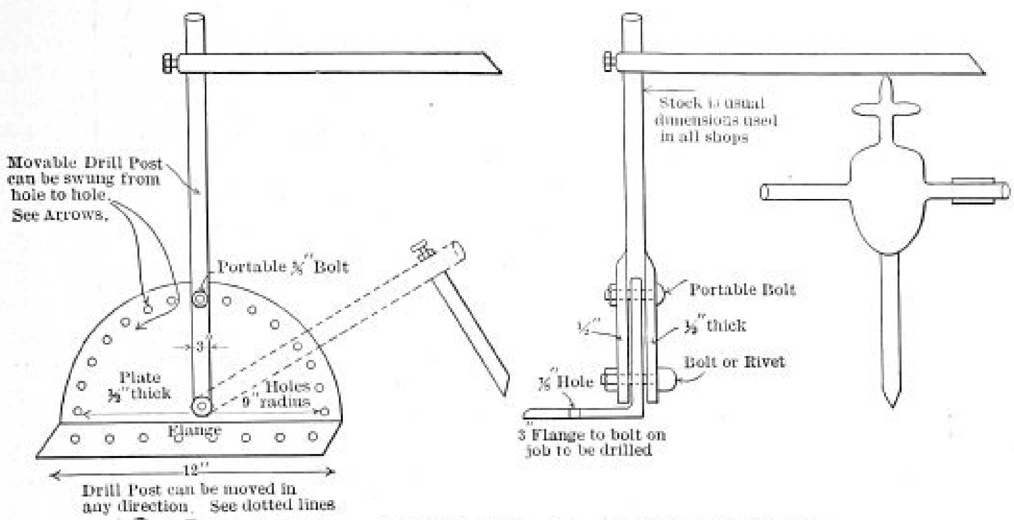
This will also apply in regard to drawing the braces so that one will not come over the other. Figs. 2 and 2b will show that some of the braces are so moved. In these sketches, the solid circles indicate braces which have been moved. Those that are not moved are marked "X," and the distance between them on the shell is so great that it is not necessary.

The reason for changing the braces is because in case of repairs, such as broken rivets, if it becomes necessary to replace the braces, repairs can be made to the brace involved, without disturbing the others.

Cambridge, Mass. HOMO.

Portable Drill Post

I herewith enclose sketch of a very handy portable drill post for use in the boiler shop or by iron workers, which I trust will interest readers of THE BOILER MAKER.



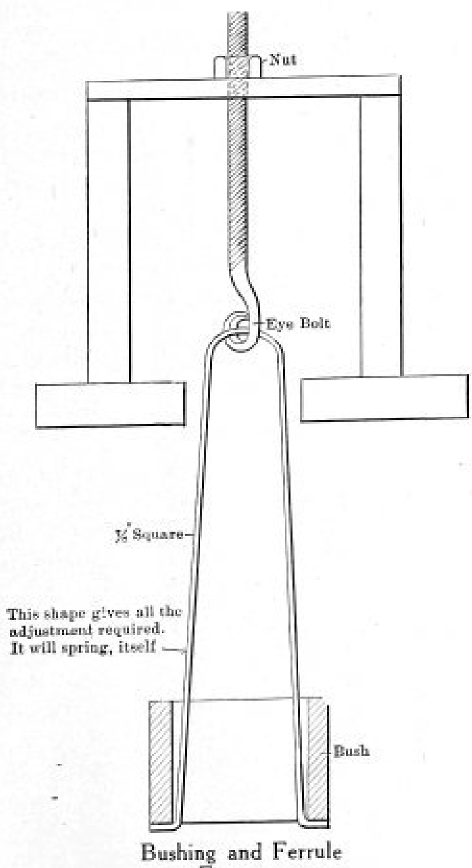
Portable Drill Post with Which Holes May Be Drilled at any Angle

The sketch should make the working of this device easily understood.

Montreal, Canada. JAMES WILSON.

Another Useful Ferrule Extractor

In the March number was shown a ferrule extractor, which reminds the writer of one made a few days ago, sketch of which is enclosed. Our machinist fitted a large



Bushing and Ferrule Extractor

bronze bush in a Lidgerwood hoisting drum which was too tight on the shaft. It was a hurry job, and not having a large reamer, to file or scrape, to fit would take too long, besides taking several helpers to handle the drum shaft.

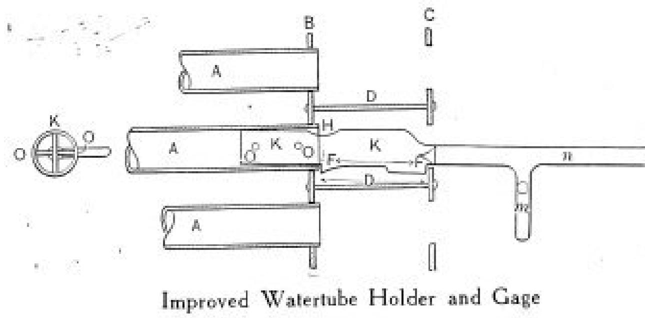
There were many ways to make a puller but in this case one was wanted at once. I made one out of ⅞-inch square soft steel about 12 inches long, all in one piece, as shown; found an eye bolt and in about an hour had the bushing out and the required amount bored out. The advantage of this design is that it is simple and can be made any length. It requires no screws to adjust, as the spring in it will give all the adjustment required.

Indianapolis, Ind. M. E. HOWARD.

Tube Holder and Gage

In retubing a watertube boiler of the Heine, or similar types, it is very important to have the projecting ends as nearly as possible uniform. To hold the tube from moving endwise when the expander is driven in as well as to keep it from revolving before the tube sets is rather difficult, in particular when the helper is not interested in the job.

In order to overcome this trouble, I designed a tool which will serve as a holder as well as a gager. The



Improved Watertube Holder and Gage

illustration shows three tube ends marked *A*, *A*, *A*, projecting slightly into the water header. The tool is shown in place in one of these tubes. It consists of a piece of flat steel or iron, about twelve inches long, slightly less than the inside diameter of the tube, to which is welded a round bar of one and one-eighth inch diameter, acting as the handle, with a piece of the same size welded to it at right angles to aid the helper in preventing the tool from turning.

F and *F* are projections used as the gage. One of these projections butts against the tube at a predetermined distance, while the opposite projection butts, on the inside of the outer sheet, thus preventing the tube from moving latterly while the expander is driven in.

In order to insert this tool, a notch, *H*, is cut out of the flat bar to permit it to pass through the hole in the outer sheet. The flat bar is supposed to be held in a vertical position while in use, and in order to hold this bar fairly at the center of the tube, two round pins are inserted at right angles to the flat portion of the bar. This makes the tool complete for the purpose intended. The men working with it have found it very convenient and I believe it will be useful to boiler makers doing such work.

Johnstown, Pa. REINHOLD BETTERMAN.

"The Good Old Days"

In recent issues reference has been made to past practice and the pioneers in the industry of making boilers. An experience of the writer in connection with one of the few survivals of the early days may perhaps be interesting. It must be clearly understood that the facts as related are the only instance which has come before the writer's notice, and it may help to throw light upon the practice of the "good old days" so regretted by the elder generation.

Some five years back, instruction reached me to travel 300 miles and report upon a new vertical stock boiler it was proposed to supply in connection with other plant equipment. There is no need to reveal the location, except to say that the identical shop was established by one of the pioneers in the earliest days of steam, whose name is respected and known by all, and no history of the steam engine is complete without reference to him.

Upon arrival, when 20 yards away from the office door, the fact that the boiler was not round struck me very forcibly. The foreman was greatly tickled when he was informed that internal, as well as external, inspection would be made. Getting nearer the boiler, the fact that literally hundreds of rivets had been calked was apparent, and that the shell plates were rolled up as a series of flats was evident before any close approach was made.

Having expressed a doubt as to circularity, the following performance was enacted in all due seriousness: a circle was struck in the dirt floor and a series of bent square rods was sorted over to find the correct templet. This found, it was applied to the exterior of the shell. It alternately touched at the ends with half an inch gap in the middle and again applied showed the same daylight under the ends. The foreman appeared satisfied; it was their method of test and the tolerance was near enough. It was how *they* made boilers, and good enough, in their opinion.

The boiler was fitted with cast iron pads directly upon shell plates without any calking strips. Flanging of cross tubes came to feather edges and every seam bore the witness of hammer marks on plate (signatures, in the language of the shop). To satisfy the shop and complete the inspection, hydraulic pressure (150 pounds) was applied; and possibly in grief and despair at so close an investigation, the tears it shed were so copious that two men with wads of waste were employed fruitlessly trying to stem the tide.

Expressing doubts as to its acceptability (I had long ago—in fact, as far back as the office door—made my decision), indignation was expressed as to what I expected a boiler to be. It seeped a little, but would take up—they always did, was the assurance given. Relations grew strained and far from cordial; one elderly man was very indignant at my mild criticisms. There was open and frank amusement when preparations were made for interior inspection; the probability was that it was the strangest thing ever witnessed—that a stranger should disappear from view through the manhole. However, a few minutes sufficed—nothing was right about the job at all.

My real work came later—the boiler was a sub-contract; it took some hours to compile a return asked for by the main contractors as to why acceptance was declined and in what particulars it contravened the specification. That report was a work of art. Clause by clause the standard specification for a high-class boiler was quoted with the existing divergences therefrom. Needless to add that every prohibition was traversed and every provision null and void. The whole proceedings were farce of the broadest description.

Now, here is the point at issue: This was a boiler made by the methods of half a century ago, in a pioneer shop carrying on the traditions of its establishment of nearly a century. Every hole was punched, seams were plugged up; *every rivet was hand closed* and the results were exactly as described above.

The episode is rather reminiscent of the sea boats and oilskins and calkings for hours described by a recent contributor. Such methods were probably sufficient when boiler pressures never exceeded 10 pounds, and the chief trouble was to keep a vacuum off the boiler.

There is always interest in trying to realize how our ancestors worked and to fathom their methods. Unless such an isolated experience had fallen my way it would have been incredible that such a survival existed. In view of recent remarks in the pages of this journal, it would almost seem as though such conditions were still common in the U. S. A.

There was also the interest common to historic things. I stood upon ground where one great pioneer of progress once stood. The troubles were due to increase in boiler pressure and the retention of the original equipment—there was no drilling machine in that shop; flanging was done over a block by mallets; there was the most antique set of rolls of a type and description now vanished from the industry.

Further inquiry elicited the fact that this identical boiler was the last made by the concern, to the probable relief of everyone concerned.

Every time the workmanship of former days is praised, the picture of that boiler in that shop springs irresistibly to my mind. I know how boilers used to be made; under what difficulties; with what effort, and I also know how modern boilers are constructed, and the feeling left is one of profound thankfulness that improvement has kept pace with increase in pressure. Indeed, the former made the latter possible.

It is with no feeling of pride that the circumstances are recorded; it is indeed a matter for regret that such a survival should have still been in existence only a few short years ago. However, recent correspondence in these pages made me decide to relate the story, lest it should be thought that my experience was limited only to modern methods and good workmanship.

It gave me an insight why legislation stepped in and penalized the maker of dangerous boilers; why it was that boiler explosions were more frequent in days gone by; why obsolete methods have been discarded and lots of otherwise inexplicable things.

London, England. A. L. HAAS.

MICHIGAN BOILER & IRON WORKS.—The Michigan Boiler & Iron Works, Grand Rapids, Mich., has been organized with a capital of $15,000 to take over the property formerly operated as the Central Boiler & Supply Co. The stockholders are Peter A. Geldhof, John Snitseler, William R. Cook and Carroll F. Sweet.

A Talk to the Boys

In a certain boiler manufacturing shop, there was a superintendent who had worked his way to the top slowly but steadily, and at each step was complete master of his position. (We'll call him Joe.) When he first starting heating rivets and tossing them to the boys, he not only learned how to do it the best way, and just why the rivets had to be heated to such a color, but he would be found during his noon hour exploring the inside of some fellow's book on construction of boilers, getting primed up with questions to fire away at the boys, so's he could find out why things were. Suffice it to say that he mastered the ins and outs of the work in due time, and became one of the most skillful men in the shop, and the logical choice for super when that job became vacant.

The boys all liked him, for he had a way that proved he was a leader of men. For instance, take the time he was first made leading man of the plate work in the machine department. It didn't take him long to get suggestions from the men running the machines as to what could be done to make things work smoother and increase production. Jerry, the old timer, who had been on the one punching press for six years, told him of an idea of his that would, he thought, make the handling of the plates much easier and quicker.

When worked out, it proved better than Jerry suspected, and when Joe asked him why he hadn't suggested it before to the management, he replied: "Well, I tried to tell it to the other leading man, but he just listened and never paid no further attention to it, and you wouldn't have got nothin' much out of any of the boys if you hadn't gone around makin' em see that you was their leader, not a big-headed driver. You know it don't take a whole lot of stuck-upness, or aloofness, to make the gang feel that the boss thinks he has all the knowledge of the job cornered. That's what was wrong with our other leading man, in spite of the fact he was a good mechanic."

Joe's rise to the super's job was talked of by all the men in the shop, including myself, and of course we all had expected him to get the place. Kinder funny, too, that a fellow like Joe could be so popular with all of us, yet keep the line of familiarity drawn, so that none could lay claim to favoritism. I have found in his ways a great deal of food for thought, and that's why I am scribing this talk to the boys, so's they can understand, as I do now, a few of the qualities a fellow must have to make good and climb as Joe did. Perhaps I might recount to you just what I heard him say in the office when the board of directors called him in to tell him of their desire to make him super, and ask him if he would take the job.

"I have not been surprised, gentlemen, in being offered this position, and I have only to say that I have studied and worked and hoped for a chance to get to the top ever since I received my first promotion, and I have always studied the job ahead with the hope that I might be able to qualify for it, if offered the chance. I realized from the first that I must have a large appetite for responsibility, together with the courage to take it on my shoulders. I learned that the time I was leading man, and my senior on the assembly floor was taken sick, and I had to take his place. Since then I have been ready to take my senior's place at a moment's notice.

"If the Board considers that I am worthy and competent to fill the former super's place, I will endeavor to fulfill your belief and confidence in me. I may not be able to meet up with your estimate of my abilities, and should I fail, I earnestly hope that you aid me to master my shortcomings, for I hope and want to succeed."

Now, boys, you all know what the war has done to this phase of the business. There will be more boilers and tanks constructed in the next two or three years than ever before constructed in a like length of time in history. This shop is going to expand. It's going to need a lot more good men to fill the bigger jobs. Joe will move up to general manager, and some one else will fill his place. I am sure we have a few more like him among us, and it's up to them to follow his example and burn some midnight oil studying.

You all have perhaps decided that making boilers is to be your trade, your life's job. If so, there must be among you some who have a strong ambition to fill the master mechanic's or the super's job. Develop that ambition by studying your chief and your fellow men. Learn human nature as well as boilers. Each time you are given an order, study it out—why it was given, and what lies ahead and behind it Learn to place yourself in the other fellow's shoes—learn to reason out each detail. Try to do your share of thinking, and you will find yourself climbing, just as Joe did.

Perhaps the greatest asset one can have, and one that is most needed, is that of sterling or undoubted character. It is something that is the personal possession of each individual that he can make priceless, or cast away, or sell at will. It is something that cannot be molded by others, but it can be influenced for the good or for the bad, according to his associates. Let your aim ever be to better the work that you are doing, but remember always that you cannot better the work you are doing without bettering yourself. The thoughts that you think, the words that you speak, and the deeds that you perform are either making you better or worse.

Concord, N. H. C. H. Willey.

Should Butt Straps Be Cleaned?

As my comments on the need for dressing contacting rivet surfaces after holing have been further amplified by "D. E. G." in the April Issue, some reply from me seems needed. This more especially as it is quite another subject to which he takes exception, for on the main theme it seems we agree passing well.

D. E. G. denies that it is part of an inspector's duty to enforce any rule or clause contained in the guiding specification, and states that if the inspector worries over contravention he is a fool (no less, the phrase is D. E. G's.), since his duty is confined to witnessing performance and rejecting the completed job if it is not in accordance with the conditions of contract.

If the duty of a supervising inspector were quite as simple as D. E. G. infers, life would be an easier adventure for the conscientious inspecting engineer. When, as in the present question of removal of burrs, all traces of neglect on the part of the shop are hidden, it is necessary to influence those responsible to carry out instructions rather than display arbitrary power even where this is absolute and not discretionary.

Unless the contract be large, a resident inspector keeping shop hours and continually present is an impossibility, and even where such an individual is stationed for the purpose he is apt to be a nuisance to himself and troublesome to the management upon whose premises he abides. To narrow down the position of a man of considerable ability to that of a policeman on the lookout for latent criminals is to misread the whole relation of inspector to firm. Whole reams could be written upon inspection, which is a very vexed subject, but the most intolerable man is the one whose conception of his duties is similar to that laid down by D. E. G. In fact, he is usually a man deficient in real knowledge who does not exercise discretion because he is without experience.

D. E. G. will find without doubt that the relation between inspector and contractor is rather more complex even where the firm is reputable and honest in intention and the inspector capable and experienced.

It is impossible to draw a specification which leaves nothing to interpret. There are usually distinct prohibitions, compulsions and conditions and always there are covering clauses which are left to the discretion of the inspector. Trade custom and the inspector's own trade experience count for a good deal in amicable relations.

A capable inspector is a judicial arbitrator, and in addition should fill something of the office of guide, counselor and friend, rather than be a silent, tongue-tied witness who lets mistakes proceed to due fulfilment and final condemnation of the finished product.

There are two kinds of mistake, honest and fraudulent, and it is the business of inspection to forestall the first and defeat the second. A great deal can be done to minimize error if both parties are honest in intention and experienced in practice. An inspector has to satisfy his authority, yet must not impede production; if he is a capable man of any character he has also to satisfy his own sense of right dealing. Contravention of distinct prohibition is clearly fraudulent intention and it does not take many discovered cases to sacrifice the reputation of the manufacturer. It is the business of an inspector to know intimately the firms with whom he deals, and usually the shop has a pretty clear idea of the requirements of any inspector who is a frequent visitor. A few instances of "getting it past the inspector" mean a loss of reputation to the firm, and undue insistence upon the letter rather than the spirit of the specification means an increased cost to the customer on the next occasion.

The writer has known cases where an extra 10 percent was always added to cover orders coming within a particular inspector's orbit, and has also known large contracts pass a responsible firm by reason of past inspection experience. Inspection cannot always defeat shop conspiracy, however detailed and severe it may be; so much depends upon the personality of the inspector, who most frequently gets served as he deserves.

No inspector is worthy of his job who has not himself had extended shop experience, and this minimizes to a very large extent friction between the inspector and shop; for a practical man realizes practical limitation, and, having wide experience of process in many quarters, knows where to be tolerant and where severe. Actually, inspection has a definite value not always realized by firms subject to scrutiny at close quarters for the first time. It raises the quality of workmanship, also the management has the great asset of an outside point of view which in itself has a real and definite value.

To return to the controversy over butt strap and lap dressing. It has been the writer's practice in the supervision of new boilers, first to identify the plates with mill tests before anything whatever is done, and, where necessary, re-mark for final identification. At least two workmanship inspections are made. The most vital is when all holes have been drilled (in position) and the entire job has been so far as possible assembled for riveting, when a careful and detailed inspection is made of holing and correspondence of plates. Slacking back a few bolts discovers whether the laps have been dressed clean. The point is, that no rivet is driven until permission is released for this to be done. It is possible at this stage to view everything before anything can be hidden up or covered over. Closer adjustment can be made at this stage if required without any condemnation or rejection.

Two matters are really important, the absence of hammer marks on the plates and the condition of holing. If such workmanship inspections are duly carried out by a man really conversant with boiler making, the shop has the satisfaction of knowing that the work done is good; the inspector, that when the boiler is hydraulically tested he will not hunt for leaks in oilskins as described by a contributor to these pages.

Much more might be said but this will suffice for the present. The defect of an included washer, mentioned by D. E. G., due to chamfer of the plates where they contact, is clearly inferior workmanship. Of course, if a pneumatic drill is used in inexpert hands, there is such a possibility, but for dressing the laps why use power? A block file and a joiner's brace are all that are needed. No man who claimed to be a boiler maker is going to sacrifice all the virtues of position drilling on the machine and close plate contact before riveting up by such folly as countersinking the holes; in any event a workmanship inspection will defeat such a practice. It is another case where if good work is done in one direction it influences the entire job.

It is only necessary to express entire agreement that intimate contact between plate surfaces is the object of cleaning off burrs, also that full size numerous tacking bolts properly pulled up are desirable. Most good mechanics working on first class boilers are careful to contact the seam as they go some distance ahead of closure. An inferior man who leaves windage for the rivet to pull up causes the trouble under test.

The precautions necessary to secure a tight boiler under test are really simple and the extra time and trouble are not great. Holes absolutely round, perfectly fair, plate surfaces that actually touch—these can all be secured at small trouble if the shop has the proper gear. Position drill on the machine all holes; every seam holed after plating up through all thicknesses at the one time. The more the matter is considered the more extraordinary is the retention of antique method. The modern method is straightforward, direct; every single factor having tangible and realized value, nothing is left to chance. The simplicity of the entire series is remarkable, while scores of British shops are convinced, not merely that it is better to be sure, but that it is cheaper to be certain.

One other word may not come amiss. The term "position drilling" has been frequently used by me in these pages and an exact definition of the term, as I understand it, is perhaps worth while.

Drilling under a machine tool is the practice advocated, not the rigging up and holing by pneumatic drill, which is often believed to be a substitute. Rapidity of operation is obtained by special machine tools on cylindrical seams where from two to six holes are drilled simultaneously. The machine in this instance carries horizontal radial spindles capable of angular adjustment. For longitudinal seams a radial drill is usual; although for standard boilers in quantities, in a modern shop, the axial seams are multiple holed by specially designed machines or by a group of radials mounted on a common base. No hole made in the flat and the plate rolled up can be cylindrical, and individual rigging by pneumatic drill is capable of grave abuse in careless hands. Moreover, punched holes reamed to correspondence by pneumatic drill are liable to be other than square to plate; and the burr raised is conditioned by the initial irregularity of the two holes to be reamed into line and by the sharpness or otherwise of the reamer itself. The application of power to reaming in itself has made the need for dressing burrs more necessary than ever, because a reamer in very bad shape can be propelled by power. This, of course, concerns inferior work, which is inadmissible in any first-class boiler.

Finally, if any shop making quantities of one size or type, or even where the run of shop work varies greatly, will install the newer methods and lay out properly, with well-designed multiple drilling machines, position drilling all holes, they will have an agreeable surprise. If the total costs are carefully kept, both under the old and the new methods—that is, compare the total overall costs, everything included—it will very much surprise the writer if the new is more expensive.

A boiler so built will be granted the highest classification under any authority extant; for up to the present it is the best conceivable method. Boilers are an outstanding instance that the best is the cheapest—and this concerns their manufacture no less than their operation.

London, England. A. L. HAAS.

Oxy-Acetylene and Thermit Welding

Noting assertions made by Flex Ible in an article in the May issue of THE BOILER MAKER, in which he makes a comparison of the oxy-acetylene and thermit methods of welding for locomotive castings and frames, and being familiar with both processes of welding, I feel that I cannot let Flex Ible's article go by without a reply.

The superiority of the oxy-acetylene process for welding cast iron and cast steel is so well known that it needs no comment. Flex Ible says in his article that frame welds made by the oxy-acetylene process break in the weld from contraction, and he speaks of the superiority of the thermit weld. Yet he does not give any method whereby his contraction is taken care of in making a thermit weld, and, of course, it is readily recognized that the contraction in a thermit weld is just as great as in an oxy-acetylene weld.

In attributing weld failures to stress set-up by the contraction of the weld in cooling, Flex Ible shows lack of familiarity with the methods employed in making welds with oxy-acetylene. Not only can the tension of the weld be removed, but a stress of compression left when the completed job has cooled. In welding a frame with oxy-acetylene, contraction stresses are controlled by the operator's preparation of his work. The effect of contraction cannot be as readily counteracted in the case of a thermit weld. It is evident, therefore, that in comparing oxy-acetylene welds with thermit welds, Flex Ible has observed only oxy-acetylene welds performed improperly, or by an operator wholly ignorant of up-to-date methods of counteracting contraction.

Any fair-minded critic will admit that good welds are made with both the oxy-acetylene and thermit processes. However, many railroads all over the country that have used the thermit for years are discarding it in favor of the oxy-acetylene process.

An oxy-acetylene weld performed by an ordinarily good operator is not only stronger than the thermit, owing to the fact that the stress can be taken care of; but it is much cheaper, and the job is completed in from one-quarter to one-half the time it takes to complete a thermit weld.

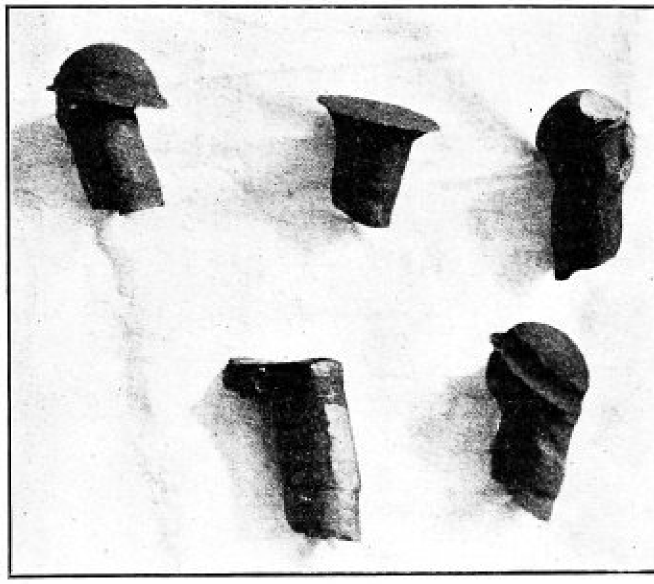
Many railroads are using the oxy-acetylene process to weld all their broken frames and have a very small percentage of failures. I personally know of several roads that have in the past year welded from 30 to 150 frames with the oxy-acetylene process and have had only from two to five failures.

Another indisputable fact I would like to call Flex Ible's attention to is that every day in many railroad shops frames that have been welded with the thermit process break, are cut out and re-welded by the oxy-acetylene process. Also that the percentage of breakage of oxy-acetylene frame welds is considerably less than that of thermit. It must be borne in mind, however, that some extraneous cause produced the original failure and that after welding the frame the original source of trouble may not have been removed, making it the most natural thing for a second fracture to take place at the point where welded.

Chicago, Ill. I. ALLISON.

Defective Rivets

As an argument in support of the necessity for the most thoroughgoing and frequent inspection of all classes of steam vessels, the cut shown below needs no elaboration. The rivets illustrated are a few of a num-



Defective Rivets from Pressure Vessel

ber taken by the instructions of one of our inspectors from the riveted seams of a vessel built but recently to carry considerable steam pressure. In all probability, their timely discovery and removal prevented what might have been a serious accident.

In days gone by, instances of poor workmanship in the riveting of seams of boilers and other pressure vessels were not uncommon. While, nowadays, such conditions are discovered with comparative rarity, the case referred to shows that, in spite of all precautions, poor work is occasionally turned out even by manufacturers of repute.

In this instance, the manufacturer was deeply chagrined to find that work of this character had been allowed to leave his plant, and we venture to say that the experience will tend to prevent the recurrence of such an incident for a long time to come.—*Monthly Bulletin, Fidelty and Casualty Company of New York.*

The boss who thinks any kind of a man can fire a boiler makes a costly mistake and endangers life and property.

The Page Boiler Company, Larrabee street, Chicago, has broken ground for a two-story extension, 48 by 90 feet.

Selected Boiler Patents

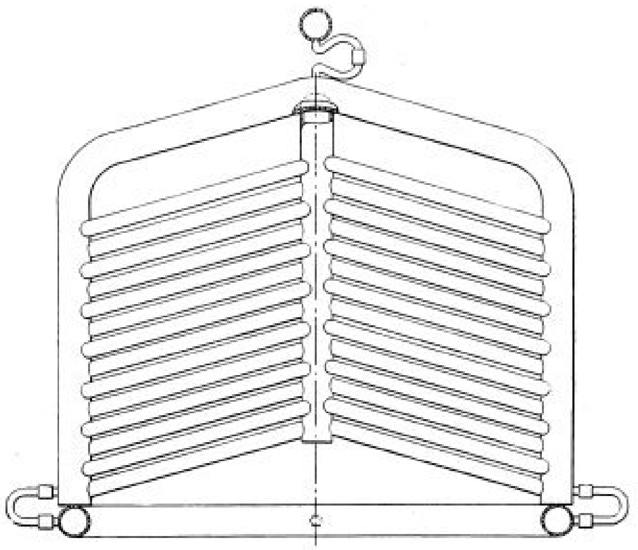
Compiled by

GEORGE A. HUTCHINSON, ESQ., Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchison.

1,259,945. STEAM BOILER. RICHARD A. WHITTINGHAM, OF NEWARK, DEL.

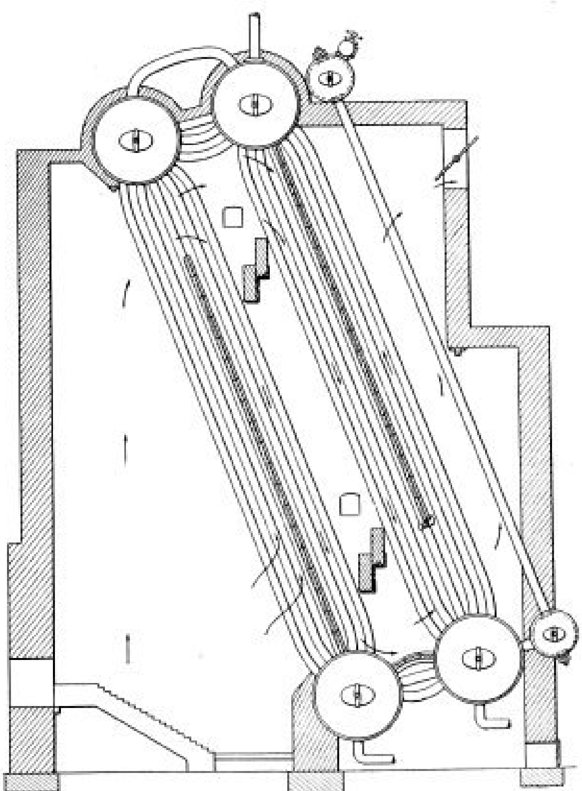
Claim 1.—In a sectional boiler, a section comprising a main header formed of a tube bent to substantial U-shape, a central header comprising a tube closed at both ends, and lying parallel with the legs



of the main header midway between the same, and a series of tubes connecting each of said legs with the central header. Four claims.

1,260,426. BAFFLE CONSTRUCTION FOR BOILERS. EDWARD C. MEIER, OF PHOENIXVILLE, PA.

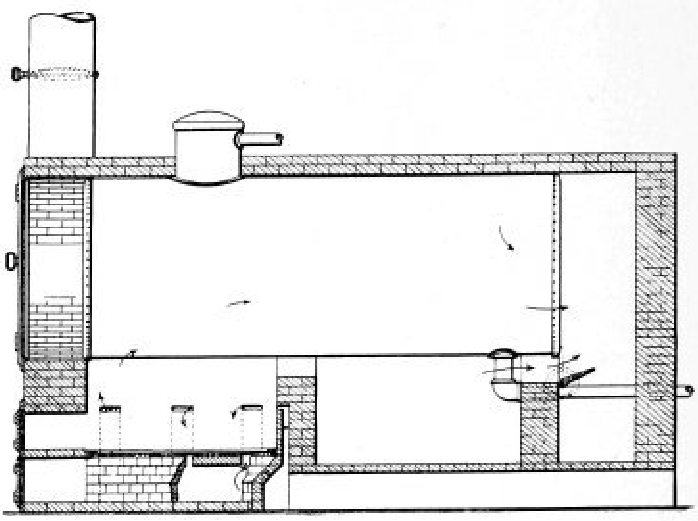
Claim 1.—The combination with a boiler having upright tubes spaced apart, of a baffle arranged adjacent certain of said tubes, said baffle



including superimposed rows of fire-brick tiles spanning the space between said tubes and resting against one side of the latter, a bar positioned under the bottom tiles, and means adjustably supported on the tubes for retaining said bar in position to support the baffle. Two claims.

1,260,196. SMOKE-PREVENTING BOILER FURNACE. EDWARD C. HOCK, OF BUFFALO, N. Y.

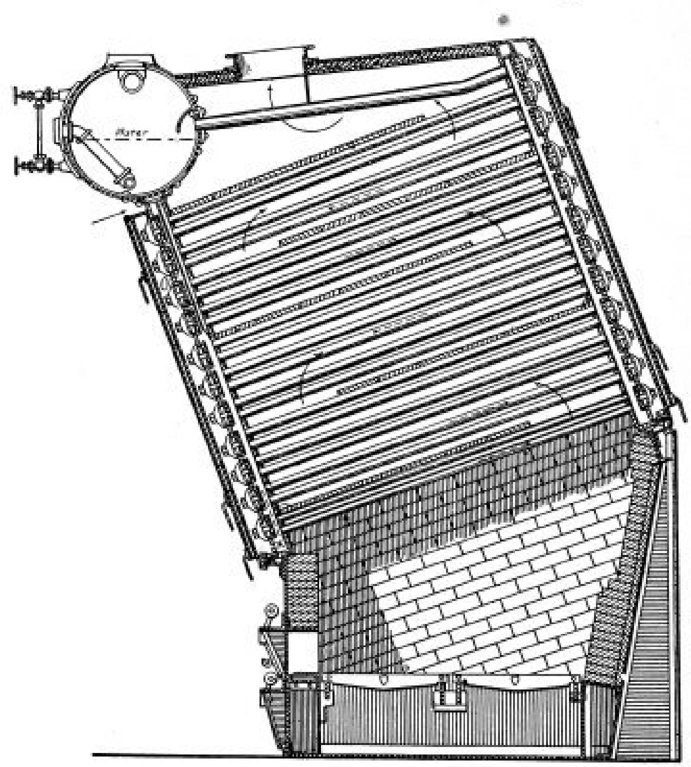
Claim 1.—A boiler furnace comprising a horizontal cylindrical boiler, back and front flue chambers at opposite ends thereof, flues connecting said chambers, an underneath combustion chamber below said boiler, extension combustion chambers continuous with said combustion chamber and extending upward around said boiler on opposite sides to the



top thereof and opening into said back flue chamber, a bridge wall disposed between said underneath combustion chamber and said back flue chamber and provided with an arc-shaped top, which forms the lower part of the boiler an arc-shaped passage connecting said underneath combustion chamber with said back flue chamber, a deflector disposed at said arc-shaped passage, and means for adjusting said deflector to vary the combustion current with respect to said combustion chamber and extension combustion chambers. Three claims.

1,262,145. WATERTUBE STEAM BOILER. CHARLES E. WARD, OF CHARLESTON, W. VA.

Claim 1.—In a watertube boiler, the combination with upper and lower headers, of a drum connected with the lower header, upper and lower banks of tubes connected with the headers, and a downflow divider plate arranged in the upper portion of the said lower header and connected with the inner wall of the header above the ends of said lower bank of tubes and below the ends of said upper bank of



tubes, the said downflow plate being constructed with removable sections whereby there may be formed in the header a downflow divider plate of greater or less height from its said connection with the wall of the header. Three claims.

1,244,915. STAYBOLT FOR BOILERS. BENJAMIN E. D. STAFFORD AND ETHAN I. DODDS, OF PITTSBURG, PA., ASSIGNORS TO FLANNERY BOLT COMPANY, OF PITTSBURG, PA.

Claim 1.—In staybolt construction, the combination of a bolt, and a sleeve engaging said bolt and having a yielding or spring section adapted to take the outward end thrust of the bolt. Five claims.

THE BOILER MAKER

AUGUST, 1918

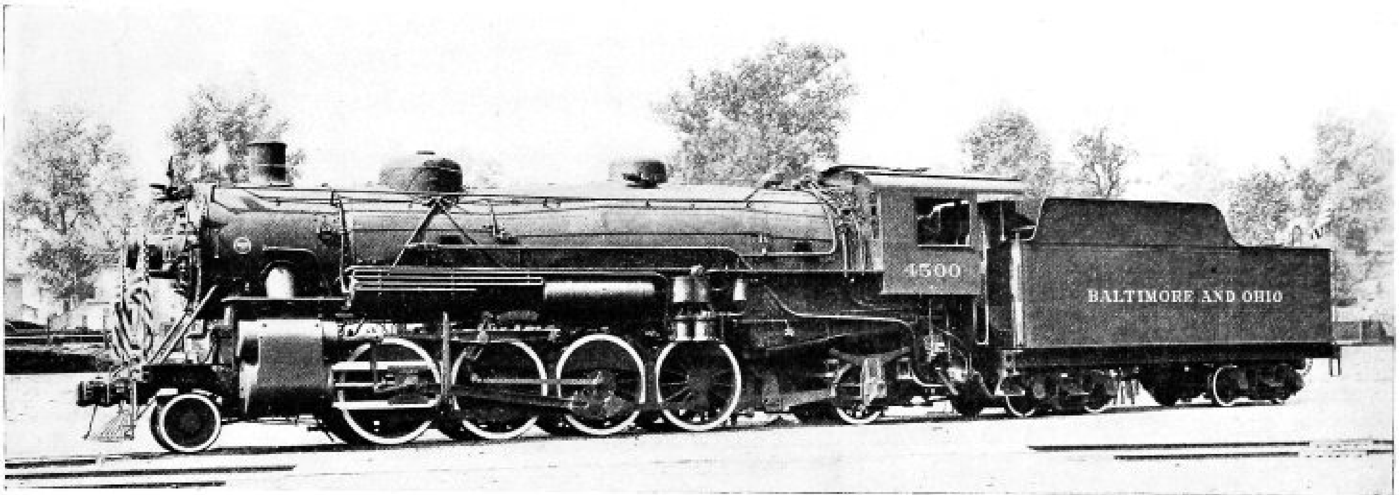


Fig. 1.—Light Mikado Freight Locomotive Built by Baldwin Locomotive Works, According to New Government Standards

First Government Standard Locomotive

Light Mikado Type Freight Engine Delivered by Baldwin Locomotive Works to Baltimore & Ohio Railroad

The first of a series of standardized locomotives to be completed at the Baldwin Locomotive Works, Philadelphia, for the United States Government was delivered on July 1 to the Baltimore & Ohio Railroad. The locomotive is of the light Mikado type with a tractive force of 54,600 pounds.

The entire number of standard locomotives ordered by the United States Government for completion in 1918 is 1,415. The contracts for the construction of these locomotives have been divided between the Baldwin Locomotive Works and the American Locomotive Company. A complete list of the designs thus far prepared (twelve in all) is given below:

Standard Types

Light Mikado (2-8-2) Type.—Cylinders, 26 inches by 30 inches; driving wheels, diameter 63 inches; steam pressure, 200 pounds; weight on driving wheels, 220,000 pounds; weight, total engine, 290,000 pounds; tractive force, 54,600 pounds.

Heavy Mikado (2-8-2) Type.—Cylinders, 27 inches by 32 inches; driving wheels, diameter, 63 inches; steam pressure, 190 pounds; weight on driving wheels, 240,000 pounds; weight, total engine, 325,000 pounds; tractive force, 60,000 pounds.

Light Mountain (4-8-2) Type.—Cylinders, 27 inches by 30 inches; driving wheels, diameter, 69 inches; steam pressure, 200 pounds; weight on driving wheels, 220,000 pounds; weight, total engine, 320,000 pounds; tractive force, 53,900 pounds.

Heavy Mountain (4-8-2) Type.—Cylinders, 28 inches by 30 inches; driving wheels, diameter, 69 inches; steam pressure, 200 pounds; weight on driving wheels, 240,000

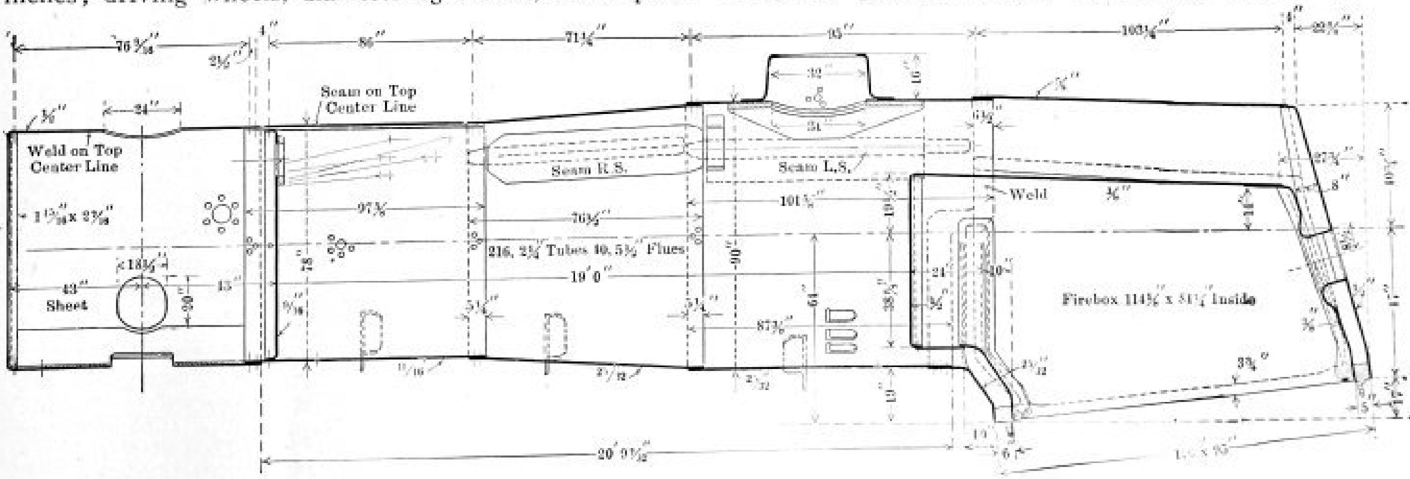


Fig. 2.—Longitudinal Section Through Boiler of First Standard Government Locomotive

pounds; weight, total engine, 350,000 pounds; tractive force, 58,000 pounds.

Light Pacific (4-6-2) Type.—Cylinders, 25 inches by 28 inches; driving wheels, diameter, 73 inches; steam pressure, 200 pounds; weight on driving wheels, 165,000 pounds; weight, total engine, 270,000 pounds; tractive force, 40,700 pounds.

Heavy Pacific (4-6-2) Type.—Cylinders, 27 inches by 28 inches; driving wheels, diameter, 79 inches; steam pressure, 200 pounds; weight on driving wheels, 190,000 pounds; weight, total engine, 305,000 pounds; tractive force, 43,800 pounds.

Light Santa Fe (2-10-2) Type.—Cylinders, 27 inches by 32 inches; driving wheels, diameter, 57 inches; steam pressure, 200 pounds; weight on driving wheels, 275,000

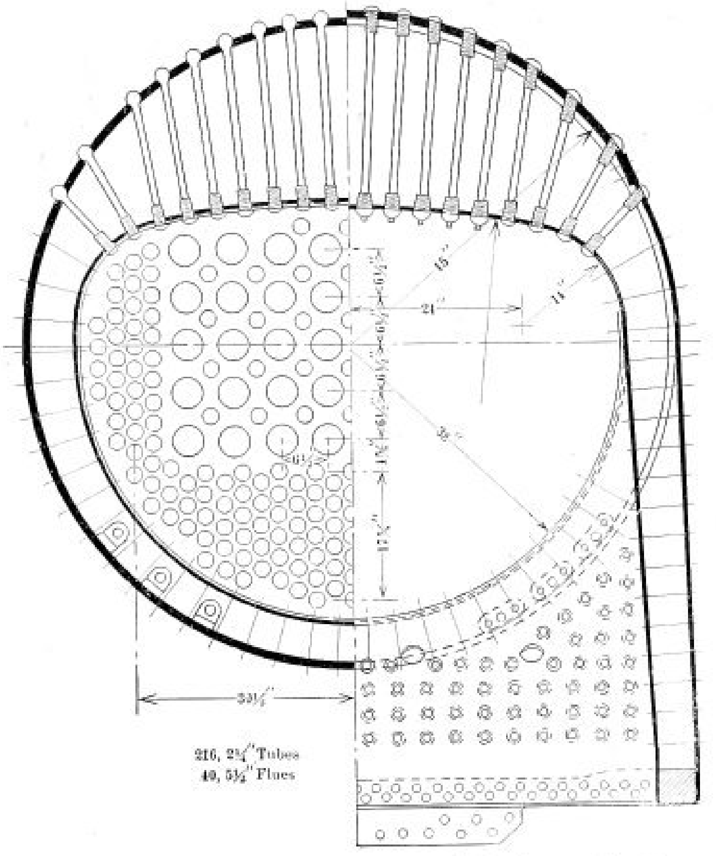


Fig. 3.—Section Through Firebox and Combustion Chamber

pounds; weight, total engine, 360,000 pounds; tractive force, 69,400 pounds.

Heavy Santa Fe (2-10-2) Type.—Cylinders, 30 inches by 32 inches; driving wheels, diameter, 63 inches; steam pressure, 190 pounds; weight on driving wheels, 300,000 pounds; weight, total engine, 390,000 pounds; tractive force, 74,000 pounds.

Six-Coupled (0-6-0) Switcher.—Cylinders, 21 inches by 28 inches; driving wheels, diameter, 51 inches; steam pressure, 190 pounds; weight, total engine, 165,000 pounds; tractive force, 39,100 pounds.

Eight-Coupled (0-8-0) Switcher.—Cylinders, 25 inches by 28 inches; driving wheels, diameter, 51 inches; steam pressure, 175 pounds; weight, total engine, 220,000 pounds; tractive force, 51,200 pounds.

Mallet Articulated (2-6-6-2) Type.—Cylinders, 23 inches and 35 inches by 32 inches; driving wheels, diameter, 57 inches; steam pressure, 225 pounds; weight on driving wheels, 360,000 pounds; weight, total engine, 440,000 pounds; tractive force, 80,300 pounds.

Mallet Articulated (2-8-8-2) Type.—Cylinders, 25 inches and 39 inches by 32 inches; driving wheels, diameter, 57 inches; steam pressure, 240 pounds; weight on driving wheels, 480,000 pounds; weight, total engine, 540,000 pounds; tractive force, 106,000 pounds.

The above designs are sufficient in number to meet the majority of the motive power requirements of American railways. Where there are two classes with the same wheel arrangement, the lighter locomotive is designed to carry 55,000 pounds per pair of driving wheels, and the heavier locomotive 60,000 pounds. The two switching locomotives are designed with the minimum wheel loading, and the two Mallets with the maximum loading. All the locomotives can traverse curves of 19 degrees, and, with the exception of the Mallets, can be turned on 85-foot turn-tables. The maximum height and width limits are 15 feet and 10 feet 4 inches respectively, except in the case of the heavy Santa Fe type and the two Mallets, where it has been necessary to exceed either one or both of these dimensions.

These locomotives are designed, as far as is practicable, with interchangeable parts, so that when a railroad is using several different types a minimum amount of stock need be carried for their maintenance. They all use superheated steam, are equipped in accordance with the most recent practice for their respective types and can be adapted to the use of either bituminous coal or oil as fuel.

There are no unusual features in connection with the design or details of construction of the light Mikado type locomotive shown in the illustrations. The total weight of the locomotive is 290,800 pounds, of which 221,500 pounds is carried on the driving wheels. The locomotive is capable of exerting a starting tractive effort of 54,600 pounds.

Boiler

The boiler is of the conical wagon-top type, 90 inches outside diameter at the dome course reduced to 78 inches diameter at the front end. The boiler is designed for a working pressure of 200 pounds per square inch and the thicknesses of the barrel sheets are 11/16 inch and 25/32 inch respectively. The longitudinal seam of the dome course is on the left-hand side of the centerline and the reinforcing pad on the inside of the shell under the dome is extended to form the inside butt strap of this seam. The longitudinal seams of the conical and front courses are at the right and on the top centerlines of the boiler respectively. These seams are all welded at the ends.

The firebox is of the radial stayed type, 114⅛ inches long, 84¼ inches wide, 83½ inches depth at the front and 61 inches depth at the back. The thickness of the firebox side, back and crown sheets is ⅜ inch, and of the tube sheet ½ inch. The water space is 6 inches wide at the front and 5 inches at the sides and back.

The tubes are 2¼ inches diameter, and the superheater flues 5¼ inches diameter. The thickness of the 2½-inch tubes is No. 11 W.G., and of the superheater flues No. 9 W.G. There are two hundred and sixteen of the 2¼-inch tubes and forty of the 5½-inch flues. The length of all the tubes is 19 feet.

The total heating surface of the boiler is 3,783 square feet, distributed as follows: 3,497 square feet in the tubes, 259 square feet in the firebox and 27 square feet in the firebrick tubes. There is also a superheating surface of 882 square feet. The total grate area is 66.7 square feet.

The principal dimensions of the locomotive are as follows:

SERVICE AND WEIGHTS

Gage	4 feet 8½ inches
Service	Freight
Fuel	Soft coal
Weight on driving wheels	221,500 pounds

(Concluded on page 235.)

Effective Collection Letters

Essential Elements of Letters to Secure Payment of Delinquent Accounts—Judgment and Tact Necessary

BY EDWIN L. SEABROOK

Successful collection methods must go straight to the debtor—make him feel that they are for him personally. He always feels safe in a crowd; it is easy to neglect or overlook at long range. The neighbor generally dodges or pays first. In laying out a collection system, always plan to keep close to your debtor.

Salesmanship and collections are closely allied; that is, the same motives, pride, utility, caution, etc., that influence in selling can also be used in collecting. A prominent man would be humiliated by a suit, therefore appeal to his pride. Just as persons can be grouped according to motive in salesmanship, so can debtors. Every business, regardless of size, can line up most of its debtors into one of these three classes—good pay, slow pay, bad pay.

Study carefully any correspondence with the delinquent, for here his personality comes out; get the facts, then an impression of the debtor. Are his excuses false or true; is he evasive, crafty, cunning, playing for time, stubborn, careless, ignorant? Decide upon the disposition of the debtor with whom you have to deal and do not attempt to handle all by the same method. Find out as much as possible about the debtor. This is good credit information and develops out of several factors, all of which are available if properly collected and tabulated. Consider the debtor's past credit experience, business capacity, etc. Have these been favorable or unfavorable, is he a profitable customer? His correspondence will show something of his education, characteristics and business viewpoint. His social standing, popularity, personality, public position, etc., will all give a line on the debtor. If possible, keep him in good humor and play upon human instinct.

The boiler maker, like the great majority of business men, must depend to a great extent upon letters in making collections. Composing collection letters is something like being all things to all men. The list will probably range from the mechanic to the professional man, property-owners and non-property-owners, to those of wealth, but slow pay. There are people who are extremely sensitive, so that it is not wise to use the same letter for all the different classes.

Letters are of two kinds: one that lacks preparation—just ink, paper, words—is glanced at and goes to the waste basket; the other grips the attention, convinces and influences action. The composition of action-securing collection letters may not be quite so simple as it seems. An editor recently said that every article has a fifty-fifty chance—the waste basket or the magazine. The letter is a messenger. Would you send a stupid, awkward, indifferent, listless messenger on a delicate and important errand? Would you send someone who would irritate rather than please?

It should be remembered that, while a letter is a messenger, it cannot force itself upon the recipient, get his attention and demand a hearing. It has just one chance to make an impression—when it is opened. The opening sentence, or sentences, must grip the mind of the reader. The proposition must be laid before him in the next; then ask for action at a definite time. Compare these three elements with an earnest personal talk and see how they parallel. A collection letter is simply talking to the debtor—asking him for money—on paper.

An article of this nature cannot give complete letters that will answer all cases. Considerable judgment and tact must be used by the creditor, to fit the circumstances surrounding each case, in framing the body of the letter. After attention is called to the overdue account and its amount, it is hardly necessary in most instances to go into any lengthy explanation. The shorter the letter, the more direct to the point it is, the better. Do not overlook the fact that courtesy will produce far better results than saying something that irritates.

The following letters, which are reproduced in whole or in part, have been tested and produced quite satisfactory results.

This letter has been used for small amounts:

"You must not take this letter as a dun, but only a reminder that your account, as per bill of June 1, is overdue.

"We do not wish to seem unduly insistent about so small a matter as this little account, but you, as a business man, readily appreciate from your own experience with some of your customers how expensive they make the collection of small amounts, while it really works a hardship."

The letter can be closed at this point or carried farther, if necessary.

This letter is a little stronger than the above and is intended to appeal to the debtor's honesty, if he has a spark of it left:

"We have every reason to believe that your transactions with us were in good faith, and we assure you that credit was extended in the same way, relying on good, old-fashioned business integrity for the other half of the contract to be kept, and we believe you mean to do this despite the fact that payment of previous bills has not been made.

"There may be some good reason why this bill has not been paid, but we do not know it."

This letter, like the above, can be used to arouse a sense of honor in the delinquent, although it is not quite so strong:

"You have certainly disappointed us in not responding to our very courteous request of June 2, also the others that have preceded it.

"You are not giving us a square deal by neglecting to remit for this account. While the amount is small, we feel that the limit of courtesy has been reached. You have only to draw on your own feelings to get our viewpoint when one of your own customers, who has had your very best attention, ignores all your requests for the payment of a small bill.

"You must not think us severe; we do not want to raise any hard feeling, but this account must have your attention not later than August 1.

This letter can be used along the same lines as the above:

"You have been rendered so many bills and requests for the enclosed statement that we have lost count of them, and for this reason really feel that you are not giving us a square deal in withholding payment for this amount.

"You realize, of course, as a business man, the unnecessary expense of sending statement after statement. You also feel that your customer has no right to impose this expense on you after he has received value.

"We ask in all fairness if you will give the enclosed bill your prompt attention and let us have your check by return mail."

One credit man secured good results by wording a letter to a certain class something like this:

"Will you kindly advise if the enclosed statement is correct? Please do not consider this a demand for payment, but the books of the firm are being audited and prompt payment would establish a better credit basis."

Many firms, in sending out statements, use a rubber stamp with something like the following:

"No doubt this has escaped your attention."

This reminder, within itself, amounts to very little, because neither party to the transaction believes it. The debtor knows that the rubber stamp was not made particularly for him, and that the creditor does not believe he is "overlooking." If something must be said about "overlooking," take it out of the stereotyped class and make it personal. Something like this is much stronger than the rubber stamp:

"In making your monthly disbursements did you overlook the amount on the enclosed statement, $45?

"As this account is past due a remittance in accordance with the terms of payment would be appreciated."

This assumes that the debtor has paid some bills at a stated period. The inference is not an oversight, but that payment was passed. It also calls attention to the fact that the account is due and should be paid.

Here is a form that is both a statement and a letter combined. The amount due being placed on the first line attracts attention as soon as the letter is opened:

"June 15,
"Amount Due: $18.00.

"On May 1 we mailed you statement of amount due, as above.

"As three dates—May 20, June 1, 10—upon which disbursements are usually made, have gone by without hearing from you, we feel that you must have overlooked or passed this account, and therefore write to ask if you will be kind enough to favor with remittance, without further delay."

This form was used with good results where other requests were ignored:

"June 1,
Amount Due: $50.00.

"Billed March 1.
"Statement, April 1.
"Letter, April 10.
"Reminder of bill and letter, May 6.
"Just why no attention has been given these is certainly a puzzler, unless business has been so big that there has been no time for little things."

Opening sentences can often be used to put the debtor in a good humor, induce him to go farther into the letter and produce good results.

Here are a few that have been tried out:

"Let's begin the New Year with a clean slate" is the way one very effective collection letter was opened.

This one brought excellent results:

"Well, here we are again!
"You see an unpaid account, however small, is always sure to pop up."

This opening sentence must have aroused an interest, because the letter brought returns from some hardened cases:

"Just what the 'unpardonable sin' is we do not know, but just now it seems to us that it is a disposition to ignore or evade answering letters of a business nature."

This opening sentence has been tried with satisfactory results in arousing the reader's interest: 'We were talking about you in the office to-day." The reader goes on and is told of the overdue account.

Someone has used this, which, within itself, hints that more appeals will come along:

"What! Another bill?
"Yes; you are tired of getting them.
"Send us check for $14.
"This will save you trouble, and postage for us."

If the opening sentence of a letter is important, the closing one is equally so. It may be possible to grip the attention of the reader at the opening and have so weak a closing that he is turned from his purpose.

The final sentence of the letter should have the "do it now" element ringing out.

"Please let us hear from you without delay" is much stronger than "hoping" or "trusting" to hear from you. A little thought will suggest a dozen ways of closing urging action.

Rubber stamps can be used effectively, but their use on bills or statements should indicate to the debtor that his action has received personal attention, that it has been singled out and his failure to remit has been duly noted.

Ofttimes it is necessary to use much stronger letters than any of the above. The time comes when the debtor must be plainly told that he must make some disposition of the account or it will be placed in legal hands for collection. When this time is reached don't waste any words or sweet-sounding phrases. When the decision is reached for settlement or suit make it very clear that it is one or the other. Have each letter a little sharper and straight to the mark. Let the debtor understand that you are going to keep your collection promises. When the day comes to enter suit, do it.

If the debtor is in another city, get the name of a good collection lawyer in that place and advise the debtor that unless he settles by a certain date the account will be turned over to the attention of this party, giving the name in the letter. This shows that you are in earnest and there is to be no let-up.

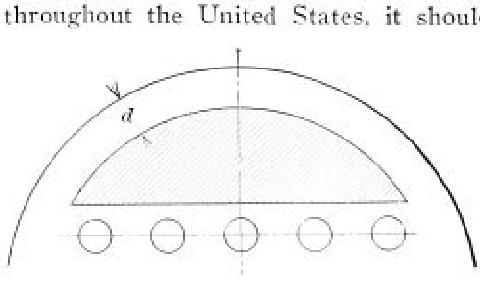
Do not put a premium on procrastination—making it profitable to withhold payment—by offering inducements to settle. This is only an encouragement for the slow-pay to sit tight until the offer is attractive enough to induce him to settle.

Table of Allowances

BY F. R. BURLINGAME*

The table of allowances given in this article has been figured from the formulæ given in the last revision of the A. S. M. E. Boiler Code, which was published in the January number of The Boiler Maker.

As the A. S. M. E. Boiler Code in time will become uniform throughout the United States, it should be ar-



Shaded Portion of Sketch Shows Area of Head to Be Stayed

ranged in a convenient size so that it can be cut out or copied in a note book.

This table will be found useful by inspectors, draftsmen and boiler makers in general who use this Code.

The formulæ used in figuring the allowances were as follows:

The value d used should be the larger of the following values, but not less than 3 inches.

(1) d = the outer radius on the flange not exceeding eight times the thickness of the head.

* Boiler Inspector, Pennsylvania R. R., Olean, N. Y.

WORKING PRESSURE IN POUNDS PER SQUARE INCH

Thickness of Heads, Inches.	50	60	70	80	90	100	110	120	130	140	150	160	170	180
5/16	3.53	3.23	2.99	2.79	2.63	2.50	2.39	2.29	2.19	2.11	2.04	1.97	1.91	1.86
⅜	4.24	3.88	3.58	3.35	3.16	3.00	2.86	2.75	2.63	2.53	2.45	2.37	2.30	2.23
7/16	4.95	4.52	4.18	3.91	3.69	3.50	3.33	3.21	3.07	2.95	2.85	2.77	2.68	2.60
½	5.65	5.17	4.78	4.47	4.21	4.00	3.81	3.66	3.50	3.38	3.26	3.16	3.06	2.98
9/16	6.36	5.82	5.38	5.03	4.74	4.50	4.29	4.12	3.95	3.80	3.67	3.56	3.44	3.35
⅝	7.07	6.47	5.98	5.59	5.27	5.00	4.77	4.58	4.38	4.22	4.08	3.95	3.83	3.72
11/16	7.77	7.11	6.57	6.15	5.80	5.50	5.24	5.04	4.82	4.64	4.49	4.35	4.22	4.10
¾	8.48	7.76	7.17	6.71	6.32	6.00	5.72	5.50	5.26	5.07	4.90	4.74	4.60	4.47
13/16	9.19	8.40	7.77	7.27	6.85	6.50	6.20	5.96	5.70	5.49	5.31	5.14	4.98	4.84
⅞	9.90	9.05	8.37	7.82	7.38	7.00	6.67	6.42	6.14	5.91	5.71	5.53	5.37	5.21
15/16	10.60	9.70	8.97	8.38	7.91	7.50	7.15	6.88	6.57	6.33	6.12	5.93	5.75	5.59
1	11.31	10.34	9.56	8.94	8.43	8.00	7.63	7.33	7.00	6.76	6.53	6.32	6.13	5.96

$$(2)\quad d = \frac{5 \times t}{\sqrt{P}}$$

where d = unstayed distance from shell in inches,

t = thickness of head in sixteenths of an inch,

P = maximum allowable working pressure in pounds per square inch.

In practice use the nearest eighth below that shown in table—as for 3.53 use 3½ inches; for 6.15 use 6⅛ inches, and so on.

My Method of Welding with the Electric Arc and Work Which I Have Done

BY EDWARD D. JOHNSON*

With nine years' experience as electric arc welder I wish to give those that are interested in welding some information.

First, to get good results you must have an experienced operator, one who thoroughly understands his business, but if you are going to break in your own men you must

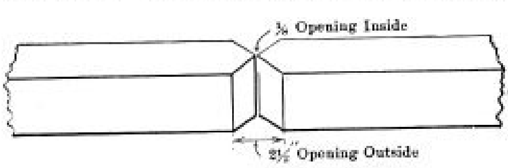


Fig. 1.—Frame Cut Out the Proper Way for Welding

start them on flat work, such as worn places on frames, spring hangers or any other worn parts of machinery. Keep them on that class of work until they can weld a close, smooth grain; they should never hold the arc more than one-eighth inch from the piece being welded. If they

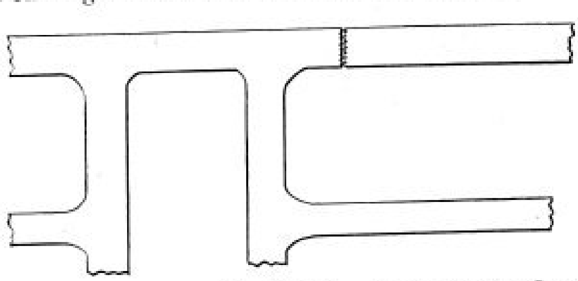


Fig. 2.—Bolt Hole Closed by Welding Before Cutting Out Frame for Welding

do, they will find that the weld will be oxidized and very porous. When using one-eighth inch iron one should never have more than 60 volts and 125 amperes and with five thirty-second-inch iron 70 volts and 150 amperes is always sufficiently high for heavy work.

I have trained a lot of men and I find it takes from four to six months before obtaining any good results, especially on a job that requires any strain or pressure on them, such as locomotive frames, patches in firebox, flues or tanks. Some people claim they can teach a man to weld in three or four days. This is not so. The trouble with welding is that when a man gets a few months' experience he thinks he knows it all and that there is nothing to it. The majority of them never study the expansion or contraction of a job. It takes years of experience to make an expert welder, and there is always something more to learn. Some men never make good welders and most of them have to be watched, for they get careless at times.

* Foreman, Electric Arc and Acetylene Welding Department, Grand Trunk R. R. Shops, Battle Creek, Mich.

BROKEN LOCOMOTIVE FRAMES

I have welded in my three and a half years in the Grand Trunk Shops in Battle Creek (the main shops of the Western Division) 210 locomotive frames, of which only four failed. The manner in which I lay out and weld my frames is as follows:

First, I have my frame jacked up and drawn together to take the weight and strain off it, then I square it to see how much it is out. I then tram it and lay it off by V'ing it out at each side, allowing 2½ inches for an opening on the outside and no less than ⅛ inch or no more than ¼ inch in the center of the break, as shown in Fig. 1.

This is then cut out with the carbon electrode, although sometimes the oxygen blow-pipe is used. It is much better, however, to use the carbon electrode, because a smoother and softer surface is obtained to chip off the oxide and slag. Then I tram it again to bring it back in place. Next get a piece of ⅜-inch boiler plate and put it under the break, allowing a lay of, say, ⅛ inch to ¼ inch for reinforcing. Then weld the plate on, put ½ inch up the center of the break, scale them ½ inch more, and scale, so on until the job is done.

In places where there is a bolt hole running through the center of the break it is best to weld the hole up solid. Cut out to the center of the outside of the hole; you will find this will save considerable welding; then have a stud put in instead of a bolt, which will make the weld stronger.

On places where I can only weld a frame from one side, such as up against a cylinder or firebox, I reinforce

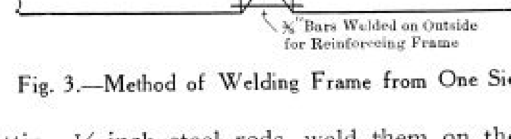


Fig. 3.—Method of Welding Frame from One Side

by getting ¼-inch steel rods, weld them on the outside of frame, as shown in Fig. 3, then put the first one on ¼ inch from the bottom, then put ¼ inch of metal, then another rod and metal, and so on, being careful to cover the rods until the job is finished. I will guarantee the weld will never break if my instructions are carefully followed.

Crystallized Frames

Where the frames are crystalized, or have had several smith welds, it is a good plan to cut out the piece of the frame, say, 2 or 3 feet, or as far as can be allowed. I have welded 17 in this way and they have proven a success.

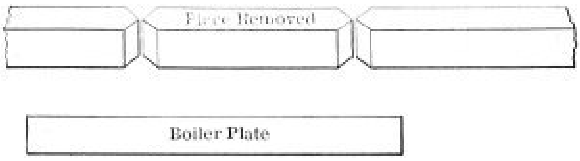


Fig. 4.—Piece Taken Out of Frame When Crystallized. Boiler Plate Laid Under Piece Set In

In Fig. 4, where there is a patch needed or staybolts renewed on the outside of the firebox behind the frames on the small type of engines, instead of taking down the frames I cut that piece out in order to get at

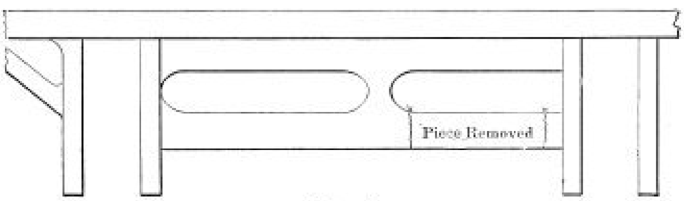


Fig. 5

the work, say 2 or 3 feet or more, and after the boiler is tested the piece is welded back, as in Fig. 5, thus saving the company considerable time and expense.

Where a frame is broken over the driving box I weld it through the spokes. I have no wheels dropped unless it is really necessary. I can cut out and weld a four by five frame in seven to eight hours. I mostly double up, using a man on each side, which will get the frame welded in half the time. We protect our eyes first by letting one man weld the ½-inch center, then get a piece of sheet iron and tack it across the top so that there are no flashes to be had from either operator.

When I was learning electric arc welding I had great trouble with my eyes. I tried all kinds of shields and

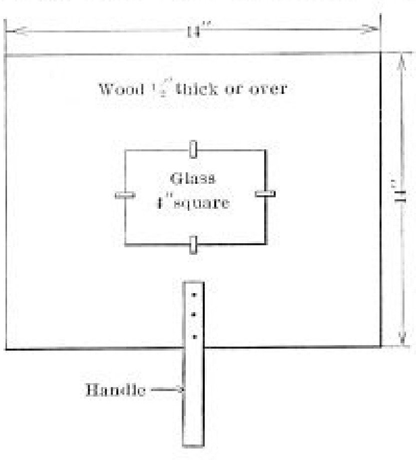


Fig. 6.—Shield

hoods but finally came to the conclusion that the smoke was more injurious to the eyes than the flashes, so I got a pair of goggles and from then on I had no more trouble. At first when putting on goggles they will sweat, but if heated a little this can be overcome. The glass I use in my shield is a red and blue, and a plain white one on the outside to protect the colored glass from sparks. The shield, shown in Fig. 6, is both light and convenient.

Patches in the Firebox

There has been a great deal of trouble experienced with both electric and acetylene welding on account of expansion and contraction in welding square patches and straight seams. I have seen welders sit down and admire their patch and before they got out of the firebox the patch would go off like a gun and scare the man almost to

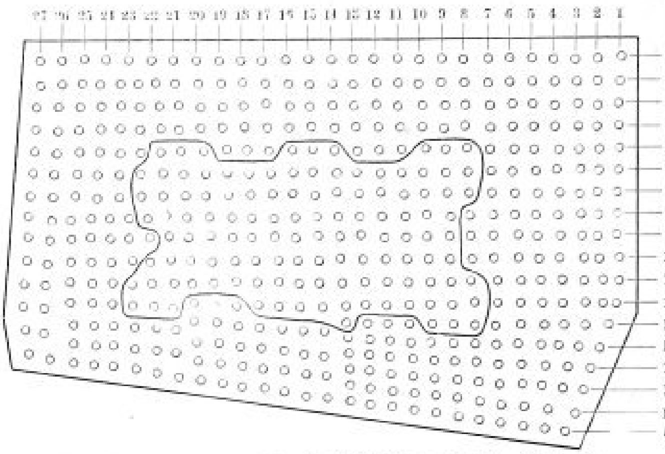


Fig. 7.—Serpentine Patch Welded in Right Side Sheet

death—four or five hours' work shot to pieces. I have seen an expert acetylene welder demonstrator have the half side crack no less than nine times before he had it finished.

These experiences brought the conclusion that straight lines did not suit me, so I started experimenting on patches of all shapes and found what I call the "serpentine patch" to be the best. These serpentine patches can be relied on to give service and never crack. They are zigzagged over three staybolts and under three, and so on, as shown in Fig. 7. They have been in use for three years and I have had no trouble with them and I know I will not, because the expansion and contraction looks after itself.

With this manner of welding in patches always see that patch or half-side, or whatever is done in the firebox or boiler, has an opening in the back where the weld is to be made of no less than 1/16 inch or no more than ⅛ inch and on the front of no more than ½ inch or no less

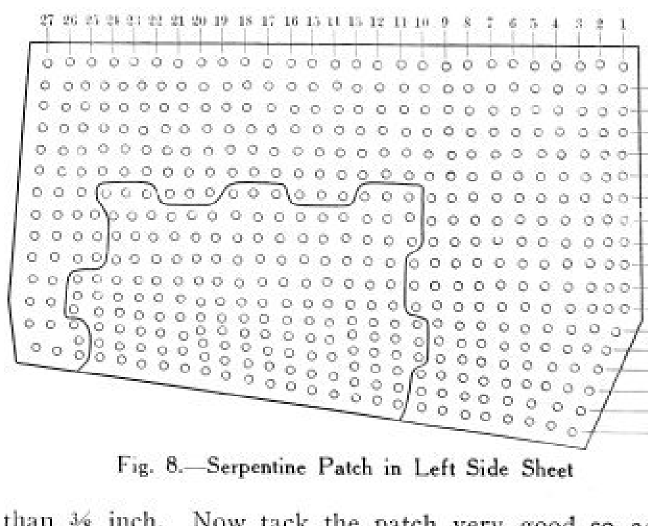


Fig. 8.—Serpentine Patch in Left Side Sheet

than ⅜ inch. Now tack the patch very good so as to keep it from shifting or getting out of place, using ⅛-inch Norway iron, as this is the best size iron to use in the firebox or on boiler work. Now fill up 6 to 8 inches, bring it out flush with sheet, then brush the oxide which forms with a good wire brush. Reinforce 1/16 inch—no more—because many a good weld has been spoiled by using too much metal and having the fire burn it.

I do not believe in welding cracks over 10 inches long, but if you have an engine that has just come in with a crack, say 18 or 20 inches long, it can be welded with good success by welding up the crack flush with the sheet, then get some ¼-inch rods, say ¾-inch long, cut a groove in the sheet, place the rods and weld them in, covering the rods, placed two or three inches apart. In order to crack the weld the rods would have to break.

Welding cracks on the top back flue sheet has been very successful but where there are more than six or seven of these it is best to put in a patch the full length of the flue sheet. Cut the patch out so that it will take half of the top row of flue holes and have the ends a good 60 degrees, as shown in Fig. 11. Weld the bridges in the center first, then reinforce both sides on the inside of boiler. Welding patches in door holes, sleeves and patches outside casing of fireboxes may all be welded in the same manner.

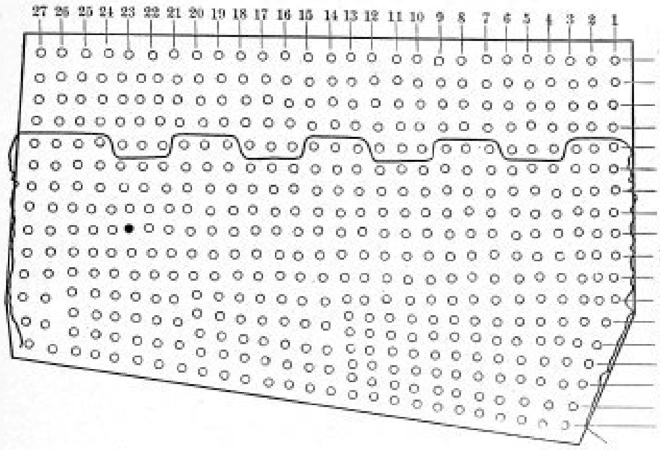


Fig. 9.—Serpentine Half Side Sheet

In the case of a broken mudring, cut out the sheet so as to give easy access to the job, then cut the mudring by V'ing it, chip the oxide off with a chipping hammer, then get a piece of boiler plate ¼ inch and put under the open and weld same as broken frame. The piece taken out to get at mudring can then be welded back in place or a new piece in its stead.

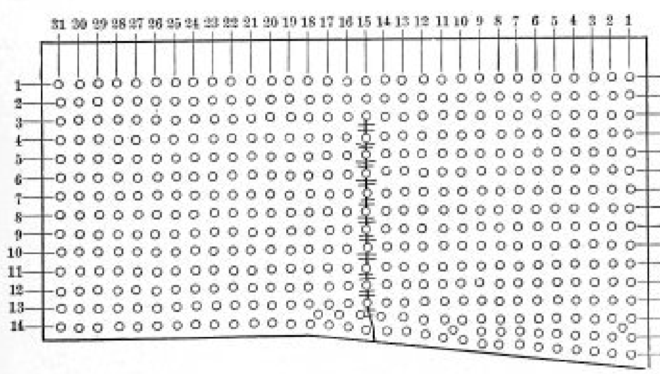


Fig. 10.—Bars Welded Across Crack in Left Side Sheet

Welding Flues in Back Flue Sheets

There are several ways of welding flues in back flue sheets. My way is to bell them, leaving 5/32-inch for superheater pipes; for 2-inch flues ¼ inch, rough the sheet or sand blast it, then get the acetylene torch to burn the oil off the sheet, or, fire the engine up and when she comes in the oil will be off the sheet. With superheater pipes and flues that have made their mileage and not been welded you can make a better weld by cutting off half the old bead and you can get two more shoppings, which is the three-year limit for flues, by welding the flues belled. This is not only welding the flues but building up the worn flue sheet that has been worn by the beading tool riding on the flue sheet. I have two fireboxes welded without a rivet in them except in the mudring.

The front flue sheet can be welded by cutting it out and putting in new sheet welding, both inside and out, in the head of the sheet. In welding star cracks around staybolt holes I have them countersunk, taking all the crack out; then get a piece of copper pipe smaller than the hole and weld all around it, thus saving the drilling of a new hole. Copper takes the place of carbon, the weld will not stick to it, and it will leave a clean, smooth surface.

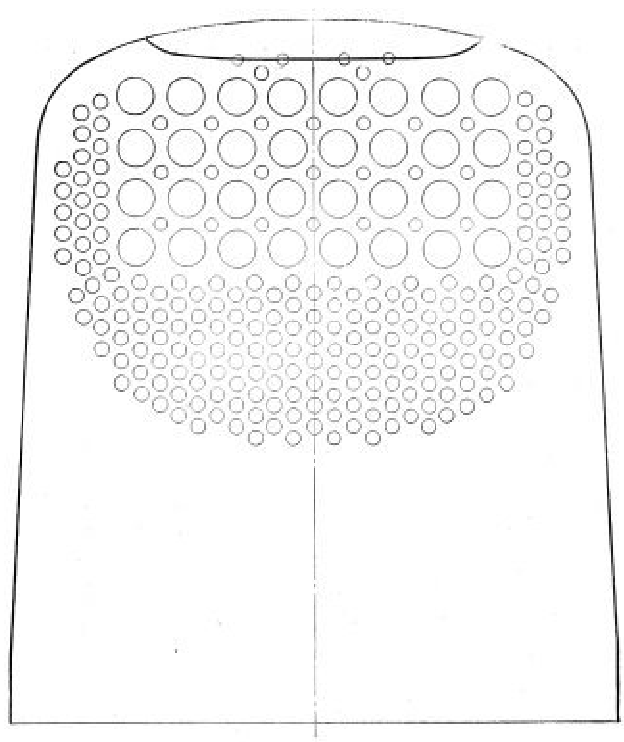


Fig. 11.—Patch on Top Back Flue Sheet Welded With Electric Arc

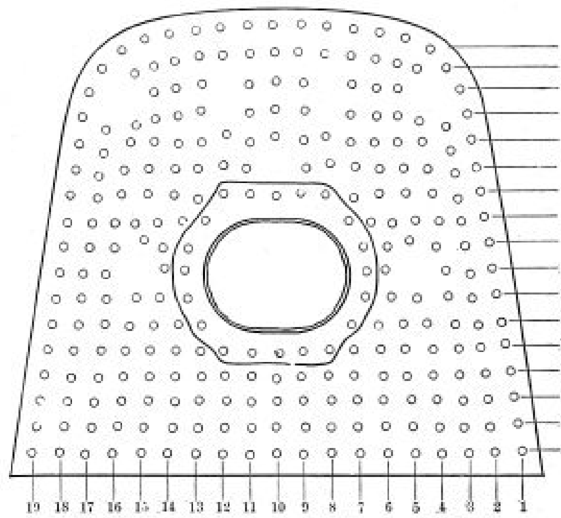


Fig. 12.—Door Hole Patch Welded in Back Head

In welding a blind flue hole I have welded it up solid, but by getting a tapered plug, and welding it in a great deal of material and labor may be saved. In welding in cracked bridges in the flue sheet where the flues are in, V out the crack, weld it up and also weld in the two flues on both sides. In welding up a flue sheet around

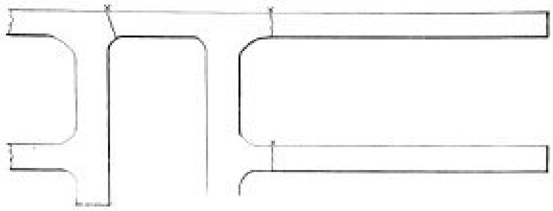


Fig. 13.—Three Breaks Welded at Same Time on Switch Engine

flue holes, where worn by the beading tool and the flues are not to be welded in, fill up flush with sheet and make

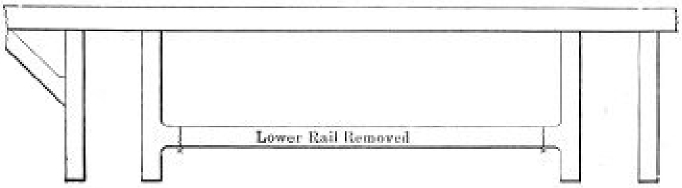


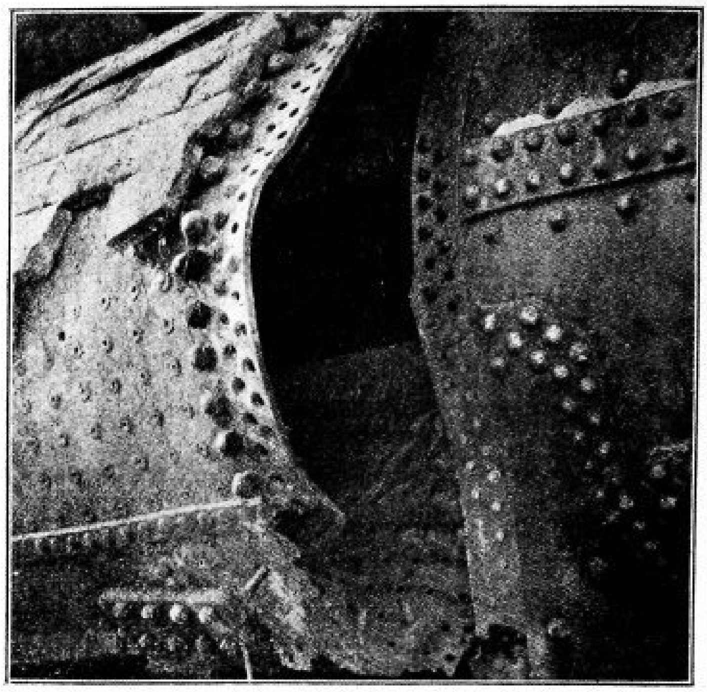
Fig. 14.—Lower Rail Removed to Renew Rivets and Welded Back in

the flue holes smaller so that when you ream and face the sheet will be as good as new.

An Unusual Boiler Explosion

The reports of the chief inspector of locomotive boilers to the Interstate Commerce Commission show that in the six years covered by the statistics there have been five shell explosions, 335 crown sheet failures due to low water, and nineteen explosions due to defective material, or water foaming. An explosion which will not fall strictly within any of these classifications is sufficiently unusual to merit notice.

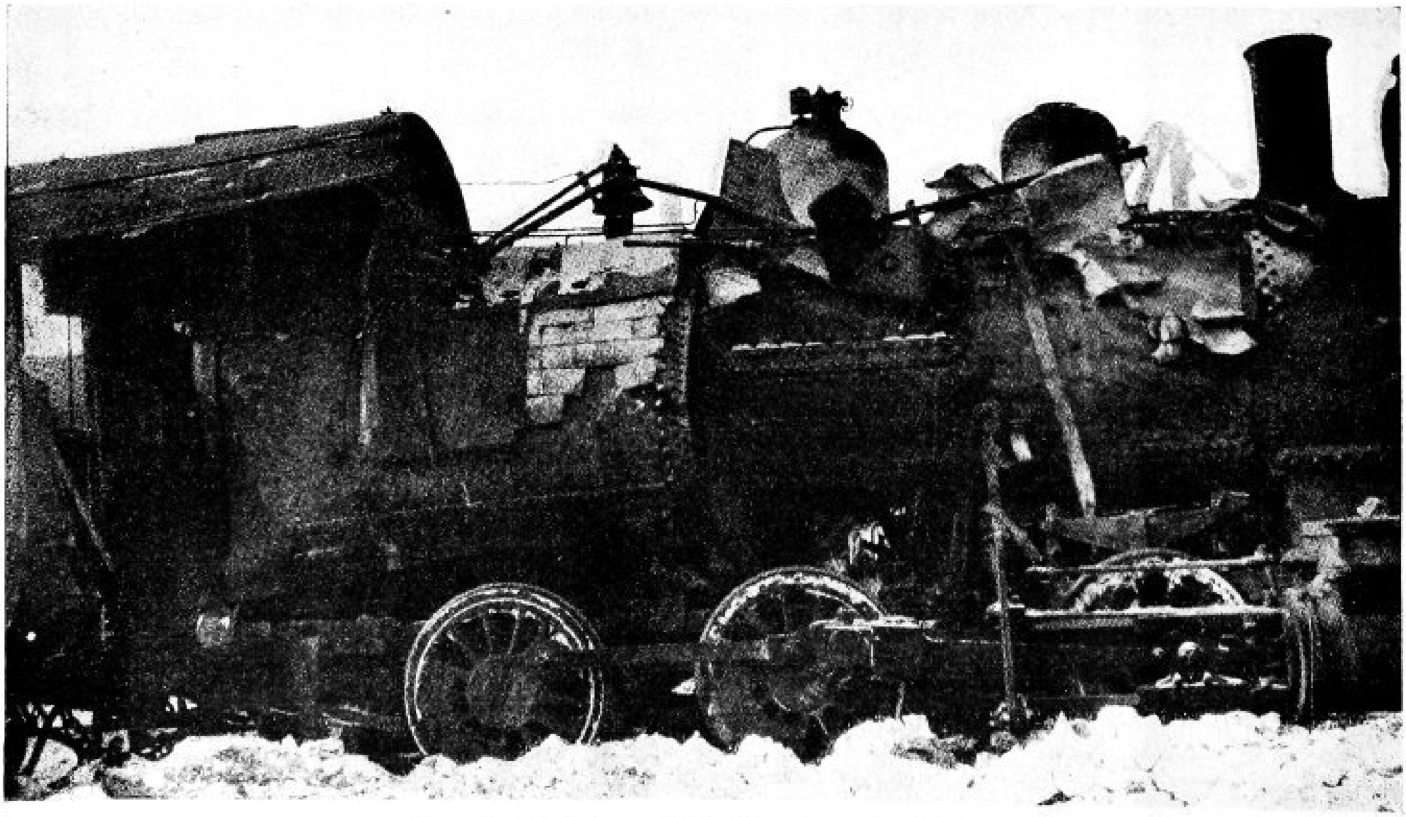
The illustrations accompanying this article show two views of a locomotive on which low water caused the side sheet to fail, the crown sheet remaining in place. The



View Showing Failure of Wrapper Sheet Seam Due to Low Water

locomotive was of the six-wheel switch type, with a narrow firebox. The crown sheet was practically flat and was supported by crown bars of a heavy T section and crown bar bolts with large heads. While operating in yard service the water level fell to a point about 18 inches below the crown sheet, resulting in the failure of the boiler as shown. The waterline is clearly defined on the side sheet by the white horizontal line.

From an examination of the boiler it appears that some of the staybolts in the right side sheet near the upper

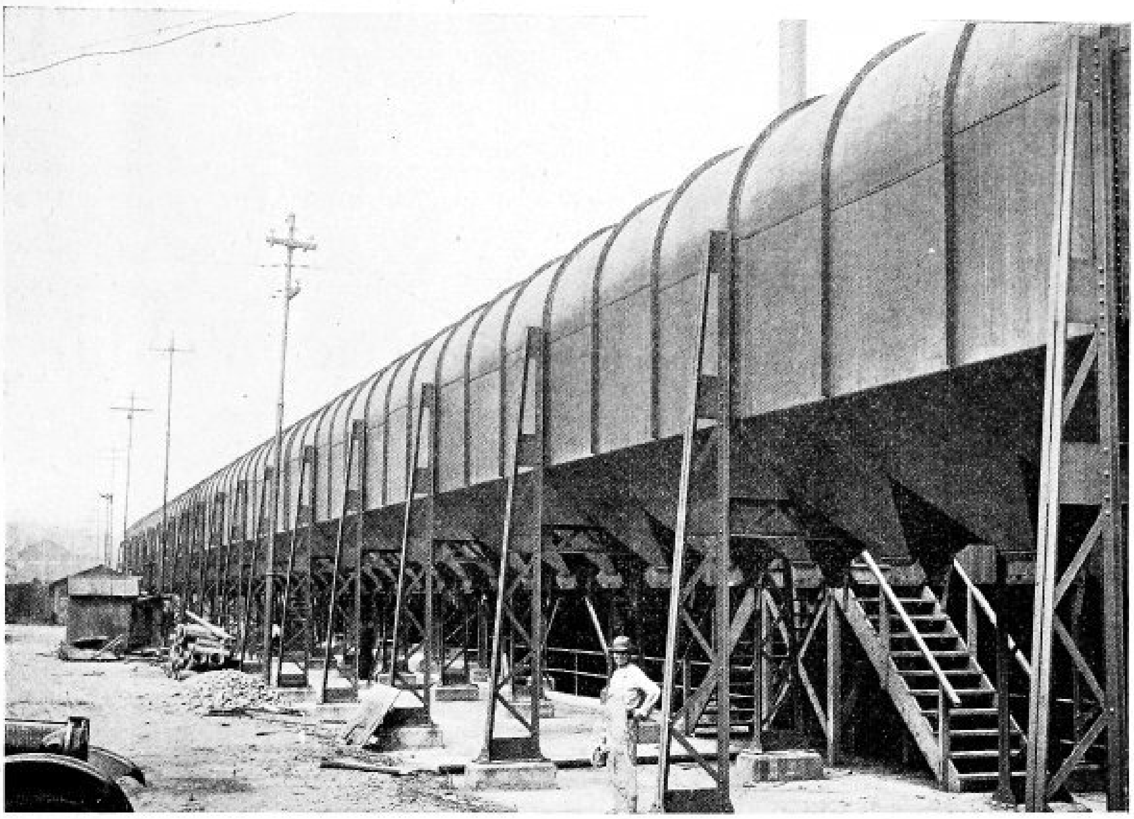


View Showing Failure of Side Sheet Due to Low Water front corner became overheated, together with the surrounding sheet, and pulled out. This caused a very great stress on the rivets connecting the wrapper sheet and the last course of the barrel of the boiler. The rivets at this point failed in tension, as can be seen by the character of the fracture. After the first rivets pulled out, the wrapper sheet was distorted, and the rivets in the barrel above the point where the initial failure occurred and those below in the throat sheet were sheared off. All the staybolts in the side sheet were either broken or pulled out. As the sheets separated the mud ring was pulled up and broke about a foot from the front corner. A patch about 12 inches wide extended along the bottom of the wrapper sheet for the entire length of the firebox. This was broken close to the throat sheet, failure occurring at the row of flexible staybolts. The back tube sheet was bent and pulled away from some of the tubes. Although the entire right side of the cab was demolished and the engineer was badly scalded by the escaping steam, he recovered from his injuries. The fireman was not hurt.

The fact that the crown sheet did not drop shows that the application of crown bars with large heads on the crown bar bolts furnishes ample support for the crown sheet, even with extremely low water. However, it is a question whether failure of side sheets would not often bring more serious results than ordinarily occur when a crown sheet fails.—*Railway Mechanical Engineer.*

A Great Balloon Flue

The illustration shows a great balloon flue installed by the St. Joseph Lead Company at Herculaneum, Mo. It is of interest to note that this vast structure—more than one-quarter of a mile long and eight feet in diameter—was made exclusively from 3/16-inch iron plates, made from ingot iron which resists rust and serves to carry the gases from the blast furnace—where the lead is refined—to the bag-house, and thence to the brick-stack.



Balloon Flue, 840 Feet Long by 8 Feet Wide, Made of 3/16-Inch Iron Plates and Installed by St. Joseph Lead Company

It is pointed out that six years ago the St. Joseph Lead Company made a similar installation, comprising 650 feet of iron plates, after they had completed series of tests on this ingot iron and other brands of so-called acid-resisting metals. In their experience, this iron has over twice the life of ordinary metals. Because of its unusual rust resistance, welding and enameling properties, easy workability, and high electrical conductivity, the iron of which this flue was made has been converted to a wide variety of uses.

This balloon flue is 840 feet long and 8 feet wide at widest point. In carrying the gases from the furnaces where the lead is refined to what is termed a bag house, the gas passes through a series of large iron boxes with baffle plates in them, and a large amount of lead is recovered in the form of an oxide. After this the gases go through the bag house to the brick stack.

Making Americans on the Railroad*

BY SAMUEL REA†

The task of producing loyal United States citizens from the millions of men and women of alien birth who are in this country, and who in normal times come here by the hundreds of thousands yearly, appears to resolve itself into two problems:

1. America must be made to seem to these people a good place, not merely to make money in, but to live in.

2. They must be induced to give up the language, customs and methods of life which they have brought with them across the ocean and adopt instead the language,

* From a statement furnished to Hon. Franklin K. Lane, Secretary of the Interior, following Americanization Conference held at Washington.
† President, Pennsylvania Railroad System.

habits and customs of this country and the general standards and ways of American living.

The management of the Pennsylvania Railroad System has consistently endeavored to solve the problem of Americanizing its foreign-born workers along purely practical lines, having in mind the two chief points of successful assimilation mentioned. In addition to the important patriotic considerations involved, it is believed to be in the highest sense good business to persuade and assist foreign-born employees to become citizens of the United States.

On the Pennsylvania Lines, of the more than 33,000 foreign-born men working on the entire system, about 25,700 are employed east of Pittsburgh and 7,500 west of that point. Some years ago, prior to the commencement of the great conflict in which the United States is now one of the leading participants, a canvass was made of the alien employees on all portions of the Pennsylvania System. This investigation showed that Italians greatly predominated in numbers. With the feeling, therefore, that Americanization work was more urgently needed among the Italians than among the representatives of any other nationality, a correspondence course in Italian-English was inaugurated.

Altogether, experiences of the Pennsylvania Railroad System in the effort to interest foreign-born employees in American citizenship have been encouraging. The United States must necessarily rely on people of foreign birth to keep up its labor supply, if the processes of further settling and developing the country are not to come to a standstill. It is, therefore, a clear duty to take care of the foreigners who come to these shores, to make life worth while for them here and safeguard them from being spoiled and degraded.

Oxy-Acetylene and Electric Welding*

Ninety-five Percent of Failures Not Due to Process—Operators Must Be Experts—Welding a Trade in Itself

BY A. F. DYER†

In boiler work, most of the welding is done with the iron electrode. Using a mild steel or Swedish iron as a filler, it is found that the electric process localizes the heat more so than the gas, though it is the writer's humble opinion that the gas makes a closer and neater weld, as all welds made by the electrode are more or less porous unless hammered up. It pays better whenever possible to do so to put in quarter or half sides in order to get out of the fire line in preference to putting in a patch, for, as a rule, however well the patch is welded it generally gives out in from twelve to eighteen months' service, and the same applies to cracks, whereas the half or quarter side should last as long as the firebox.

When a nest of small cracks is found round the staybolts, the bolts are removed and the holes countersunk and welded up. This method has been found to be very successful.

For cutting steel and wrought iron the oxy-acetylene process has practically no competitor, it being impossible with the carbon point to cut as fast or as fine and neatly as the gas torch, although for scrapping fireboxes and frames the carbon point is cheaper if time is no object and labor cheap.

No roundhouse should be without an oxy-acetylene outfit, both for repair work and as a part of the wrecking outfit. Many days are lost by engines being tied up through parts having to be sent to the nearest big shops for repair which could be repaired on the spot with a welding and cutting outfit. All large roundhouses should have both processes, as they would pay for themselves over and over again.

There are many different opinions as to which is the best process. No shop is complete unless it has both equipments, although the gas has really the widest range; but, on the other hand, a heavy piece of steel or iron needs no preheating with the electrode, but welding can be commenced as soon as your arc is drawn; 95 percent of the failures which occur, instead of being laid on the process, should be placed on the shoulders of the operators.

Welding should not be treated as a side line of the machinists' or boiler makers' business, but should be treated as a trade in itself, as it really is, for it needs the entire concentration of a man's mind, careful study, plenty of practice and a conscientious man to make a welder.

Wherever possible, a separate building or suitable space should be provided for bench work and should be equipped with a suitable furnace for heating and annealing castings, and also plenty of floor room to allow of charcoal fires being built for preheating cast iron jobs for welding.

An unusually interesting discussion followed the reading of Mr. Dyer's paper, in the course of which Mr. Barry, of the Oxy-Acetylene Company, said that the company's work came from all over the country—from the smaller roads, such as lumber roads and contractors' outfits, and the like. They ran up against anything and everything, and it is interesting to see what they have accomplished when it comes to acetylene and electric welding. If you wish, you can weld fireboxes complete with either the acetylene or electric welding. It is quite immaterial which process you use, and, of course, the acetylene operator will claim that his process is the best, but he does not know anything about electric welding. Both processes have their advantages, and you can use both. In using the oxy-acetylene process on fireboxes we have tried the butt weld and the result looks fine, but on account of the chance of the operator being careless the lap weld is best. I beg to differ from Mr. Dyer, as by putting a lap weld in fireboxes, especially in the corners, you can reinforce as heavily as you like, and we have found more success with the lap weld than with the butt weld, but there is no doubt that in welding side sheets to crown sheets or in the corners of fireboxes, either the butt or lap weld can be used—it depends upon the operator. The same thing applies to steel tank work.

* From paper on "Oxy-Acetylene and Electric Welding and Cutting Processes in Locomotive Works," read at recent meeting of the Canadian Railway Club, Montreal, Canada.

† General Foreman, Welding Department, Grand Trunk Railway, Montreal.

Boiler Repairs by Electric Welding*

Development of the Arc-Welding Process—Description of the Equipment—Examples of Application of Process to Boiler Repairs

BY R. S. KENNEDY

It is hardly necessary to state that welding is one of the oldest branches of the working of metals. In some respects it is a lost art, as there are good grounds to believe that the ancients were able to weld some of the bronze alloys.

In the following remarks the author proposes to confine himself to the welding of iron and steel, unless otherwise stated. A weld is the intimate union of two pieces of metal produced, when the pieces have been raised to welding heat, by pressure or hammering, and the welding state of the metal only exists within a limited range of temperature, being something like 100 degrees for iron and steel but varies with the metal. As a rule, good iron will stand a higher temperature than steel, although certain steels, such as blistered or good shear, will stand a high temperature. In the smith's fire steel can and should be forged with a lighter tool than iron, the blows being in rapid succession. In the ideal weld the two surfaces to be united are brought to the plastic heat together, neither at too high nor too low a temperature, when the point of juncture should be as strong relative to its section as any other portion. From the foregoing remarks, however, it will be appreciated that much depends upon the skill and experience of the operator, and it is recognized in ordinary engineering practice that an allowance has to be made for inevitable human frailties.

The first process of electric arc welding to be employed in a commercial sense was that of De Bernardos, which was used in Messrs Lloyd & Lloyd's Works, over twenty years ago, in the welding of flanges and branches to iron and steel pipes. In the De Bernardos process a carbon is employed, an arc being drawn between the carbon and the job, a portion of which is brought to welding heat, and the added metal is heated in the flame of the arc. In the early Bernardos process the work was made the negative pole and the carbon the positive; but latterly the poles were reversed, thus doing away with the dangers of carbonization of the metal caused by the natural flow of carbon particles from the positive to the negative. The Bernardos process is still largely employed in this country.

Metal Electrodes

Slavianoff substituted a metal electrode for the carbon electrode of the Bernardos process, although Bernardos as far back as 1885 had the idea of using a hollow carbon filled with the adding metal. In fact, there is very little that Bernardos does not seem to have anticipated, his difficulty being that, like many other great inventors, he was in advance of the means and appliances of his time.

The names of many investigators and workers in our own and other countries during the eighties and nineties of last century could be honorably mentioned, each doing his little bit to advance what is practically a new trade. Among them Charles Lewis Coffin, of Detroit, U. S. A.; Mark Wesley Dewey, of New York, U. S. A.; Pouméa, of Altoria, nr. Hamburg; W. P. Thompson, of Liverpool; Thos. Odlum, of Virginia, U. S. A.; Francis Todd, of Newcastle-on-Tyne; Joseph Fouillond, of Paris, etc.

Electric arc welding is primarily a form of autogenous welding—that is to say, that the metals to be united are heated to such a temperature that they will fuse together on contact without the application of external pressure. It is, however, found in practice that the application of even the moderate amount of pressure produced by a hand hammer increases the tensile strength and tenacity of the weld from 5 to 10 percent.

Pressure Improves Strength of Weld

It is, however, essential that this work should be put into the material when it is at welding heat, or, at any rate, above the black heat. It may here be remarked that it is often said that the value of metal added in this fashion is analogous to the ball of iron obtained in the puddling furnace. This, however, is not the case, and the better results are probably due to the fact that the iron wire used is of the very best material, with preferably a small percentage of manganese. This iron wire has been very heavily worked in the process of manufacture, and subsequently annealed, and as used by the writer's firm shows a tensile strength of 28 tons with an elongation of 50 percent. Somewhat similar results are obtained in another field with cast iron, which has several times been remelted. The whole question of the amount of work put into the material of a weld is very fascinating, and there is no doubt that the capacity of a weld for taking up rapidly-alternating strains for a long period, and for absorbing sudden shocks, very much depends upon this factor.

Returning to our blacksmith, we find that they all employ some kind of flux, usually sand or borax. This flux surrounds the heated iron or steel and protects it against the impurities of the fuel, removing at the same time the coating of the scales. Some impure wrought irons flux themselves, but with steel other mixtures are used. The flux, as its name indicates, also increases the fluidity of the heated metal.

In electric arc welding with a metallic electrode one great advantage is that, with the exception of the atmosphere, we have no impurities to guard against, except such as are introduced in the materials. The source of heat is pure, and we have to see that the job is properly cleaned and the metallic electrode of suitable material.

Still, to provide against oxidization and also to increase the fluidity of the metal a flux is necessary to good work in arc welding, and the heated metal is protected from oxidization by an inert gas given off by the flux. The most convenient method of applying the flux is to coat evenly the metallic electrode, thus providing a constant and uniform supply.

Electric arc welding is a process of building up, and consists of adding metal to an existing structure. For this type of welding the electric arc has one great advantage in its high temperature. This is the highest known, and thus by the application of a small number of calories a part of the job, say about ½ inch diameter, is almost instantaneously raised to welding heat, and the drop of adding metal from the pencil, also at welding

* From a paper read before the Institute of Marine Engineers, London, March 12.

heat, is united to it, and the process of building up is continued till the required section is reached. The small quantity of heat required does not cause any undue expansion of the job in hand, and contraction troubles are reduced to a minimum. It is quite a common practice to weld over a riveted seam, although in this case it is necessary that rivets in the area dealt with should be completely welded over, and not left half covered. After welding a seam it is necessary to calk the landing edge for some 6 inches at each end of welded portion. Cracks in furnaces, end plates, combustion chambers, etc., are dealt with by cutting out the defective portion, leaving a V-shaped opening, which is filled in with the welding material. Work can be carried out directly overhead, or in any position that is accessible to the welding pencil, and where the operator can see what he is doing. As the work is one requiring constant attention on the part of the operator, it is advisable, in order to get the best job, to make it as accessible as possible, and that the operator should be reasonably comfortable.

In common with all hand welding, a good job depends on the conscientious work of the man. The writer's firm have always trained their own welders, and keep them in constant employment. A full report is made of each job, and the name of the welder recorded, and the whole object of the training is to inculcate a sense of responsibility.

The materials at present dealt with on a commercial scale are wrought iron and steel and cast steel, and occasionally cast iron. The range of temperature of the welding heat is the determining factor in the adaptability of a substance for welding. Much successful work has been done with cast iron, notably with castings of considerable age, which have not been subjected to corrosive action, and with the good mixtures of more modern times. It is probable that there is a welding temperature of cast iron, but the range of this temperature is very small, something of the nature of 10 degrees.

The voltage across the metallic arc is about 22 to 25, and the writer adds an equal steadying resistance, which makes the voltage at the terminals of the dynamo about 45. A substitutional resistance is employed which is put in circuit by an automatic switch, when the welder breaks his arc, thus keeping the load on the machine constant. The amperes actually employed are about 175, but in practice a 200 ampere machine is necessary, while the writer's firm use machines designed for 250 amperes. In the big passenger liners it is the practice to weld from the ship's dynamo, suitable welding and substitutional resistances being provided.

By a special winding of the dynamo, known as separate excitation, the machine can be steadied under varying loads, but even in this case the writer still prefers to retain the substitutional resistances in addition.

The design of the portable machinery for generating electricity presents many interesting problems. The plant is designed to meet the varying conditions, consists of wagons generating their own electricity, portable gasolene-driven generating sets, self-propelled or dumb barges with steam-driven or kerosene sets, steam turbine plants, and last, but not least, the motor generator sets.

This last plant is of great service in a port like London, where the docks are well served with electric power mains at a constant voltage. The design of the dynamo is a matter for the electrical engineer, but the conditions of working are trying, and it is advisable to have ample commutator surface and good ventilation, as in urgent marine repairs it is possible that a machine may be asked to run continuously for two or three weeks.

The preparation of a job for electric welding is a matter of considerable importance, as the presence of impurities is likely to be detrimental to the weld. In dealing with the external of fire surfaces of a boiler it is usually sufficient to use an ordinary chipping hammer, and then thoroughly wire-brush the metal to be dealt with; but some superintending engineers prefer to have a light chipping taken over the surface, which is, of course, the ideal preparation. In marine work, however, the time available is often so short that as a general rule the former method is adopted. When, however, it comes to dealing with the water surfaces of a boiler greater care is necessary, especially if zinc plates have been freely used. The welder, if a properly-trained man, would at once recognize this difficulty and apply the only remedy, which is to chip down till pure metal is reached.

Arc welding being a building-up process, cracks are dealt with by veeing out at the line of fracture, the vee being made wide enough to ensure that the welder can reach with his pencil to the bottom on either side with a certainty of striking his arc at any required position. As the welder is a highly-skilled man, it is usual for the boiler makers to prepare the work to instructions, and the welder himself puts in the finishing touches. The welding in of new backs to combustion chambers or tube plates, or work of that kind, is dealt with in precisely similar manner, although here certain allowances have to be made for the work drawing together as the welder proceeds. It should be mentioned that in dealing with cracks it is absolutely essential that the whole of the fractured portion be cut away, and a very good guide is to cut away till a solid chipping is obtained, and then go a bit deeper to be on the safe side. If welding is carried out over a partially cut away fracture it is certain that sooner or later it will work to the surface. One of the most unsatisfactory matters we have to deal with is the welding of a crack in the original weld of a furnace, as it is most difficult to say where the defective weld ends, and a further defective portion some short distance along may work back into the part dealt with.

As in all engineering matters it is better to know the worst and to deal with it. The writer recalls an incident in our early days—about 1910—when we were called in to weld a crack, apparently about one inch long, in the back of a combustion chamber of a Swedish vessel. Our man started to cut out the crack when, with a loud report, the chamber back split right across, showing a fracture a full sixteenth open. This caused great alarm at first, and we were charged with using undue vigor, but on veeing out the fracture for welding it was found that the back was grooved right across on the water side, so we were exonerated. It is a merciful dispensation of Providence that such defects develop mainly when the boiler is cold or under banked fires, and it is generally recognized that a boiler is never safer than when warmed up and steaming steadily. Owing to its higher temperature the electric arc is more suitable for dealing with the heavier sections than the oxy-acetylene or oxy-coal gas, while, on the other hand, for thicknesses of 3/16 inch and under one or other of the gas systems is preferable.

The writer has been asked to summarize as briefly as possible the conclusions reached in the very able papers recently read by Commander E. P. Jessop and Naval Constructor H. G. Knox, both of the U. S. Navy. The full report of these papers has been largely circulated on this side by our leading technical journals, and has no doubt been seen by most of you. The principal welding consisted of the repairing of the cylinders of some eighteen German vessels, where large pieces had been broken from the upper portions. The method of a repair consisted of the welding in by the electric arc or oxy-acetylene gas of a new piece in cast steel or cast iron to replace the portion broken away. In arc welding the old and useful device of tapping short steel studs into the cast iron was used to enable the added steel (in this case) to make a surer weld. The electric arc welding repairs were carried out with the cylinders in place, while with the oxy-acetylene process it was necessary to remove the cylinders so that the joints for welding could be laid in a horizontal position, and also that the cylinders could be heated. Commander Jessop quite truly points out that the great difficulty found in the arc welding of the cast iron surface was to get the first layer of the adding steel material to adhere and that this layer was always added before the patch was put in position for welding. In the oxy-acetylene jobs, as before remarked, the cylinders were secured in place, and, the joints being horizontal, both sides of the joint were made fluid, and cast iron sticks melted into the bath thus formed. Both methods appear to have given excellent results, and the repairs are certainly the largest of their nature that have yet been carried out, and reflect the greatest credit on all concerned. It would not be wise, however, to generalize on the treatment of cast iron from these results. You will remember that we have before remarked that with good mixtures of cast iron, one can, with fair certainty, make a good weld. It must be remembered that these were high class vessels, and that in all probability the very best metal would be used in their cylinders and liners, and certainly in superheater jobs the high pressure cylinders and liners would be of a very special mixture, which so far as the writer's knowledge is concerned has only been made in this country during the last five or six years. The writer trusts that we hear further on this point, but his present information is that these vessels were superheater jobs.

The writer claims that arc welding, where carried out by skilled operators with suitable materials, is absolutely reliable, and can point to some 20,000 jobs, some of a very big nature, while the percentage of even partial failures would, at any rate, be on the right side of the decimal point. These partial failures would be mainly accounted for where the work was carried out under unfavorable conditions, and often in the nature of a forlorn hope. Great difficulties are met with in hurried repairs to the lower portions of the hulls of vessels in dry dock, where water is constantly dripping from the leaky portion, and owing to the cement inside it is often impossible to stop it in the time available. It must, however, be remembered that metal added by the heat of the electric arc or other methods has not been subjected to the same amount of work as a rolled steel plate or forging. It is, therefore, not so well adapted to take up work suddenly applied, and one would not recommend it for a position of responsibility where such conditions arise. This, however, is a condition generally recognized by engineers with all welds.

Modern Pneumatic Riveting and Chipping Hammers

"Safety First" in pneumatic riveting, as in all occupations with a hazard, is receiving a great deal of attention to-day, not only from the users of the hammers themselves but from the law-makers and the manufacturers as well. Ever since pneumatic riveting hammers were first placed on the market, there have been offered safety appliances and attachments to be used in connection with the hammers in various ways, leaving it optional whether the hammers are fitted with these devices or not. As a matter of fact, the first successful pneumatic riveting hammer made was considerably complicated by mechanism designed to prevent the shooting out of the rivet set. But workmen preferred the simpler but more dangerous riveting guns in which the safety devices were omitted.

About six years ago there was devised a tool-holding device which consists of a knurled nose piece which is screwed over the end of the hammer cylinder, the cup end of the rivet set projecting through the opening in same. This nose piece or collar effectively holds the rivet in place. The advantage of the tool holder lies in its simplicity and in the fact that it can be applied to any hammers now in use which may be sent in to the factory for that purpose.

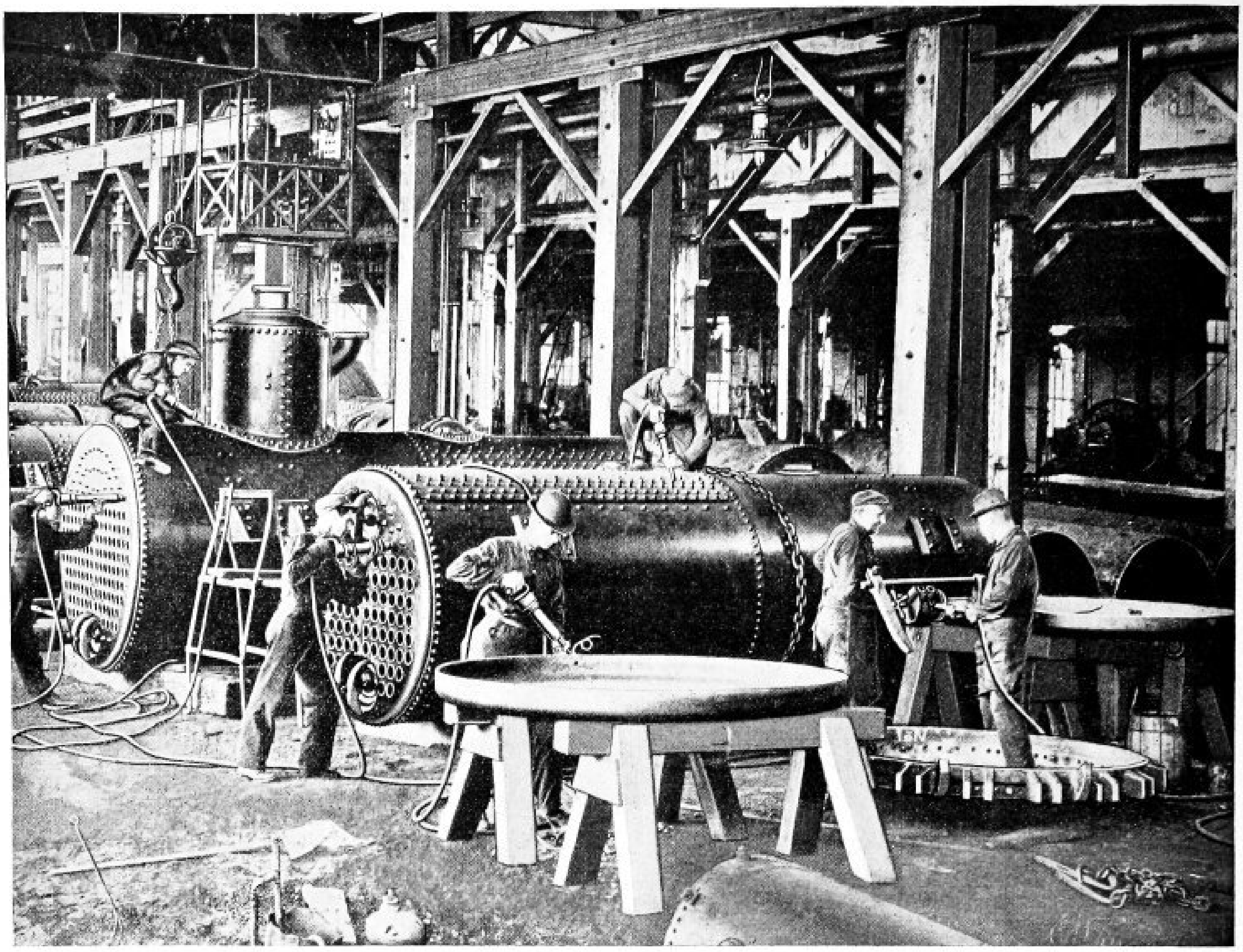
There is another more recent safety device, which is known as the piston retaining wall. The lower end of the cylinder is slightly closed in with a taper throat, corresponding with the taper end of the piston. It is impossible for the piston to come out of the cylinder at the lower end either by accident or otherwise. A secondary advantage of this method is that it prevents the use of unreasonably short pistons. Operators using this style of safety hammers are cautioned not to run the hammers unless held against the work in the usual way, for undue and unnecessary jamming of the taper-ended piston in the cylinder can do the latter no good, and may result in damage to the cylinder.

It may be stated that any size of riveting hammer can have a "piston retaining wall" when so desired. Another class of safety devices are those known as trigger locks, operating on the throttle valve in the handle by means of locking devices applied directly to the trigger. This arrangement is automatic in its action, as the throttle cannot be opened until the trigger lock is released. Various kinds have been offered, but the pistol trigger lock and the U-trigger lock are most satisfactory.

There has been developed a staybolt riveter adapted to the driving of staybolts. By means of two of these riveters both ends of the staybolt are driven at the same time. The staybolt riveter is held in position while riveting by means of its air feed attachment, which also cushions the recoil. It provides an adjustment of 6 inches, being 26 inches over all in its closed and 32 inches over all in its extended position. The net weight of the machine is 36 pounds.

Another interesting tool is the pneumatic plate straightening device, which consists of a riveting hammer clamped into a carriage which is mounted on roller bearings with a convenient throttle control to enable the operator to start and stop the hammers at will, at the same time guiding the tool to the work. There is enough weight in the carriage to absorb the recoil of the hammer and the old hand method of straightening steel, copper, or brass plates. It is very much more economical than the power hammer, especially when large plates are to be straightened.

The care and maintenance of pneumatic hammers is of importance. Pneumatic hammers, like all other classes of machinery, must receive proper care and lubrication in order to give proper results; therefore, one of the most important factors connected with their care is to keep them clean and well lubricated. The material used in their construction is usually the very best that money can buy and is the result of long period of experiment at an outlay of much time and money to get material that is best able to withstand the vibrations and wear and tear which pneumatic tools are given. The moving parts are



Pneumatic Drilling, Riveting, Chipping and Calking Tools in Operation in Modern Boiler Shop

accurately and closely fitted, and when proper lubrication is neglected, which is the most unpardonable offense to which a piece of fine machinery can be subjected, they wear rapidly and in a very short time refuse to work.

It should be noted that as the air taken into the compressor generally contains some particles of grit and dust, it is almost impossible to prevent this foreign matter from entering the working parts of the hammer, causing its ports to become clogged and rendering it inoperative. The use of a poor grade of heavy bodied oil will also cause the same trouble. A good plan to follow in such cases is to clean by using benzine freely through the throttle handle. This dislodges all foreign matter and cuts the thick oil, which can then be removed by blowing the air through the hammer. Another source of trouble is sometimes located in the pipe line. Moisture carried in the air will rust the pipes; and if a hammer is connected up without first blowing out the pipes a sediment is liable to be blown through into the tool, causing the valve or piston to stick.

It is recognized that rubber deteriorates very fast and particles of the hose may blow into the valve box and stop up some of the ports. Many times we have had hammers that would not operate sent into the factory, and on dismantling them found the port holes plugged up with pieces of rubber, or sediment from pipes, which when thoroughly washed out with gasoline, reassembled and properly oiled, would operate perfectly. It is an excellent plan to submerge the hammer occasionally over night in a bath of benzine, then blow out under pressure the following morning, and lubricate with a good quality of light machine oil, or, better still, a special grade of oil, which is manufactured especially for use with pneumatic tools. This not only materially assists in prolonging the life of the tool, but it will also be found to give better results.

In case the air is usually laden with foreign matter, it is desirable to use strainers or filters attached to the tool or placed in the supply pipe, as the case may be. Pneumatic hammers are subject to many abuses, but space will not permit a review of the subject as a whole. However, the most flagrant abuse to which the riveting hammer can be subjected is the use of short pistons. The objection to their use is minimized when they are properly made. When made by merely cutting off a standard piston, damage will result from the peining or spreading action, due to the soft center portion of the piston. The corners of the piston will also break off and lodge in the cylinder where the broken parts cut out the inner casing, and, if it is not damaged beyond repair from this cause, it is only a question of a short time when the cylinders will crack or the handle be broken.

In case the cylinders are cracked and handles and rivet sets are broken, hammers should be carefully examined to ascertain whether or not the workmen have substituted a short piston improperly made. This can only be done when the hammers are in service, as it has been found the workmen carry the short pistons with them and make the exchange after taking the hammer out of the toolroom and again replacing the proper piston when turning the hammer into the toolroom at the close of the day. Pneumatic hammers are also abused in taking them apart and putting them together again. Some repairmen, instead of using a wrench or soft hammer in loosening or tightening the handle, use a hard steel hammer, battering the parts badly and in many instances breaking them. The finished parts should never be struck with anything but lead or copper hammers; and even when this is done, good judgment should be used to avoid the strain put on the threads of the handle and the cylinder.

Many men who operate pneumatic hammers in the shops know very little, if anything, about the construction of the tools, and it pays any large institution using pneumatic tools to employ a competent man to look after them, see that they are properly lubricated and returned for cleaning when through with their work. In some foundries where large numbers of hammers are used in cleaning and chipping castings, at the sound of the whistle the hammers are thrown down, generally in the sand, and enough sand or grit gets into the tool, so that when the air is again turned on the piston sticks fast after one or two blows. This necessitates a cleaning of the tool, causing a loss of time in its use of from twenty to thirty minutes. This is entirely avoided in the best regulated shops and foundries.

In starting to drive rivets in cold weather, especially on structural or out-of-door work, the hammer is warmed up enough to take the frost out of the steel, as a hard piece of steel full of frost is liable to break at the first blow, but after a few rivets have been driven there is enough heat from the rivets to keep the tool warm and thus prevent the tool from breaking.

Organization and Co-Operation*

Trade Organization Necessary for Progress—Closer Co-Operation Among Boiler Manufacturers Badly Needed

BY DAVID J. CHAMPION†

Organization should appeal to every man who seeks to obtain recompense for his labor. If we stop to reflect we can easily see the part played by organization in the inception, perpetuation and sustenance of every created thing, from the humblest forms of animal and vegetable life to the highest forms of planetary creation, all performing their natural duties and movements with method and precision that to the human being is incomprehensible.

Even uncivilized man follows out the written law of organization for social and defensive existence in his intercourse with his fellowmen. In a word, all nature teaches us the necessity of organization, if we value our existence. There is no real healthy life without it.

This leads me to think of a story as told by the late Elbert Hubbard, who at one time had occasion to visit a state hospital for insane. Walking over the beautiful grounds half a mile from the main buildings one morning he came across an attendant in charge of twenty-five patients. The attendant was a little chap, a sort of half portion. Many of the patients looked and weighed twice as much. The comparison aroused the Fra's curiosity. He joined the attendant in his stroll and walked with him for some distance. In the course of the conversation, Mr. Hubbard asked: "What is to hinder half a dozen of these big fellows behind you getting together and setting up a job on you and fleeing into the woods? If they should get you all at once you wouldn't stand a ghost of a show. There is no help within a half mile at least and you are not armed?" (This he had told Hubbard.) The attendant looked at his questioner in severe rebuke, then smiled and replied:

"You belong right here, all right, friend. What is to hinder these men getting together and setting up a job on me? Why, the fact is, if they could get together with anybody or anything they would not be here. That's their trouble."

Further, along these lines, I wish to quote a few excerpts from an article written by a Mr. C. R. Trowbridge, as published in "The Dodge Idea," as follows:

"The badge of sanity is the ability to organize. Organization is a modern policy. The organized man is a power; he moves shoulder to shoulder with his brother; the unorganized man is merely a part of a mob, with no chart or compass to guide him.

"Organization is the spirit of progress, and the spirit of progress is the greatest asset a business or an individual can have. The more people we can work with, and for, the bigger and better you and I are. Reciprocity, mutuality, co-operation are combined in this spirit, and the greatest of these is co-operation.

"Competition may have been the life of trade once, but it is no longer so. Competition died when the inventive genius of American engineers devised machines that will manufacture beyond our present economic wants. Competition then became suicidal and destructive, and anything that is suicidal is dying—is *dead*. We have passed through the savage age, the stone age, the competitive age, and now we are passing into the co-operative age. We will not be here so very long, anyway, and soon Death, the kind old nurse, will come and rock us to sleep—and we had better help one another while we may. The idea of the brotherhood of man is no idle, vacuous dream, and this idea of brotherhood is coming about, not through the preaching of ethics of morality but as a matter of self-preservation.

"The strength of unity is indisputable. Few things do more to retard the natural progress of a business or of a movement than a lack of co-operation.

"There are two chief reasons for lack of co-operation: one is that men do not agree on what is best to be done; the other is that selfish motives deceive men into thinking that they can get more by going alone.

"The remedy for the first is comparison of views, exchange of ideas and the establishment of the right idea in the minds of all. The remedy for the second is the knowledge that the common good is also the real good of the individual. Selfishness is often but another name for ignorance. If a man desires to obtain the most good for himself he should know that his legitimate share of a great common good is greater than any possible good he could

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† President, Champion Rivet Company, Cleveland, Ohio.

obtain for himself alone. The narrow-minded man fishes with a hook and thinks to have the whole catch for himself. The broad-minded fellow joins with others in using a seine, and his portion of the returns exceed by far what he might get with the hook.

"Co-operation is greater than competition, and we should constantly bear in mind the great fundamental law of the universe—the laws of interdependence. There is not a thing in the world which is not dependent upon some other favorable thing or condition. We all need each other, and therefore should co-operate with each other. He who loses sight of this important law is bound to become worthless timber in the life of the world.

"Simply because one is in the same line of activity as another is no reason why he should attempt to destroy him. A certain amount of mutuality is absolutely necessary to live. Increased consumption is the rule of every line of human endeavor.

"Organization is the spirit of progress. You stand for progress or fall. Let your desire be to know what constitutes true success and the willingness to take the patient steps which lead to it; the desire to correct errors, traits and tendencies which retard advancement and the willingness to receive new ideas and to act upon them; the desire to act from sound motives and the willingness to give up false and temporary success for vital and permanent growth; the eagnerness to utilize every wholesome opportunity, the enthusiasm to strive for excellence for its own sake, and the energy to push on, pausing only when victory is won. With this spirit, development into rich reward is inevitable. It is as natural as for a tree to grow.

"Forget price. Don't seek to control the action of the individual. Look rather to benefit from an exchange of experience and be free with them. Don't be a peanut man. Little peanut men live by themselves. They think they have secrets and they are afraid of somebody getting the secret away from them. The fact is, we only grow as we give, and anybody who *locks* the world *out* shuts himself *in*.

"The world may furnish many opportunities, appreciation will quicken some motives. The onward movement of the world can change some conditions, but that spark of fire—the spirit of progress—must come from within, must spring up in a moment of noble resolve, must never be allowed to die, never to want, never to waver."

Some will probably remember that in our convention in 1916 I made a few remarks in regard to the advisability of the boiler manufacturer getting a fair recompense for his labor and product. At that time the paramount question was, "What have we accomplished?"; and to-day that question is again before us, "What have we, as boiler manufacturers, done towards establishing a better organization and a better understanding among us?"

The necessity of trade organization, especially at this time, is so apparent and so necessary that it passes ordinary understanding how any manufacturer can feel he can be self-centered and indifferent to what his competitors are doing. To make a long story short, if we wish to know what our competitor is doing we must be willing to tell him what we are doing. In other words, take him into our confidence and it will only be a short time when he will take us into his confidence, and between us we will be able to determine if the buyer is seeking to get some of our product without paying a fair price for it. If we had had a trade organization when the Government called for bids some little time ago we would have made a better impression in Washington, and those in charge of the purchasing would have recognized that an organization had to be dealt with instead of a disorganized body of manufacturers. Organization stands for co-operation and progress, and, after all, progress is, or should be, the prime object and aim of our lives.

At the meeting in 1916 I outlined my views and ideas as to plans, etc., for establishing a better understanding among us for fair prices—suggesting the appointment of an eligible engineer or secretary to represent our association, the duty of said secretary to be to compare prices and exchange them with other eligible bidders. I am now of the same opinion as I was then—in fact,, more convinced than ever, as I have seen by actual experience the advantage of this method of organization. This has proved to me that organization is the proper thing for all classes of manufacturers. I do not mean by this that an organization should exercise its power to get high prices. It should rather foster the idea of securing fair living prices by frank and friendly communications and interchange of ideas.

The Government has no objection to an organization publishing openly lists of prices which are deemed fair and reasonable, but, of course, criticism could be made if manufacturers tried to establish and maintain by any secret method any special fixed prices. It is not necessary for the success of an organization that it should try to increase prices. If good fellowship exists among the various manufacturers—respect for the other fellow's rights—trade and conditions will so regulate themselves that a living profit will be secured by everyone.

We all realize that serious difficulties are encountered in the first step at organization in any business. This is probably due to the fact that all manufacturers have been educated through generations to distrust their competitors; consequently, it is difficult for any of them to accept entirely the fact that their competitors will treat them with absolute fairness and frankness. Of course, this is an old fallacy, and we all know that it should not, and in reality does not, apply to-day or exist among modern, progressive, broad-minded business men.

When organization is carried to the proper conclusion, I feel that each manufacturer will find that his competitor is just as frank and willing to work in harmony as himself. In fact, all—each and every one of us—has that desire. The lack of harmony and co-operation is caused by the lack of faith in one another. This feeling, by systematic effort and constant day-to-day exchanges of prices, etc., I know can be overcome, and as each one gradually readjusts his mind, the inherent distrust in time can be broken down and everyone will be entirely frank—in fact, willing and anxious to see that his competitor succeeds.

This is the true spirit of "live and let live"—"live and learn." See the object lesson Germany has set of the world; look around us here and observe the success of organizations like the United States Steel Corporation, American Tobacco Company, National Biscuit Company and numerous others. When every manufacturer has been educated to the point that he is anxious to see his competitor succeed, then he can rest assured no competitor will take advantage of him.

This applies to each and every one of us, and when we arrive at the point where we thoroughly understand each other and are willing to co-operate and, above all, to be frank, we will stand as a united body of men who have, as the saying goes to-day, "gone over the top." Our working as a unit means much—it means all—for the success of our organization. Next to organization and closely allied with it is a comprehensive system of cost keeping. After that comes the fair amount of recompense to which honest and intelligent service is entitled.

Briefly, to sum the matter up, the following suggestions, if conscientiously carried out, would assure success to every one of us:

Organization.
Scientific cost accounting.
Fair recompense.
Co-operation.

If you think well of these ideas, appoint a committee or refer it to your executive committee with power to act. Call it the "harmony committee," if you will, and go about this work in earnest. You will then reap the reward of your labors covering a period of thirty years.

"The oak is slow of growth. Should we, then, refuse to plant the acorn?"

Design and Maintenance of Locomotive Boilers

Autogenous Welding Successful—Broad Field for Application—Great Saving in Cost Reported by One Road

At the joint convention of the Master Car Builders' and Master Mechanics' associations, held at Chicago, May 19 and 20, the committee on the design and maintenance of locomotive boilers, C. E. Fuller, chairman, presented the following report:

Smoke Boxes

There is no doubt that the construction and renewal of smoke boxes is handled expeditiously and economically by the use of autogenous welding. For joining smoke boxes at the longitudinal seam, several roads use the oxy-acetylene torch, while an equal number prefer to electric-weld this seam. The usual method followed is to tack the edges of the sheet together at intervals of about 8 inches with strips about 2 inches expansion of the sheet than if a thorough weld were made. The voltage at the panel is usually about 70, reduced at the arc to about 25. One road reduces at the arc to 65 volts; another road uses a much lower voltage at the panel, from 28 to 35, reducing to 15 at the arc. The amperage is about 125, although this varies in the reports from 120 to 160. The best results appear to be obtained by the use of a 3/16-inch welding wire. Wherever welded seams have been used the results have been satisfactory. The cost is approximately 60 percent of a riveted seam.

Practically all of the roads reporting, cut off old or damaged smoke box plates by oxy-acetylene. It appears to be the usual practice to weld in small plates, but for larger plates to use riveted joints. The reinforcing rings in smoke boxes are usually not disturbed, the weld being made ahead of the ring.

Flues

The practice of electric-welding flues, particularly superheater flues, is quite general. The flue is applied in the usual manner, after which the firebox ends are beaded and welded lightly around the head. Some roads, in doing this, use a 1/8-inch welding wire, others 5/32-inch welding wire, the former being representative practice. The voltages reported vary from 28 to 220, most roads using 60 to 70 at the panel, 20 to 25 at the arc. The amperage is usually about 125. Where used, the results have been satisfactory, although some trouble has been experienced from leakage when locomotives are located at points which have no welding apparatus. Forty-two percent of the roads reporting use the oxy-acetylene or electric process for filling up pit holes in flues, using, with the latter, 1/8-inch welding wire, voltage of 70 at the panel, 22 at the arc and an amperage of about 125.

It is evident that a broad field for the application of autogenous welding process lies in the safe-ending of flues, or the welding in of a new section near the center for the purpose of lengthening them for re-application. The advantage which comes from not having to limit the length of safe ends, on account of capacity of flue-welding machines, certainly offers an opportunity to reclaim material which would otherwise not be serviceable. Of the roads reporting, 20 percent are using autogenous welding process for safe-ending flues, with satisfactory results. Three of the reporting roads have welded a new section of the flues, and the results from this have also been satisfactory. Twenty percent of the roads practice the cutting out for replacement the entire flat surface of front flue sheets without disturbing the flange or rivets. This method, however, has not been generally adopted, and it is usual to cut out the entire old sheet by acetylene process and to replace it with a new one. The practice of cutting out the section of front flue sheet under the dry pipe containing the flue holes and replacing it by welding in a new section suitable for application of superheater flues has not met with wide favor, although the roads doing this report satisfactory and economical results. For this work the best results have been obtained with a voltage of 70 at panel, 22 at arc and a current of 125 amperes. A welding wire 3/16 inch in diameter has been found suitable. One road reports that by following this practice they can replace sheets at a cost of $28, as compared with $150 for entire new sheets riveted in place.

The majority of roads reporting do not apply back flue sheets by welding, but this is being satisfactorily accomplished on some few roads by either process. The use of oxy-acetylene or electric welding for repairing cracks in the knuckle of flue sheets is quite general and produces good results. There is, however, a wide variance in the methods of welding. Seventeen roads report that such cracks are welded on both sides, six weld on water side only, while three weld on fire side only. One road reports that they prefer to use electric welding from the water side and oxy-acetylene from the fire side. When electric welding, the voltage of 70 at panel is reduced to about 22 at the arc. Using a 3/16-inch welding wire with a current of 125 amperes seems to give the best results. For repairing cracks in fluesheet bridges the usual practice is to remove the adjacent flues, cut the sheet, both sides, at about 45-degree angle and then fill in the space. The voltage at the panel is usually about 70, at the arc about 22, requiring a current of about 125 amperes. There is a wide variance in the size of welding wire used for this class of work, ranging in the reports from 3/32 inch to 3/16 inch, the latter being more often used.

Staybolts

A number of roads are using oxy-acetylene torches for burning off protecting ends of new staybolts before riveted over. The results obtained have been, in most cases, satisfactory. To insure all bolts being cut off uniformly, one road reports the use of a guide next to the nozzle. Electric welding of cracks radiating from staybolt holes seems to be the most satisfactory. It is customary to remove the staybolt, chamfer hole for the purpose of eliminating the cracks, or, should the crack extend too far from this, to bevel both hole and crack to 90 degrees and fill the crack and hole up solid; sheet is then drilled and tapped for the application of a new staybolt. The usual voltage is 70 at the panel, reduced to about 20 at the arc, with a current of about 125 amperes. Welding wire 3/16 inch in diameter is ordinarily used, and the results are reported as satisfactory.

Fireboxes

There is no part of the boiler where the application of these processes of welding have been so uniformly successful or resulted in greater economy than for firebox application and repairs. Ranging in scope from putting in entire new fireboxes to building up around leaky mud ring rivets, the manifold utility of autogenous welding seems to be limited only by the ingenuity of the operator. Of the roads reporting, 25 percent are using the electric process for welding in entire new fireboxes. The application of part or full firebox sheets and door sheets has been quite generally practiced. Door sleeves are renewed, part wrapper sheets and part back heads applied, and the application of patches reduced to a minimum by welding.

Where patches are required, the work is accomplished by welding at about 60 percent of the cost of riveted patches. The forms of patches used vary with individual roads. Some cut the sheet out with square edges, lay the patch over the hole in the sheet, with a lap around the outside of about ⅜ inch, the patch being beveled on its edges, then building up over the bevel and onto the sheet. Another method is to flange the edges of the hole outwardly, lay the patch on the extending flange, with its beveled edge projecting outside the flange toward the sheet, and then join the beveled edge of the patch to the flange by building up a bead. Still another method followed on repairs to firebox sheets is to V out the sheet on the fire side, place a patch which has edges beveled in the opposite directions from the sheet into the opening, then fill up the 90-degree opening. With this style of patch an expansion knuckle parallel to the vertical center line of staybolts provides for stresses. The results are uniformly satisfactory. The voltage approximates 70 at the panel, 20 to 24 at the arc, and the current used about 125 amperes, 3/16-inch wire having been found satisfactory. For filling up staybolt or rivet holes, both processes are largely used. Eight of the reporting roads weld exterior bosses usually by the oxy-acetylene process on the outside wrapper sheet, to give increased full threads for angular radial staybolts. Only two roads report having welded in arch tubes, while three weld fire-brick arch studs to firebox side sheets successfully.

Three roads have reported cutting off firebox and wrapper sheets above mud rings to avoid disturbing mud-ring rivets, then welding new fireboxes at this point. This practice, as yet, has not been followed to any extent.

Welding of cracks is usually limited to those from 4 inches to 35 inches long, the latter being done only to keep the locomotive in service. Practically 8 inches is considered about as long a crack as it is desirable to weld for permanent repairs, most roads preferring not to exceed 4 inches.

Mud Rings

For mud-ring repairs, either electric or oxy-acetylene welds are used, the former being preferred. The usual method followed is to cut out a piece of the side sheet over the crack in the mud ring, level the mud ring from the top, then fill up the opening, after which the sheet is patched. In cases where the mud ring is removed from the locomotive, some roads prefer to bevel from both sides and then weld. The welding wire is usually ¼-inch diameter, and a large saving in the cost of repairs results from welding mud rings in place. Troublesome leaks in mud ring corners are eliminated by building up the calking edge.

General

Among the many other repairs made by these methods may be cited reducing worn washout plug holes, reclaiming superheater units, building up worn places on stayed surfaces and welding up abandoned flue or plug holes. The use of a carbon electrode or a metal electrode is primarily dependent on the size and strength of weld desired. The carbon electrode process should be used on work of considerable size, if maximum strength is not a limiting factor, and is very desirable for rapid cutting. When using the carbon electrode it is customary for the operator to heat around the weld, so that extensive contraction may be avoided. The current required for carbon welding is usually about 400 amperes.

The metal electrode process, which is generally used in the various phases of boiler maintenance work, has the advantage of confining the heat more closely, and is used for welds requiring strength and for small work. The current required has a much lower value than that used with the carbon electrode process.

If the current is too high for the size of welding wire being used, it is found the metal oxidizes and the weld becomes hard and brittle. Representative practice appears to be about as follows:

⅛-inch wire................	100-120 amperes
3/16-inch wire..............	115-135 amperes
¼-inch wire................	130-150 amperes

The voltage at the panel should be from 70 to 75, reduced at the arc to about 20 to 30 volts. By following these limits it has been found the metal flows in its most natural state, leaving the weld unoxidized and ductile.

As a general rule, it is desirable after starting a weld to complete it if possible before stopping, on account of the effect of the contraction of the sheet if work ceases. In some cases it will be found advisable to have two men work alternately in order to accomplish this. On account of the wide variance in the methods followed and the costs reported, your committee does not feel that definite recommendations can be formulated, believing that local conditions so far govern these as to make such recommendations of little value.

Greater Progress in Future

While it is gratifying to consider how much has been accomplished in the use of the oxy-acetylene and electric processes for boiler maintenance, it is believed that the art is still in a formative and developmental state, and the future will see even greater progress, as the possibilities of economical application are exploited. It may not be amiss for your committee to sound a warning against too radical application. Stayed surfaces and appurtenances, which are not subject to direct radial pressure, offer a safe and attractive field for future experiment, and any work for the time being should be limited to these sections of the boiler.

Get Ready for the Next Liberty Loan.—The Fourth Liberty Loan will open September 28. Now is the time to prepare for this investment. Be ready to subscribe on the opening day.

The Boiler Maker

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H. H. BROWN, Editor

"Work or Fight" is a government policy which leaves no loophole for evasion. At a time when American and Allied forces are making gigantic efforts to break the power of the enemy and there is greater need of increased production in munitions and in all essential supplies than ever before, industrial strikes must be summarily dealt with. It rests with the government to see that our forces at the front are backed up by 100 percent efficiency in the industrial work at home.

What is probably the most drastic action that the government has taken since putting the National Army draft into effect is the ruling which went into effect on August 1 centralizing the supply of common labor to the war industries in the United States Employment Service of the Department of Labor and prohibiting the individual recruiting of common labor by manufacturers having a payroll of more than one hundred men. This action, which was forecasted in our last issue, is in accordance with the decision of the War Labor Policies Board, which was approved by the President on June 17. This action was found necessary to overcome a serious shortage of unskilled labor in war industries; a condition which was aggravated by the almost universal practice of labor stealing and poaching. While the restrictions against the private employment of labor apply only to common labor at the present time, these restrictions will, as soon as possible, be extended to include skilled labor. In the meantime, recruiting of skilled labor for war production will be subject to Federal regulations now being prepared.

This drastic change in the nation's labor programme has been found necessary, in order to protect the employer and the employees, to conserve the labor supply of the communities and to keep down unnecessary and expensive labor turnover, which in some cases is as high as 100 percent a week, and finally to increase the production of essentials for the prosecution of the war. While non-essential industries will be drawn upon to supply the necessary labor for war work, the withdrawal will be conducted on an equitable basis, in order to protect the individual employer as much as possible. Under the operating methods adopted, the country has been divided into thirteen industrial districts, each district being in charge of a superintendent of the United States Employment Service. The States within any district are in turn in charge of a State director, who has full control of the service within the State. In each community there is being formed a local community labor board, consisting of a representative of the United States Employment Service, a representative of employers and a representative of employees. This board will have jurisdiction over recruiting and distributing labor in this locality. A survey of the labor requirements is being made and, in order that each community may be fully protected, regulations have been issued that no labor shall be transported out of any community by the United States Employment Service without the approval of the State director, nor shall any labor be removed by the Service from one State to another without the approval of the United States Employment Service at Washington. Every effort will be made to discourage any movement from community to community or State to State by any other service. This labor programme has the approval of all producing departments of the government, through the War Labor Policies Board.

The requirement that unskilled labor must be recruited through the sole agency of the United States Employment Service does not at present apply in the following five cases: (1) Labor which is not directly or indirectly solicited; (2) labor for the railroads; (3) farm labor; (4) labor for non-war work; (5) labor for establishments whose maximum force does not exceed one hundred.

What is graphite? is a question frequently asked not only by boiler makers but more particularly by boiler users, as some form of graphite is often used in boilers to prevent foaming, priming or injury to the boiler plates and tubes. In answer to this inquiry, the following is submitted from an authoritative source.

Graphite is one of three forms in which carbon exists, the three forms being as follows:

First—Substances represented in a general way by coke, lampblack, charcoal, carbon from gas retorts and substances of this type, none of which has a specific gravity above 2.15. They have no unctuous qualities and are all amorphous; that is, they have no crystalline structure.

Second—The second form is technically called graphite or graphitic carbon. It is also frequently known as plumbago or black lead and is a substance having a specific gravity approximately 2.25. Its peculiar and distinguished characteristic is that of unctuousness; that is, its extreme smoothness and softness to the touch. This substance is also peculiar in that it exists in both the crystalline and amorphous conditions. The material is therefore natural or artificial, the latter form always being amorphous. Graphite, on rubbing, produces a high polish, black or dark gray in color.

Third—The third form is the diamond, a transparent crystal of very great hardness, having a specific gravity of about 3.45. This is as different from graphite in its physical properties as two substances can possibly be.

All forms of carbon are practically insoluble in all chemicals and are consumed in the presence of oxygen of high temperatures.

Engineering Specialties for Boiler Making

New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

Westinghouse Brings Out Small Turbo-Generator Unit

To-day it is the duty of everyone to do his utmost in winning the war; and, therefore, no stone should be left unturned in obtaining a greater production with the same number of men, or the same production with fewer men; and no waste material, time, nor money should be permitted. To aid in furthering work in many lines, the Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., has recently produced a small turbo-generator unit for direct-current service. This unit is designed for 10 kilowatts output, although a temporary load of approximately 12.5 kilowatts may be obtained. A

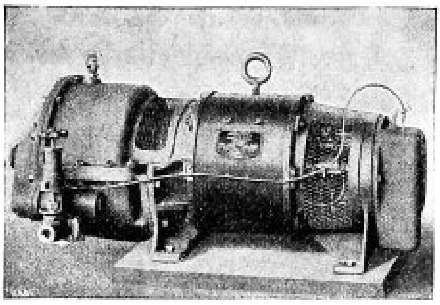


Fig. 1.—Ten-Kilowatt Set Complete

smaller unit of 8.5 kilowatts gives a range of capacity suitable not only for lighting work, but also for the majority of electro magnet work.

Its range of capacity, its range of operating conditions and its construction make this an admirable unit for many uses. Its range of operating conditions (80 to 235 pounds inlet, and from zero to ten pounds back pressure) make this a suitable unit to install in oil refineries where it can be used as a reducing valve between sufficient light for his plant as a "by-product" in his oil refinery.

Since the energy developed is direct current, it is finding great favor on steam locomotive cranes, where it is used for lifting magnets. To-day, locomotive cranes are in demand as never before; and as many of these cranes are now equipped with electro magnets, this unit enables the purchaser and the user of these locomotive cranes to have all the advantages of the electric locomotive crane in handling the scrap and pig iron. It is needless to say, that to-day, with the scarcity of labor, any labor device in handling raw material in yards and factories is of high importance in getting out larger production. Its simple, rugged, and reliable construction enables it to be used at great distances from machine or repair shops, as there are no reciprocating parts to wear out, and as practically the only attention which it requires is to have its oil well filled occasionally.

In building this 10 kilowatt set, the manufacturer has recognized that it must operate under the most trying conditions. For that reason, it is as simply constructed as possible, while yet having many of the features found desirable larger units. Among these is a hand and automatic throttle valve and an emergency overspeed governor. This latter feature is placed on the generator end of the unit and automatically closes the throttle valve of the turbine, if the unit should show a disposition to overspeed. The device consists of a small weight placed in the shaft of the unit, which, at a predetermined speed, engages a trip lever connected in such a way to the throttle valve that it is automatically closed, thus stopping the unit.

The most important feature of this unit is that there is but one revolving element in which the generator shaft is extended so that it also carries the turbine rotor. This not only makes a very compact machine, but eliminates all coupling and misalinement troubles, and dispenses with turbine bearings and packing.

The turbine rotor is made of a high grade open hearth steel forging accurately finished, in the periphery of which are placed blades of electric furnace steel which are held in place by pins tightly driven in through blade and rotor. The blades are of the impulse type; and although there is only one row of blades, yet by means of a reversing chamber the same steam is passed through the blades a second time, thus allowing complete expansion of the steam.

Since the unit is designed to occupy the least possible space, the manufacturer has equipped the generator with ball bearings (no bearings being required on the turbine) instead of the usual type of surface bearing; thus saving in bearing friction, while a consequent decrease in length and weight of the unit is effected. Moreover, these self-alineing ball bearings on small units are suited for a variety of services, particularly for marine work, which oftentimes compels the unit to operate at an angle.

As is shown in the illustration, all open places on the unit have been covered with pieces of expanded metal,

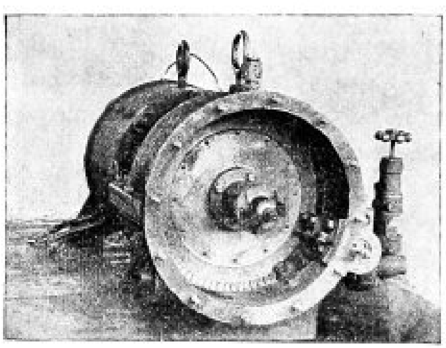


Fig. 2.—Set With Turbine Cover Removed

which protect not only the operation but also the generator parts from incoming foreign matter. The unit is only 3 feet 8½ inches long, 23 inches wide and 18¾ inches high and, as it is light, can be used where space is valuable or for portable work.

Acheson Boiler Graphite

Made in the electric furnace, Acheson-Graphite possesses peculiar properties for use in boilers. In its production it is subjected to a temperature of 7,500 degrees F., which drives off in the form of vapor all impurities which are ordinarily present in mined graphite. As this graphite is guaranteed to contain 93 percent pure graphitic carbon, the remaining ash being nearly as inert as the graphite itself, it is claimed that there is no possibility of injury to the boiler due to the graphite.

Since graphitic carbon is one of the most inert substances known to science, it will not bring about any chemical reaction, and therefore tends to remove any cause of foaming, priming, pitting or any injury to the boiler in any way. It is generally conceded that its action is purely mechanical. Analysis of the average scale will show it to be composed largely of carbonates and sulphates which have been precipitated, due to the boiling of excess CO_2, from the former salt and to the fact that the latter salt is insoluble in hot water. From some of the water there will also be found a deposit of magnesia, because magnesium salts are decomposed at high temperatures. As the newly liberated molecules of scale-forming material are thrown out of the solution, it is claimed that they will attach themselves to a particle of graphite instead of adhering to the boiler and will settle to the bottom as a sludge instead of forming scale.

This sediment differs from the ordinary sludge in that it will not solidify or "freeze" to the metal. Owing to the fact that it does not harden, and because the presence of graphite makes it a better heat conductor, it does not cause overheating of the plates or tubes and is readily blown out. Any scale which may have formed previous to the use of graphite gradually cracks and falls, due to the contraction and expansion of the boiler, and to the action of the graphite as it works into the grease, preventing them from being closed by the formation of new scale.

Acheson boiler graphite is made by the International Acheson Graphite Company, Niagara Falls, N. Y.

First Government Standard Locomotive

(Concluded from page 216.)

Weight on truck, front	20,200 pounds
Weight on truck, back	49,100 pounds
Total weight, engine	290,800 pounds
Total weight, engine and tender (about)	463,000 pounds

CYLINDERS

Diameter	26 inches
Stroke	30 inches
Valves, type	Piston, 14 inches diameter
Maximum travel	7 inches
Steam lap	1⅛ inches
Exhaust clearance	0 inch
Lead	3/16 inch

BOILER

Type	Conical wagon-top
Diameter at front end	78 inches
Thickness of barrel sheets	11/16 and 25/32 inch
Working pressure	200 pounds
Fuel	Soft coal
Firebox, staying	Radial
Length	114⅛ inches
Width	84¼ inches
Depth, front	83½ inches
Depth, back	61 inches
Thickness of sheets, sides	⅜ inch
Back	⅜ inch
Crown	⅜ inch
Tube	½ inch
Water space, front	6 inches
Sides	5 inches
Back	5 inches
Tubes, diameter	5½ and 2¼ inches
Material	Steel
Thickness	5½ inches, No. 9 W.G. 2¼ inches, No. 11 W.G.
Number	5½ inches, 40; 2¼ inches, 216
Length	19 feet
Heating surface, firebox	259 square feet
Tubes	3,497 square feet
Firebrick tubes	27 square feet
Total	3,783 square feet
Superheating surface	882 square feet
Grate area	66.7 square feet

DRIVING WHEELS

Diameter, outside	63 inches
Diameter, center	56 inches
Journals, main	11 by 13 inches
Journals, others	11 by 13 inches

TRUCK WHEELS

Diameter, front	33 inches
Journals	6½ by 12 inches
Diameter, back	43 inches
Journals	9 inches by 14 inches

WHEEL BASE, ETC.

Driving	16 feet 9 inches
Total engine	36 feet 1 inch
Total engine and tender	71 feet 4½ inches
Length over all	81 feet 11⅝ inches
Width over all	10 feet 4 inches
Height over all	15 feet
Height, rail to center of boiler	9 feet 6 inches

TENDER

Wheels, number	8
Wheels, diameter	33 inches
Journals	6 inches by 11 inches
Tank capacity	10,000 U. S. gallons
Fuel capacity	16 tons

Boiler Makers Wanted By U. S. Navy

Enlistments of boiler makers for the regular Navy (duration of the war) are specially needed. The present war pay is $77.50 per month. In addition to your salary you are privileged to make special monthly allotments to your dependents, which is paid by the Government, and also subscribe for insurance which the Navy offers at a very low rate. Age limits 21 to 35 years.

LIEUTENANT COMMANDER NEWTON MANSFIELD,
Recruiting Inspector, Eastern Division,
225-227 West 42d St., New York, N. Y.

Apply at any recruiting station.

PERSONAL

F. H. Charbono, who for many years has represented the Independent Pneumatic Tool Company in the East, traveling out of the New York office, has just been appointed manager of the Southern district, with headquarters at No. 1721 Jefferson County Bank Building, Birmingham, Ala. Mr. Charbono succeeds Mr. George C. Wilson, who has resigned to look after his interests in the North.

R. C. Sermon, formerly foreman of the structural and plate department of the Universal Portland Cement Company, has accepted a position as general foreman boiler maker of the new boiler shop of the McDougall-Duluth shipyard, Duluth, Minn. This new shop is one of the finest and best equipped of its kind in the Northwest, having all the latest improved machinery for building Scotch marine boilers. The McDougall-Duluth shipyard has recently closed a contract to build and deliver in 1919 twenty-five ships. The boilers for these vessels will be thirteen feet and fourteen feet six inches diameter.

Copy of February, 1917, Issue of The Boiler Maker Wanted

A. L. Haas, a frequent contributor to THE BOILER MAKER, will be specially grateful to any reader of this magazine who can spare a copy of the February, 1917, issue. This may be sent to the Editor for forwarding or sent direct to 146 Crowborough Road, Tooting, London, S.W./17, England.

ANALYSES OF COALS.—At this time, when fuel engineers and manufacturers are deeply interested in the conservation of fuel in order that those industries essential to winning the war may not be handicapped, they will welcome a publication just issued by the Bureau of Mines of the Department of the Interior, giving thousands of analyses of coals from many hundred mines in the United States, for these analyses enable the users of coal to realize the amount of heat they are buying. Bulletin 123, "Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1913 to 1916," is a continuation of the sampling and analyzing of the coals of the country began by the Federal government in 1904. It is the third of the series.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, *461 Eighth avenue, New York city.*

Sloping Y Connection

Q.—We are sending inclosed a sketch of a Y connection (Fig. A) for two watertube boilers, the connection to fit on two stock plates with round ends and straight sides, as shown on top sketch. The connection fits onto the boilers at the back end and runs horizontal to a brick stack, the bottom of the connection to be straight, as shown on bottom sketch. The middle sketch is a plan looking down on the connection.

We would appreciate it very much if you would give us a simple way of laying this connection? P. B. CO.

A.—The shape of this object is such that the triangulation method of development must be employed. The first step is to draw the plan and elevation showing the relative arrangement of the two branches of the connection. Divide the circle plan view into equal parts, in this case 12. Divide each semicircle representing the curved ends of *Y* into six equal divisions. Connect those numbered 1-2-3-4-5-6 and 7 with the corresponding divisions on the circle. Connect those on the opposite end at 1′2′3′4′5′6′ and 7′ with those on the circle numbered 1′2′3′, etc. Now draw in the dotted construction lines as from 4 to 5, 5 to 6, 6 to 7, etc. Complete the elevation in a like manner.

The next step is to determine the true lengths of these construction lines, as illustrated in the diagram of triangles. The height of the triangles is the same for all of them and it is equal to the vertical distance shown between the circular and oval-shaped ends. The bases of the triangles are transferred from the plan view. The true lengths of solid lines are shown at 2-2, 3-3, 4-4, etc., and the dotted at 2-1, 3-2, etc. Where the legs of the *Y* come together as at *a b c d* and *e* it is necessary to construct, in order to develop this part, the triangles for lines 4-*c*, 5-*b*, 6-*a*, etc., as shown to the right of the elevation.

PATTERN DEVELOPMENT

Draw the line 4-4 equal in length to 4-4 of the diagram of triangles. With dividers set to the arc length between the spaces of the circle plan view and with point 4 at

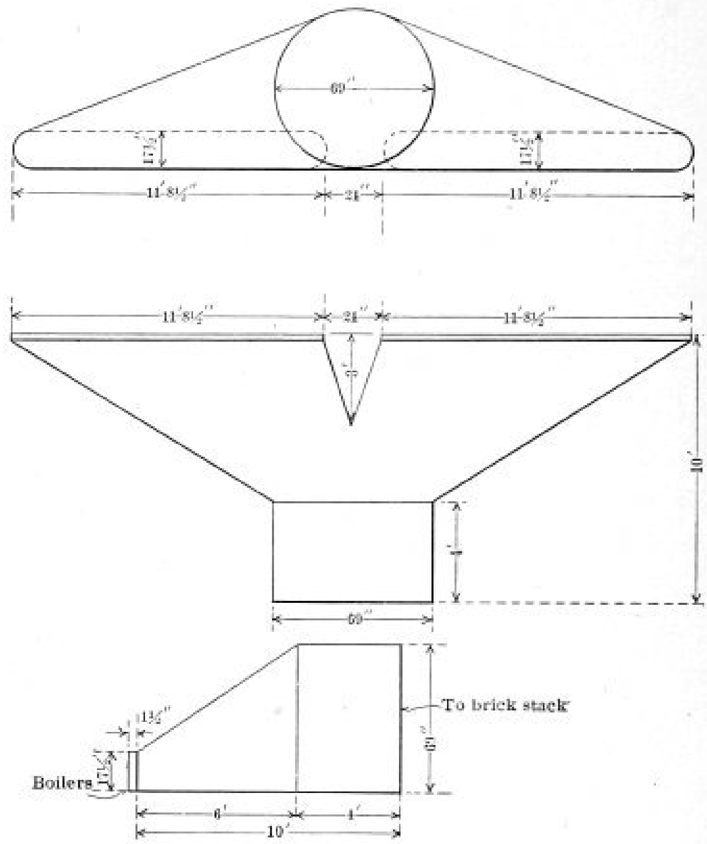


Fig. A

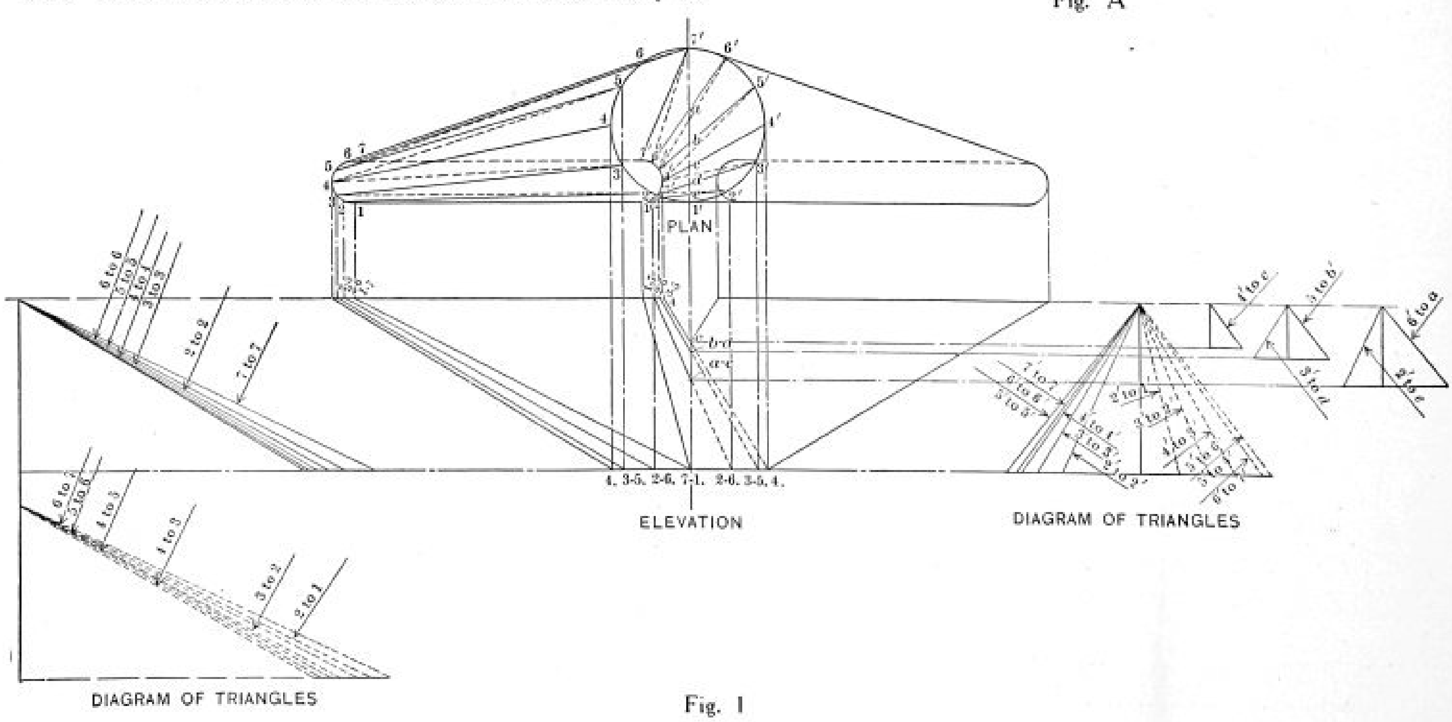


Fig. 1

the top of the pattern draw arcs. From point 4 as a center at the bottom and with trammels set respectively to distances 4-5 and 4-3 of the dotted triangles, draw arcs, thus locating points 5 and 3 at the top of the pattern.

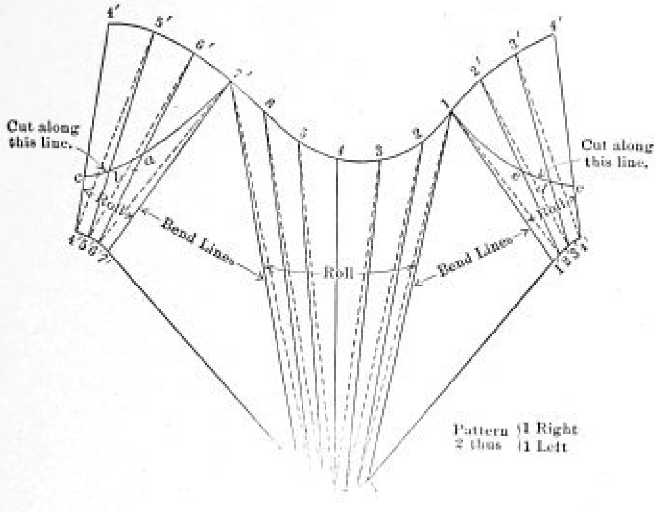


Fig. 2

With these points as centers and with trammels set to 3-3 and 5-5 of the triangles draw arcs at the bottom of the pattern. Then with point 4 at the base as a center, and with dividers set to the arc length between points of the semicircles plan view, draw arcs, thus locating points 3 and 5 at the bottom of the pattern. Continue in this way until the outline 4'-4'-4'-4' is completed. The straight lines 7'-7' and 1'-1' at the base of the pattern equal the distance between the extremities of the straight sides of the oval openings plan view. The curves 7'a-b-c and l-e-d-c represent the line of intersection for the connection between the two sections of the breeching. Make the necessary allowances for laps.

Layout of Dome Liner

Q.—Will you please send me a diagram or formula for laying out a dome liner for 113-slass engine? Is it a true circle? N. E. S.

A.—The layout of a dome liner is fully illustrated in the accompanying drawing, and it will be noted that its shape is an elliptical flat plate that must be bent to fit the curvature of the cylindrical shell to which it is riveted. The three views, plan, sectional end and side view, show a section of the shell course, dome base and dome liner in their relative positions. It is unnecessary in practice to show the dome base, and the sectional views of the other parts as indicated when laying out the pattern of the liner. But they show to advantage the development.

Draw a vertical center line and from a center on it draw an arc with a radius equal to one-half the inside diameter of the shell; then with the same point as a center draw the arc *a-g*, which is along the neutral section of the liner. Draw the circle (*a*) equal in diameter to the horizontal distance between point *a* and *g*, and divide it into a number of equal parts. Project vertical lines from the points 1-2-3, etc., of (*a*) through the plan view and where they intersect the arc *a-e*, points *b, c, d, e* and *f* are located. At right angles to the vertical center line draw the horizontal center line and upon it locate the center of circle (*b*), the diameter of which equals the greatest width of the liner; also divide this circle into the same number of divisions as in (*a*). Where the horizontal projectors from (*b*) intersect those from (*a*) fixes the points through which the elliptical outline of the line is drawn in the plan.

On the horizomal axis lay off the arc lengths between points *a-b, c-d*, etc., of the sectional end view, then draw the projection lines *b-b, c-c*, etc. The lengths of these lines are projected from the plan as shown. The opening in the liner is also developed in this way. The distance between *x-c* and *x-e* in the pattern equals the corresponding distances on arc *a-g* of the end view.

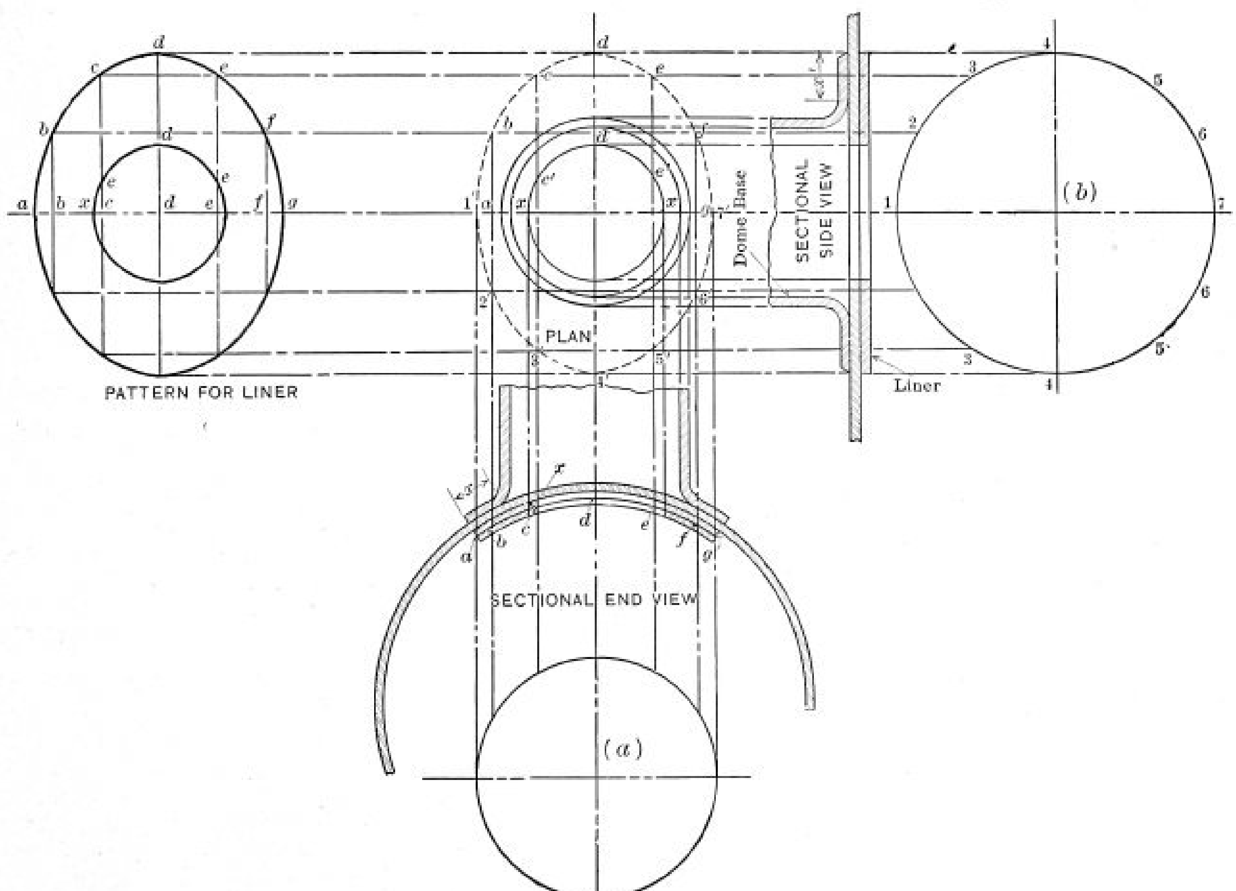


Diagram Showing Layout of Dome Liner

Letters from Practical Boiler Makers

This Department Is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

The Foreman and His Men

In the first place two definitions are needed, what is a foreman and what precisely is intimacy? To answer either is puzzling, but we will confine the matter to work and discipline alone. It was F. W. Taylor who pointed out that the functions of a foreman were so complex and exacting that a first-class foreman was altogether an exceptional man; whether he is born or made is rather beside the point. Certainly there are some men drawing large salaries who would find their work child's play in comparison with that of the average shop foreman. In his search for industrial efficiency Taylor substituted eight functional men for the one office of foreman, not altogether that he multiplied the shop executives by eight, but that he so rearranged shop duties that eight distinct functions hitherto carried out by one man were separately cared for.

In the best interests of discipline no foreman can be intimate with his men in the dictionary sense of the term. No foreman, to get the best results, can help being intimate with his men; the common interest in the work in hand forms a bond of union between them. There are men who occupy the post of shop foreman who are literally the salt of the earth, to whom the welfare of the men, the quality of the work and the interest of their employers go hand in hand. A foreman is the focal point where man and management co-join. If he be a man of sterling character, acute intelligence, proven integrity and real ability, he will command the respect of both the forces whose resultant is himself.

At least half the shops where unrest is evident and trouble is periodical have the wrong man in control. To hold the job with ease and dignity needs personality, executive ability, tact, discrimination and real grit. A man who can fill the conditons, find pleasure in his day's stint, maintain his status without cringing or patronage, be approachable and of kindly disposition, anticipate mistakes—not have simply command of lurid adjectives after the event—may not be held in affectionate regard, but he will win respect and confidence. Above all, his is rather a lonely job—he cannot, for disciplinary reasons, associate out of hours with his men. He may not discuss his own troubles from above with his men below; to do so invites undesirable advice. Like the skipper of a ship, the shop foreman has to be more or less sufficient unto himself and he must consume his own smoke.

He is less perhaps a technician than a master of craft, more akin to a general than a non-commissioned officer, for, above all, he must know, decide quickly and have a directive intelligence. It is a little curious seeing how vitally important is his post, how intensive his training, how educational in the broadest aspect of the term his position, that it should be mostly a blind-alley occpuation, and for this reason is rather shunned by those with large ambitions. To the credit of F. W. Taylor, for it was he who first showed, all contradiction notwithstanding, that a competent shop executive, proof at all points, was too good a man in any organization to remain a foreman. It was simply waste of the finest human material produced in mechanical industry.

The highest non-commissioned rank in the British army is comparable; to achieve the post of regimental sergeant-major was one of the most difficult things in the world, and to leave it behind infintely more difficult still—he was so indispensable, if the right man, that it was impossible to promote him or minimize his value. Probably no other posts existing make the same severe demands or are as difficult to fill adequately. To handle a large shop intimately aware of the precise limitations of each man, personal and as a craftsman, to so plan and route the work to keep all busy cheerfully means a sacrifice of self and power to organize denied to most, for education or technical ability is neither preparation nor substitute. To obtain results without losing dignity and with a real measure of discipline is no mean feat, for even where penalty follows swiftly upon infraction of rule there is no sense in incurring trouble if it can be avoided. No man senses the need for the hand of steel in the velvet glove more exactly, and few are able to put this counsel into practice in a more telling fashion than the real man as a shop executive.

The writer has come into contact with scores of capable men in the capacity indicated, counts several his personal friends and has discussed the matter in all its bearings with managers, employers and men as well as with the subject of this article. He entertains a warm regard and wholesome respect for the majority he meets in the course of his duties. When as a stranger in a strange shop comsioned to see the progress of work, even when of some magnitude, it is always safe to consult the shop foreman. His word may not be final, but, in the experience of the writer, *he knows*.

The position carries peculiar responsibilities, few privileges, and never a large salary. Its one sterling advantage is the type of man it makes, and the question is left to the consideration of employers generally whether they would not be even better served if the job were differently assessed.

INSPECTOR.

Vise Helps

Occasionally there is a class of small work in the boiler shop that is done at the bench by the aid of the vise. The

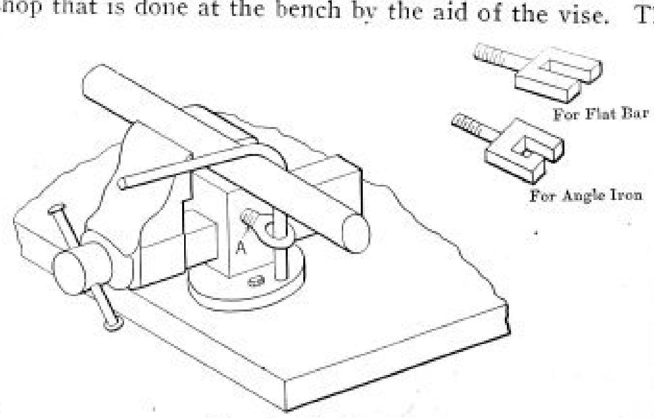


Fig. 1.—Bending Stock

kinks or helps shown in the sketches may be useful to some of the readers. It is with that idea that I am passing them along.

Fig. 1 is a very simple, yet none the less useful, idea for bending different kinds of stock. A suitable hole is drilled and tapped into the side of the vise below the back jaw, as shown at *A*. The different fixtures shown are screwed in this hole and used as illustrated for holding the

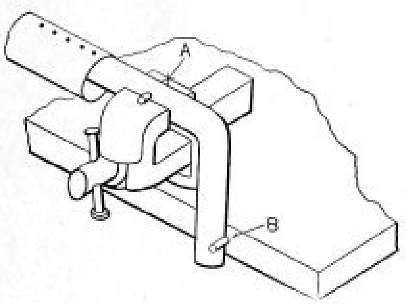


Fig. 2.—Riveting Stake

stock while it is bent over a stake held in the jaws of the vise.

Fig. 2 hardly needs describing. The pins shown at *A* and *B* do the whole trick of securely holding the stake

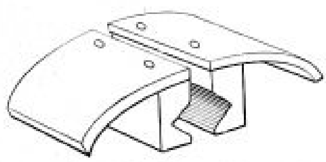


Fig. 3.—Pipe Jaws

against movement in the vise jaws from the downward riveting blows.

Fig. 3 are boiler tube jaws made from steel *V* blocks, a tab or ear being riveted on each, and bent to fit the vise jaws.

Fig. 4 shows a quite simple idea for supporting long work, such as boiler tubes, etc. It is made from a long

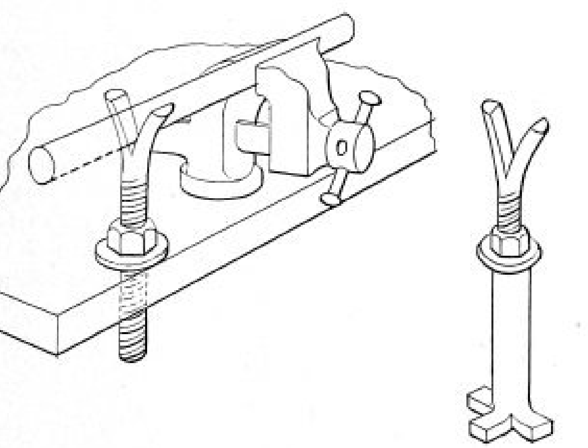


Fig. 4

bolt by cutting off the head and splitting in half the body of the bolt for 3 or 4 inches, bending each off center to make the *V*. When the vise has a swivel base, a hole bored in the bench will come in handy for it, as shown, but for ordinary work the stand shown at *A* is used, it being made of an old boiler tube, the one end of which has four ears cut and bent for feet.

Concord, N. H. CHAS. H. WILLEY.

PERSONAL.—R. F. Moznetts, formerly foreman boiler maker of the Spokane, Portland & Seattle Railway, Vancouver, Wash., has accepted a position as layerout in the new steel shipyard of the G. M. Standifer Construction Company.

Rivet Information

The following data have been compiled from trade and other sources and will serve the double purpose of comparison and reference. All good boiler specifications give the requirements of the rivet material and also the tests which the finished rivets have to stand. As careful supervision at every stage of manufacture of the boilers is common to the authorities quoted, and, as all material is tested, the specifications are rigidly adhered to and are met without any difficulty.

The tests on the finished rivets themselves are such as any good commercial samples at random should give, and a boiler maker can ensure the quality of his supply by making the tests from any delivery. Special attention is directed to the advice as to rivet heating, which has a considerable bearing on the soundness of finished work and the necessity for a difference between hand and machine work in this particular. It is one more link in the chain of reasons why some riveted work is not tight under pressure tests, and adds to the importance of every detail in the limited series of operations whereby good work is assured.

The number of processes needed to make a riveted seam are not numerous, but sound work can only be obtained if there exists particular exactitude in each and all of them. In very few quarters elsewhere does so much depend upon the individual workman, and save in one instance only—that of fusion welding—can a sightly exterior be presented which covers up from view in too many cases unreliable work. Unsound and leaky seams can be produced in pressure work by the neglect of any single factor in the process.

Heating Rivets

From one of the best manufacturers of boiler rivets in the United Kingdom the following notes are taken.

Iron Rivets

For hand or machine riveting, rivets should be heated

TESTS OF MS RIVET BAR MATERIAL

Authority	Tensile	Elongation
British Standard	*Bridges, constructional* work and marine *boilers*, 26 to 30 tons per square inch	25 percent on 8 diameters of test pieces.
	Shipbuilding work 25 to 30 tons per square inch	25 percent on 8 diameters of test pieces.
British Lloyds	Same as above	25 percent on 8 inches.
Board of Trade	*Marine Boilers*, 26 to 30 tons per square inch	25 percent on 10 ins.
British Corporation	Same as Lloyds	Same as Lloyds.
German Lloyds	*Shipbuilding* and *Boilermaking*, 34 to 45 kilos per square m/m = 22.2 to 28.75 tons per square inch.	28 percent on 200 m/m = 28 percent on 7.87 inches.
Bureau Veritas	*Boilermaking* 24 to 27 tons per square inch	25 percent on 8 inches.
Indian State Railways *India Office* Crown Agents for the Colonies	*Structural and Shipbuilding*, 26 to 30 tons per square inch. *Boiler making*, 24 to 27 tons per square inch	25 percent on 10 inches.

Authority	Description of Test
British Standard	Rivet to bend double cold without fracture. Rivet to be heated to riveting temperature, and the head flattened, so that it measures in diameter equal 2.5 that of shank without cracking at edges.
British Lloyds	As above with following additions. Rivet to be heated to red heat and bend double without fracture. Rivet to be nicked and bent over to show quality of material without breaking off short.
Board of Trade	Same as British Lloyds with following additions: Rivets to be machined to a suitable diameter and under test give the following results: *Tensile*, 27 to 32 tons per square inch; *elongation*, not specified but usual results are 35 to 40 percent on 2.5 diameters of turned shank as tested. Contraction of area unspecified, usual results 55 to 60 percent at fracture.
British Corporation	Same as Lloyds.
German Lloyds	Part of rivet shank equal to two diameters, cut off and staved cold to .6 of original length without crack or fracture. Similar test piece staved at red heat to .25 original length and then punched through the center without fracture.
Bureau Veritas	Same as British Standard with the following additions: Part of rivet equal to two diameters to be compressed cold to one diameter in length. Similar test piece to be compressed when at red heat to .5 diameter long and then punched through center without fracture.
India State Rys *India Office* *Crown Agents for the Colonies*	Same as British Lloyds

in a clean fire. The fire should have a good body of red hot fuel, if of the ordinary foot or hand-bellows type, and the rivets should be buried in the fuel and heated equally all over. If a furnace is used for heating, the rivets should not be put into the furnace until the temperature of the heating chamber is at a white heat.

The correct temperature for iron rivets is 2,200 degrees F. (a white heat), and the rivet should be riveted up before the heat is reduced to 1,000 degrees F. (dull red heat). Care should be taken not to overheat or burn the rivets, as this causes them to break in riveting or with subsequent vibration.

STEEL RIVETS

For machine riveting, the most suitable temperature is 1,500 degrees F. (bright red heat). If a lower heat is used, the rivet shank may bend in the hole instead of staving and properly filling it up. Rivets staved up at this heat with a suitable machine very rarely require calking.

For hand riveting the most suitable temperature is 2,200 degrees F. (a white heat), and the rivet should be riveted up before the heat is reduced to 700 degrees F. (faint red heat).

Planishing (if required) should not be commenced until the temperature of the rivet has fallen to about 300 degrees F., as between these two points, 300 degrees F., and 700 degrees F., the molecular structure of the steel is undergoing such change that there is great danger of rupturing the rivet if it is hammered at this time. The planishing should not be more than is absolutely necessary to finish the head, as too much cold hammering tends to make the steel brittle.

The numbers above may vary ± 2½ percent. For flat countersunk heads, measured overall, add 30 percent to numbers given. For raised countersunk heads, measured from edge of head to point, add 30 percent to numbers given.

London, Eng. A. L. HAAS.

NUMBER OF RIVETS IN 1 CWT. (112 POUNDS). PAN HEADS OR SNAP HEADS WITH PARALLEL SHANKS (BUTTON)

LENGTH MEASURED UNDER HEAD

Diameter	¾	⅞	1	1⅛	1¼	1½	1¾	2
⅜	2,450	2,300	2,100	2,000	1,850	1,630	....	....
½	1,265	1,150	1,100	1,050	970	870	820	730
⅝	730	690	670	640	600	540	495	450
¾	....	....	425	410	385	340	315	290
⅞	....	....	....	290	275	250	225	205
1	....	....	....	....	....	172	160	150

LENGTH MEASURED UNDER HEAD

Diameter	2¼	2½	2¾	3	3¼	3½	3¾	4
½	650	590	555	525	....	....	....	....
⅝	410	380	342	325	308	294	....	....
¾	270	250	235	220	208	200	190	180
⅞	190	175	162	150	140	134	127	120
1	140	130	118	114	110	105	98	94

LENGTH MEASURED UNDER HEAD

Diameter	4¼	4½	4¾	5	5¼	5½	5¾	6
¾	170	160	150	145	140	135	130	124
⅞	117	114	111	108	104	100	95	90
1	90	86	82	79	76	73	70	63

Proportions and Shapes of Rivet Heads

As the writer is well aware, standardized or codified proposals in the manufacturing field are beset with many drawbacks and those responsible for their formulation find many unexpected hindrances.

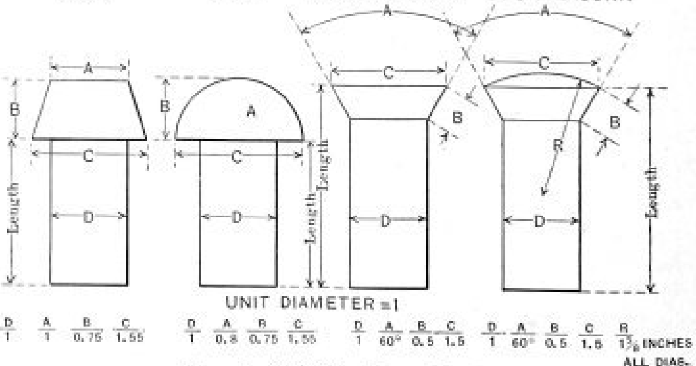
In every completed set of standard designs there are inevitably some things included which, from an ideal or strictly rational viewpoint, were best omitted. Such recommendations are more the mean of existing practice than deduction from first principles. Indeed a rational basis is scarcely the end sought, as to adopt this would defeat the end in view because of trade hostility. Like legal practice or new legislation, standardization cannot proceed much in front of public or trade opinion, as the case may be.

The manufacturer and user must acquiesce or exceptions will defeat the proposals, or, like a minority legal enactment, it will be honored in the breach only.

What standards committees try to do is to crystallize existing practice and drop the unusual and exceptional; abolish extreme cases and win the acceptance of an entire trade, who are then willing to limit their wants to the existing choice.

In looking through the revision of the A. S. M. E. code, the rivet heads illustrated caught my attention; and that these eight shapes are general in the United States appears to be proved by manufacturers' advertisements.

In criticism (which, by the way, appears to be officially invited), there seems little reason for the retention of eight distinct shapes which omit two very familiar types.



Standard British Rivet Heads

The pan head with a taper neck is fairly common, while the countersink with a raised head is quite usual here.

The steeple head and also the double radius button head are obsolete survivals from the days of hand riveting; neither as illustrated can be "held up" without deformation, and the manufacturer's advertisement shows a flat on the top of the steeple, making it approximate to the cone head.

The heads illustrated herewith are standard British rivet heads and the proportions given are approved by Board of Trade, Lloyds, Bureau Veritas, Hamburg B. P. and British Standards Association, among others. Unless otherwise specified (and increased cost paid for variation), if lengths and head are ordered, the heads shown to the proportions given are invariably supplied.

The raised countersink has some sterling advantages where it can be applied, as it provides a certainty of good holding up even at a slight angle of the dolly bar. It is only ruled out where both sides of the plates must be flush, and such instances are few.

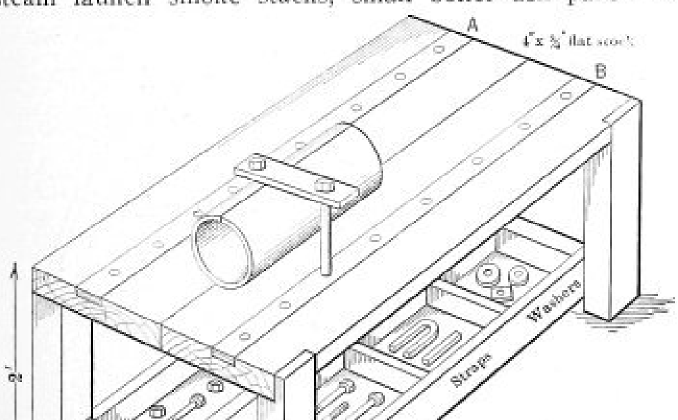
In British boiler practice, because of universal hydraulic closure snap rivets being the rule, at least 90 percent of all rivet heads are snap (button). Pan head rivets are also closed snap at the reverse end.

The proportions as given in the illustration differ slightly from the A. S. M. E. code, and it is the considered opinion of the writer that the heads illustrated as acceptable to the code can be lessened in number with advantage to pan, button and countersink. The divergence between the cone and the pan, as also between straight base button and button, does not seem warranted. Double radius button and steeple might, with advantage, be omitted, and there seems also no need for the flat head in boiler making.

Old Scotch.

Handy Work Bench

This is a somewhat different type of work bench from that found in the average shop, and was the idea of the master boiler maker of one of our Navy Yard shops. A large amount of small work, such as long air cylinders, steam launch smoke stacks, small boiler ash pans and



Rigid, Low Height Bench Devised by Navy Yard Boiler Maker

numerous boiler accessories, which have to be held fast while chipping, filing, drilling, etc., are strapped to this rigid low height bench.

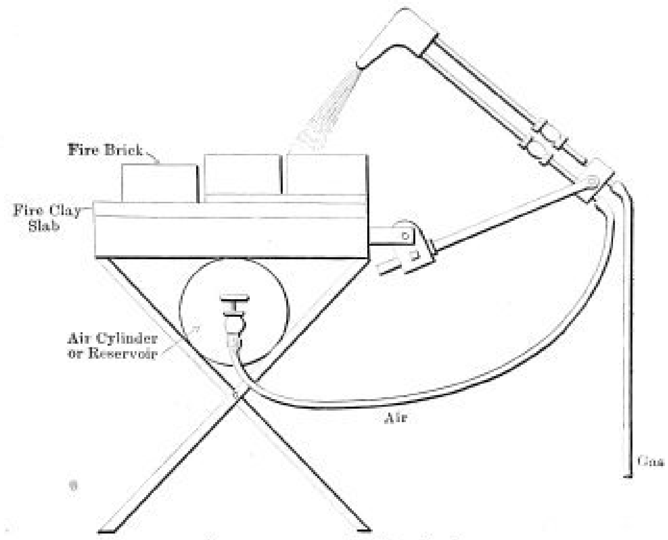
Two lengths of 4 inches by ¾-inch flat bar stock are set in and secured flush with the top of the bench, and series of holes are drilled in them to permit bolts to be used as indicated in the sketch. The base of the bench is divided into a number of compartments that provide a means of keeping the various bolts, straps, nuts, and washers for use on the bench.

Three of these benches were in use at the time of my visit, and they were all busy—a good testimonial as to their worth.

Navy Boiler Maker.

Handy Torch Forge

The sketch shows a handy gas torch forge that recently came to my notice in a small shop. The table formed a



Arrangement of Torch Forge

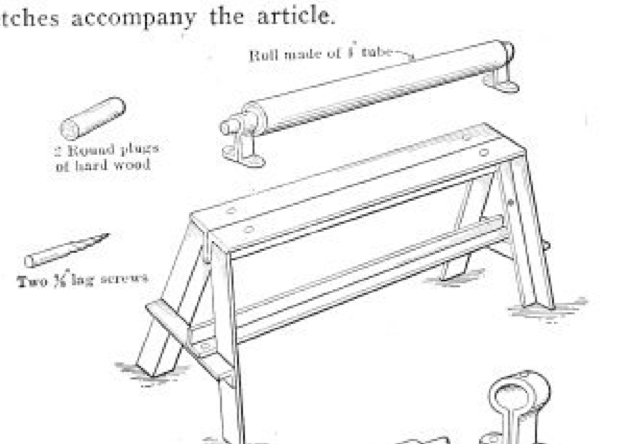
support for the air reservoir. This air tank close to the point of delivery to the torch gave a uniform flow of air, thus eliminating the disagreeable pulsations so often found in the shop air line. The top of the table was of boiler plate covered two inches thick with temperature fire brick. Common standard fire brick was used as side walls.

The burner was held in a universal bracket, thus permitting the torch flame to be directed at any desired angle. The whole contrivance was home-made and seemed very worthy of passing the idea along to readers of The Boiler Maker.

Heater.

Unique Shop Horse

This rugged horse, built of an angle iron, and having the advantage of being used for a common work horse or as a plate roller stand, came to my notice during a visit to a boiler shop in East Boston, Mass. I took the time to sketch it down in my note book in detail; the sketches accompany the article.



Combination Angle Iron Work Horse and Plate Roller Support

The unique feature of the roller used is worthy of description. An old 4-inch tube is used. The tube is cut to length and the ends squared off. Then each end was plugged up tight with two pieces of hard wood (turned plugs). When these were in place, they were secured with screws through holes drilled in the outside of the tube. Then in the center of the plug two ½-inch holes were bored.

Next two lag screws ⅞-inch in diameter were screwed in until there was but 2 inches of the body of the screw left; then the heads of these lag bolts were cut off. This gave a light weight durable roller. By keeping the bearings well supplied with grease, very little wear was noticed on these iron lag bolt journals after one year's use.

By a little close study of the sketches one can easily see how to construct this useful shop horse.

OBSERVER.

Temporary Chain Repairs

Perhaps these kinks on how to make quick temporary repairs to a chain may not be new to some of the readers of THE BOILER MAKER, yet the writer, not having seen them in print, is tempted to send them in.

When out on an erecting job setting up boilers, or a stack, there are times when a chain parts, or it is desired to connect two pieces together.

If you will make up a few sizes of cold shuts, such as shown in Fig. 1, and carry them along in your rigging chest, you will be able quickly to join two parts of any chain.

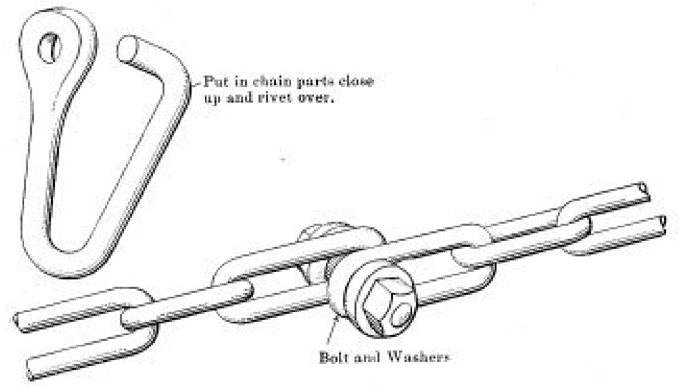


Fig. 1 Fig. 2

When you have nothing at hand but a bolt, nut, and washer, you can make the repair shown in Fig. 2. The bolt should be larger than the stock used in the chain link; and then when you put a strain on this sort of repair, remember it's not as strong as the original chain. To make it stronger, take four links of each part of the chain; lay parallel and bolt together with two bolts.

RIGGER.

Base Piece for a Smoke Stack

To lay out this object by triangulation, proceed as follows: First lay down the plan, Fig. 1, *A-B-C-D*. In this case it will not be necessary to lay down the whole plan, one-quarter is sufficient. Draw the circles and divide them into equal spaces, as shown. Fig. 2 shows the elevation, which isn't needed, however, for this layout. Fig. 3 shows the development of triangles. Now lay down lines *F-E-G* at right angles.

To lay out the pattern, lay down the lines 1-1 and *E-F* (Fig. 4) at right angles, measure the height *F-E*, Fig. 3, then set the trams at *F-G*, Fig. 1; place it on *F-G*, Fig. 3, then take the distance *E-G*, Fig. 3, and place it on *F-E*, Fig. 1, which gives the proper height.

Having found the proper height proceed as follows: Have two pairs of dividers, one for the large spacings and one for the small spacings, Fig. 1. Now set the trams 1-1, Fig. 1, place it on *F*-1, Fig. 3, then take the slant height *E*-1, Fig. 3, and place it on 1-1, Fig. 4. Now take your dividers for the large spacings at point 1, Fig. 4, and draw an arc at point 2. Do the same at the small end. Take your trams from 1-2, Fig. 1, and place the distance on *F*-2, Fig. 3, and proceed in the same manner as you did for points 1-1. Then take 2-2, 2-3, 3-3, 3-4, 4-4, 4-5,

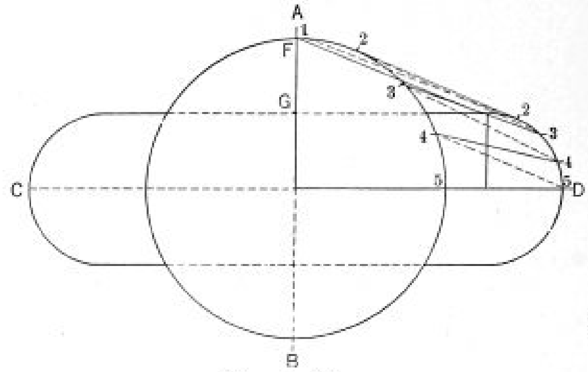


Fig. 1.—Plan

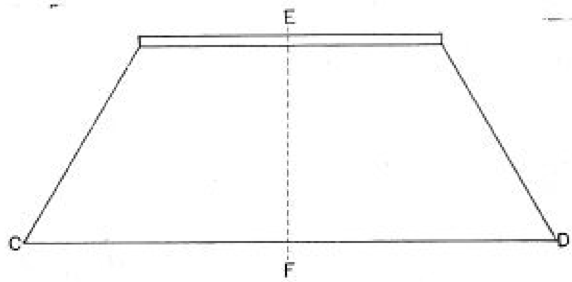


Fig. 2.—Elevation

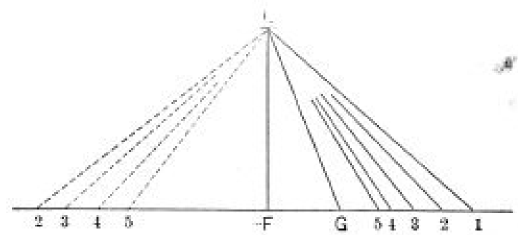


Fig. 3.—Development of Triangles

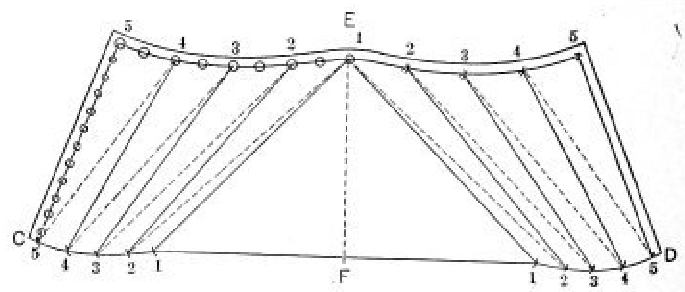


Fig. 4.—Half of Pattern

5-5, just as they are shown, and half of the pattern is complete.

It is good practice to check up the circumference. If the dividers are set at the proper distance all measurements will come out correctly.

CHARLES MILLER.

INDEPENDENT PNEUMATIC TOOL COMPANY LEASES NEW QUARTERS.—The Independent Pneumatic Tool Company have leased the entire sixth floor in the Otis Building at 600 W. Jackson Boulevard, Chicago, Ill. This space contains 12,000 square feet and will be occupied by the company as general offices about September 1. John D. Hurley, president of the company, states that the great demand for pneumatic tools for government work and shipbuilding has forced the company to seek larger quarters.

Selected Boiler Patents

Compiled by

GEORGE A. HUTCHINSON, ESQ., Patent Attorney,

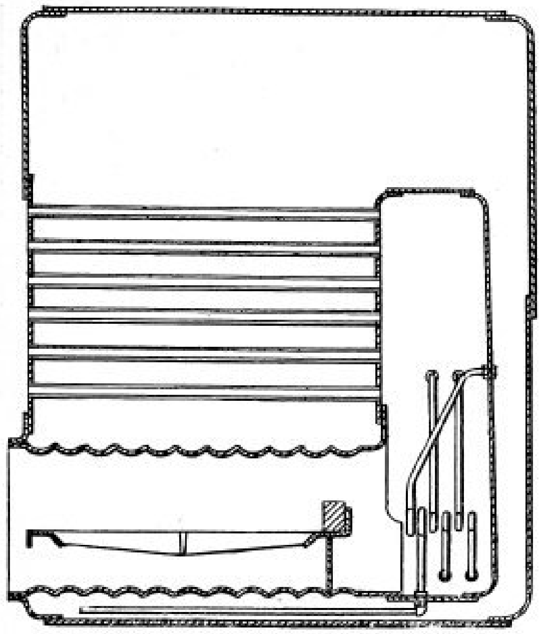
Washington Loan and Trust Building,

Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchinson.

1,260,679. BOILER. ALFRED E. JORDAN, OF BROOKLYN, N. Y.

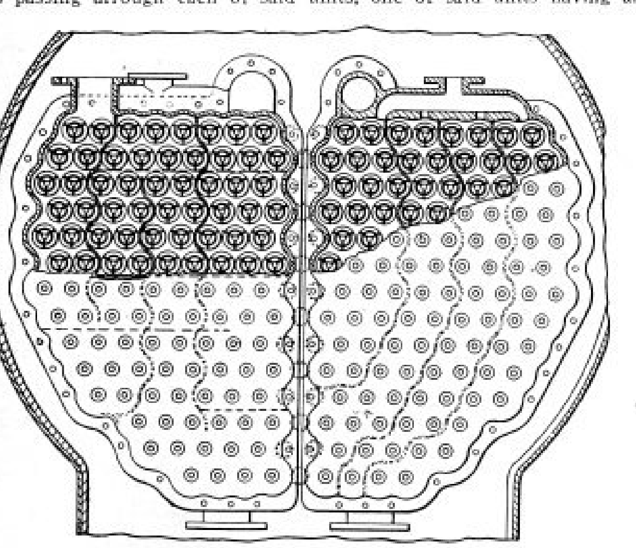
Claim 2.—In a boiler the combination of a shell, a front plate and a rear plate for the shell, a plurality of furnace flues extending from the front plate into the boiler, a combustion chamber extending to the rear of each furnace flue, transverse watertubes secured in each combustion chamber having their ends opening into the water space of the boiler with their longitudinal axes intersecting a line coincident with



the longitudinal axis of its furnace, the upper ends of some of said transverse tubes secured to one of the side plates of the combustion chamber and their lower ends secured to the bottom of the combustion chamber, and other similar transverse tubes having their upper ends secured to the opposite side plate of the combustion chamber with their lower ends secured to the bottom of the combustion chamber. Two claims.

1,262,428. STEAM SUPERHEATER. ROBERT ALLEN, OF CAVERSHAM, ENGLAND.

Claim 1.—A superheater comprising a casing divided into units, tubes passing through each of said units, one of said units having an



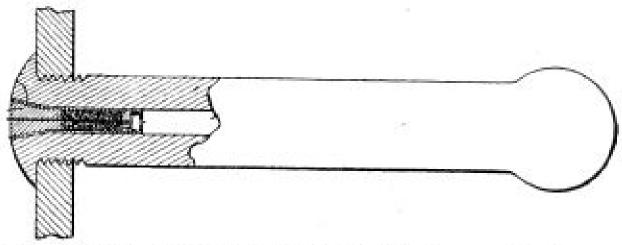
extended side which makes joint with its co-operating unit forming a steam-tight chamber between them through which said tubes also pass, said tubes having apertures in the portions thereof which pass through said steam-tight chamber, and means for admitting steam to said space. Three claims.

1,268,679. BOILER. WILLIAM H. CAHALL, OF RACINE, WIS.

Claim 1.—In a boiler construction, a steam drum having an open end, a header having an inner and an outer header plate, and common means for securing said inner header plate to the open end of the steam drum and for bracing the outer header plate. Seven claims.

1,268,827. STAYBOLT STRUCTURE. JOHN ROGERS FLANNERY, BENJAMIN E. D. STAFFORD, AND ETHAN I. DODDS, OF PITTSBURGH, PA., ASSIGNORS TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PA.

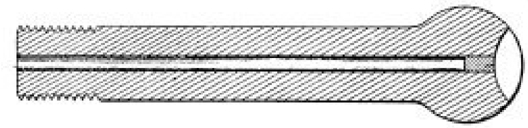
Claim 1.—The combination with a staybolt having a tell-tale bore, and closure for said bore, of a piston in said bore constructed to permit the



passage of fluid, soluble material located between said piston and closure, and manually operable means connected with said piston. Three claims.

1,268,951. MANUFACTURE OF STAYBOLTS FOR BOILERS. JOHN ROGERS FLANNERY AND ETHAN I. DODDS, OF PITTSBURGH, PA., ASSIGNORS TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PA.

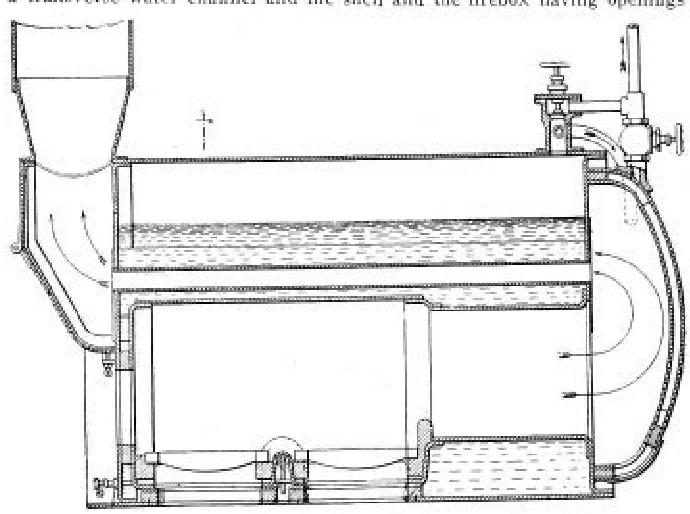
Claim 1.—A staybolt, consisting in forging a head at one end of a tubular bar, boring the headed bar to reopen the portion of the bore



closed by the forging operation, and then permanently closing the end of the bore at the headed end of the bolt. Three claims.

1,270,195. BOILER. ROBERTO FRITZ EMIL OKRASSA, OF ANTIGUA, GUATAMALA.

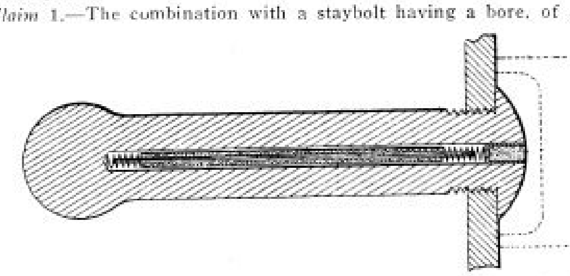
Claim 1.—A boiler, comprising a shell, tubular firebox, open annular frames, one behind the other and connecting the bottom of the firebox with the bottom of the said shell, the frames being spaced apart to form a transverse water channel and the shell and the firebox having openings



in register with the openings in the said frames, and a hollow transversely extending reinforcing and grate-supporting member arranged above the space between the adjacent frames and having flanges attached to the opposite end members of said frames. Five claims.

1,268,826. STAYBOLT STRUCTURE FOR BOILERS. JOHN ROGERS FLANNERY AND ETHAN I. DODDS, OF PITTSBURGH, PA., ASSIGNORS TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PA.

Claim 1.—The combination with a staybolt having a bore, of a device



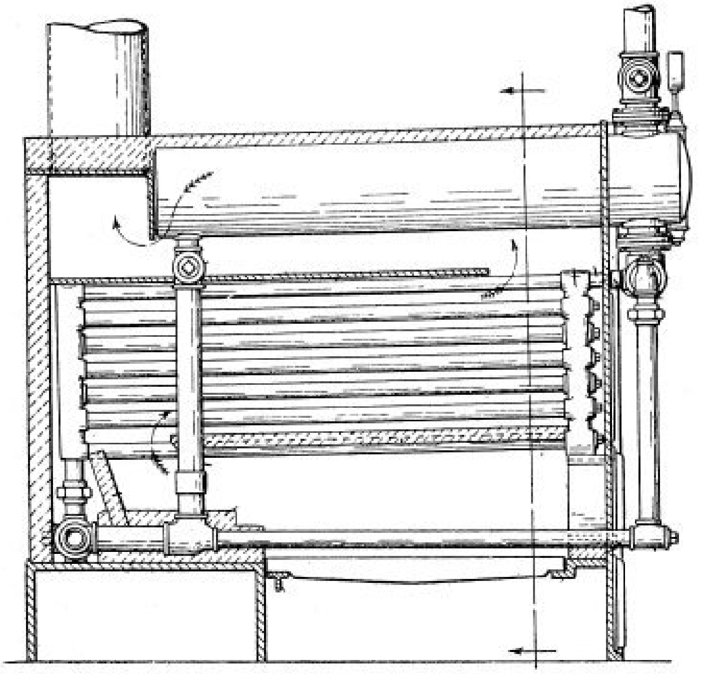
confined and movable in said bore to provide an audible signal within the latter. Six claims.

1,268,828. STAYBOLT STRUCTURE. JOHN ROGERS FLANNERY, ETHAN I. DODDS, AND FREDERICK K. LANDGRAF, OF PITTSBURGH, PA., ASSIGNORS TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PA.

Claim 1.—The combination with a staybolt having a tell-tale bore, of an expansible container packed with soluble material, contained within said bore, and means to permit the application of turning force to said container. Two claims.

1,269,849. WATERTUBE BOILER. CHARLES H. PARMELEE, OF SEATTLE, WASH.

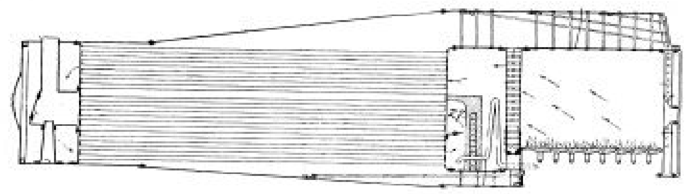
Claim 1.—In a watertube boiler, the combination of a plurality of upper longitudinal steam drums, a plurality of transverse horizontal headers detachably joined end to end, each connected to and arranged below one of the drums at the forward end thereof, rear and front substantially vertical headers arranged below said drums, a plurality of



substantially horizontal watertubes connecting said vertical headers, pipe connections between the front vertical headers and the transverse horizontal headers, and pipe connections extending from the rear ends of said steam drums and from the transverse horizontal headers to the rear vertical headers. Five claims.

1,270,017. STEAM BOILER AND APPLIANCES. CHARLES W. CROWELL, OF SALISBURY, N. C.

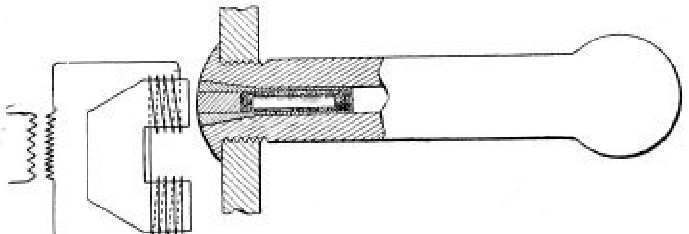
Claim 1.—A steam boiler having a firebox, a fire chamber and a smoke box arranged in advance of each other, all being substantially circular in cross section, a group of flues extending from said firebox to said fire chamber, and a second group of flues extending from said fire chamber



to said smoke box forming a forward passage, a third group of flues forming a rearward passage from said smoke box to a combustios chamber within said fire chamber, and a fourth group of flues forming a forward passage to an inclosed member in said smoke box, having an outlet thence through a stack. Seven claims.

1,268,953. STAYBOLT STRUCTURE. JOHN ROGERS FLANNERY AND ETHAN I. DODDS, OF PITTSBURGH, PA., ASSIGNORS TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PA.

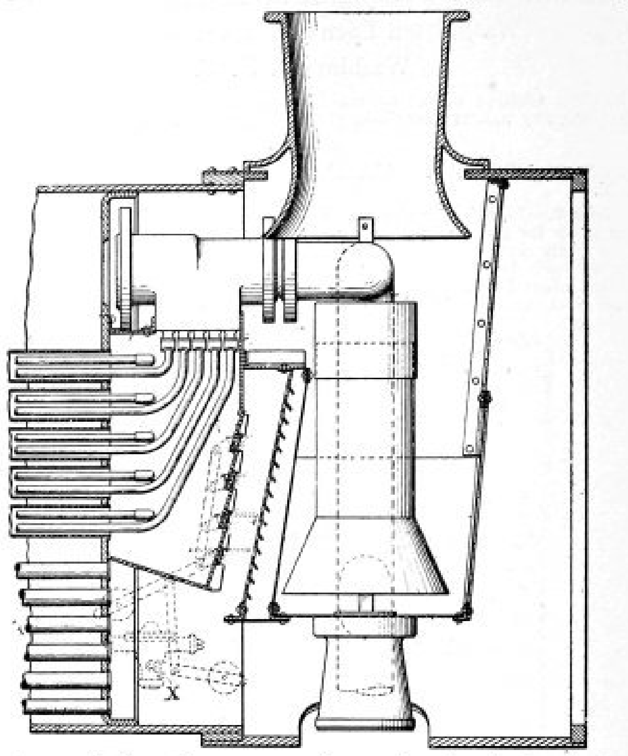
Claim 1.—The combination with a staybolt having a tell-tale bore, of soluble material in said bore, and an iron piece normally held fixed by



said soluble material and adapted when said material shall have been dissolved by the entrance of moisture into the tell-tale hole, to be moved by the application of an electro-magnet having its coil included in an alternating current source of electrical supply to provide an audible signal denoting a ruptured condition of the bolt. Three claims.

1,269,322. LOCOMOTIVE. IRWIN A. SEIDERS, OF READING, PA., ASSIGNOR OF ONE-HALF TO HIMSELF AND ONE-HALF TO AGNEW T. DICE, JR., OF READING, PA.

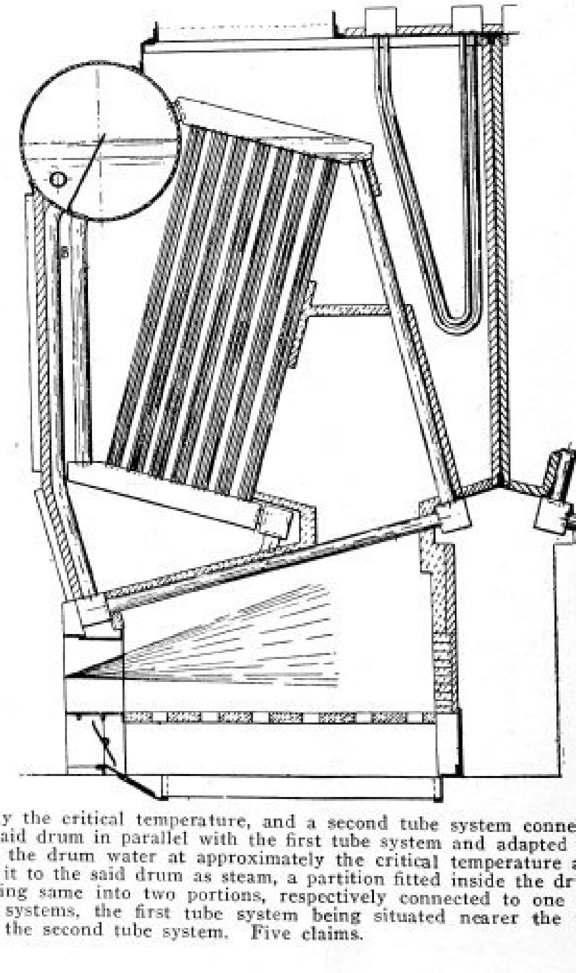
Claim 1.—In a locomotive, the combination with the boiler shell, the tube sheet dividing the steam and water space of the locomotive from the smoke box, the smoke stack outlet, the firetubes connected to said tube sheet, the exhaust nozzle located in the lower portion of the smoke box, the superheater pipes located in some of said tubes, and the chambered superheater header, a spark breaker plate and damper mechanism adapted when open to permit the direct passage from said mechanism into contact with the said spark breaker plate of products of combustion issuing from the firetubes containing superheater pipes and to divert



away from said plate the gaseous products of combustion issuisg from the firetubes not containing superheater pipes, and adapted when closed to permit the products issuing from the firetubes not containing superheater pipes to pass into direct contact with said spark breaker plate while preventing the passage of gaseous products of combustion through the firetubes containing superheater pipes. Two claims.

1,268,549. STEAM BOILER. EMILIO DE STRENS, OF GAZZADA, ITALY.

Claim 1.—In a steam generating system, the combination of a furnace, a main steam and water drum, a tube system adapted to take water from the said drum and return it to the said drum at approxi-



mately the critical temperature, and a second tube system connected to the said drum in parallel with the first tube system and adapted to take from the drum water at approximately the critical temperature and deliver it to the said drum as steam, a partition fitted inside the drum and dividing same into two portions, respectively connected to one of said tube systems, the first tube system being situated nearer the furnace than the second tube system. Five claims.

The Boiler Maker

SEPTEMBER, 1918

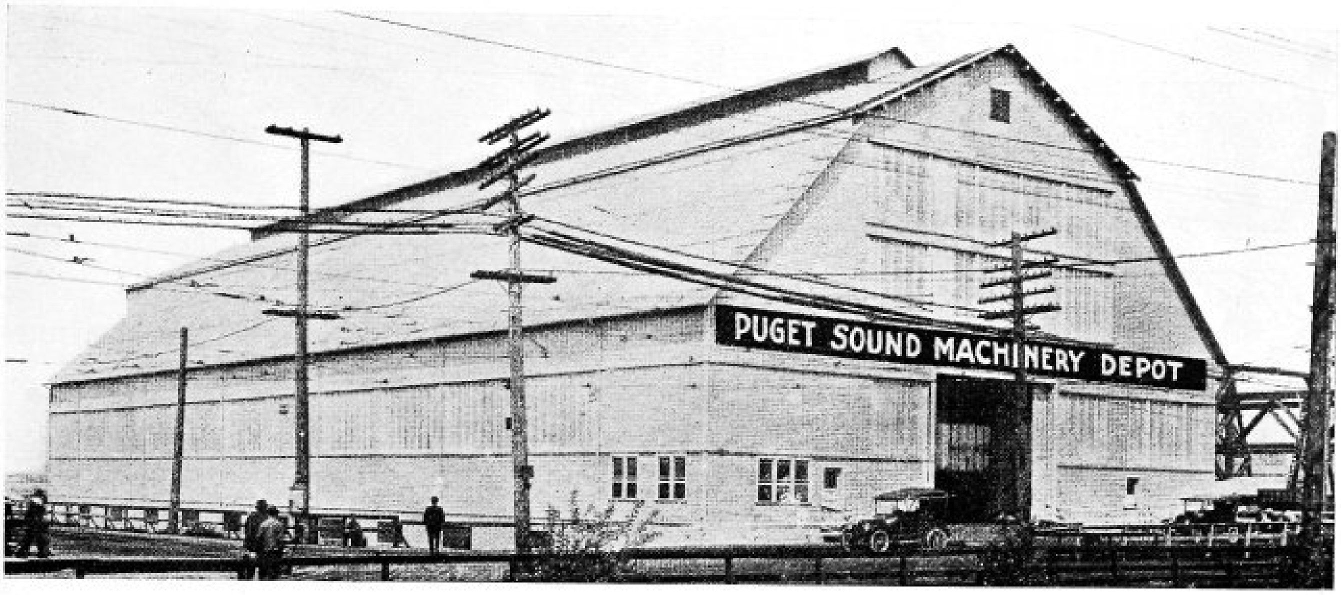


Fig. 1.—New Shop for Building Marine Boilers Erected in the Northwest

Marine Boiler Shop Erected on Puget Sound

Scotch and Marine Type Watertube Boilers Built at New Shop of Puget Sound Machinery Depot

The Puget Sound Machinery Depot recently erected a fine large boiler shop where a great amount of marine work is already being turned out. This shop is 240 feet long and 160 feet wide, being divided into three main bays by the arrangement of overhead handling equipment. Great care has been exercised in selecting the machinery for this shop, and among the larger acquisitions are a set of plate tools accommodating work fifteen feet wide, two hydraulic bull riveters, one of the largest hydraulic flanging presses on the Pacific Coast, several six-foot radial

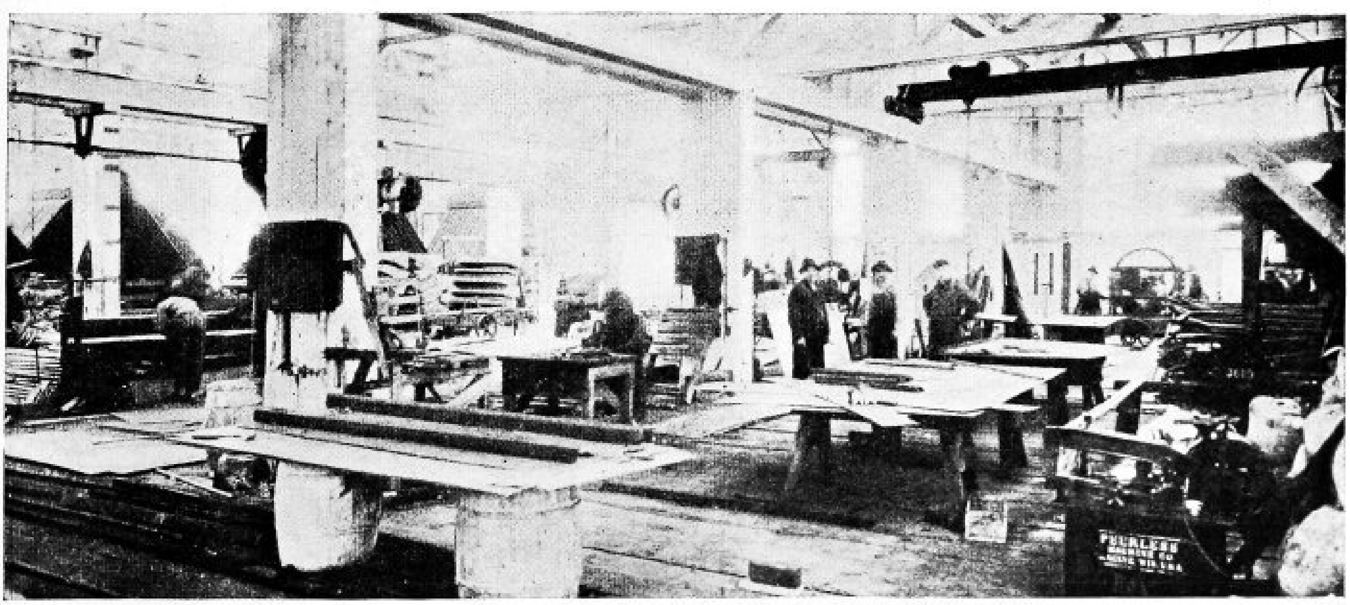


Fig. 2.—Light Sheet Metal Department, Where Boiler Casings Are Made

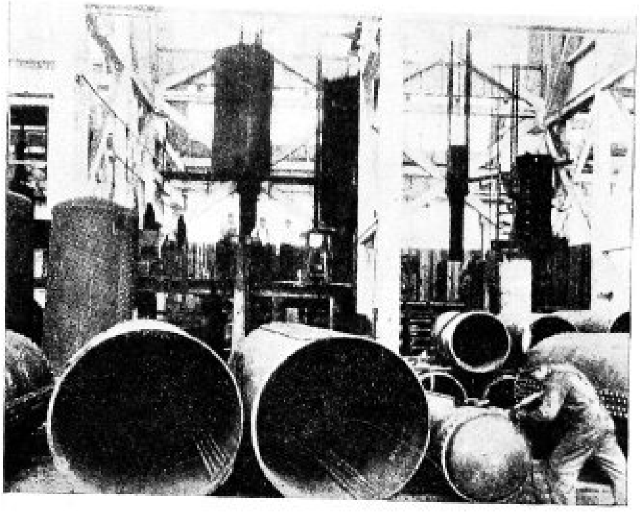


Fig. 3.—Hydraulic Riveters

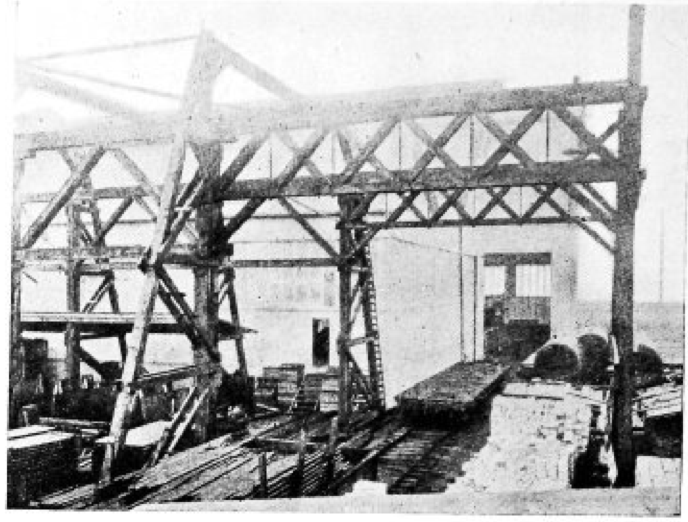


Fig. 5.—Storage Yard

drills, punches, shears, etc., as well as the smaller tools and equipment required in the manufacture of watertube boilers.

There are eight electric traveling overhead cranes serving the boiler shop, the largest crane in the main bay of the building having a fifty-foot span, traveling the full length of the structure, and having a capacity of 30 tons, with a clearance under the hook of forty feet. The other cranes are located in the main and side bays. Cars are run in at the rear of the shop, and handling both to and from them is accomplished direct by the shop cranes.

The storage yard in the rear of the shop is served by an overhead crane running on a wood craneway, by means of which the plates and other materials are transferred from the railroad cars.

The facilities have been provided for a heavy output of both Scotch marine and watertube boilers, and the demand is such that the firm has been employing three shifts per day in order to keep up with orders.

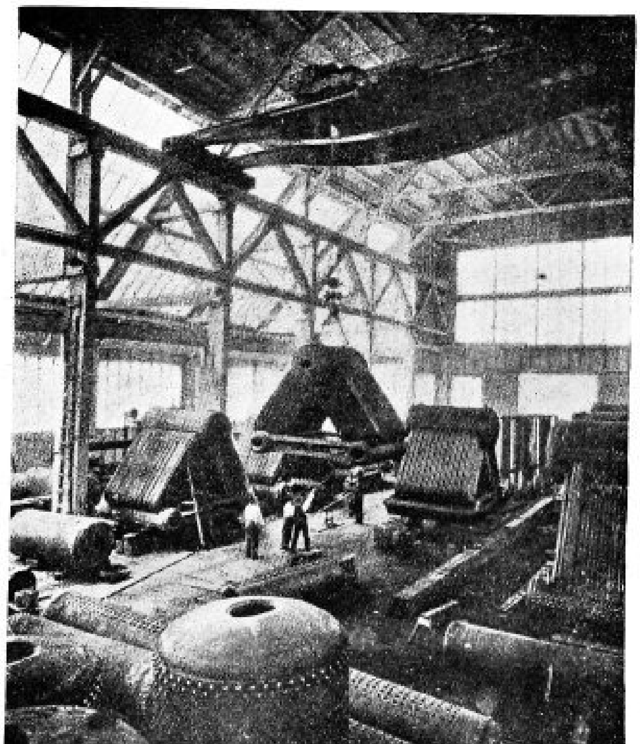


Fig. 4.—Erecting Floor

Rules and Rule-of-Thumb Methods

BY JAMES LESLIE LANE

"Putting a triple riveted butt joint on a measly little boiler like that is all nonsense," declared the old superintendent to the engineer, hotly. "A lap joint, double riveted, is plenty good enough. You can't tell me it isn't, for I've built enough of them to know!"

The engineer smiled, and, turning to the shelf back of his desk, took down a paper-covered volume. "Maybe so, Henry," he agreed mildly, "but here are the rules. Like them or not, they've got to be complied with."

He didn't argue. He knew the superintendent well enough for that. It was the old question, one that always came up whenever such a piece of work was to be done; this wrangle about practical methods and old-time ways of doing things.

Henry had been at the business forty years. He was, to use his own words, a workman of the "old school." When nine out of ten of these pestiferous inspectors, with their new-fangled ideas, were kids in knee breeches, Henry would frequently explain, he had been building boilers in the open air, with only a pair of rolls and a few hand tools; so he had the utmost contempt for inspectors and all their ways. In fact, rules were about as welcome to Henry as fleas to a clipped dog.

Henry tossed aside the little volume contemptuously.

"You mean to tell me that if that boiler were built with a lap joint it would blow up?" he demanded, belligerently. The engineer was a technical man, and, in spite of the fact that he had had nothing whatever to do with the rules, the superintendent always insisted on holding him responsible for them.

"No; I dare say it wouldn't!" was the answer.

"Then, why go to all the labor and expense of putting on a triple riveted butt joint when it isn't necessary?"

The engineer smiled resignedly.

"The main reason is, I suppose," he replied, at length, "to make doubly sure that it isn't going to be necessary. As you say, the vast majority of old-time boilers probably did stand up and see a good many years of severe service—but some of them did not. And it's the boilers that fail, not those that narrowly escape failure, that necessitate rules."

"Of course!" agreed the superintendent, beginning to hedge. "Accidents will happen now and then. That's to be expected anywhere."

"Expected—yes," agreed the other, "but prevented, if possible. Human life is a dangerous thing to trifle with, and it's to prevent just such accidents that these rules were formulated."

"Of course! But if, in spite of your dislike for them, you don't think they have been effective in cutting down explosions, a look at the insurance companies' records ought to be convincing." He reached for the shelf again, but the movement was not necessary. As was usual with him when an argument came down to a matter of cold facts, he now suddenly remembered an important piece of work in the shop, and turned toward the door.

The engineer smiled as he watched him go. A younger man might have jumped to the conclusion that the superintendent's attitude was sheer prejudice, but the engineer knew better. Being old at the game himself, he had learned there were always two sides to every question, and that the traditional antagonism of the old timer toward new innovations was due rather less to ignorance than to misunderstanding.

Henry's deep-seated objection to butt joints was a case in point. It rose mainly through his conception, or rather misconception, as to the real reason why a boiler failed.

Why a Boiler Explodes

Asked to explain what caused an explosion, Henry probably would have said that it was due to the sudden formation of a large volume of steam, through injecting cold water into the boiler when the supply was low and the exposed shell overheated. If the steam line were small or the safety valve failed to work properly this caused a sudden and terrific strain to be put on the walls of the vessel, with the result that it gave way.

Just how enormous this pressure was he had no idea, but certainly it was many times the normal working pressure, if one was to judge by the damage it caused. At any rate, it was so high that the boiler would have failed, no matter how strong the seam. Hence, he argued, the fallacy of putting on a butt joint.

If the latter were five or ten times as strong as a lap joint, all well and good. The boiler would then be strong enough to bear this additional strain. As it was, a lap joint was some 70 percent efficient, a butt joint about 15 percent more; not enough to be of any use in case such a sudden excess of pressure developed. If conditions remained normal the lap type of construction was sufficiently strong; if abnormal conditions arose they would be so severe that a mere addition of 15 percent to the strength would be of no use. The boiler would burst, anyway. The butt joint was stronger, no doubt, but it was more expensive and did not help any in such an emergency.

Henry's theory was logical; perfectly so. Not only is it held by a great many boiler makers, but by the general public at large. And therein lies their inability to see the excuse for many of the new and irritating restrictions in the modern code.

Undoubtedly, under such conditions as Henry had in mind, any boiler, no matter how strong the joint, would fail. The only drawback is that boilers also fail for other reasons.

Causes of Weakness

As soon as a plant is put into operation a multitude of forces, all tending to weaken the shell of the boiler and lower its ability to resist rupture, make their appearance. Stresses due to uneven circulation, to unequal expansion and contraction, soon cause checks and other cracks to appear at the seams. The same stresses and expansions gradually impair the efficiency of the joint by loosening defective or imperfectly driven rivets. Rust and erosion soon eat away the staybolts and reduce the thickness of the shell, the rate depending a great deal on the purity of the feed water and the care exercised by the engineer. In time, this impairs the strength of the whole until, if the original factor of safety be low, the vessel is liable to give way under any fluctuation in pressure, even though it be but slightly above normal.

If one boiler fails on account of sudden and extremely high pressures, many times that number fail at moderate overloads, because deterioration has left practically no margin of safety. And it is just such cases of failure that the code seeks to prevent by insisting on a standard of construction which, even after the efficiency of the whole has been reduced by inevitable corrosion and misuse, insures a sufficient margin of strength.

Through the same misunderstanding a great many operating engineers and builders jump to the hasty conclusion that there is a wide discrepancy between the designer's figures and the pressure that a boiler will safely carry. They maintain that if such a boiler, built years ago with a lap joint, stood up and gave satisfactory service, it should do the same to-day.

When told that such a boiler is not good for the desired pressure they imagine that theory and practice do not agree; that, since such construction actually did stand up in pioneer days, the designer's figures must be at fault. The reason is, of course, that they do not appreciate how close to the danger point these antiquated boilers were operated—that they were often run at a pressure scarcely below that required to cause their failure.

If this fact, and the real reason for the code's insistence on such construction, were more generally understood there would be less friction between the practical, old-time boiler maker and the high-toned technical man for whose figures and theories the other so often has such contempt.

Hop to This—Everybody!

The three Liberty Loan issues already successfully floated have been put over by the win-the-war spirit of the American people. Keep the thing up. Organize a Liberty Loan club in your shop or plant. Thus you will help to "carry on" as in no other way you can help.

In connection with the great work of awakening and quickening to action the spirit of war sacrifice which has been the greatest factor in the success of Liberty Loans, it would be impossible to put too high a valuation on the splendid voluntary work of American business men, bankers, labor leaders and molders of thought in all professions and occupations.

The very success of this volunteer leadership in creating enthusiasm has shown the desirability of organized methods for increasing its usefulness. And particularly to suggest to those leaders who feel that their circle of action is relatively small the enormous amount of good they can do as a whole *if each, no matter how small or great (relatively) his sphere may be, will act with enthusiasm and system.* The great factory or store, society or club, church, or other organization with, say, 5,000 employees, members, or audience, does a great work in "selling" the Liberty Loan idea to such an aggregation. But that work is fully matched in aggregate importance by a hundred such institutions, whose average payroll membership, or audience, comprises only fifty persons each.

The nation has much other work to do. The Liberty Loan drives are necessarily carried through largely by volunteer work. In consequence, they must be limited to specific brief periods for the actual subscription to the bonds.

Locomotive Firebox and Boiler Maintenance and Repairs*

Prevalent Causes of Locomotive Boiler and Firebox Troubles and the Means at Hand for Their Suppression

BY GEORGE AUSTIN†

From observation and investigation of boiler and firebox repairs on our own lines and information from other sources, it is concluded that repair work, both back shop and roundhouse running repairs, are made along very similar lines, and that the requirements of the service in which the locomotive is employed largely controls the character and extent of repairs. While this discussion will deal somewhat with repairing, more stress is laid on those causes which make repairs necessary. It is not because locomotives are not handled pretty much the same on all roads, but because it appears to the writer that any improvement in handling which will prevent the necessity for repairs or lengthen the time between repair jobs is decidedly of greater importance than finding an improved method of making repairs.

Causes of Leaks

Formation of mud deposits on the water side of firebox sheets covering the scale formation, or water in the boiler heavily charged with suspended matter, are causes for overheating and leaking. Other causes are accessory before and after the fact. The first indications of flues, and sometimes other parts, being near the leaking point are small light-colored beads of sodium salts, mixed with other solids, adhering to the edge of the flue beads. Although flues are tight in the holes, there are small crevices through which the slime works its way, and as the moisture quickly evaporates on the hot plate there is left a dry, hard deposit that temporarily plugs up the hole it leaked from. In most cases the engine will make another trip: on some districts it will not do so without leaking pretty badly or failing. A knowledge of local conditions should and usually does govern the kind of work, if any, to be done on flues showing those preleaking indications. The remedy, of course, is to remove the scale which has formed on the water side. To wait until a leak starts is to wait until some damage is done. Leaks caused by overheating damage the parts affected by it, nor can repairs be made without further injury; that is, nearly every time flues are worked their life is shortened.

Since overheating causes the necessity for repairs our energies should be directed to keep the boiler clean and prevent overheating. This statement will be regarded by many as a futile remark, and in view of their conditions they are justified in thinking so. Feed waters heavily charged with incrustating solids will form scale, and it forms among the flues and staybolts where one cannot get at it to wash it off, and, since it couldn't be washed off if one did get at it, it must be knocked off. Scale forms mostly while the engine is working and at those parts which attain the highest temperatures, probably because those parts evaporate more water and a large quantity of solids are precipitated.

In the case of waters heavily charged with alkalies, the remark to "keep the boilers clean" will also create a strong sense of the futility of such a remark. Those boilers are clean when they leave the terminal, perhaps freer from mud and scale than boilers on other districts which give much better performance. The fillet of scale which forms over the copper ferrule, regardless of what it is composed of, reduces the power of the copper ferrule as a conductor to keep the end of the flue from getting hotter than the flue sheet, and it has been suggested that a wider ferrule than is commonly used will require heavier incrustation to impair its efficiency as a conductor and widen the interval between leaks, which reasoning is very plausible. Flue beads should be maintained small and compact, free from burrs of surplus metal, for the reason that excess metal exposed to the heat of a firebox absorbs heat in proportion to its area and bulk, and gets out of harmony with the other parts.

The best tool for removing incrustation from flues, staybolts and firebox sheets from the flues at the sheet is the sectional or prosser expander. We use for setting flues when applying them, sectional expanders form B, 9/16-inch deep for ⅜-inch sheet. For hot work, or reworking after flues have been beaded, we use a ½-inch expander for a ½-inch sheet. This keeps the prosser groove hugging the sheet. We use a 3½-pound hand hammer on hot work. We do not encourage the smooth type of expander and have very few in use. The prosser expander has been mentioned as being the best tool to jar the scale from the end of the flue on the water side. The objection to its use is that it stretches the flue holes and distorts the flue sheet, which is true. Some light knocking tool should be designed that will work in the prosser groove and part of the flue in the flue sheet and not disturb the outside bead; that is, in order to prevent breaking or splitting the flue at the prosser groove or breaking the bead or weld joint, the flue in the sheet will have to receive part of the blow. We help out large superheater tubes, which in hard service give trouble, by applying a 3/16-inch or ¼ by 4-inch wide thimble of the diameter of the flue made from scrap steel or sheet iron. It is not welded.

Setting the Thimble

We set it with the butt joint at the bottom and hold it in place with a flat wedge of No. 12 or 16 iron driven between the flue and thimble at the top. The philosophy of the thimble is that it absorbs some of the heat the flue end would otherwise get and relieves it from overheating to that extent. When one end of this thimble burns off, it can be reversed. It is believed welding the flues to the back sheet will be an improvement on that practice, but until we are fully equipped for welding we are getting some help from applying these thimbles. With the above-mentioned exception, superheater tubes are worked according to instructions and with tools recommended by the superheater people. Applying the thimbles or shims is mentioned at this time as being along the line of preventing the necessity for repairs.

Scale formation in arch tubes and firebox sheets is indicated first by a sand paper roughness of the parts which

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* From paper on "Locomotive Firebox and Boiler Maintenance and Repairs," read at February meeting of Western Railway Club.

† General Locomotive Boiler Inspector, Atchison, Topeka & Santa Fe Railway.

are becoming effected, and later by clinker, or, as it is sometimes called, honeycomb, clinging to it. It actually seems as though it was trying to defend itself from injury by establishing a non-conductor of honeycomb on one side to offset the scale formation on the other. The smooth, slightly rounded flatter or bobbing tool in a No. 3 air hammer is effective in most cases to remove this scale. By working on the fire side the jar seems to cause it to flake off; boilers should be warm when such work is done. There is little danger of cracking the plate by using the methods here mentioned to remove the scale, and there is greater danger of developing cracks if it is not removed. On some divisions we "rattle" our fireboxes, which is our term for the operation, nearly every month.

Simmering Leaks

By simmering leaks is meant small leaks in fireboxes that leak continually, but not enough to form a stream and run down the plate and give trouble. These should not be permitted, especially where the water in the boiler is heavily charged with suspended solids. These small simmering leaks are just big enough to let the water through and fine enough to keep back the mud and build up a mud fillet around the flue or staybolt; overheating is frequently so severe that the flues and staybolts affected become loose in the holes, and failure reports frequently say "flue busted." Many engine failures are due to permitting simmering leaks, especially among the flues. The above class of failures most frequently occur during muddy water seasons. Flue performance may be accepted as a barometer indicating firebox performance. If you have no flue troubles, you have no other boiler trouble. If you have small flue mileage, you have small firebox mileage. If you help the flues, you help the box.

Keeping Boilers Clean

Any water treatment that will dissipate the fillets of scale from the flue ferrules or other parts to prevent its formation is far and away ahead of any mechanical treatment, for the reason that chemical action anticipates and prevents possible damage and affects all parts, while mechanical treatment is deferred and local only, and follows possible damage and fuel losses. It is therefore evident that we may look for the greatest improvement through water purification or treatment, either by treating the water before it is delivered to the locomotive or in the tank and boiler. If the volume of business on a district is small or the water is not bad enough to justify the expense of water treating plants, during these times it may be very profitable to treat the water in the engine tank. Increasing demands for power, and on power cost of labor and material and greater value of the locomotive, have changed and are still changing values; what would have been considered extravagance yesterday may be good business to-day.

The Atchison, Topeka & Santa Fe has 125 roadside water treating plants; the road also uses anti-foaming boiler compound, as well as a compound to prevent incrustation and foaming. Soda ash is also applied to the locomotive tanks. All water treatment is under the advice of the chief chemist. On some districts the water treatment is supplemented to a limited extent by mechanical means; that is, it is found profitable to a limited extent on some districts to use both chemical and mechanical means; for example, if the staybolts show leakage and inspection shows scale forming. A light pneumatic hammer and bobbing tool is used on bolts and plates in the leaking zone, and scale is knocked or jarred off. When water treatment creates too much foaming, we may obtain better results by allowing a little scale forming, which may be taken care of by mechanical means. Water treatment may be brought to a point where it is better to allow a little scale than have excessive foaming.

Pitted Flues and Other Corrosion

The Santa Fe, like other roads in bad water districts, have to contend with pitting and corrosion. While corrosion of firebox plates has resulted in short life of many boxes, flue pitting causes frequent failures and is most annoying on that account. It has been observed that passenger engines using anti-foaming compound pitted more than freight engines on the same district; that superheater passenger engines in the same service pitted more than saturated engines, and it has been found that when a small quantity of boiler compound is applied when the boiler is washed, or has water changed, and also applied in the engine tanks wherever water is taken, thus keeping the water in boiler slightly saturated at all times, flue pitting has been reduced.

Any method of water treatment is benefited by the judicious use of the blow off, short frequent openings, a short time after the locomotive comes to a stop, or just after starting, give the best results. Starting with the beginning of the trip, frequently blowing a small quantity of water out at convenient times, when it can be just as well done as not, will keep down the concentration of foaming solids and greater mileage be had between washouts. There are occasionally times when it is necessary to practically change the water in the boiler, but these occasions are usually due to failure to anticipate that condition; or, in other words, the blow off was not used soon enough to prevent the water becoming heavily charged with foaming matter. When the water in a boiler becomes so bad as to practically need changing and the engineer wants to give it a good blowing out, do not fill up and then blow out; blow out all that can safely be done first and then regain the usual supply slowly; if necessary, repeat the operation. Filling up before the blow off is opened simply dilutes the foul water we want to get rid of and wastes the fresh water.

Frequent Blow-Offs Beneficial

With muddy or roily water not accompanied by foaming, the boiler is greatly benefited by frequent short blow offs, and the possibilities of mud burning and flue and staybolt leakage are reduced. The water in the boiler is free from suspended matter and better circulation and steaming is assured. Blowing out from both sides should be the rule when, as is often the case, more blowing is done from the left than the right side. The effects are shown by more staybolt leakage, cracking and patching on the right than on the left sheet. While it must be admitted there is a point at which blowing out begins to be a waste of effort, water and fuel, and different districts require different treatment, a generally good rule is to use the blow off freely in all districts where bad water prevails. This brings the engine to the terminal in the best possible condition to be turned. If boiler compound is used, the water should be kept saturated with it, thus reducing pitting and foaming and the liability of running short of water on account of working it out through the cylinders and stack. Foaming will lose more water than need be blown out in a trip to prevent foaming. The boiler will be in a better condition to take the troop or munition train through on time without tieing it up to be washed or water changed. All will have been done that could be done that trip to help win the war, and we have thus used the best known methods to protect the property and interests of our railroad.

Acetylene and electric welding are rapidly bringing about a complete revolution in firebox repairs. Either process has its own particular line to which it seems better adapted than others, though either process with a good operator will weld anything in a firebox it is applied to. It is up to the boiler maker to lay out the work and properly prepare it. There is no trouble with half or whole sheets or small parts when contraction is amply provided for. When firebox patches are to be applied on parts where the elastic limit of the plate has been reached, which is indicated by small cracks near the patch being applied, do not weld them; a patch-bolt patch leaves no contraction strains; it will need to be worked at times, but will not cause a failure. Welding transverse cracks in the top flanges of back flue sheets has not been reliable. Welding side and door sheet cracks has been disappointing, except as a quick repair job. It may be that we will improve present methods; but at this time a strict regard should be held for high standards to prevent failures and the necessity of repairs, welding patches and cracks in the fireline of side or door sheets should be emergency or roundhouse jobs only. Of course, favorable conditions and experience will finally govern.

PIECING FLUES WITH THE ELECTRIC WELDING MACHINE

Piecing flues by the butt welding electric process is very attractive, because the flue is not wasted near or at the weld—in fact, it is thicker. Second, there is no smoke or noise from welding fires, or trouble with bricking up furnaces. There is no heat used, only when taking the heat, and that is about twenty seconds to each flue. The process promises to become the standard method of piecing flues. We have about 200,000 of these welds in service, and flue failures on account of bursting, are not increasing.

Until some method is found that will keep the flue end clean and free from scale accumulation or some tool devised for knocking it off without disturbing the weld, welded flues in the back sheet will be disappointing. Where feed water carries considerable incrustation matter, the scale will form, regardless of how the flue is applied, and overheating is certain to follow and the weld or flue will break.

THE INJECTOR AS A CAUSE OF LEAKING

Too much injector while the engine is standing is the secondary cause of many firebox leaks and failures, on account of causing extreme variation of temperatures between the upper and lower parts, due to injecting a large quantity of water at one operation. Heavy clinkered fires, short firing or other causes which tend to cause poor steaming operate to produce unequal temperatures. Poor injector work is also a close second in causing corrugating and cracking of firebox plates, and especially so when aided by bad water conditions. It seems reasonable to assume that every engine man wants to be known as a good engineer and is greatly pleased when he is praised for good work, whether for making a good run, keeping up his engine by correctly reporting work or being a first-class air man. Many of these are good boiler men. They rarely make a boiler failure, and then only when it is unavoidable. Others are good at everything else, but if there is a chance to cause a leak in the firebox of their engine they are pretty certain to make use of it, either through ignorance or indifference, or both. Some enginemen get from a fourth to one-half greater mileage from a set of flues of the same type of locomotive in the same service than others, the principal reason for which will be found to be better injector work.

When John Purcell was made assistant to the vice-president of the Atchison, Topeka & Santa Fe Railway, one of his first achievements was a book on the care of locomotive boilers and their appurtenances. One of the rules reads as follows:

"Engine crews and hostlers should be instructed to use the injector as little as possible when engine is standing. Boilers should have at least two-thirds of a glass of water when set out for service. Incoming engines should have nearly full glass of water before crew leaves them, and the water should be put in while engine is moving from the train to the ash pit. Use of the injector while engine is standing should be avoided whenever possible to do so. It must be understood, however, that safety of the boiler is the first consideration, but this can be had by using the injector frequently for short periods. Instead of injecting large quantities of water into the boiler at one operation, a good safe rule to follow is not to put in more than one-half an inch of water at any one time while the engine is standing."

The above rule is as good a rule as the book contains, and our men who understand and live up to it are good men with the boiler, as well as with the rest of the machine. They know that when they start an injector there is a stream of water about 200 degrees colder than the boiler, entering it at a rate of from 40 to 100 gallons per minute, and that this colder and heavier water sinks to the lower parts of boiler shell and firebox water spaces, filling up these parts, and, if continued, cooling and shortening all parts in proportion to the reduction of temperature. The cooler part must contract and the process causes the hotter and longer part to buckle out slightly between the staybolt rows and assume a slightly wavy form, the staybolt being in the trough, or lowest part between the waves. This bulging or wave forming crimps the end of the bolt on the fire side of the plate and opens slightly on the water side and breaks the joint. This starts the staybolt leak, which most frequently shows when engines have stood a few minutes at the ash pit after engine crew has injected the water which should have been put in before they left the train, or while coming from the train to the ash pit, or is caused by the hostler using the injector before or after engines are placed in roundhouse. In short, the engine crew did not handle the water according to the best practice for the good of the boiler, and the conditions prevented the hostler from doing so.

COLD AIR DOES NOT CAUSE FIREBOX LEAKS

Flue and staybolt leakage is frequently attributed to cold air entering firebox, but when one considers the relative density of air and water there seems slight probability that cold air can have any appreciable effect in causing firebox leaks. Consider, for example, that the fire, when the engine is working, reaches a temperature of 2,600 degrees and the water in the boiler at 225 pounds pressure gets to 396 degrees and yet the high temperature of the fire, as shown by tests, does not heat the plates above 450 degrees if they are clean. This is because the greater density of the water gives it the power to absorb heat as fast as the flames can give it to the plates; therefore, cold air will have as little effect to cool plates when backed by hot water as the flame has to heat them when backed by water, but cold air entering the firebox does affect the steaming and we trade water for steam while the engine is working, and trade a tight firebox or flues, or both, for leaky ones while drifting down hill or standing at stations.

The use of the blower on the modern large boiler has little effect to promote circulation. It is true that it will maintain the steam pressure, but the cold water goes to the bottom just the same, and using the blower maintains the top temperatures while the bottom temperatures continue falling as long as the injector is operated. A clean fire gives the best circulation, and no particular harm results to firebox sheets; but with a heavily clinkered fire, or an oil-burning engine with considerable of the area of the lower parts of the firebox sheets covered with brick, there is a very serious doubt whether or not the use of the blower, while using the injector, is not altogether the wrong thing to do. For the reason that there is no circulation below the fireline, the hotter water circulation on the top of the cold water in the water leg of a locomotive firebox just the same as if the mud ring was raised that much, there is no circulation unless there is heat to produce it. When there is 8 to 12 inches of clinkers in a coal-burning engine, there is no circulation (that is, when the engine is standing) below the top of the clinker. In an oil-burning firebox there is no circulation back of brickwork which covers the heating surface of the firebox plates until the bricks become hot enough to produce it, and it seems very likely that condition is responsible for some of the corrugated and cracking of firebox sheets, as well as for leaking flues and staybolts in oil-burning engines.

In connection with the above subject of injector and blow-off cock use, it must be apparent that railroad companies should require their firemen to obtain a reasonable knowledge of the effects of producing unequal temperatures before promoting them to take charge of an engine. Hostlers, also, should be required to know how to properly care for the locomotive while in their charge. Do not put it all up to the boiler maker; let the other fellow do his part.

Among Tennessee Boiler Shops

Odds and Ends of Shop Kinks Picked Up in a Railroad Boiler Shop

BY JAMES FRANCIS

Recently it was the experience of the writer to be "frozen up" in Memphis, Tenn., for two weeks, during which period the mercury went squarely down to zero. Ten inches of snow fell in a single night, and the combination paralyzed nearly all business operations in the city. Memphis is not fitted for snow or cold, and when these things do come the people just don't know what to do with them.

Refrigerator for the Acetylene Generators

It was the good fortune of the writer to spend an afternoon in the shop of the Southern Boiler & Tank Works, where the cold weather seemed particularly discouraging on account of the latitude of Memphis shops not requiring heating apparatus, save in such exceptional cases. The Southern Boiler & Tank Works is located in a fine new shop adjacent to "Wolf River," a tributary, of course, to the Mississippi, and the shop is very close to the big river. "Yes," said one workman, "it's a mighty fine shop, but it's hotter than h—— in the summer and colder than h—— in the winter!" And the latter description sure represented things on the day of the writer's visit.

The shop has a heavy plank floor, set up some distance off the ground, as is necessary in all buildings near the river, in order to be above high water mark in flood time. And no workman could keep his feet warm in that shop on account of the streams of zero air arising through each crack between the floor planks. It sure was fierce, and no one could blame the workmen for acquiring each and every carbide can which could be found empty, cutting a few holes in one side near the bottom end and then building a soft coal fire in each fire pot thus extemporized. As the vent holes in the cans were usually cut to represent eyes, nose and mouth, à la "Jack-o-Lantern," the effect was very weird and savored of Hallowe'en night.

This shop had its own acetylene generator. It was a portable affair, mounted on wheels, so as to be readily moved as required. The cold snap put the generator out of business the very first round. There was nothing else to do but to drain it thoroughly, which was done, and "store" gas used for a day or two. But store gas proved a bit too expensive to suit the manager, who caused to be built a neat little "refrigerator" with double air spaced walls, the same as is done with regular butter and egg refrigerators. Large doors were made on one side of the little room, which was about ten feet square and the same in height.

The device was made without any bottom. A couple of thicknesses of builders' felt were spread on the floor, a couple of sheets of tank steel placed on top of the paper, and the little room was builded thereon. Heavy wall plates were put into the structure, but the sills were very light. The plates were made heavy, in order to furnish strength-resistance to crushing, so that in warm weather the little room could be picked up by the overhead crane and carried to a corner of the shop, where it would be out of the way.

The "refrigerator"—which, by the way, the writer suggested to the superintendent, would be the slickest possible place for the watchman to sleep in—was then provided with a heating system. The previous winter's experience had led the management to put in the "generator refuge," and, accordingly, they ordered, early in the autumn, an electric heater for keeping the generator house above freezing temperature. But, alas! four months after the order had been placed no electric heater had come along, so a little coal stove was arranged outside of the generator building, with a "water back" placed inside the stove and a kitchen boiler set inside the house and connected to a small expansion tank on the roof. Thus the house was heated, and without fire inside of it, in order to be in line with "Safety First" principles.

Air Guns Frozen Up

The cold seems different in the Southern cities. When it is cold there it seems much colder than at a corresponding temperature North. Things freeze worse, too. In the shop above noted the writer saw "air guns" freeze almost while they were being used. While a fresh rivet was being slipped into position a gun would "stick" and have to be thawed out. Indeed, it was almost impossible to use the pneumatic riveters without first connecting a piece of iron pipe into the air hose, building a fire over the pipe, and keeping the fire burning permanently, a piece of boiler plate, with sand underneath, being placed on the shop floor and the fire built directly upon the plate.

The foreman remarked that if the cold weather lasted much longer he would pile up some bricks around a few iron rods, thus making little furnaces, through which the air pipe should pass; then soft coal fires could be kept in the little furnaces without the trouble or danger of maintaining wood fires.

A Welder's "Pin Cushion"

Calcium carbide drums were sure in great demand in this shop, being used for many purposes besides "keeping war furnaces." The welder always used one to keep his tools in, and another was in evidence on the job as a sort of tool and material bench. It might well be called the "Welder's Pin Cushion," for it resembled one very much, as is evidenced by Fig. 1 herewith.

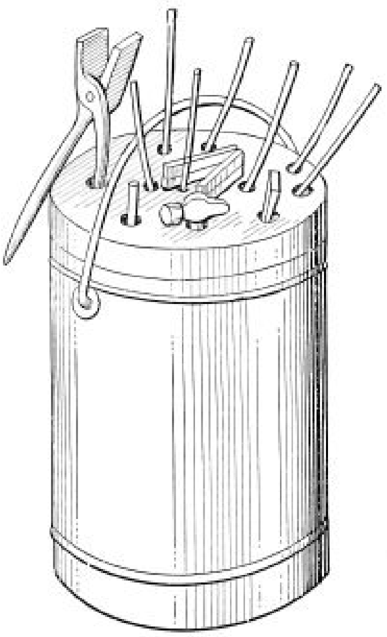


Fig. 1.—Welder's "Pin Cushion"

The cover of a drum, or, more properly speaking, a "can," would be punched full of holes, then stuck full of welding rods, tongs, hammer, a punch or two, one or two wedges, and what other "duffle" the welder might need on that particular job. The scheme was a right good one, too, for the reason that in case of an upset the rods and tools did not come out of the holes to any great extent, and after the can had been righted the tools and rods were nearly all in place and no time lost in picking them up, as would have been the case had they been kept in a box or in a "boiler maker's tool box," i. e., a nail keg!

A Good "Hold-On" Rig

"A rivet holds a good deal better if it is well held up during riveting by a solid dolly," said the shop foreman as we passed some big pressure tanks made of 9/16-inch plate, which were being driven to hold about 200 pounds of air pressure. The rivets certainly were being driven "solid" in every sense of the word. The usual "dolly bar" was absent. In its stead was the apparatus shown in Fig. 2. This apparatus was rigged for one size of boiler only; but the same vertical piece of steel, which actually came in contact with the rivets instead of the traditional sledge, could be used with several boiler diameters by varying the size of the block and the thickness of the lever upon which the hold-on bit of three-inch shaft was shown to stand.

The block in this case chanced to be 6 inches by 6 inches and about 18 inches long. A smaller or a shorter block would permit the same steel bar to be used in a smaller shell. The same may be said of a thicker lever. The one shown in Fig. 2, upon which the "hold-on man" is sitting,

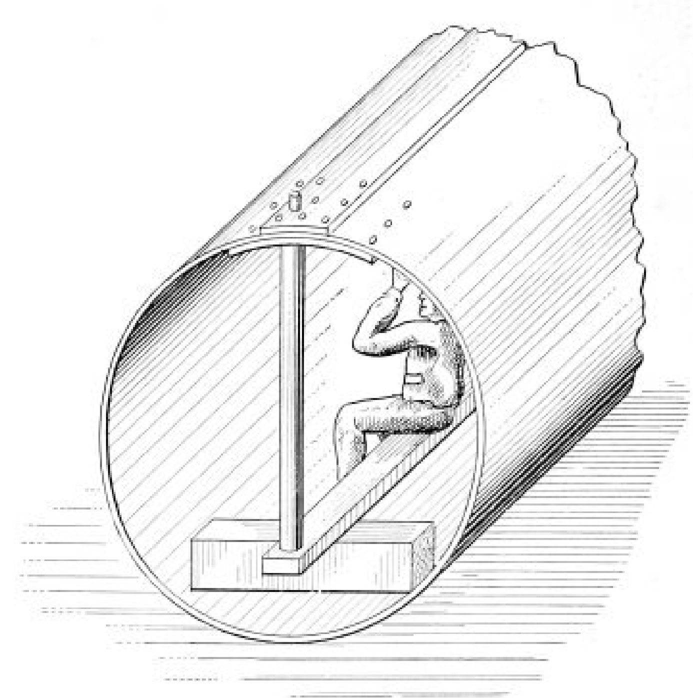


Fig. 2.—Good Hold-On Rig

is a bit of 2-inch by 4-inch North Carolina pine. The shop foreman stated that they carried in stock several bars of varying length, so that it was only necessary to make the proper selection in order to procure a hold-on rig for any size of boiler within the limits of the sizes usually made.

When a little care is taken to keep the steel bar squarely vertical, it is evident that this rigging forms the most solid hold-on that can well be arranged. In using this device the boiler shell should be so placed that the bar will stand squarely upon the block and as nearly vertical as can be determined by the eye. It is neither very easy nor very comfortable to work this device upon an angle. It can be done, though, but it does not pay. It requires too much time and there is danger always that the bar will not stand radial with the shell and axial with the rivet. Therefore, it would be better to arrange things by rolling the shell so that the bar stands plumb, when the rivets may be driven as quickly and as solidly as though "squeeze-driven" in a heavy machine.

Rounding Welded Shell Sections

Another lot of air tank work which was being done in the shop called for welded longitudinal seams on sections about 42 inches long and 36 inches in diameter. When these sections were being prepared for welding they were rolled up to perfect circles, with the edges fair together and about an eighth of an inch apart. Welding was commenced at one end of the seam, and as soon as the sheet had been "caught" there a wedge was driven between the sheet edges at the other end of the section, until the edges were separated about an inch and a half. As the welding progressed the wedge would be backed out, until at the finish the edges would barely touch each other.

The above treatment was found necessary in order to make the edges come together during the act of welding.

Should the weld be started and carried along without first separating the far ends of the sheet, the resulting shell, so the welder stated, "would look like a cocked hat"—whatever that may be!

But even then, so the foreman stated, the sections did not always come out quite round, and it was necessary to true them up, as shown in Fig. 3. "If we don't round each ring," the foreman explained, "the shell won't be

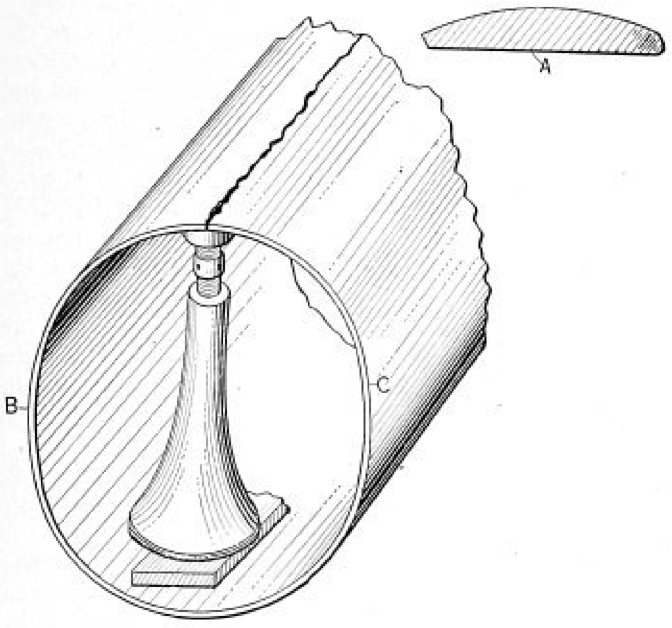


Fig. 3.—Rounding a Welded Shell

straight after the sections have been riveted together, and, what's more, it never can be made straight after the sections have been fastened together; so we have to round up each ring in order to get a good job of work."

The operation, as shown, was to place a jack screw inside of a ring near one end, screw out the jack until a considerable strain had been given the sides at *B* and *C*, and these portions of the shell "belted" heavily with a sledge as large as a man could swing comfortably.

The sledging was, of course, done upon the outside of each section, and to obtain some idea of the effect of the blows, segment *A* was prepared from thin sheet metal, being cut to the radius of the inside of the section. By testing the shell section with segment *A*, it was found that a flat place existed along parts of the weld, and the jack screw would be placed under the flat place and a good strain taken as stated. Before a blow was struck the segment *A* would be tried along the shell from the weld, down past *B* and *C*, and the variation from the segment very carefully noted. After a few blows had been struck at *B* and *C*, or elsewhere, as experience dictated, the segment *A* would be tried again, and if the blows had taken effect the result would be apparent in the fit of the segment.

Thus the segment would not tell when hammering enough had been done—not, at least, until after the jack had been removed. However, the segment did tell, and, with the shell under stress, showed that the blows of the sledge had taken effect and had caused some change in the shape of the shell section. In this manner the sections were eventually rounded up until they were sufficiently accurate to bring the finished shell to the required straightness.

The shop foreman remarked that sometimes a shell section would weld up perfectly round and require no "belting" or jacking. Again, he said, other sections which had been treated in exactly the same manner, as far as he could see, would come out very flat at the weld and require a good deal of jacking and hammering, although as yet he had been unable to determine what made the difference in the behavior of the seemingly similar shell sections. "And," he concluded, "if any reader of The Boiler Maker can tell me how to determine in advance how much each section will flatten during the welding operation, then he will do me a great favor by putting me next to the reason therefor and to the proper treatment and handling of such sections."

A Very Queer Boiler

While the writer was in the Southern shop he saw repairs in progress—new tubes and some calking—on one of the queerest boilers it has ever been his lot to behold. There was no clue to the maker of the boiler or of its age. It was 48 inches in diameter and the heads had been bored for forty-two 3-inch tubes.

Fig. 4 shows the layout of one of the heads of this queer boiler. The tubes, instead of being in level parallel rows in the usual manner, were laid down upon segments of circles, all apparently struck from the same center—about 18 inches radius for the lowest row of tubes and 43 inches radius for the upper row, thus bringing the rows about 5 inches apart vertically.

The writer fails to see the why of this peculiar design, unless it be that the water in the boiler will flow upward

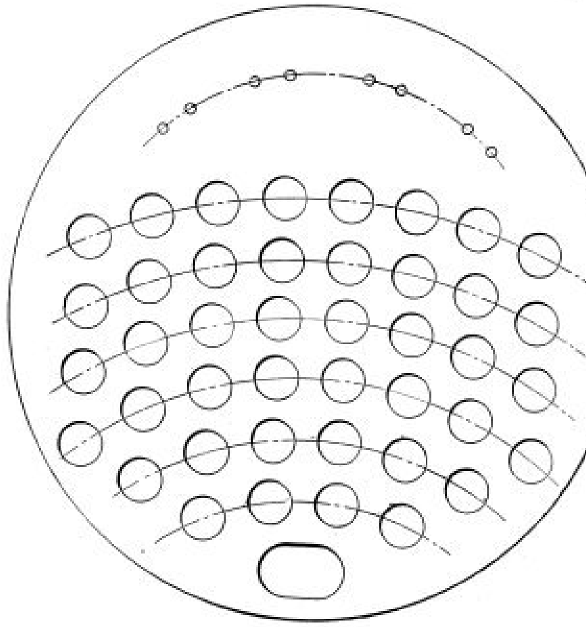


Fig. 4.—Queer Boiler Head

between the tubes in the center, thence downward at the sides or against the shell, with the tube rows inclined in order to favor the flow of the water in these directions.

Should the above be the true reason for curving the tube rows in this boiler, the scheme does not look good to the writer. It seems as though there would be a rather poor circulation on account of the very restricted water passage between the shell and the two outer tubes in the third row from the bottom.

The head above the tubes is stayed by four crowfoot braces, and it seems there is considerable unsupported area between the tubes and the braces; also at the bottom, around the handhole, which is not the best practice. If any reader of The Boiler Maker knows the why and wherefore of this boiler, will he kindly tell the rest of us?

Decimal Time Keeping

Time in the Southern Boiler & Tank Works Company shop is all handled by a decimal system—that of the Day

Time Register Company, of Syracuse, N. Y. The foreman marks up all the time spent on each job, using for this purpose a time clock which registers 24 hours a day instead of 12 hours twice, and which has the hours divided into hundredths instead of into sixtieths (minutes).

Fig. 5 shows one of the cards used. When the foreman starts a man on a job he numbers and dates the card and writes the man's name at the top, as shown. The foreman then enters the number of job which the workman is to commence, adds a short description of the job for shop convenience, and finally inserts the card in the time clock and the "on" time, "7.01" is thereby printed on the card, as shown. This does not mean one minute past seven. It means one one-hundredth of an hour past seven, which, however, is not very far from one minute—rather less than a minute, to be accurate. Which closes the performance. No more attention is given to the card until the job is finished or the workman leaves the job for some purpose or other. In the card shown here the man was seemingly called off the job to do a little hurry work on "older job" 1854, upon which he worked 43/100 of an hour—the foreman always time-stamping the card each time a man is switched from one job to another or when a job is finished.

Southern Boiler & Tank Works
DAILY TIME TICKET No. 492
Date 12-13-17
Name John J Jones

ORDER No.	DESCRIPTION OF WORKS		ELAPSED	
18.97	new tubes in 48" Shell	1.75	OFF	8.76
			ON	7.01
18.54	Cut out rivets	0.43	OFF	9.19
			ON	8.76
18.97	new tubes in 48" Shell	8.79	OFF	17.98
			ON	9.19
18.99	Calking leaky seams	2.04	OFF	21.00
			ON	18.96
	10.54	10.97	OFF	
	.43	9.97	ON	
	10.97	2.04	OFF	
		3.06	ON	
		13.03	OFF	
			ON	
			OFF	
			ON	
			OFF	
			ON	
			OFF	
			ON	
SIGNATURE		TOTAL		

Fig. 5.—Time Card

HARD ON THE FOREMAN

In addition to the job ticket shown by Fig. 5, each man, if required, may have a personal weekly ticket, which is kept in a case at the clock. As he comes to work or leaves the shop, each man may "punch the clock" and print by his own action the figures upon his card, from which his pay envelope is made up. A comparison of the two cards by the "efficiency man" may lead to some interesting deductions, and, perhaps, to some way of saving shop time which is paid for by the employer, but which proves of no value either to the shop or to the customer.

The system seems a bit hard on the foreman, too, for he must punch each and every card each time a man changes a job; and when a dozen men are standing around waiting, it is evident that some time is going to waste which the efficiency man can't very well lay hand upon. To be sure, the same amount of time would probably be lost under any other system; but if the foreman lets all the cards go until after he has sent the men away, then waste time as per the time clock will be charged against the new jobs before a stroke of work has been done on them. On the other hand, should the foreman punch all the cards "off" before he starts the men at their new jobs and punch them "on" as fast as they are sent out, then there will be elapsed time which does not show on the job ticket, but which is in evidence in each man's time slip.

The matter of the two charges against job No. 1897, Fig. 5, shows this, but not heavily. The elapsed time on these two periods shows a total of 10.44 plus 0.43, equal to 10.94 hours. There evidently must be deducted from this the dinner hour, whatever it may be, and if one hour, the time on job 1897 is 9.54 hours. Adding in the time on job No. 1854, which is 0.43 hour, the chargeable time of Mr. Jones for December 13, 1917, is found to be 9.97 hours.

True, in this instance the loss is only about two minutes, but in many instances the loss totals hours for all the men employed. Although this workman's time slip showed that he was on duty 10 hours, and he must be paid for 10, how does the shop get even on the one and eight-tenths minutes not accounted for? Charge it up to "overhead," same as one must do with shop rent, welding gas, and lots of other things which cannot be charged out where they belong? Yo no sabe! There is sure some interesting figuring for the boiler shop owner along this line, be he in Tennessee or anywhere else!

Hold Meetings in Your Shop for the Fourth Liberty Loan

The tremendous impetus which Charles M. Schwab has given to shipbuilding has been largely achieved by making every individual engaged in the industry feel a personal responsibility for results and a personal pride in helping to make great results possible.

The creation of that spirit among the workers of the nation in all lines of activity would be of incalculable benefit to the workers themselves, to employers, and to the nation.

Every employer can be a leader and a center of influence toward pushing the Liberty Loan by holding meetings in the shop.

The man who operates a small business with relatively few employees may feel that his circle of influence is too small to be worthy of any effort. That is a mistake. It is the aggregate that counts.

The man who is in a relatively small circle may not hold so pretentious a meeting; it may not be formal or run under parliamentary rules; it may not be especially announced or accompanied by music and oratory; but the man who will quietly call a dozen employees around him and informally, thoughtfully, lead discussion into win-the-war channels, pointing out the importance to the individual of doing his best in support of Liberty Loans and all other war activities, can do a real service in this way. It can be so well done in no other way. And ten thousand such little meetings would produce an enormous aggregate result.

Making Business Transactions Legally Safe

Legal Points Worth Knowing About Contracts—"Caveat Emptor" Still Actively a Part of Lawful Procedure

BY EDWIN L. SEABROOK

Every-day business transactions become so commonplace that the importance of doing them in a way to make them legal, should any future dispute arise, is ofttimes entirely overlooked or neglected. It is only when some transaction is disputed that the necessity of having recorded it properly is seen. However good the faith may be between the parties, if one blunders, or does a right thing in the wrong way, and a dispute arises, the blunderer often loses, simply for the lack of a little care at the time the transaction occurred.

Bookkeeping

Making the entry of a sale in bookkeeping seems to be a very simple matter, yet many accounts, when disputed, have been lost because the entries were not properly made when the transaction took place. The importance of proper bookkeeping and of recording business transactions concisely and correctly at the time these take place cannot be too strongly emphasized.

The original entry of a transaction in bookkeeping is most decidedly important from a legal standpoint, if this transaction, or series of transactions, with which this particular business item may be connected, is disputed or brought into court.

The historical or original entry is made either in the Day Book, Journal, or Cash Book. The entry should be brief, but plain enough to describe the transactions intelligently to a stranger. The quantity and price of each item should be given. Also, every original entry should be made, if possible, on the day the transaction occurred.

Legal Importance

So important is the historical, or original, entry in a set of books that it alone, of the records, can appear as evidence in a disputed account. In settlement with a person with whom one has had dealings, if the account is disputed and the case submitted to a court for decision as to the correct balance, these historical or original books of entry only will be accepted as evidence and only on certain conditions, namely, that the records in other cases than those under dispute can be proven correct; that the records were written at or near the time of the transaction, and that there are no signs of erasures or alterations in the original entries in question. To meet these requirements and to have a set of record books that will inspire confidence as evidence in a disputed case, care in making entries is necessary.

A Case in Point

The failure to produce the original books of entry in a disputed case in court is very timely illustrated by a sub-contractor in Pennsylvania, who recently took his case to trial and was non-suited.

This sub-contractor had done work for a general contractor, who also had done work for the sub-contractor. There were other matters involved which led to a series of transactions on both sides, covering quite a period of time. Bills were rendered each other from both parties to the transaction. The sub-contractor finally demanded a settlement from the general contractor. The amount of this was disputed, each claiming that a balance was due him.

It is well to bear in mind that this account was what is termed "a running book account"; i. e., not settled to any particular date. The entire series of transactions had to be considered when it was brought into court. This shows the importance of settling accounts to a particular date.

The sub-contractor brought the case to court before a jury of twelve men. His counsel outlined the case, claiming that of this series of transactions there were only three items in dispute, and claimed a balance of so many dollars due his client.

The plaintiff was put on the stand, and, after some questions by his lawyer, to verify the balance claimed, was told that that was all. The judge demanded the original books of entry. The best the plaintiff could produce in court were bills, statements, etc., although his lawyer had told him to bring his books into court. The judge said, "You are suing on an open book account, yet you do not produce your books; we cannot go on with the case." Without a word from the defendant the case was non-suited, and the expense thrown on the plaintiff.

Probably this particular case could be multiplied without number. The plaintiff did not produce the evidence of the transactions at the time they occurred. Which only goes to prove the care that is necessary in bookkeeping.

However trivial the transaction, it should be put on the books the day it occurs, because it may be linked with a series of transactions in the nature of a running account, the whole of which may be disputed. If suit is brought on a running book account, it is necessary for the one bringing the suit to prove his case, and not the man whom he is suing to prove that he does not owe it. The burden of proof is on the one making the claim.

In the case noted above, the sub-contractor could bring another suit, but he would have to begin all over again; and unless the books of original entry with these transactions entered therein at the time and in the order they occurred were produced, it would be very difficult for him to support his claim.

Caveat Emptor

This is a legal term and principle in law meaning "Let the buyer beware." The responsibility of getting what he pays for is on the buyer and not on the seller. This principle is probably not so strictly enforced in commercial practice as formerly, because the idea is to please and hold customers rather than to antagonize them, but it still has rather a strong hold legally.

It is well for the buyer of contracts or orders, as well as merchandise, to remember this old legal term of "Let the buyer beware." It is quite possible to buy a contract, perform it, yet not be able to collect for it without a great deal of legal trouble. This is illustrated by a case that was tried in a State court a few weeks ago.

The defendant in the dispute thought he had contracted with a corporation, but it developed later that he had done the work for a member of this corporation, and he was bowled out before the trial was half finished. In every

State there are very close corporations, the stock being held by two or three persons and its management conducted entirely by one person. In these cases the dividing line between the corporation and the person managing it is well nigh invisible. Hence, in dealing with a corporation of this nature or any member of it, *caveat emptor*—let the buyer of contracts beware.

In this particular case the corporation was a peculiarly close one. It was practically owned and conducted by one individual. It had some dealings with a general contractor, and there were several transactions on both sides. The contractor was given an order to do some work on the property of the corporation manager, which he did, supposing it would apply on account of what he owed the corporation. After some later transactions a dispute arose over the amount due. The contractor was sued and given a non-suit, but this particular item was not brought into question by the corporation at the trial.

Result of Second Suit

A second suit was entered and brought to trial. The amount of the bill for work done for the member of the corporation was objected to by him as not owing by the corporation; it was done for him and not for the latter. The corporation manager, however, conducted exclusively all of these various transactions with the contractor. The court sustained the objection. The amount of this item was more than the amount in dispute, and the contractor was forced to drop his case without being heard. His claim is against the corporation member who told him to do the work.

In a close corporation owned and managed by a single individual it may not always be easy to determine which is which. Where the responsibility of one person ends and that of the other begins may not be easily decided where an order is given verbally. In the eyes of the law, a corporation and the man owning 99 percent of its stock and managing its every detail absolutely are just as distinct as two strangers a thousand miles apart when it comes to something like the transactions noted above.

If the owner and manager of such a corporation comes in, slaps you on the back and says: "Hello, old top, just step over and do so and so for me, will you?" you had better remember *caveat emptor*, and say: "Right you are, old chap! Shall I bill it to you or to your corporation? Sign here, please."

Buying Without Authority

A man in New Jersey turned a neat trick some time ago, and succeeded in getting something for nothing. The local newspapers came out with the statement that he had bought a suburban property. This was only partially correct, for the title was taken in the name of his wife. Certain improvements were needed on this property and he told several who were engaged in the different building lines to do certain work, not very much work for each, but considerable in the aggregate.

When the bills were presented for this work he said the property belonged to his wife. When these were presented to her she said that she never had ordered the work done, nor had even authorized it to be done, and refused to pay. The man bluffed the storm of protests, threats, etc., through and was finally left in peace. Of course, he ran some risk, but was an adept at the game and knew how to handle himself. A suit could have been brought for conspiracy to defraud, but as a conspiracy is very often hard to prove and as the amounts involved in this case were small, no one wanted to undertake the expense of such a suit.

Beware of accepting a promissory note signed or endorsed with the words "Without recourse" on it. These words serve notice to the holder that no obligation is assumed by the one using these words, either in signing or endorsing the note. The one using these words may be worth any amount of attachable property in case of a law suit, but not a penny could be collected from him or her on account of such a note.

Without Recourse

A firm of lawyers engaged in building operations in a certain city actually tried to work this scheme on a contractor. They offered quite a good-sized contract to the contractor, who was in the office of the lawyers arranging the terms of payment. Very naturally they wished to put as little money into the building operation as possible, depending on the placing of mortgages, sales of property, and the taking of equities by the different contractors, to carry the operation through. After some bickering they offered three-fifths cash payable as the work progressed, and two-fifths in deferred payments. The contractor said he would accept the offer if the lawyers would give him their individual notes for the unpaid amounts. He was safe in making this offer, because they were good for the notes.

Note now what happened. They came back at the contractor with this proposition: *"These houses are being erected by a corporation. We will have this corporation give a note, 'without recourse,' to our superintendent for the amount due, who will endorse it and turn it over to you."* The superintendent was merely a "straw" man financially, and the note would be worthless. Fortunately, the contractor knew something about the value of the words "without recourse" and said he did not care to deal along any such lines. He immediately left the conference, somewhat to the amazement of the lawyers.

This shows the importance of knowing the meaning of the words on certain business instruments.

Here are a few other legal points worth knowing.

The acceptance of an offer completes the contract. After the buyer accepts, the seller cannot withdraw, even though the acceptance may not have had time to reach him.

You cannot buy or sell an interest in a partnership to a third party without the consent of the other partner. The legal power to make a transfer is unquestionable, but the one to whom the transfer is made does not become a tenant in common with the other partner; he simply acquires a share in the business after the affairs of the firm are settled and the debts paid.

The words "without defalcation" in a promissory note mean that the maker will pay in full to the holder without any claim for offset, however good such claim may be.

If a debt is more than six years old and outlawed, it can be revived for another six years if the debtor pays only a dollar on it, or acknowledges it and makes a promise to pay.

A verbal agreement guaranteeing the payment of an account of another (unless it is exceptional in character, which must be shown) cannot be enforced. An agreement guaranteeing the payment of the debt (or account) of another must be in writing.

A story is told of two boys who went to their village school professor as to the result of their examinations, and were told that the matter was in "status quo." The boys retired very much puzzled as to the meaning of this phrase and went to the village postmaster for an explanation. He shook his head and referred them to the town constable, who said it was evidently some legal term, but beyond him, and they had better consult the squire.

The predicament was placed before that important personage, who looked wise, took down several law books, banged them about the table and finally said: "Boys, if you are in status quo it means that you are in one deuce of a fix."

The moral of this story will apply to those who are careless or indifferent about certain legal requirements in business transactions. When in doubt, consult a lawyer to be sure you are right. It is much more economical to pay a lawyer to keep you out of mistakes, blunders and trouble than it is to get out of trouble through errors of your own making and which were entirely unnecessary.

In legal matters the game is something like that of playing checkers—you make a mismove and lose.

Defective Oxy-Acetylene Welds*

Expert Acetylene Welders Needed—Operators Lack Necessary Technical Knowledge—Causes of Defective Welding Analyzed

BY CAPT. D. RICHARDSON, R. F. C., WH. EXH., A. M. I. M. E.†

The use of oxy-acetylene welding has become so important and valuable that all who have the interests of the industry at heart must welcome the opportunity which meetings like this offer for the interchange of views, dissemination of knowledge, and the development of that spirit of organization and co-operation which are so badly needed at the present time in the welding industry.

In spite of the intensive development of the process, there is still a large body of opinion in the mechanical trades opposed to the use of acetylene welding in any shape or form, and, in addition, there are engineers who only consider it suitable for the class of work where the strength of the joint is of secondary importance.

This opposition is frequently based upon the uncertainty of the results, for it is no exaggeration to say that a large percentage of the welds made at the present time would, on examination, give rise to serious criticism.

We all know that daily some inexperienced welder is tackling a job about which he knows nothing, and failure of the joint may, in many cases, lead to accidents. This uncertainty of results is due very largely to the absence of adequate supervision and restriction, and to loose methods. It is now possible for anyone with the price to purchase welding equipment and tackle anything that comes along.

Expert acetylene welders are few and far between. So-called "expert" welders—men who have been handling the blowpipe for several years and have classified themselves under this head—generally prove, as a scrap pile at Holloway will testify, that they have no real knowledge of the process or its development.

The proper growth of the industry depends upon it being supervised and operated by competent workmen, and perfection in this, as in any other important mechanical field, can only come about by education and co-operation; in this work, needless to say, there is immense scope for the activities of such an association as this.

Given good apparatus and accessories the majority of acetylene welds will be more or less defective because the operator lacks the necessary technical knowledge. It is exceptional to find a skilled mechanic welding, and the unsystematic way in which the majority of welders are trained is a serious handicap to the rational development of the industry.

An illustration of the latter point is brought to mind by a recent visit to a northern welding school. No definite plan of instruction appeared to be laid down and the valuable time devoted to the lectures was more or less wasted in dealing with relatively unimportant matters, such as the manufacture of oxygen and carbide, the sketching of details, etc. The necessary metallurgical knowledge and methods of dealing with the various classes of work likely to be met with were missed altogether. I hesitate to mention the sad fact that the instructor had never seen a copy of a journal.

A further illustration is to be found in the course of instruction given at a welding school not a hundred miles from here. At least one of our members could testify that the instruction leaves very much to be desired, and the fact that the instructor wrote to me for assistance in giving him technical points to pass on to the men speaks for itself.

There is a whole host of points in which the skilled welder must be well versed. He must know the fundamental principles of the process and care of the apparatus; the power and position of the flame for various classes of work; the preparation and adjustment of the work, so as to take care of expansion and contraction effects; the adjustment and handling of the blowpipe, so that the metal is properly joined with the minimum of overheating and of change in the physical and chemical properties; how to obtain a maximum efficiency from the consumption of gases; how to judge by the appearance of the metal when the methods are correct, and so on.

Skill can only be obtained by practice under proper instruction and at the expenditure of a great deal of time. The consumption of gases, filling materials, and time will be large before a man becomes thoroughly efficient. Long before he becomes an expert welder he will be able to handle in a satisfactory manner a large variety of work, but it will be some time before he can produce welds at a minimum cost.

It should be clearly understood that an expert welder with good apparatus, correct filling materials and the necessary metallurgical knowledge can produce welded joints on materials like wrought iron, mild steel, grey cast iron, copper, brasses and bronzes, aluminum and certain aluminum alloys, lead and zinc, with mechanical properties approaching those of the metal joined, and in which the strength and service of the joint are absolutely reliable.

Common causes of defective oxy-acetylene welds are:

(1) Defective or badly handled generating plant yielding impure acetylene.

(2) Defective installation giving irregular delivery of gases at blowpipe.

(3) Faulty manipulation of the blowpipe.

(4) Faulty filling materials.

* Abstract of a paper read before the General Meeting of the British Acetylene Association, March 13, 1918.

† Technical Contributing Editor, Acetylene and Welding Journal, of London.

(5) Faulty preparation and adjustment.

(6) Faulty after treatment of welds.

This is not the time or place to do more than briefly deal with these causes; frequently the failure of a welded joint may be traced directly back to the apparatus or gases. The design and layout of the generating plant may be such that the acetylene reaches the blowpipe in a condition which will make the welds porous, brittle and burnt. The importance of quality in the choice of apparatus cannot be overestimated.

The overloading of the generating plant is very common and is responsible for many defective welds. The maximum requirements are usually badly underestimated, and portable plants are often installed where fixed plants working more economically and producing better gas should be given the preference. Sufficient emphasis has not been laid on the fact that overloading of a generator generally gives a gas that is saturated with tarry products, water vapor, lime dust and chemical impurities.

Inefficient Purification

Assuming the generating plant is well designed and not overloaded, much unsatisfactory welding may be traced to inefficient purification of the gas—an essential often overlooked. It is not difficult to agree with Mr. Charles Bingham's conclusion in "Carbide of Calcium" that not one acetylene user in ten keeps his purifier in a really efficient condition. I know of one important aeroplane works where the purifying material is changed at definite periods irrespective of the quality of gas used in that period. It should be well known that a well-designed and efficiently kept purifier is indispensable for the elimination of moisture, lime dust and chemical impurities, which are a common cause of defective welds.

Faulty design or layout of the installation may result in the acetylene reaching the blowpipe not only in an impure condition but in insufficient quantities and at a varying pressure.

The layout of the acetylene piping in the majority of installations leaves very much to be desired and is a cause of defective welds. The piping is frequently too small, and the considerable loss in pressure leads to aspiration of air through the hydraulic safety valve and unsatisfactory working of the blowpipe. This question of piping should receive much more serious attention on the part of installators and users of the process.

A standardized form of the Fouché hydraulic safety valve suitable for the largest size of blowpipe is badly required. Oxidized welds are common when using medium or large sized blowpipes in conjunction with certain makes of valves. It is unfortunate that with some classes of valve the charging should take place under gas pressure, and in others under atmospheric pressure. The importance of proper charging and care of hydraulic safety valves in relation to the quality of the welds obtained is not well recognized.

From the oxygen supply point of view the most prolific cause of defective welds is defective regulators. These, thanks to bad handling, get almost immediately out of order. Few welders understand the principle and consequently do not know the care that is required to keep them in good working order. Successful welding demands that the oxygen and acetylene be delivered to the blowpipe in unvarying proportions and at the correct pressure. Oxidized welds are common when using faulty or badly manipulated regulators.

Defective welds can occasionally be attributed to the flexible tubes conveying the gases to the blowpipe. If the tubes are long the balance and good handling of the blowpipe are interfered with. Certain classes of tubing give too great a loss of pressure, and if the tubes are very flexible the character and composition of the flame tend to vary.

The oxy-acetylene blowpipe, which is apparently a simple tool, has had thousands of dollars spent on its development with a view to constructing one which will deliver the mixed gases in correct proportions and with the correct velocity. Provided the design is not faulty, defective welds are frequently caused by the use of a defective blowpipe, or by bad regulation and manipulation.

The choice of the correct size of blowpipe and its proper manipulation has a direct influence on the quality of the welds, especially in the case of steel welding.

Lack of knowledge of the structure of the flame and of the influence of different parts of the flame on the metal being joined is one of the principal causes of defective welds. There is still a host of welders who consider the white cone, or the luminous part of the flame, as the *Alpha* and *Omega* of the welding flame, and whether they are melting steel, cast iron, aluminum, copper or any metal, the part of the flame is alternately dipped in and taken out of the molten zone. Even when the welder appreciates the importance of the correct use of the flame, the question of re-regulation is overlooked, and those blowpipes in which the proportions of oxygen and acetylene do not vary appreciably with heat effects have a marked superiority, owing to this general neglect of re-regulation.

Defective or unsuitable filling materials are responsible for the failure of many acetylene welds. The greatest care is essential in choosing welding rods and fluxes. It is important to note in passing that constructors are only just beginning to pay attention to the other side of the question and to make or purchase material suitable for the application of the oxy-acetylene flame. Not only must the filling materials be of the correct chemical requirements so as to replace loss in the molten zone, or to counteract the tendency to oxidize, or assist in making the molten metal flow readily, or to break down oxides when formed, but they should act satisfactorily under the blowpipe.

Faulty preparation is responsible for many defective welds. From an oxy-acetylene welding point of view co-operation between the designer and the welder is the exception rather than the rule. One frequently sees lap welding arranged on new work, and it is difficult to get good strength or to eliminate oxide layers in such cases. The beveling and cleaning of the parts is frequently looked on as wasted time, whereas failures due to overheating effects, burning, bad penetration and oxide inclusions are a natural result of this neglect. Apart from the question of the strength and ductility of the welds, it is not difficult to demonstrate that it is a marked economy to carry out these important preparations.

Expansion and Contraction

The importance of taking care of expansion and contraction effects is not well realized. Warpage and internal strains, followed by failure at the weakest point, are the common result of a welder not knowing how to deal with this problem. In castings where preheating is used for this purpose the arrangements are often unsatisfactory. The heat is given in anything but a uniform manner, and it is impossible to carry out the repair without moving the casting.

It is quite common to see work bolted to plates to prevent expansion, devices for preventing contraction, rigid jigs and clamps, and welders are more or less surprised when consequently distortion or fractures take place. It should be realized that devices such as jigs, unless specially designed for welding in position, should only be used for their main purpose, that is, adjustment or tacking in position previous to welding proper.

The methods of taking care of expansion and contraction are not generally known, with the result that many welders assume that all castings must be heated all over, whereas this method is only one of half a dozen for taking care of expansion and contraction.

Defective welds are common where the proper after treatment is not applied. The weakness of the structure of the welded area is generally very great, but few welders realize that if strong welds are required the structure must and can be restored. It is useless to attempt either the understanding of the method or its correct application unless we are certain that the fundamental principles already outlined are in practice. Thermal and mechanical treatments of the majority of defective welds will help but little. The thing to do is to first make a proper weld.

Learning the fundamentals of successful oxy-acetylene welding is not difficult. If the same study is given to the process as to any other trade, failures and defective welds will practically disappear. It does little good to prepare the work properly unless the operation is intelligently carried out. Defective oxy-acetylene welds should be viewed by engineers and others in the light of the incorrect application of the process rather than upon the process itself. If these few notes result in directing greater attention to the importance of apparatus, the preparation of work, the importance of expansion and contraction, the requirements of the welder, the after treatment of the weld, and the limitations of the process, their purpose will have been achieved and the writer's hopes more than realized.

Smoke Prevention—Coal Saving Suggestions

Some Do's and Don'ts for the Coal Consumer

Just at this time, when the conservation of coal is an absolute necessity and every practical suggestion for such conservation is a shot at the enemy, everyone realizes that smoke issuing from boiler stacks represents unused heat units. But everyone does not realize that certain simple rules, if observed in the fire room, will materially decrease this loss. The suggestions herein are based on many years' experience of the Westinghouse Electric & Manufacturing Company's combustion engineers and are briefly outlined below.

1. Give your fireman an opportunity to acquire the fundamental principles of fuel burning.

2. If you have a difficult fuel problem, consult a combustion engineer.

3. Prevent smoke by proper firing methods.

4. Use gages to indicate exactly the condition of fire bed at all times. As a minimum these gages should consist of draft gage indicating draft in furnace above fuel bed, draft gage indicating draft at boiler side of flue damper, and a steam flow meter for individual boilers.

5. CO_2 is the principle product of complete combustion of coal. Ten or twelve percent CO_2 should be obtained in flue gases to insure minimum fuel loss.

6. Avoid loss due to unburned coal in the ash.

7. If you are wasting exhaust steam you are wasting coal.

8. Do not permit grates to clog. A systematic method of keeping the air spaces clean must be followed.

9. Inspect the baffles in boilers, as broken or leaky baffles raise the flue gas temperature and waste coal.

10. Avoid leaking in of cold air around boiler setting.

11. Install stokers. Hand firing is rapidly being recognized as an obsolete and wasteful method of firing.

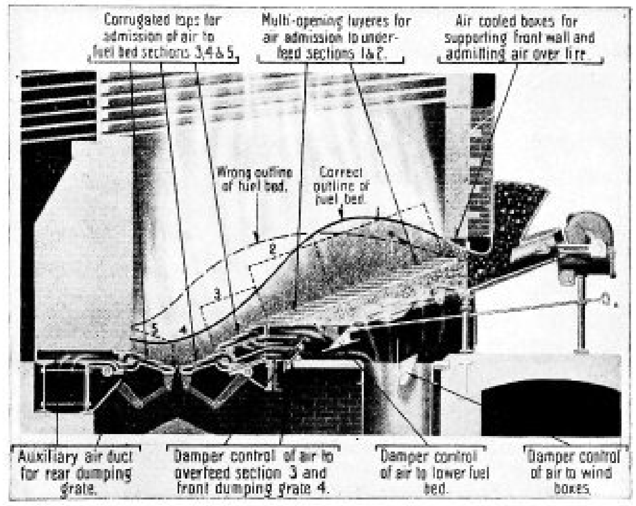
12. Clean scale from tubes, as every particle of scale represents wasted coal.

13. Avoid soot formation. All boiler tubes should be blown externally once every eight hours when in continuous service.

14. All smoke flues should be as short and straight as possible. Flues should also be made airtight, and all joints and connections should be well fitted, calked and riveted. Use asbestos gaskets on clean-out doors.

15. Locate flue dampers in front of boiler, so that fireman will adjust them as required. Dampers located in rear of boilers are seldom disturbed, regardless of conditions.

16. The size of coal has much to do with capacity and efficiency of boilers. In general, the air pressure penetrates the fuel bed formed by coarse coal easier than that formed by finer coal, resulting in disturbance of best furnace conditions.



Typical Fire Bed—Stoker Fed

In addition to the above suggestions, the following "don't fail to do" list should be followed:

Don't fail to—

Keep the heating surfaces of the boilers free from soot, scale or oil.

Keep the fires level and free from holes.

Do not carry the fires so thin as to draw a lot of excess air through.

Do not carry the fires so thick as to have incomplete combustion of the coal.

Do not soak the coal with water before firing.

Be sure the blow-off valves do not leak.

Do not have the safety valve popping off continually.

Cover steam pipes.

Do not waste steam through leaky valves or traps.

Never use live steam if exhaust steam is available and can be used as well.

An observance of the foregoing simple rules and suggestions should materially reduce the coal consumption of the average plant.

The Failure of Boiler Plates and the Stresses in Riveted Joints*

Investigations Made Into the Causes of Cracking of Boiler Plates—Both Lap and Butt Joints

BY E. B. WOLFF, DR. IR.†

This research was undertaken with the view of finding the causes of the cracking of boiler plates over the riveted seams.

The boilers were of the single-ended ordinary marine type with three flues. The shell plates and the rivets were generally approximately 32 millimeters thick, made some from basic and some from acid open-hearth soft steel with an ultimate tensile strength of 42-48 kilograms per square millimeter and an elongation of 23 to 20 per cent on ten diameters. The phosphorus and sulphur contents had to be under 0.05 percent. After the plates had failed these particulars were checked and the plates, as far as the above-mentioned rules prescribed, were found to be good. Most of the boilers with the cracked plates belonged to steamship companies, the boats of which made voyages with a great many stops, so that the fires were frequently extinguished and re-lighted. Most of the boilers being oil-fired, this could be done very easily. The plates of coal-fired boilers, however, cracked in the same manner. Boilers made of the same material for other companies, the boats of which had only long non-stop runs, did not fail.

The researches were started after one of the boilers had exploded. An investigation of this case showed that the explosion had been caused by the shell plate of the boiler having burst open in the middle of the double butt strap joint at the side. Through the large opening the contents of the boiler had been ejected, destroying the hull of the ship and causing much damage. The ship was fortunately lying alongside a quay, so that it was not lost. Had the explosion occurred an hour later, probably nothing more would have been heard of the ship.

After the rupture, the shell plate, at the place where it had failed, had a thickness varying from 33 millimeters, the original dimension, in the middle, to 27.5 and 28 millimeters at the sides—see Fig. 1. As the plates had an equal thickness in all other parts, the only possible explanation of this difference was that the plate had failed by the forming of a crack in the middle of the length of the boiler, this crack having gradually developed to such an extent that the sound part at the sides could not withstand the boiler-pressure and failed suddenly, showing a reduction of area only in that sound part. As at the time the direct cause of this disaster could not be ascertained, it was decided to take out of service all boilers made of the same material and at the same time as the burst boiler. One of these was sent on, taken to pieces, and examined thoroughly. It was found that a large part of the shell plate, under the butt strap cover plate, had cracked. The crack could only be detected by taking off the cover plate. If the boiler had been kept in service much longer a similar disaster would have followed.

In the years following, other boilers, made with every precaution and good workmanship, and of the best material obtainable, also cracked, but not always in the same seam; sometimes the lap joint joining shell plate and front plate failed; in other cases both joints developed cracks in some parts.

It would take too much space to give a full description of all the tests made to obtain an insight into the mechanism of this cracking. It will be sufficient to give a general review of the results. The author here wishes to observe that he has found the same kind of cracks in cases of leakage of ordinary Lancashire factory boilers, and in a case of the cracking of the waterdrum of a Yarrow type marine boiler.

The investigations included tensile and binding tests, macroscopical and microscopical examination and chemical analyses of the material. The continual observation of the boilers in service at sea being much more severe in later years, several cases were detected where cracks had only just started.

General Description of the Cracks

All the cracks found are, in the beginning, defects of microscopical dimensions. After having increased in length and breadth they could be detected. It would occur that a boiler, the side seam of which had failed, would be sent back to the boiler shop to be fitted with a new shell plate. After detaching the front plates, nothing abnormal would be seen, and it would be decided to make use of the old front plates and fit new shell plates to them. The shell plates were bent with great care to the radius of the front plates and bored in position. When the first rivet joining the front and shell plates was put in, cracks appeared in some of the old rivet holes of the front plate. By a renewed examination of the other rivet holes, after cleaning the metal by scraping it carefully and later etching it, minute cracks were detected. The etching of the front plate, in the manner presently to be described, disclosed a great many miniature cracks, so that it was impossible to use it any more.

As has been stated above, the cracks were found in the butt joints as well as in the lap joints, but in all cases they started either from the inside of the holes, in two places, where the highest tensile stress occurred, or at the surfaces of the plates, there where they were pressed on the surfaces of other plates. The fact that cracks start frequently on the inner surfaces of boiler plates has been mentioned by several investigators, but a good indication of the causes has not been given.

The accompanying diagrams show the peculiar form of these cracks.

It will be seen that the cracks cover a certain part of the surface, depending on the direction of the stresses that acted on that part. Where they are found in the rivet holes of the plates, they occur generally on two sides of the holes; in the case of the pipe holes of the tubular boiler they spread from the top of the hole inward. When they occur on the surface of the plate, it is in general mostly around the rivet holes, but also in other places.

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* From a paper read before the Iron and Steel Institute of Great Britain.

† Bussum, Holland.

The cracks start as miniature surface cracks of microscopical dimensions; it appears that every little crack has been formed by itself, without the slightest reference to its neighbors. A polished and etched section through these cracks shows that the crystallites in the immediate neighborhood have not been deformed. The structure of the material has in most of the cases been found quite normal, no free cementite being present. Afterwards the cracks grow in length and depth, and unite in longer ones, forming a peculiar stepped line.

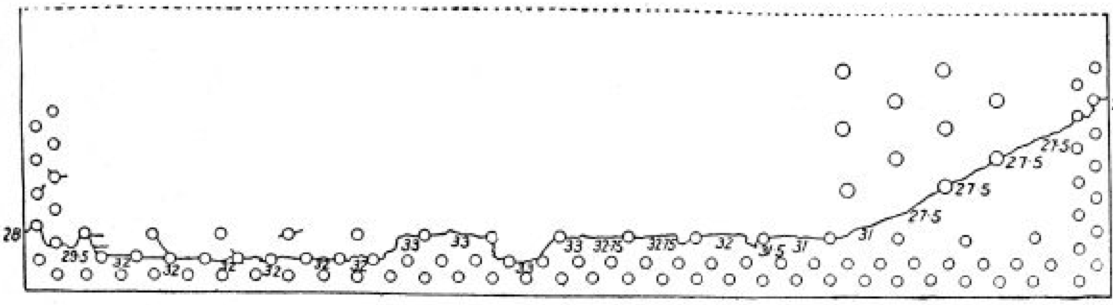


Fig. 1.—Joint of Exploded Boiler, Showing Line of Failure

All evidence points to a peculiar form of destruction of the surface layers of otherwise very plastic metal.

As the cracks always started at the surface of the metals and in the holes over the entire thickness of the plate, phosphorus or sulphur segregations, if these had occurred, could have had no influence. No segregations of importance were, however, found in most of the cracked plates. At first it was thought that the deformation of the material in the rivet holes made by the boring of these holes might have had a great influence. As it was not possible to produce similar cracks in holes that were bored with a blunt drill, and as pieces cut out of such a hole and bent open till the deformed surface broke showed sufficient deformation before breaking, it was concluded that if the deformation had been one of the causes, it could only have been a secondary one. As hand riveted joints cracked in exactly the same manner as joints where the rivets had been pressed in by the hydraulic riveting machine, the pressure of this machine on the plate also cannot be the cause of the cracking—Fig. 4. Parts of the cracked plates, where no cracks occured, were tested by joining them by rivets, driven in with the maximum pressure the press could give. Afterwards the rivets were taken out and the plates examined and bent. Here a great deformation of the surface also preceded the rupture.

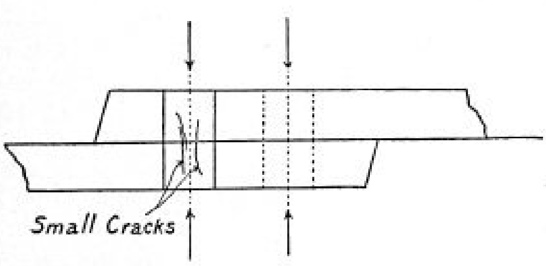


Fig. 2.—Diagram of the Cracking of a Lap Joint

To reveal the miniature cracks it was found necessary to etch the metal with dilute sulphuric acid (1:10) during twenty-four hours or more. Before this etching the cracks were covered by the surface oxides, and they could not even be detected after scraping the plates thoroughly. It was necessary to ascertain that this etching did not cause similar cracks. It was found that in no case of deformation could cracks be seen after etching, not even if the metal was left in the etching solution for an abnormally long time. The deformed places were corroded in most of the tests before the rest of the metal, but this corrosion never caused sharply defined cracks. By an abnormally long immersion the deformed places could not be differentiated from the neighboring metal; the cracks, however, showed very clearly. Microscopical sections through non-etched parts showed that the cracks were clearly to be seen without the aid of an etching solution.

These parts in the boilers being subjected to stresses of such magnitude, it may be asked how it is that the few alterations during the lifetime of a boiler can cause these cracks.

It may be observed, in the first place, that the ships with boilers that have cracked, made relatively short voyages along the coast, and that in the beginning no care was taken to avoid changes in the steam pressure. When later care was taken to maintain the steam at a regular pressure, the cracking diminished, but did not stop altogether. The first boilers were oil-fired, and were made of basic open-hearth material; afterwards boilers

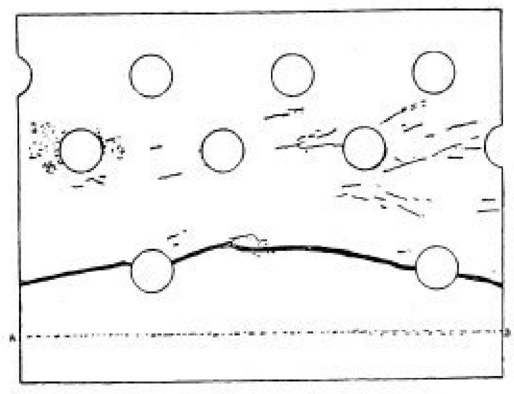


Fig. 3.—Diagram of Cracks on a Shell Plate

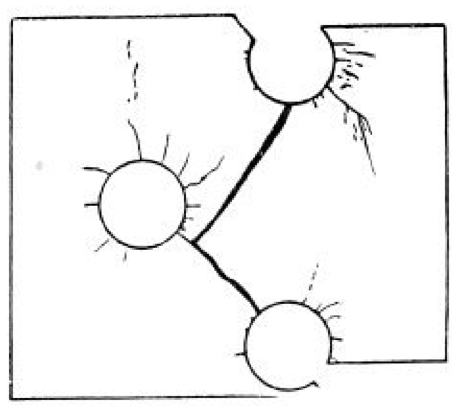


Fig. 4.—Diagram of Cracks in a Shell Plate

both oil- and coal-fired, made of first quality Scottish acid steel, cracked in the same manner. Notwithstanding the severe conditions of the service, the number of the alternations is, however, only few, when compared with that required to produce ordinary fatigue breaks. Only when it can be proved that at the places where the cracks are found abnormally high stresses can occur may we accept "fatigue" as the cause of these cracks.

It was necessary, therefore, to start an investigation of the stresses occurring in these parts of a boiler.

It is known from the theory of Kirsch and Leon, and the tests by Preuss, that the tensile tension at the edges of a hole in a bar loaded in the direction of its axis may amount to three times the average tension calculated for that bar. When it can be proved that the holes of a riveted joint can behave as in ordinary bars, we have an explanation for the fact that the tensions at the edges of the holes can reach a very high value. The average tensional stress in the cracked plates was approximately 11 kilograms per square millimeter. When this value is trebled, we reach such a high stress in these places that very few alterations will suffice to cause a crack.

It is thus necessary to prove that the friction between the plates will not be sufficient to counteract the deformation of the sides of the holes.

With a view of testing this, and in order to learn the values of the local stretch in different places of the surfaces of the plates that are pressed against each other, the author has made use of a special type of extensometer, designed by Mr. Okhuizen.

It consists of two knife edges that are pressed to the surface, where it is sought to ascertain the elongation as a measure of the stress. The change in the distance between these edges, one of which belongs to the fixed part, the other to a movable one, can be read from a scale by means of a simple arrangement of levers. The test pieces were riveted with great care in exactly the same manner as the riveting of a real boiler. The plates were of the thickest kind used in boiler design; the rivets were put in with the ordinary heavy pressure. The test pieces were put into the tensile testing machine and loaded to the amount necessary to produce stresses approximately equal to the ordinary working stresses of the boiler.

The extensometer was read in every place with the loads zero, maximum, and zero again. In all the measurements no permanent deformation occurred, the extensometer showing exactly the same figure of the scale before and after the loading.

Furthermore, a reading was taken with one of the knife edges of the instrument on one plate, the other on the other.

The Lap Joint

From the diagram—Fig. 5—it can be seen distinctly that the plates are bent as a result of the somewhat eccentric loading. It can be clearly seen also that although the plates are pressed together by the rivets, the material of both plates shows a similar elongation only in the immediate neighborhood of the rivets. In all other places the elongation is different, so that the surfaces move along each other. This movement, which is entirely elastic, has been recorded by putting the extensometer with the knife edges on different plates. The tensile stresses reach a maximum value at the inner surfaces of the plates, *i. e.*, the places where the cracks are observed to start. As these maximum stresses are far higher than the mean stress calculated for the entire section of the plate, it will no longer be surprising that in such spots even few alternations of stress will cause local cracks.

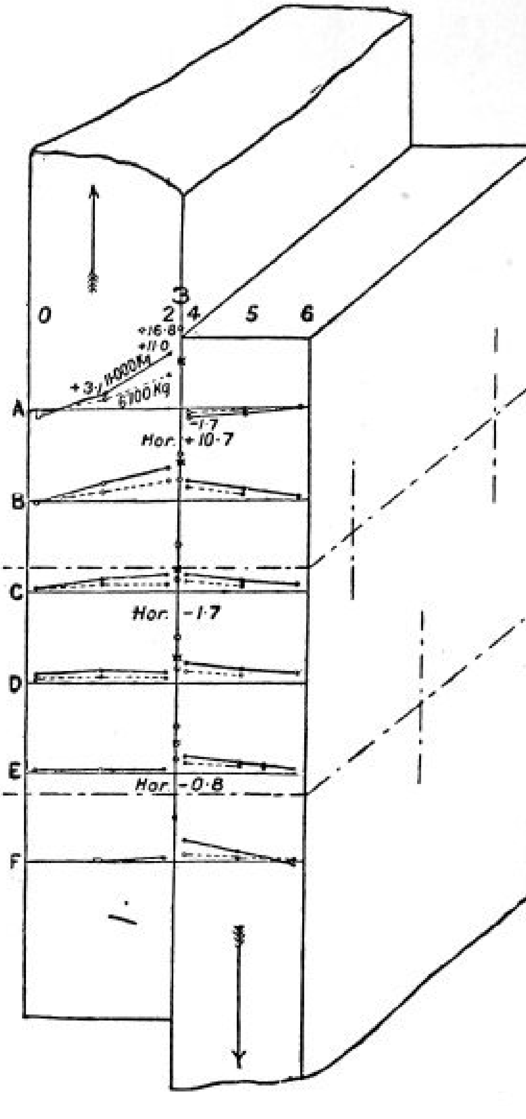


Fig. 5.—Diagram of Extensions Measured

The tests were executed with a total load of 17,000 kilograms, and one series was repeated with 25,000 kilograms. The values found here for the elongations are much more equal, but the displacements of the corresponding points of the two plates again show a great variety, as can be seen from the diagrams. Although the plates had become thinner at the places where the rivets press them together the measurements show that the underpart of the shell plate in the diagram has almost supported the total load, the cover plates showing very little stress. The cause could not be ascertained without destroying the test-piece, but without doubt the same situation can occur in a boiler.

The load is more or less gradually taken over from the shell plate by the cover plates; the gradual change will be different for every vertical section through the joint, depending on the position of the neighboring rivets and on the pressure of these rivets on the plates.

Photomicrographs of the separation line of the two plates disclose the fact that in those cases where the plates have been cleaned before riveting by scraping them with a stiff brush, as in normal practice, the metallic parts do not come together, but are separated by a very compact layer of some sort of oxide. This layer has irregular breadth, the surface of the plate being very irregular under this magnification. When elastic displacements of the plates occur of the magnitude demonstrated, we can easily accept the supposition that stresses will hereby be caused high enough to explain the cracking of the plates.

Proper Size and Spacing of Staybolts

Effect of Rusting on Relative Strength of Different Size Staybolts—Method of Preventing Corrosion

BY J. L. LANE

Conditions in boilers due to corrosion and erosion are constantly changing after the plant is in operation. If this fact were kept more in mind by the designer, a more efficient product would result.

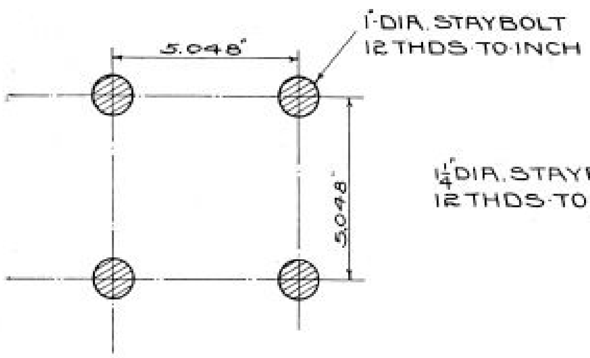
This is particularly true of boilers of the firebox type where supporting of the combustion chamber by means of staybolting becomes necessary. In spite of the excellence of the rules governing the construction and operation of boilers formulated by the different States they do not, and cannot be expected to, cover all points. To prescribe the exact size of staybolts and their correct spacing for different pressures and thicknesses of plates would be impossible. The most that the scope of these works permit is to define the construction between certain limits.

Between these limits the designer must use his own judgment in choosing the layout that promises the greatest efficiency. Simply because two designs each satisfy government requirements for a certain pressure, and are equally efficient at the time the boiler is installed, does not imply that the same state of affairs will exist a year later.

This is due to the fact that staybolts are being continually rusted away, and that the ratios of uneffected metal in two staybolts of different diameters, after the rust has penetrated to a given depth in each, is not the same as at the time the boiler was built.

To illustrate this, let us work out two designs for a staybolted surface, each for the same pressure, and then see how their efficiencies compare after a lapse of months; assuming, of course, they have been operated under the same conditions and that the rust has penetrated to a like depth in each.

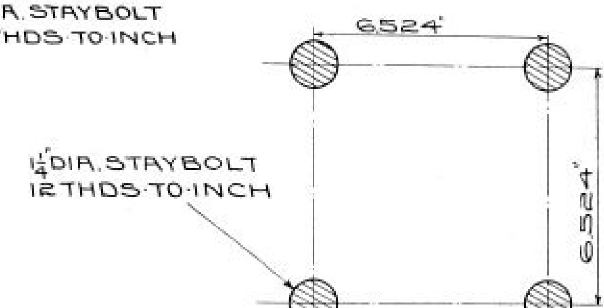
FIG-1



9/16" PLATE, 150# W.P.

DESIGN-A

FIG-2



9/16" PLATE, 150# W.P.

DESIGN-B

FIG-3

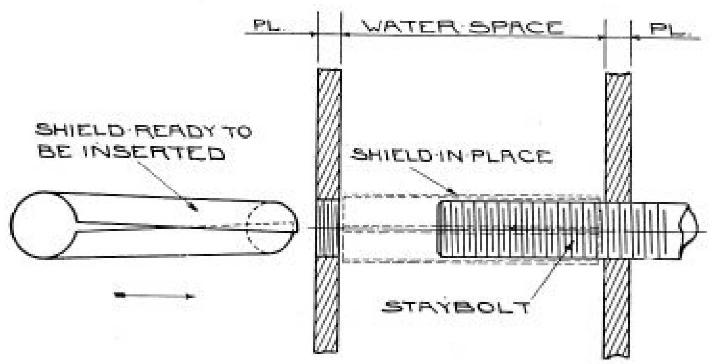


FIG-4

Diagram Showing Spacing of Staybolts

We will assume that each boiler is to withstand a safe working pressure of 150 pounds per square inch, that all plates are to be 9/16-inch thick, all staybolts to have twelve threads per inch. For the sake of convenience, let us follow the rules as laid down in the Massachusetts code.

DESIGN (A)

In design (A), staybolts 1 inch in diameter are used, and the required pitch is to be found.

From the table of allowable stresses on staybolts, we find that the allowable stress in pounds per square inch is 6,500 for mild steel or wrought iron staybolts for sizes up to and including 1¼ inches in diameter.

Now, consulting the table of areas, we find that the diameter at the root of the thread for this bolt is .8557 inch and the net cross sectional area .575 square inch. Therefore, the allowable load on the bolt is 6,500 x .575, or 3,737 pounds.

The formula for determining the pitch of staybolts is

$$(p^2 - a) \times P = L$$

Where

p = pitch of staybolts in inches.
a = area at root of thread in square inches.
P = safe working pressure.
L = allowable load in pounds on the staybolt.

Substituting the respective values in the above formula, we have

$$(p^2 - .575) \times 150 = 3737$$

$$p^2 - .575 = \frac{3737}{150} = 24.913$$

$$p^2 = 24.913 + .575 = 25.488$$

$$p^2 = \sqrt{25.488} = 5.048 \text{ inches}$$

Now, again consulting the code, we find that the maximum allowable pitch for staybolts, where the plate thickness is 9/16 inch and the working pressure is 150 pounds, is 7⅛ inches. Therefore the above spacing will be suited for the required pressure.

DESIGN (B)

In design (B), using the same pressure and the same thickness of plate, and proceeding as in design (A), we find that if 1¼-inch diameter staybolts are used the required pitch is 6.524 inches. As this is also less than the maximum pitch allowed in the code, this spacing satisfies all requirements.

Here we have two designs, using different diameters of staybolts and different pitches. At the time the boiler is put into service both are good for exactly the same pressure—150 pounds. Let us see how they compare later, after the rusting has, in each case, reduced the diameters of the bolts by ¼ inch.

1-Inch Diameter Staybolt (New)	1-Inch Diameter Staybolt (Rusted)
Diameter at root of thread = .8557 inch.	Net diameter = .8557 — .25 = .6057 inch.
Area at root of thread = .575 square inch.	Net area = .2882 square inch.

From this we see that the safe working pressure now is

$$150 \times .2882 \div .575 = 75.18 \text{ pounds.}$$

1¼-Inch Diameter Staybolt (New)	1¼-Inch Diameter Staybolt (Rusted)
Diameter at root of thread = 1.1057 inches.	Net diameter = 1.1057 — .25 = .8557 inch.
Area at root of thread = .96 square inch.	Net area = .5751 square inch.

Proceeding as in the previous case, we find that the safe working pressure for this design now is

$$150 \times .5751 \div .96 = 89.85 \text{ pounds.}$$

From this it is seen that, while both designs in the beginning are good for 150 pounds, after a like depth of rust penetration in each design, (A) is good for 75.18 pounds, while design (B) is good for 89.85 pounds, a net gain of nearly fifteen pounds.

Some attempt to compensate for this loss of strength due to rust penetration is made in the code by fixing the allowable stress per square inch in bolts on a graduated scale according to their diameters as follows:

Bolts up to and including 1¼-inch diameter = 6,500 pounds.

Bolts over 1¼-inch diameter = 7,000 pounds.

This is equivalent to increasing the factor of safety as the diameter of the bolt decreases. However, when it is seen from the preceding examples that after a rust penetration of one-eighth inch in each case a 1¼-inch diameter bolt retains 60 percent of its original effective cross section, while a 1-inch diameter bolt retains only 50 percent, it would appear advisable to extend this rule further, beginning with a ¾-inch diameter bolt and increasing the allowable unit stress per square inch for each sixteenth of an inch increase in diameter, instead of simply striking a dividing line at 1¼-inch diameter, as it now stands. This would tend to make different designs equally efficient after rusting had set in and leave less opportunity for inefficient design.

This naturally leads us to the subject of rust formation and to inquire whether there is not some practical way of preventing or at least hindering it. While the author does not believe it can be entirely prevented, he does believe that simple and inexpensive means can be devised for considerably retarding it.

The rapidity with which the cross sectional area of a staybolt is decreased depends on two factors—rust and erosion. As soon as the boiler is put into service, water comes into contact with the bolt and a coat of rust begins to form on its surface. If the water were stagnant and there were no circulation to contend with, the rate of penetration would soon begin to slow down, due to the layer of rust already formed, thus preventing the water from acting freely on the solid metal beneath. However, as the circulation is rapid, due to the formation of steam bubbles in the water leg, this protecting outer layer of rust is washed away almost as soon as it is formed, with the result that the uncorroded metal is directly exposed to its action.

It is to prevent the washing away of this protecting covering that the writer suggests the sleeve shown in Fig 3. This sleeve is made of one-thirty-second copper, rolled to a diameter slightly larger than the staybolt and open along one side, as shown in the cut. Its length should be slightly less than the width of the water leg. Since it will be larger in diameter than the staybolt hole, it is put in position in the water leg by overlapping the edges, as shown in Fig. 4, and forcing it through the hole, while the bolt is inserted from the opposite side.

A sleeve of this construction, while not entirely preventing rust, will lengthen the life of the bolt by keeping a layer of protecting rust about it at all times. In addition, it has the advantage of being easily installed, and, considering the saving in repairs, its initial cost should not be prohibitive.

Four skilled men fired four boilers as they thought best, slicing and raking at will. The amount of coal used was noted. These four men were also made to fire at stated intervals, with a given amount of coal for each firing; slicing and raking was also done at given intervals. In both cases the water was kept at a constant level. The regular firing showed a gain of about 8 percent in coal. The steam pressure was kept fairly constant in both cases and the work done by the steam was about the same.

A lump of coal is what is called static power. When this lump of coal, by heat, has turned water into steam, then its power is dynamic.

The Boiler Maker

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E. L. SUMNER, Secretary
H. H. BROWN, Editor

Beginning with the first of October, the Government will occupy the entire space of the Printing Crafts Building. This has compelled a change in home for THE BOILER MAKER. We have moved—moved to larger quarters—and happily announce our new address as 6 East 39th Street, New York, where we shall be pleased to receive our contributors and subscribers and advertisers at any time.

These days the measure of a man is revealed in the readiness with which he responds to Government appeals. The Fourth Liberty Loan is announced. We must prepare to give. We must economize—even go without—to meet this appeal. The war is entering upon its third and most important phase. Every man, woman and child is interested to a gravely vital extent. The loan must go over, and go over with a rush. The psychological effect alone upon the enemy of a bond issue eagerly snapped up in this country cannot be measured in concrete terms. That it does tend to weaken the enemy morale is a fact well recognized. Therefore, let us buy bonds, and buy till it hurts. In no other way can many of us serve our country in this great crisis. So let us serve. Let us put this loan over with a bang that will be heard to the innermost recesses of the house on Wilhemstrasse, Berlin, Germany.

Buy bonds!

The position which this country is destined to occupy in the markets of the world has been anticipated by a small body of men who have grouped themselves together into an organization known as the Allied Industries Corporation. The general plans laid down have been formulated to co-operate very closely with the various domestic and foreign trade bureaus of our government in order to work in harmony with the various international foreign trade bureaus of the allied and neutral governments. The corporation plans to conduct the broadest campaign of education possible and to promote and embody in this campaign principles of good will and international understanding. Thus it hopes to generate an influence that will be made to radiate as widely as possible through a comprehensive system of public education having as its object the fostering of reciprocal international trade relation, establishment of international customs tariffs, standardization of merchandise, the promotion of international legislation affecting trade relations and all international good will and co-operation. Besides investigating international market requirements and international natural resources, it will tabulate international exporters and importers for the service of buyers and consumers and disseminate information on these subjects. Also, international trade markets and patents will be listed and international financial investigations made and kept on file. In other words, the Allies Industrial Corporation aims to become a communicating link for and between the organized trade associations of the entire world.

The Allied Club, which will be operated in connection with the association, will afford all the usual and some very unusual club privileges to its members, who will consist of foreign and domestic importers and exporters, brokers, bankers, lawyers, shipping men and commercial agents—a membership that will include all of the proposed branches at London, Paris, Milan, Brussels, Lisbon, Shanghai and Tokio. The home will be located in the Grand Central Palace, New York. Since New York is very definitely the gateway through which American goods must go out to the markets of Europe and South America, just as it is the gateway through which the products of these countries must largely enter the United States, it is proposed to centralize in New York as far as possible the entire flow of foreign trade. Yet it is not the purpose of the organization to narrow the gateway, but to broaden it, very definitely locating a place where buyers from all the world may come together under one roof to facilitate the exchange of commodities and the interchange of ideas.

We feel that this indicates a very important step in the advancement of the foreign trade of the United States. Manufacturers of boilers and boiler accessories should take advantage of this opportunity to build up an international market for their products. Trade extension is always of vital importance, and what with the promised reconstruction period of France alone after the war the Allied Industry Corporation holds out special encouragement and ready inducements for all manufacturers to show a little life.

Men have always been upgraded and new men have been instructed in our tool rooms, but carelessly and slowly for the most part. An able head of a tool room in a big Philadelphia factory said, "You can't put women in our tool room. Our work is very diversified." Five minutes later he pointed out two green boys in the same tool room; one had been there two weeks, and the other three, and this man was proud of their work!

One factory with a turnover of 3,500 good machine operators per month is stealing far and wide. It will soon be stopped in this; but the point is it can train men from the non-essential industries, and women, if need be.

Owing to unprecedented transportation facilities, your copy of THE BOILER MAKER may reach you late. If you do not get your copy in time please do not be impatient, as it will eventually reach you.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, *6 East 39th street, New York city.*

Layouts for Crown Sheets and Throat Sheets

Q.—How do you lay out a crown sheet by triangulation? What is the easiest way to lay out a throat sheet? Will you kindly send a copy of your answer of this. E. R. N.

A.—In some cases no triangulation is needed to lay out a crown sheet. Thus, when the firebox is straight, as in Fig. 1, the layout will be a straight sheet. In case the crown sheet is in one piece with the sides, the whole sheet is sometimes called a wrapping plate. Its pattern will consist of a development of a series of straight lines and curves placed end to end, and both edges of the pattern are alike. Remember, however, when making the pattern, to take the measurements along the middle or neutral line of the curves. Mark off the middle rivet hole first and space the rivets each way from the middle.

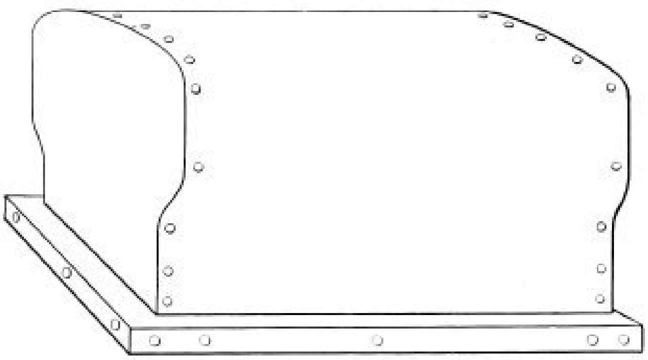


Fig. 1.—Straight Firebox

When the firebox is tapered, as shown by the dotted lines in Fig. 2, then triangulation applies. The pattern is shown in Fig. 3, and the true length of the sides of the triangles in Fig. 4. The crown sheet is usually formed by one long middle arc and two short arcs. Divide each of these arcs into three or more equal sections and draw the vertical and the diagonal lines as shown. The true length of the vertical lines is shown at *L* in the side view, while the amount of the taper is given by the length of the vertical lines between the two curves. The true length of the connecting lines is found by making the triangles shown in Fig. 4. Make the length between the horizontal lines equal to the length *K* of the firebox. The horizontal spaces *BC*, *BD* and *BE* are equal to the diagonal lines 1-10, etc. The diagonals *AC*, *AO*, *AE*, etc., are the true length of the diagonal lines shown in Fig. 2, and these are used for the radii when drawing the arcs on the pattern.

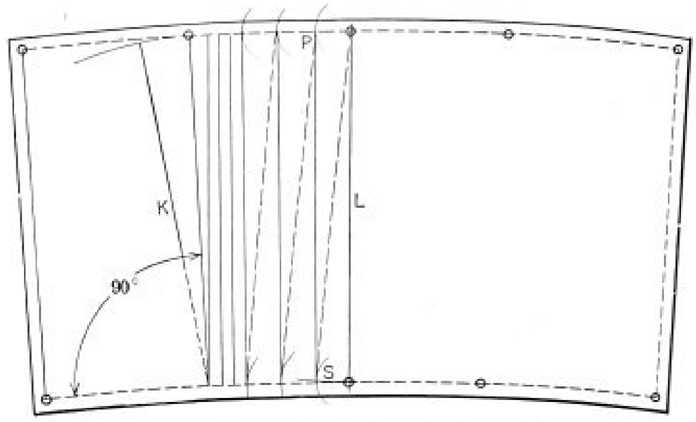


Fig. 3.—Pattern for Tapered Crown Sheet

Begin at the center line *L* of the pattern, Fig. 3, and at the lower end of this center line describe an arc with a radius equal to the length of 9-10 in Fig. 2. From the upper end of the middle line use a radius equal to the true length of the diagonal, or *AC* in Fig. 4, and describe the second arc. The point *S* of intersection of these two arcs will be a location on the rivet line of the pattern. From the upper end of the middle line use a radius equal to the longer arcs, 1-2, etc., at the larger end of the firebox. Then use a radius equal to *L* and a center *S* on the

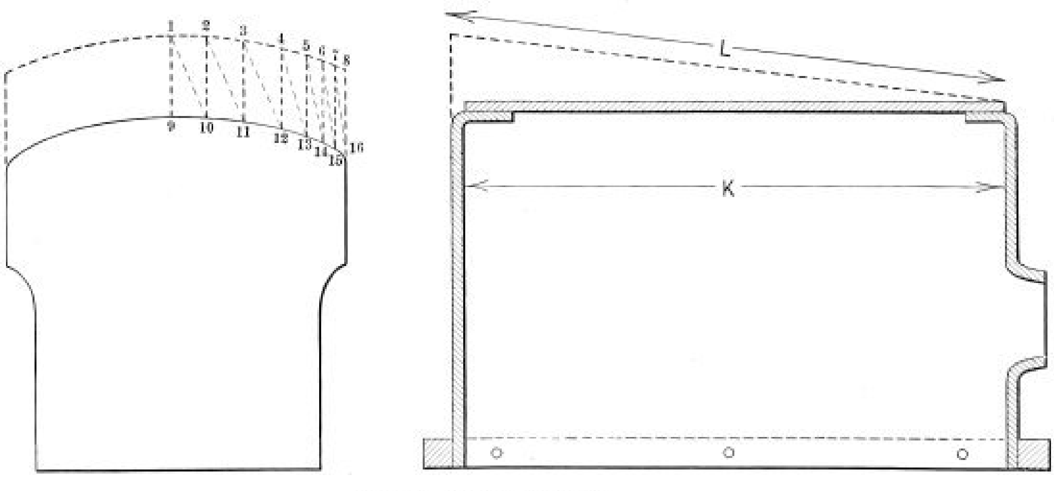


Fig. 2.—Tapered Firebox

lower edge of the pattern, and strike an arc that will locate a point P on the upper rivet line.

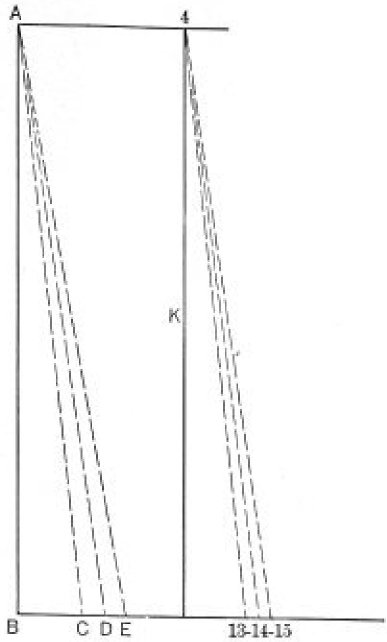


Fig. 4.—True Lengths of Diagonal Lines on Tapered Crown Sheet

This construction is continued until the curves are developed. Then lay off the straight lines that form the edges of the flat sides of the firebox and which extend to the mud drum.

Throat Sheet

In order to lay out the pattern for a throat sheet like that shown in Fig. 5, a mechanical drawing should first be

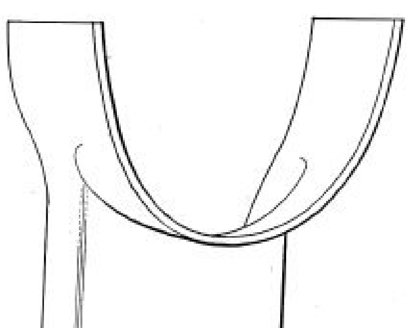


Fig. 5.—Throat Sheet

made of it, as in Fig. 6. Note that the neutral lines must be drawn along the middle of the sheet section for all the curves. The pattern is laid out as shown in Fig. 7. As the sheet must be flanged and distorted considerably, it is necessary to make allowances for the probable changes that cannot be accurately determined beforehand. These allowances are shown on the pattern by the dotted lines around the solid lines of the pattern.

First lay off the length A on the sheet that will be the same as that on the drawing. Then space off on the stretchout lines the widths for the length of the flats and curves as taken from the drawing. The flange lines are located on the pattern and are shown by the dotted lines. Some of the curve centers, as J, must be found by trial. Radius $M = V + H$, Radius $L = V - (a + b)$, and Radius $J = X - (H + G)$.

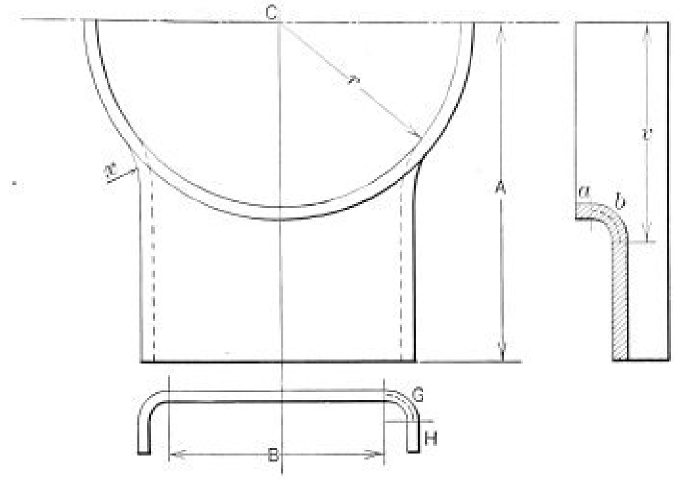


Fig. 6.—Throat Sheet Drawing

The allowances Q, R, I, etc., should be liberal, as it is better to be safe than sorry. Make the top allowance at least one inch, and that on the side curves one-half inch,

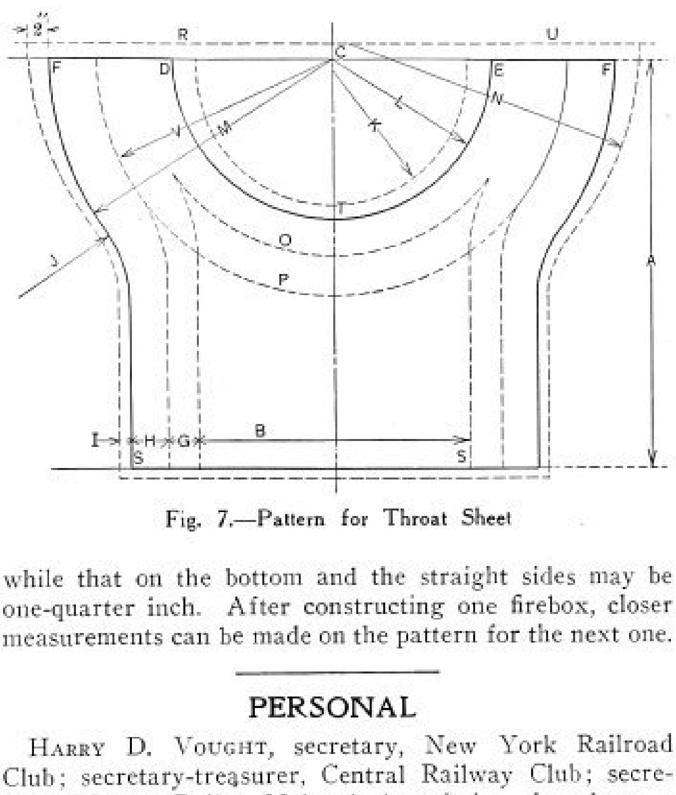


Fig. 7.—Pattern for Throat Sheet

while that on the bottom and the straight sides may be one-quarter inch. After constructing one firebox, closer measurements can be made on the pattern for the next one.

PERSONAL

Harry D. Vought, secretary, New York Railroad Club; secretary-treasurer, Central Railway Club; secretary, Master Boiler Makers' Association, has been a patient of St. Mary's Hospital, Orange, N. J., for the past six weeks, where he had undergone two very serious and dangerous operations. His recovery for a time was very uncertain.

Mr. Vought's friends will be glad to know that the ordeal through which he passed has ended in his convalescing, and it is hoped within the next ten days it will be possible to remove him to his home, 295 Orange Road, Montclair, N. J.

The Chicago Pneumatic Tool Company announces the appointment of C. W. Cross as special representative for the sale of pneumatic tools to railroads, vice L. C. Sprague promoted to be district manager of sales for the company at New York.

It is a curious fact that a left-hand thread always appears to be steeper in pitch than a right-hand one. Why this visual impression exists has not been explained.

Letters from Practical Boiler Makers

This Department Is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

Technical Contributing

Among the most common of the disabilities under which only too many first-class technicians labor is the inability to express clearly their ideas on paper. Large numbers of competent experienced engineers of a practical turn of mind simply cannot write a decent letter on an important subject. The neglect of the art of expression is one which carries many penalties in its train, not the least of which is that all responsible posts involve its need. It is one thing to explain in the vernacular to a sympathetic superior, but it is quite another to indite an explanation to an outsider. Such correspondence involves restraint, courtesy and explicit statement; the thought must be clear, the expression adequate, the style cogent, and the reasoning logical. It is admitted that such letters are unusual, but from a first-class business house they are not rare. In any case they compel notice and satisfy the recipient.

The cultivation of such an accomplishment is worth considerable trouble, and it is almost possible to assess both intelligence, ability and education, upon a simple letter of some length. The letter of application for an important appointment is closely scrutinized by shrewd men; it carries nearly as much weight as the impression produced at a personal interview, and, while it will not supercede technical qualifications, it will turn the balance between rival candidates otherwise equal.

The above is only one aspect of the matter. The cultivation of expression in writing clarifies the thought, and, indeed, it is not until an attempt is made to fix thought on paper that obvious gaps in the chain of knowledge or sequence of ideas make themselves felt. It is even of greater value to the individual than verbal discussion, which is a complementary means. To prove this is fairly easy. A letter will offend where exactly the same words spoken leave no bad impression; expression and tone modify the spoken words, but are absent from the written words.

Clarity of Style

Clarity of style is the most coveted of literary distinctions. Clearness of phrase, right grouping, correct sequence, all serve in some popular writers to cover paucity of idea. The great thing about literary work is to have something to say; the next, the manner in which it is said. The ideas voiced by the world's greatest writers are common enough to all mankind; but the art through which they are expressed is termed literature. Without aiming so high as this, it is worth while to every trained man to cultivate the art of clear expression in writing and speech. In fact, what is termed education as apart from specific training is little else than the power of grasping new ideas and giving clear expression to them. Every critic of engineering education deplores the frequent lack of clear expression among engineers. It is one of the great drawbacks to the technical man, who might otherwise be chosen to face large issues. For this reason alone he is often passed over, to his own great chagrin and the regret of those having the power of choice. The lack is lamentable. Now for the remedy.

Whatever one man finds interesting he can make interesting to others; in fact, if he is enthusiastic about the subject he cannot help but rouse interest in others—it is one of the motive forces of mankind. Among individuals near at hand he is apt to find little response; but could he be sure of one sympathetic ear he would by practice gain greatly in expression of thought.

The Technical Press

The technical press is the medium whereby he gains the interested audience he seeks, if his interest be in technical things, and in this not one ear but many. The only lack is the quick response of the live individual. In that it stands permanently, print has a power denied any other vehicle of expression. The indestructibility of literature is well known. Moreover, mistakes and errors of fact are certain to bring along the critic. Then there is another tangible advantage—it pays. It produces other printed paper, checks, which can be cashed. All this in return for practice in the art of expression, which of itself is so valuable in other connections! Not that wealth beyond the dreams of avarice is at the editor's disposal, but useful sums do come along to supplement, it may be, a slender salary.

The gain is double, for it is both tangible and intangible—cashable and educational. It sharpens faculties, revives the need for grammar, helps verbal exposition and leads to new viewpoints. The intangible may not be easy to assess and its marketable value may be long delayed, but the check on account is an extremely useful publication, even if the honor and glory go for naught. There is also the useful experience accruing from the despised and rejected, which helps to caseharden the spirit and prevent undue expansion of the cranium—otherwise "swelled head."

Moreover, contributions to the technical press are not turned down for literary fault. If the material is first class, the experience unusual, or the device uncommon, the editor supplies the lack, and the contributor, by comparison, gets paid for a free lesson in composition. He does better next time—or ought to. Indeed, no editor is ever overwhelmed with first rate stuff. He prays for its arrival, and when it comes it relieves him of responsibility and receives a warm welcome.

Benefits Derived

The benefits derived from contributing to the technical press are many—intellectual development, capable in itself of further extension; paid lessons in English composition, since the editor furnishes both the tuition and the pay; improvement in the invaluable art of individual expression; the turn given to independent criticism so nearly akin to original thought; and last, but not least, the very real pleasure literary composition affords the author. It must not be forgotten that one additional interest given is the one common to every journalist, whose eye, trained by need, finds subject matter in what other people miss. Article writing is a gamble at longer odds than any bookmaker gives. A penny stamp and a fountain pen are the tools of the trade. Naturally some brains go with the ink, but there is no one in the mechanical business who is destitute of some experience worth printing.

If this encourages the diffident, the purpose of this attempt of mine to turn even the mechanics of writing itself into coin of the realm will be served.

London, England. A. L. Haas.

Oxy-Acetylene and Thermit Welding

We are told that an "Open confession is good for the soul," and so I am anxious to make a confession, and that is, that I am not an acetylene or thermit welder, and that the thermit weld described by me in the May issue of The Boiler Maker was the first of such welds that I ever saw made, and its simplicity and the rapidity of the actual operation so appealed to me that I felt compelled to send a description of it to this journal.

I am glad to be able to report that the weld is still standing in good condition, and it may not be untimely to state that this frame had been welded twice previously by the acetylene process without success; another engine frame had been welded three times and failed each time, although the operation was performed by an expert especially hired for that particular job.

I have seen nice work done on flanges of flue or other sheets in locomotive fireboxes; old cracks filled up and, to all appearances, made as good as new. For some reason, however, the cause of which I do not know, this same kind of work at other times has failed. Evidently something occurred in the chemical composition of the sheets or the operator was unable to control the flame of his torch. It is quite probable that in making welds the flame of the acetylene torch must be a neutral one; that is, both gases must be equal or some other chemical action takes place in the material being worked.

I have seen a blacksmith with a natural gas furnace built around the frame do the job in jig time.

There is something in the chilling of cast steel frames when new that renders them difficult to weld. As to contraction, the only way to take care of that is by preheating. Setting up a stress of either compression or tension can be done in several ways with the application of jack screws, which will aid contraction. In the case of the thermit weld mentioned, however, the fact that the welded frame was in a flask of sand that had been dried out thoroughly when the beeswax was melted out and the ends of the frame preheated to almost the fusing point and then allowed to cool during the night (some fifteen hours of time) before the flask and sand were removed, shows how contraction was taken care of.

The various processes of welding all have their advocates. Therefore, I have no desire to champion the cause of any; but when failure of a certain process occurs daily the natural inclination is to turn to the process that does not fail.

In the district of Greater Pittsburgh there is a foundry that makes steel castings, and recently a very large order was received for locomotive frames from several firms building locomotives. Some of these frames were found to be defective and they were handed over to the acetylene welder to put in good condition. The firm which ordered the work done, on learning that the acetylene process had been used in the reclaiming of the frames, rejected the whole lot and the foundry people were notified that if the acetylene process was used again they would cancel their order, which was for two years' work. There was, however, no objection made to the electric arc weld. This firm employs many arc welders and uses many oxy-acetylene outfits, but the acetylene is confined to the cutting of various jobs and never to welding.

As to the strength of the acetylene weld over that of the thermit, I fail to see it. I believe I am fair-minded enough to admit that good work can be done with either process, but, as I said before, when failures occur every day and you know that one is a success and the other is not, one forms a very strong opinion as to which process to use if a choice is given.

Acetylene may be the superior of the thermit, for all I know, for my experience with the thermit is so limited. The result of my first experience, however, was so good that I think it worthy of another trial.

I cannot very well divulge the names of the firms I have mentioned for publication, but I will give the Editor of The Boiler Maker this information and will satisfy him that what I have written is the truth and can be verified at any time. I trust that Mr. I. Allison will be satisfied with my explanation.

Wilkinsburg, Pa. Flex Ible.

Repairs on Gravity Stills

I appreciate very much your remarks on the communication from Mr. Derrick and trust that it will lead to a correspondence through your columns which will be interesting to all your readers and helpful to many.

I regret for Mr. Derrick's sake, though on my own account I am rather pleased, that we do not have any high pressure stills to contend with here. I find quite enough to keep me busy and thinking with our gravity stills. Yet I think it would be interesting to know something of the construction of the stills of which he writes.

Our stills here are in four batteries—asphalt, continuous, lubricating and steam—and vary from 25 feet to 45 feet in length, and from 114 inches to 162 inches in diameter. The bottoms of the first three batteries are formed of two plates 5/8-inch thick, each equal in length, and 108 inches broad. All seams are double riveted, and, while the seams give quite a bit of trouble, we are gradually overcoming this by cleaning and closing the seams thoroughly and insisting on good riveting. When I came here, eighteen months ago, we were renewing bottoms steadily—more because of deformation than anything else. Our chief asked me to keep the worst under observation for some time and to note when variations took place; and for the past fifteen months we have had four that were bagged over an area of 120 inches by 60 inches, and averaging 9 inches in depth. However, they are no worse to-day than they were then.

I am sorry I cannot say much about the coke stills, as we do not have any here. In the mineral oil work where I served my apprenticeship we had coke stills, pot shape, made of cast iron, 14 feet 6 inches diameter and 10 feet deep, with a wrought iron cover of the same diameter and 12 feet high. The connection was made with a rust joint, but the stills did not work under pressure. They varied in thickness from 2½ inches to 4½ inches, and when cracked usually had a soft 3/8-inch patch riveted on, until they were a mass of patches. On coke stills I consider that when the bottom has been burned through it would be unwise to patch them. On other types of stills the only danger would be the chance of the oil coking over the patch, which is liable to occur on any part of the bottom, as I have experienced here. When it is imperative, I would recommend a patch, say, 1/16-inch lighter than the original plate, all the plate edges scarfed from the center of the hole out to a knife edge, the holes countersunk and heads of rivets filling the holes nicely and calked so that the flame would have as little play on the edges of the patch and rivets as possible.

Here we have locomotives and locomotive-type boilers, Babcock & Wilcox, Stirling and Lancashire boilers. In all my travels about the States I never came across a Lancashire boiler, and it was like renewing the acquaintance of an old friend. I sometimes wish Mr. A. L. Haas had had some experience in the building of these some thirty-eight years ago, when the only mechanical riveter was the "steam banger" and when most of the boilers were hand riveted by riveters who could be had for eighteen shillings per week, "an' guid anes for £1," as one manufacturer used to say.

I trust your suggestion regarding Mr. Derrick's letter will meet with a hearty response and am confident it will prove beneficial to all readers. Mexico.

Hand Versus Power Riveting

While loath to continue the controversy, there are certain statements made by Mr. Harrison in the June issue which call for remark.

First of all, the tribute to British workmanship, labor and tradition is frank and full; there is no cause on my part to add to the remarks of a man of long experience on both sides of the Atlantic who can substitute authoritative comparisons on the subject.

It is perfectly true that locomotive boilers of iron plate and iron rivets made in England have carried 160 pounds per square inch; also that they were hand riveted. These facts are within my own personal knowledge. Lowmoor, Bowling and Farnley iron are most exceptional materials. All who have had dealings with them know that there is no fibrous ferrous material in the world which comes within hailing distance of them, especially Lowmoor. The quantity of plates of this very high-grade iron used for boilers has been, and always was, negligible beside the infinitely greater amount of Staffordshire plate used in making boilers.

This bears out my contention that more liberties can be taken with iron plates and iron rivets. Another matter is the thickness of plates, which in locomotive boiler practice are, by comparison, thin. This is another factor which modifies practice.

Exactly what is the practice of to-day in English locomotive boiler shops, as to material, process and method, the writer is unable to say, but wherever mild steel plate is used methods common to the practice of a past generation have of necessity had to be revised. Hand-driven rivets can be made tight, and the fact has never been denied; but any boiler, wherein all the rivets are hand driven, with the accompaniment of punched holes, flogged laps, drifted over holes and the other discarded details of manufacture, will have a proportion of leaky rivets. As to the contention that the stem of a hand-driven rivet does not drop out of the hole when the head is severed, in only a minority of cases is it straight enough, even if loose in the hole, to come out peaceably. It needs a set punch. The writer has been interested in viewing the scrapping of old boilers on many occasions, and the experience is of value in that 50 percent of the rivets are considerably curved when punched out. This points its own moral; and, whether they were tight or not under steam pressure, they were certainly never straight when closed. Another contributory factor is the taper shape of the punched holes; the bolster side being outwards serves to make withdrawal difficult.

It is a pity that a specimen closure of a 1¼-inch rivet in 1-inch plates which lies on my desk cannot be generally seen. The seam is sawed through and the section polished. The specimen represents an actual test of an up-to-date hydraulic plant. It is just possible to find the line of demarcation between the rivet and plate, and that with considerable difficulty. The collar formed by imperfect previous bolting up, referred to by more than one contributor, is just as easy to make with hand riveting as with machine. The thing is not dependent upon process of closure, but upon negligence in preparation. There is a simple explanation of the distortion of the 1 3/16-inch plates under hydraulic closure quoted, and that is insufficient volume of rivet. There is no hydraulic closure known to me with sufficient power to distort the lap, provided it is given sufficient food in the form of hot rivet to eat.

A leaky rivet is a rivet which, under hydraulic test, shows moisture. Leaky rivets are practically unknown with modern methods, and leaky seams are rare. There is still necessity to fuller plate edges, but, as explained before, the use of a narrow calking tool should be prohibited, as, indeed, is already done in good boiler specifications. The boiler works with a world-wide reputation for good work, and which had to calk its boilers three and four times before they could stand the required test, requires some understanding. If their methods are right and the joint design good, the first time pressure is applied there might be revealed a suspicion of moisture at a lap with three intersecting plates, this lightly calked with a broad tool, and the boiler should be ready for statutory test in the presence of the accredited authority. That is definite personal experience. If it is possible in one place, then revision of methods is overdue elsewhere. The writer has no experience with second-grade firms. There is no sense in placing an order with inferior makers. No doubt there are inferior boilers made here, but it is quite senseless, in dealing with high explosive, to consider anything but those made under the best possible conditions of ingredient and process. Boilers are on a par with T N T, cordite and nitro-glycerine, and the trade, in its own interest, should have revised its methods as better came along and not waited for legislative action. In the case of Great Britain it was only necessary to enforce the practice of the first class firms upon the rest. There is no doubt that a few firms of consulting engineers of the front rank insisted upon certain requirements being met, and a few firms enjoy a confidence and reputation based upon merit due to their progressive spirit and desire to be in advance of requirements.

The pioneer work done by Marshall's, of Gainsborough, among others, deserves special notice. A Marshall boiler is a thing of beauty, and, while there are doubtless others that could be mentioned, the boiler department of this firm is an example and pattern to the trade at large.

The size of boilers has nothing to do with light seams. In fact, it was the requirements of the Scotch marine type which forced the necessity for mild steel plates of great thickness and large-diameter rivets. This made hand closure an impossibility.

Iron can be maltreated with some reasonable safety. Mild steel must be treated with respect and demands revision of method and process. However good the Siemen's acid open hearth material may be, it is sheer nonsense to punch 1⅜-inch holes in 1⅛-inch plates, hence position drilling was an absolute essential. One and three-eighth-inch rivets want some knocking down, hence the hydraulic closer.

In conclusion, under modern demands of high pressure, together with mild steel plates and other factors, the old methods will not serve. This includes hand-closed rivets. Unfortunately, hand closure of rivets is accompanied by all the other defective methods and is inferior in all respects to hydraulic closure under right and proper conditions. It is possible to abuse any gift, whether of man or nature, and even if such abuse be pretty general, that is no argument for scrapping a process which, under proper conditions, serves to give a superior product.

Mr. Harrison and myself have one desire in common:

to improve the business of boiler making and, incidentally, that of the men who gain therein their daily bread. We are opposed in one single particular: that of the closure of rivets. It is enough to assure him that the exact means of closure is really the least important matter. It is the previous processes that count for most. So many things have been altered simultaneously; and, for my part, if hydraulic closure were fifty percent slower than the method of knocking down by hand, I should assuredly, so far as it lay in my power, insist upon its use. However, the contrary is actually the case.

London, England. A. L. HAAS.

The Arch

Oftentimes one hears the roundhouse boiler maker condemning the brick arch. Many men declare that the arch is a detriment to the boiler maker and only makes him more work, while being of no use to the firebox.

It is true that a firebox with an arch is hotter to work in than is one without an arch. In a roundhouse at a time when power is short it is a common sight to see the boiler maker throwing out of the firebox an arch that is still red hot. Yet, while the arch makes the roundhouse boiler maker's job hotter, it also saves him from many a job of calking or expanding the flues, as after the fire is knocked the arch is red hot for some time, thus keeping the cold air from coming into contact with the beads on the flues and causing them to leak. Also, it prolongs the life of the flues, since they are not exposed directly to the heat of the fire, as is the case where there is no arch.

The advantage of the arch may be seen by the following instance: Take two engines coming out of the shop at the same time, each with new flues or with old flues having new ends welded on them; place an arch in one and let the other go without one; use the same fuel and water, and on the same class of work. It will be noticed that the flues that are not protected by the arch will begin to burn and crack much quicker than will the flues on the engine that has the arch, besides giving more trouble from leaking.

Last winter, on a roundhouse job, there was one flue in a switch engine that bothered quite a bit. This engine had an arch five-brick high, with a space about six inches between the flue sheet and the arch. Although I rolled the flue, it leaked again just as badly in a couple of days, and I decided to change the arch and see if it would help the leaky flue.

After rolling the flue firmly, I placed the front brick of the arch against the flue sheet. It was one of the bottom ones, about in the center of the sheet, and this covered it. I then put up the remainder of the arch, leaving the space between the first and second rows of brick from the flue sheet. The engine ran for over a month without leaking, and each time I worked it I placed the arch back again as I had done before. The flue, however, did leak occasionally, although not so often or as badly as it had before.

Denver, Colo. ARTHUR MALET.

A New "Old Man"

It is difficult to refrain from criticising the design described by Mr. Forbes in the June issue. The device rather strains credulity. Doubts arise as to the anatomical strength of the ancient gentleman, and whether or not he ever got past his juvenile teething or design stage. It is certain that if put into commission he will never become antique, though he may start aged.

The normal "old man"—the usual type—is of pretty hefty construction. He consists of a solid forging forming the foot and stem, while his biceps, in the shape of his swinging arms, are in keeping with his backbone. Even so rigid a construction gives ample opportunity to become acquainted with the theory of elasticity.

The scantling of the usual device and its consequent weight are about three times that of Mr. Forbes' paternal relative, and, even so, complaints are not unusual that it is insufficiently rigid.

Five-eighths plate foot and radius arm, attached by screwed barrel for a stem, are a visionary conception wherewith to tackle the drilling of a 3/4- or 1-inch hole. Plate arm and foot of the dimensions given may serve the amateur workshop, but assuredly are ineffective for boiler making.

As to the barrel stem of 1-inch pipe, the less said the better. The screwed 3/4-inch extension is described as of "tough" machinery steel. A sample of this might add to metallurgical knowledge, as nothing up to date would refrain from flexure. Like the lubricant holes, the refinements indicated are praiseworthy, but resemble the combination of clean finger nails with a broken back, small use either to labor or to wait.

I would suggest this: Put some more stuff into him—stiffen the old man up. Take a piece of 2-inch diameter shafting for a stem and fuse, weld some 1-inch plate to it for a foot, drill the shafting axially for 1 1/4-inch tapping size, and clear the hole from the foot end to within two inches of the top. Although the device criticised has only four inches radius of action, be generous with the swinging shelf; use a lock nut to fix the extension at top of arm and weld the arm to the extension screw and make it of 1-inch plate. In short, give the old man a sturdier build. The idea is all right. It is the dimensions quoted which will spoil his welcome in the shop.

Perchance, however, Mr. Forbes forgot to mention that he has two legs. If not, doubling him up may serve to give him needed strength. Doubling him up in his present proportions may make him useful. With his present barrel stem and other proportions, if of single leg type, doubling up in use will send him to the junk pile.

The question of strongbacks is worth ventilation. Is it possible to design a lightweight old man of trussed construction? Considering the strain taken by bicycle tubing, it should prove possible to combine the screw extension idea and tubing by trussing the main stem to outer end of foot and truss the arm above the business surface. Could not, for instance, an old man be made entirely of tubing? The welding torch and an ingenious mechanic in combination might contrive a lighter type whose anatomy should prove feasible in practice.

The writer recently saw one of the largest strongbacks he has yet come across. It was designed for a peculiar purpose. A firm which repairs quantities of welded barrels and drums was faced with the difficulty that numerous bumps proved recalcitrant. Alkaline and acid fluids which are transported in such containers always foul the threads of the bumps in emptying. The bumps are then replaced, and if out of commission for a spell they freeze solid in their seating. The increasing use of threads in this connection has also a bearing on the trouble. It is really the ancient rust joint which was made with iron filings and sal ammoniac all over again. Such frozen-in bumps present a pretty problem.

As it is never certain what the barrel originally contained, there is great danger in the application of heat. Even if this risk is taken with a blow lamp, the application of the welding torch makes it imperative to remove the bump. Also, in any event, the bump must be removed to refill.

The apparatus now in use for dealing with light bumps consists of two upright 8-inch by 4-inch channels tied at the foot by four 1-inch rods and cemented solidly in a mass of concrete. A horizontal cross channel is gapped at the ends to adjust its position and is secured to the uprights by means of bolts and adjusted in height by a series of holes. Through the center of this horizontal channel passes a jack screw through a flange riveted to the center. Through the sides of the uprights are similar screws.

The barrel is rolled under the device, the ends are clamped with timber by the side screws, a piece of square tool steel (hardened) is then placed in the square hole of bump and a 4-foot ring spanner placed. The vertical screw is then run down to pinch the tool steel bar. Through the hole at the end of the spanner a luff tackle is led and a good initial pull exerted by a couple of men. A flogging hammer is then used on the end of spanner. Most bumps yield to the gentle persuasion, but on the occasion of the writer's last visit there were half a dozen stubborn cases which refused to budge and were being drilled out under the machine. The engineer in charge of the plant is going to experiment toward taking out bulges with the same apparatus. He proposes to stay the flat ends externally with the horizontal screws and then use a boiler test pump to restore the bulge to cylindrical shape by hydraulic means.

There seems distinct prospects in the treatment, but, as the writer pointed out, there is also the danger of starting seams. Anyhow, the proposal is ingenious and the experimenter deserves to succeed.

Since the apparatus described may have other utilities, and, in any event, is worth notice on account of its size, it deserves publicity.

OBSERVER.

Steam Locomotives Are Most Wonderful of Machines

The most successful engines we have to-day, and the most wonderful machines that we have ever designed, are steam locomotives, according to a statement made by Charles E. Lucke, Professor of Mechanical Engineering, Columbia University, in a paper on "The Heavy Oil Engine," read before the Engineers' Club of Philadelphia, January 29, 1918. When you consider what they have to do and how well they do it, Professor Lucke goes on, they are truly wonderful. What would happen to a locomotive that was built stiff? And what would happen to the rails on which it runs? You would have neither locomotive nor rails at the end of the first run. The steam engine that gives years and years of service and is regarded as a model of reliability, carrying a ship trip after trip back and forth across the ocean like a ferryboat, is that a stiff structure? It is not; it weaves and twists, but that does not hurt it. Why, then, should we insist upon the cast iron stiff structure for oil engines? There is no reason on earth why we should. So I say that we can take the steam engine structure from bedplate to cylinder and design and apply it to oil engines, selecting dimensions to give similar elastic factors, bearing loads, and so forth, and it should give equal success.

Locomotive Builders Plan to Double New Production

At a meeting of representative locomotive builders with Bernard M. Baruch, chairman of the War Industries Board, and other officials of the board, the Railroad Administration and the Government departments, one of the heaviest problems connected with the direction of war work—an adequate supply of railroad locomotives—was solved.

Plans were worked out whereby the output of the American locomotive manufacturing plants will be doubled, the increase being from more than 3,000 on a pre-war basis to more than 6,000 completed machines. An equable distribution of the output to meet the military needs in France and the needs of the Railroad Administration for the steam roads of the United States has been provided by the chairman, which has met the approval of the Government officials involved.

Among those attending the meeting were Samuel Vauclain, of the Baldwin Locomotive Company; Mr. Fletcher, president of the American Locomotive Company; Mr. Lassiter, general manager of the American Locomotive Company; Colonels Tyler and Wright, of the Army Engineers Corps; Assistant General Manager Hines, Director of Operations Gray, and Director of Railroad Equipment J. R. Flannery, of the Railroad Administration, and Henry Rea, of the committee on munitions and plants.

Newport News Shipbuilding and Dry Dock Company Builds $4,000,000 Marine Boiler Works

The Government's decision to build a big boiler plant was recently announced, and it is understood that the buildings, with their equipment, housing facilities and public utilities, will represent an investment of $4,000,000. The building construction contract, amounting to $1,000,000, was awarded to the Mellon-Stewart Company, of New York. The plant construction cost and equipment will be arranged by the Emergency Fleet Corporation, and the Newport News Company will build and operate the works.

The plant is to be located on the west side of the James River, near South Richmond. It will consist of one main building 600 feet long by 160 feet wide and smaller structures for power plant, office, storerooms and service buildings. The main building will be of steel, with glass and brick curtain walls. The machinery will consist of standard boiler shop equipment for constructing Scotch marine boilers. It will have a capacity of approximately 200 Scotch boilers annually, and it is hoped to complete the plant in about nine months, and then will employ approximately 800 men.

The output will be installed in the various Government vessels being constructed along the Atlantic seaboard.

Chicago Pneumatic Tool Company Enlarging Cleveland Plant

The Chicago Pneumatic Tool Company announces that contract has been let and work started on the erection of an up-to-date addition to their Cleveland plant, which is planned to double the present output. It is expected that work will be completed on the building itself about November first. The necessary equipment has been ordered and it is believed will be delivered and ready for installation by the time the building is completed, so that the additional production contemplated will be available very soon thereafter.

Change of Address

The Pearsall Company, Inc., announce the removal of their office from 30 Church Street, to 14th floor, 30 East 42d Street, New York.

Selected Boiler Patents

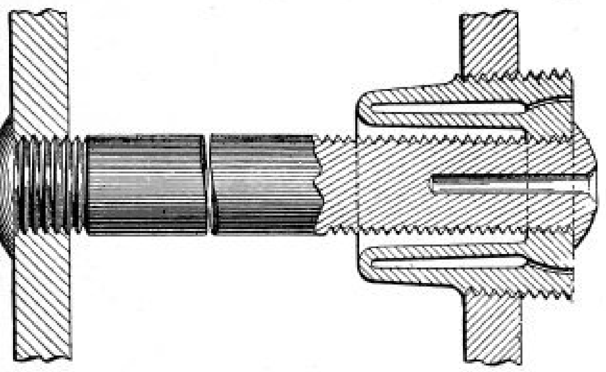
Compiled by

GEORGE A. HUTCHINSON, ESQ., Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchison.

1,272,465. STAYBOLT FOR BOILERS. HARRY ANTHONY LACERDA, OF SCHENECTADY, N. Y., ASSIGNOR TO FLANNERY BOLT COMPANY, OF SCHENECTADY, N. Y.

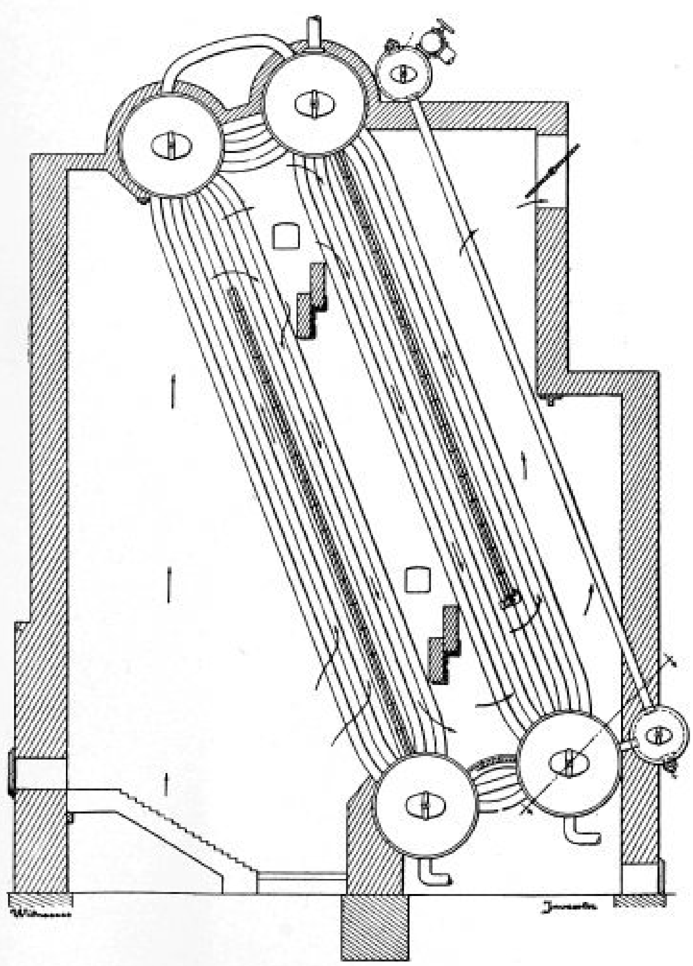
Claim 1.—A staybolt structure comprising an integral nut and plug, the plug having a seat to be engaged by the nut, the nut being within



the plug and connected thereto at its inner end only, and in rear of the said seat by a U-shaped bend, and a bolt secured to the nut. Three claims.

1,263,506. BOILER. EDWARD C. MEIER, OF PHŒNIXVILLE, PA.

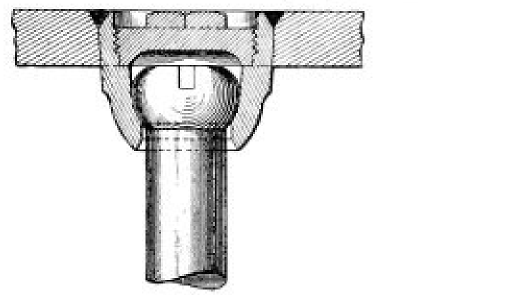
Claim 1.—The combination in a boiler, of a casing, a boiler unit mounted within the casing, two feed water drums arranged respectively at the top and bottom of the casing, said bottom drum having openings outside of the wall of the casing, the other of said drums having openings located outside of the top of said casing, pipes connecting said



drums and extending through the space within the casing, means for admitting feed water to one of said drums, means forming communication between the other of said drums and the boiler unit, said openings being in alinement with said pipes, and means for closing said openings, substantially as described. Two claims.

1,264,570. FLEXIBLE STAYBOLT CONNECTION FOR BOILERS. BENJAMIN E. D. STAFFORD, OF PITTSBURGH, PA., ASSIGNOR TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PA.

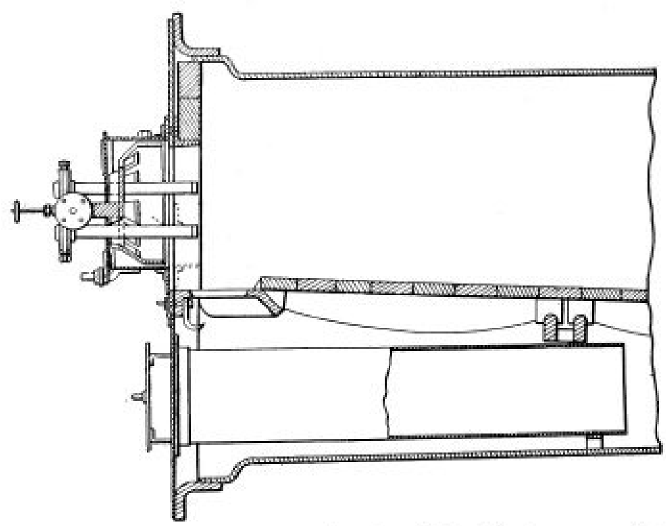
Claim 1.—In staybolt connection for boilers, the combination of a boiler plate having a conical threadless opening, and a sleeve having a plain conical outer surface mounted in said opening with its outer end



approximately flush with the outer surface of the plate, the sleeve being secured to the plate by welding the outer end of the sleeve to the plate. Three claims.

1,270,680. FURNACE. CORNELIS ZULVER, OF LONDON, ENGLAND, ASSIGNOR OF ONE-HALF TO LAUNCELOT EUSTACE SMITH, OF SOUTH SHIELDS, ENGLAND.

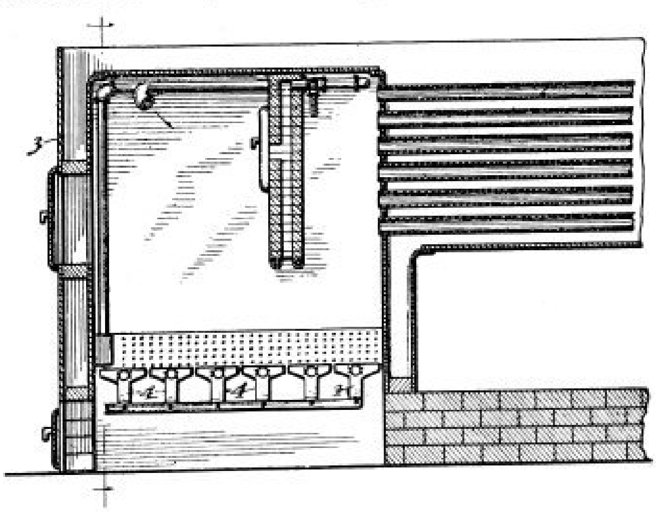
Claim.—In a furnace, the combination with a furnace front having a fuel supply opening, a baffle formed with air inlet openings, with means



to inclose said baffle, of a plate closing the ashpit of the furnace, and air supply tubes attached to said plate and extending into the ashpit, substantially as described. One claim.

1,274,155. FURNACE. IRA W. FOLTZ, OF CHICAGO, ILL.

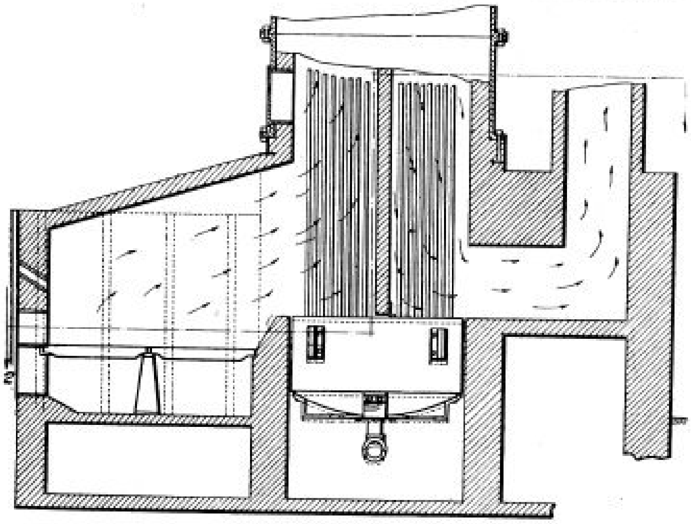
Claim 1.—In a furnace, a furnace chamber comprising surrounding walls and a grate, a transversely extending wall separating said furnace compartment into two divisions, said wall being located approximately one-fourth the distance from the rear of said furnace chamber and arranged to close the upper part of said furnace chamber while providing communication between the two divisions of said chamber at the lower end of said wall, said wall being provided with a vertically ex-



tending passage open at its lower end and communicating above said lower end with the larger of said divisions of the furnace chamber, a conduit extending upwardly from the ashpit and extending into the smaller of said divisions and from there leading into the larger of said divisions and having an outlet for air in the larger of said divisions. Eight claims.

1,274,342. BOILER SETTING. THOMAS SMITH, OF BIRMINGHAM, ALA.

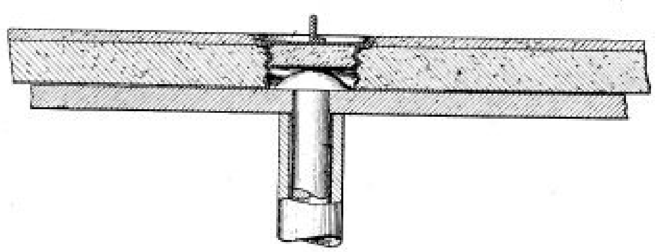
Claim 1.—In a vertical tubular boiler, upper and lower drums, vertical tubes connecting the drums, a brick work setting for the drums, the setting for the lower drum comprising vertical guides, co-acting guides on the lower drum to permit a free movement only in a vertical direction, external columns free of the brickwork setting, horizontal tie members



connecting the upper ends of said columns, and brackets mounted on said tie members and penetrating the setting for the upper drum and made fast to said upper drum for supporting both drums from said external frame work, substantially as described. Two claims.

1,264,695. STAYBOLT INSPECTION PORT. IRA D. SIEGFRIED, OF CLEVELAND, OHIO.

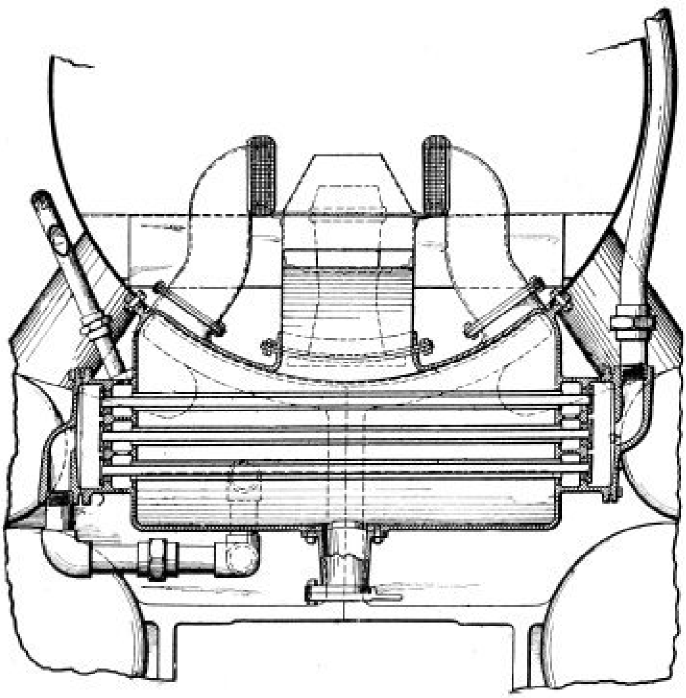
Claim 1.—In combination with an insulating covering for boilers and the like, an inspection port applied over a staybolt of the boiler, said



port having a plate provided with an aperture, and a cover for closing said aperture. Six claims.

1,266,185. LOCOMOTIVE FEED-WATER HEATER. HARRY S. VINCENT, OF RIDGEWOOD, N. J.

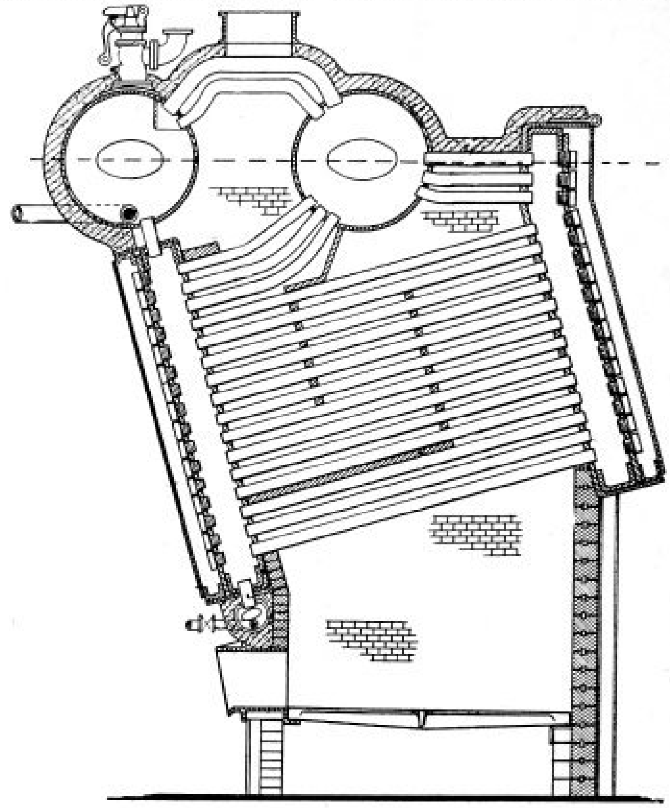
Claim 1.—The combination, with a locomotive boiler, of a heater casing, located exterior to, and below, the boiler and its accessories;



means for passing feed water through said casing; means for diverting a portion of the waste gases from direct passage to the stack, through the heater casing; and means for effecting the application of the heat of such diverted gases to the feed water, in its traverse through the heater casing. Ten claims.

1,266,664. STEAM GENERATOR. LAWRENCE E. CONNELLY, OF CLEVELAND, OHIO.

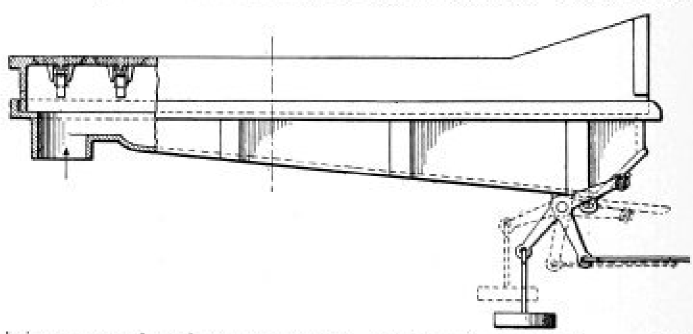
Claim 1.—In a steam generator of the class described a pair of box-like headers, one of which is placed at a higher elevation than the other, a series of inclined watertubes connecting said headers, a transverse steam liberating drum above said inclined tube, a series of steam and water conveying tubes connecting the upper portion of the higher of said headers with said drum, and a series of down-flow watertubes connecting the lower portion of said drum with the upper portion of the lower



header, another transverse steam and feed-water receiving drum over the lower header, means to connect the said steam and feed-water receiving drum with said lower header, and a series of steam conveying tubes connecting the upper portions of said steam liberating drum and said steam and feed-water receiving drum, substantially as set forth. Two claims.

1,274,147. FURNACE GRATE. HARRY O. DORSEY, OF ATLANTA, GA.

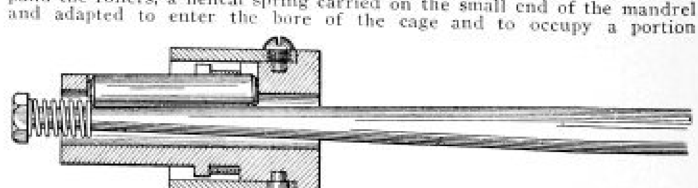
Claim 1.—A channel grate bar provided with holes at intervals in its top surface and also a pair of inwardly extending lugs at a distance below the top surface of the bar, one pair of oppositely extending lugs



being arranged under each opening, each nozzle plate being provided with two pairs of depending fingers, each pair being adapted to embrace one of said lugs and thus prevent the nozzle plates from rotating. Five claims.

1,265,283. BOILER TUBE EXPANDER. OTTO WIEDEKE, OF DAYTON, OHIO, ASSIGNOR OF ONE-HALF TO GUSTAV WIEDEKE, DAYTON, OHIO.

Claim 1.—In a tube expander, the combination of expanding rollers, a cage in which said rollers are placed, said cage having a central longitudinal bore, a tapered mandrel adapted to penetrate said bore to expand the rollers, a helical spring carried on the small end of the mandrel and adapted to enter the bore of the cage and to occupy a portion



thereof and thereby prevent the expanding rollers from passing out through the bore of the cage when the cage is at the small end of the mandrel, and means engaging the circumference of the cage and the rollers and serving to hold the rollers in the cage when the tool is not in use. Two claims.

The Boiler Maker

OCTOBER, 1918

Building Boilers for the Merchant Marine

Scotch Boilers Are Turned Out in This Yard at the Rate of Better Than One a Week

The Standard Shipbuilding Corporation, Shooter's Island, New York, is doing its bit in the production of boilers as well as in ships. The boiler shop is 400 feet long by 60 feet wide and is turning out boilers at the rate of one every six and a half days. The boilers are of the Scotch type, 14 feet 6 inches diameter and 12 feet long, with an indicated horsepower of 850. The shop just now is undergoing expansion, practically doubling its capacity, and with the new extensions and equipment the output is expected to be doubled also.

Fig. 1 shows three Scotch boilers completed. They are in readiness to be transferred by means of overhead cranes to the flat cars which convey them to the yard frontage, where they are loaded upon lighters and taken around to the piers. At the piers they are held in readiness to be set aboard the ships as soon as these are launched. Very little delay occurs in hoisting the machinery into place, once the ship is afloat, and this includes boilers, as well as engines, and auxiliary parts of engine room equipment.

The view looking down one of the bays of the boiler shop, Fig. 2, shows the boiler heads in process of shaping. As will be seen, there is plenty of light on the work, somewhat more than in many boiler shops, and in this light the work of shaping the heads proceeds in systematic manner. The shop is roomy as well as well lighted; and though there is much work going through all the time, but

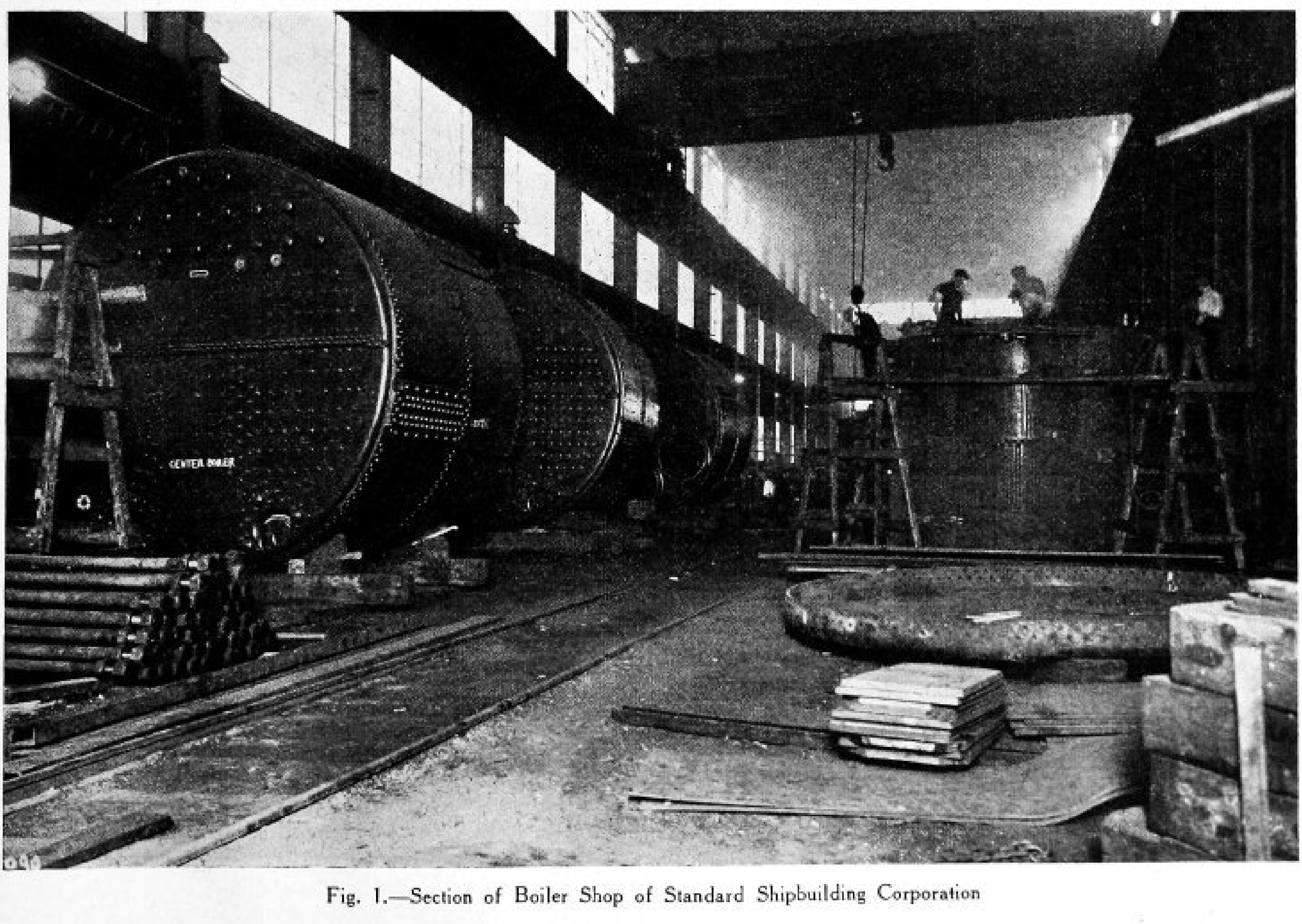


Fig. 1.—Section of Boiler Shop of Standard Shipbuilding Corporation

Fig. 2.—Boiler Shop Bay Where Heads Are Shaped

little sign of the usual boiler shop congestion is in evidence in this bay.

A right handy and systematic plant—and a patriotic. In the rough wording here and there on columns and machines and plates, "Buy Liberty Bonds," the workmen reveal evidence of an enthusiasm that has impelled them beyond the point of toil, that is a part of the day's work, to a vigorous expression in chalk as to their patriotism.

Boiler Efficiency

Few locomotives evaporate more than 6 pounds of water to each pound of coal consumed in the furnaces; the most efficient compound stationary or marine engines, with the best design of boiler, very rarely evaporate more than 10 pounds of water to the pound of coal. These are undeniable facts, yet accounts of boiler efficiency are sometimes published that display gross ignorance or a desire to deceive. When a new type of boiler is offered to steam users, extraordinary claims are frequently made concerning the performance. A case is cited of a new furnace abroad, which, it is said, evaporated 36 pounds of water per pound of coal, and another gentleman (a professor, be it noted) says that an ordinary boiler furnace evaporated 26 pounds of water per pound of coal. The improved furnace was one-third better than the common one, while the latter got twice as much energy out of a pound of coal as there was in it. People who say that engineering is not advancing will have to revise their statements.

Take a mailing tube, say, 18 inches long and two inches diameter. Put your mouth at one end and blow through it and feel the effect of the blast on your hand at the other end. Now hold the tube about an inch from your mouth and blow into the end of the tube. You will be surprised to feel the increase of the effect at the other end.

This experiment illustrates the principle of the Jeffrard injector, brought out by that Frenchman in the fifties of the last century. The scientific world called him crazy and all said the injector would not work; but it does.

Take this mailing tube and try to twist it, holding it at each end; now slit it from end to end with your knife and again try to twist it. This experiment will give you a better lesson in the value of forms in resisting strains than the best *x* chaser can show on one thousand sheets of paper. Just try it.

Analyzing the Business

Close Examination a Periodical Necessity—Estimated Expenditures and Real Expenditures

BY EDWIN L. SEABROOK*

Analysis is a process of sifting out. Does the plan grip you when applied to business conduct? Lucius Boomer manages two big hotel restaurants in New York. Go into one of them, the McAlpin, for instance, at the noon lunch hour and you will find scores of other diners ordering different kinds of food. How does the management know the quantity of each to prepare daily?

The sifting out process—analysis—tells Mr. Boomer that on Mondays, during certain months of the year, just about twelve hundred people will take the mid-day meal in the McAlpin restaurant. The analysis further shows that a certain percentage will order roast beef. The preparation of other food articles is calculated to a nicety, waste and loss prevented by the analytical process. There is nothing left to guesswork in the management of these big restaurants. The process of determining what people eat and how much is subject to daily analysis. If it were not for the use of this analytical method, every restaurant would be headed for bankruptcy.

Sifting Process in Boiler Making

"That scheme ought to work out fine for a restaurant," I hear some boiler maker say, "but you cannot make any such plan work in our line. You cannot make any parallel between analyzing what people order in a restaurant and our line of work." Well, suppose we gather some facts and attempt to reason it out.

A boiler maker in New York, you are told, did over $50,000 worth of business in 1917, and had a "fine year." The first thing that would go shooting through your mind and find expression would be: "And how much did he make?" Answer your own question, if you can, without a lot of analyzing of the factors that make up the real business of the boiler maker.

A complicated piece of machinery is often taken apart and given a thorough overhauling; not that there is any particular piece of the mechanism out of order, but simply that every part may be properly adjusted. How far would you trust an employee with the overhauling of a delicate piece of mechanism if he knew little or nothing about it? The business machine is, after all, delicately adjusted. The margin of safety—the difference between profit and loss—is never very great. Sometimes it does not require much of a jar to throw it out of gear.

Application of the Principles of Analysis

Many men when considering the analysis of a business seem to go on the idea that the facts required are entirely outside of their own operations and distinct from their own business transactions. They act on the presumption that some other business must be taken as a comparison, when the facts they want lie entirely within their own business.

How many business men use the data that their own business transactions can furnish them? How many do not? How many ever consider the need of analyzing, compiling and profiting by these data. How many are looking for something from an outside source, when all the information they need is within the business itself? How many men look at the volume of business rather than at the results of the amount of business transacted? How many dollars are there left in the bank at the end of the year, not how many pass through the bank account, is the test. When the sifting out process is applied to many small businesses, the results are ofttimes most gratifying as to the profits.

A Concrete Illustration

The business transactions used in the following analysis are taken from the records of a specific concern. The business is kindred to boiler making, and the proportions will probably parallel the business of many a boiler maker. In making this analysis the principles involved should be considered rather than the amounts, proportions, etc. The total amount of business and expenditures differs slightly from the real amounts, but this difference in no way affects the results sought in making the analysis. It is well to consider that these figures were compiled from a year when business conditions were normal. This fact, however, can in no way affect the conditions under which a business can and should be analyzed at the end of every year.

Total amount of business	$35,965
Material cost	$13,667
Labor cost	12,228
First cost	$25,895

Very naturally the first cost item is extremely easy to analyze. The time book of the mechanics and invoices for material show the amount spent for these two items.

Detailed Analysis of Expenses

If the owner of this business had no other expense during the year, he could very well claim the difference between the total amount of his business and the amount disbursed for the first cost, $10,070, as his own, or profit. When he reached the end of the business year he found that the amount he could claim for profit was far less than the balance which remained after the items for supplies and labor were paid.

Management, salary	$1,700
Rent	600
Light	20
Heat	46
Telephone	72
Auto truck, hauling, etc.	1,300
Office	730
Insurance	290
Taxes	86
Depreciation	360
Losses from collections	162
Wasted material	120
Lost time of mechanics (estimated)	190
Postage, printing, advertising, etc.	420
Association dues	18
Total	$6,114

As profits go in businesses of this size, he fortunately did have rather a good one: it was, however, only a few cents on each of the $35,965 that passed through his hands. What became of the difference between $10,070

* Secretary, National Association Metal Contractors.

and his profit? It was not owing to him by his customers, his bank balance did not show it, he had not lost it through speculation or bad debts. Evidently it must have been disbursed in some form. At the end of the year the analytical or sifting out process showed that he had spent the above amounts to maintain the business for the year.

The analytical process showed that the total expense of the business for the year was $32,009, leaving a profit of $3,956. The owner of this business knew how to manage the business end efficiently as well as the mechanical part of the work. Of course, mechanical ability counted for a great deal, but good business management counted for much more in producing a fair profit.

Percentage Profit on the Dollar Basis

Carrying the analysis further, the proprietor found that from each of the $35,965 received he had disbursed, disregarding the fractional parts of a cent, as follows:

Material	$.38
Labor	.34
Expense conducting business	.17
Total	$.89
Profit	.11
	$1.00

This analysis on the dollar basis forcibly illustrates how little of each of the $35,965 handled in the course of the year could be claimed as his own, or profit, by the proprietor. For every dollar received he had to pay out the amounts indicated for the three great essential items—material, labor and expense. When these disbursements had been made, there remained 11 cents out of each dollar that he could retain, or call his own. It is a well-known fact that even this small margin of profit is from two to three times above the average on each dollar of business transacted. In other words, the great majority of businesses make but a small margin of profit. Because of this narrow margin, even in the best of times, the necessity for a yearly analysis is made all the stronger.

Proportional Expenditure for Labor, Materials and Expense

A further analysis shows some interesting relations between the expense of maintaining the business for the year, $6,114, and some other factors entering into its conduct. This proprietor discovered through the sifting out process that when he paid a dollar for material it was necessary to pay out about 45 cents for the expense of carrying on the business. At the end of a week, when he paid his productive labor, he found that he had spent 50 cents for running the business to every dollar he paid his mechanics. At the end of the year, when the comparison was made between the total number of dollars received for all his transactions and those expended for maintaining the business, it required 17 cents out of each one of these dollars. Even in normal times this would be a fairly low expense rate and is due largely to careful management. Low as this cost of conducting business may seem to some, the analysis of the entire business proved it to be correct. The owner could, therefore, rest fully assured that his estimating, prices, charges for labor, etc., were based on his own business facts, not guesswork nor hearsay regarding the business of some one of his competitors.

If the owner of this business desired to go still further into the sifting out process, other than percentages, costs, volume, etc., some other very valuable data would be found.

Every business man knows, or he should know, that all parts of a business are not equally profitable. Some establishments are able to do one class of work more economically, or dispose of it at a greater profit, than some other parts. If these features are not analyzed, how can it be determined which part yields the largest profit? If a business is never analyzed it is by no means improbable that some parts of it are conducted at a loss, or at least without profit. Only a careful analysis could determine the facts. There are plenty of instances on record to prove this statement.

Naturally, the parts yielding the largest profits should be pushed more vigorously than those handled at a very small profit. Can the average boiler maker doing contract work and jobbing tell offhand which is yielding him the most profit? Can he tell whether certain contract work secured under strenuous competition produces enough profit to warrant the outlay in time and money that must be given to it? Does he know whether one part of his business is being carried on at a loss? The sifting out process enables the owner to get at these facts and to eliminate the unprofitable features. This is done in other lines of merchandising. Any up-to-date merchant knows what profit is yielded by the different articles passing over his counter. He either cuts out the unprofitable lines or finds a way of handling them at a profit.

Accuracy an Essential

One thing which is absolutely essential in making a business analysis is accuracy. Guesswork is worse than useless, because it only furnishes a false basis. An analysis must necessarily bring in the bookkeeping system. If a business analysis is to be of any practical value whatever, the bookkeeping must be accurate, must be kept up to date, and must show the status of a business. Some owners attempt to make an analysis of their business with inaccurate bookkeeping and a lax system, only to find themselves stalled, and the introduction of a proper bookkeeping system the first essential.

The necessity of making income tax returns to the government at the beginning of this year showed small business men the need of more accurate business methods, particularly in their bookkeeping. Many managed in some form to get through with the income tax return; but it was necessary to go over all the invoices for material purchased, the check book for expense of conducting their business, and guessing at those items which their books did not show, but which the report to the government demanded. If making the income tax return has done nothing more than wake up thousands of business men to the necessity of keeping their business records accurately, so that an analysis could be made in making the return, it will have proved of incalculable value.

Illuminating Discoveries

Many business men would undoubtedly be startled if their businesses should be put through a thorough analysis and the result shown. No doubt many who think they are going on fairly well would at once make an energetic effort to change their course on learning the facts. The surprise, however, would not always be unpleasant.

Last winter a friend of mine asked me to help him make up his income tax return. He did not do a very large business; it might almost be termed "a one-man affair," although he employed two or three mechanics a greater part of the year. He was uncertain as to whether his business made him enough profit to report to the internal revenue collector. Like many other business men, his bookkeeping consisted almost entirely of the statements of what people owed him and a record of the payment of these accounts—a very lax and slipshod method indeed.

After going over his various transactions for the year it was possible to make a fairly accurate report to the revenue officer. This man never kept a record of what he himself took from the business; he had thought that he was not getting any more than mere mechanic's wages. He was greatly surprised when his net profits were determined, and was still more surprised when the figures showed that it was necessary for him to make a return to the government. Without realizing it, his little business had been earning over $40 a week and he was taking twice as much for himself as he was paying any mechanic.

Analyzing the transactions—the sifting out process—did it.

Among Railroad Boiler Shops—V

Electric and Oxy-Acetylene Welding—Different Types of Trestles—Portable Bench Vise—Bicycle and Motorcycle Racks

BY JAMES F. HOBART

The writer thinks the Boston & Albany Railroad Shop at West Springfield, Mass., is a mighty pleasant place and a right good shop to work in. Truly, it might well be called the "shop of trestles and flower pots," for they have lots of both in and around the shops. The outside of the shops—the land around the buildings—has been cleared of the junk and rubbish, so frequently found adjacent to some railroad shops, and a decided attempt has been made at further ornamentation by the placing of a large number of "flower pots" around the buildings. The pots have been placed in the center of a ring of white stones from three to six inches in diameter, and the space between stones and pipe has been treated in various ways, some places being filled with sand, others with grassy sods, while still others have been sown with annual posies, petunias and "sich-like."

The question may be asked: "How much does a flower pot add to the efficiency of a railroad shop?" Whatever the answer, it is a sure thing that flowers make the workmen a little better pleased with things, a bit more contented, and more ready to do their best for the company, which is adding to the efficiency of the shop every time.

A Lot of Expert and Contented Workmen

It is the policy in these shops to make the men contented. The organization never hires any mechanics, either boiler makers or machinists, because it "makes 'em" right there in the shop. And this statement was made to the writer by foreman Burns, to whom, after untangling a bit of "red tape on the carpet," he was turned over.

"No; we haven't hired a boiler maker for twenty years. I have been here that length of time myself—eight years as journeyman apprentice and 'boy,' and twelve years as foreman boiler maker. We break in all our mechanics and don't hire any journeymen. We pay our men well and they stay with us. After a man has been with us for twelve years he is given an annual pass for himself and his family. No; we have no trouble in getting men [this statement was made on August 27, 1917], for they are with us and stay with us. But we have lots of trouble in getting steel. Delay, when there is any, is from the lack of steel, not from the lack of men and mechanics."

Forging on a Floor Plate

Considerable forging, flanging and bending of angle steel is done in this shop, right on a floor plate—heating and all—without putting the metal in a forge fire at all. Large kerosene torches are used liberally in this shop for heating the parts to be thus forged or flanged, the heating being done as stated—right on the floor plate. Pieces of sheet steel—waste pieces—are used plentifully to confine the heat from the torches and to direct the blast toward the parts to be worked.

Bricks are used very sparingly indeed. Sometimes a few bricks will be piled up to deflect and confine the heat, but rarely, except when necessary, to support the sheet steel plates, which are largely used for heat confining and deflecting. Sometimes, when an obstinate piece does not heat as readily as desired, a few bits of charcoal will be thrown between the shape and the enclosing sheet metal. This treatment is always very effective and satisfactory.

Electric and Oxy-Acetylene Welding

Both electric and oxy-acetylene welding processes are largely employed in these shops. The electric is used wherever pressure is to be carried, the other method of welding being employed on other than pressure-containing vessels. Although boiler work which had been oxy-acetylene welded has been in use for five or six years without mishap, the electric arc is now used entirely on pressure work, for the reason that the metal in the weld can be depended upon to be soft and of the same nature as the rod used in making the weld, something which may or may not be true when the weld is made with the oxy-acetylene flame. Therefore, to be on the side of "safety first," the electric arc is used altogether, as stated, on pressure-containing work.

The two tanks of each oxy-acetylene outfit used in this shop, instead of being mounted upon the usual two-wheeled truck, which is stood upright when not being transported, are placed upon a little two-wheeled wagon in a horizontal position. The arc welding operation, whenever possible, is enclosed by screens of cotton cloth placed on all sides of the work. For tasks which can be carried to the bench, a little cloth house with four sides is used, which shuts off from all sides the glare of the arc, thereby protecting every workman from possible eye injury, which might result from accidental exposure of his eyes to the light of the arc.

Work which cannot be carried to the bench is carefully screened by draping muslin curtains around the parts to be welded, the draping being so thoroughly done that it is impossible for the light to reach the eyes of any workman—either those who might be at that boiler or elsewhere in the shop.

Trestles

At the beginning of this article it was stated that the West Springfield Boston & Albany shops might well be called the "shop of trestles and flower pots." The reason for the flower pot part of the title has already been set forth. As for the trestles—well, the writer has never been in any other shop where the comfort of the men was so generously looked after in the way of convenient trestles to work upon as in these shops. There are large trestles, and strong ones. Some are strong enough to carry a whole locomotive, while others are light enough to be used under a single sheet for laying out purposes, thereby permitting the time-honored oil barrels to take a long-needed rest from supporting work during shop fabrication.

A couple of the trestles are pictured in this story. The one shown by Fig. 1 is a lusty one and is intended to be placed underneath a boiler when there are no wheels to support it. This trestle is made very heavy indeed. In fact, the ones in use in the West Springfield shops show no signs of breaking down, and look as though they were good for 75 to 100 years' more service!

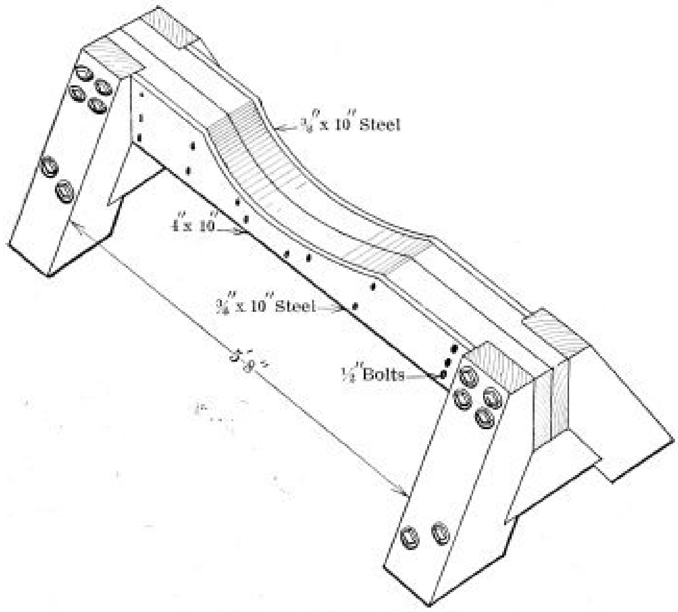


Fig. 1.—Boiler Trestle

As shown, the "backbone" of this trestle consists of two white oak timbers, each 4 inches by 10 inches, set up edgewise and reinforced on either side by a piece of boiler plate ⅜-inch thick and 10 inches deep, or wide. The plates thus described are bolted together right through the timbers, and the carrying power of the trestle is thus many times the heaviest load ever likely to be placed upon it. The end construction of the trestle is also very strong, the backbone and its load being carried upon a cross timber at either end, which in turn is so interlocked with the A-legs that it is almost impossible to break or split the ends or the legs.

Another trestle, and one of the handiest which the writer ever saw in use in any shop, is shown in Fig. 2. This is made to be placed across the drop pit when work is to be done at or inside of a "front-end." Not only is this trestle just the thing to work on, as it has plenty of room on top also for material to move around on, but it also is very easy to get up on, there being a flight of six easy steps at either end of the device. It is safe to say that this trestle need not be seen to be appreciated. Just a look at the picture is all that a live man in a railroad boiler shop needs in order to make him wonder how he ever got along all these years without this more than handy trestle; and he will have some made for use in his shop "pronto."

There are a lot more trestles in these shops which have not even been mentioned in this story. And there is not room enough to even call them by name. But some day the author will write a little story which will tell all about, and about nothing else save "boiler shop trestles"—and a right interesting story it will probably be, too!

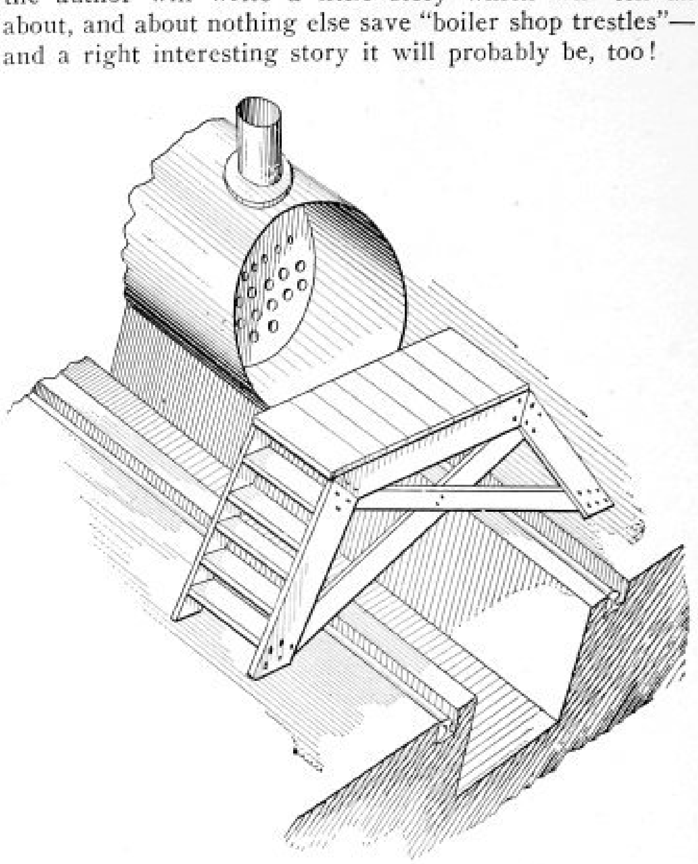


Fig. 2.—Trestle Across Drop Pit

He is, however, going to mention one more trestle—no, not a trestle, but a ladder—one which is used entirely for work on top of a boiler. There is very little fun or profit in climbing to the top of the boiler of a modern locomo-

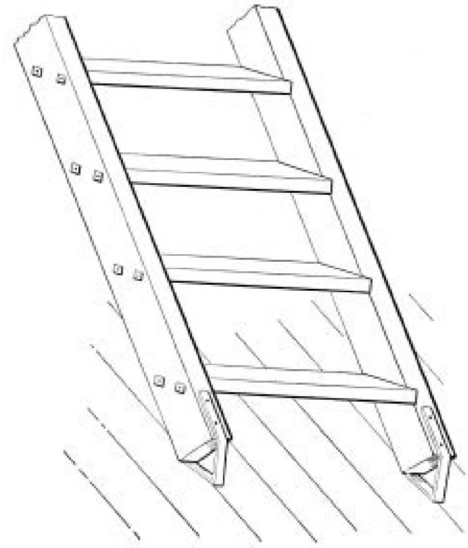


Fig. 3.—Top of Boiler Ladder

tive; and when it comes to doing the stunt from three to thirty times a day it gets to be wearisome, as well as a time consumer.

Top-of-Boiler Ladder

The ladder, a portion of which is shown in Fig. 3, is put together in the regulation "up-attic" style, the board treads being gained into the plank sides of stringers and each tread fastened therein by two threaded rods, as shown. This ladder is about twelve feet long, and the sides taper from bottom to top. The lower ends of the stringers are protected from wear and slipping by the irons shown in the engraving, said irons being fastened to the rails or stringers by means of through-bolts, which pass through the depth of the ladder sides, as well as through both sides of the irons, as shown.

Portable Vise Benches

A considerable number of portable vise and work benches were seen in this shop, and, while useful to the machinist in his work around the engine, these benches were also used a good deal by the boiler makers.

Each bench was about five feet long. The top thereof consisted of two planks—three-inch hardwood, each 12 inches wide—well fastened to the sides and legs, which in turn were braced to stand almost any lateral pull without

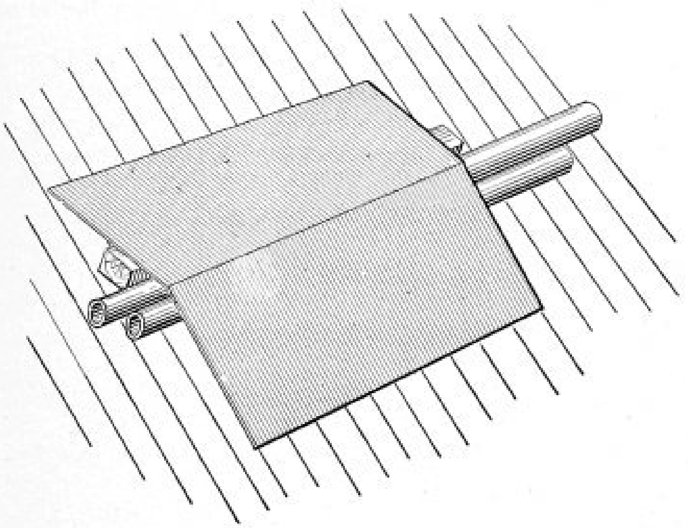


Fig. 4.—Runway Over Pipes

springing the legs or tearing them loose from the bench-top. Also, each bench was supplied with two heavy vises—good large ones, too—with 6-inch jaws, and a vise fastened to either side of the top of the bench, so two men could work without interfering with each other. The lower part of the bench was securely tied together by two shelves, cut in between the legs and very securely fastened thereto. There were also two drawers under each bench, a drawer to each vise, pulling out from opposite sides of the little bench.

These benches were each mounted upon four wheels, one to each leg, the axles being attached directly to the legs, the axles themselves being fixed. The wheels were each 2¼-inch face, 8 inches in diameter, and placed on the outside of each leg, the wheels being held on the axle by means of a washer and a cotter pin to each wheel.

A number of other portable vise benches were in use in the shop, each with a single vise on one end, the other end being occupied by a heavy bar of iron securely fastened to the bench and used for hammering upon, as well as for light fitting and sheet metal work.

Runway Over Pipes

In a large shop it is sometimes considerable of a problem to bring compressed air, steam, water, and the electric current to work requiring such things without running a network of pipes, conduits and wires all around and all over the shop, and even then, many times, the wires or tubes must needs lie along the floor, where they are sure to be in the way of tramping or trucking.

The writer noticed several places in the Boston & Albany shops where runways had been laid over pipes which crossed one of the main thoroughfares of the shop. Fig. 4 shows the manner in which the pipes were protected. A piece of wood, ordinary 2-inch by 4-inch scantling, was laid on the floor beside the pipes; then a piece of 24-inch by 42-inch boiler plate, which had been bent in the middle, as shown in the engraving, was placed over the pipes, the bend in the steel plate being placed parallel with the scantling.

Men and trucks had no trouble in passing over this "bridge," which completely and effectually protected the tubes beneath it. The writer saw one place where two of these bent plates had been placed end to end over some tubes and wires, thereby making sure that no truck could run off the end of the plate and thus "get" the tubes or electric wires.

Corrugated Floor Plate

"Somebody, sometime," evidently had been having trouble by these runway bridges proving slippery. To remedy this trouble the runway plates had been corrugated, as shown by Fig. 5, in such a manner that there was no more danger of a man's ever hurting either his

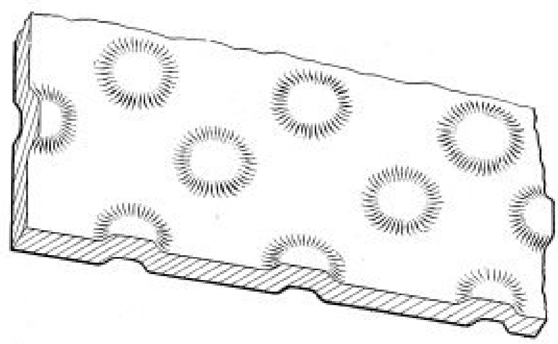


Fig. 5.—Corrugated Floor Plate

shins or his disposition by a possible slip. To that end, each plate had been corrugated by partial punching. As shown by Fig. 5, there are round punches on the top side of the plate, each about three-quarters of an inch in diameter, an eighth of an inch high, and stagger-spaced about two inches apart.

The edge of the broken sheet, shown in Fig. 5, tells quite plainly the manner in which the corrugation might have been made, the small inch punch being allowed to go only about half way through the sheet, and that, too, over a hollow die about three-quarters or seven-eighths of an inch in diameter, so that the sheet was pressed downward into the hollow die, as well as being partly perforated at the same time by the small punch.

In some shops the same effect is produced in the foot plates used to cover the gap between engine running board and the tender. But it worked first rate with the runways above described, and a man while pushing a truck never had any trouble in maintaining his foothold on these runways.

In the Tube Shop

A pretty large shop was devoted exclusively to the handling of tubes, of which there was a very large quantity in evidence—some needing welding, and some already having been welded or in process thereof. In order to store such a large number of tubes and have them out of the way, and yet at the same time be instantly available whenever wanted, and this, too, without overhauling either these or other tubes, was quite a problem. Yet it seemed to have been satisfactorily solved in these shops.

Tube Rack

For storing the great number of tubes some portable tube racks were employed, a portion of one rack being shown in Fig. 6. The engraving only shows one side of the rack. The piece of iron on the floor extends across the width of the rack and is formed into another upright stake or post exactly like the one shown, which is made up of several pieces of boiler plate securely riveted together, anything evidently having been used which the

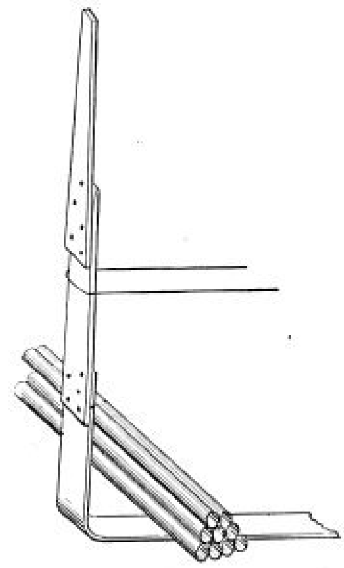


Fig. 6.—Tube Rack

maker could find around the shop or could lay hands upon.

Two complete racks were used. The one at the far end of the tubes, however, is not shown in the picture. The steel being quite light, not more than one-half inch thick for the bottom of the rack, and one-half and three-eighths inch for the side posts, it was necessary to stay the posts to prevent their being spread apart by weight of a mass of tubes piled between the posts.

To forestall such a happening, wire ties were used, the wire being doubled and the ends twisted together and slipped over the ends of a rack after the tubes had been piled high enough to make the rack-ends show signs of distress. A second or a third tie wire was used when found necessary, which was not often, as a considerable height of tubes could be handled by means of the single tie wire shown in the engraving.

As these tube racks were in no way fastened nor attached to the building in any way, the racks could be located anywhere where one might be required, and even set up when required in parts of the shop where racks of a permanent nature would not be tolerated. But these, after being emptied of the tubes, were quickly removed and stored away until required again by a heavy influx of tube work.

Bicycle and Motorcycle Accommodations

One thing more, since the comfort of the workmen at these shops must not be overlooked. In the yard between shops and office, among the flower pots, there is a shelter pavilion, inside of which, or under which, are rack accommodations for fifty bicycles and motorcycles, where the men may leave their wheels in perfect safety—well protected from the weather and securely locked to the racks in such a manner that a wheel could not be removed without first breaking something.

As he was leaving the boiler shop, the writer noticed a man doing "park" work here and there with a sack and wire-pointed stick, spearing and gathering into his bag each and every scrap of paper which had found its way into the yard. At other times, it was said, this man did duty as flagman and attendant at the coaling station, which was also located close by.

The Difficulties in Welding Cast Iron*

Carbon in Cast Iron—Line of Weld a Factor—Expansion and Contraction—Danger of a Too Rapid Cooling

The welding of cast iron is not as difficult to accomplish as the welding of wrought iron or steel, but offers a little more difficulty to the beginner because the metal flows so much more freely and some difficulty is experienced in controlling the molten metal. The two principal difficulties experienced by the beginner, however, are the overcoming of hard, brittle metal in the weld and the casting cracking either in the weld or adjacent to the weld, owing to internal strains set up by unequal contraction.

The melting point of cast iron is approximately 2,100 degrees F., while iron oxide has a melting point of about 2,400 degrees. A bright red heat is sufficient to cause the combination of the oxygen of the air with the iron of the casting, thus forming iron oxide. It is not possible to melt this iron oxide and flow it from the weld, so it remains in the casting in the form of thin flakes or crust. This not only prevents the alloying of the molten metal, but also combines with the free carbon. It is consequently conducive to the formation of white iron; therefore this oxide must be removed or destroyed.

The proper method of doing this is to puddle the molten metal with a filling rod, causing the oxides to flow to the top, and then to scrape them off. In the same way blow holes can be worked out, which are formed by gases being pocketed in the molten metal.

Carbon exists in cast iron in different states. In what is called white iron, which is very hard, the carbon is combined with or dissolved in the iron. In the grey iron, which is soft and easy to work, most of the carbon is in a free state in the form of graphite. Since it is generally necessary to machine or file a weld in cast iron, it is indispensable that the line of weld be constituted of soft grey iron. Thus in welding cast iron, always remember that too rapid cooling brings about a combination of carbon and iron, forming hard, brittle white iron, while slow cooling, or reheating after the weld is completed, keeps the carbon in a free state, resulting in a softer and more workable material.

Expansion and contraction should be treated with more importance in the welding of cast iron than in any other metal. Cast iron is absolutely lacking in elasticity and its

* From *Journal of Acetylene Welding.*

tensile strength is very low. In preparing work for welding, it is always necessary to take fullest precautions against the effects of expansion and contraction where the part to be welded is not free to expand and contract, such as cylindrical or box-shaped castings or any shaped casting where the expansion of the metal and subsequent contraction would be restrained, due to the shape. Where the internal strain produced by contraction is greater than the tensile strength of the section to which it is confined, cracking or breaking will occur; but, where the strain is not great, internal strains are set up which may cause a break later when subjected to shock, and for this reason the importance of properly taking care of the forces of expansion and contraction will be apparent.

The Final Decision of Bobbie and Jimmie

The Kids Give Voice to Their Ambitions—Take a Slant at the Future—Come to Some Very Definite Conclusions

BY W. D. FORBES

Two young boiler makers were seated in a little garden behind their boarding house in the cool of a summer evening. They had been so engrossed in their own thoughts that they had even let their pipes go out.

Finally Bob broke the silence with his momentous conclusions: "Yes, old top, I have made up my mind. I have served my time now and I am going to stick to the job. I like to roll tubes, drive rivets, turn a flange, roll up plates and all the rest of the work."

"I like to boss men," he continued. "The old man has sent me out on several jobs of repairs in charge of the bunch and I have made good. It's on the first of the job that I make the men hurry. Over at Milltown the other day I put it up to them something like this: 'Boys, we have three hours to do the job in. It wouldn't take over an hour and a half to get through with it. If we rush it through, then we can wash up, take a smoke and go home looking decent instead of grimy and sweaty. Anyway, we can't get away until four o'clock.' They were right with me. I told the super about it. He said, 'Good work,' and signed up the cards for me.

"You know, I don't care a hang if the boilers ought to have a double or single row of rivets. I follow the dope, of course, exactly. I mean I don't care to know *why* I put on a four- or five-inch safety valve, or how much heating surface there is. I like to get the boiler finished up and tested without finding a leak, and then to go and tell the old man that I am ready for another job. I think I am cut out for a doer. What do you think about it?"

Jimmie nodded. He rather prided himself, however, on seeing things with a bigger slant than Bob, although he would never think of mentioning it. "I guess you have hit it all right. I like to work and I shall never be sorry that I worked out my apprenticeship. But I do hate to work and not understand just why things are as they are. I want to know why the firebox is made the size it is; why they put in 2½-inch tubes instead of 2-inch; how they figure out the size of the safety valve; how they got at the length of the tubes; how much the boiler ought to evaporate, and all the rest of it."

A full five minutes of silence followed. Finally he continued his thoughts aloud: "Yes, I would like to lay out the drawings of the complete boiler, but I don't know how to do all this now, so I am going to a technical school. I am in dead earnest about this. I have saved up my money—enough to give me a good start. I went to see one of the professors at the school. He was mighty nice to me. He told me that, with my practical knowledge, if I would work hard I could jump a half year—I think he called it a 'semester'—and make just that much gain. He even said he would help to get me a scholarship. That means that I would not have to pay any tuition after the first year.

"But I even had bigger luck than that," and his enthusiasm resounded with each tap of his empty pipe upon the flag stones. "He told me that the chap who had charge of the heating apparatus of the two buildings had graduated and that I could have his job if I passed. I have looked over the questions he gave me of last year's examinations, and with a little study I know I can pass them and enter. Maybe I will have the job of making all the repairs on the other steam plants.

"Who knows," continued Jimmie, with a calculating glance into the future, "but we may make a team yet—I doing the designing and office work and you doing the rest in the shop? Then we would both have just what we wanted, and we ought to make a go of it, eh?"

"That's the way it strikes me," said Bob. "I may change my mind after a while and find out that I've made a mistake; but it is a sure thing that we have got to have somebody chop up the equations and do only the headwork. I am going to use my head and my hands, too, and if you run aground for money, old man, and I have got any in my jeans, you will be sure welcome to it."

The boys shook hands on it. Bob stretched his long arms and finally stood up. "I guess I'll slip down the street and see Annie for a minute," he said, as he swung off.

Jimmie grinned. "Perhaps Annie had something to do with your decision," he flung after him, and himself turned and walked off.

(To be continued.)

Someone has said that a path would be worn to the door of a house in which lived a man who knew more about a certain subject than anybody else in the world. That may be true, but the trouble lies in the fact that the world is slow in finding out a man's knowledge until after he is dead. Still, dead men don't care; do they?

Many a man loses interest in his work in the fireroom when he sees that his work is never recognized. A little encouragement is wise. Go down into the boiler room now and then and say a word of appreciation to the man with the shovel. If he is not worthy of it, fire him instead of letting him fire. But let him know you are on earth.

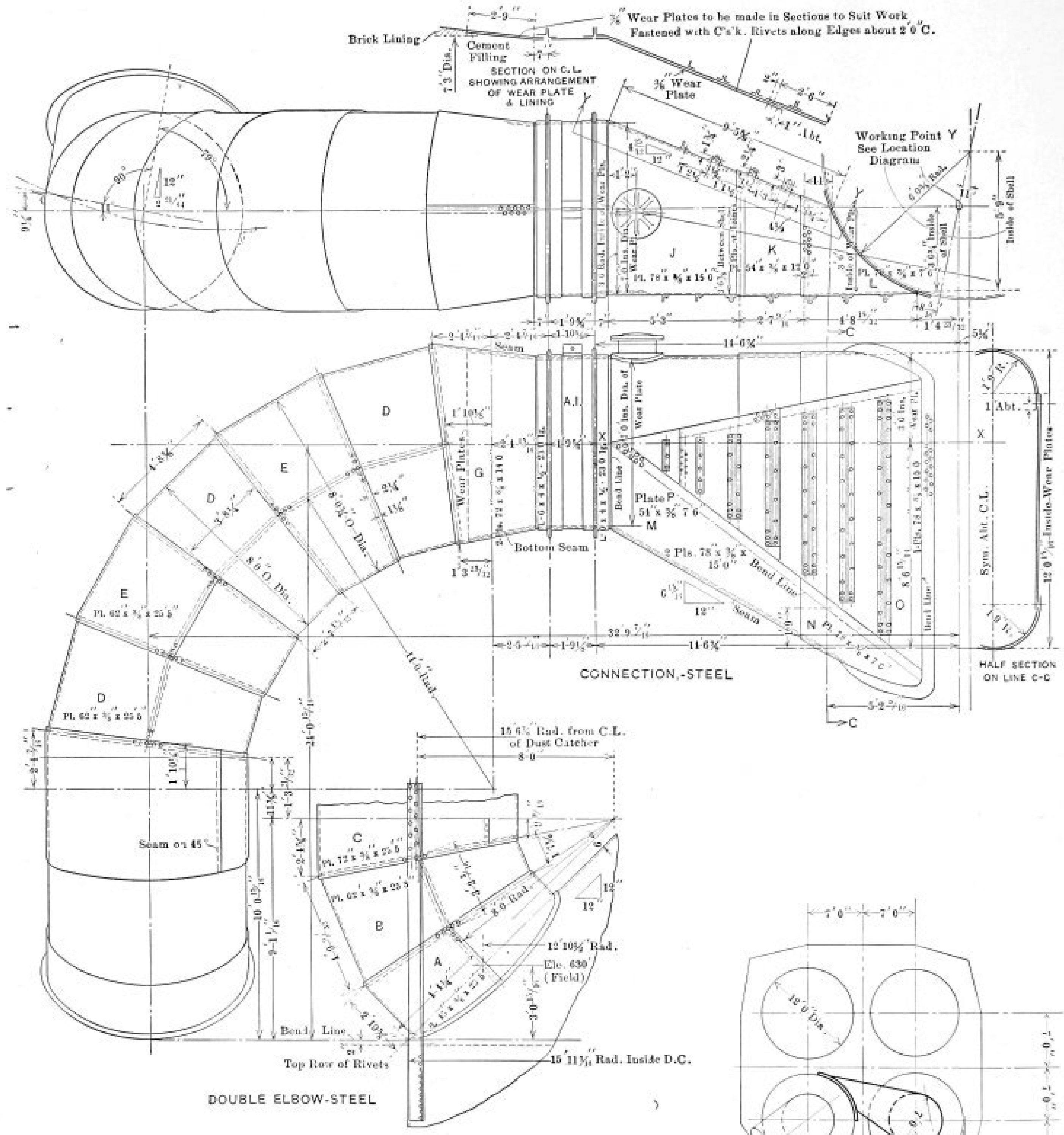


Fig. 1.—Elbow and Connection Leading Out of Side of Stack—Long Radius

Intricate Jobs of Laying Out

Rarely do problems of a difficult nature such as those shown in the illustration come up in the work of the average boiler maker. When one does come up, however, the man whose job it is to lay it out ought to be prepared to handle it successfully. Small shops frequently are called upon to do difficult work normally out of their line, especially these days, when work is hunting the man, often without success, and the drawings herewith ought to be well worth studying in order that the boiler maker be prepared for all future emergencies.

The proportions of the various parts, the methods of joining, the distribution of rivets—the points here shown are representative of good construction in this type of work. Certain details of construction are more minutely shown in the sections of Fig. 2, giving dimensions on lines *A*, *B*, *C* and *D*, also the exact arrangement of the material at the joints and other well-planned features of the job.

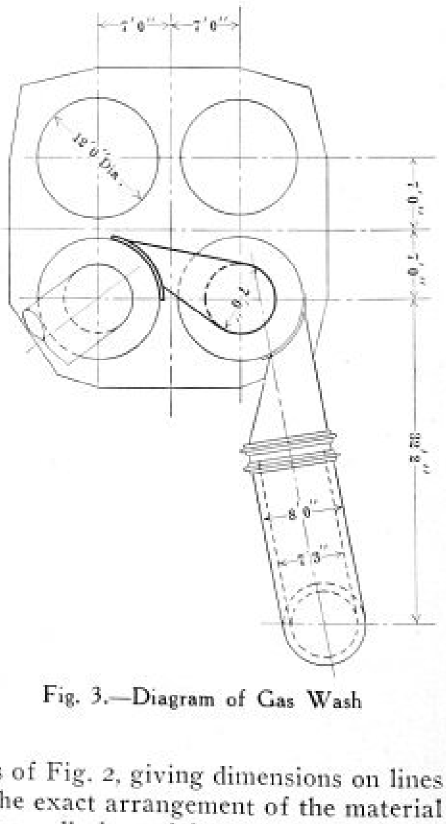


Fig. 3.—Diagram of Gas Wash

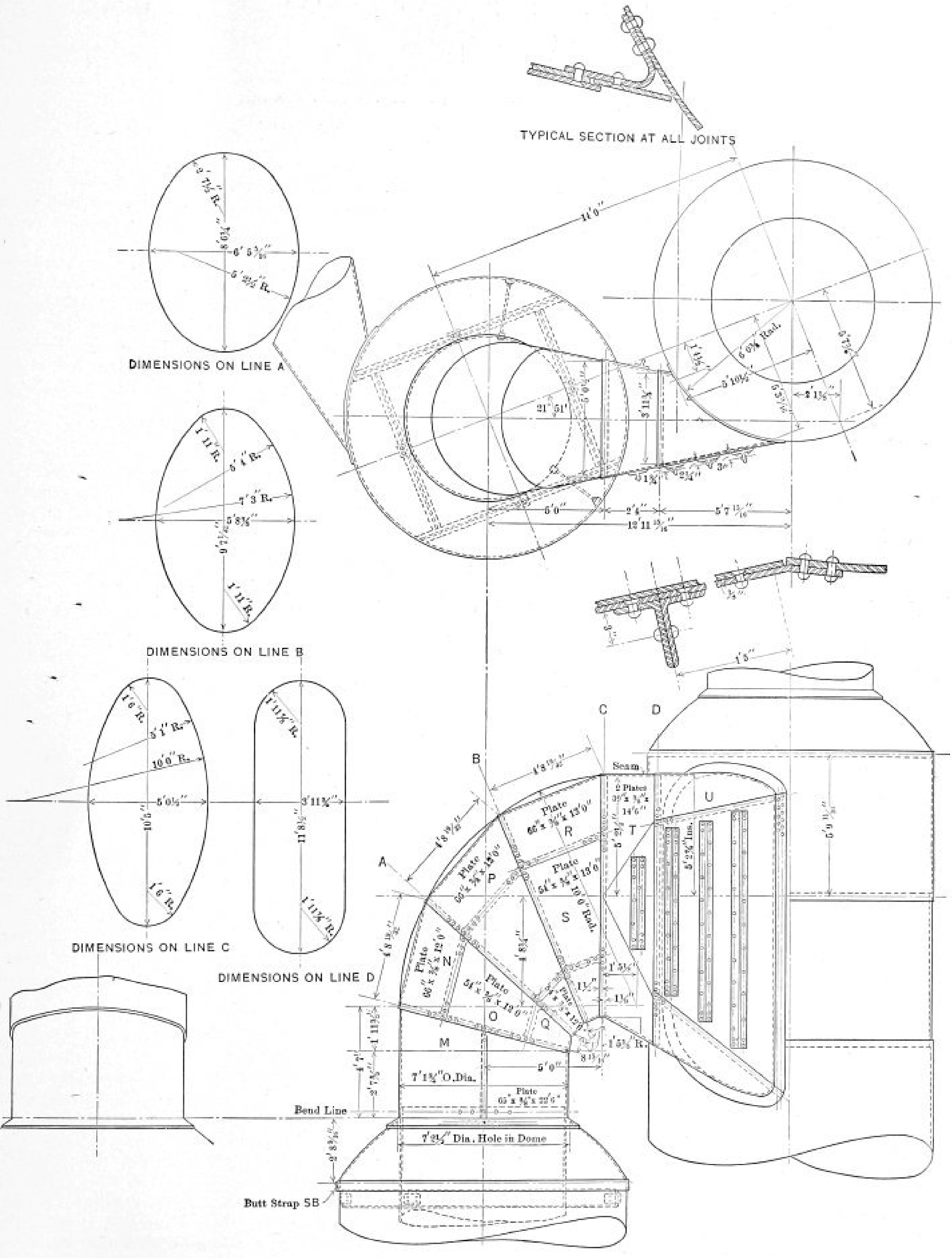


Fig. 2.—Elbow and Connection Leading Out of Side of Stack—Short Radius

Boiler and Other Repairs by Electric Welding*

Effects of Hammer Upon Tensile Strength of Weld —Consideration of Difference in Temperatures

BY R. S. KENNEDY

It is hardly necessary to remind an audience of engineers that welding is one of the oldest branches of the working of metals. In some respects it is a lost art, as there are good grounds to believe that the ancients were able to weld some of the bronze alloys.

In the following remarks the author proposes to confine himself to the welding of iron and steel, unless otherwise stated. A weld is the intimate union of two pieces of metal, produced when the pieces have been raised to welding heat, by pressure or hammering, and the welding state of a metal only exists within a limited range of temperature, being something like 100 degrees for iron and steel, but varies with the metal. As a rule, good iron will stand a higher temperature than steel, although certain steels, such as blistered or good shear, will stand a high temperature. In the smith's fire, steel can, and should be, forged with a lighter tool than iron, the blows being in rapid succession. In the ideal weld the two surfaces to be united are brought to the plastic heat together, neither at too high nor too low a temperature, when the point of juncture should be as strong relative to its section as any other portion. From the foregoing remarks, however, it will be appreciated that much depends upon the skill and experience of the operator, and it is recognized in ordinary engineering practice that an allowance has to be made for inevitable human frailties.

Province of the Engineer

It is generally agreed that the province of the engineer is to utilize the forces and methods of nature for the benefit of mankind, and nature in this case has provided that the positive pole of the electric arc shall be much hotter than the negative pole. We consequently arrange in electric arc welding that the positive pole shall be on the bigger mass, which in 999 cases out of 1,000 is the job, and the negative pole on the smaller mass of metal, which in modern electric arc welding is the metallic pencil of the adding material. By working with nature we thus provide favorable conditions for the first essential of a good weld, namely, that the pieces to be united shall be brought to a welding heat at the same time. You will note that we have only provided favorable conditions; the actual carrying out of this requirement rests with the skill of the operator.

This consideration of the difference in temperature of the two poles of the electric arc makes it at once apparent why direct current is more suitable than alternating for arc welding. On the other hand, alternating current is quite suitable, and probably better, than direct current for what is known as resistance welding or for spot welding.

Recently tests were made not only with the object of getting at the tensile strength of the weld, but of finding out if the process of welding affected the neighboring material. Numbers of specimens were tested, and some of these were annealed, but it was found that annealing made no difference to the results, and the material immediately adjacent to the weld behaved in a normal manner. These tests gave a tensile strength of about 17 to 18 tons per square inch, but since then improvements in the materials and methods have increased the tensile strength of welds in boiler steel to about 27 tons per square inch. In practice, however, the writer would not recommend that a tensile strength of more than 20 tons per square inch be worked to, this giving a sufficient margin for possible small defects in workmanship. It might here be remarked that in no single case has the writer known an electric weld to give way suddenly; failure has always been preceded by a small crack, which has gradually developed.

Best Results With Best Materials

Electric arc welding is primarily a form of autogenous welding—that is to say, that the metals to be united are heated to such a temperature that they will fuse together on contact without the application of external pressure. It is, however, found in practice that the application of even the moderate amount of pressure produced by a hand hammer increases the tensile strength and tenacity of the weld from 5 to 10 percent.

It is further essential that this work should be put into the material when it is at welding heat or, at any rate, above the black heat. It may here be remarked that it is often said that the value of metal added in this fashion is analogous to the ball of iron obtained in the puddling furnace. This, however, is not the case, and the better results are probably due to the fact that the iron wire used is of the very best material, with preferably a small percentage of manganese. This iron wire has been very heavily worked in the process of manufacture, and subsequently annealed, and as used by the writer's firm shows a tensile strength of 28 tons with an elongation of 50 percent. Somewhat similar results are obtained in another field with cast iron which has several times been remelted. The whole question of the amount of work put into the material of a weld is very fascinating, and there is no doubt that the capacity of a weld for taking up rapidly alternating strains for a long period, and for absorbing sudden shocks, very much depends upon this factor.

Under the Chestnut Tree

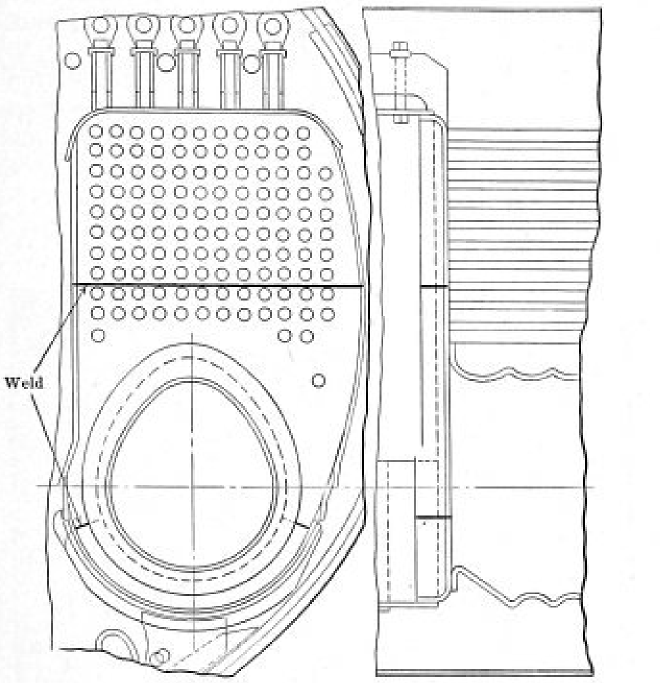
Returning to our blacksmith, whether under the spreading chestnut tree or in the more prosaic conditions of the modern smithy, we find that they all employ some kind of flux, usually sand or borax. This flux surrounds the heated iron or steel and protects it against the impurities of the fuel, removing at the same time the coating of scales. Some impure wrought irons flux themselves, but with steel other mixtures are used. The flux, as its name indicates, also increases the fluidity of the heated metal.

In electric arc welding with a metallic electrode one great advantage is that, with the exception of the atmosphere, we have no impurities to guard against, except such as are introduced in the materials. The source of heat is pure, and we have to see that the job is properly cleaned and the metallic electrode of suitable material.

Still, to provide against oxidization and also to increase

* Extract of paper read before Institute of Marine Engineers.

the fluidity of the metal, a flux is necessary to good work in arc welding, and the heated metal is protected from oxidization by an inert gas given off by the flux. The most convenient method of applying the flux is to coat evenly the metallic electrode, thus providing a constant and uniform supply.



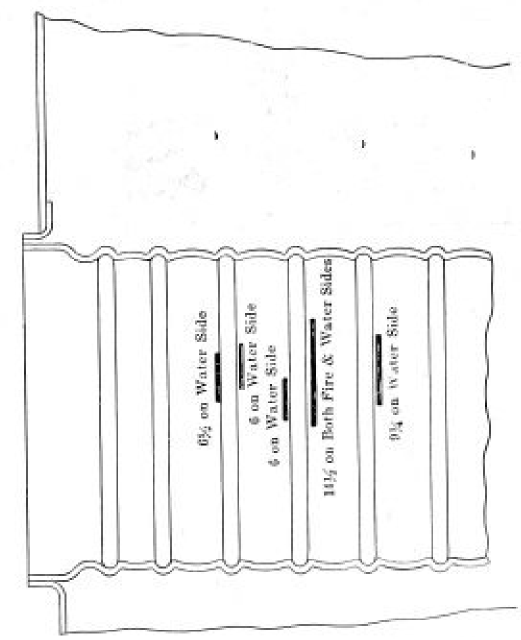
Showing Weld Joint in Boiler

Electric arc welding is a process of building up, and consists of adding metal to an existing structure. For this type of welding the electric arc has one great advantage in its high temperature. This is the highest known, and thus by the application of a small number of calories a part of the job, say about ½-inch diameter, is almost instantaneously raised to welding heat, and the drop of adding metal from the pencil also at welding heat is united to it, and the process of building up is continued till the required section is reached. The small quantity of heat required does not cause any undue expansion of the job in hand, and contraction troubles are reduced to a minimum. It is quite a common practice to weld over a riveted seam, although in this case it is necessary that rivets in the area dealt with should be completely welded over, and not left half covered. After welding a seam it is necessary to calk the landing edge for some 6 inches at each end of welded portion. Cracks in furnaces, end plates, combustion chambers, etc., are dealt with by cutting out the defective portion, leaving a V-shaped opening, which is filled in with the welding material. Work can be carried out directly overhead, or in any position that is accessible to the welding pencil, and where the operator can see what he is doing. As the work is one requiring constant attention on the part of the operator, it is advisable, in order to get the best job, to make it as accessible as possible, and that the operator should be reasonably comfortable.

Most boiler manufacturers have no doubt had experience in arc welding, and will understand that, in common with all hand welding, a good job depends on the conscientious work of the man. The writer's firm has always trained its own welders, and keeps them in constant employment. A full report is made of each job, and the name of the welder recorded, and the whole object of the training is to inculcate a sense of responsibility.

The materials at present dealt with on a commercial scale are wrought iron and steel and cast steel, and occasionally cast iron. The range of temperature of the welding heat is the determining factor in the adaptability of a substance for welding. Much successful work has been done with cast iron, notably with castings of considerable age, which have not been subjected to corrosive action, and with the good mixtures of more modern times. It is probable that there is a welding temperature of cast iron, but the range of this temperature is very small, something of the nature of 10 degrees.

The voltage across the metallic arc is about 22 to 25, and the writer adds an equal steadying resistance, which makes the voltage at the terminals of the dynamo about 45. A substitutional resistance is employed which is put in circuit by an automatic switch when the welder breaks his arc, thus keeping the load on the machine constant. The amperes actually employed are about 175, but in practice a 200-ampere machine is necessary, while the writer's firm uses machines designed for 250 amperes. In the big passenger liners it is the practice to weld from the ship's dynamo, suitable welding and substitutional resistances being provided.



Repairs of Wasted Parts of Starboard Boiler Indicated by Black Lines

By a special winding of the dynamo, known as separate excitation, the machine can be steadied under varying loads, but even in this case the writer still prefers to retain the substitutional resistances in addition.

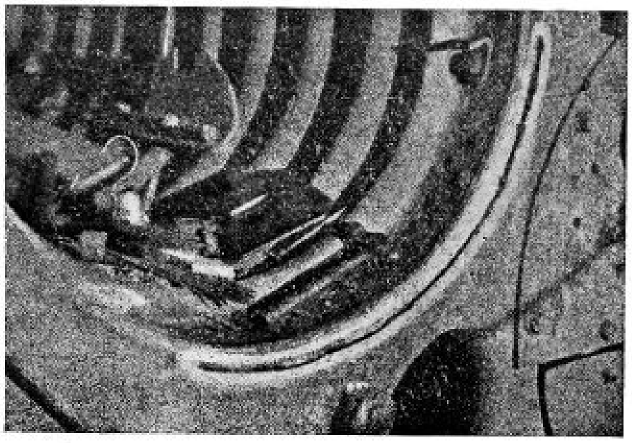
The design of the portable machinery for generating electricity presents many interesting problems. A plant is designed to meet the varying conditions, and consists of wagons generating their own electricity, portable gasoline driven generating sets, self-propelled or dumb barges with steam-driven or kerosene sets, steam turbine plants, and last, but not least, the motor generator sets.

This last plant is of great service in a port like London, where the docks are well served with electric power mains at a constant voltage. The design of the dynamo is a matter for the electrical engineer, but the conditions of working are trying, and it is advisable to have ample commutator surface and good ventilation, as in urgent marine repairs it is possible that a machine may be asked to run almost continuously for two or three weeks.

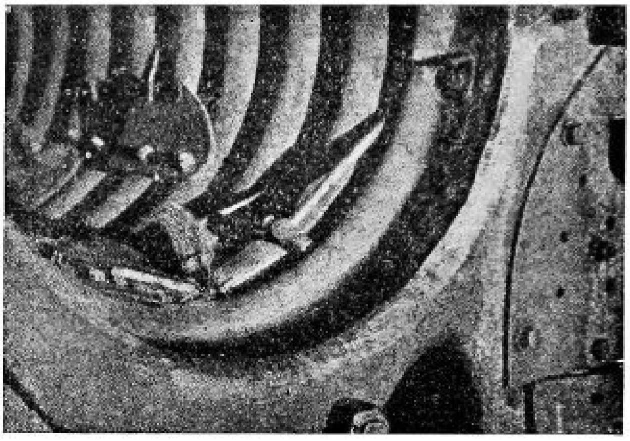
The preparation of a job for electric welding is a matter of considerable importance, as the presence of impurities is likely to be detrimental to the weld. In dealing with the external or fire surfaces of a boiler it is usually sufficient to use an ordinary chipping hammer, and then thoroughly wire-brush the metal to be dealt with; but some superintending engineers prefer to have a light chipping taken over the surface, which is, of course, the ideal preparation. In marine work, however, the time available is often so short that as a general rule the former method is adopted. When, however, it comes to dealing with the water surfaces of a boiler, greater care is necessary, especially if zinc plates have been freely used. The welder, if a properly trained man, would at once recognize this difficulty and apply the only remedy, which is to chip down till pure metal is reached.

onerated. It is a merciful dispensation of Providence that such defects develop mainly when the boiler is cold or under banked fires, and it is generally recognized that a boiler is never safer than when warmed up and steaming steadily. Owing to its higher temperature, the electric arc is more suitable for dealing with the heavier sections than the oxy-acetylene or oxy-coal gas, while, on the other hand, for thicknesses of 3/16 inch and under, one or other of the gas systems is preferable.

The writer has been asked to summarize as briefly as possible the conclusions reached in the very able papers recently read by Commander E. P. Jessop and Naval Constructor H. G. Knox, both of the U. S. Navy. The full report of these papers has been largely circulated on this side by our leading technical journals, and has no



Before Welding



After Welding

Arc welding being a building up process, cracks are dealt with by veeing out at the line of fracture, the vee being made wide enough to ensure that the welder can reach with his pencil to the bottom on either side with a certainty of striking his arc at any required position. As the welder is a highly skilled man, it is usual for the boiler makers to prepare the work to instructions, and the welder himself puts in the finishing touches. The welding in of new backs to combustion chambers or tube plates, or work of that kind, is dealt with in precisely similar manner, although here certain allowances have to be made for the work drawing together as the welder proceeds. It should be mentioned that in dealing with cracks it is absolutely essential that the whole of the fractured portion be cut away, and a very good guide is to cut away till a solid chipping is obtained, and then go a bit deeper to be on the safe side. If welding is carried out over a partially cut away fracture it is certain that sooner or later it will work to the surface. One of the most unsatisfactory matters we have to deal with is the welding of a crack in the original weld of a furnace, as it is most difficult to say where the defective weld ends, and a further defective portion some short distance along may work back into the part dealt with.

As in all engineering matters, it is better to know the worst and deal with it. The writer recalls an incident in our early days—about 1910—when we were called in to weld a crack, apparently about one inch long, in the back of a combustion chamber of a Swedish vessel. Our man started to cut out the crack, when, with a loud report, the chamber back split right across, showing a fracture a full sixteenth open. This caused great alarm at first, and we were charged with using undue vigor, but on veeing out the fracture for welding it was found that the back was grooved right across on the water side, so we were ex-

doubt been seen by most of you. The principal welding consisted of the repairing of the cylinders of some eighteen German vessels, where large pieces had been broken from the upper portions. The method of repair consisted of the welding in by the electric arc or oxy-acetylene gas of a new piece in cast steel or cast iron to replace the portion broken away. In arc welding the old and useful device of tapping short steel studs into the cast iron was used to enable the added steel (in this case) to make a surer weld. The electric arc welding repairs were carried out with the cylinders in place, while with the oxy-acetylene process it was necessary to remove the cylinders so that the joints for welding could be laid in a horizontal position, and also that the cylinders could be heated. Commander Jessop quite truly points out that the great difficulty found in the arc welding of the cast iron surface was to get the first layer of the adding steel material to adhere, and that this layer was always added before the patch was put in position for welding. In the oxy-acetylene jobs, as before remarked, the cylinders were secured in place, and the joints being horizontal, both sides of the joint were made fluid, and cast iron sticks melted into the bath thus formed. Both methods appear to have given excellent results, and the repairs are certainly the largest of their nature that have yet been carried out and reflect the greatest credit on all concerned. It would not be wise, however, to generalize on the treatment of cast iron from these results. You will remember that we have before remarked that with good mixtures of cast iron one can, with fair certainty, make a good weld. It must be remembered that these were high class vessels and that in all probability the very best metal would be used in their cylinders and liners, and certainly in superheater jobs the horsepower cylinders and liners would be of a very special mixture, which, so far as the writer's knowledge is concerned, has only been made in this country during the last five or six years. The writer trusts that we may hear further on this point, but his present information is that these vessels were superheater jobs.

The writer claims that arc welding, where carried out by skilled operators with suitable materials, is absolutely reliable, and can point to some 20,000 jobs—some of a very big nature—where the percentage of even partial failures would, at any rate, be on the right side of the decimal point. These partial failures would be mainly accounted for where the work was carried out under unfavorable conditions, and often in the nature of a forlorn hope. Great difficulties are met with in hurried repairs to the lower portions of the hulls of vessels in dry dock, where water is constantly dripping from the leaky portion, and, owing to the cement inside, it is often impossible to stop it in the time available. It must, however, be remembered that metal added by the heat of the electric arc or other methods has not been subjected to the same amount of work as a rolled steel plate or forging. It is therefore not so well adapted to take up work suddenly applied, and one would not recommend it for a position of responsibility where such conditions arise. This, however, is a condition generally recognized by engineers with all welds.

The question of the resistance of welds to rapidly alternating stresses and shocks is somewhat obscure. Some year or two ago the writer's firm was asked to weld the broken piston rod of a 10-hundredweight steam hammer which had already been twice welded in the fire. This was carried out, and is now running satisfactorily.

It is not permitted at the present time to refer specially to work carried out, but, outside of the boiler repairs, repairs to hulls include the welding of broken stern frames, "A" frames for twin screws, and the welding in of a new piece of stem is quite an every-day occurrence.

Boiler repairs are of infinite variety, and include the welding up of cracks to any extent, the welding in of new plates, thickening up of corroded surfaces, and building up of landing edges and defective rivets. Leaky stays and tubes have been welded in position with excellent results, and in cases of trouble with stays with loose washers it is excellent practice to build up from the solid plate to form the washer, which can then be faced off with a special tool.

How Much Money Does a Cleaner Save?

Some interesting computations have recently been made available by the Vulcan Soot Cleaner Company, Du Bois, Pa. They show that a soot cleaner saves much more money during its lifetime than is generally supposed.

Just at this time, when we are all trying to save as much fuel as possible, these figures are of especial value.

The computations have been simplified to "savings per foot of pipe." Thus they find that each foot of pipe used in connection with a permanently installed soot cleaner saves approximately 18.3 tons of coal during the lifetime of the cleaner. In addition to that, each foot of pipe saves one man's labor for one day. This makes it a simple matter for the reader to compute the savings that can be expected from each foot of pipe after the installation of the cleaner. Since the average watertube boiler requires about two hundred feet of pipe, it is not difficult to compute the total money saved, or the money saved by the reduction of labor cost alone. In some cases it is found that the computed labor saving alone pays for the cleaners. The money saving due to the lower coal consumption is, of course, many times larger.

Wages and Price of Coal

Wages at the present time are high, but if we assume that boiler room labor can be secured at $2 per day, the labor saving with the average cleaner is $2 × 200, which is $400 for the lifetime of the cleaner.

As for coal saving, if we assume the price of coal to be $4 per ton and 200 feet of pipe per cleaner, the money saving for the lifetime of the cleaner will be, in round numbers, $4 × 18.3 × 200 = $14,600.

Add this to the $400 obtained above, and we get a total saving of $15,000. These figures vary, of course, with labor and coal cost, but can be easily adjusted by the reader to fit his own conditions and thus determine whether or not a permanently installed soot cleaner would be profitable in his plant. These figures are based on boilers operated at 140 percent capacity, average coal consumption 4 pounds per boiler horsepower per hour, boilers operating 24 hours per day, 325 days per year.

It is also assumed in the above that the life of a Vulcan Cleaner is seven years, which is claimed to be a very conservative figure. The manufacturers point out that five years ago cleaners were installed on thirty-two Babcock & Wilcox boilers in the plant of the United Electric Light & Power Company, New York City, totaling 20,000 horsepower. These boilers are now carrying 300 percent of their rated capacity at peak load and are using a total of 2,688 nozzles. During these five years only 36 nozzles were bought and placed in stock for emergency use. Very few of the nozzles have been used to date, which may be considered a very good record indeed. The reason for relating this is simply to show that seven years as the life of a cleaner is a conservative assumption.

High Safety Factor

As now made, the cleaners have a still higher safety factor than those installed five years ago, because of the cast iron sheathed elements with which they are now equipped. The elements in the plant of the United Electric Light & Power Company, mentioned above, are uncovered, untreated, unprotected, absolutely bare to the high temperatures. Yet they appear to be as good now as when first installed. Anyway, by keeping tubes clean the elements cannot be subjected to high temperatures. If they are clean the boiler tubes absorb the intense heat before it reaches the soot cleaner elements.

The fact that those who have installed permanent soot cleaners never do without them after once trying them is convincing proof that they are an economy factor. Inasmuch as a cleaner costs only a fractional part of $15,000, the saving computed above, there can be little question about the desirability and profit in such an investment.

Air and water fluids. In compressing air very small clearances are necessary, as air is elastic. In pumping water, clearances need not be small or even taken into account, as water is non-compressible.

Large profits are possible on small transactions; small profits generally go with large deals. No one will get poor taking even very small profits; but they must be real profits and not book profits.

The surface blow in a boiler is, in fact, a skimmer removing all that floats; the bottom blow is a remover of sediment or anything that does not float. Both foreign materials are a detriment to a boiler. Get them out as soon as possible.

How to Lay Out Transition Piece With Round Top and Rectangular Bottom

BY CHARLES MILLER

To lay out this object, mark off points *A, B, E, F,* as shown in Fig. 2, together with the dotted lines *C-D, H-G.* Using the intersecting point of these lines as a center, draw the circle as shown and divide one-half into equal parts, marking the points of division 1, 2, 3, 4, 5. Lay down lines *A-B, M-M,* Fig. 4, and, taking the distances *M-A* and *M-B,* Fig. 1, place them on line *A-B,* Fig. 4, using *A* and *B* as centers. Take the height *M-N,* Fig. 1, and place it on *M-N,* Fig. 3. With the distance *L-K,* Fig. 2, placed on *L-K,* Fig. 3, and the distances *L-N,* Fig. 3, placed on *M-N,* Fig. 4, the proper height of pattern is secured.

Take the distances 1-*A*, 2-*A*, 3-*A*, 4-*A* and 5-*A*, Fig. 2, and place them on line *M*-1, Fig. 3. Do the same with 1-*B*, 2-*B*, 3-*B*, 4-*B* and 5-*B*. Take the distance 1-*N*, Fig. 3, and place it on *A-N*, Fig. 4. With the dividers set to the equal spacing on the circle, Fig. 2, and with point 1, Fig. 4, as a center, strike an arc at 2. Take the distance 2-*N*, Fig. 3, and with *A*, Fig. 4, as a center, strike an arc through point 2, cutting the arc previously drawn from point 1. Take the dividers as set, and with point 2, Fig. 4, as a center, strike an arc through point 3. Follow out the same procedure with *N*-3, *N*-4, *N*-5, Fig. 3, locating the points 3, 4 and 5, Fig. 4.

To get the end, take the distance *I-C*, Fig. 2, and place it on *M*-1, Fig. 3. Then take the distance *I-N*, Fig. 3, and with 5 as a center, Fig. 4, cut an arc at *C*. Take the distance *A-C*, Fig. 2, and, taking *A*, Fig. 4, as a center, strike an arc at *C*, intersecting the arc previously drawn through *C*.

Draw the line from 5 to *C* and add lap, and one-quarter of pattern is complete. Do the same with 1-*B*, 2-*B*, 3-*B*, 4-*B* and 5-*B*, Fig. 4.

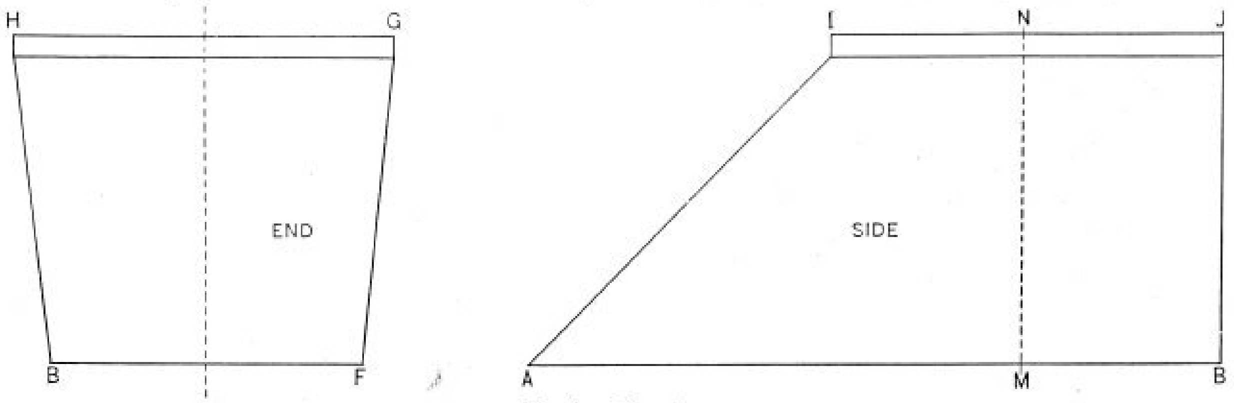


Fig. 1.—Elevation

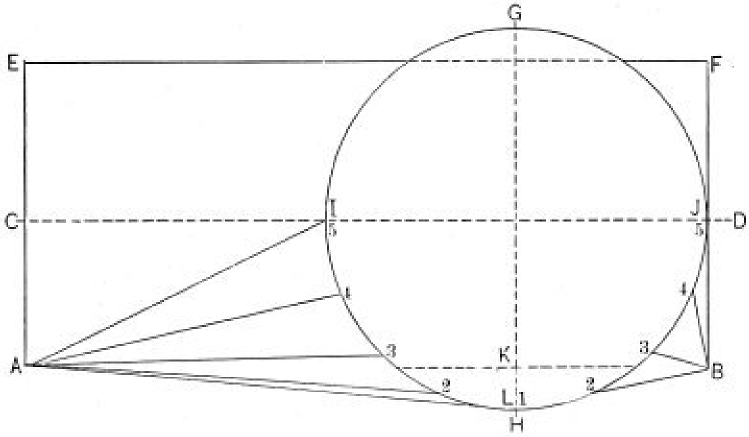


Fig. 2.—Plan

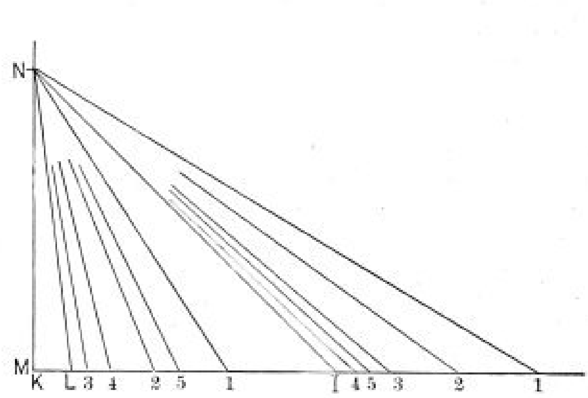


Fig. 3.—Development

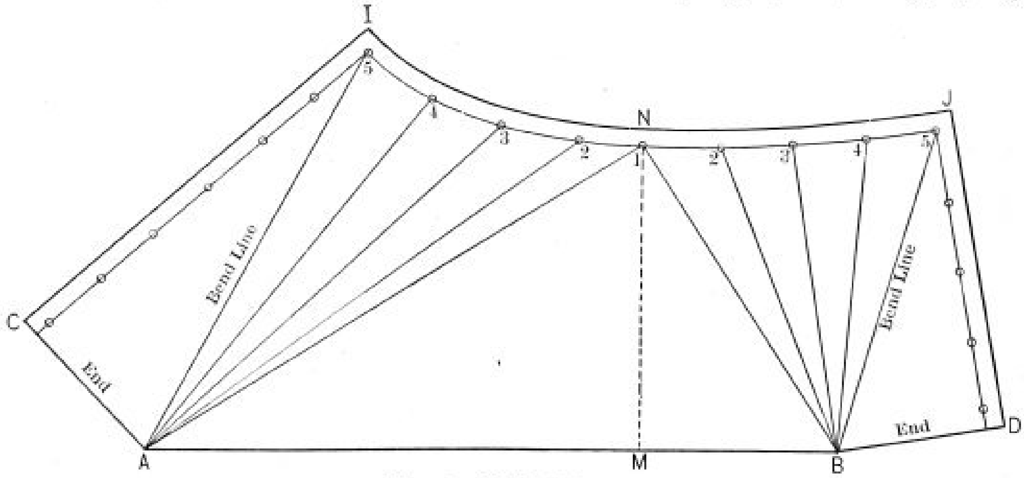


Fig. 4.—Half of Pattern

The Boiler Maker

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The safety movement is receiving great impetus these days. Employers of labor everywhere are giving this phase of management careful consideration and attention. In order to bring the thing home to workmen, rallies are being inaugurated in every section, sometimes once in every four or five weeks, but always at irregular intervals, so that workmen may not tire of them. To follow this work intelligently, communities should be divided into sections. Workmen will not travel long distances to attend such meetings. By a series of meetings held on consecutive nights the entire community can be covered.

Programmes in each section should be as nearly alike as is practicable, in order that when a group of meetings is completed all the workmen in the community will have had practically the same message. Because of the large number of people to be handled, it is probable that the best programme should consist entirely of moving pictures, or, failing this, of stereopticon slides. Each meeting should be opened with a very brief talk—four or five minutes at the most—by the chairman, who should be a local favorite, or at least well known. If the section be a small one, or the attendance small, a longer talk may be interjected into the programme, but not otherwise. In any event, the rally should not be permitted to become tedious. The introduction of some humorous speeches or good music—not mediocre, amateur musicians—would do much to keep up the spirit of the meeting.

The new twist to the much-used slogan "Safety First" will make it a boomerang for both employer and employee. The safety of each workman depends upon the perfect control of good equipment, the use of safety devices and the care of each employee. The liability of the employer depends upon the same factors. Get together on this safety platform.

It is always well to sit back and take a good square hard look at ourselves occasionally. Such a "going into the silence" frequently bears fruit in remarkable ways. We discover faults and defects in our individual make-ups that have crept in upon us without sounding any form of warning. Analysis such as this helps us to round out our being to a better chance for the fulfilment of our destinies.

The same is true of a business. Every so often—and by that is not meant the annual or semi-annual stock-taking—a man ought to take a good square look at his business. He will often see things which he did not know existed, and, seeing them, he will promptly effect a remedy, to the end that the business will be the better for his searching scrutiny. Take a look at your business to-day. You may get a very agreeable, or disagreeable, surprise, depending upon what you see. The end of the war—a war now happily crumbling in our favor—will compel just such an analysis eventually. Why not be early on the job!

The United States entered the war on April 6, 1917, and eighteen days later, by a practically unanimous vote, Congress passed the Liberty Loan Bond Bill. On May 2 the First Liberty Loan was announced. The issue for $2,000,000,000, the bonds bearing 3½ percent interest and running for 15-30 years. Four and a half million subscribers from every section of the country, representing every condition, race and class of citizens, subscribed for more than $3,000,000,000 of the bonds where only $2,000,000,000 was allotted. The Second Liberty Loan campaign opened on October 1, 1917, and closed on October 27. The bonds of this issue bear 4 percent interest and run for 10-25 years. They carry the conversion privilege. Nine million subscribers subscribed to $4,617,532,000 of the bonds—an over-subscription of 54 percent. The Third Liberty Loan campaign opened on April 6, 1918, exactly one year after our entrance into the war, and closed on May 4. The bonds of this issue bear 4¼ percent interest and run for ten years, are not subject to retirement prior to maturity and carry no conversion privilege. The loan was announced for $3,000,000,000, but the right was reserved to accept all additional subscriptions. Seventeen million subscribers came to the front with $4,170,019,650 of the bonds, all of which was allotted.

The Fourth Liberty Loan campaign, which opened on September 28 and is due to close October 19, calls for $6,000,000,000. As may be seen, the three previous loans were readily taken up. It is regrettable to note that this fourth loan is lagging. But a few days yet remain in which to meet the quotas. Many towns and cities long since have gone "over." A few yet remain who are struggling with a couple or three recalcitrants who "can't afford it"—who "haven't got it"—who "need it for coal," etc. A wallop on the jaw would bring these citizens to a fresh and exhilarating viewpoint. The big drive must end with a finish that will leave no doubts in Austria's mind—following Bulgaria and Turkey—that German plutocracy is a doomed and dead thing on this little old mud ball. Come over—go over—everybody. The world, as well as ourselves and our allies, needs the money.

It need not be urged that the effect of these loans on our national life, on the individual citizen, on our home life is immeasurable—of incalculable benefit. Not less incalculable is their effect on the destiny of the world. No American doubts that this loan will be a success. No good American will fail to contribute to its success. The blood of our men fallen in Europe calls to us. Our answer must and will be worthy of them and our country.

Yet the loan is lagging!

Engineering Specialties for Boiler Making

New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

The Victory Lubricated Air Cock

Developed by engineers whose years of experience have brought them into contact with the many difficulties and requirements connected with compressed air service, and particularly pneumatic service in shipyards, with full knowledge of the extreme hard working conditions and the terrific strain that would be placed on every part of the plant, the Victory lubricated air cock was designed as a part of the special equipment for the air service lines of the largest shipbuilding plant in the world.

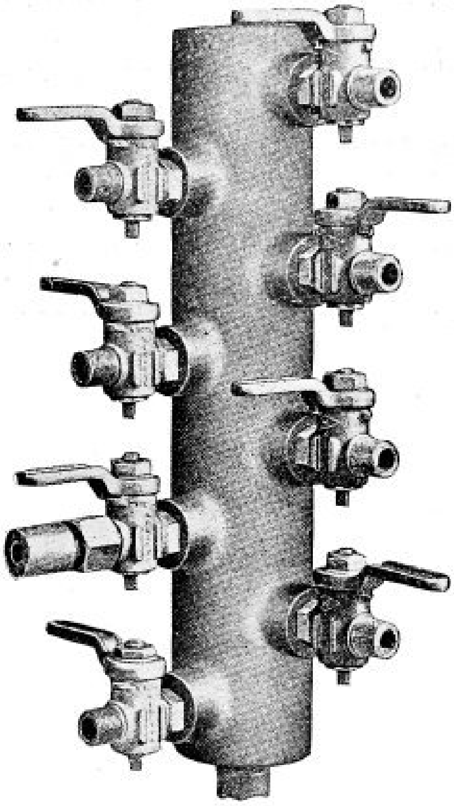


Fig. 1.—Cock in Use in Manifold

This cock, which is placed on the market by the Victory Equipment Corporation, equipment engineers, 75 State Street, Boston, Mass., has an oil pocket in the spindle with outlets so located that each time it is operated enough lubricant is passed into the two oil grooves on the inside of the body to prevent "freezing" or sticking. The stop plugs on body limit the handle to a quarter turn, preventing to a degree the scoring of body or spindle by any foreign matter that may lodge there. The large tension spring, which is a part of the Victory cock, will retain its properties, it is said, under severest use. The tension spring is so adjusted that the proper tension between the spindle and body is readily maintained.

The valve is adaptable to any pneumatic, oil, gas or low-pressure hydraulic service, and may be furnished with any type of connections desired. It is designed to be applied directly to the manifold pipe line or whatever fitting may be in use, thus obviating the necessity of additional nipples or connections.

An inspection of the valve will show that the body is of sturdy construction throughout; is compact, and the movable working parts are well protected by generous amounts of material around the sensitive portions. All parts are of extra heavy construction and are built to withstand excessive strain and abuse.

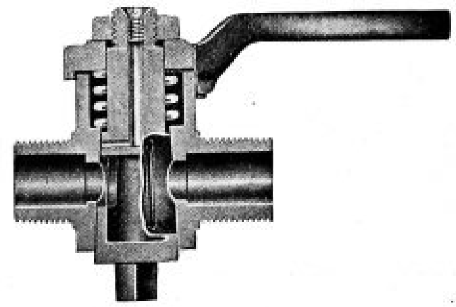


Fig. 2.—Section of Victory Cock

As a means of shutting off and turning on the flow of air to a pneumatic tool, this valve is claimed by the manufacturers to be the most efficient on the market. It is the quickest in operation, it is said, and absolutely free from leakage troubles.

All cocks are tested before leaving the factory and are guaranteed to be air-tight for hard shipyard service. They are made in all standard pipe sizes, from ¼ inch to 3 inches.

A New Slant on the Rivet Question

The American Flexible Bolt Company, Pittsburg, Pa., is introducing a novel rivet to the trade. It is designed

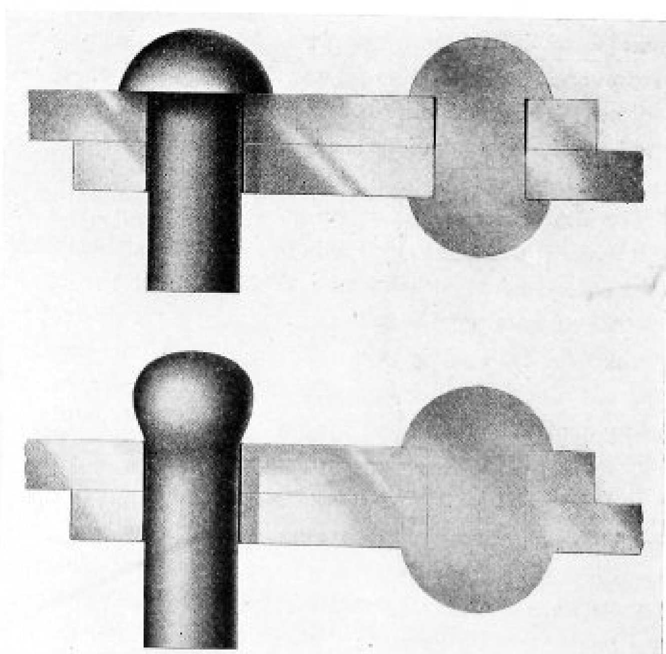


Fig. 1.—Old and New Style Rivets

to form a perfect head in the driving, since in the manufacture the head is shaped free of sharp corners, which, it is asserted, prevents accumulation of scale under the head and during the driving causes the metal to flow into the opening, making an absolutely tight rivet.

A rivet must fill the hole in order to secure tight work. Ordinary rivets fill the holes at the driven end only. The

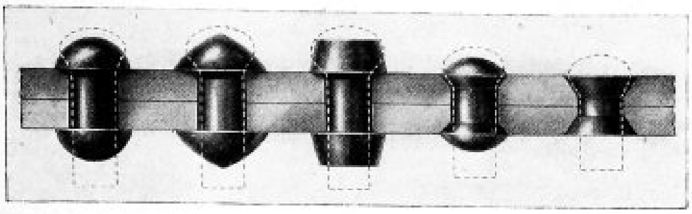


Fig. 2.—Possibilities in Single Type Head Rivet

product illustrated herewith fills the hole at both ends, because of the shape of the head, and this permits the rivet to upset equally from both ends, compelling the flow of the metal into the entire space, as shown. Other advantages claimed are that it reduces the necessity for calking, reduces the stock of various forms of heads, costs no more than ordinary rivets, adds no new features to present methods of driving, and saves idle capital and storage space. Likewise, its weight and pound price is the same as the ordinary rivet and it is ordered to the same specifications.

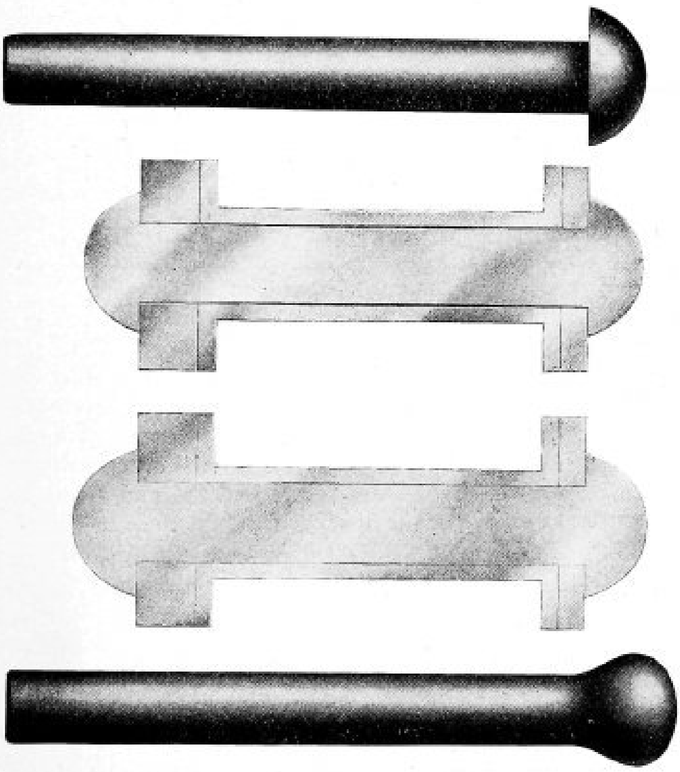


Fig. 3.—Relative Bits of Old and New Rivets

A fireman who had been at sea applied for a job of running a boiler in an apartment house. He said to the owner, "Although my hair is gray, I am as fit as ever I was, but most men don't want a gray-haired man around."

The proprietor replied, "I hire a man for what is in his head, not what is on it."

That was a wise man indeed.

I can call spirits from the vasty deep. Oh, but will they come?

I can drive rivets by the thousand feet. Oh, but will they stay?

A Novel Clamp for Lifting Boiler Plates

In the boiler plate yards of the Standard Shipbuilding Corporation, Shooter's Island, New York, there is in use a clamp for the work of lifting plates that possesses extreme novelty. It consists of a lever bolted into a clamp in such a manner as to grip the plate through friction the moment that pull is exerted upon the clamp by the overhead crane. As a device offering quick attachment and detachment, with a maximum of safety, it is especially recommended to the trade, although as yet it is not marketed. Unquestionably it admits of increased efficiency in the work of handling plate material, since it is capable of lifting two and even three plates at one time, and does it through no other holding device than the one exerted through plain friction.

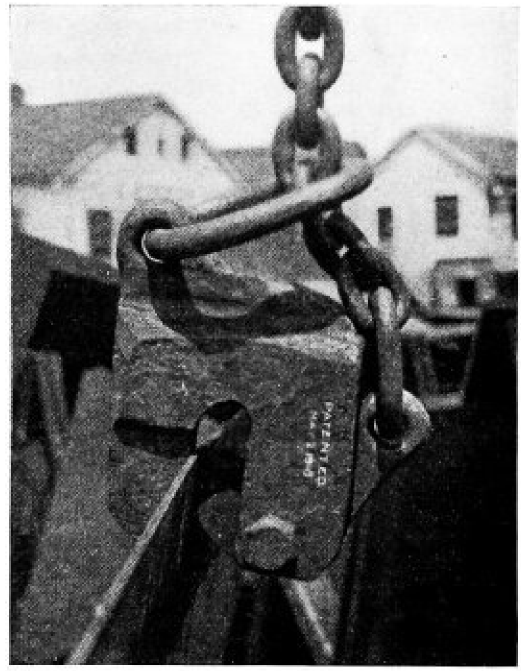


Fig. 1.—Hook for Lifting Plates

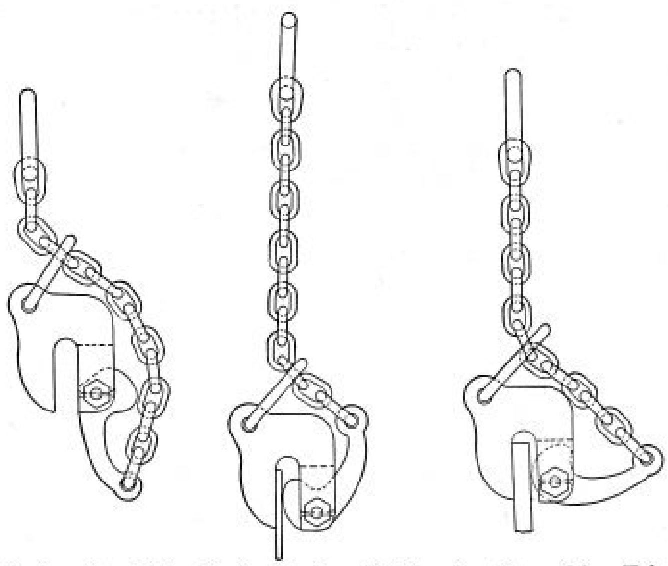


Fig. 2.—Sketch Showing the Various Positions the Clamp May Take When Lifting Plates

The device was invented and patented by the foreman of the blacksmith shop at Shooter's Island.

Can anyone tell why small spring wire deteriorates in sunlight and becomes brittle?

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, *6 East 39th street, New York city.*

Shop Practice of a Butt Joint When Quadruple Riveted

Q.—Will you kindly publish in an early issue the usual shop practice of a butt joint as per sketch inclosed? You will note, supposing on a boiler the specifications mentioned ½-inch plate, butt joint quadruple riveted, as per design of Hartford Steam Boiler Inspection & Insurance Company, the spacing at the right hand end is very poor. How would this spacing be remedied without losing any efficiency and conform to the specification? R. H.

A.—In your sketch there are two defects. First, the spacing of the rivets in the outer row is not even, since one end rivet is much nearer the girth seam than the rivet at the other end of the row. Second, the rivets are crowded at the right-hand end of the inner rows, as shown in Fig. 2, which is enlarged from Fig. 1. For zigzag riveting there should be an odd number of spaces between the girth seams in the rows having the most rivets. You have used twenty-four spaces, and it would be better to shift the templet so as to use twenty-three spaces.

One method of preventing crowding of the rivets is shown in Fig. 3. In this case the spacing of the rivets in the girth seam is shifted so as to locate a rivet on the joint line. The end of the cover plate may be sheared so as to receive only the center line rivet, or it may be extended at its full width, as shown by the dotted lines at *A*. In this latter case the end of the cover plate will receive three rivets in the girth seam.

Where the standard layout, as advocated by the Hartford Steam Boiler Inspection & Insurance Company, is insisted upon, a templet of such a layout could be placed over the cover strap and shifted until the ends are alike, or balanced. The result is shown in Fig. 4. Start by making the outer row of rivets equally spaced, giving 7 inches at each end and 5 of the regular 15-inch spaces in the line. This arrangement results in a slightly shorter pitch between the girth seam rivets and the end rivets in the two inner rows, but the spacing is better than in Fig. 1. This arrangement makes both ends alike, and there is no crowding of the rivets at either end, because there is an odd number of spaces. The whole thing possesses possi-

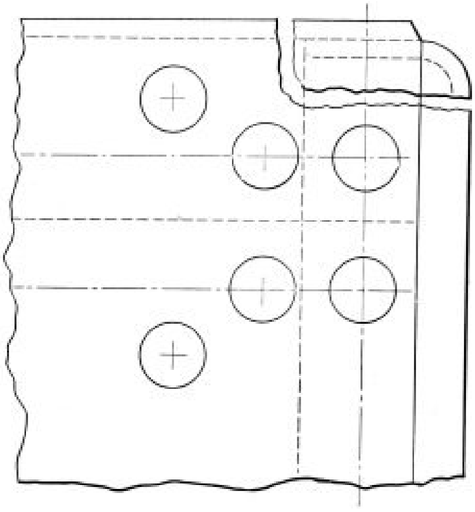


Fig. 2.—Enlarged View of Fig. 1, Showing Crowded Rivets at End of Cover Strap

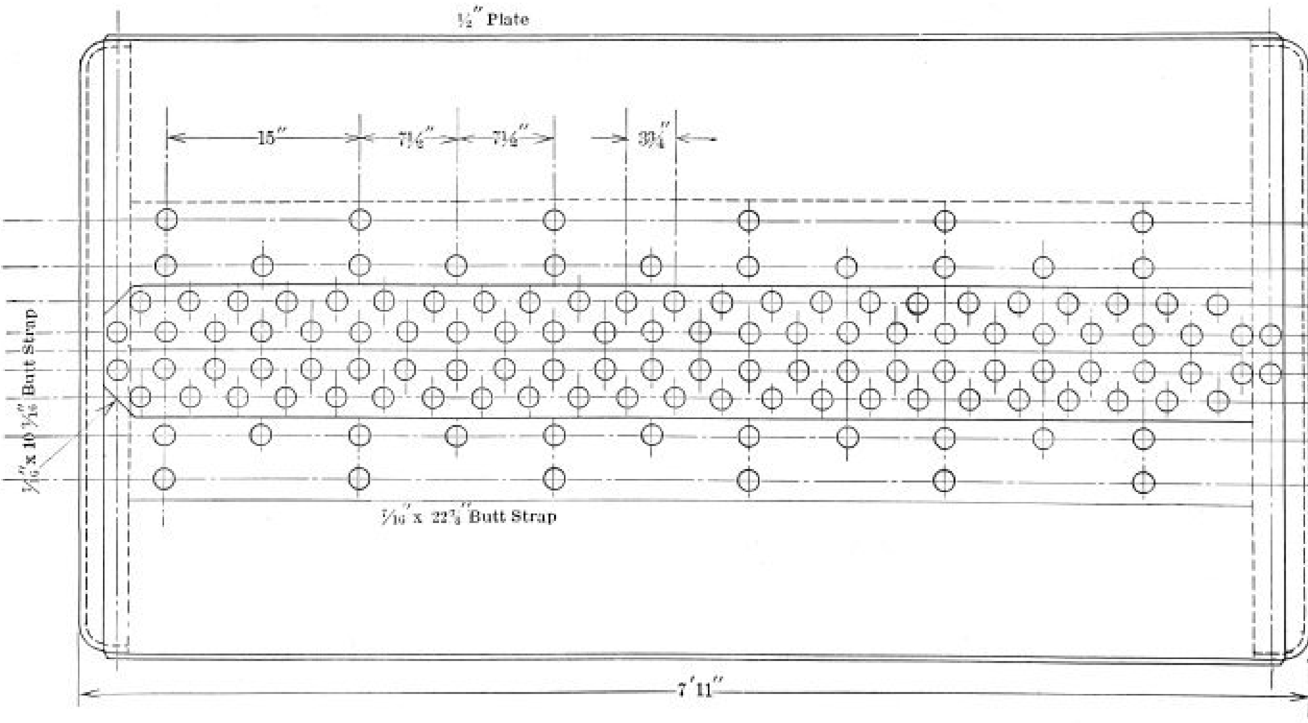


Fig. 1.—Standard Quadruple Riveted Butt Joint as Advocated by Hartford Steam Boiler Inspection Company

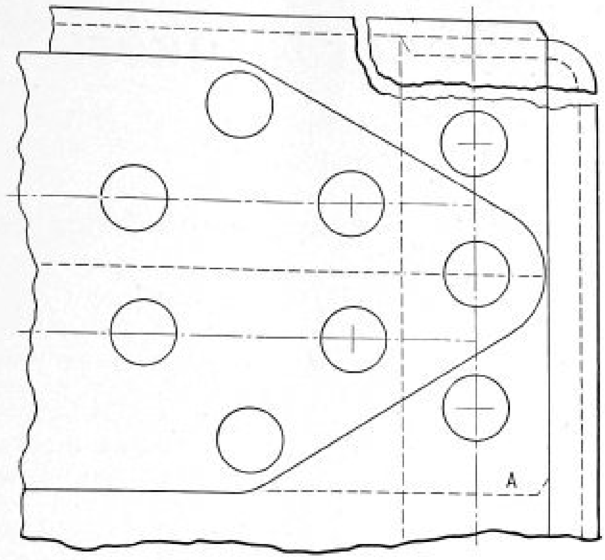


Fig. 3.—Arrangement of Rivets at Right End

bilities which ought to make their appeal to any practical boiler maker.

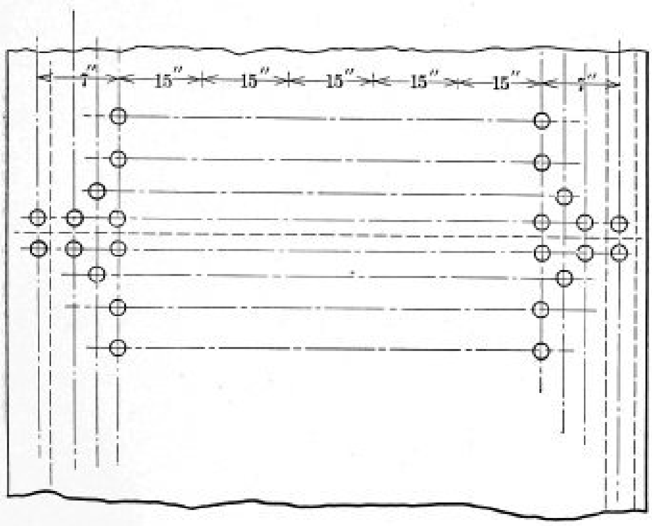
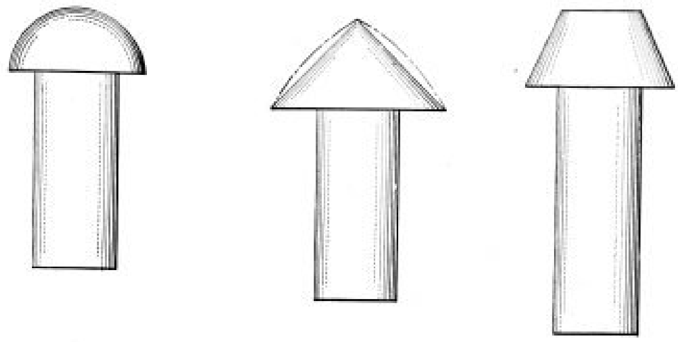


Fig. 4.—Arrangement of Rivets So That Both Ends Are Balanced

Lengths of 1¼-Inch Rivets for Various Grips

Q.—Please inform me regarding the lengths of 1¼-inch rivets for the various grips for boiler work. The largest sized rivet tabulated in any of the books that I have found is 1⅛ inches. Yet larger rivets are being used these days. J. A. F.

A.—There is little or nothing in print on the rivet lengths for the various grips where the rivets are over one inch or so in diameter. Therefore, this information must be given from practice. Even if the general data were published, it does not follow that these data would fill the needs of all the shops alike. The conditions under which the riveting is done should be noted when stating the length of the rivet to use for any style of head. First, the amount of clearance that the undriven rivet has in the hole is not made the same in all the shops. It varies from 1/32 inch to 1/16 inch on the diameter, and the rivet length must allow for the metal that will be swedged up in the hole. Second, the form of the rivet head and the contents of the cups of the riveting dies must be considered. It is generally necessary to experiment with every new die, so that there will be no excessive collaring on the finished heads. This is the case even where the general dimensions of the die cup are in accordance with the published standards of rivet heads. Third, in case the plates do not lie close and fit perfectly, an allowance should be made on the rivet length to take care of the irregularity



Rivet Heads—Button, Steeple and Conical

in the surface. In some work 1/32 inch is allowed between each pair of plates in the grip.

The following data are for 1⅛-inch and 1¼-inch rivets where the rivet holes are 1 3/16 inches and 1 5/6 inches in diameter respectively:

1⅛-INCH RIVETS

Grips, Inches	Length of Rivet Measured Under the Head Inches
1⅞	3¾
2	3⅞
2½	4⅜
3	4⅞
3½	5½
4	6

1¼-INCH RIVETS

Grips	
2-inch to 3-inch	Add 2 inches to the grip
3⅛-inch to 4⅝-inch	Add 2⅛ inches to the grip
4¾-inch to 6-inch	Add 2¼ inches to the grip
Over 6 inches	Add 2½ inches to the grip

The lengths of the rivets apply when making button heads, the two forms of steeple heads, and conical heads, as shown in the accompanying illustration. The grip is considered the length between the two rivet heads or the overall thickness of the lapped plates that are held together. The maximum grip should not be greater than 4 times the diameter of the rivet. The minimum thickness of the single plate used for 1½-inch rivets is 15/16 inch, and for 1¼-inch rivets use a plate having a thickness of 1 inch or over.

Many men will see a thing for years and not understand or appreciate it, as, for instance, why it is that the sunlight coming through small openings always makes a round or oval spot of light on the floor.

"Almost a pound" is all right for one pound, but when it comes to a large number of pounds it is another matter. Wood screws are sold by the length and number, the latter referring to the size of wire used in making them.

A worsted tassel oiler on a horizontal piston rod is a most satisfactory rig. If you have never seen one ask about it. It will come in handy sometime, perhaps, to know about it.

A syphon is a mystery to some, as they cannot see how water can run up hill. It does not. It is forced up the short leg of the syphon tube by the weight of the air and then runs down the long length by gravity. There are no mysteries in nature.

Letters from Practical Boiler Makers

This Department is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

Chart for Ascertaining Area of Ellipses

By means of this chart the area of almost any ellipse can be found without doing any figuring. Just stretch a thread across the chart from "major diameter" to "minor diameter" and the area is found in the middle column.

The dotted line drawn across the chart shows that the area of an ellipse having a major axis of 20 inches and a minor axis of 10 inches is just a shade less than 160 square inches. Perhaps you can estimate it correctly, so, before reading further, I would suggest that you estimate the area and then compute it from the formula:

$$\text{Area} = 0.7854\ Dd$$
$$\text{where } D = \text{major axis,}$$
$$d = \text{minor axis.}$$

Of course, where the measurement is made in inches the area will be in square inches. Where the measurement is made in feet the area will be in square feet.

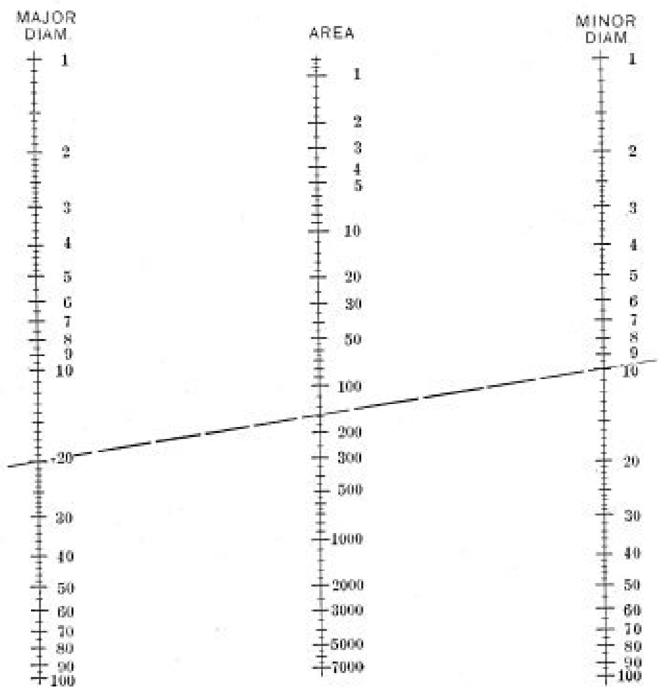


Fig. 1.—Ellipse Chart

The chart can also be used to find the area of a circle of any diameter between 1 and 100. This is true because one limit of the ellipse is a "circle," or when the minor axis becomes equal to the major axis. So, if you want to find the area of a circle of, say, 2 inches in diameter, stretch the thread from 2 to 2; for a 3-inch circle, 3 to 3; for a 4-inch circle, 4 to 4, etc.

W. F. Schaphorst.

Years ago alchemists were constantly searching for the touchstone which would turn all metals into gold, or for a universal solvent—a something which would dissolve anything. These men never seemed to get the idea that the more gold there is the less it is worth, or to wonder in what they would keep the universal solvent if they found it.

Bending Action in Channel Beams

I am reading with interest the articles written by Haas, Willey, Hobart, Francis, "Flex Ible" and "N. G. Near," and am going to ask these men, or any other reader of The Boiler Maker, to help me in a bending problem.

I am building tanks of large capacity, from 30 feet to 150 feet in diameter, and am bending the angle iron rings first and then laying them out from a templet afterwards. This makes expensive work. I might add that the marking templet for the angle ring is made from the shell sheets. What I wish to accomplish is to lay out the angles "in the straight" and then, after punching, bend them cold in a bending machine and have the holes in the angle come fair with those in the sheet.

"Laying Out for Boiler Makers" claims that it can be done by taking the diameter of the ring at the heel, adding or subtracting one-third the width of flange plus or minus the thickness of the angle and using the result to calculate the circumference. It says further to divide the circumference obtained by the number of pieces of which the ring is to be made, make practical allowance for stretch in punching, and the result will be the right length for one section of the ring.

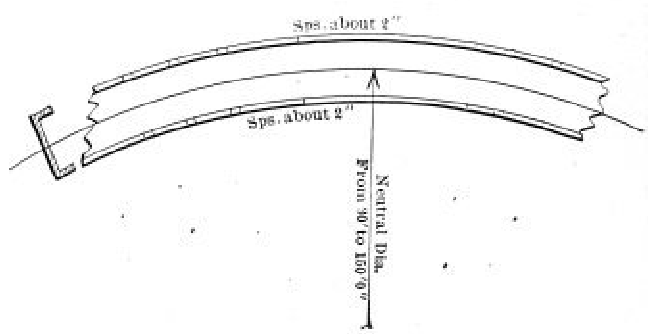


Fig. 1.—Bent Channel Used in Tank Work

I would like to read some of the experiences of men acquainted with problems of this character. No doubt, many of your readers are employed in the large Eastern tank shops, and any advice they might lend would be deeply appreciated.

Also, I should like to hear what their opinions are as to the accuracy of the work done on automatic spacing tables. I refer particularly to tank sheets in shells of large diameter. Are any of the larger shops punching their angle rings "in the straight" on these spacing tables and then bending them afterward?

And, finally, I would like to learn if it is possible to lay out a 6-inch or 8-inch channel with holes in both flanges and have the holes come fair with holes laid out in shell sheets. The channel would be bent as shown above.

What I'm getting at is this: Would the bending action about the neutral diameter of a 6-inch or 8-inch channel ring be the same as in a plate? Would the stretch in the outer flange equal the "upset" in the inner flange? If the action is equal, I could punch these channels while straight and bend them afterwards.

An early reply would be greatly appreciated.

Bucker Up.

Flexible Bolt for Locomotive Boilers

I am submitting herewith illustrations of an economical flexible "hollow heating surface" bolt for locomotive boilers which may prove of interest to your readers.

The illustrations reveal six types of the bolts in use in six different positions. Fig. 1 shows a bolt that offers ready inspection for heads in the bolt by a glance from the interior of the firebox, which will reveal through the telltale hole any leakage that may be taking place. The second bolt, Fig. 2, likewise being a flexible bolt riveted in the tube, offers the same opportunities for quick knowledge of breaks through leakage without removing cap. Fig. 3 has a copper ferrule between its sleeve and the tubular member, where it is connected with the firebox sheet. Fig. 4 shows a flexible crown bolt countersunk in the bar for the nut to roll upon. A clearance on the hole of the bar is allowed so that the bolt will not jam when the same moves back and forth with the expansion and contraction of the crown sheet. These bolts have a fusible

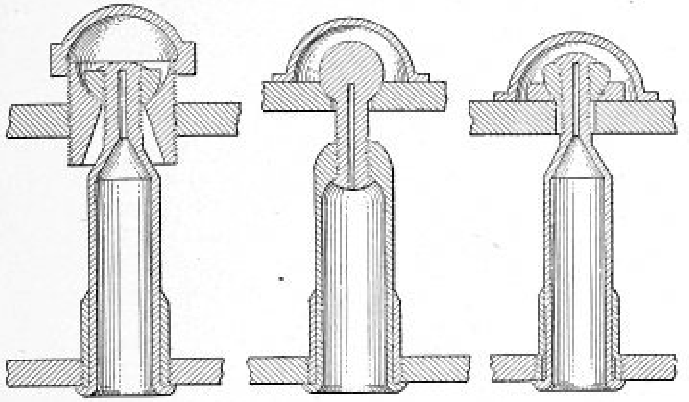


Fig. 1 Fig. 2 Fig. 3
Hollow Flexible Bolts With Caps

plug soldered on the end of the telltale hole, so that when the water gets low these plugs will melt and cool off the sheet and put the fire out, thus preventing an explosion. Fig. 5 shows a superheater flue having a sleeve over the tubular member. When the flue is rolled in tight in the front flue sheet the main tube will not cut against the hole in the flue sheet; it is also put in with threads in back flue sheet. The last bolt shown is a rigid stay bolt riveted on the outside. The telltale hole not being through the head, the bolt consists of a weld outside the firebox sheet.

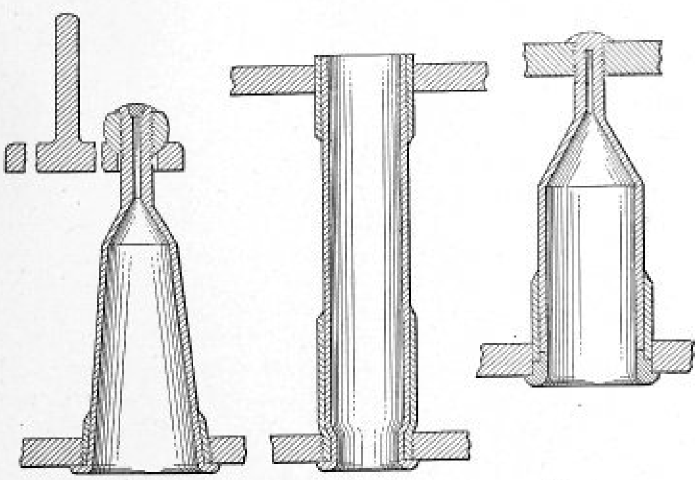


Fig. 4 Fig. 5 Fig. 6
Hollow Flexible Bolts Without Caps

All the sleeves that are put on these tubes should be solid or welded in order to make them leak-proof. If they are to be welded on the firebox sheet, then they can be made solid all the way through; otherwise, if these sleeves have threads, they will soon break at the point where the thread enters the sheet.

These bolts are made of 3/16-inch material, or heavier if it is necessary. The advantages of the patent are the lack of tendency to break; enlarged heating surface, and economical handling of fuel. Also the engine will be in service more days in the year because the government inspector can see that everything is O K by simply going into the firebox. These bolts do not require a hammer test in order to ascertain whether or not they are in good condition.

An ordinary firebox containing 1,200 staybolts and crown bolts, by the use of a 6-inch water space, can be increased about 300 square feet, in addition to the 90 to 110 square feet already present. By the use of these bolts in the same firebox, or by making a special firebox to use these bolts, one can secure twice, or even more, heating surface as the result of a wider water space.

The tubular member in Fig. 1 can be made 4 to 6 inches long; the rest of the bolt can be made any length which may be desired.

These heating surface bolts are in themselves a safety device; they are also economical in fuel and labor.

Oakland, Cal. Michael Pascale.

Closing Rivets

A record made by Charles Schock, who at Baltimore drove 2,720 rivets in nine hours, stimulated the employees of Messrs. Fraser & Fraser, tank and boiler makers, of Burnley-by-Bow, Endon, E., England, to try to beat this fine feat. They asked the management to give them an authenticated opportunity to establish a new record. It may be noticed in passing that the London workman has sporting instincts, and the spirit of rivalry is nowhere more alive than here.

This matter of workmanship feats should stimulate output in the present crisis. A quantity of tanks under the license of the Food Controller for margarine and to the order of Messrs. J. Baker & Sons, Willesden, London, N., provided the material on which to work. Messrs. Baker's representative, Mr. Prescott, acted as official referee during the test, which was witnessed by several authorized representatives of the press and Government departments, including the American Embassy, who were invited by Messrs. Fraser.

A selected squad, consisting of Robert Farrant, riveter, Payton and Baxter relieving each other as holders-up, together with four rivet carriers, succeeded in closing 4,276 rivets, ½-inch diameter by 1⅛ inches in length, snap head outside, flush inside, in an exact nine hours. This is an average of 475 per hour, 8 per minute and one every 7½ seconds.

A 5-inch stroke, 1 1/16 hose pneumatic hammer, weighing 28½ pounds, closed the whole of the rivets. The original endeavor was to knock down 2,850 rivets in the nine hours, but this total was passed at the end of six hours.

The feat speaks well of endurance, both pneumatic and human, and will require some beating; however, the international rivalry probably engendered will only stimulate further endeavor across the Atlantic, which will aid the good cause.

It was estimated at the time that it took 25 cubic feet of free air per minute compressed to 100 pounds gage, and that 540,000 blows were struck altogether. Unfortunately the writer was unaware of the test, and the above details have been supplied by the firm, who are more than willing to authenticate the claims. OBSERVER.

Graphics and Breeches Pipes

No apology is needed for the graphical statement of information otherwise accessible. The plate worker in the main is more familiar with geometric solutions because these are a part of his daily work. His arithmetic is apt to be a little rusty owing to lack of practice. The draughtsman often prefers the direct arithmetical solution, forgetting that, having normally clean hands and access to books of reference and by reason of his familiarity with figures, he is in this sense superior to the rule-of-thumb man in the shop.

There is an additional and tangible value in a graphic solution. It is visual in nature and thereby easily memorized. Figures and rules involving them, on the other hand, being more abstract, are less easily remembered.

The majority of graphic solutions are accurate and may be mathematically demonstrated by the exercise of pure reasoning faculty. They are as accurate as the care and means of measurement employed. Figures, we are told (in a political sense), are things that can be made to prove anything. They are capable of distortion, and certainly an error usually results in a mistake of considerable magnitude. Hence the vogue of the slide rule, either for direct calculations or as a means of proof.

On the other hand, straight lines and circles cannot lie. An obvious error is immediately apparent, and results which are surprisingly accurate may be obtained with due care on the part of the mechanic.

Every apprentice, or, for that matter, full mechanic, should, for actual demonstration, verify the circumference of a circle by actual experiment.

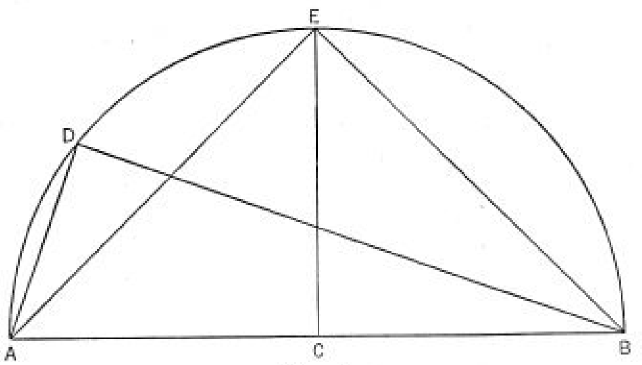


Fig. 1

One man known to the writer, and who has ideas on this subject of demonstration by the use of a disk of exact size rolling the same in contact with a plate surface of considerable length, claims that he can get closer accuracy than 3.1416. He certainly can get closer than 3 1/7 in this way, and it is worth the trouble of experimenting. One-quarter of this multiplied by the diameter squared gives the area, as is well known. We do not, however, always stop to think that this rolling of a disk is the only practical method of finding the incommensurable quantity known as π. For ordinary purposes the experimental determination is sufficiently accurate.

Concerning angles, the scale of chords is considerably more accurate than the finest protractor made. Three lengths can always be made into a triangle with considerable accuracy, while the radius of the protractor is small. There are three chances of error in making out an angle from a protractor. First, the determination of the position of protractor with relation to the center; second, the setting to base line; third, the marking from the protractor edge to the plate.

Two-foot steel rules with a scale of chords accurately divided are decidedly worth the small extra cost involved. The shop geometrician is often quite ignorant as to the meaning of this scale; anyhow, numerous mechanics have no idea of the meaning of the use of such a marking on their rules.

A scale of chords is a means of setting out angles with considerable accuracy. Suppose we start to lay out an angle of 80 degrees. Having set out the base line, with the compasses take off the length 0 to 60 on the scale and describe an arc of a circle from the end of the base line. This center will form the apex of the angle. Now set the compasses to length 0-80 on the scale. From the point where the original arc cuts the base line describe an arc to cut the original arc. This point joined to the first center of the base line gives the required angle.

The result should be easily within one-tenth of one degree. The scale of chords dispenses with a protractor altogether and gives superior accuracy when setting out. It will be observed on inspection that the divisions on the scale of chords gradually diminish from 0 to 90 degrees, which is the limit of the scale.

If reference can be made to any pocket book a more accurate method still is available. This involves the use of a table of natural sines. A decimal is there given against each angle from 0 degree to 90 degrees. The great value of this method of setting out an angle is that we make a base line of any length to suit the job in hand and are not confined to a predetermined distance, as with a scale of chords.

Suppose we take again an angle of 80 degrees. This must be halved, and we find from the table that the sine of 40 degrees is .64279 inches. Now set out the base line, and for length it is best to choose a multiple of 10. Taking 10 inches, we multiply the sine of half the angle by the length of the base line. Multiplying by 10, we simply shift the decimal place. The figure thus becomes 6.4279 inches. This result requires doubling. Thus we get 12.8558 inches, or 12 55/64 inches, very nearly, the table of decimal equivalents in the same pocket book being consulted as to the actual length.

With one end of the base line as center (this will be the location of the point of angle), we describe a circular arc with compasses set to 10 inches. From the other end of the base line, where the arc cuts it, as center, and 12 55/64 inches in compasses, we strike across the original arc, the point so found joined to the center of the former arc gives us the angle required with very great accuracy. If 100 inches be chosen as base line, the length determined from the table of sines becomes 128 9/16 inches = 128.558 inches, nearly. Determination as to areas may also be geometrically made, especially with regard to circles.

In connection with air duct work, exhaust systems and ventilating plants, these problems find their value. Most of such work consists in the provision of a central fan exhausting or impelling air over a widely distributed system of piping. Such work in sheet metal makes considerable demands upon the skill of the plate worker. From the fan runs a large main which gradually diminishes in size as branch after branch is taken off to various quarters. Two branches may be taken. The main may need to be split in two, and from the same point on main or branch as many as five junctions may be led away.

Take a concrete instance. A large smith's shop installs an exhaust system and one hundred fires have to be provided for. The sheet metal work necessary has to be actually seen before erection in order really to get any idea of its amount. Such a system probably starts with a 48 or

60-inch fan and main and terminates in 6-inch or 9-inch pipes with hood to each hearth. Each range of fires, say five in number, has a common duct gradually diminishing in size to the outermost fire. From the main duct two ducts are taken away at the same point for each range of fires. The main itself has a gradually diminishing area after each main branch is reached. The shapes, elbows, tees and branches cover almost every conceivable kind known to the trade. Branches are led away at various angles and the layout of such a system calls for quite a lot of shop geometry. One point in such a system is the lay of the sockets, which should be consistent with the direction of the smoke. A system of duct work of this kind may have its efficiency greatly reduced by want of care on this single point.

Now, all the problems concerned in a complicated plant of this type may be solved graphically, and with the aid

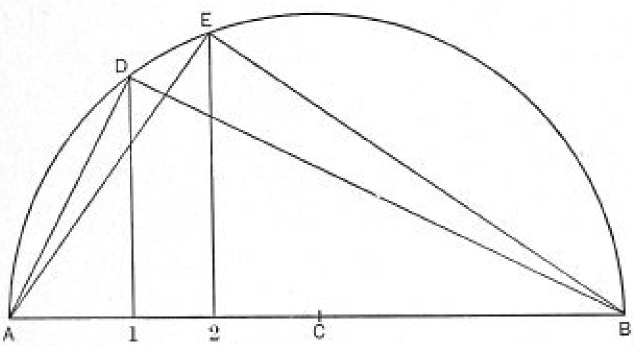


Fig. 2

of common sense, helped by some geometrical knowledge, the angles, and more especially the areas, of the various pipes can be directly ascertained. Let us assume some typical cases:

Example I.—With a 10-inch main, required the diameters of two pipes to form a breeches piece of equal area. Lay out line *A-B*, Fig. I, 10 inches in length. Erect perpendicular at *C*. Join *A-E*, *E-B*, and you have the diameters required.

Example II.—One pipe 3 inches in diameter is taken at a certain point. Required the diameter of the main from this point. Proceed as before, but mark off *A-D* = 3 inches. Main from this point is *D-B* in diameter.

Example III.—To split a 10-inch main into three pipes, each equal in area and the combined total of areas equal to the area main. Lay off, Fig. 2, line *A-B* = 10 inches. Divide same into required number of parts. From the first of these erect a perpendicular *2-E*. Distance *A-E* gives the diameter of the pipes required.

Say that the main 10 inches diameter is to have four branches led away at intervals throughout its length and terminating in a pipe of equal area to branches. Divide *A-B* into five equal parts. Erect a perpendicular *I-D* from the first of these. *A. D.* is the diameter of first branch. The main reduces to *B-D* in diameter. Using *B-D* as base line, repeat the division, this time into four, or marking off length *A-D* upon the semi-circle. The line joining *D* to *B* is now the diameter of the main beyond the second branch, and so on.

If the method be once grasped from the examples given, the application of the rules to any instance is easy.

Rule.—Divide base line, either full size or to scale, into the number of parts required; erect perpendicular from the first of these to the circumference; join the point so found to the extremity of base line. The diameters are the lines so joined. The rule holds good for any number of divisions.

The construction is based upon four fundamentals mathematically true and capable of reasoned proof.

1.—Circles vary in area as the square of their diameters.

2.—The angle contained in a semicircle is always a right angle.

3.—The sums of the squares on the sides of a right angle containing the angle are exactly equal to the square on the side opposite the right angle.

4.—That in any circle, any two chords cutting each other, the areas given by the two sements as rectangle of either chord are equal. Fig. 3 shows an interesting variation of the same problem.

It is required to divide a 10-inch circle into ten concentric circles, with each division or concentric ring to be equal in area, or, another variation, to cut up a circle into ten concentric portions equal in area.

Construct a semicircle on one-half the diameter, i. e., the radius; divide the radius base line into ten parts. Where the perpendiculars from the divisions cut the semicircle, the points through which the required circle have to pass are found.

The utility of this special case may be seen in the case of draining plates where equal distribution of holes with regard to area is needed.

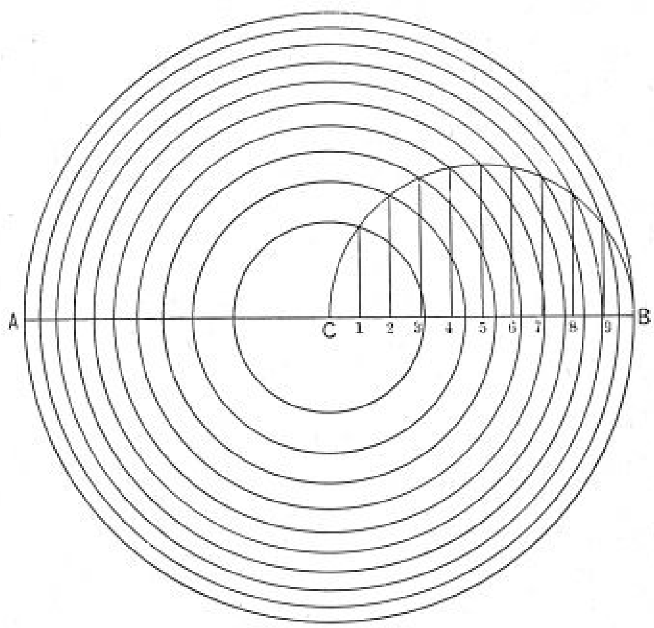


Fig. 3

If the same number of equally spaced holes of the same size are drilled within each ring and the center circle, equal effect over the whole area will be produced.

The figure is also a visual indication of how small is the extra amount needed in the diameter of the circle to produce 10 percent excess area.

We are too apt to assume that a small increase over size in a hole makes little difference. If the actual circle is set out as described and illustrated, it may serve to rectify an indifferent attitude toward the matter and lead to better workmanship and appreciation of the actual facts.

No originality is claimed for the construction shown. Anticipation by Euclid precludes such a claim, even if the methods were new to plate workers. It is, however, not in general application.

It is also curious and a significant fact that from the earliest times the craftsmen versed in geometry shrouded their methods in mystery. Even to-day those who possess such knowledge are inclined to shield it and consider that they are the sole repositors of hidden wisdom. They can only be persuaded to reveal their methods in a confidential and semi-secret manner.

Perhaps there is something in the survival of masonry, after all. The level, square and compasses are symbols of meaning, while as actual tools they may be made to do uncommon things in the light of reason only.

London, England. A. L. HAAS.

Mr. Forbes Comes Back

After reading the remarks of "Observer," it seems to me it would have been better perhaps for his comprehension if my original article had been headed a new old "boy." I confess that I do not quite grasp the idea which he seems to convey in using the word "credulity." He may mean that he doubts if the tool was ever made, or he may mean that the tool was not one with which a ¾-inch or 1-inch hole could be drilled.

If he means the latter, he is certainly right. Doubtless any mechanic who would merely glance at the tool described would never for a moment suppose it was to carry a ¾-inch or a 1-inch drill, any more than a man would expect a light wooden foot bridge of proper construction to carry a locomotive. The design which I described was self-evidently for light drilling, and it could, of course, be designed for heavier work. It was, in fact, used for drilling dowel holes in some machines which I had built, in which the dowel holes could not be conveniently reached by any of my drill presses. The dowel holes were small, probably not over 3/16 inch, and for such work the tool was satisfactory.

It seems to me that the construction, as described, is pretty nearly a tubular one, and no doubt an entirely tubular construction could be designed which would negotiate a ¾-inch or 1-inch hole.

In the description of the tool as suggested by "Observer," I get mixed up on just what he means by the following sentence: "Use a lock nut to fix the extension at top of arm and weld the arm to the extension screw; make it of 1-inch plate." I fail to see why, if the extension arm is welded to the screw, it should be held by a lock nut also. To drill and relieve the body would be all right, as "Observer" suggests, but this would be a much more expensive construction than the one I described. There is certainly nothing to stand in the way of making my original design as heavy as the work which it is to do would demand.

"Observer" remarks that a possible design for an "old man" could be gotten up wherein the back could be stiffened by placing a brace which would be the hypothenuse of a right-angle triangle.

Some years ago an Englishman called on me to show a patent ratchet drill which rotated the drill in both the pull and push action of the handle, and to illustrate its value he had with him an "old man" made exactly on this principle, it being a light steel casting.

The design was certainly good, but it had no adjustable feature, of course. I have seen the back of the "old man" "stiffened up" by having the back, or vertical turn, 90 degrees to the foot and arm in the forging. I have also seen an adjustable type of "old man" made by bending up at right angles a foot, and a second piece bent up likewise, the back of the one and the face of the other of the verticals being milled with serrations and clamped together by a stud and nut, the stud being fixed in one piece and sliding in a slot in the other.

As to the matter of tough steel, I wish to say that if "Observer" will take a piece of round screw machine stock and clamp it in a vise and note the deflection of, say, a 10-foot bar, and then take an equal length and size of merchant bar steel and clamp it in the vise and note the deflection, he will get a pretty clear idea of what I meant to convey in using the expression "tough steel."

However, the "old man" of the shop, like the old man in life, is pretty generally made useless by the introduction of electric and other light portable drills, and yet at times he does come in handy and fundamentally. As he is only used occasionally, the cheaper his construction, so long as he will do the work, the nearer he is to proper economy.

New London, Conn. W. D. FORBES.

Fitting Hammer Handles

If a good hammer head be examined it will be found that its eye is tapered from both openings and that the center is a pronounced waist of smaller dimensions. In making, the eye is drifted hot from both sides by an oval tapered drift. Any hammer without this peculiarity is not a mechanic's tool. It may serve to nail up packing cases, but it is certainly not an implement of craft.

Assuming that a hammer head has been chosen—and it is well to examine the squareness of the eye relative to the body of the tool both axially and perpendicularly—or that the old shaft has been removed, select a good hickory or ash handle of requisite size. Place the handle in the vise and fit it to the head by the use of draw knife and rasp.

Before proceeding further, certain important preliminaries are worth mentioning. The stock of handles should be kept in a dry place. Half a dozen should have the end which fits into the head placed adjacent to a convenient steam pipe or radiator. This slow toasting process will reduce the circumference by at least 5 percent. The contraction increases the subsequent utility of the handle.

I was at one time responsible for the manufacture of a handled implement in quantities running into hundreds of thousands. Each handle bore a ferrule, and interchangeability was absolutely necessary. In my experience the shrinkage of bone dry, well seasoned handles under similar treatment amounted in three days to a double wrapping of paper 5/1000 inch in thickness. That is, the diameter was reduced by 20/1000, or 1/50 inch, by slow drying against heater pipes. The occurrence of that amount of shrinkage subsequent to handling is fatal, whatever type of wedging is used in the hammer head.

To return to the actual process of handling a hammer. Use a draw knife to pare down the excess material. This is a double handled cooper's tool, which is insufficiently known among allied trades. If the draw knife edge is set on an oil stone, the facility with which an irregular shape can be worked is remarkable. To finish the fitting, use a rasp or "vixen" file. Try the head on the helve repeatedly until a first class fit is evident. When in place, the handle will project an inch or so beyond the head. Prepare a hardwood wedge about ¼-inch thick at the top with an inclination of ⅛ inch per 1 inch of length; taper it sidewise to correspond with the waist in the eye. Using an ordinary hack saw, make a cut down through the upper end of the handle to the point at which the waist of eye will seat. Locate the head on the helve firmly by dropping the handle on its lower end to bed the head. Make sure that all is square; dip the wedge into hot glue and drive it home. Butt off the projection of the handle with the hack saw and the job is done.

The important points of the process are: The use of a shaft end which has been seasoned, honest and proper fitting, intelligence and care in every operation.

London, England. OBSERVER.

Selected Boiler Patents

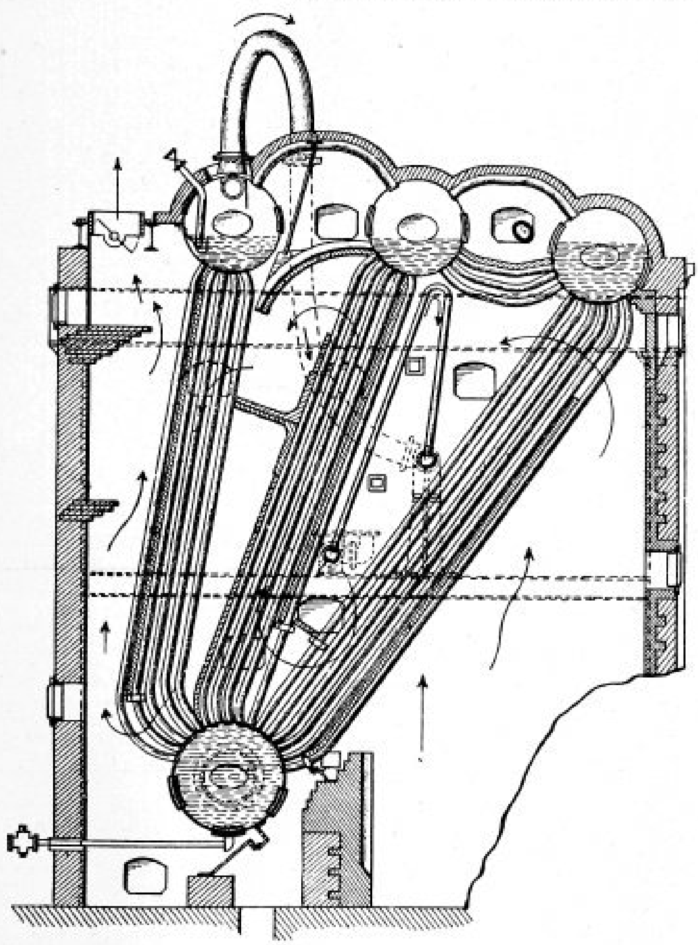
Compiled by

GEORGE A. HUTCHINSON, ESQ., Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchison.

1,267,078. STEAM BOILER. DAVID S. JACOBUS, OF JERSEY CITY, N. J., ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, N. J., A CORPORATION OF NEW JERSEY.

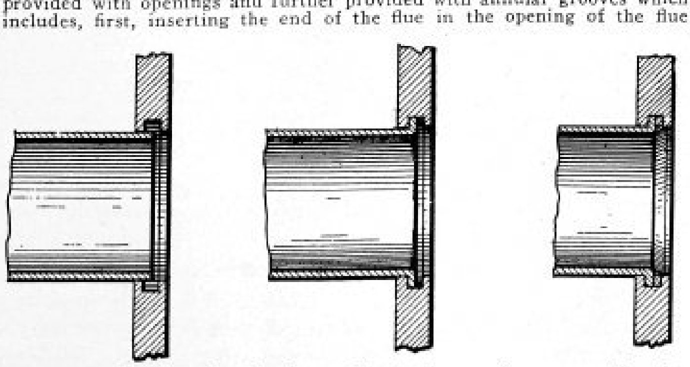
Claim 1.—A steam boiler comprising at least three upper transverse drums connected by banks of tubes to a lower water chamber, the rear upper drum being set at a higher level than the front upper drum, a main steam offtake leading from said rear drum, baffles for giving the



gases serial up and down passes over the banks of tubes, with an up pass in the middle bank and a down pass in the rear bank, a special baffle extending rearwardly from the middle upper drum and arranged to direct the gases leaving the upper part of the middle bank into the rear bank to protect the rear drum from excessive heating, and an offtake for the gases in the rear of the rear bank of watertubes. Five claims.

1,267,143. METHOD OF SECURING THE ENDS OF BOILER FLUES IN FLUE SHEETS. JOHN SULLIVAN, OF PERU, IND.

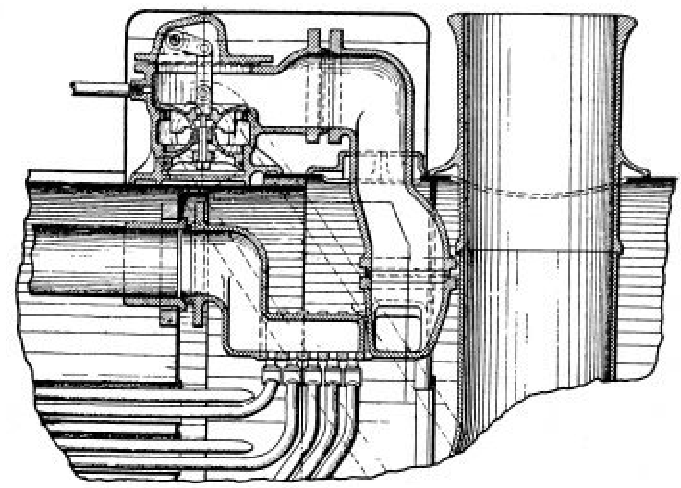
Claim 1.—The method of securing boiler flues to flue sheets which are provided with openings and further provided with annular grooves which includes, first, inserting the end of the flue in the opening of the flue



sheet; secondly, flanging the flue to lie in the annular groove, then inserting a ring in the annular groove, and then welding the flanged end of the flue, the flue sheet and the ring together. Two claims.

1,266,184. LOCOMOTIVE BOILER SUPERHEATER. HARRY S. VINCENT, OF RIDGEWOOD, N. J.

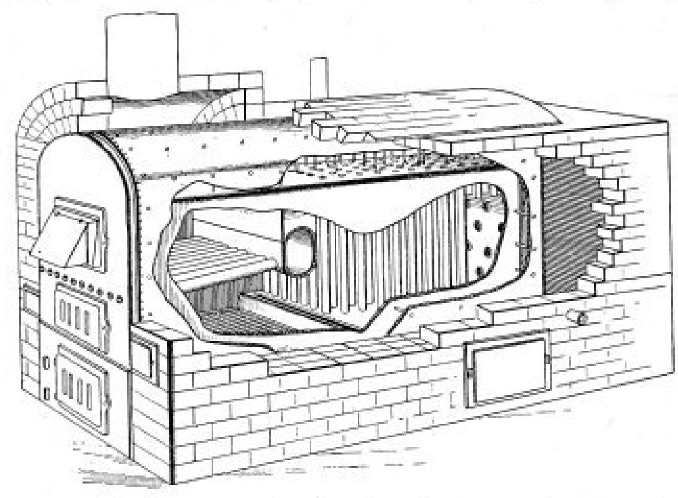
Claim 1.—The combination, with a locomotive boiler, of a superheater header located in the smoke box, and having a single delivery nozzle entirely inclosed therein; a throttle box supported, independently of the superheater header, on the exterior of the boiler shell; an angle pipe secured to, and supported by, the throttle box, said pipe passing



through the smoke box and being connected, at its lower end, to the delivery nozzle of the superheater header; branch steam pipes leading, exterior to the boiler, from the throttle box to connections with the distribution valve chests of the engine; and a throttle valve seating in the throttle box and controlling communication therefrom to the branch steam pipes. Three claims.

1,265,201. BOILER. MICHAEL E. HERBERT, OF CHICAGO, ILL.

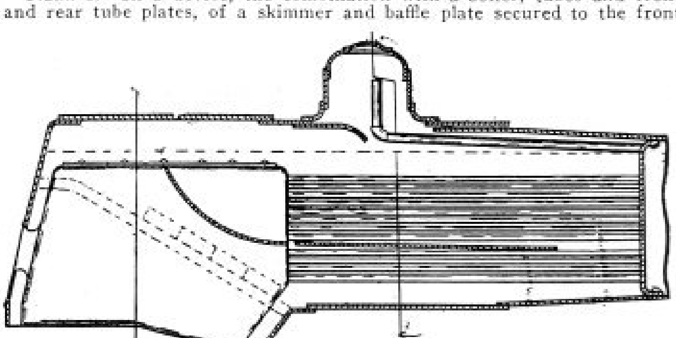
Claim 1.—A boiler of a character comprising inner and outer shells connected in spaced apart relation and forming a water chamber therebetween, the inner shell of which defines a combustion space and has outlet flues at its rear end extending through the rear end of the outer shell, said inner shell being provided with a plurality of depending



water tubes in its rear portion, closed at their lower ends and opening at their upper ends into said water chamber between the shells, a grate at the lower forward portion of the inner shell, a plate in the lower rear portion of the inner shell receiving and supporting the lower ends of the said watertubes, and a slotted bridge wall between the grate and the said tube supporting plate. Two claims.

1,263,844. LOCOMOTIVE BOILER. JOHN G. BROMAN, OF CHICAGO, ILL.

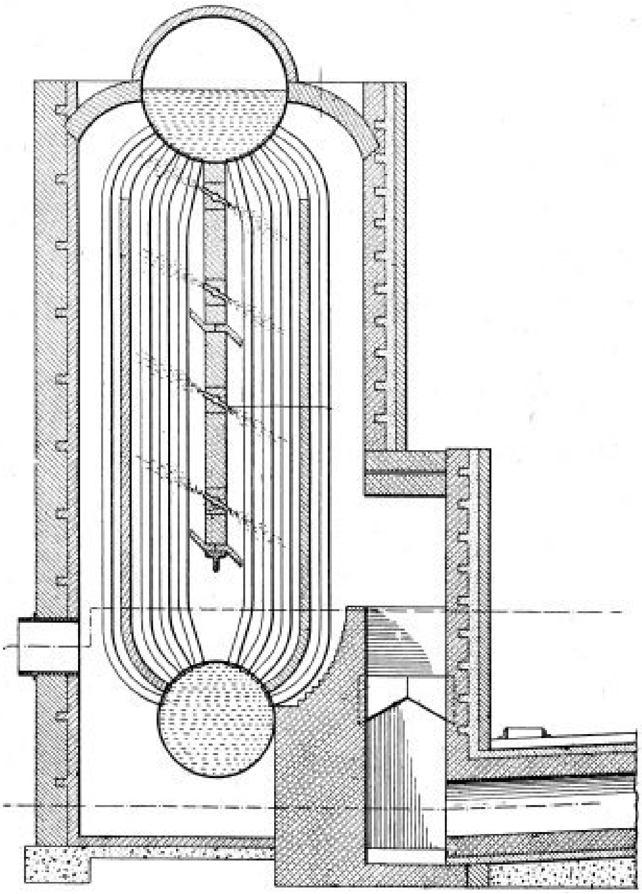
Claim 1.—In a device, the combination with a boiler, tubes and front and rear tube plates, of a skimmer and baffle plate secured to the front



tube plate adjacent the top of the waterline and curved upwardly, presenting a curved lower surpace, and a baffle plate secured adjacent the bottom of the boiler inclining downwardly toward the front of the boiler and extending from adjacent the rear tube plate forwardly to have its forward edge lie in approximately vertical alinement with the rear edge of the upper baffle and skimmer plate. One claim.

1,266,906. VERTICAL WATERTUBE BOILER. JOHN E. BELL, OF NEW YORK, N. Y.

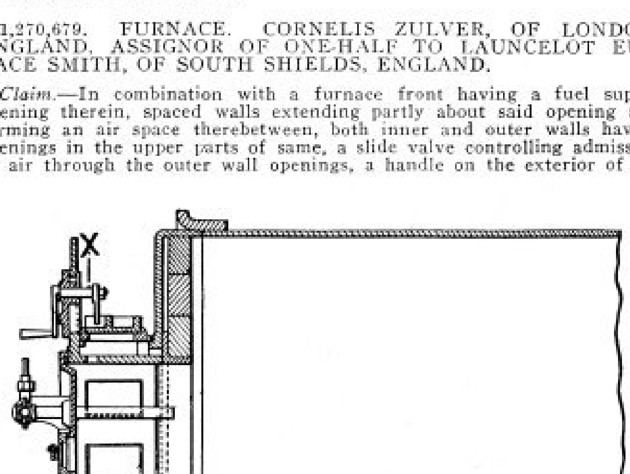
Claim 1.—A vertical watertube boiler, consisting of a transverse steam and water drum and a transverse mud drum, rows of watertubes connecting said drums, a central baffle extending frm the steam and water



drum to a point above the mud drum, and a second baffle in front of the first baffle supported on the mud drum and held in position by the tubes in one of the rows of tubes in front of the central baffle; substantially as described. Three claims.

1,270,679. FURNACE. CORNELIS ZULVER, OF LONDON, ENGLAND, ASSIGNOR OF ONE-HALF TO LAUNCELOT EUSTACE SMITH, OF SOUTH SHIELDS, ENGLAND.

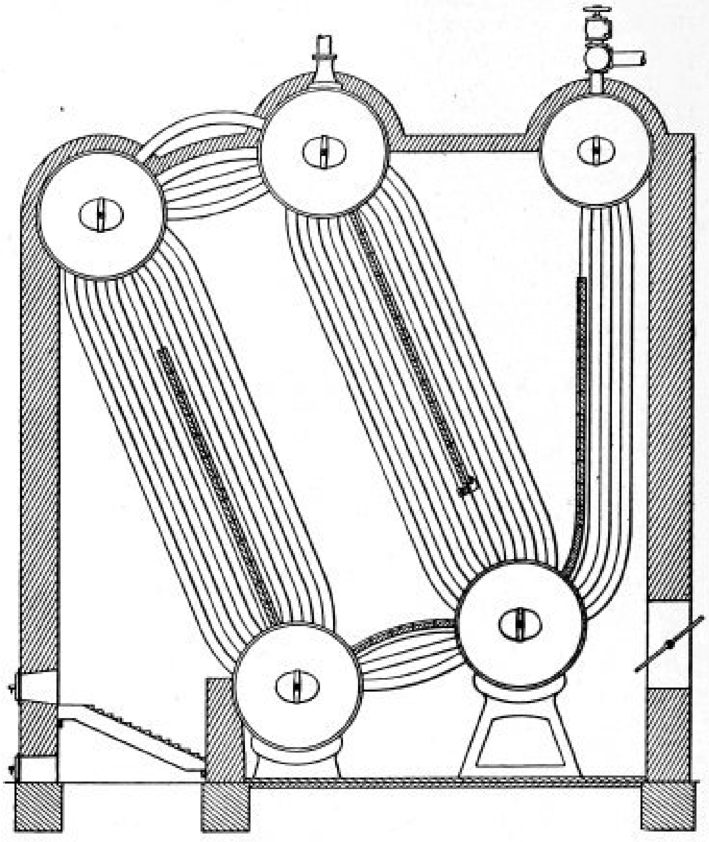
Claim.—In combination with a furnace front having a fuel supply opening therein, spaced walls extending partly about said opening and forming an air space therebetween, both inner and outer walls having openings in the upper parts of same, a slide valve controlling admission of air through the outer wall openings, a handle on the exterior of the



furnace for operating said slide, dampers for controlling the supply of air to the under sides of the furnace grates, handles for operating said dampers, a bell-crank lever, and links connecting said slide handle and a damper handle to be simultaneously operated from said bell-crank lever, substantially as described. One claim.

1,271,598. BOILER CONSTRUCTION. EDWARD C. MEIER, OF PHŒNIXVILLE, PA.

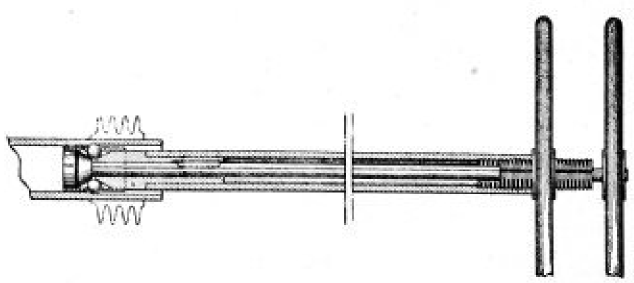
Claim 1.—The combination in a boiler of a casing; a boiler unit within said casing; an independent feed-water drum within the top of said casing; means for conducting feed water to the drum, said boiler unit having an upper and a lower drum connected by tubes, said lower drum being mounted below said independent feed-water drum; a plurality of tubes connecting the lower drum of the boiler unit with said feed-water drum; a baffle leading downwardly from the upper drum of the boiler unit and supported by the tubes thereof, said baffle stopping short of the



lower drum to provide a passage for the products of combustion; and a second baffle extending from said lower drum toward said feed-water drum and located to the rear of said first baffle and passage and in front of the tubes connecting with the feed-water drum, said second-mentioned baffle stopping short of the feed-water drum to provide a passage for the products of combustion between said latter tubes and between said second-mentioned baffle and the rear of the casing, said casing having an outlet passage for the products of combustion below and to the rear of said second-mentioned passage, substantially as described. Two claims.

1,273,475. TUBE EXPANDER. PELL W. FOSTER, OF NEW YORK, N. Y., ASSIGNOR TO POWER SPECIALTY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

Claim.—In a tube expanding machine the combination with a rotary stem of a central adjustable rod carrying one conical member of a ball race, a second conical member secured to the stem, the angle of the rear



member, relatively to the direction of movement of the tool through the tube to be expanded, being less than that of the other member of the race, balls adapted to run on the members and a casing with apertures through which the balls project secured to the stem and confining the balls. One claim.

The flat top and bottom of the U. S. standard thread is produced by simply grinding off a certain amount of the point of the thread tool. The theory of the round top and bottom is that the corners of the tap will wear off, anyway, after a little use, and you had better do this when making the tap. However, the trouble with the theory is that the flat topped tap stands up well and gives no trouble in practice.

THE BOILER MAKER

NOVEMBER, 1918

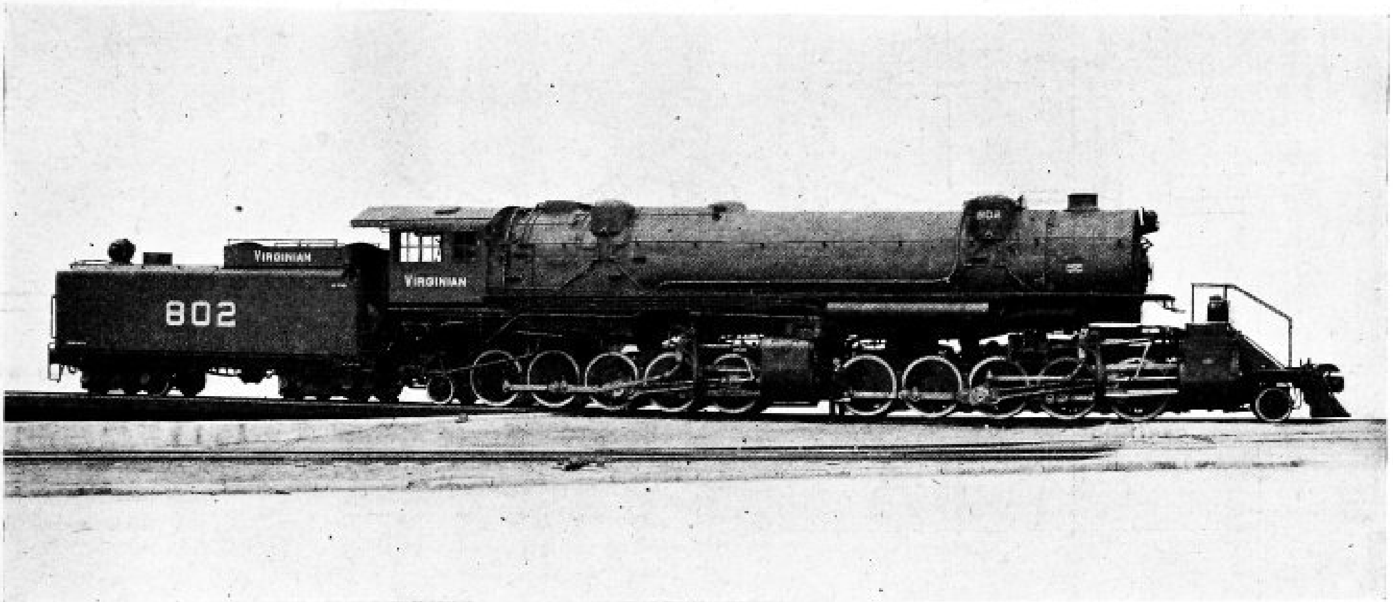


Fig. 1.—Largest Locomotive of the New Mallet Type, Built for the Virginian Railway

Large Boiler for New Mallet Locomotive

Built for Heavy Grades on the Virginian Railway—Firebox Length, 181 1-16 Inches—Working Pressure, 215 Pounds

On a certain portion of the Virginian Railway between Elmore and Clark's Gap, on the Deepwater Division, a distance of about fourteen miles, there is a grade for the last eleven and one-half miles of 2.07 percent, with maximum compensation curves of 12 degrees. For the first two and one-half miles the grade is .5 percent. This fourteen miles, all single track, includes five tunnels, which compel the use of an absolute block system. It is the crucial part of the entire system, since all the eastbound tonnage of the Virginian must pass over it.

Ten Mallet locomotives, each having a tractive effort of 147,000 pounds working compound and 176,000 pounds

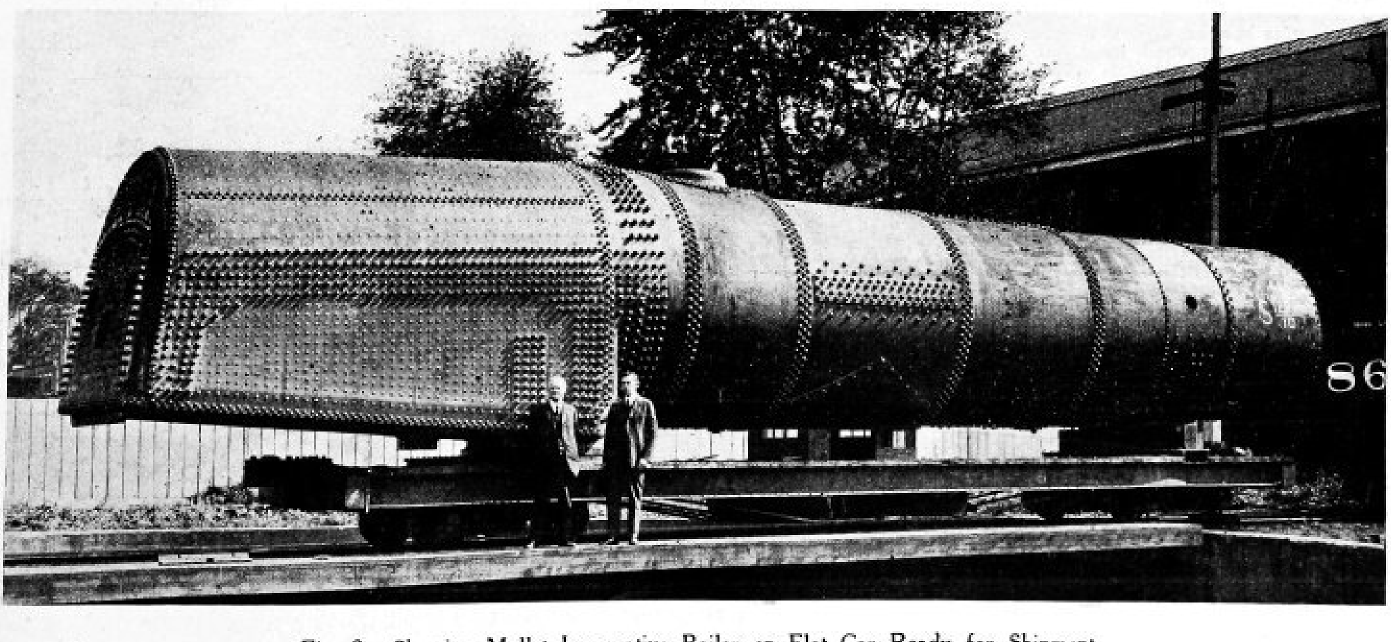


Fig. 2.—Showing Mallet Locomotive Boiler on Flat Car Ready for Shipment

working simple, are now being delivered by the American Locomotive Company to handle the increased volume of traffic on this particularly difficult section. The size and power of the Mallet locomotives, which have been used for this traffic for the last eleven years, have progressively advanced to keep pace with the growth in the volume of traffic. Four engines of the 2-6-6-0 type, with tractive effort, each of 70,800 pounds, constituted the first installment; eight of the same wheel arrangement, but with a tractive effort of 90,000 pounds each, followed. One engine of the 2-8-8-2, with tractive effort of 100,800 pounds, was next installed. Six engines of the 2-8-8-2 type, with a tractive effort each of 115,000 pounds, made up the fourth lot.

LOCOMOTIVE MEETS INCREASED TRAFFIC VOLUME

Trains passing over the mountain section are operated at present by one 2-6-6-0 type Mallet road engine, with a tractive effort of 90,000 pounds at the head, and two 2-8-8-2 Mallet pusher engines, with a tractive effort of 115,000 pounds each at the rear. The maximum tractive effort thus available is 320,000 pounds per train, which enables the hauling of 4,500 tons in 60 cars having an average weight for car and load of 75 tons.

Since the traffic volume is still growing and the track is single, it has not seemed desirable to increase the number of engines on any train above three. Consequently it has been found necessary to put still larger locomotives into service.

The specifications for the new 2-10-10-2 type follow:

Total weight of engine, pounds	684,000
Total weight, engine and tender, pounds	898,300
Heating surface, square feet	8,606
Superheating surface, square feet	2,120
Tractive effort, compound, pounds	147,200
Tractive effort, simple, pounds	176,600

It may be noted that the weight including the tender is greater than that of the Triplex locomotives and the tractive effort, working simple, is 10,000 pounds greater.

The boiler is of the extension wagon-top type. It is designed for a working pressure of 215 pounds per square inch. At the first course it is 105½ inches in diameter outside, while the outside diameter of the largest course is 112⅞ inches. The barrel is fitted with 381 tubes 2¼ inches in diameter and 70 flues 5½ inches in diameter, 25 feet long. The combustion chamber is 36 inches long.

The firebox is 181 1/16 inches long and 108¼ inches wide. The front portion of the firebox is included with the combustion chamber behind a Gaines fire wall, so that the grate is about 144 inches long and has an area of 108.75 square feet. A total heating surface of 8,606 square feet and a superheating surface of 2,120 square feet are obtained.

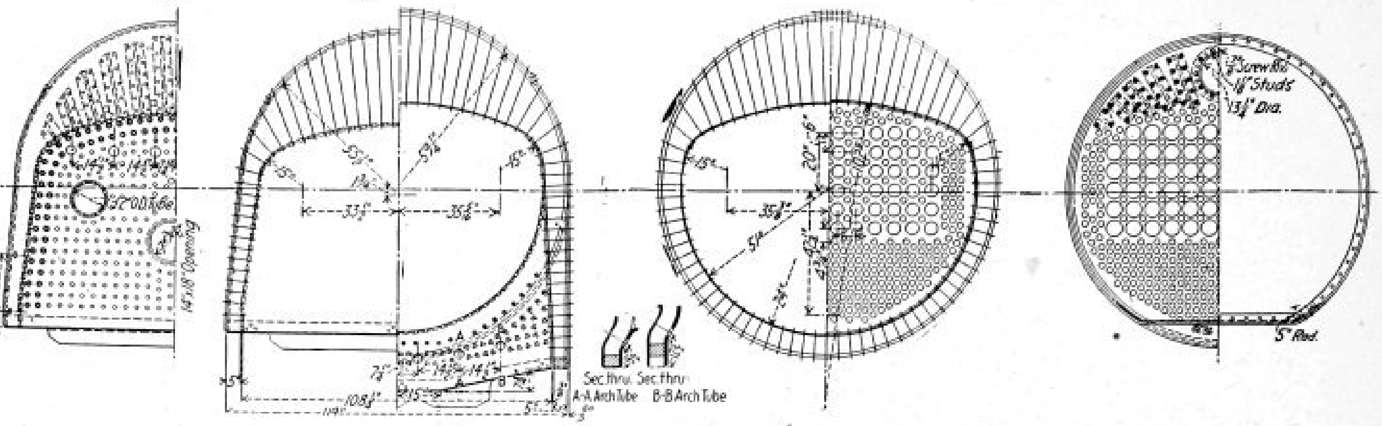


Fig. 3.—Sections and End Elevations of Mallet Locomotive Boiler

The high pressure valves are of the piston type, 16 inches in diameter, while outside admission slide valves are used for the low pressure cylinders. Steam admission is controlled by the Chambers outside connected throttle. A Lewis reverse gear is used.

Both the front and trailer trucks are of the Woodward type and the tender trucks are equalized. The design as a whole follows the builder's ordinary practice, differing from previous designs only in modifications made necessary by the increased size and capacity.

BOILERS STRIPPED OF OUTSIDE PARTS FOR SHIPPING

These large locomotives presented an unusual problem. It was impossible to ship them completely assembled and moving dead on their own wheels. After the consideration of many plans it was finally decided to leave the boiler on the frames, but trimmed of all outside parts and projections. The cab, low pressure cylinders, and some other parts were removed and the remaining skeletons, with their tenders, were shipped on their own wheels. Each locomotive required one flat, one gondola and one box car to carry the loose and detached parts. Each locomotive was accompanied by a messenger, who had sleeping quarters fitted up in the cab. The actual running time from Schenectady, N. Y., to Princeton, W. Va., was approximately two weeks. For complete specifications of this locomotive, see page 323 of this number.

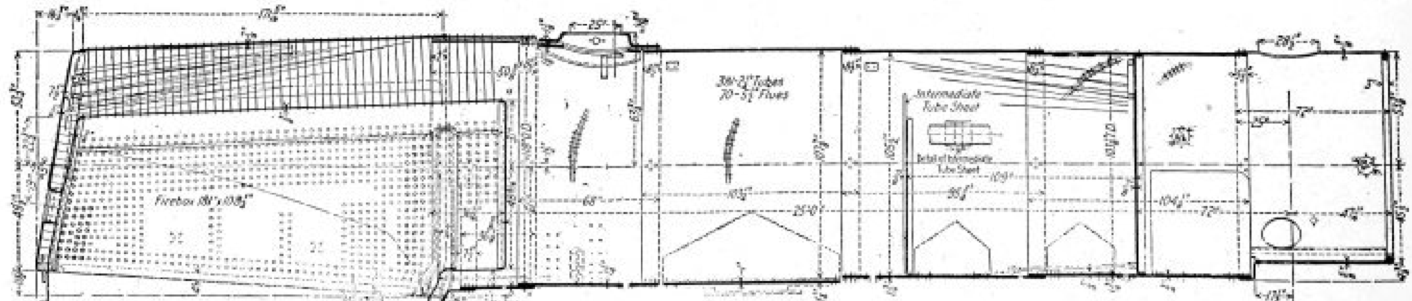


Fig. 4.—Longitudinal Section Through Mallet Locomotive Boiler

Business Equipment in the Boiler Shop

Measuring Business Equipment Efficiency—The Sixteen Items of Business Conduct—Intangible Assets

BY EDWIN L. SEABROOK*

Every boiler maker has two kinds of equipment—the mechanical and the equipment that operates the business. Undoubtedly every boiler maker who is worthy of the name takes pride in his shop equipment. The machinery and tools, to say nothing of the mechanical ability of his employees, must be of the best. Does the average boiler maker realize that the equipment which operates his business is just as important as the mechanical equipment, and ought to be just as efficient? Is there not some basis by which the efficiency of this business equipment can be measured?

The business equipment of the boiler maker consists of certain working devices, which are just as essential to efficient business conduct as the tools and machinery are to the turning out of the finished mechanical product. As every up-to-date boiler making shop must have the best tools and machinery, so the business management must be provided with the best equipment.

There is a wide distinction in comparing these two classes of equipment. One is tangible; can be seen; handled; its productive capacity calculated, measured, weighed. The other is a force. You can see a tool or a machine, but you cannot see salesmanship or credit standing; yet these are forces that enter into business conduct and as such are part of its equipment.

Comparable with Tool Equipment

Because of the fact that the business equipment is not visible in the same sense as is the mechanical, it is often neglected, overlooked, or not operated to the full capacity. The lathe must be kept in the prime of condition, turning eight hours a day at full speed. How much it costs the business to operate that lathe may be so inadequately known that as a force in the business equipment it is useless.

The least inaccuracy in a punching machine may be noticed and immediately remedied. On the other hand, there may be no records kept of the cost of a piece of work as it goes through the plant, so that no comparison can be made with the estimated cost upon which the contract was secured. The output of the mechanical equipment is comparable and valuable as to efficiency, because of the adoption of definite standards as guides. Its productiveness is measured in value by the dollar mark, in quantities by weights or measures; comparatively, with proper standards, by the percentage sign.

Measuring Business Equipment Efficiency

The business equipment is not a tangible thing; it cannot be operated like a machine, yet it must be productive. The output of one machine or mechanic can be compared with another. But can a standard be set by which a comparison of business equipment efficiency may be measured? Is it possible to find a gage which will indicate mathematically the efficiency of the business equipment? Possibly measuring business equipment efficiently in percentages (mathematically) is a new way to treat this important subject. Can these forces, which are used to produce or drive a business, be measured in some such manner as to give an idea of their efficient use in the individual business?

This force was quite successfully measured at a convention of business men which I attended recently. The men attending this convention were not exactly boiler makers, although some of them used a certain line of boilers. However, so closely allied were the trade problems of the two lines of business that, if the average boiler maker had sat in that convention and had changed certain trade phrases into his own trade terms, he could have very readily imagined himself at a boiler makers' convention. So far as the business problems were concerned, the gathering might well be taken for one of boiler makers.

A Convention That Looked Within

One of the members was assigned this subject for discussion: "Is the average shop in our business conducted along efficient lines?" This subject was handled in a new and rather novel way by the one to whom it was assigned. Instead of preparing a paper to be read, he used a large blackboard and began to assemble upon it the parts that make up the business equipment. These were placed on the blackboard, one by one, and discussed as to the percentage of efficiency attained by the average shop for each item. There was no attempt on the part of the speaker to arbitrarily fix a percentage of efficiency. The percentage that was reached developed altogether out of the discussion on the part of those attending.

The attendance at this convention was not confined to those who are operating shops, but included manufacturers, jobbers, credit men, sales managers, and salesmen serving in the industry. As these all participated in the discussion, the whole range of business efficiency, or equipment, was represented in the conclusions reached as to the percentage of efficient management.

The mechanical management was not considered, because it was generally conceded that the mechanical ability of the average shop was efficient, and that this particular feature belonged to the mechanical rather than to the business equipment, anyway. No doubt this will apply with equal force to the boiler maker.

The Sixteen Items of Business Conduct

Sixteen items of business conduct were taken as the necessary equipment for business. Here they are:

Buying.—It was conceded that most men knew how to buy material at the right price, and this item was given the highest percentage of all. This does not necessarily imply that because a man is a shrewd buyer he is equally efficient in conducting other parts of his business.

Estimating.—Probably not one-half of the estimating is properly done, nor are proper records kept of the estimates. Estimating is the most vital part of a business, but it is often done recklessly in compiling the items that go into it. The cost of work as it goes through the plant is essential in order to compare the finished cost with the estimated cost. Probably not more than one-half of the estimating is properly done.

* Secretary, National Association Metal Contractors.

Closing Contracts, Salesmanship.—A great deal of this is done on the question of price rather than on merit, quality of material and good workmanship.

Bookkeeping.—The average set of books shows only two things—how much is due the firm from others, and what the firm owes others. It does not show the loss or gains of the business, nor the status of it at any given date. A profit and loss account in the bookkeeping system is not a rule, but rather an exception.

Costs and Accounting and Collecting

Contract Costs.—The average of men who keep an account of the time and material going into a contract is not very high. When the average contract is completed there is little or nothing to show whether it was done at a loss or a gain

Cost Accounting.—This is an exceedingly important item of business conduct. In how many offices will the bookkeeping show what it costs to conduct the business? The discussion did not develop a very high percentage.

Rendering Bills.—The bills should be sent just as soon as the work is done. Many are in the habit of rendering bills once a month or at any time that it may be convenient. The customer is entitled to the bill immediately upon completion of the work, and prompt rendering of it will aid in collections.

Collecting.—This ought to be done systematically. The consensus of opinion showed that it was often neglected. All present frankly stated its importance, but the rush of work, securing contracts, fear of offending customers by undue pressing for settlement of accounts that were due, were some of the excuses given for lack of prompt collections.

Bills and Credit Standing

Discounting Bills.—Only a small percentage take advantage of this feature, although it is a money-saving proposition for those who do it. The discussion developed that because other parts of the business equipment were inefficient, advantage could not be taken of this item.

Paying Bills.—The opinions of the credit men in this and the following items were valuable. They pointed out that material is sold with payment specified at a definite time. A good percentage of business men pay on time, but the experience of the credit men shows that this percentage is not as large as it ought to be.

Credit Standing.—A good many business men do not always get the credit standing to which they are really entitled. This is due in part to the disregard of giving credit information or their inability to give it when it is asked. Supply houses must necessarily have something upon which to base credit, and a clean-cut statement is not always given even when urgently requested. Slowness in making collections and paying bills also have a great influence on credit standing.

Publicity and Studying to Give Satisfaction

Publicity.—Newspaper advertising, circularizing, letter writing, or any other form of publicity did not seem to be practiced to a very great extent. At least, this item was small in comparison with the great business-getting possibilities of this part of the equipment. Before the public can bestow its patronage it must know what the seller has to offer.

Developing New Business.—One delegate said it was better to develop new business than to spend a lot of time trying to take away existing business from one's competitor. On the installation of each piece of work he examined the premises to ascertain if he could not definitely place some other article or offer suggestions for other work. This item was conceded to be important from the profit standpoint, but it did not claim a very high percentage of efficiency.

Answering Correspondence.—The qualifications of a man and his business conduct are often judged by the manner in which he handles his correspondence. Everybody agreed that this was an important item in efficient business conduct, but not a very high percentage could be accorded it.

Studying to Give Satisfaction.—Henry Ford once told his salesmen to remember that they were not selling machines but satisfaction. Of course, everyone tries to give satisfaction, but how many realize that they are not selling merely the material that enters into the equipment they are handling, but something that is necessary to the comfort, utility or health of their customers and must *satisfy* these requirements? It is satisfaction that is being sold and not the products of shop or counter. Unless the sale satisfies it had better not be made. From the viewpoint of studying to satisfy, making this the paramount object, rather than the mere sale the feature of the transaction, the percentage allotted to this was not very high, although all admitted the desire to satisfy, in some sense at least.

Good Will Greatest of Assets

Good Will.—This is one of the greatest assets that any business can have, yet many, whether realizing it or not, sometimes assume an antagonistic attitude toward their customers. Perhaps the customer is not always right, but it is always expedient to look at the proposition from his viewpoint. The percentage of striving to secure good will was only fair.

As these items were placed on the blackboard one by one and discussed, the percentage of efficiency was marked opposite each, and when completed showed this result:

Business Equipment

	Percent
Buying	90
Estimating	50
Closing contracts, salesmanship	50
Bookkeeping	25
Contract costs	10
Cost accounting	10
Rendering bills	15
Collecting	17
Discounting bills	5
Paying bills	60
Credit standing	50
Publicity	15
Developing new business	5
Answering correspondence	2
Studying to give satisfaction	5
Good will	25
Total for sixteen items	434

The system or general efficiency was 27⅛ percent.

The efficiency of a business depends upon the system which operates its equipment. The above sixteen items of business equipment show a total credit of 434 percentage points, or an average efficiency of a little more than 27 percent. It cannot be claimed that these percentage points are correct. No one has ever had the opportunity of compiling an analysis to guarantee the accuracy of any set of percentages along this line. It is probably the first time that such a subject was discussed from this viewpoint in a convention of business men. The percentage points had to be decided somewhat impromptu as the discussion or experiment developed.

The object sought in handling the subject in this manner was not to attempt absolute accuracy of the percentage points, because that was not possible, but to bring out the weak spots and show the lack of efficient business equipment in these parts. No ordinary business is equally efficient in all of the above items, and yet the actual results in money which any business will produce depends upon the successful operation of *all* of these intangible factors.

Your shop may be mechanically equipped to do twice the business which it now handles, yet how can that business be brought in if you fail to advertise its possibilities? On the other hand, if you fail to answer inquiries for estimates when they are received, the shop will still lack work. And even after the work is in hand, if your credit standing registers zero, you may not be able to get the raw materials to work upon. Billing, collecting and accounting in their turn supply capital and knowledge for future developments.

These practical, successful business men have demonstrated that there is such a thing as measuring the efficiency of your business equipment in percentages. Suppose you analyze your own business equipment. Give yourself credit for what you believe to be the correct rating on each item. Doubtless it may look somewhat different from the above, but can you give each item the same credit rating? Will estimating, bookkeeping, studying to give satisfaction, all have an equal rating in your own business? Will there not be some weak spots in the whole equipment that demand attention?

If the above demonstration sets any boiler maker to thinking, investigating, comparing and testing, it will have accomplished its purpose, regardless of the fact that the "efficiency rating" may not be entirely correct. Now is the time of all times to consider this phase of your business, owing to the reconstruction period now upon us.

Shipping Large Marine Boilers*

A Type of Car That Was Needed—Permits Clearance Under Bridges and Tunnels for Boilers

Herewith is presented an interesting photograph of one of thirty large marine boilers, 14½ feet diameter by 11 feet 2 inches in length, built by the Kingsford Foundry & Machine Works, which are being transported by rail for installation in fifteen vessels building at various points on the lakes. Up to very recently it was impossible to ship boilers over 11 feet in diameter from Oswego, N. Y., where the Kingsford Foundry is located, except by canal. The special car shown in this illustration, however, makes it possible to transport boilers of the dimensions stated. These boilers weigh about 91,000 pounds each; two are carried in each 3,500-ton ship. The car shown is built so that the bottom of the I-beams are only one foot clear of the rail. This allowance is necessary to get clearance under bridges and tunnels. In some instances, in fact, the boilers have clearance of only one inch, and must therefore be loaded very carefully and centrally. The Kingsford Foundry is working 100 percent in all its departments on government work for the Emergency Fleet Corporation, and is building watertube as well as Scotch boilers for the new ships that are now almost daily coming from the ways. The car not only served this organization as stated, but also will tend to encourage boiler manufacturers farther inland to a serious consideration of the production of boilers of large designs.

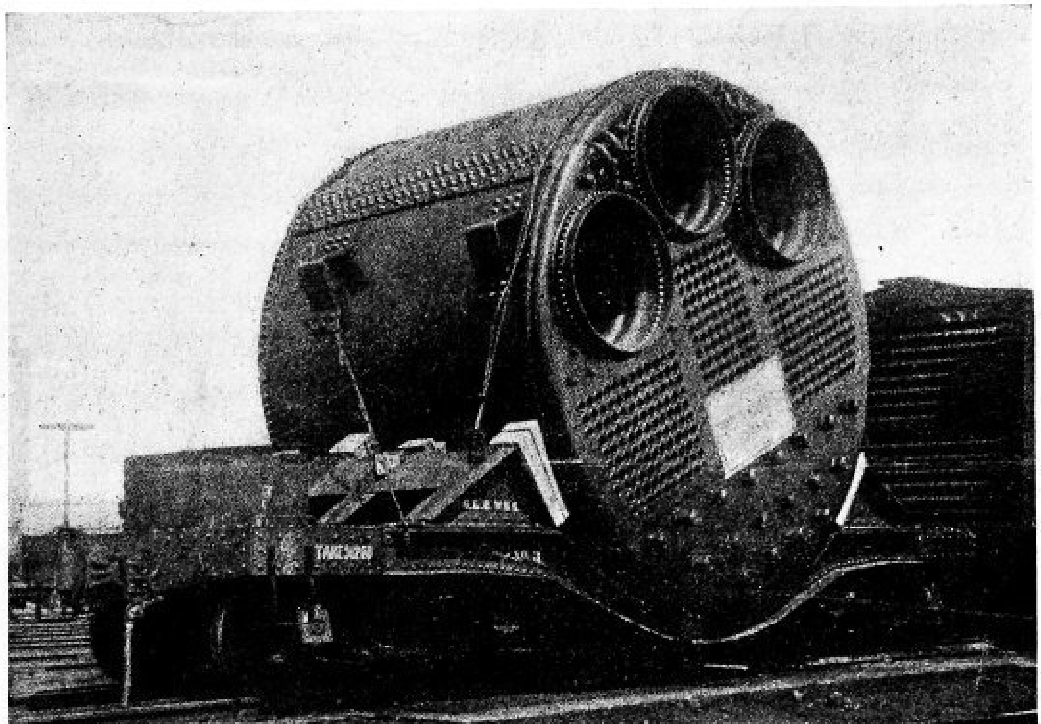


Fig. 1.—Special Flat Car for Shipping Scotch Boilers

* The *Marine Journal*.

Electric Welding on the Rock Island Lines*

Actual Results of Welding Operations on Rock Island Lines Show Reduction in Maintenance Cost—Increased Saving of Equipment

BY E. WANAMAKER†

Forge welding has probably been practiced ever since man had intelligence enough to construct a crude anvil and a hammer. It rests on the fact that when two pieces of iron are raised to such temperature that they become plastic, they may be forged together and will become, at the junction, a homogenous mass. The art of forging depends upon three things.

1. The surfaces which are to be welded together must be clean so that the molecules of iron may come into intimate contact during the operation.

2. The temperature of the metals must be such that cohesion of the molecules may take place, but must not be high enough to depreciate the physical properties of the metals.

3. The mechanical pressure must be applied in such a manner as to bring the molecules into such intimate contact that cohesion will take place.

The Thermit Welding Process

The first of the new welding processes, which may properly be called autogenous processes, since the welding takes place more or less automatically, was the thermit welding process. In this process the metals to be welded together with the additional quantity of metal of approximately the same composition are heated to a liquid state by a chemical reaction, so that cohesion takes place while they are in the molten state, without mechanical pressure. This process found a wide application in the repair of broken steel parts on the railroads, and the saving which resulted from its use without doubt aggregated millions of dollars.

Welding with the oxygen and fuel gas flame was the first widely used autogenous welding process. In this case the heat for welding is produced by the chemical union of oxygen and some fuel gas, such as acetylene. The gas flame as a tool in the railway shop is best described by the once fictitious term "putting on tool." The parts to be welded are heated to a liquid state at their surfaces by the heat of a flame and the metal to be added is melted simultaneously. The union, or fusion, takes place and the metal in the joint cools off, leaving a homogenous mass, which we call a weld. Since everyone is more or less familiar with gas welding, this paper will deal primarily with the electric welding process. It is sufficient to state that at the present moment the essential difference between the two is in the method of producing the heat for welding, rather than in the fundamental principles involved.

Butt and Spot Welding Popular

In passing, it may be stated that there is a form of electric welding which is not an autogenous method of welding, but which is increasing in prominence in railway work, that being butt or spot welding. In these processes both heat and pressure are used to produce the weld. The heat is produced by the resistance offered to the passage of an electric current through the pieces to be welded. The temperature is raised to the point at which the metals become plastic, and the pressure applied. In principle, the processes are identical to the forge welding process. Butt welding, as applied to the safe ending of flues, offers an attractive saving and will undoubtedly become the standard practice in use on all railways in the very near future.

The Two Kinds of Electric Arc Welding

There are two kinds of electric arc welding, known respectively as carbon electrode welding and metal electrode welding. In the former an arc is drawn between a carbon electrode and the piece to be welded and the metal to be added fed into the arc in the form of a "melt bar." This process is not used extensively in railway work, due to the fact that welding may only be done in the horizontal plane in this manner and that the work is in general inferior to that which is possible with the metal electrode process.

The metal electrode process uses, as the name implies, a metal electrode, the arc being drawn between the electrode and the piece being welded. The heat of the arc melts the metal of the piece and the metal of the electrode simultaneously. As the metal of the electrode melts it is drawn across the arc to the molten metal of the piece, where a complete and homogenous union is formed, which we call an autogenous weld. That the metal of the electrode is drawn across the arc rather than that it falls through the arc must be said advisedly, since it will flow straight overhead as well as straight downward. The temperature of the arc is extremely high at its center, actually vaporizing the metal to form the visible arc. With the exception of work with certain electrodes (manganese steel and slag-covered electrodes), the work is always made the cathode or negative electrode; that is, the current of electricity flows from the piece being welded to the metal electrode. The reason for this practice is that the greatest amount of heat in an electric arc is liberated at the point at which the current passes from the solid medium to the heated vapor of the arc. Since the metal of the piece has more mass and conducts the heat away from the point at which the welding is being done more rapidly than the electrode, it is desirable to have the greatest amount of heat on the piece. Due to the composition of the manganese and slag-coated electrodes, it is absolutely necessary to make these electrodes the positive.

Good Welding Wire Essential

The characteristic of the wire which is used for the metal electrode is an important matter. A dead soft steel wire has been found entirely satisfactory for this work. Not all dead soft steel wire, however, works well in the arc. Uniform mechanical treatment in manufacture and careful annealing are required to secure the best results. Good welding wire may be relied upon to give metal in the weld which has a tensile strength of from 50,000 to 55,000 pounds per square inch. The deposited metal is very soft and easily machined, although it is without appreciable elasticity. When properly deposited, the metal

* Abstract of paper on "War and Welding," read at September 17 meeting, Western Railway Club.

† Electrical Engineer, Chicago, Rock Island & Pacific Railroad.

is practically free from blow holes and slag inclusions, although a certain amount of oxide in solution is unavoidable. Except for the absence of elasticity, the deposited metal is of the nature of cast steel.

The voltage required for metal electrode welding is approximately 20 volts and direct current power is necessary. The various types of welding equipment are merely different plans for rendering available a rather heavy current at this voltage, and the power economy of the several systems for obtaining this result varies over a wide range.

A little over six years ago the Chicago, Rock Island & Pacific Railway installed four electric welding units of the first type that had been manufactured in this country. During the time since their purchase, and up to the present, it has been quietly investigating and developing its electric welding practice. As a result, it has been found that to obtain a suitable welding system it is necessary to secure a light, compact portable unit of few parts and of extreme simplicity and which is entirely free from complicated mechanical regulating devices.

Careful Analysis of Conditions Desirable

In planning the Rock Island installation a careful analysis was made of the service which is demanded of electric welding equipment in railroad shops and engine houses, and an attempt was made to design an equipment which would show, under such conditions, maximum reliability and flexibility with minimum installation and operating expense. It appeared certain that the welding process would find a wider field of application than was apparent at that time, and the installation was made in such a manner as to lend itself readily to enlargement, should that become necessary. In view of subsequent experience and results, it was indeed fortunate, and expansion of the welding facilities has been rendered easy. The lack of standardization of operations in the practice at that time made it extremely difficult to predict accurately the size of installations which would be required at the various points on the system, so it appeared desirable to install equipment which could be moved from one point to another until proper distribution could be obtained.

It was considered particularly desirable to have the arc welding equipment available at all points in the shops and engine houses, since it was quite evident that the advantage of the low cost of the arc welding process would be lost if, for instance, the locomotive had to be moved from a haphazard location to a point where the welding power would be available. These features led to an analysis of distributing systems for the welding power and showed the necessity of using portable arc welding equipment similar, so far as possible, to the portable gas welding outfits. With the total capacity divided at each shop among several units, it appeared certain that so long as power was available there would not be a complete shutdown of the welding equipment. Each operator would be entirely independent of the others, although as many as necessary could be concentrated on any engine or job in the shop.

Variable Voltage Type Best

Operating economy, while not a deciding factor, was important, since at some shops the power plants were loaded to their capacity, and at other points the cost of power purchased from small central stations was rather high. Under these conditions, the variable voltage type of equipment was considered the best because this type eliminated the resistance ballast from the arc circuit, thus increasing the power economy of the units to such a degree that a single operator unit may be operated from a power line large enough to carry a five-horsepower motor.

As a result of the analysis of the requirements of the shops and car repair yards, 33 individual unit welders were installed, 10 of which were mounted on brackets on columns in the largest locomotive shop, while the other 23 were portable machines weighing, complete with truck, approximately 1,700 pounds. All of these units are motor generators having inherent regulation and arc stabilizers. The portable units are equipped with ball bearings, which require lubrication about once in six months. Part of the machines are equipped with 230-volt direct-current motors and part with 440-volt three-phase 60-cycle motors, these two kinds of power being the standard on the Rock Island lines. The portable unit system was found to be from 30 to 40 percent lower in total initial cost of installation, due to the elimination of the low voltage distributing system.

Advantages in Shifting Apparatus

With a system of portable welders, such as has been installed on the Rock Island lines, the equipment has been made a system proposition rather than a series of plants to take care of certain shops or terminals. The plan is extraordinarily flexible and has many desirable features that would be impossible to obtain with any other plan or type of equipment. For instance, if it is found that one or more welders are needed at some shop, it is very probable that some can be transferred from another point which has more than can be used to advantage at that particular time. It is only necessary to pull the units to be transferred into a car, block them substantially and bill to the point where needed. Immediately on receipt they are ready for operation. Advantage has been taken of this feature on a number of occasions, and thereby it has been possible to relieve congestion of work and get engines into service considerably ahead of the time originally estimated. However, officials at all points are very reluctant to surrender any of their welding equipment, claiming that they have not nearly enough as it is.

System Both in Apparatus and Operation

The electric arc welding process on the Rock Island lines has been made a system proposition, not only in the matter of the apparatus itself, but also in its operation. It being apparent that the successful application of the process requires the combination of three factors—engineering knowledge, craftsman's skill and enthusiasm—the direction of the practice was made to rest with the engineering staff of the mechanical department. The actual operation is done by skilled members of the boiler makers', pipefitters', machinists' and blacksmiths' crafts, novices or apprentices not being employed in the work. Under competent direction, the skilled and enthusiastic operator will seldom make serious blunders in the application of the process. Further, the skilled craftsman who is enthusiastic about the process will continually find new and profitable fields for its application. The connecting link between the engineering staff and the operators is the "supervisor of welding," who is fully informed on the range of approved applications and is also the most expert operator on the road and who continually travels between the shops, keeping the practice of each up to date. The operators at local points are under the supervision of the foremen and master mechanics in exactly the same manner as lathe operators or other craftsmen.

The necessary instructions for properly operating a complete welding system as formulated on the Rock Island lines comprise some thirty typewritten pages. It is the purpose of this set of instructions to standardize the major operations as far as possible. The extreme range of the application of the process has made it quite impossbile, up to the present time, to standardize every single operation, but these instructions cover the field in such a general way that the operator is prevented from making serious blunders. In view of the fact that our practice has been so rapidly developed by this method, it will be necessary soon to revise and reprint our standard welding instructions, which will then be very complete. Let it suffice to say that the ability of the operator to make good welds requires that he have some knowledge of metals and their properties, especially as regards expansion and contraction, and that his education by the supervisor be thorough and complete. It is evident that the complete instruction and training of the craftsmen in the art of electric welding should be considered as a necessary additional course to the apprenticeship he served when learning his trade, in order to keep pace with the rapid strides that are being made in mechanical engineering practice.

A $40,000 Installation Justified

The actual results of welding operations on the Rock Island lines have proved very interesting. The real answer to the question of whether or not the expenditure of some $40,000 for the installation of the system was justified lies in the facts that a reduction in maintenance cost and an actual gain in engine days has been brought about. As compared with former methods, the advantage of the electric process arises principally in the saving in labor. In other words, the operation of the process in our shops may be said to have rendered each man more effective and has enabled each man to accomplish more towards the maintenance of our equipment with the same amount of effort. In view of the present labor conditions, which involve principally the very serious shortage of skilled labor, this is quite an important matter.

Our figures show that the saving effected by the electric arc welding system is being made at the rate of approximately $200,000 a year with our present equipment. This figure includes a direct saving as compared with other methods of about $136,000; the saving arising from the fact that we keep the engines in service a greater proportion of the time makes up the balance of the figure. Our figures show that this saving is being made at the rate of about 1,400 engine days per year.

Another way of looking at the same matter is that by the operation of the electric welding system we have obtained the service of four engines without additional investment beyond that required to install the welding system. Four engines are worth approximately $200,000. The welding system installed complete cost about $40,000. The cost of operation of the system for a year is approximately $34,000. Figuring the value of the engines at $40 per day, we will pay for the operation of the whole electric welding system and will clear $22,000 from this feature of the operation of the electric welding system alone. However, important savings were made in the repair of parts on engines, where there could not be shown an actual gain in engine days of service, this saving amounting to more than twice the saving arising in the increase of the number of engine days of service. The net return secured on the electric welder investment thus amounts to approximately 500 per cent per annum. The net cost of the installation and equipment per unit under present conditions is approximately $1,300.

In spite of the fact that we have probably a larger number of operators than any of the Western roads, we believe that we are far from being fully equipped. The field of application of the process is continually widening. There is a totally unexplored field in maintenance of freight and passenger cars, which promises to eclipse in importance the maintenance of motive power. There is a field in the repair of special track work which we have not gone into up to the present time. The present indications are very strong that when we go fully into the electric welding process in firebox, boiler, locomotive, machinery, steel tanks, car work, track work, etc., that we can well use 150 units and effect a net saving of approximately one million dollars a year.

Wonderful Future Developments Promised

Within the last three years the arc welding process has been greatly improved and developed, both in the equipment for making the weld and in the welding material. It has, in fact, been developed to such a state that it will no doubt cause changes in many forms of construction. In the car field of construction and maintenance we may look for a wonderful development. For instance, to-day the cast steel truck side frame will last almost indefinitely where the electric welder is used in maintenance. Also, it is a preventative of loss and excess wear that the electric welder has a great field by the intelligent application of spot welding with the electric arc. It will, no doubt, be possible to tie down bolts and nuts in the various parts of the rolling stock and motive power in such manner as to prevent their working loose, with very large savings in maintenance and operating expense. Quite recently it has been possible, by using what is called a slag-coated electrode, to deposit steel having a carbon content of .50 percent, which will make possible the doing of certain work which could not be done heretofore. We can successfully take care of the worn or damaged flanges of driving wheels.

Whether Gas or Electric Depends Upon Conditions

It has been our purpose in establishing the practice in the welding field to look the facts squarely in the face and apply either the gas or electric process, depending on which shows the best results at the lowest price. At the present time we are of the opinion that the electric process will supersede the gas process on all steel welding and some of the rough steel cutting. In the cutting of boiler steel and all close cutting, however, and the welding of cast iron and the non-ferrous metals, the gas process has unequaled advantage. We are operating 75 gas torches and one acetylene generating plant on the same general principle as obtains in the case of the electric arc welding equipment. It is also best to use gas welders at all points where only occasional welding is done and which would not justify the investment necessary for the installation of electric welding.

It is easy to realize the enormous possibilities in the direction of increasing the service from motive power equipment on the combined rail systems of the nation were they all equipped with welders. The demand for transportation service is so urgent, and the effectiveness of the nation in this war depends so directly upon the quantity of service which may be rendered, that it seems imperative that the railroads should go into the welding field on a large scale at the earliest possible moment. These figures have been given with particular reference to motive power units. While we have no tangible data on what may be accomplished in the rolling stock field, it is our belief, from the preliminary survey of the situation, that even a greater gain can be made towards keeping the equipment in service in this field than has been made on the motive power units.

How to Design and Lay Out a Boiler—I

Formula for Safe Working Pressure—Maximum Ultimate Tensile Strength for Steel—Factors of Safety

BY WM. C. STROTT*

When the writer first went into a boiler shop drafting room, which was some ten years ago, he possessed only a quibbling of algebra and geometry and trigonometry. Because of his meager education he encountered many difficulties in acquiring practical knowledge, owing to the intricate character of the formulæ which he found available covering the design of boilers. In working up the present series of articles, the first of which follows, he remembered those old days, and, holding himself constantly in mind, treated the subject as he had wanted to find it treated during his apprenticeship course in the drafting room.

The articles of this series were used by the writer in teaching a course in design in a vocational school in Erie, Pa. In order clearly to understand the course, all the reader is presumed to have is a practical knowledge of boiler construction and a working grasp of common mathematics. The "code" used throughout is the one which was recently adopted by the American Society of Mechanical Engineers. Wherever a certain phase of design is not covered by the A. S. M. E. rules the best modern practice has been followed.

The horizontal return tubular boiler, commonly known as the H. R. T., is probably the most extensively used type of boiler in existence to-day. Therefore, it is probable that the design of this type holds the most widespread interest among the readers of this magazine. The only information we are supposed to have is the size of the boiler and the working pressure for which it is to be designed. The dimensions are, say, 72 inches inside diameter, and the boiler is to have seventy 4-inch diameter tubes, 18 feet long. In boiler-shop parlance it is known as a 72 by 18. The safe working pressure is to be 150 pounds per square inch.

We shall now proceed.

The formula for the safe working pressure allowed on a shell or drum under internal pressure is:

$$P = \frac{T_s \times t \times E}{R \times F}, \qquad (1)$$

in which

P = allowable safe working pressure in pounds per square inch.
T = ultimate tensile strength of the material, in pounds per square inch.
t = thickness of plate in inches.
E = efficiency of longitudinal joint in percentage of solid plate.
R = radius of shell (one-half outside diameter of outside course) in inches.
F = factor of safety.

The values of P, T, R and F have been established, thus:

$P = 150$.

$T = 55{,}000$.

This is the minimum tensile strength in pounds per square inch allowed for firebox steel; *i. e.*, steel used for such parts of a boiler exposed to the products of combustion on one side and subjected to pressure on the other. By studying the drawing, Fig. 1, it will readily be seen that every plate used in the construction of an H. R. T. boiler comes under this classification.

The maximum ultimate tensile strength allowed for "firebox" steel is 63,000 pounds per square inch. In other words, the steel mills demand a leeway of 8,000 pounds tensile strength per square inch, because they have found it impossible to "work to a line." For such parts of a boiler that are not in the path of the furnace gases, "flange-steel" may be used. Its ultimate range of tensile strength is from 55,000 pounds to 65,000 pounds per square inch—an allowable variation up to 10,000 pounds.

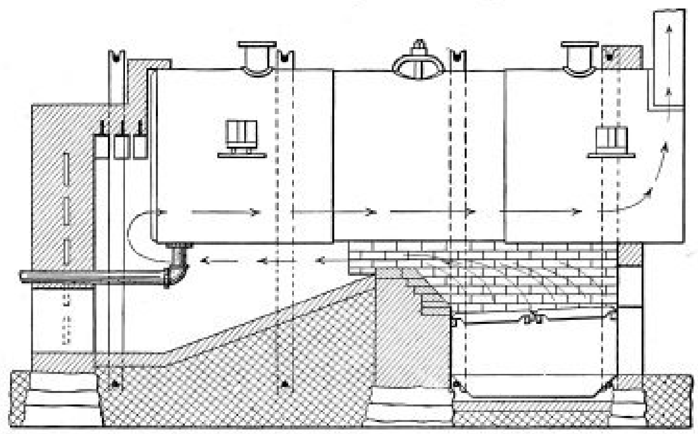


Fig. 1.—Side Elevation of Typical Boiler and Setting

The higher the tensile strength of the steel composing the shell, the higher will be the pressure which a shell having a given plate thickness will withstand. The reader can satisfy himself on this point by substituting different values of T_s in the formula. The plates when they come from the mill might have a minimum tensile strength of 60,000 pounds per square inch, which we could then use in the formula. But one plate might be 65,000 pounds and another 55,000 pounds, and since "a chain is no stronger than its weakest link," in that case we could use only 55,000 pounds tensile strength in our calculation. The A. S. M. E. code specifications demand that all plates be stamped with the minimum tensile strength allowed, viz., 55,000 pounds per square inch. Therefore, when designing boilers to pass A. S. M. E. specifications the value 55,000 must always be used in the formula.

TABLE I

When the diameter of shell is	
36 inches or under	1/4 inch
Over 36 inches to 54 inches	5/16 inch
Over 54 inches to 72 inches	3/8 inch
Over 72 inches	1/2 inch

Let us revert again to our formula: t = 3/8 inch, or .375 inch, which is the thinnest plate allowed for shells 54 inches diameter to 72 inches diameter, inclusive, as per Table 1. This restriction upon using lighter plate for certain diameters of boilers eliminates the tendency for an unscrupulous manufacturer to "skin the job." Since we do not care to make the shell any heavier than necessary (from a standpoint of cost) we will use 3/8 inch for a trial calculation.

R = 1/2 inside diameter of the outside course, or 36 inches, F = factor of safety, or the designing engineer's way of saying a "factor of ignorance." Whatever value

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we give to this symbol, be it 2, 3, 4, 5, etc., means that we are designing the boiler just that many times as strong as would be theoretically required to rupture it when under pressure.

This safety factor allows for possible errors in calculations, gradual weakening of the boiler through years of operation, and the ever-attendant dangers met with while the boiler is in service, as when an "engineer" needs more steam he "gags" the safety valve so she won't "pop," and he is therefore carrying a higher pressure on the boiler than that for which it was designed. Careless operation, etc., are other factors included in this "factor of ignorance." But the chief reason for so high a factor of safety is best explained as follows:

When steel is placed in tension, as when a boiler is under pressure, it stretches. This elongation or amount of "stretch" is directly proportional to the pull, *i.e.*, if a

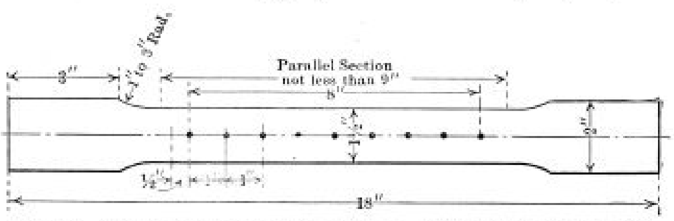

Fig. 2.—Standard Specimen for Tension Test of Plate Material

force of 1,000 pounds stretches a bar of steel 1/16 inch, a force of 2,000 pounds will stretch it an eighth of inch. Consequently, a force of 500 pounds would stretch it but 1/32 inch. This is known as "Hooke's Law" covering the elasticity of metals. All metals are elastic—some more so than others. Steel is very elastic. This elasticity, however, ceases when the metal has been stretched to a certain limit. It will no longer spring back to its original proportion when relieved of stress. This limit is known as the "yield" point of the material. If we continue to apply the stress after the yield point has been reached, the material takes on a permanent "set" and is now said to be "distorted." From this point on, if stress be still applied, the original physical properties of the material are destroyed, elongation increases rapidly, and the area of the metal at the center is reduced until rupture occurs. By means of the usual testing machine, it is possible to find exactly what physical properties a material may have.

Fig. 2 gives the details for a test specimen required for all tension tests of boiler plate material. The black dots shown on the centerline are not holes, but sharp marks

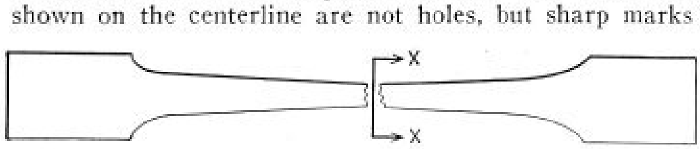

Fig. 3.—Condition of Specimen After Being Tested

made with a prick-punch. After the specimen has been placed in the machine and tested to destruction, these little marks will be seen to be farther and farther apart toward the center. From these it can be determined exactly the amount of elongation in eight inches which the bar underwent (eight inches is the standard adopted by which all such tests are made).

Fig. 3 shows the approximate condition of the specimen after being tested to destruction. Note that the area of the bar through section "x-x," when subtracted from the original cross-sectional area, gives the value known as the "reduction in area."

From the foregoing, it will be readily comprehended that long before the boiler shell, or any portion thereof, "lets go," a permanent set or distortion has occurred. Therefore we must avoid a design such that, during running conditions, the material would be stressed to its elastic limit. In fact, we want to work considerably below that limit.

The minimum yield point required under the A. S. M. E. code specifications is .5 of the minimum unit tensile strength of the material = (.5 × 55,000 pounds) or 27,500 pounds per square inch. We can easily see now where at least 2.5 of our factor of safety of 5 has gone. So in the final reckoning we do not have any too much margin of safety to provide for the "factors of ignorance," cited previously—probably not more than .5.

The expression "ultimate tensile stress" having been used quite frequently so far in this treatise, it might be well to explain just what is meant thereby. The test specimen is always 1½ inches wide at center (see Fig. 2). Let us suppose, as an example, that we are going to test a sample cut from one of the plates which are to compose the shell of our boiler. Its thickness is, therefore, 17/32 inch, or .53125 inch. Its cross-sectional area we find to be (1.5 inches × .53125 inch) or .796875 square inch. We now clamp the ends of the test specimen between the two heads of the machine and throw on the power. Slowly the heads separate, stressing the specimen. When the elastic limit is reached, and on the instant when the plate takes a permanent set, the beam on the machine drops and the pull in pounds can be read directly therefrom. Beyond this stage the specimen undergoes distortion and finally snaps, having by this time taken the form similar to Fig. 3. The machine then automatically stops, and the total force that has been applied to rupture the specimen is also indicated on the machine. Let us assume that the specimen broke at 44,000 pounds. This value is what is termed the ultimate tensile strength. Resolving this to a unit per one square inch, we get $\frac{44{,}000}{.796875}$ = approximately 55,000 pounds per square inch as the ultimate tensile strength of this plate.

Suppose, further, that the distance between the first and last punch mark on the test specimen is found to measure 10 inches, thus indicating an elongation of 2 inches in 8 inches, or 25 percent. The percentage of elongation in 8 inches required by the A. S. M. E. code specifications is

$$\frac{1{,}500{,}000}{\text{unit tensile strength as tested}} = .2727, \text{ or } 27.27 \text{ percent.}$$

This would demand a minimum elongation in 8 inches of (.2727 × 8 inches) or 2.18 inches. It follows that the inspector might not pass this plate on account of its being a trifle brittle. Tolerances are provided by the "code" for plates ¼ inch and under and over ¾ inch in thickness covering this subject of elongation, but they need not be considered here.

In addition to the physical requirements of boiler material, certain chemical compositions must be conformed to, such as the percentage of carbon, sulphur, manganese and phosphorous content. But these are worries for the chemical laboratory at the steel mill. The author wishes to call to the reader's attention the fact that there is practically no commercial difference between "flange" quality and "firebox" quality steel, other than that the latter may probably be considered of a trifle purer grade and it contains a "trace" of copper. Copper, it should be understood, is one of the best fire-resisting materials we have. Many years ago the fireboxes of locomotive boilers were made wholly of this material. The young boiler designer should obtain a copy of the A. S. M. E. code and familiarize himself with the specifications covering boiler material.

A factor of safety of less than 5 is not permitted. We can use a higher one at will, but it necessitates shell plates being impractically heavy; hence, the factor most generally used for new work is 5.

Now, the only unknown quantity is the value of E. Transposing formula (1) for E arranges the formula thus:

$$(2) \qquad E = \frac{P \times R \times F}{T_s \times t}.$$

Substituting values for symbols, we have:

$$E = \frac{150 \times 36 \times 5}{55{,}000 \times .375} = 1.308, \text{ or } 130.8 \text{ percent.}$$

This is a ridiculous figure, calling for a joint 30 percent stronger than the solid plate, which is taken at 100 percent. But the result of our calculation proves two things—first, that our assumed plate thickness of 3/8 inch is far too light; second, that if our boiler were to be a seamless shell—thus, being 100 per cent strong—3/8-inch plate would even be too light for the specified safe working pressure.

The reader should now try a heavier plate thickness—say 1/2 inch. The resulting value of E is 97.7 percent. As the reader will soon learn, it is impossible to design a practicable joint having even so high an efficiency. By figuring on 17/32-inch (.53125-inch) plate, the required efficiency drops to 92.4 percent. This is a value which may quite reasonably be expected of a quadruple riveted joint of the double butt-strapped type.

RULES GOVERNING STRAPS AND RIVETS

When shells or drums exceed 36 inches diameter, the longitudinal joint must be of double butt-strapped construction. If the shell diameter were 36 inches or less, single butt straps or lap-riveted seams could be employed, provided the allowable safe working pressure were not to exceed 100 pounds per square inch. Hence, for any boiler larger than 36 inches diameter a longitudinal joint with double (inside and outside) straps must be provided. This rule holds, regardless of pressure, even though the boiler was to be used for low pressure steam heating purposes.

No restriction is placed on the kind of riveting to be employed—that is, whether single, double, triple, quadruple or quintuple—but knowing as we do the type of joint and its required efficiency, the style of riveting can be determined by calculation. At this point suffice to say that nothing less than quadruple riveting will give us the joint efficiency which we require, viz., 92.4 percent.

Elsewhere in this treatise will be found the formulæ, with examples of their application, for calculating the efficiencies of joints of every known type. Applications for their use will also be given in the following paragraphs for the design in hand.

As the maximum pitch of rivets is practically the dominating factor in designing any joint, it is first necessary to determine this pitch. Now, it would seem a simple matter to strike at any convenient pitch, and, if after calculating, we found it to give the required percentage, to adopt that pitch. But not so in practice; for the pitch of the rivets on the calking edge must first be considered. If this "calking pitch," as it is commonly called, is made too great it becomes difficult to maintain a tight joint. The drawing, Fig. 2, illustrates (considerably exaggerated) how leakage takes place along the calked edge of any seam. The plate between the rivets on the calked edge may be considered as a beam of length "X" fastened at each end and uniformly loaded with the internal pressure. If "X" be too great for a given load, the imaginary beam will deflect sufficiently to cause leakage. Note that the made lap does not deflect because it is subjected to pressure on both sides, being what is termed under "neutral" pressure, such as, to give a further example of neutral pressure, that portion of a boiler shell under the steam dome, where the pressure of the steam in the dome is resisted by that in the boiler proper with the plate merely separating the two.

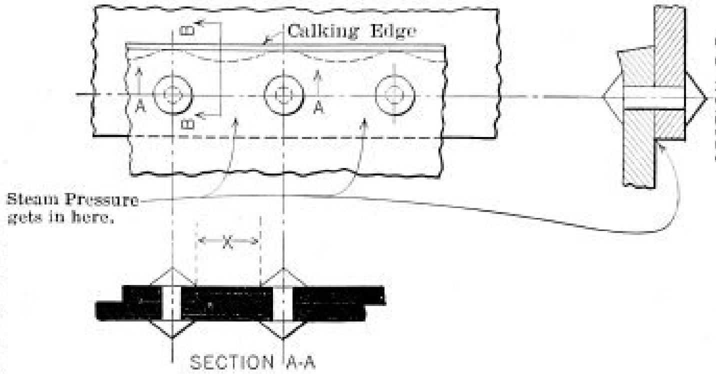

Fig. 4.—Showing Action on Plate of Effective Calking

The purpose of calking, as probably very few practical boiler makers realize, is to prevent this deflection by forcing some of the metal of the calking edge of the plate between the upper and lower laps. This driving of metal between the two plates raises the calking edge slightly, causing a springing action at this point, which effectively resists the lifting action of the steam. Section B-B of Fig. 4 clearly illustrates this theory and demonstrates that no amount of calking will render tight a joint having the rivets spaced too far apart at the calking edge. The deflection of the plate between the distance "X" is so much that during calking the boiler maker keeps on crowding metal under lap, until his corking edge looks something like the dotted curve shown.

From the foregoing, there appears to be an upper limit for this pitch. On the other hand, if the rivets be pitched too close together the net section of the plate is greatly reduced, thus resulting in a weak joint. Furthermore, the rivet heads might come so close together as to interfere with driving.

RIVETING TABLE 2

	Inches						
Thickness of plate....	1/4	5/16	3/8	7/16	1/2	9/16	5/8
Diameter of rivet.....	5/8	11/16	3/4	13/16	7/8	15/16	1
Diameter of rivethole.	11/16	3/4	13/16	7/8	15/16	1	1 1/16
Pitch-single riveting...	2	2 1/16	2 1/8	2 3/16	2 1/4	2 5/16	2 3/8
Pitch-double riveting..	3	3 1/8	3 1/4	3 3/8	3 1/2	3 9/16	3 5/8

Table 2 gives the usual pitch and diameter of rivets for various plate thicknesses as adopted by some of the best establishments in the United States. It should be borne in mind that the pitches here given cannot always be adhered to exactly, and a fraction of an inch either way can do no harm so far as producing a tight joint is concerned. In short, this table gives us something on which to base our calculations. Referring to Table 2, we notice that 17/32-inch plate is not tabulated, so we will use the standard for 1/2-inch, which calks for 7/8-inch diameter rivets, with a calking pitch of 3 1/2 inches.

To facilitate matters for the "layerout," the calking pitches should be equally spaced from the center line of one girth seam to the centerline of the next; in other words, this dimension should be exactly divisible by the calking pitch. If it is not, then we must use the nearest to this pitch, which will give us the result desired. This is where possible variations from standard pitches, as given in Table 2, will present themselves. Sometimes, however, it so happens that the trial pitch "goes in" exactly.

(To be continued)

Early Progress of Bobbie and Jimmie

The Kids Talk Over Their Experiences—Enter Mr. Kelly and Mr. Donovan—A Change and a Promotion

BY W. D. FORBES

A little more than a year slipped by. Jimmie began his technical studies; Bob returned to the practical work of boiler making. On this Saturday evening he had come home, eaten his supper and gone to his room—not the little one he and Jimmie used to have, but a corner room with an open fireplace. He had sogged down in his comfortable chair with his faithful pipe and the leaping, crackling fire for company.

There was a thundering rap at the door. Jimmie came in.

"Well, well, old top," exclaimed Bob, "where did you blow in from? 'Rest' your coat and hat on that nail, as they say down South, and your bones in that chair and tell me all about it."

Jimmie looked around the room and at the cheerful fire. "Some change here. Open fireplace; curtains at the windows; pictures on the wall, magazines on the table. Everything but the girl. How is she, anyway?"

Bob blushed. "Oh, cut it! Start in and tell me about yourself."

"No," said Jimmy, "just tell me how you got to be foreman so quick."

"Well," began Bob, "it's hard for me to understand. Luck was the main thing, I guess, but you can judge for yourself.

Bob Tells How It Happened

"After you left it was blamed lonely in that room, and in the shop, too. Old man Donovan had had rheumatism, you know, pretty bad. As the cold weather came on it got worse and he finally could hardly walk about at all. I was just out of my time and he seemed to think I was sort of a kid yet. He kept me running to the storeroom to see if we had enough rivets and other truck, and out to the plate shed looking up plates and chasing blue prints, until they got to calling me 'Donovan's shadow' in the shop. I got tired running out to the plate shed cold days, so I took a couple of Sundays and measured up all the plates and put the dimensions down in a little book. Every time we used a plate I marked it off. Any time we got more stock I put it down. Donovan tumbled to this and told the boss about it. He told me to make another book for the office. I put up a kick, telling him that if there were two books we would be in a fine mess in no time. I would be pretty sure to think that the office had crossed off the plates used or put down any that had come in, and we wouldn't know where we were at.

"The old man gave a grunt and turned to Anderson. 'What do you think of that?' he said. You know how precise old Anderson is.

"'I think Mr. Kelly's idea is the correct one,' he answered. So I had my way.

"My hands were getting as soft as a girl's, while my feet were getting corns running about. It was the third of December when the boss called me into the office.

"'Bob, the Wright mill over at Freedom just phoned that all the boiler tubes in one boiler had started leaking,' he said, 'and they've asked us to send over the auto for them. Donovan is sick abed, so you take a couple of men and two 2½-inch expanders and fix 'em up. Better take some calking tools and, of course, a testing pump and gage.'

"I hustled about and told a couple of boys to come with me, and pretty soon along came the car and away we went, tools and all. When I got to Wright's the super began to ask me what started the boiler leaking. I told him that perhaps I could tell him later, but that I wanted to get the leaks stopped first.

"The boiler had cooled down pretty well and they had all the water out of it, but the firebox (it was a locomotive type of boiler) was too hot to work in, so I started in at the back end, giving the tubes 'an army touch.' Well, to make a long story short, we got all the tubes re-expanded and the pressure on by three o'clock. We were some tired. Everything was O. K., but we couldn't get away until a five o'clock train, so we sat down to have a smoke. In came the super. Luckily I had not taken off the test pump, so I pumped up the pressure again and he was satisfied. I got him to sign our time slips. We got back to the shop again about half past five.

Praise and a Substantial Reward

"Oh, I forgot. The super called me into a little office just before we left and said, 'Here, young man, you have done a good job, and there's five dollars for you.' It made me kinder mad, and I told him that I was much obliged, but that my boss paid me for my work. Then I started to go, but the super called me back.

"'Hold on, young man,' he said, 'tell your boss that if there are any more repairs to be done here, I want you sent over to do them.' You bet I told the boss when I got home, and told him about the five dollars, too. He didn't say anything, but Anderson remarked, when he had gone out, 'Your position in this matter was perfectly correct, Mr. Kelly.'

"Work was kind of slacking up, when one day an order for a couple of boilers came in that would have kept us going for quite a time. We couldn't get the plates we wanted from the mill, however, under six or eight weeks. The specifications called for ⅜-inch plates. Looking over my book, I found we had plenty of 7/16-inch that would be just the right size for the job. The boys were hanging on to their work so they wouldn't be out of a job for Christmas. That's bad luck, you know. Donovan had come down to the office for the first time in quite a while, so I marched in to him.

Effect of the Doctor's Decision

"'Mr. Donovan,' I began, 'I'm driving the boys as hard as I can, but there is no work in sight, and I can't make them hurry much. We can't get any plates for the new boilers for weeks. Now, we've got a mighty good gang in there. I was wondering if the boss wouldn't let us use those 7/16-inch plates instead of the ⅜-inch. They weigh a little more, but we have had them in stock a long time, and if we could use them we could rush the work in the shop and get out those two new boilers in a jiffy.'

"Donovan was humped up over the radiator leaning on his cane. He didn't say anything for a minute or two and I began to get scared. Then he looked up and said, 'Ask the boss to come in here, I can't move.' When the boss came in, Donovan told him what I had said, and, after talking a minute, the boss called in Anderson and they chinned awhile. Then the boss said to me, 'Use those 7/16-inch plates and start right in.' I did.

"It was just two days before Christmas when they sent for me to come to the office. Donovan was hunched up over the radiator as usual, and the boss was looking pale. (He hadn't been looking well for some time.) Anderson's face was as long as a boiler tube.

"The boss turned to me. 'Bob,' he said, 'Mike has got to go away, and the doctor tells me I have got to get out or I will not live through the winter. I am going to make you foreman of the shop.

"Well, old top, I thought my stomach would leave me entirely, and my knees shook so I couldn't stand. I couldn't say a word. When I could, I blurted out, 'What's the matter with you, boss, anything serious?' Anderson began to rub his hands as he always does when he is pleased. 'Yes, it is pretty serious,' the old man answered, 'but what do you think of taking the job?' I told him that I was grateful, but that I would like to think it over until to-morrow. Anderson nodded. You bet I didn't sleep much, old top, that night. I wondered if I could get along with the old men and what they would think of my being boosted way over their heads. I knew that I could handle the new men.

"The next morning when I went into the shop I ran plump into Pat Doran. You know he is a keen old fellow. He stopped me with a kind of twinkle in his eye and said, 'The old hands will stand by you, me boy, so you take the job.' How he knew about it, I don't know, but that settled it. I went to the office and told the boss that I had thought it all over and would take the job. He shook hands with me. 'I've got to drop all this business or peg out,' he said in explanation. 'I am going to-morrow. You must consult with Mr. Anderson, and my lawyer, Mr. Rogers, will look over all contracts, and be sure you don't figure them too low.'

"Gee, Jimmie, that staggered me. I hadn't thought of that. Then I thought of Howland, the draftsman. I was sure he would help me out. That noon there was a notice stuck up on the board by Anderson saying that Mr. James Kelly would be foreman of the shop in the place of Mr. Donovan, who had for many years so ably filled the job. So that was the way it came about. Was it luck or what?"

Was it?

Accident Prevention in Boiler Shops

What the Bethlehem Steel Company Has Accomplished—Consideration of Causes of Accidents—Judging Future by Past

The success of the "Safety First" movement is irrefutable. Available statistics show that industrial and transportation casualties have been reduced in some instances by nearly fifty percent. And, since at no time in the history of the nations has the need for the conservation of life been more urgent, America should save, in these new days of peace, every man that has been spared her from those years of war.

As the result of the war conditions through which we have passed, and are still passing, though peace is already with us, many shops have lost a large number of trained and alert workmen. In their places we find inexperienced boys and men farther advanced in years whose senses of sight and hearing are not so keen as those of younger men. The unfamiliarity of these workmen with the hazards of their new occupation, as well as the high speed at which plants are operating to-day, introduce new factors, all of which require that the human mind only should be depended upon to prevent an accident when it is difficult to remove a dangerous condition through the means of safeguarding.

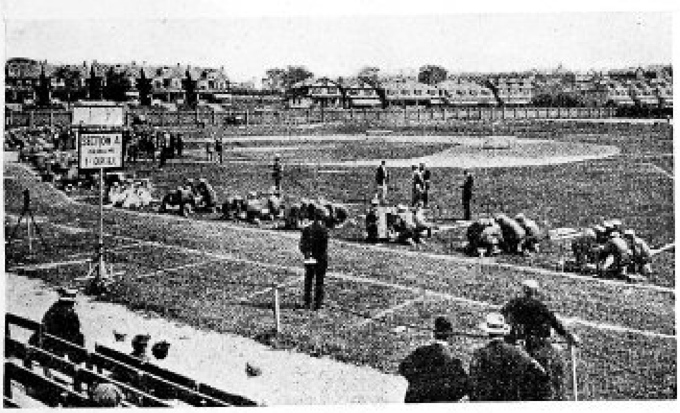

Fig. 1.—Showing First-Aid Teams in Competition

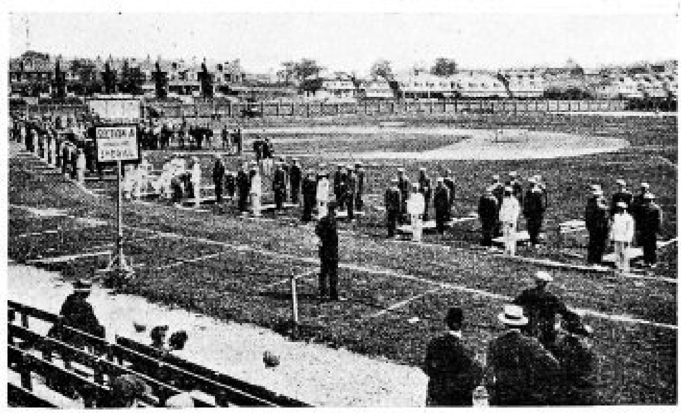

Fig. 2.—First-Aid Teams Receiving Instructions

With these new conditions in mind, work in accident prevention should be undertaken along two distinct lines. The first covers the human elements involved, the second the use of good machinery and approved mechanical devices for protecting dangerous parts; for, since we have many boiler makers and apprentices who are "new" at the work, the first move toward prevention pivots around their general education in the hazards of the occupation. We must secure the hearty support of every boiler maker, designer, pattern maker, riveter and apprentice in the shop. The results rest upon their active co-operation. The programme must include concrete studies in the causes of accidents, definite knowledge as to the means of prevention and a thorough understanding of the details of first aid, by the intelligent use of which a fatal termination of an accident may be prevented.

At an annual inter-plant first-aid meet of the Bethlehem Steel Plant recently, there was in evidence the spirit which may be fostered along these lines among the employees of a large plant. Sixty-three competing first-aid teams were entered, and, after some preliminary tryouts, each team was given three specific problems to handle. The movements were closely watched and recorded by judges, who, after giving each team very careful individual consideration and checking the marks backwards and forwards, found that thirteen teams had finished the preliminaries with a score of 100 percent. These teams, therefore, were scheduled to enter the finals, in which twenty-eight teams, representing all the plants, competed.

The skill of the participants shown at such a meet represents the splendid co-ordination of brain and hand which every workman should possess to minimize the possibility of accident and to prevent serious consequences when accidents do occur. As one of the army judges expressed it, "The work was excellent; the best I have seen. I wish the army boys could equal the work of these boys."

That this training produces results is aptly proved by the experience of a team of the Bethlehem plant which is composed of boiler men. While practicing for the meet the team rushed to the aid of an Allentown painter who had accidentally fallen from a 20-foot platform and come into contact with a 6,600-volt high tension line. The team at once treated the man for electric shock, as well as bandaged a burn and a lacerated scalp. Quick, intelligent treatment no doubt saved the man's life.

A less spectacular feature of accident prevention work comprises the systematic study of the causes of accidents. This study and classification of accidents should be made to apply particularly to all the various departments. First-aid teams can undertake this analysis of accident causes and prevention as a part of the regular course.

In any shop the surest way to judge of the future is by a study of the past. Accidents can best be prevented by anticipating and removing or changing the conditions which might cause them. Any work along these lines must, of course, be handled intelligently in order to avoid creating opposition to the accident prevention movement. The idea, of course, is to be a source of help to the department which has had the accident. Care must be taken to avoid conflicting with the State and insurance company inspection departments and to avoid interjecting the personal element into the work.

The mechanical control of the conditions which cause accident is a vital factor. This feature is most intelligently handled on the basis of previous experience. It is of primary importance that one should know the reasons for the accidents which have occurred. A workman may be severely injured in a fall from poorly constructed scaffolding, one where the equipment had not been carefully calculated for sufficient strength. Anyway, and whatever the cause, the subject ought to be thrashed out and every scaffold or other structure scientifically tested by the "man who knows" before the enthusiastic "new" hand mounts it for work. This done, the amount of brace for scaffolding above the roof, thickness of planks, position, and all other factors will be so fixed that future results can never be anything but certain.

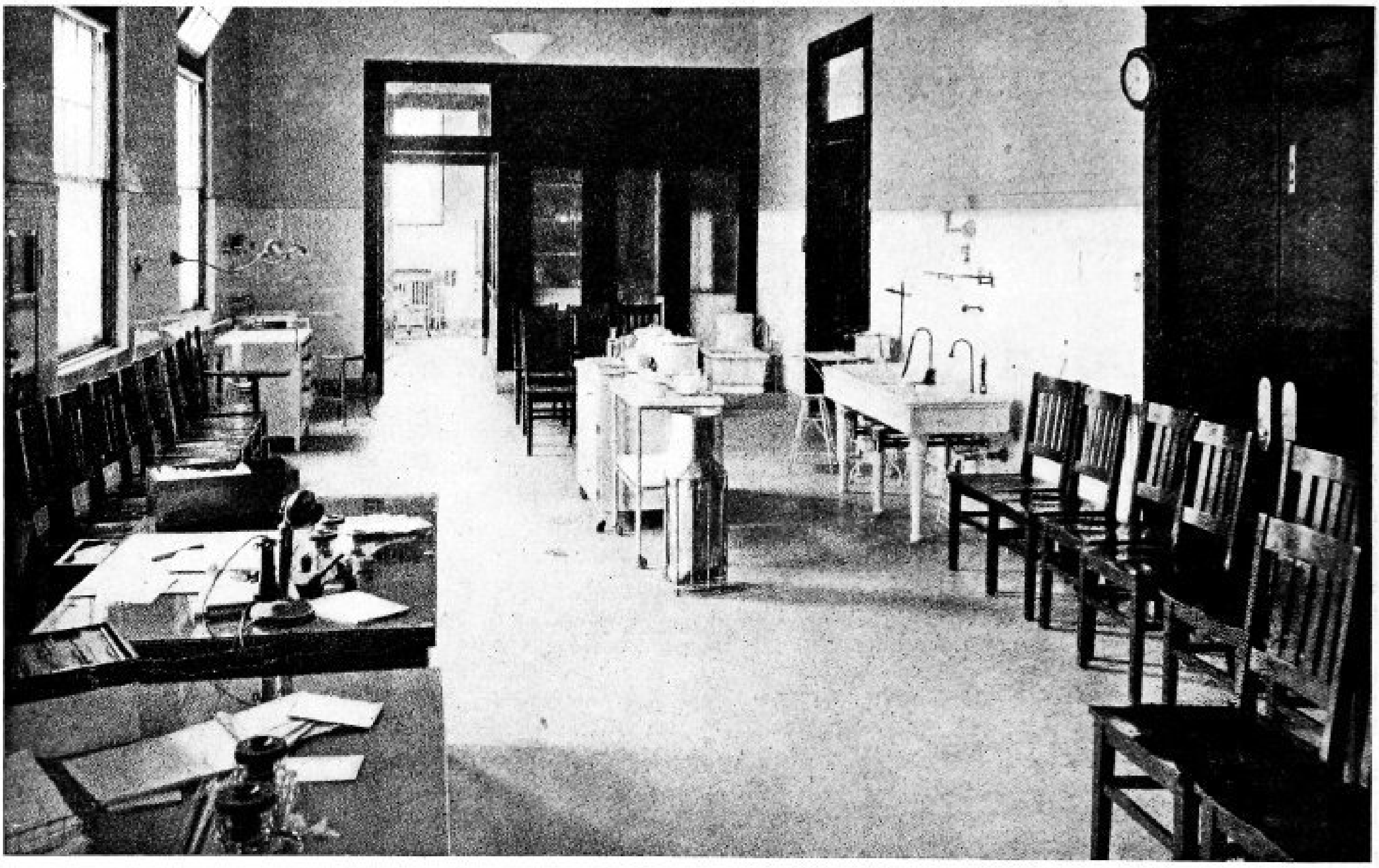

Fig. 3.—Dispensary in the Bethlehem Steel Company Plant

New complications must be provided for before accidents occur. Problems of accident prevention should be completely covered in the shop. Managers should consider carefully all new factors—willing but inexperienced help, abnormal labor turnover, unavoidably congested working conditions, temporarily crude systems of operation, breakdowns due to the age of the premises and equipment and to the forcing of equipment beyond the capacity for which it was originally constructed, or exposure during enlargement of the plant. Unless these mechanical conditions have been thoroughly considered and properly provided for, the personal care of the individual employe will go for naught.

The general outlines of a wide shop movement toward accident prevention are in the hands of employers, executives and safety engineers. The working out of the details rests with the men. They know or can find out where the hazards exist; they can discuss especially difficult problems on getting together. Real results can be obtained if each specific problem is concretely worked out. For instance, if on using the electric welder during the morning it developed such an unusual amount of heat that the arms of the operator were badly burned, talk it over at the lunch hour. Also find out how other shops have handled such a problem. A good source of information is the National Safety Council, 208 South La Salle Street, Chicago, Ill., and the American Museum of Safety, 18 West 24th Street, New York city. But make each problem worth solving and try to find the solution. In each shop the new situation complicated by the problems of the old must be worked out to accomplish the maximum of safety for the industrial army quartered there. These measures are as necessary in the days of peace as in war. Carry the care which the Red Cross and our doctors and nurses have used upon the battlefields into our industries, and "make industry safe in democracy."

Fig. 4.—Patient Treated for "Fractured Back" by First-Aid Team

Fig. 5.—Colored Team Demonstrating Method of Treating Fractured Back

Materials of Steam Boiler Construction*

Action of Carbon in Boiler Plate—Free Use of Cast Iron Dangerous—Laminar Structure of Wrought Iron

BY A. J. DIXON

Years ago copper was largely used for firebox sheets and stay-bolts in boilers of the locomotive type, while the flues consisted of brass tubing. The ductile and flexible properties of copper, as well as its ample tenacity and high heat conductivity, and its ability to resist the corrosive action of furnace gases, caused it to be regarded as the ideal material for the purposes mentioned. For nearly all other requirements of boiler making at that time the staple material was a high grade of wrought iron produced by the reduction of pig iron with wood charcoal alone used as fuel. This charcoal iron, so called, is practically free from the impurities resulting from the combustion of coke and similar fuels in the blast furnace.

Copper fireboxes and stays have long since gone out of use. In recent years wrought iron has given place to the low-carbon or mild steels; in fact, steel is now the only material specified for shells, drums and fireboxes in all first-class boiler design, its use being required by law in many localities.

The grades of steel used in boiler making are distinguishable from the best grades of wrought iron only in their physical characteristics. Chemically, low-carbon steel and charcoal iron are virtually the same. The main difference between the two metals is the homogeneous structure of steel as compared with the laminated and fibrous texture of wrought iron, due to the different methods of manufacture.

In the making of wrought iron the puddling process leaves the metal in the condition of a soft plastic ball saturated with slag. This ball is taken from the furnace and dropped into a machine which squeezes out most of the slag. It is then passed through a train of rolls which ejects much of the remaining slag and gives the plastic mass the form of a bar. This muckbar, as it is called, is cut up into strips; enough strips to produce a sheet of the desired size are bound into a bundle, the bundle is then brought to a welding heat and passed through the rolls.

Thus it is that a wrought iron plate consists of a series of welds. This accounts for its laminar structure. The presence of slag in the material contributes largely to its fibrous texture, the rolls drawing the metal out into a

* From Power.

stringy mass, each fibre of iron being, in fact, the core of a slender thread of slag.

In the manufacture of mild steel the metal comes from the furnace in a liquid state and is run into ingots. Since it has only a trace of the essential properties of genuine steel, this material has been termed ingot iron.

The first essential of boiler plate is a uniform blending of the physical properties that will enable the material to recover from the strains induced by the various stresses of operation. The most important of these properties is tenacity, or ability to resist a pulling stress. Carbon is the ingredient that gives this property. Carbon possesses no great strength on its own account, but when joined in chemical affinity with iron it develops strength therein. Correct proportions must be maintained, however. Increasing the carbon content up to a certain percent conduces to strength; beyond this point the strength deteriorates. Mild steel that contains 0.1 percent of carbon, for example, has a tensile strength of about 50,000 pounds per square inch; while 12 times this quantity, or 1.2 percent, increases the tenacity to nearly 140,000 pounds per square inch, which is probably the limit for carbon steel. Increasing the percentage of carbon above this figure causes a proportionate drop in the tenacity of the steel. With 2 percent, its strength is about 90,000 pounds. A further gradual increase of the carbon component causes the material to rapidly acquire the characteristics of cast iron.

Hardness Desirable In Boiler Plate

Carbon also contributes to the hardness of boiler plate. This quality is especially desirable in flues and tubes and the sheets of fireboxes and combustion chambers, where the metal must withstand the abrading action of cinder-laden gas current. There is, however, a degree of hardness beyond which it is impossible to go without sacrificing other very necessary qualities of good boiler plate. Enough carbon to give a high degree of hardness would, for example, diminish the ductility of the material or the property which permits it to be drawn out or elongated. Its malleability or the property by which it adapts itself to change of shape by hammering, bending or rolling, might also be impaired to a ruinous extent. Likewise the plate would be lacking in toughness; enough carbon to make it quite hard would also make it brittle.

Good boiler steel contains just enough carbon to insure proper melting in the furnace. This consideration amply gages the amount necessary to produce a satisfactory blending of the properties enumerated. Generally, the quantity of carbon is considerably less than 0.25 percent. This practically removes all liability of the material to harden and crack under stress caused by a sudden and wide change of temperature.

Open Hearth Process of Steel Making

The laws of some states require that mild steel for boiler making be made by the open hearth process. In this process either of two methods is employed, known as the basic method and the acid method. These terms refer to the chemical reactions taking place in the furnace elemental substances of either an alkaline or an acid nature in the lining of the furnace and in the slag being the determining factors in the reactions. The acid method is more simple than the basic method, inasmuch as it removes none of the phosphorus and sulphur from the charge of pig iron. The quantity of these impurities is, therefore, greater in the product of the acid hearth. Hence the basic method is preferred in the manufacture of boiler steel.

Besides the chemical elements already mentioned (carbon, phosphorus and sulphur) there are two others (silicon and manganese) that combine with iron in the composition of steel boiler plate. Excepting carbon, without which iron would be of little commercial value, these elements are present in mild steel principally because the expense of getting rid of them prohibits the attempt.

Sulphur is detrimental in various ways, its effect being mostly to impair the tenacity and ductility of the plate, especially when hot.

Phosphorus enhances the strength of steel. It also adds to the hardness of the plate and thus makes it better able to resist abrasion. These qualities are, however, best secured through the medium of carbon, because phosphorus tends to make the material brittle. Steel containing much phosphorus is particularly weak against shocks and vibratory strains. On this account it may be considered the most harmful impurity in steel boiler plate.

The small quantity of silicon present in boiler plate tends to make the steel slightly harder than it would otherwise be, but apparently without diminishing its toughness or ductility, and also without appreciably affecting its tensile strength. This element might, therefore, be regarded as a beneficial ingredient.

Effect of Manganese in Steel

Manganese is a hardening agent. Steel containing a considerable proportion of this element acquires a peculiar brittleness and hardness that makes it difficult to cut. Manganese has, however, a neutralizing effect on sulphur. It combines with the sulphur in the steel to form manganese-sulphide. This compound is less objectionable than the iron-sulphide that would otherwise be formed. The presence of manganese may, therefore, be regarded as advantageous. To insure a complete union with the sulphur, however, the quantity of manganese must be at least four times greater, since the affinity between these elements is comparatively weak.

The standard rules of boiler design require the physical and chemical properties of the grades of steel used for plates, stays and rivets to conform to certain uniform specifications. Plates that require staying or flanging, for example, as the sheets of fireboxes and combustion chambers and the heads of cylindrical shells, and also plates exposed directly to the gases of combustion, must not contain more than 0.04 percent of phosphorus nor more than 0.04 percent of sulphur. Shell plates not directly exposed to the fire or gases of combustion may not have more than 0.05 of either phosphorus or sulphur. The percentage of manganese is left to the discretion of the steel maker.

The tensile strength of flange steel and of steel intended for the shell plates of externally fired boilers must be between 55,000 and 65,000 pounds; of firebox and rivet steel, from 55,000 to 63,000 pounds; and of shell-plate steel for internally fired boilers, from 65,000 to 70,000 pounds. In the tensile test a bar having a cross-sectional area of one square inch is stretched in a testing machine until it pulls apart. The force exerted at the instant of rupture measures the ultimate tenacity of the material. During this test the elasticity and ductility of the steel are also determined.

In any substance there is a limit beyond which the material cannot be strained without producing a permanent change of shape; this is called the elastic limit or yield point of the material. In the case of boiler steel it is generally required that the yield point shall not be less than one-half the tensile strength. Firebox steel, for example, that has a tensile strength of 56,000 pounds, should retain its elasticity until the testing machine records a pull of 28,000 pounds. When released from a less tension than this, the bar should return to its original length. The snap and vigor shown in the action is an indication of the resilience or spring-like quality of the material. The specifications require that staybolt steel shall have an elastic limit not less than 0.5 the tensile stress and a tensile strength not less than 50,000 pounds. Staybolts made of charcoal iron must have a tensile strength of at least 49,000 per square inch and an elastic limit not less than 29,400 pounds or 0.6 the tensile stress.

When the tensile stress exceeds the elastic limit, the bar becomes permanently lengthened. If the bar is of very soft steel, it may stretch to almost double its original length before breaking. This elongation of the material is a measure of its ductility and is expressed as a percentage of the original length of the test piece, which is commonly taken as eight inches. Thus, the rules require that shell plate steel shall have an elongation not less than 24 percent, flange steel not less than 27 percent, and firebox and rivet steel not less than 30 percent in excess of an original length of eight inches.

Bending Test Determines the Malleability

The bending test determines the malleability of the steel. This is the most exacting of all the tests to which boiler steel is subjected. A specimen one-half inch thick must show no trace of fracture when bent double upon itself and hammered down to close contact while cold. This is called the "cold test." A similar specimen is given the same treatment after being heated to a cherry red and quenched in water at a temperature of from 80 to 90 degrees F. This is called the "quench test" and is intended to show if the metal has the hardening character of genuine steel, which, very evidently, would render it dangerous as a boiler material.

In the making of mild steel, small cavities are apt to be formed by gas bubbles in the molten ingot. Seams may also be found in the finished product, either on account of incomplete welding or separate strata of the metal or of slag getting between the strata. These defects are particularly objectionable in steel intended for shells and drums and butt straps. The tensile stresses in these parts, and in fact in stayed flat sheets as well, demand that the steel be as nearly homogeneous as it is practicable to make it, while a less degree of homogeneity may be permitted for rivet steel. The test for flaws of the kind mentioned is to nick the specimen with a chisel so that it may be held in a vise and broken with a hammer. Examination of the fracture should reveal no seam more than one-fourth inch long.

In the design of boiler shells the compressive or crushing stresses in the section of metal between the edge of the sheet and the rivet holes must be given consideration. The molecules of the metal oppose greater resistance to compression than to tension. Mild steel has a compressive strength of about 95,000 pounds per square inch.

The prime requisite of good rivet steel is malleability. The comparatively low percentage of carbon in this class of steel insures this quality, but it also reduces the ability of the metal to resist shearing and tensile stresses. Tension in the rivets of a boiler is, however, relatively unimportant, while the cross-section of the rivets can readily be made large enough to give ample strength against shear. Rivet steel should have a shearing strength of at least 44,000 pounds per square inch in single shear, and 88,000 pounds in double shear, or when cut through simultaneously in two separate planes of cross-section.

Much cast iron was used in boiler making at one time. The plain cylinder boilers of long ago usually had cast iron heads. Sectional boilers also were built of cast iron, while the tubes of watertube boilers were formerly expanded into cast iron headers. Its use in this class of work, however, has been restricted chiefly to the making of boiler mountings and supports, handhole plates and manheads. Cast steel, which is generally stronger and more homogeneous in texture than cast iron, is now largely used for these purposes, but the best practice calls for stamped or forged steel.

Cast iron is a dangerous material to use where high steam pressures are concerned, chiefly because it is impossible to know the internal condition of a casting from the appearance externally. Large slag holes and cavities made by gas bubbles may be hidden under an apparently sound exterior surface; also there may be severe local strains in the grain of the metal on account of unequal cooling in the mold. Even when the castings are sound, there is still the danger of sudden cracking from stresses caused by the extreme variations of temperature prevailing in the generation of steam.

The only thing about cast iron to recommend it as boiler material is its practical imperviousness to ordinary corroding elements. This property renders it peculiarly adapted for use in the making of mud drums. Until recent years it was so used in the leading types of watertube boilers. The mud drums of these boilers are now made of cast or wrought steel.

$2,000,000 Steamship Boiler Factory at Richmond, Va.

A contract has been awarded to John T. Wilson and Company, Richmond, Va., for the erection in South Richmond of a boiler factory for the Newport News Shipbuilding and Dry Dock Company, this, it is said, being let through the Emergency Fleet Corporation. The estimated cost of the plant and machinery, it is said, is about $2,000,000. The plant will be built upon land recently acquired, but of sufficient size to permit of extensive enlargement when necessary. It was because of lack of room at the main plant at Newport News that a site at Richmond was bought for the boiler factory, which will make Scotch boilers for the ships built at Newport News. It is expected to complete the buildings and the installation of the machinery by next spring.

Violation of Safety Laws

The Division of Operation of the Interstate Commerce Commission has issued Mechanical Department circular No. 3 signed by Mr. McManamy, assistant director, stating that attention has been brought to numerous instances where it has been necessary for Interstate Commerce Commission inspectors to order locomotives out of service for repairs under circumstances which indicate willful violation of the federal laws regarding safety, and also where locomotives were not in condition to render efficient and economical service. In the future, the circular says, master mechanics and shop and roundhouse foremen will be required to know that locomotives are in good condition before leaving terminals, and it is directed that locomotives that are in violation of the federal laws or that are not in condition to make a successful trip should be repaired before being offered for service.

Relative Economy of the Locomotive of 1900 and Today

BY JOHN E. MUHLFELD

The general development of the steam locomotives in use in the United States since 1900 can be best shown by the data in accompanying table, which are approximately correct.

Prior to 1900 considerable development work had been done on two-, three- and four-cylinder types of compound locomotives by Mallet, Webb, Pitkin, Mellin, Vauclain and others. Pitkin's two-cylinder system was applied to a Michigan Central ten-wheel locomotive in 1889, and Vauclain's four-cylinder system was first introduced on a Baltimore & Ohio eight-wheel locomotive in October of the same year. These and other developments caused the adoption of both the two- and four-cylinder systems in new locomotives, the maximum application being reached during 1904, when approximately 1,000 two-cylinder and 2,000 four-cylinder compound locomotives were in existence.

Previous to 1900 Schmidt, Pielock and others had done considerable experimenting with superheated steam, the former having succeeded in 1894 in producing a boiler and motor in which superheated steam of relatively low pressure was used at about 700 degrees F.

The failure of the compound locomotive to produce the economy predicted, due largely to the factors of indifferent design, lack of proper maintenance and operation, cheap fuel and road failures, resulted in the general return to the single-expansion cylinder locomotive, and this, with the demand for greater steaming capacity per square foot of boiler heating surface, naturally brought about consideration of the use of superheated steam. The results of further experiments by Vauclain, Vaughn, Horsey, Cole, Emerson, Jacobs and others along the lines of high and low degrees of superheat, in combination with either high or low steam pressures, by means of smokebox, firetube or a combination of both types of superheaters, resulted in the firetube type being now practically a standard part of all new equipment, and it is further being rapidly applied to existing saturated steam locomotives in the United States.

STEAM LOCOMOTIVE IN THE UNITED STATES SINCE 1900

Year	Item	Single Expansion Cylinder	Two-Cylinder Compound	Four-Cylinder Compound	Mallet Articulated Compound	Total Locomotives
1900						
	Number	36,600	1,000	900	....	38,500
	Aver. tractive pwr., lb.	19,000	28,000	29,000	....	......
	Aver. wt. on drivers, lb.	85,000	125,000	130,000	....	......
1905						
	Number[1]	48,949	900	1,800	1	51,650
	Aver. tractive pwr., lb.	23,000	31,000	32,000	75,000	......
	Aver. wt. on drivers, lb.	100,000	140,000	145,000	335,000	......
1910						
	Number[2]	56,425	875	1,500	200	59,000
	Aver. tractive pwr., lb.	27,000	31,500	40,000	72,000	......
	Aver. wt. on drivers, lb.	120,000	142,000	175,000	320,000	......
1915						
	Number[3]	62,000	650	1,300	800	64,750
	Aver. tractive pwr., lb.	30,500	32,000	33,000	79,000	......
	Aver. wt. on drivers, lb.	135,000	145,000	148,000	350,000	......

While the Cook and Vauclain balanced compound types of locomotives, as brought out since 1900 along the lines of the French De Glehn system, have not made much progress, the Mallet articulated compound system, introduced on the Baltimore & Ohio in 1904, is now in use on over fifty railways in the United States and aggregates more than 1,500 locomotives. This latter type of locomotive not only permits extreme concentration of great power over a flexible wheel base within axle-load limits, but also reduces the stresses by greater distribution and lightness of parts, and through the combination of high-pressure superheating, compounding, simpling and reduction of unbalanced pressure gives the maximum direct and reserve tractive power for from 25 to 35 percent less fuel and water consumption per ton-mile than a superheated single-expansion locomotive.

[1] Includes one superheater locomotive.
[2] Includes 300 superheater and 3,000 oil-burning locomotives.
[3] Includes 14,000 superheater and 4,250 oil-burning locomotives.

With regard to the present status of the relative economy of steam and electric locomotives in the United States, as compared with the results obtained in 1900, general conditions have been substantially changed and the predominating factors to-day are manual labor and fuel for operation. While the inauguration of the use of fuel oil on almost 4,500 steam locomotives has somewhat improved the firing and steam generation conditions, the increasing cost and demand for oil for more essential purposes and the reducing supply will soon make its use for locomotive fuel prohibitive. However, the use of oil as a locomotive fuel has long since demonstrated that the mechanical feeding and burning of fuel in suspension, whether gaseous, liquid or solid, for the production of steam in a self-contained motive power unit is the most logical, successful, effective and economical method for generating power and moving long-haul heavy tonnage traffic on railways.

Oil and Hydroelectric Power

Even where hydroelectric power is available the self-contained steam power plant locomotive will show a much lower cost for fixed charge, maintenance and operation than the electric unit, as the transmission and the conversion of electric current into drawbar hauling capacity is a very wasteful and expensive process in the present state of the electrical art. In fact, the principal economies brought about in the electrical field during the last quarter century have been in the production and use of steam for the generation of current and not in the electrical apparatus.

As applied to a long-haul railway, the metering and conveying of extremely high-voltage current from various power plant sources into transmission mains, through switching sub-stations, transforming and converting, conveying to contact lines and converting into great hauling capacity at the drawbar results in enormous line and bonding dead losses, which will bring the cost of even hydroelectric current per drawbar horsepower hour to from 6 to 7 mills. This cost, which, in combination with copper limitations, fixed train speeds up and down grades, general tie-up of operation in case of failure, and like factors, will hardly admit of comparison with steam locomotive boilers operating at equivalent to 700 percent of the rated capacity of stationary boilers, with a 75 percent combined furnace, boiler and superheater efficiency, and furnishing a boiler horsepower for each 1½ square foot of evaporating surface and producing a drawbar horsepower hour for 2¼ pounds of coal.

In conclusion, it is not inconsistent now to predict that a self-contained steam-electric articulated compound locomotive, combining the advantages of both steam and electric motive power, will shortly find a useful field in services where maximum power and efficiency at high speeds, greater utilization of existing waste heat, high-starting and low-speed torque and rapid acceleration are required and where an exclusive electrification system would not be permissible from the standpoint of first cost or justified on account of the combined expense for operation and maintenance.

The Boiler Maker

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The church bells tolled out the message at 4 o'clock. The armistice had been signed. A people had been freed. Once more the world could right about and face the future. where for a period of four years and three months and seventeen days it had looked backward into the past—looked backward to the depth of a thousand years!

We are again born. We have witnessed a new dawn of democracy, a new peace on earth, a new good will toward men. It means much. It means universal freedom and the right of people to pursue happiness, to the end that future generations may likewise freely pursue happiness. It means that. But most of all it means, and meant—this earth. The War is over. Thank God for it!
sits on his throne, and that Christ again walks upon the earth. The War is over. Thank God for it!

The value of vocational training cannot be estimated. The interest which it holds for students is strongly apparent, however. Youngsters everywhere eagerly await the opening day for instruction in these branches, while these same youngsters lament this same opening day in the regular grammar courses. Certainly that is the handwriting on the wall. It is worse—or better—in the evening classes. Young men, and men not so young, look forward to the opening night, usually in October, when they may register for a course in mechanical drawing or shop work, that each may the better fit himself for the trade which he has elected to follow. Vocational training has come to stay. As a form of study it has proven popular.

We are printing in this issue the first of a series of articles covering boiler design. The author at one time was an instructor in a vocational school in Erie, Pa. His work there, as well as his protracted shop and drawing room experience, early gave him to know just what was needed by apprentices, both shop and drafting room, in order that they might make intelligent progress. In this series he has given of his notes and experience freely and clearly. We are strong for these articles, and in publishing them feel that we are bringing night school home to the student. What more could a fellow ask?

It is said that most of the discontent in this world, if not all of it, is due to the fact that the majority of men are unhappy in their work. By that it is meant that in their early days they chose the wrong vocation, or else had the selection erroneously made for them by guardians. However that may be, slackness is exercised by everybody when choosing a life's following. In the professions, young men elect to become doctors or lawyers or engineers not because they know what the work in these professions broadly consists of, but rather base their choice on some light, effervescent thing having no tangible connection either with the profession or their own adaptability for it. Uncle John having successfully been a doctor is no real excuse for son Tommy following in Uncle John's footsteps and taking work leading to the degree of M. D.

Mr. Haas, in a timely letter in this number, makes some interesting comment on this important subject.

There is a great scarcity of technical men who can write interestingly on technical subjects. There always has been such a scarcity. Among the book publishers there is an axiom to the effect that men who have something worth while to write about cannot write about it acceptably, and those who do possess the knack of writing in an interesting manner have nothing about which to write. However true that may be in the field of fiction, if applied to engineers it is a sure enough compliment, since a very small percentage of them write for publication.

There is great need for technical writers. Meetings held monthly or yearly among the several societies, while offering opportunities to the members to get up and transmit thoughts and experiences to others, yet these verbal utterances, which in great measure they are, do not offer the possibilities for wide distribution that comes of the written word and the printed page—the technical magazine.

The editor wishes to encourage technical men to try their hand at writing for these pages. The rewards are many besides the one of money compensation. Reputations are made through the medium of continued contributing. Names become familiar to a wide circle of readers, the writer's point of view becomes generally known, his personality is "sensed," and he one day receives a letter from someone in authority somewhere who wants him to round out the personnel of the establishment—salary the least of things to be considered.

Why not try your hand? However short, anything which you may submit will be given careful consideration.

IMPORTANT NOTICE

Due to Government restriction on paper, it has become necessary for THE BOILER MAKER to discontinue immediately at expiration date all subscriptions for which cash has not been received for renewal.

We regret very much the necessity for this action, as heretofore we have always allowed 90 days' grace.

Our subscribers are urged to send remittance for the renewal of their subscriptions as soon as notice of expiration is received. If the subscription is allowed to lapse it will be impossible for us to furnish back numbers and our subscribers' files will be broken.

Engineering Specialties for Boiler Making

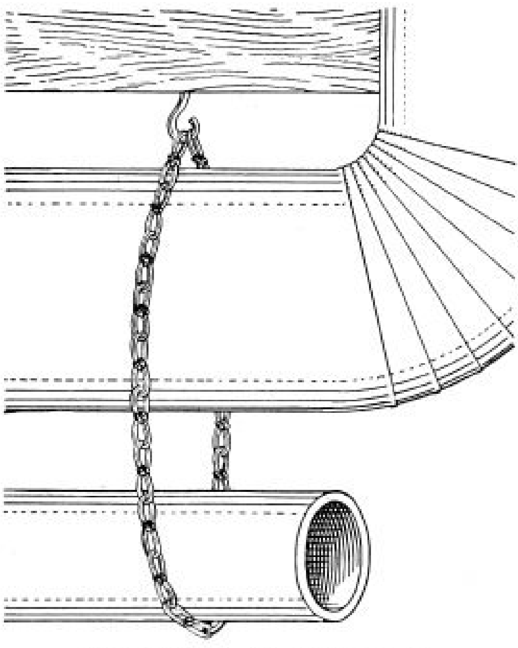
New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

Special Chain for Hanging Pipe

Chain has its limitations as well as its adaptations. This is brought out rather forcibly by the recent announcement of a special chain designed and placed on the market to be used solely for "suspending" or "hanging pipe."

Former methods of supporting pipe have offered many difficulties which are evident to those who have had experience in this line of work. The demand for a better method of hanging pipe has brought out numerous patented devices from time to time. None of these have been entirely successful in overcoming these difficulties.

"Bulldog" chain, which is made by the Cleveland Galvanizing Works, Cleveland, O., used in combination with screw eyes, offers an excellent device for this purpose. The chain is furnished in reels from which the desired lengths can be cut as required. Consequently, there is no waste. For quick installation, a screw eye is screwed into the ceiling or beam above the pipe. The chain, having been cut to approximately the desired length, is



Bulldog Chain for Hanging Pipe

looped around the pipe and both ends of the chain are slipped onto the hook of the screw eye. The flexibility of the chain increases its uses. In cases where there are temporary or unstable obstructions between the pipe and the place to which the hanger is to be fastened, chain can be passed around the obstruction.

A notable feature of this pipe hanging chain is the ease with which the level of the pipe can be adjusted. By removing the chain and tightening or loosening the screw eye, the level of the pipe can be raised or lowered any desired distance.

Not only are vertical adjustments easily made with these chain hangers, but horizontal adjustments are also greatly facilitated. The extreme flexibility of the chain allows the pipe to be moved several inches without making any change in the length of the chain and without shifting the location of the screw eye. This will be found of great benefit when it is desired to shift the position of pipe suspended from open joists, as it does away with the use of cross piece to which the hanger is fastened. Since adjustments can easily and quickly be made to correct difference in level caused by contraction and expansion, the chain is adaptable for use in supporting steam or hot water pipes.

Lagonda Locomotive Arch Tube Cleaners

The cleaners illustrated herewith are manufactured by the Lagonda Manufacturing Company, Springfield, Ohio, and are the standard machines for 3-inch outside diameter arch tubes. The case of these cleaners is made very short and compact, and the extra heavy head is attached to the motor by means of a toggle joint, so that the machine will easily pass around the bends of the tubes.

The Lagonda arch tube cleaners are equipped with quick repair heads, as shown in the illustration, although

Lagonda Arch Tube Cleaner

a drill and porcupine head can also be furnished. The operator thus has a choice of three types of heads. When scale is hard or thick the use of the drill heads is recommended. Where the scale is brittle and cracks off cleanly these heads will do the entire cleaning, but if the scale is chalky and adheres to the tube the cleaning should be finished with the quick repair head. A sight feed lubricator is furnished with each cleaner, which should be connected in the supply line.

Seamless Hollow Staybolt Iron

After long experimenting and study, a seamless hollow iron is now being produced from the solid finished bar of staybolt iron. It has been the aim in producing this bar to diverge from the practice customary in this country of making hollow iron from welded sections by producing a seamless hollow iron with the toughness and lasting quality of the best solid staybolt iron. This new hollow bar is made from the solid finished bar of Ulster special staybolt iron that is standard for staybolts on the majority of leading railroads in this country. No change of any kind has been made in the process of manufacture. Made without welds, this hollow staybolt iron will not split in threading or driving.

Ulster iron is older than the locomotive in this country. Whether or not Ulster was used for staybolts in the first locomotive cannot be proven, as the records are lost. However, building operations on the mill of the Ulster Iron Works began in the fall of 1825, while the first proposal for the construction of locomotives in the United States was not made by the Baltimore & Ohio Railroad until January 4, 1831.

The company claims that no scrap is, or ever has been, used in the making of Ulster special iron. This mill policy that has so long governed the character and quality of Ulster special has resulted in a product which for over fifty years has been the standard for staybolts on the majority of leading railroads. Since no new processes or material have been used in the manufacture of the iron, Ulster special hollow, as well as the solid, will pass all railroad and other standard staybolt iron specifications.

The company has found that the holes in the bolts are perfectly round and true. Inasmuch as this hollow bolt is exempt from the hammer test, inspection is simplified. In order to eliminate crop ends, time and cost of cutting, and to facilitate handling, this iron is furnished in the lengths and sizes in which it is to be used.

Principal Data and Dimensions of Mallet Locomotives

General Data

Gage	4 feet 8½ inches
Service	Freight
Fuel	Bituminous coal
Tractive effort, simple	176,600 pounds
Tractive effort, compound	147,200 pounds
Weight in working order	684,000 pounds
Weight on drivers	617,000 pounds
Weight on leading truck	32,000 pounds
Weight on trailing truck	35,000 pounds
Weight of engine and tender in working order	898,300 pounds
Wheel base, driving	19 feet 10 inches
Wheel base, total	64 feet 3 inches
Wheel base, engine and tender	97 feet

Ratios

Weight on drivers ÷ tractive effort, simple	3.2
Weight on drivers ÷ tractive effort, compound	4.2
Total weight ÷ tractive effort, compound	4.6
Tractive effort, compound × diameter drivers ÷ equivalent heating surface	699.4
Equivalent heating surface ÷ grate area	108.4
Firebox heating surface ÷ equivalent heating surface, percent	4.4
Weight on drivers ÷ equivalent heating surface	52.4
Total weight ÷ equivalent heating surface	58.0
Volume equivalent simple cylinders	41 cubic feet
Equivalent heating surface ÷ vol. cylinders	287.4
Grate area ÷ vol. cylinders	2.7

Cylinders

Kinds	Compound
Diameter and stroke	30 inches and 48 inches by 32 inches

Valves

Kind	high pressure, piston; low pressure, slide
Diameter	high pressure, 16 inches
Greatest travel	high pressure, 6½ inches; low pressure, 6 inches
Steam lap	high pressure, 1 inch; low pressure, 1⅛ inch
Exhaust clearance	high pressure, ¼ inch; low pressure, 9/16 inch
Lead in full gear	high pressure, ⅛ inch; low pressure, 3/16 inch

Wheels

Driving, diameter over tires	56 inches
Driving, thickness of tires	3½ inches
Driving journals, main, diameter and length	12 inches by 15 inches
Driving journals, others, diameter and length	11 inches by 13 inches
Engine truck wheels, diameter	30 inches
Engine truck, journals	6½ inches by 13 inches
Trailing truck wheels, diameter	30 inches
Trailing truck, journals	6½ inches by 13 inches

Boiler

Style	Extension wagon top
Working pressure	215 pounds per square inch
Outside diameter of first ring	105½ inches
Firebox, length and width	181 1/16 inches by 108¼ inches

Railroad Shops Have Capacity for Work on New Locomotives

The condition of locomotive repair shops of the various railroads has been improved so much during the year that in addition to repairing more than 500 more locomotives per week than last January, some of them now have surplus capacity to undertake some work to relieve the plants of the locomotive builders. Last January the railroads were trying to have some of their locomotive repair work done by the locomotive builders. Now the builders are doing practically nothing in the way of repairing locomotives for the Railroad Administration and at the request of the Baldwin Locomotive Works the mechanical department of the Railroad Administration has ascertained that at some shops there are machines which are not being used to maximum capacity, and arrangements have been made to allow the surplus capacity to be used on work for the Baldwin company. The work thus far arranged for includes the following:

The Philadelphia & Reading shop at Reading, Pa., will plane and slot locomotive frames at the rate of two per week and will build new boilers at the rate of one per week.

The Delaware, Lackawanna & Western will plane and slot 50 sets of frames and finish 50 sets of rods per week.

The Lehigh Valley shops at Sayre, Pa., will plane three sets of frames per week, and the shops at Easton will finish 16 driving boxes per week.

The Erie at its Meadville, Pa., shops will finish shoes and wedges for four locomotives per week, and at the Susquehanna shops cylinders for one locomotive per week and frames for three locomotives per week. At its Dunmore shops it will finish driving boxes and shoes and wedges for three locomotives per week.

The New York Central will build new boilers at its West Albany, N. Y., shops.

Recorder to Adjust Pressure on Rivet Cup

There is a danger in riveting steam boilers by hydraulic pressure, that the pressure on the cup may be released before the shank of the rivet has had time to cool. In such an event the plates may spring apart to such an extent that the shrinkage of the rivet in cooling is not sufficient to ensure a tight seam. According to *The Engineer*, London, a description was recently published in a technical paper of an autographic recorder designed to overcome this possible defect of hydraulic riveting. Pressure upon the warm head of the rivet is transmitted through piping to clockwork and sets a pointer in motion until the required pressure is reached. This pressure is kept constant until a predetermined number of seconds has passed, when a red pointer indicates that the pressure may be released, and the pointer returns to zero. This result is graphically recorded upon a traveling paper band, from which the pressure and the period of compression can easily be read.

Pennsylvania Boiler Rules Modified

The Industrial Board of the Pennsylvania Department of Labor and Industry has adopted the following ruling as a temporary war amendment to the code for safety of construction and operation of steam boilers:

Until further notice in this emergency, steam boilers not Pennsylvania standard may be installed and operated in this commonwealth, provided the prospective purchaser or user makes a written request to the Department of Labor and Industry setting forth therein information concerning the construction and history of such boilers as becomes necessary to determine the safe working steam pressure and subject to the following rules:

In new construction of boilers not Pennsylvania standard, the factor of safety shall be not less than five. This factor of safety shall be increased 0.5 each five years thereafter.

For second-hand boilers the factor of safety shall be not less than 5.5. This factor shall be increased 0.5 each five years thereafter.

When the chemical and physical properties of materials in the shell plate are not known, the tensile strength shall be assumed at not more than 50,000 pounds for steel plates and 40,000 pounds for iron plates. All such boilers shall be inspected and tested prior to operation by an inspector duly qualified by the Pennsylvania Department of Labor and Industry.

The W. J. Crouch Company, Inc., and Rownson, Drew & Clydesdale, Inc., announce the amalgamation of their respective organizations under the name of Rownson, Drew & Clydesdale, Inc., with offices at 68 William Street, New York.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, *6 East 39th street, New York city.*

Re-Tubing Locomotive Boilers

Q.—I am a subscriber to your valuable magazine. I should like to get information about proper procedure for best and cheapest method of re-tubing locomotive boilers using 2-inch and 2¼-inch tubes; that is, removing flues, cleaning boiler of scale, welding or re-tipping and installing for service. Also would like to get ideas for making oil burner rivet forge for heating up to ¾-inch by 8-inch rivets.

A.—First, cut out the old tubes at the front tube sheet end by splitting the tubes back a distance of about 1½ inches. In this work use a cape chisel or a ripper of the form shown in Fig. 1. In Fig. 1 is also shown how the

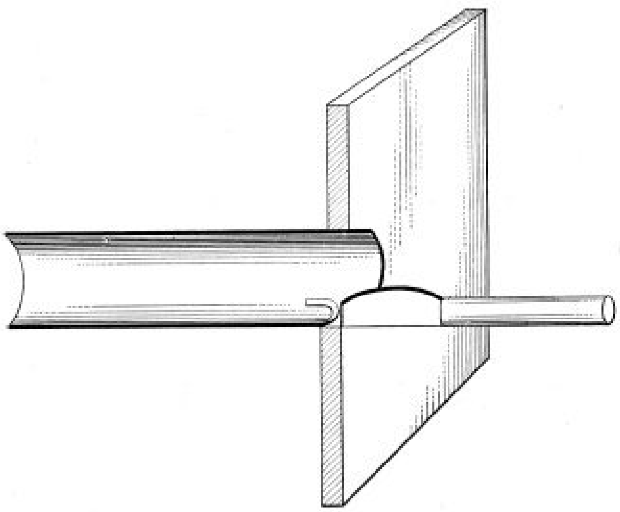


Fig. 1.—Cutting Out an Old Tube

tool should be placed, so as not to injure or cut the tube sheet. After the tubes are split along the bottom in the manner described, bend the cut ends inwards, as shown in Fig. 2, with the use of the tool shown in Fig 3. Drive

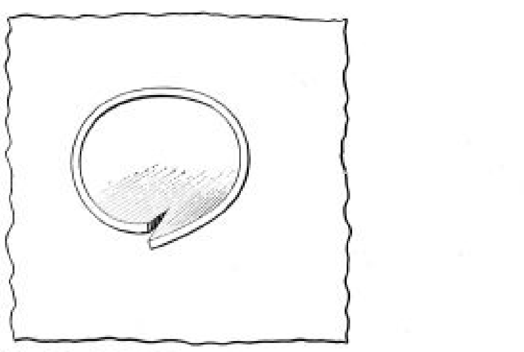


Fig. 2.—End View of Split Tube

the tubes from the rear with a small sledge hammer and remove the tubes from the firebox end.

If there is a large quantity of scale on the tubes it may be necessary to remove it in order to draw the tubes out. Sometimes it is necessary to cut some of the tubes in two inside the boiler and remove them through the manhole.

Some of the old tubes may be re-ended by welding on tube sections about 12 inches long at the ends. Before

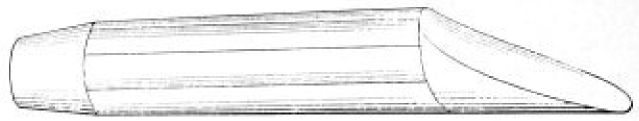


Fig. 3.—Tool for Bending Cut Ends

this is done, however, each tube should be thoroughly examined to be sure that it is in condition for use again.

The length of the new tubes should be so that the tube ends extend about ⅜ inch from the outside surface of the front and rear tube sheets. When the tubes are in place, expand them with both tube sheets and then roll until they fit snug in the tube sheet holes, but be careful not to

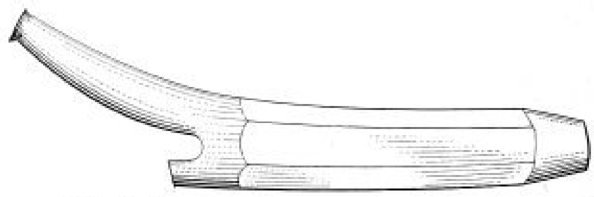


Fig. 4.—Boot Tool for Beading Tube Ends

roll them too much, which, if done, will break or split the ends. The ends projecting in the firebox are beaded over by first turning the ends a trifle with the peening end of a hammer and then beaded with a *boot* tool, Fig. 4

Your inquiry on the design of an oil burner rivet forge is left open for suggestion from our readers.

Laying Out Smokestack Sections

Q.—Please give me the easiest method to lay out the connection of many tubes of the same diameter, something like a smokestack 25 feet in length, in five sections. If I am not mistaken, it is called the crown line.
J. B.

A.—It is assumed that you wish to join five similar circular sections by means of telescopic joints, as in Fig. 1. In this case the outside diameter at the small end of the section must be equal to the inside diameter of the large end. It is also necessary to add or subtract a certain allowance to cover imperfections in workmanship or variations in the thickness of the plates, etc., and it is

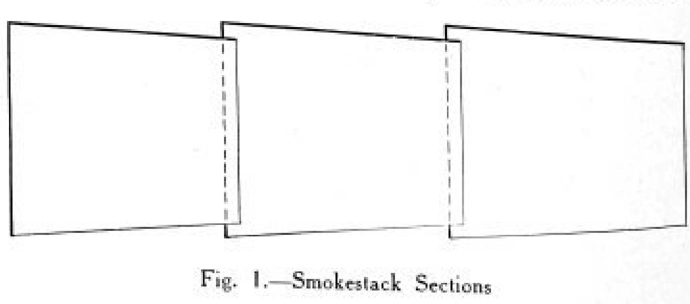


Fig. 1.—Smokestack Sections

desirable to make a loose fit, as this makes the erection easier. For smokestacks the allowance for the taper is about seven times the thickness of the plate. This measurement is applied to the length of the circumference of the end of the section. The circumference is figured as a neutral line, which is in the middle of the plate.

As the taper for the smokestack sections is so light, it is not necessary to lay off the plates as for conical work. Instead of this, a quicker and easier method is used. Make a pattern like that used in Fig. 2.

The sheet for the pattern is laid off on its center line. The end line at *A* is made equal in length to the circumference of the large end of the section, and that at *B* is made equal to the circumference of the small end. This

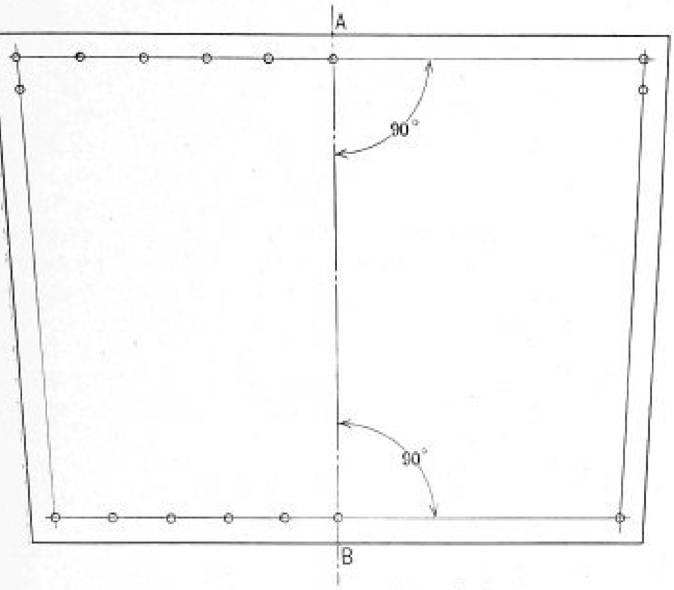


Fig. 2.—Pattern for Smokestack Section

circumference was figured from the dimensions given in Fig. 1 by multiplying by 3.1416. Figure the circumference for either the small or the large end and apply the allowance of seven times the plate's thickness.

Mark the first rivet holes on the center line and make the same number on each end line. This is done by laying off the required number at one end and then putting the same number equally spaced in the other end, regardless of the length of the spaces. This method will make the holes match up when the sections are joined together.

Rules for High Pressure Tanks

Q.—Would be pleased if you would give me some help. Where I am employed as layer out we have quite a few high pressure tanks to build. Do you think that these tanks should be built under the rules governing boilers? We have been working by the A. S. M. E. Code on all this work, with a few modifications. We punch all rivet holes under size, and ream in place, as we are not equipped to do position drilling. These are scrubber tanks and accumulator tanks for oil refineries. What factor of safety do you consider right for this work, and do you think it would be good practice to punch rivet holes full size? We are putting on Hartford Standard joints. The tanks are made of tank steel. I have been figuring on 45,000 pounds tensile strength for this steel. Is that right? Would like some dope on the effect of putting cast iron nozzles on shells and dished heads also. Have been unable to find any rules on this. Any information you or any reader can give through your columns will be appreciated. S. R. W.

These tanks should be built under the rules governing boilers. Punch the holes under size and ream in place. A factor of safety of 4 or 5 could be allowed. It is usual to use steel having tensile strength of 60,000 pounds. Cast iron nozzles should not be used. Make these nozzles of steel. It is a good plan to use dished heads. The rule for dished heads, according to the Massachusetts law, is as follows:

The thickness required in an unstayed dished head with the pressure on the concave side, when it is a segment of a sphere, is as follows:

$$t = \frac{1}{8} + (5.5 \times P \times \frac{L}{2} \div TS),$$

where *L* is the radius to which the head is dished, *T S* is the tensile strength in pounds per square inch of the metal, *P* is the working pressure and 5.5 is the factor of safety. The thickness should not be less than that calculated where *L* is equal to at least 80 percent of the diameter of the tank. The heads are usually dished to a radius equal to that of the cylindrical drum. When the dished head has a manhole opening, the thickness of the head shall be increased by not less than ⅛ inch. The manhole opening in the dished head shall be flanged to a depth of not less than three times the thickness of the head measured from the outside. The tank should be tested before leaving the shop. Thus, the tanks that are to be used for 110 pounds working pressure should be tested to at least 165 pounds cold water pressure. Tanks that are to be used at 100 pounds working pressure should be tested under 150 pounds cold water pressure.

Tube Trouble

Q.—In a battery of three return tubular boilers 72 inches diameter, 16 feet long, each containing ninety 3½-inch tubes, 16 feet long, eight tubes in one of the boilers have pitted so badly that they have eaten through, and it will be necessary to replace them. These eight tubes all appear to be in one place. The balance of the tubes in this one boiler, and all the tubes in the other two boilers seem to be in first-class shape. The tubes in these three boilers were all taken from the same lot, were all alike so far as appearances go, were put in the boilers under the same conditions and operated under the same conditions. The feed water goes into the center of the boiler, as shown in the sketch. This boiler is used in a sawmill. In the summer it is used in connection with a heater; in the winter time the heater is not in use, but the water is supplied direct with an injector. The pitting, so far as we know, occurs all around the tubes. If possible we will secure some of the water used in this boiler and have it analyzed. In the meantime we will be glad if you can give us any information regarding this trouble. C. H. W.

A.—We believe that there were two conditions that affected the tubes and which promoted corrosion, namely: *corrosive feed water* and *laminated tubes*. Tubes having a rough or scaly surface are more easily attacked by the

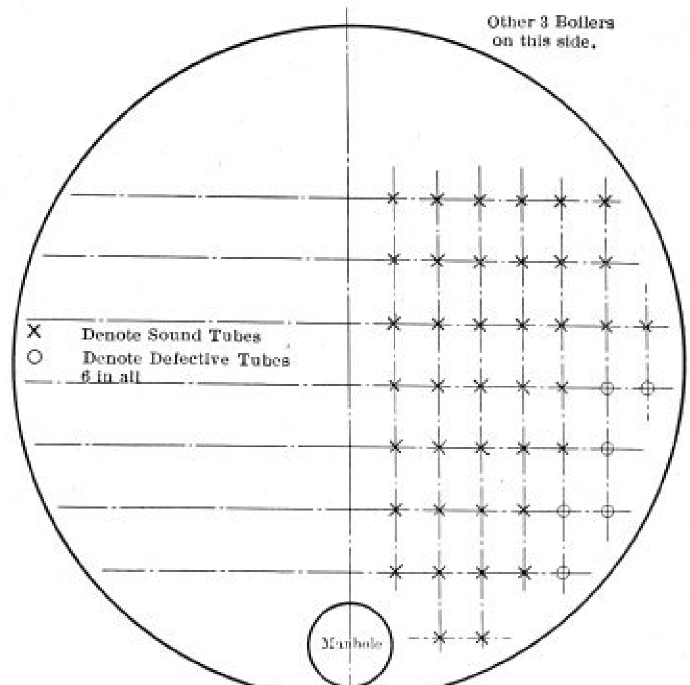


Fig. 1.—End View Showing Sound and Defective Tubes

corroding elements of the feed water than tubes having a smooth surface. We cannot state exactly where the trouble lies, and we therefore would advise that you have the feed water tested and also make a close examination of the tubes that have been found defective.

This question we are leaving open to our subscribers, who may be able to give some further information.

A drop of oil will often prevent a squeak, but it may take a gallon to stop its squeaking.

Letters from Practical Boiler Makers

This Department is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

The Selection of a Trade

The choice of a career is one of the most important decisions of any lifetime. Save only one—marriage—it is the most vital of all, and it may broadly be stated that only a limited number ever have the opportunity for re-consideration or a second choice.

The location of every individual in a career fitted to his special abilities is of paramount importance to a nation. All of a nation's available assets should be realized.

The State has gone the length of expert demonstration in agricultural matters, even to the cost of mobile equipment, to serve scattered districts. State technical advisers in industrial districts seem quite as important to the community as stimulation of good methods in agricultural pursuits. The results of such expenditure would certainly justify themselves.

It must be remembered that where choice is possible a boy's career is a matter of peaceful persuasion, in a domestic sense; or, more frequently, it is chosen for him by those having ties of natural affection—sorely strained at times between the desire of the boy and the decision of the parent.

The choice of the boy and his natural inclinations is often thwarted or restricted by those responsible for his upbringing. Wisdom is perhaps not to be calculated in terms of years, is the manner in which the boy regards the matter. To the credit of the normal boy, however, cleanliness is not so great an objective as sheer interest. It is his elders who insist most often upon a clean collar, for instance. Almost without exception, every lad has a natural leaning toward the use of tools; in fact, tools possess a fascination for practically all mankind, and any boy having seen mechanical work in operation hankers after manual dexterity.

The opportunity of a limited trial period to find whether desire and ability correspond in the boy would seem as desirable as compulsory education. The tendency in any locality where a particular industry is ready to hand is that the boy, without reflection, gravitates to its ranks, irrespective of fitness. There is indeed national utility in the suggestion that every lad, without exception, should learn at least the rudiments of a trade. Failing the ability of the parents to educate him beyond legal requirements, he should be drafted, for a period, where manual dexterity is to be acquired. The period might be two or three years, subsequent to which the decision might rest with the boy or his parents. Any industrial nation would be better governed if, without regard to social standing, every boy of the rising generation had actual experience of industrial conditions. Such practice might revise peculiar ideas current in high places and so lead to better understanding. Certainly present conditions of war work, without regard to class, are tending in this direction.

Were such a scheme socially accepted it would at least serve to bring to light the qualities of intelligence, physique, mentality and dexterity normally required of engineering workmen, and so lift the veil which secludes their activities from public print.

There is too much tendency in the case of people in comfortable circumstances to place their sons in genteel occupations, and it is difficult to persuade guardian or parent that a liberal trade is quite as important as a liberal education. Investment in either is likely to be equally fruitful. Anyone possessing both has an equipment for life's business second to none.

It is important not merely to attract candidates for the mechanical trades, but to select candidates most fitted for the trades—those who would find perennial interest in the most complex of all the modern industries from the practical side. In the struggle of the future in international trade, that country having the best brains correctly located is going to have a long pull and a great advantage over another nation whose methods are more haphazard. It is too late when impressionable youth has passed to convince those responsible in the matter. Most of us in the business were caught young, and many had to fight to be allowed to enter a business involving grime. If a man is to work for average pay, it is in all respects better that he find interest in his work. In suchwise he lives a fuller and more satisfactory life and his daily occupation is less wearisome.

The case for the independent State-paid technical adviser seems made out; it must be recognized that forethought is worth more than all after-regret. While a first class educational foundation is going to count anywhere, it is going to count most where similar equipment is least apparent. The genteel occupations find all rivals more or less similarly equipped, the competition keener, and the chance of success more remote.

In the mechanical trades there are opportunities unbounded, not so much for those who can afford lengthy academic training as for those whose money is limited but whose mental qualities are apparent. Few occupations offer the same ultimate chances of a successful career.

The choice between working as a clerk and as a mechanic has preponderating advantages with the latter. Assuming the pay as roughly equal, the mechanic has a fuller life, more intrinsic interest in his work, his independence is well known, which is an attitude few clerks can afford to adopt, and beyond this he has the respect of every first class man in the business.

It must be remembered that the skilled, trained, practical mechanic is the leaven in the loaf of industry. All the recent expansion by diluting with inferior, because untrained, labor has enhanced his importance and given prominence to his value. It was, considering all things, a mercy that specialization had not captured all the metal industries here. The enormous immediate expansion called for would have been impossible without the considerable quantity of skilled and trained practical men which are found available.

The notice which the mechanic has recently received is embarrassing in its novelty. Often he is a silent individual; indeed, industry as a whole is surprisingly inarticulate. Yet the rather grimy individuals classed by the uninitiated as "workmen" have frequently a surprising mentality and skill, comparable only to that of a doctor or other professional man. Indeed, it takes roughly about the same number of years to make either a medical practitioner or a skilled mechanic. The operating surgeon is a very close parallel case, since he is an anatomical mechanic, while the engineer workman performs operations of equal dexterity. However, no blood is shed in the latter work, although life and limb may frequently be in danger.

It is little realized that the 50,000 or so marine engineers afloat in the British mercantile marine are each and every one a skilled mechanic, because the qualifications laid down by the Board of Trade ensure a lengthy shop experience. It would astonish the general public to learn how many past captains of industry came from the same raw material. From James Watt down to the Wright brothers there are names held in universal respect whose work has entirely changed the face of the universe, and who had little more beginning than an apprenticeship at bench and machine. The two names cited carry the point. The work of James Watt started the industrial revolution, while not ten years ago the Wright brothers conquered the air to such purpose that men have become as birds in their flight. Scant recognition has been given to the question of the inherent merits of the mechanic whose work is everywhere and whose grimy imprint is written large over all modern effort.

It may be frankly stated that the nation having the greatest number of trained and skilled technical and practical men is going to prosper mechanically. It must be insisted upon that factory methods and specialized processes do not impart skill in the sense indicated. To pursue specialization to its logical outcome is to commit industrial suicide, and means must be found to create the future generation of practical and skilled men. Unless this is done without loss of time, it is certain that industry is going to be stultified, the class that brought it into being for the main part having ceased to exist; the direction will be in the hands of academically trained men without the supplementary manual experience. One of the direct causes of the immense expansion in national output has been that there existed a prejudice against too specific a specialization, hence the greater adaptability to novel conditions. It is true that specialized methods are in vogue, but the hands that direct and control the essential portion of the business are those of the skilled worker. Owing to the incidence of specialization, really first rate mechanics are growing scarcer. In the United States it has already become a serious problem, and serious consideration is being paid to the matter.

It must be remembered that the lower the type of labor employed, the higher the capital cost of the plant; the higher the type of labor, the less costly the machines and accessories. The two phases seem approaching a point where in some instances they can be equated and a resumption of simpler and more highly skilled processes be made equally economical. The tendency towards complexity seems to have approached its zenith, and it is possible that we are breeding inferior, unadaptable industrial labor where we might almost as easily produce labor of a higher type. If this be the case, it is for consideration as to which is the best in the national interest, and it is hoped that the issues here raised will bear some fruit. There are two products from any industry—one, the article made; the other, the men who produce it. The economy in the first appeals commercially; the production of the latter has a national bearing of vital moment to the world at large.

Real skill in the use of tools has a peculiar satisfaction to the possessor. It enlarges his mental horizon. There is really little difference between the crafts termed artistic and those practiced by the skilled mechanic. In essentials they are similar, and the work of past craftsmen is treasured and thought highly of to-day.

It is infinitely better to produce skilled men than to obtain a nation of operatives hired to obey and not to think.

London, England. A. L. HAAS.

Putting in Arch Tubes

A few weeks ago I got a job putting in a set of arch tubes in a Mallett type engine. Since the shop was small, all the work of reaming had to be done by hand. After laying all the holes off 2⅞ inches in diameter, they were burnt out with an oxy-acetylene weld cutting torch. As there was no reamers of that large size in the shop, I had to grind off a couple of old taps to use for reamers. I reamed and tapped the outside holes first, then went inside and reamed the holes out in there.

I then made a template out of a piece of ⅜-inch square iron, to which I bent the tubes; a gage, made from a board 2 by 8 inches, served to hold the tubes in place while rolling them. After the tubes were bent by use of the improvised template and annealed, I cut them the proper length, placed them in the gage and rolled them. A test of 265 pounds water pressure was applied after the job was completed. Not a leak appeared.

Denver, Col. ARTHUR MALET.

Two Welding Kinks

I have found a very good method for taking care of expansion and contraction when welding cracks in side sheets. It is to heat the sheet on each side of the weld, after the weld is finished, first allowing the weld to cool.

A good method for welding a patch in a firebox is to

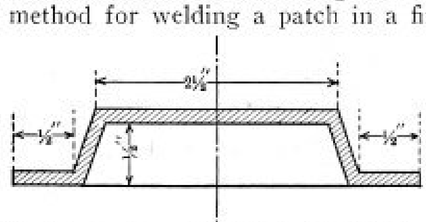


Fig. 1.—Section of Patch Used in Welding

make a box the shape of the patch, about ½ inch deep and ½ inch from the edge, all around—see sketch. I welded a patch yesterday like the above, 4 inches by 13 inches, and the inspector was well pleased with it. I was only six hours doing the job.

Albany, Ala. R. G. McCLURE.

Position Drilling Versus Separate Drilling

Position drilling of boilers seems to be the topic of the day. There are so many opinions on this subject and that of riveting that one sometimes wonders if there is such a thing as a perfect boiler.

In fact, I have made up my mind that the way a man learns is the way he thinks. For instance, Mr. Haas, of London, England, maintains that a boiler which is not position drilled is not worthy of the name *boiler*. This gentleman seems to have full sway as to his opinions on this subject. No doubt his articles have great influence on those who read THE BOILER MAKER.

Position drilled work may be modern and Mr. Haas may maintain that all the large shops follow that system, but I wish to know why a boiler plate must be position drilled to be acceptable on first-class work.

Authorities all say that a punched hole is not acceptable on high-class boiler work. Of course, we all know a punched hole is not to be considered on first-class boiler construction. What is required, then, is a *drilled* hole; not necessarily a *position drilled* hole. One that is drilled on the flat would serve as well, just so it is a drilled hole. Why insist that a plate planed on the flat must be position drilled to be first class? Are not the possibilities of fractures from the edge of the plate in rolling the same as they would be if the holes were drilled on the flat? Mr. Haas' interpretation of this theory is contrary to itself, since the edge of the plate in all cases is planed on the flat before rolling. And yet he maintains that this same steel which is planed before rolling cannot be drilled before rolling and still be first class. Certain inspectors disagree with Mr. Haas, inasmuch as there is more than one shop on the Atlantic seaboard to which they are giving the same efficiency on boiler plate drilled before bending as that which is position drilled. The following are the British Board of Trade Rules on the drilling of holes in boilers:

"When boiler shall have been drilled in place, 4.5 may be used as a factor of safety in calculating the working pressure. And when the above conditions are not complied with, the following scale should be added to the factor of safety according to the circumstances in each case:

LONGITUDINAL SEAMS

*A** .... .15 to be added if all holes are fair and good but drilled out of place after bending.

*B** .... .3 to be added if the holes are fair and good but drilled before bending.

CIRCUMFERENTIAL SEAMS

*I** .... .1 to be added if the holes are fair and good but drilled out of place after bending

*J** .... .15 to be added if the holes are fair and good but drilled before bending.

* If the holes are to be reamed or bored out in place, the case should be submitted to the board as to the reduction or omission of *A, B, I, J,* as heretofore."

To explain the expression "omission of *A, B, I, J,*" they would consider it the same as position drilled. This shows clearly they consider position drilling before bending all right in cases where the boiler has been position reamed.

Of course, the finished product must be the same regarding the holes which should be fair and good and cylindrical. Owing to the fact that in this case the mean diameter remains on the center, making the holes small on the inside and large on the outside. When two plates are matched together, the inside of one ring and the outside of another ring would leave a small shoulder. This would not do on first class work. To eliminate this defect, the practice is to drill the holes one-eighth of an inch under size and reamed to full size after assembling the boiler.

Regarding the comparison of the cost of the two methods, position drilling will prove to be the more expensive. On the one hand, the modern position drill, such as is used in the large shops manufacturing Scotch marine boilers, sells at about $50,000, occupies a space forty feet square, can drill but two holes at once, and requires two operators. Consider the interest on the $50,000, floor space rental, and the labor cost of two operators. On the other hand, drills for flat work, commonly known as wall drills, which have a radius up to ten feet, can drill one hole at a time, and cost $750. To drill two holes at once, as a modern position drill would handle the work, would require two wall drills, making the total cost of machines $1,500. The floor space would be the width and length of the boiler plate, which at most would be twelve feet by thirty feet.

After considering the facts of practical practice, it seems that what is required on the subject of drilled holes is more or less the application of common horse sense. It should be realized that in the United States to-day there is a greater demand for marine boilers than there is for ships. Men in advisory capacities who are responsible for the equipment of new marine boiler shops are ordering the new type of $50,000 position drills to accomplish this work. These drills cannot be delivered even to the government in less than ten months, which means a ten-months' delay in starting the drilling in the boiler shop. On the other hand, if the smaller wall type of drill were specified, they could be made in any small machine shop in two weeks, and delivered in one month.

With the above proof, I think the reader will agree with me that position drilled boilers do not show to advantage at this time either in cost or quality of work.

St. Louis, Mo. LAWRENCE MCCARTHY.

Chart for Determining Pressures for Flues

Paragraph 241 of the A. S. M. E. boiler code reads as follows:

"*Circular Flues.*—The maximum allowable working pressure for seamless or welded flues more than 5 inches in diameter and up to and including 18 inches in diameter

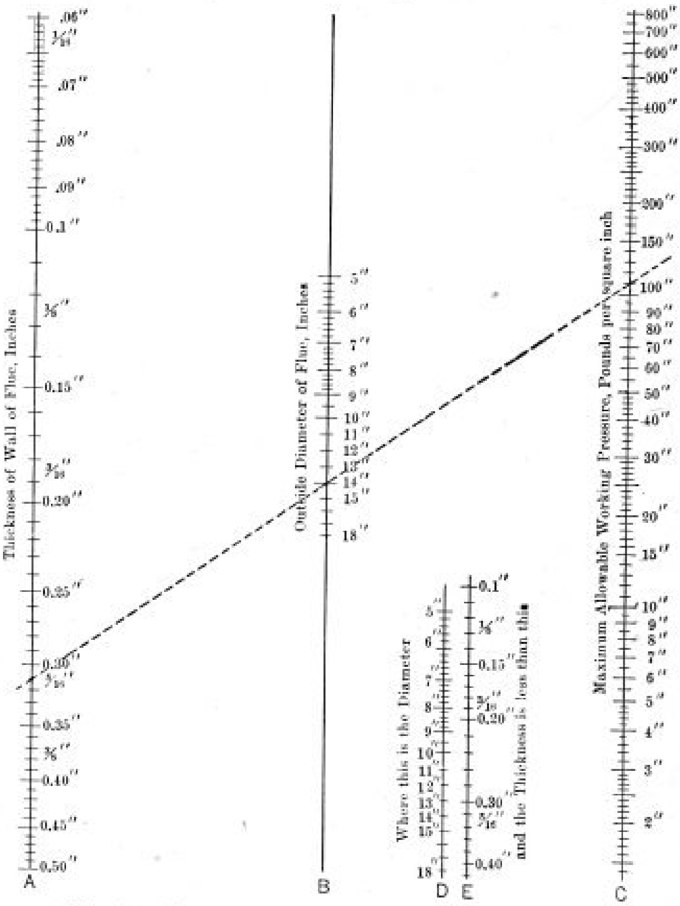


Fig. 1.—Chart for Determining Pressures for Flues

shall be determined by one or the other of the following formulae:

(a) Where the thickness of the wall is less than 0.023 times the diameter,

$$P = \frac{10{,}000{,}000 \times T^3}{D^3}.$$

P = maximum allowable working pressure pound per square inch

D = outside diameter of flue in inches

T = thickness of wall of flue in inches."

Since cubes are rather difficult to work with, even when a slide rule is used, I have developed this chart scheme to eliminate all figuring. By simply laying a straightedge across the chart, the value P is immediately found in column C.

For example, the A. S. M. E. code gives this problem: "Given a flue 14 inches in diameter and 5/16 inch thickness."

First find the diameter (14 inches) in column D. Glance across to column E, which shows that 5/16 inch is less than 0.023 times the diameter. That being the case, we can now safely go ahead with the problem.

Connect the thickness (column A) with the diameter (column B) and column C gives the pressure—110 pounds per square inch.

If desired, of course, the process is easily reversed. The chart will enable one to quickly determine the proper flue thickness or diameter. N. G. NEAR.

Tool for Drilling in Corners and at Angles

Take a piece of ⅜-inch boiler iron 12 inches square. Measure over 3½ inches on one end and make a line to flange on. The remainder is to be cut in the shape of a semicircle. After all shearing is done, flange the pieces marked for flanging at right angles to the semicircle. Make a line in the center of the piece flanged and lay off three holes 15/16 of an inch in diameter, one near each end and one in the center.

Measure over 2 inches in the center from the flange on the piece cut in a semicircle and drill a hole 15/16 of an inch in diameter.

Measure in on the semicircle 1¼ inches and make a line around the edge of the semicircle. Lay off 13/16-inch holes about 1½ or 2 inches apart. Now take a piece of

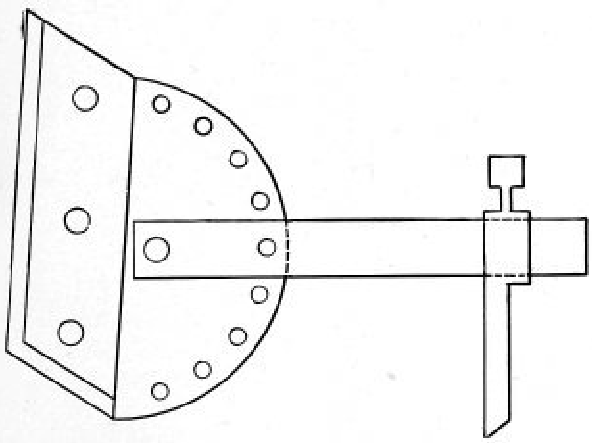


Fig. 1.—Tool for Difficult Drilling

1½-inch round iron 24 inches long and slot out one end so that it will slip over the semicircle and move from one end to the other. Near the end slotted out, drill a 15/16-inch hole in line with the hole drilled in the semicircle near the flange. Also drill a hole so that it will come in line with the holes along the edge of the semicircle.

Rivet the piece of iron to the semicircle through the hole near the flange, leaving it loose enough to turn freely. By placing a ¾-inch bolt through the iron and any of the holes near the edge of the semicircle this is held stationary at any angle desired.

After attaching a movable arm, that will slide over the piece of iron easily, with a ⅝ or ½-inch set screw in it to hold it in place when set, you have a very handy tool for drilling in corners or in close places. The tool may be used when drilling at any desired angle.

Denver, Col. ARTHUR MALET.

Spherical Boiler Heads

While many authorities raise objection to and will not permit the use of a dished convex boiler end, and some specifications explicitly prohibit this design, the objection is withdrawn where such an end is half a complete sphere. At all events, a well-known British vertical boiler has the upper end of the shell made in this form. Since the design in question is in universal employment and is approved of by all the insurance companies and marine authorities in the United Kingdom, the design may be safely said to receive endorsement from all quarters.

The calculations necessary for the determination of strength in a cylindrical shell are well known and involve quite elementary reasoning and formulae. On the other hand, the mathematics needed for a spherical shape are more obscure to the ordinary practical mind. The usual

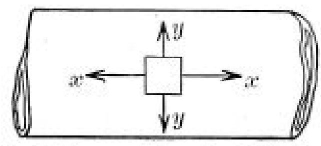


Fig. 1.—Diagram of Longitudinal Stresses

practice is to make the spherical portion of the shell with the same thickness of plate as the cylindrical portion, and to a practical man such a procedure seems only common sense. If any doubt exists as to the correct thickness 1/16 inch is added to the plate to salve the conscience of the designer and act as the factor of ignorance in the calculations. Such a procedure appeared to the writer to be contrary to known fact. Common sense seems to point to the conclusion that the sphere is the shape best fitted to resist pressure, and consequently could be safely made thinner than the remainder of the shell.

To settle doubt on the matter, the question was submitted to a friend with the academic advantage of an engineering degree. The substance of his communication on the subject is as follows:

Considering the question about which we were talking recently, it appears that the plates on the spherical dome

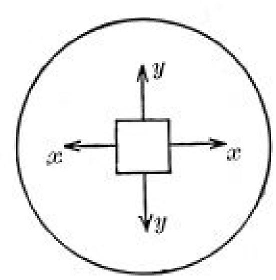


Fig. 2.—Diagram of Spherical Stresses

of a vertical boiler should be three-sevenths of the thickness of the plates in the cylindrical portion.

I think there can be little doubt that the stress is nearly uniform all over the hemispherical portion. It is obvious that the stress is uniform in a complete sphere and therefore it must be so in the hemisphere, provided no strain is applied due to a difference in expansion between the circumferential edges of the hemisphere and the cylindrical portion to which it is riveted.

Approaching the problem from this point of view, namely, that the cylindrical and the hemispherical circumference should enlarge to an equal extent under pressure, the above result is obtained, as follows:

Where

S = strain or expansion
E = modulus of elasticity
N = Poissons ratio = 4
F = stress.

In the sphere

$$S_x = S_y$$
$$= \frac{f_x}{E} - \frac{f_y}{En} = \frac{3}{4}\,\frac{f_x}{E}.$$

In the case of the cylinder, it is easily proved and is common knowledge that the stress (f_y) on a longitudinal section xx is one-half the stress (f_x) on a circumferential section yy. Using the same symbols as before,

$$S_y = \frac{f_y}{E} - \frac{f_x}{En}$$
$$= \frac{f_y}{E} - \frac{f_y}{2En}$$
$$= \tfrac{7}{8}\,\frac{f_y}{E},$$

so that

$$\frac{\text{Maximum strain in sphere}}{\text{Maximum strain in shell}} = \frac{\tfrac{3}{4}\,\frac{f_x}{E}}{\tfrac{7}{8}\,\frac{f_y}{E}}$$

(as mentioned about $f_x = 2f_y$)
$= 3/7$.

The results are so far from being usual practice that confirmation of the foregoing seems desirable. The matter has importance no less than interest, and, while the reasoning seems perfectly sound, the result should not be adopted until definitely checked from other quarters.

If accurate, it means that to use plates of equal thickness with the cylindrical portion of shell results in the spherical end being far the strongest portion of the boiler. Against this may be set the fact that few boilers are of suitable size for the end to be in one plate, and where two or more plates are involved the percentage of strength of a seam difficult to calculate also would qualify the results.

Until the facts of the case are established beyond dispute by reason of actual experiment, it would be wiser to follow usual practice in the matter.

It is submitted, however, that, provided there is no flaw in the reasoning, a prima facie case is made out for experimental determination when the trade generally will benefit by the results obtained.

It seems a first rate opportunity for one of the academic faculties who would find here a practical problem to tackle, whose results would possess immediate value and give us definite data upon an obscure but important question.

Observer.

The Price of Safety

Safety cannot be bought; there is no market where it is for sale; no "ambassador of commerce" "represents" altruistic safety. It is only to be obtained at the price of eternal vigilance; accident has to be foreseen, forestalled and prevented in advance. Although some safety is dearly purchased, all but one percent of untoward happenings may be eliminated by caution, care, skill and foresight.

There are times when risk must be assumed and hazard taken by deliberate choice, to do otherwise were cowardly and unmanly; but to assume risk where the same can be eliminated is pure stupidity, for which pardon cannot be granted.

Honor is rightly paid where risk is taken to save human life, for high and noble principles, for the sake of nationality or patriotism, or definite conviction. Mankind has from the earliest days paid homage to bravery. The essential feature of such action is that it is unselfish—the individual from choice assuming risk on behalf of another. Such assumption lends more than dignity, and no honor can equal the supreme sacrifice in such a big cause.

The responsibility assumed by every member of a mechanical trade is considerable, his default in workmanship alone must some time or other be discovered. There are risks enough in the uncertainty of material, possible wrong use, oversight or deliberate intention subsequent to manufacture. Realization such as this should impose greater restraint upon the mechanic who often does not see that he is the first link in a long chain of subsequent events. If the first link be faulty or weak, those who later are forced to depend upon his conscience and honesty suffer inexcusable wrong because their trust is misplaced. Unlike an anatomical mechanic, who is consulted after the damage is evident, it is the privilege of the mechanic to ensure that his product is originally sound in wind and limb; later he may have to prescribe remedies for wear or maltreatment, but if the patient is initially sound there is less regret than if it is diseased or imperfect at the start.

It was a competent man who, when complaining of the men under his charge, stating that they were unreliable, took exception to the reply that as responsible chief it was his function to play Providence to his men. Later on he agreed that the statement was just; both the management and workman relied upon his foresight, clear vision, and mental acumen to forestall mistakes, plan ahead and see further than the men under his charge.

Upon each unit in production is placed responsibility in direct relation to that particular job; but all are responsible, however limited their post. Only by the co-operation of specialized units can a productive whole be maintained. To be safe is more than worth while; regret is never pleasant and it always lets someone else down. This is the essential point at issue—if interdependence rules, default of one causes mischief to many. The price of being safe is negligible beside the total costs of failure. This is so in every instance where workmanship is involved.

There are numerous firms whose reputation is unassailable although rivals quote lower prices; the reliable firm's business is safe because it *is* reliable. In every case where public risk is involved or default involves large numbers of others, it is less a question of price than one of quality. It has even been necessary for the state itself to regulate some trades in the interests of public safety.

Although the price of safety is largely a matter of the conscience of the individual workman, conjointly with the responsible executives and the management in every mechanical connection, nowhere is it so much an individual matter as in the case of boilers and their makers—whether manual, mental, or commercial. The price of safety is so low in terms of manufacture and the price of casualty so high in terms of failure that price, as such—skinning or skimping to cheapen quality—is entirely negligible beside the greater cost of risk.

H.

Obituary

Alfred R. Jones, president of Hilles and Jones Company, Wilmington, Del., maker of machine tools for working plates, bars and structural shapes, died October 9, aged 55 years, after an illness of five days with Spanish influenza. Mr. Jones' connection with the company began in 1887 as bookkeeper. Later he became treasurer, and upon the retirement in 1902 of his uncle, Henry C. Jones, one of the founders of the business, became president, which office he filled to the time of his death.

Captain L. H. Bertsch, vice-president of Bertsch and Company, Cambridge, Ind., who has been serving in the Ordnance Department, Cannon Division, died in Washington, D. C., on October 13.

Selected Boiler Patents

Compiled by

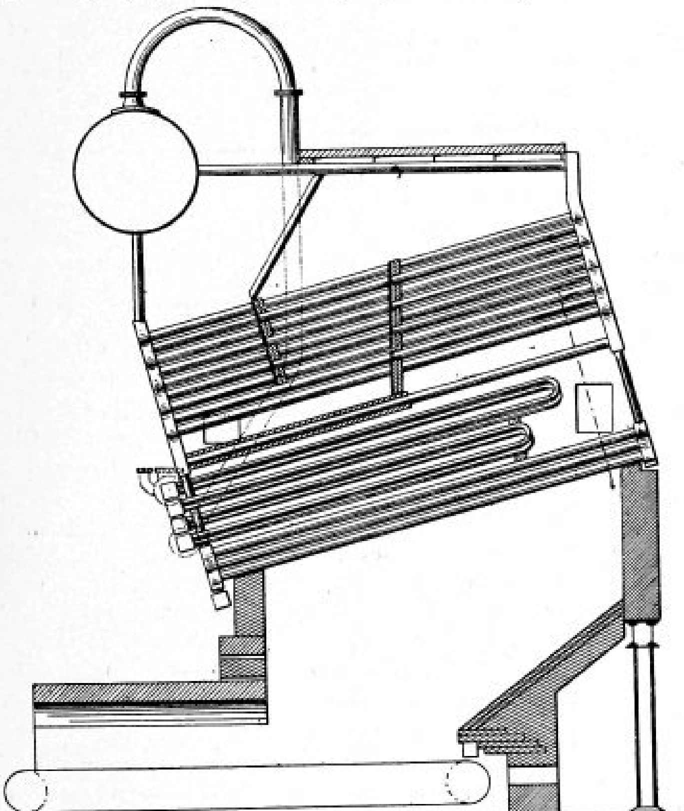
GEORGE A. HUTCHINSON, ESQ., Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchison.

1,274,327. WATERTUBE BOILER. ARTHUR D. PRATT, OF NEW YORK, N. Y., ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, N. J., A CORPORATION OF NEW JERSEY.

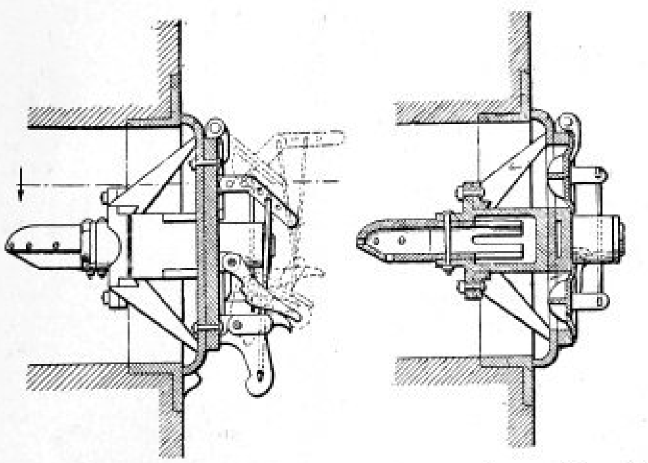
Claim 1.—A watertube boiler having horizontally extending tubes connected to upper and lower headers, said tubes being divided into separated groups, vertically extending nipples connecting the headers of



the groups of tubes, and a superheater having horizontal headers at different levels in front of the lower boiler headers and U-shaped tubes extending from the headers into the space between the groups of watertubes, said U-shaped tubes embracing the nipples between which they extend and causing a parallel flow of the steam through the tubes from the header box at one level to the header box at another level. Two claims.

1,275,339. SMOKE ABATOR. LEONIDAS D. WEST, OF DENVER, COL.

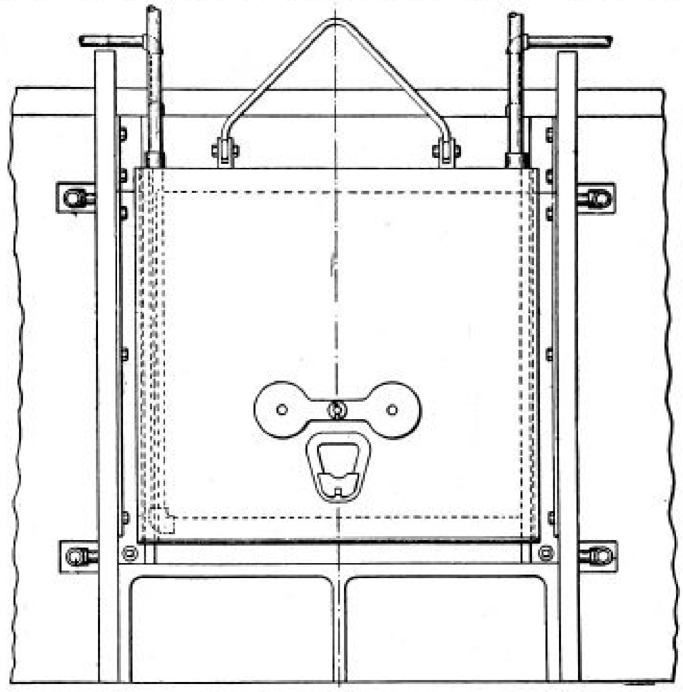
Claim 1.—The combination with a furnace coaling door having at its inner side an air heater for continuously supplying hot air to the firebox



and having adjacent said heater a dampered air inlet for supplying additional air after coaling; of plurlity of webs extending at an angle from said heater to said door and disposed in the path of the incoming air from said inlet. Ten claims.

1,275,943. DOOR FRAME AND DOOR STRUCTURE FOR FURNACES. LUTHER L. KNOX, OF BELLEVUE, PA., ASSIGNOR TO BLAW-KNOX COMPANY, PITTSBURG, PA., A CORPORATION OF NEW JERSEY.

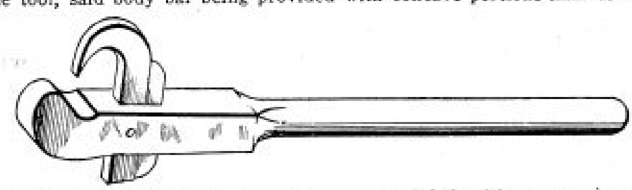
Claim 1.—The combination with a door frame having vertical water cooled members, each of which is formed with a guiding offset at the



inner corner of its outer side, of a hollow water cooled door having its end walls extended inwardly in the edgewise plane of said walls and beyond its seating faces, said extensions co-acting with said offsets to form guiding means for the door, the door and door frame having abutting seating portions adjacent to the end-wall guiding extensions; substantially as described. Three claims.

1,273,831. BOILER-TUBE EXTRACTOR. GARRETT C. DEE, OF HARTFORD CITY, IND.

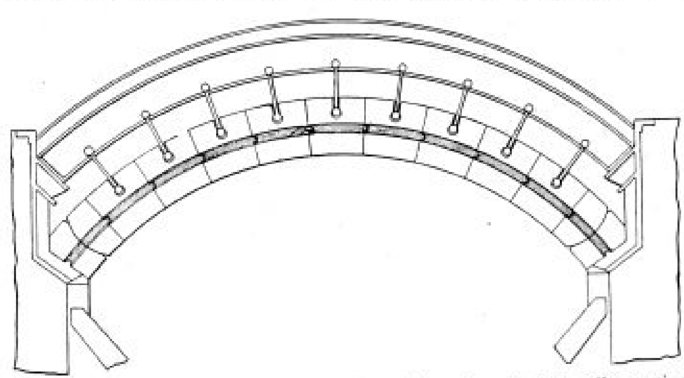
Claim 1.—In a boiler-tube extracting tool, a body bar, one end of said body bar shaped to form a hand grip, a head formed upon the other end of said body bar, said head being curved for snugly fitting the interior of a boiler tube and acting as a fulcrum for pivotal movement of the tool, said body bar being provided with concave portions immediately



in the rear of said head, said body bar provided with an opening extending therethrough, a boiler tube engaging jaw having a shank, said shank extending through said opening and being pivotally connected to said body bar, said jaw provided with an inserting edge, and a wedge for driving into said opening against the rear edge of said jaw for forcing inserting edge between a boiler tube bead and a boiler plate. Four claims.

1,275,709. ARCH CONSTRUCTION FOR FURNACES. WILLIAM LEMB, OF BROOKLYN, N. Y.

Claim 1.—In a boiler furnace, the combination with a pair of opposed supporting walls, of a series of parallel spaced beams flanged at the lower edge and extending between the walls, sets of hangers between the beams, each comprising a flat web with a rib on the top and bottom



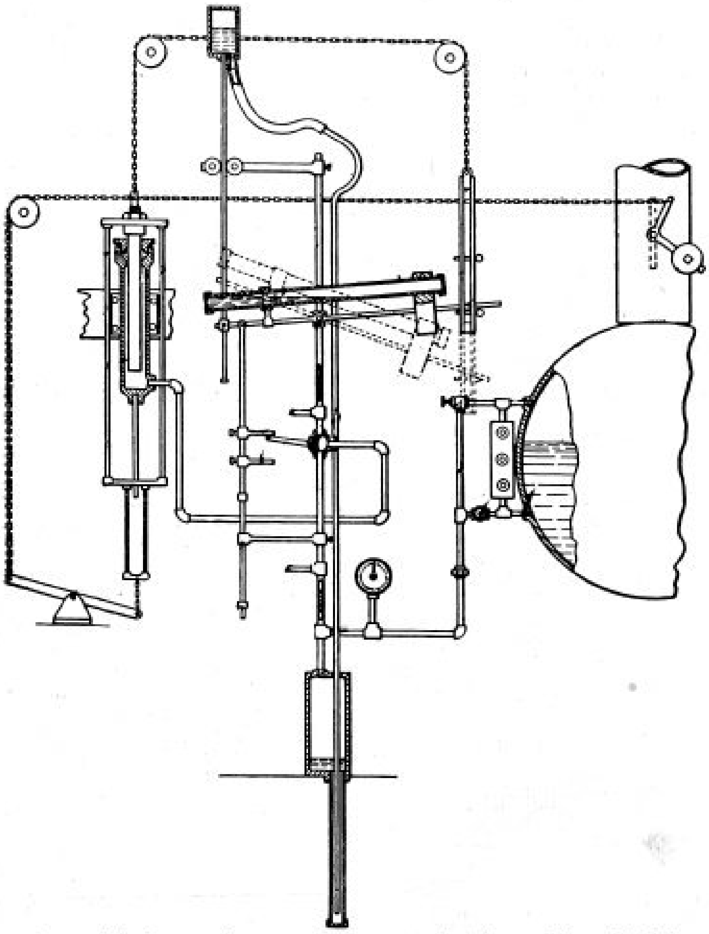
edge projecting beyond the web at the ends, said projecting ribs resting on the beam flanges whereby the hangers are suspended in alining rows transverse to the beams, and blocks each having a slot in the upper edge that is enlarged in the block whereby each block may slide on the lower rib of the hanger and be suspended thereby to form a closed top wall for the furnace. Nine claims.

1,264,569. FLEXIBLE STAYBOLT CONNECTION FOR BOILERS. BENJAMIN E. D. STAFFORD, OF PITTSBURGH, PA., ASSIGNOR TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PA.

Claim 1.—In staybolt connections for boilers, the combination of a boiler plate having a conical opening, and a conical sleeve mounted in said opening and supported on the conical wall of the same, the said sleeve being secured to the plate by welding the parts in the plane of the outer face of the plate. Two claims.

1,276,003. BOILER PRESSURE REGULATOR. ISAAC A. BACKLUND, OF CHICAGO, ILL., ASSIGNOR TO CARRICK ENGINEERING COMPANY, OF CHICAGO, ILL.

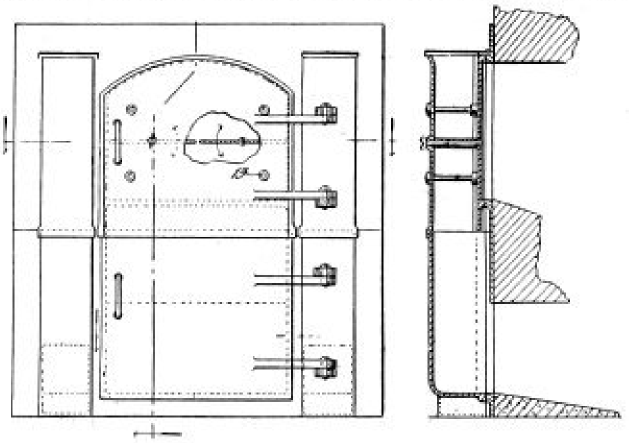
Claim 1.—In apparatus of the class described, a steam boiler, a draft-regulating device, a hydraulic cylinder, a plunger therefor, water pipe connections, a valve therefor, a lever operatively connected to said



valve and influenced by steam pressures obtaining within said boiler whereby water is caused to be admitted to or discharged from the cylinder to actuate said plunger, a member containing liquid operating with said lever, and a slotted bar operatively connected to said plunger and engageable with the lever and co-operating with the weight of the liquid within said member to accelerate the action of the valve in controlling the flow of water to and from said cylinder. Eight claims.

1,275,650. FURNACE DOOR. JOHN BORGE, OF NEW YORK, N. Y., ASSIGNOR TO BORGE INCINERATOR CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

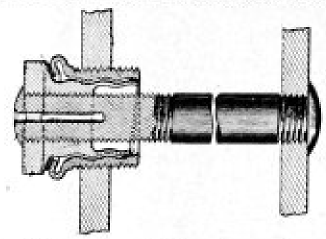
Claim.—In a device of the class described, a furnace having ash pit and fire box openings, a door in two sections, the upper section covering the fire box opening, the lower section covering the ash pit opening, and



the upper section overlapping the lower section, a rear plate secured to the upper section and spaced therefrom to form an air passage between said upper section of the door and said rear plate, means for regulating the air flow through said passage, said air passage being open to the atmosphere at its upper end and extending downwardly between the lower section of the door and the front wall of the furnace to the ash pit opening. One claim.

1,275,944. STAYBOLT FOR BOILERS. HARRY ANTHONY LACERDA, OF SCHENECTADY, N. Y., ASSIGNOR TO FLANNERY BOLT COMPANY, OF SCHENECTADY, N. Y.

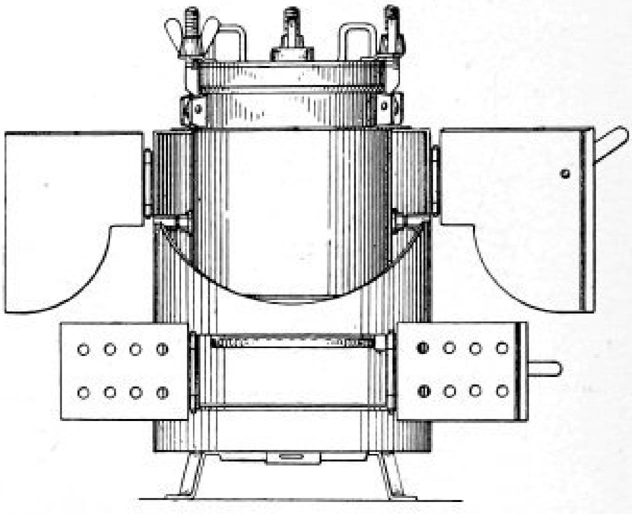
Claim 1.—A staybolt for boilers comprising a bolt, a nut secured to



the outer end of the bolt, and a tubular plug, the nut and plug having intermeshing coarse threads which permit of a limited movement of the nut and plug relative to each other. Six claims.

1,275,596. BOILER. LAWRENCE PODLASEK, OF BERLIN, CONN.

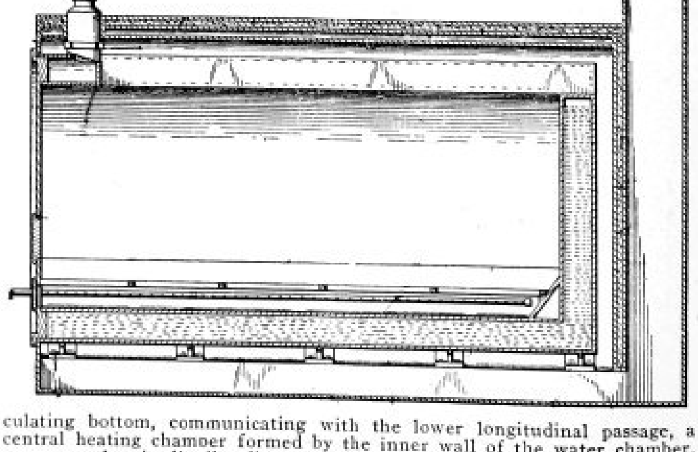
Claim 1.—A device of the class described comprising a stove having a cut-away front portion and an open top, an inwardly projecting rim at the top of the stove, swinging doors carried by the stove for the said cut-away portion arranged with rim sections forming a continuation of the



rim of the stove when the doors are closed, inwardly projecting opposite sockets carried by the stove adjacent the cut-away portion, a container adapted for arrangement within said rim oppositely projecting axles upon the container removably journaled in the said sockets, a rim upon said container adapted for overlying said stove top rim when the container is arranged upright. Two claims.

1,274,759. STEAM BOILER. TRUMAN J. PARKER, OF DALLAS, TEXAS.

Claim.—A steam boiler comprising an outer cylindrical casing, a lower longitudinally extending passage projecting from and communicating with the interior of the casing at the bottom thereof, a vertically disposed outlet flue communicating with one end of said passage, a water chamber formed of inner and outer spaced walls arranged concentrically with and spaced from the inner wall of the casing to provide a heat cir-



culating bottom, communicating with the lower longitudinal passage, a central heating chamber formed by the inner wall of the water chamber, an upper longitudinally disposed passage extending through the upper portion of the water chamber to establish communication betwen the heating chamber and the heat circulating chamber and a vertically disposed passage formed by spacing the rear wall of the water chamber from the rear wall of the casing for establishing communication between the heating chamber and the flue through the upper longitudinally disposed passage. One claim.

THE BOILER MAKER

DECEMBER, 1918

Fig. 1.—Showing Interior of the Boiler Shop of Marshall Sons & Company, Gainsborough, England

Boiler Making in an English Shop

Hopwood, Cornish, Lancashire and Britannia Types of Boilers—Position Drilling to Produce Results—Combustion Chamber Crown

BY A. L. HAAS

With the close of the present year the firm of Marshall Sons & Company, Ltd., Gainsborough, England, completes three score and ten years of mechanical service. It was exactly seventy years ago that the founder of the business took over an already existing small millwright and general engineering concern. To-day finds this concern covering 45 acres of ground and employing upwards of 5,000 workmen. There is reason for this steady and continuous progress. It may be found in the almost unique reputation Marshall's enjoys as a conservative concern, and rightly so, as to workmanship, that was a pioneer in raising standards. The products of the organization comprise steam engines, up to 2,000 horsepower; oil engines, up to 500 horsepower; steam rollers; portable and semi-portable engines; tractors, threshing, sawing, grinding, and other agricultural machinery. One out-of-the-way activity in which Marshall's is the leading company is that of machinery for tea preparation. The firm has extensive business connections in this respect in the Far East, although Marshall products as a whole are well known all over the world.

The writer has always been insistent upon the need and importance of high-grade workmanship in boiler making. For several reasons he selected Messrs. Marshall as a typical high-grade English boiler works about which to write. These are that their boiler business is of considerable size, they are a contract shop whose work is not confined to a

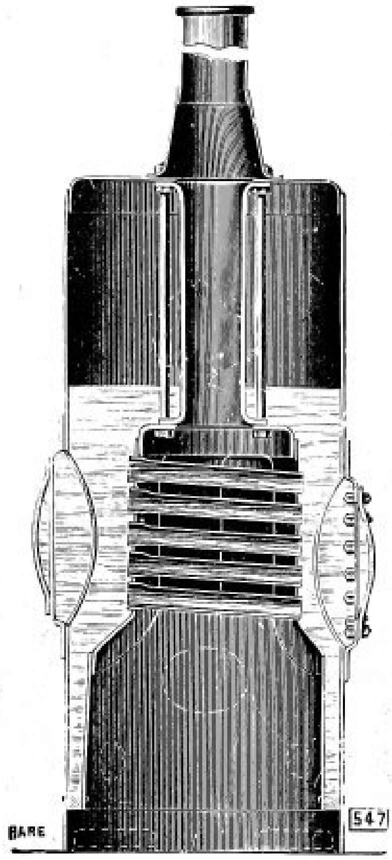


Fig. 2.—Sectional View of the Hopwood Watertube Boiler

single specialty, they were pioneers in improving the quality of workmanship, especially in locomotive multi-tubular and allied types, and the whole industry in England is to some extent in their debt in this particular. From personal experience and the unanimous opinion of experts

Fig. 3.—View Showing Position Drilling

whose opinions he values, the writer considers that the finish and workmanship turned out at Gainsborough are unexcelled.

Reputation Built on Good Workmanship

To the discriminating mechanical intelligence a Marshall boiler is a thing of beauty; it is just as good as a boiler can be made, and nothing whatever is spared to maintain the reputation of the firm. Locomotive-type boilers sold in 1861 are still in service under by no means the best conditions of operation.

The firm's boiler-making business comprises a large and very well-equipped works occupying 170,000 square feet of

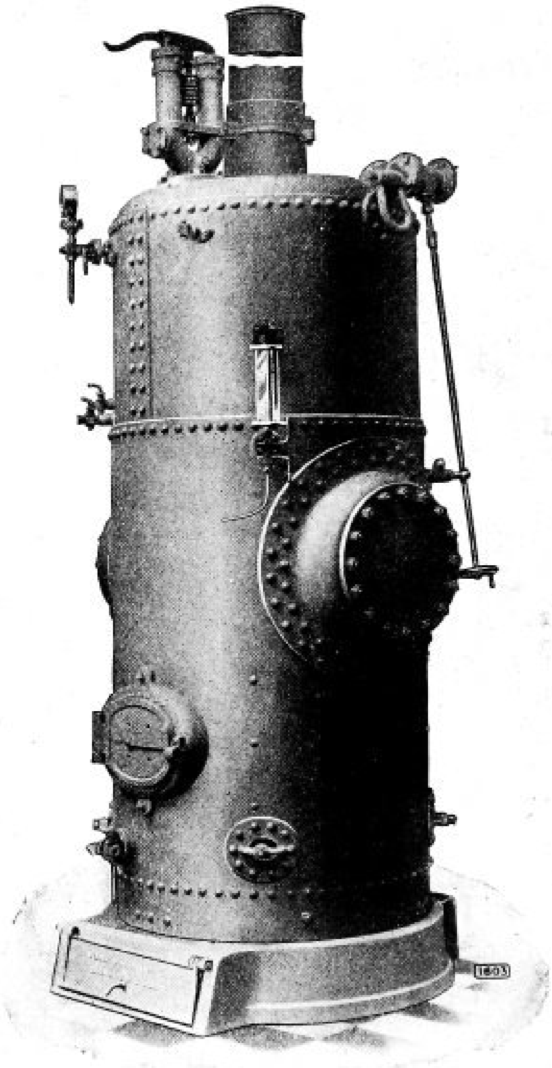


Fig. 4.—Exterior View of the Vertical Watertube Boiler

floor. The average weekly output exceeds fifty boilers of assorted types, and while a large proportion of the steam plant marketed is complete with boilers, a considerable proportion of the boiler output is sold separately as boilers only.

The normal vertical cross-tube boiler is usually the most finished of any type; the contrast between such a boiler as turned out at Gainsborough and the ordinary article of commerce is remarkable, for no other word will describe the difference.

Regular Lines Made by the Firm

The regular lines made by the firm comprise Cornish, Lancashire, locomotive, vertical and watertube, so that their produce covers a very wide range. The Cornish multi-tubular is a specialty, while a variant of the locomotive type known as the Britannia is another; their specialty in vertical boilers is a watertube type known as the Hopwood. While large numbers of these special types are always in progress, the regular lines mentioned above are quite as numerous.

The resources and equipment of the firm represent the most modern obtainable, and include a laboratory for material testing and selection, a rather noteworthy feature in association with a boiler works.

The Britannia boiler is a variant of the usual locomotive design, which has a cylindrical combustion chamber and cylindrical shell to correspond. Its design was influenced by the need for a colonial type of boiler easily transported which would burn wood fuel and contend successfully with impure and muddy feed water.

By courtesy of Messrs. Marshall, the writer is able to illustrate some of the foregoing types and, although never at any time connected with the firm in any way, he is willing to have English boiler making judged by their product.

A side issue which more than any other consideration decided me to select them as representative was the fact that wherever the writer came into personal contact with a Marshall-trained boiler maker in responsible charge elsewhere, I was more than favorably impressed by the standards of workmanship introduced and the evident capacity of the man, due to his upbringing in the Marshall atmosphere.

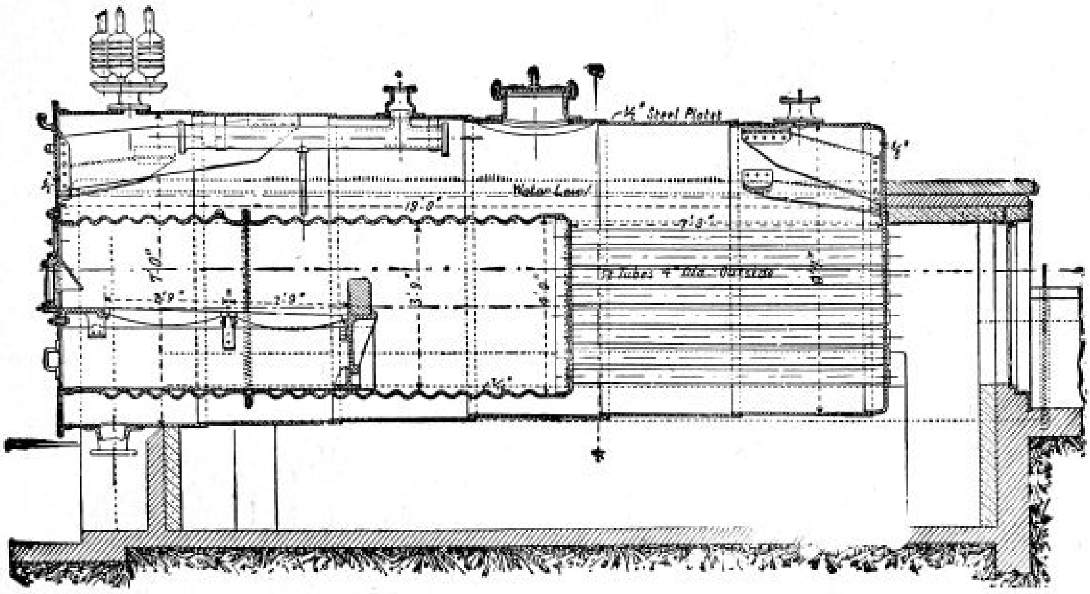


Fig. 5.—Special Design of Boiler to Facilitate Scaling

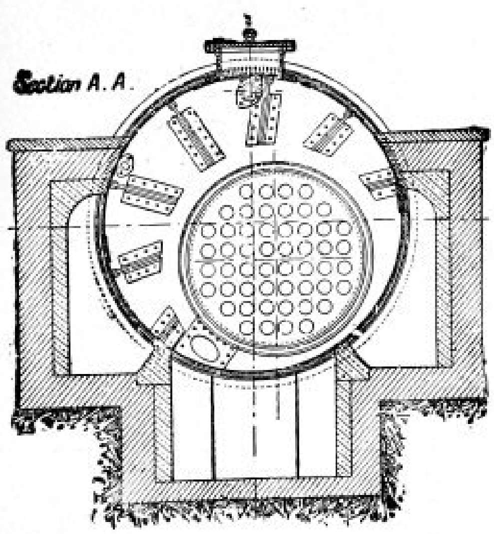


Fig. 6.—Section of Boiler Shown in Fig. 5

SHOP CONDITIONS EXCELLENT

The three interior views of bays in the boiler shop speak for themselves. The good light and lifting facilities and the variety of boilers in all stages of progress will be of interest to any practical man. The photographs if closely examined bear out the quality of workmanship, although much will be lost in reproduction. Position drilling is shown in the foreground of Fig. 3. Vertical water-tube boilers in various stages of construction are in the center of the picture.

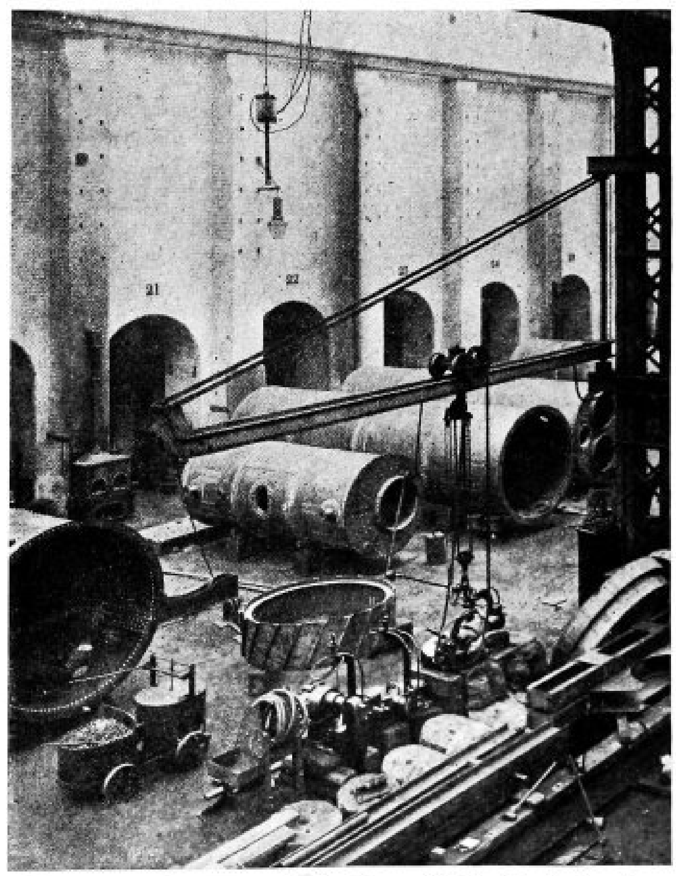


Fig. 7.—Another View of the Shop, Which Emphasizes the Excellent Lighting

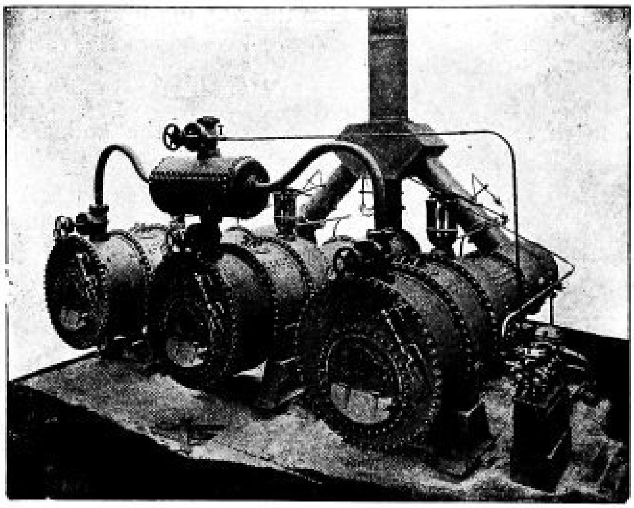


Fig. 8.—Battery of Britannia Boilers

While, owing to the depletion of staff and other factors of the present situation, it was impossible to illustrate special types for special ends fully, the special vertical watertube boiler shown in Figs. 2 and 4, giving exterior views and sectional elevation, differs so much from normal design that unusual interest is lent to the type. Regular sizes are from 2 feet 3 inches diameter by 5 feet 6 inches length to 6 feet diameter, 13 feet high in eleven graduated sizes.

Boilers Exported Knocked Down

Special interest attaches to Fig. 8, which shows a battery of three Britannia boilers erected complete. The usual design is, of course, riveted, but for ease of foreign transport across rough country they are made in rings or sections with bolted joints; the only trouble at destination is expanding the tubes in position, a job which need not necessitate the services of a skilled boiler maker, but which can be done by the engineer mechanic responsible for the installation of the plant. The same type is supplied in numerous instances upon road wheels to facilitate transport. The careful erection marks on the sections are indicative of the care that minimizes trouble when away from civilized resources.

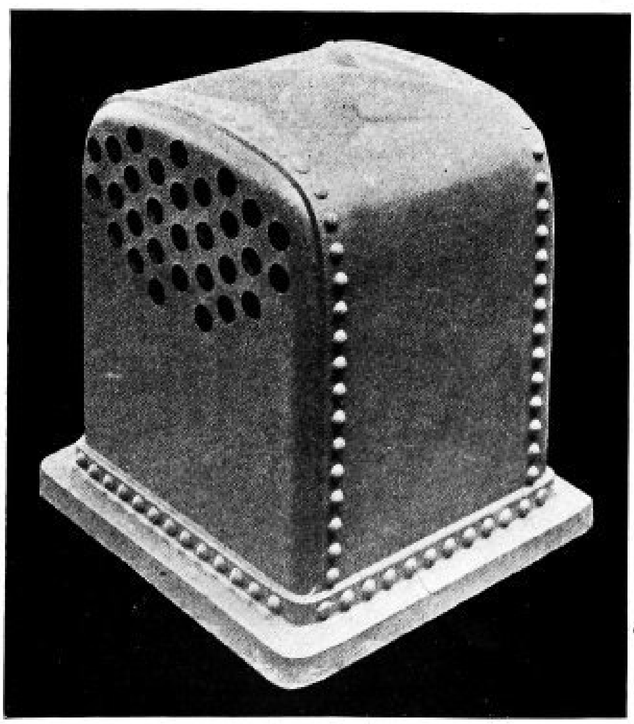


Fig. 9.—English Combustion Chamber Crown

Another interesting boiler, shown in Figs. 5 and 6, is a design to facilitate scaling. The boiler shown is one of a series for the printing department of the London *Telegraph*. It is 19 feet long by 7 feet diameter at the front end, the rings of shell being arranged telescopically so that the back end is 6 feet 7 inches diameter. The feature of the design is that the furnace is placed out of center to give greater room for cleaning. This boiler is set with brick side flues, like a Lancashire boiler, the gases, after leaving the tubes, passing first under the boiler and then dividing and passing through the side flues to the chimney. After installation one of the boilers was subjected to an exhaustive test by Sir Alexander B. W. Kennedy, LL.D., F.R.S., and the late Mr. Bryan Donkin, both eminent engineers whose reputation and standing are above reproach.

Seven-Hour Test

In a seven-hour test with hand stoking and Welsh coal, with an atmosphric temperature outside of 47 degrees Fahrenheit and an inside reading of 86 degrees Fahren-

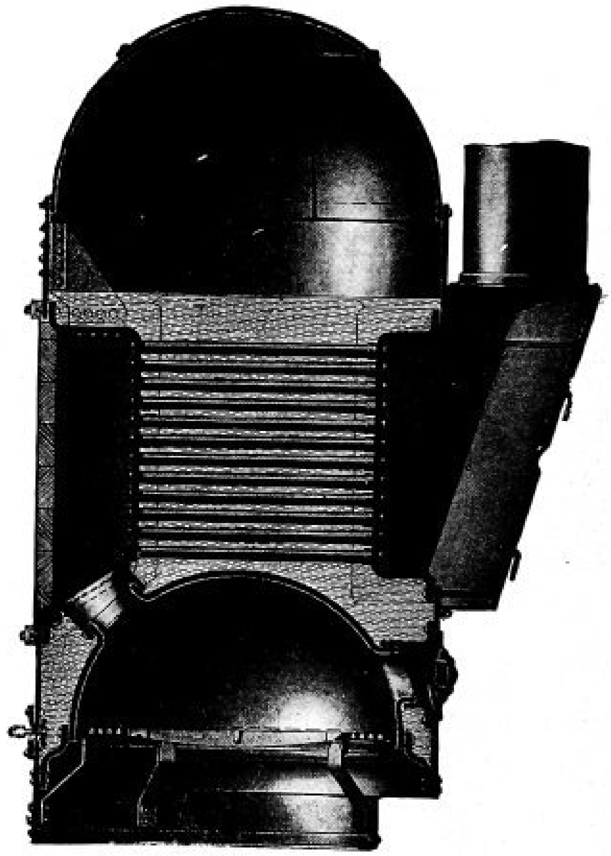


Fig. 10.—Cochran Vertical Boiler

heit, chimney draft 3/4 inch water, the total coal consumed was 3,008 pounds. The water evaporated per pound of coal from feed temperature was 9.36 pounds, equivalent evaporation from, and at 212 degrees Fahrenheit, 10.15 pounds, while deduction for moisture in fuel raised the final result to 10.6 pounds of water evaporated per pound of coal burned.

Results of Test Excellent

While higher results have been claimed for special boilers, these results are extremely good for the usual run of Welsh steam coal without economizer, with an independent feed heater raising the feed temperature from 47.5 degrees Fahrenheit to 163 degrees Fahrenheit. An evaporation of 28,141 pounds of water with 3,008 pounds of coal to 74 pounds pressure in seven hours is first-class practice.

Marshall's is one of the largest makers of boilers of regular locomotive type as applied to purposes other than railway work; their output of portable and semi-portable engines using this type for steam generation is at least equal, if it does not exceed, that of any other English maker.

Some while ago it was my privilege to describe and illustrate a combustion chamber crown of unusual character which had no stays to the crown sheet.* Fig. 9 shows the solution (Messrs. Marshall are the originators), which in extended practice has proved successful, experiments over a long period with different forms of corrugated crowns resulting in the patented design shown. The corrugations spring from the opposite corners of the firebox, intersect in the center and form a truss to the roof or crown sheet. Their precise form is such that they distress the metal in flanging to the least amount. The peculiar shape of the crown sheet allows this to breathe freely under pressure, while the total absence of roof or sling stays is an undoubted advantage to circulation at its most active point. Cleaning is facilitated and there is a slight gain in heating surface at its most important point of conduction.

Value of New Firebox Crown

Several controlling authorities in Great Britain allow this firebox crown to be substituted for the more normal design. There are now 3,000 boilers so fitted in operation which have been giving every satisfaction in service. It has been carefully tested under 400 pounds hydraulic pressure for deflection and permanent set and has been regularly steamed under 180 pounds pressure. The firm now adopts it as their standard design, and believes it marks the best solution yet made of locomotive combustion chamber crown design.

Boilers for Different Requirements

The firm is insistent that there is no best type of boiler; choice must be made from several alternatives guided by the conditions of service; fuel and available water, most specially the latter, decide the type to be installed. Tank boilers such as the Cornish and Lancashire and the Cornish multi-tubular are readily cleaned and therefore more suitable for impure feed water. Expensive fuel makes a high efficiency boiler more or less essential. The firm manufactures a high-grade watertube boiler for which they make larger claims, but, as the varieties of watertube boilers are almost endless and several first-class boilers of this type are commonplace in the United States, reference to Marshall's specialty in this connection is omitted.

* Firebox Crowns, The Boiler Maker, December, 1912.

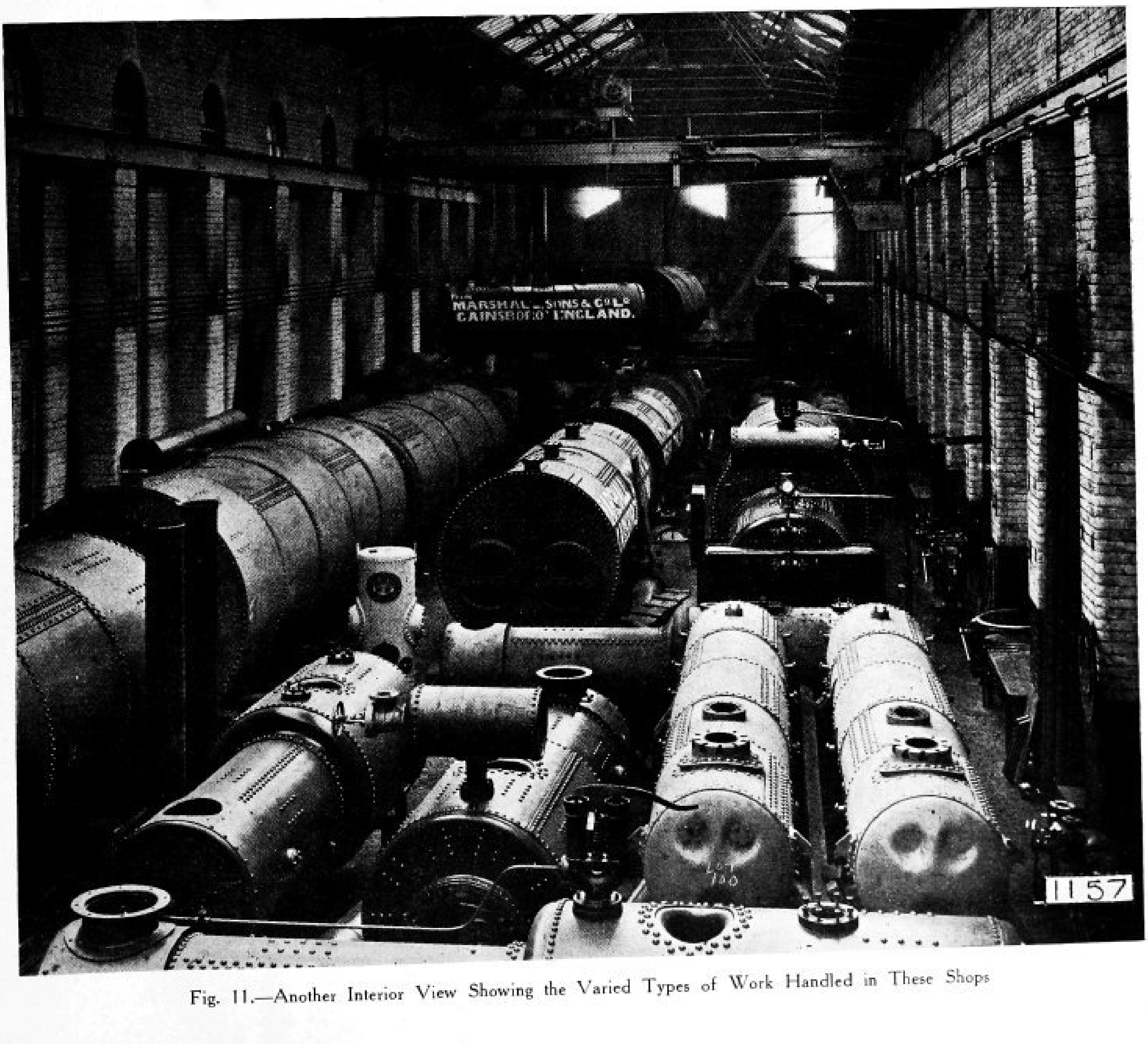


Fig. 11.—Another Interior View Showing the Varied Types of Work Handled in These Shops

Reconstruction of American Business

Advisability of Government Control During Transitional Period—Adjustment of Wages and Prices—Special Legislation

BY EDWIN L. SEABROOK

The most vital problem before American business men—and practically the whole world—is that of adjusting the machinery of business from a war to a peace, or industrial, basis. The question as to how the nation shall do this with as little disturbance as possible is uppermost in the minds of American business leaders. It is a problem that must be faced squarely, and it is useless to undertake to dodge it, although no one really wants to dodge it. We shall face it, as we faced the war.

For some individuals to get into a scrap is easy enough; it is not so easy to heal the wounds after the scrap is over. It was easy for America to plunge into war and turn its industries into producing all the implements of destruction. It was easy because the three great essentials for productive activity were here—orders, material, money. The nation stood back of these, yet in almost a single day business was confronted with the truth that now it is not the nation, but the individual, to whom we must look for these three essentials.

What Shall Be Done?

You can get all kinds of ideas as to what ought to be done during the reconstruction period. Some men treat the problem lightly, while others take it seriously. I know of one group of business men who, discussing the subject, said there was nothing to it. Great quantities of everything that could be named were needed. The easiest thing in the business world would be to turn factories, mills and men, now doing war work, to making materials that the nation had done without for nearly two years and which were badly needed. Just throw a lever, war work stops, and the next turn of the machine produces the needs of peace-time industry. This was the way the readjustment process appealed to this group. Why should there be any interruption when there was so much needed? Perhaps there were a few things that these men had not considered.

The importance of a proper readjustment policy is evidenced by the action of the United States Chamber of Commerce calling together the best business brains of three hundred and fifty industries the first week in December, to discuss the situation and formulate a definite line of action. Practically one entire week is to be given over to considering the best methods of meeting the readjustment of business during the coming months.

Is Government Control Necessary?

It is at this point that the question of government control or regulation appears. How far shall it go, how long ought it to be permited? Up to the present the government of the United States has devoted itself to the function of governing. It has never sought to substitute itself for the people in their business activities and enterprises, nor undertake the business of the people.

During the last eighteen months the American people have most unanimously and loyally responded to any request—which, however, in effect, was a regulation—to curtail the use of anything that contributed to ending the war or supplying the army or navy. The so-called gasless Sunday for pleasure automobiles is a good example of how the nation responded to a "request." Until the fighting stopped, the government was regulating the industrial and economic life of the people. We were told how much sugar we could have, how long the light might be used in the shops and stores in the evening. Even the staff of life—bread—was doled out to us in certain quantities. Of course, all these regulations developed little by little, so that the full extent of regulation was not altogether appreciated.

Will the government, having had a taste of control and regulation, cheerfully relinquish these, or will it be disposed to hold on to at least a portion of what it now has? The disposition of all governments—municipal, state and even national—is to add to its power rather than relinquish it. The attitude of all war-peace making governments is bound to exercise an influence world wide on business for the immediate and near future.

The tendency in Great Britain of private organizations in commerce, industry and finance is toward co-ordinating. The same tendency is seen in the United States. Most trade organizations are stronger in sentiment and purpose, if not in membership, than before the war.

Five Great Factors

There are five great factors that enter into the reconstruction problem, and each of these touches every business man. These are: material supply, price, transportation, labor, capital or money.

In nearly every industry the government has regulated the supply of material that the individual could use. For example, The Boiler Maker, along with other publications, was told not very long ago just about how many pounds of paper it could use for the next twelve months. In a certain sense, about so much iron and steel were allotted to the various industries using these materials. It was not made in so many pounds, but in practice it amounted to the same thing. The iron- and steel-using industries were told that they must reduce their production to a certain percentage of what they had been producing within a given time. Now, the question that confronts business to-day is: Will it be wise to continue these regulations, relaxing gradually, of course? If it is wise, how long shall the regulation continue? What would be the effect if the ban were lifted on everything and all materials released?

Price Regulation

The maximum price regulation has been effective on a good many things from the raw product to the finished article. When the government began fixing prices on pig iron and steel mill products, and the resale of these, it evoked severe criticism in certain quarters, and some dreadful things were bound to happen, but fortunately did not. In the main, price fixing was beneficial. It steadied the market and rendered an even distribution possible, it was no advantage to buy and hold for a rising market. How soon shall the price-fixing ban be lifted and prices left to the law of supply and demand? If it were lifted now what would be the effect?

The government has taken over all the railroad trans-

(Continued on page 352)

Legal Decisions Affecting Boiler Makers

Employer Responsible for Condition of Tools—Employers' Liability in America and England—Employee's Risk When Precaution is Disregarded

BY JOHN SIMPSON

A company had a rule whereby each workman was given ten metal checks with his number on them. When he needed any tool he could only get it on presentation of one of his own checks at the tool room. He was expected to return the tool to the shop when it became impaired by use and have it restored to proper condition. The purpose of this rule was to enable the company to keep a line on the tools and to keep them in proper condition. If a workman could repair his own tools by grinding them on an emery wheel, he was allowed to do so. This was done in respect to the punches, mainly when they became burred by use. If a required tool could not be furnished at the time by the shop, the workman must, under the rule, apply to the foreman of his department for instructions. The foreman could direct him to some other workman for the loan of a tool.

A punch which had become burred by the blows of a heavy hammer and flattened over on the stem was borrowed by a boiler maker from another workman, on the suggestion or direction of another workman and not on the direction of his department foreman. In using it a sliver flew from it, entering one eye and destroying the sight of it. In an action for the boiler maker's injury it was held that since the tool was not furnished by the master he was not rendered liable for the condition of the tool. (*Nashville, C. & St. L. Ry. Co. vs. Kallock, Tennessee Supreme Court,* 204 *S. W.* 1157.)

Employee's Assumption of Risk

A railroad boiler maker was directed to repair an oil tank car by riveting a grab-iron. It was necessary for either him or his helper to go inside of it. When the helper found that there was gas in the car which made his eyes water, the boiler maker himself went into the car and directed a rivet to be heated red hot and dropped down to him. This was done, resulting in an explosion. There was a compressed air hose lying nearby, with which he could have had the gas in the car blown out. In an action for his injuries the Virginia Supreme Court of Appeals held that the plaintiff assumed the risk of injury though he did not specifically know of the danger of an explosion; since, if a servant has full knowledge of the physical conditions, he is chargeable in that case with knowledge of all the dangers proximately resulting therefrom which would be obvious to a man of ordinary care and prudence. (*Houston's Adm'r vs. Seaboard Air Line* [*Va.*], 96 *S. E.* 270. *Decided June* 18, 1918.)

Decision Covering Steam Pipe Fitting

One who undertakes to install steam pipes upon the premises of another is liable for injury resulting from his negligent failure to make proper inspection and tighten loose bolts before turning steam pressure on, holds the Appellate Term of the New York Supreme Court in a recent case. The plaintiff sued the owner of a building in which the former subleased quarters and the steam company to recover damages caused by giving way of a steam valve on the premises, and escape of steam which injured the plaintiff's goods. Pipes to heat the premises had been installed by an independent contractor acting under agreement with the owner, and the steam company turned on pressure.

The court holds that the owner of the premises is not liable, since the accident resulted from omission of the contractor to have two flanges of pipes at a point of connection properly bolted together. But it is decided that either or both the contractor and the steam company are liable for any negligence on their respective parts. The former's liability is rested on omission of his employees to properly tighten the bolts, and the latter's responsibility rests on omission of its employees to take reasonable steps to ascertain that the new pipes would safely carry steam pressure. (*Charles G. Robin, Inc., vs. New York Steam Company,* 171 *New York Supplement,* 55.)

Employers' Liability in England

The following facts were brought out at a formal investigation, under the Boiler Explosions Acts of 1882 and 1890, concerning a fatal boiler explosion which occurred on February 27, 1918, at Danes Farms, Retford, England.

The boiler in question was of the single-flued or Cornish type, 12 feet long by 4 feet in diameter. The mountings consisted of two safety valves, each 3 inches in diameter, one being a Salter spring balance and the other a lever-weight valve loaded to blow off at 45 pounds pressure to the square inch. There was a steam pressure gage, graduated to 145 pounds, fixed on the front of the dome; also a glass water gage, two check valves, and a blow-off valve, a cast-iron steam pipe, 1¾ inches in diameter from the top of the steam dome to the engine, which was used to drive a threshing and grinding machine, and another 1-inch cock to a potato steaming pan. Steam was supplied for the grinding and threshing machine about one day a week, from the latter end of September to the middle of March each year, and for the remainder of the time it remained idle, except for a few days in the summer, when corn had to be ground. The pressure of steam required for the grinding of corn was about 20 pounds, and for threshing not above 45 pounds.

The boiler was set in brickwork in a building attached to the engine-house and was below the level ground. The date of installation of the boiler was so ancient that the name of the maker could not be ascertained. In 1884 the boiler was taken over by George Agars Walker with the farm from his father's executors. The boiler was then on the farm and had been working there for some years previously. In 1892, all the machinery, including the boiler, were placed in charge of Henry Himsworth, a farm blacksmith, who attended to and worked from that time to the day of the explosion, which resulted in the death of the latter.

Some twenty-seven years ago, about 1891, the boiler was sent away to a firm of engineers to be overhauled, and a new end plate, together with several belts of plating, was applied. The boiler was not insured, and from the time these repairs were carried out it had never been inspected by any competent person. There was no record of any trouble with the boiler until towards the end of the year 1917, when a leakage occurred at the furnace end, and in January, 1918, by Mr. Walker's orders, or with his knowledge, Himsworth, the blacksmith, fitted a rough bolted patch round the mud hole at the bottom of the front end plate. This repair took several days to execute. The boiler seemed to have been used once afterwards before the explosion occurred. On February 27, about 6:15 A.M., the fire was lighted by a man named Richardson, foreman at Danes Hill Farm, where he had been working for thirty-four years. Himsworth arrived later and took charge. About 8:30 A. M. steam had been raised to 40 pounds per square inch, and the engine was set to work threshing wheat, with Himsworth in charge. Between this time and 10:40 A. M., Richardson went into the boiler house two or three times, but noticed nothing wrong with the boiler. He passed through to obtain some oil and noticed Himsworth going down some steps to the stokehole. He got the oil and was coming out when the boiler exploded and he was blown across the yard, but not severely hurt. Himsworth was so seriously injured that he died the same day.

In testimony, Mr. Walker stated that Himsworth had been taught to drive the boiler in 1892, and that he considered him to be a perfectly capable man. The safety valve was then set at 45 pounds, which was sufficient to drive the engine. He had often seen the safety valve, fixed outside the building, blow off. It had never occurred to him to have the boiler insured, and personally he had "never seen anything wrong with the boiler."

Investigation by an expert after the explosion showed that the plates resting on the brickwork were so wasted away by corrosion that there was practically no boiler plate left on that part. The explosion was beyond a doubt due to this condition.

In answer to the prosecutor's question—Is the owner of the boiler to blame, is he to pay any, and if so, what part of the cost of this formal investigation?—the court held the owner guilty and directed that he pay the cost of the investigation. The court expressed their sympathy with "the relatives of the man Himsworth, who had so unfortunately lost his life in the explosion." This seems to have been the limit of the employer's liability, although the coroner's inquest, when returning the verdict of accidental death, stated that "the employer, Mr. G. A. Walker, was guilty of gross negligence for not having the boiler periodically examined by a competent man, seeing that the boiler had been in use over fifty years and it was over twenty years since it was last repaired." A rider was also added "that all owners of boilers ought to be legally bound to have them examined every twelve months by an official examiner."

LIABILITY UNDER THE FEDERAL BOILER INSPECTION ACT

The Federal Boiler Inspection Act, enacted by Congress in 1911, making it unlawful to use steam locomotives in interstate commerce unless the boilers are in proper condition and have been inspected and tested, is a "statute enacted for the safety of employees," within the meaning of the Federal Employers' Liability Act, declaring that an injured employee shall not be deemed to have assumed a risk of injury arising from his employer's violation of a statute enacted for the safety of employees. This point has been established by a decision of the highest court in the land.

Other points decided in this case, in which judgment in plaintiff's favoi on account of the death of her husband, a locomotive engineer, in an explosion of a locomotive boiler is sustained, are that the evidence was insufficient to show that government inspectors had approved the use of the large type of button head on the crown bolts of oil-burning engines, and that a railway company is not exonerated from liability for the explosion of a boiler because an unsafe feature of construction to which the accident may be directly attributed was not disapproved by the federal boiler inspectors. (*Donaldson vs. Great Northern Railway Company*, 38 *Supreme Court Reporter*, 230.)

Calculating Area of Segments of Boiler Heads

Tables Available for Determining Supporting Load for Staying Purposes— Reckoning Volumes of Steam and Water Spaces—Allowance for Tube Area

BY WILLIAM N. ALLMAN

Engineers and others concerned in the design and operation of boilers frequently have occasion to calculate the area of segments on boiler heads in order to determine the supporting load for staying purposes. Again, it is often desired to arrive at the required volume of steam and water space in this work

The table here shown has been extracted from "Trautwine's Civil Engineers' Pocket Book" and will be found extremely convenient for arriving at such areas and volumes, as it gives results for such small increments of heights that it will be of great service where accuracy is desired, for the reason that it contains no errors.

In explaining the use of the table, let it be said that "R" represents the height of segment, and "A" the area of segment divided by the square of the diameter. In other words, to find the area of a segment of a circle or a boiler head, when the diameter and height of segment is known, multiply the value in column "A" by the square of the diameter.

The values shown in column "R" are the results obtained when dividing the height of segment by the diameter of boiler, or, in other words, are the heights of segment in parts of the diameter of boiler. Therefore, the first number, .001, refers to a segment whose height is 1/1000 of the diameter of the boiler; the second, 2/1000, and so on, up to a complete semi-circle.

Considering a 6-foot boiler, 1/1000 of the diameter would be equivalent to a height of segment equal to 72/1000 (.072), or about 1/14 inch. As the area of a circle is directly proportional to the square of the diameter, it follows that if it is desired to find the area of a segment of a boiler head whose diameter is 8 feet, with height of segment equal to 2 feet, it will only be necessary to ascertain what part of the diameter the height of segment is, which in this case is 2/8, or ¼, = .25. Referring to table in column "R," we find opposite .250 the number .153546 in column "A." Multiplying this value by the square of the diameter, the following is obtained: $.153546 \times 8^2 = 9.8269+$. This is the area of the segment.

The table is also of value when it is desired to determine the volume of steam or water space, by proceeding along the same lines as described above for obtaining the area, and then, having the area, multiplying this by the length of boiler to obtain the volume. Of course, it should be borne in mind that when figuring the volume of water, allowance should be made for that taken up by tubes.

TABLE FOR CALCULATING THE AREA OF SEGMENTS OF BOILER HEADS

R = Height of segment ÷ by diameter of boiler. A = Area of segment ÷ by square of diameter.

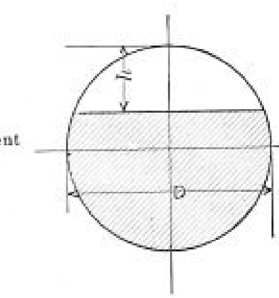
R	A	R	A	R	A	R	A
.001	.000042	.025	.005231	.049	.014248	.073	.025714
.002	.000119	.026	.005546	.050	.014681	.074	.026236
.003	.000219	.027	.005867	.051	.015119	.075	.026761
.004	.000337	.028	.006194	.052	.015561	.076	.027290
.005	.000471	.029	.006527	.053	.016008	.077	.027821
.006	.000619	.030	.006866	.054	.016458	.078	.028356
.007	.000779	.031	.007209	.055	.016912	.079	.028894
.008	.000952	.032	.007559	.056	.017369	.080	.029435
.009	.001135	.033	.007913	.057	.017831	.081	.029979
.010	.001329	.034	.008273	.058	.018297	.082	.030526
.011	.001533	.035	.008638	.059	.018766	.083	.031077
.012	.001746	.036	.009008	.060	.019239	.084	.031630
.013	.001969	.037	.009383	.061	.019716	.085	.032186
.014	.002199	.038	.009764	.062	.020197	.086	.032746
.015	.002438	.039	.010148	.063	.020681	.087	.033308
.016	.002685	.040	.010538	.064	.021168	.088	.033873
.017	.002940	.041	.010932	.065	.021660	.089	.034441
.018	.003202	.042	.011331	.066	.022155	.090	.035586
.019	.003472	.043	.011734	.067	.022653	.091	.036162
.020	.003749	.044	.012142	.068	.023155	.092	.036742
.021	.004032	.045	.012555	.069	.023660	.093	.037324
.022	.004322	.046	.012971	.070	.024168	.094	.037909
.023	.004619	.047	.013393	.071	.024680	.095	.038497
.024	.004922	.048	.013818	.072	.025196	.096	.039087

R	A	R	A	R	A	R	A
.097	.039087	.122	.054690	.147	.071741	.172	.090042
.098	.039681	.123	.055346	.148	.072450	.173	.090797
.099	.040277	.124	.056004	.149	.073162	.174	.091555
.100	.040875	.125	.056664	.150	.073875	.175	.092314
.101	.041477	.126	.057327	.151	.074590	.176	.093074
.102	.042081	.127	.057991	.152	.075307	.177	.093837
.103	.042687	.128	.058658	.153	.076026	.178	.094601
.104	.043296	.129	.059328	.154	.076747	.179	.095367
.105	.043908	.130	.059999	.155	.077470	.180	.096135
.106	.044523	.131	.060673	.156	.078194	.181	.096904
.107	.045140	.132	.061349	.157	.078921	.182	.097675
.108	.045759	.133	.062027	.158	.079650	.183	.098447
.109	.046381	.134	.062707	.159	.080380	.184	.099221
.110	.047006	.135	.063389	.160	.081112	.185	.099997
.111	.047633	.136	.064074	.161	.081847	.186	.100774
.112	.048262	.137	.064761	.162	.082582	.187	.101553
.113	.048894	.138	.065449	.163	.083320	.188	.102334
.114	.049529	.139	.066140	.164	.084060	.189	.103116
.115	.050165	.140	.066833	.165	.084801	.190	.103900
.116	.050805	.141	.067528	.166	.085545	.191	.104686
.117	.051446	.142	.068225	.167	.086290	.192	.105472
.118	.052090	.143	.068924	.168	.087037	.193	.106261
.119	.052737	.144	.069620	.169	.087785	.194	.107051
.120	.053385	.145	.070329	.170	.088536	.195	.107843
.121	.054037	.146	.071034	.171	.089288	.196	.108636

R	A	R	A	R	A	R	A
.197	.109431	.220	.128114	.243	.147513	.266	.167546
.198	.110227	.221	.128943	.244	.148371	.267	.168431
.199	.111025	.222	.129773	.245	.149231	.267	.169316
.200	.111824	.223	.130605	.246	.150091	.269	.170202
.201	.112625	.224	.131438	.247	.150953	.270	.171090
.202	.113427	.225	.132273	.248	.151816	.271	.171978
.203	.114231	.226	.133109	.249	.152681	.272	.172868
.204	.115036	.227	.133946	.250	.153546	.273	.173758
.205	.115842	.228	.134784	.251	.154413	.274	.174650
.206	.116651	.229	.135624	.252	.155281	.275	.175542
.207	.117460	.230	.136465	.253	.156149	.276	.176436
.208	.118271	.231	.137307	.254	.157019	.277	.177330
.209	.119084	.232	.138151	.255	.157891	.278	.178226
.210	.119898	.233	.138996	.256	.158763	.279	.179122
.211	.120713	.234	.139842	.257	.159636	.280	.180020
.212	.121530	.235	.140689	.258	.160511	.281	.180918
.213	.122348	.236	.141538	.259	.161386	.282	.181818
.214	.123167	.237	.142388	.260	.162263	.283	.182718
.215	.123988	.238	.143239	.261	.163141	.284	.183619
.216	.124811	.239	.144091	.262	.164029	.285	.184522
.217	.125634	.240	.144945	.263	.164900	.286	.185425
.218	.126459	.241	.145800	.264	.165781	.287	.186329
.219	.127286	.242	.146656	.265	.166663	.288	.187235

R	A	R	A	R	A	R	A
.289	.188141	.316	.212941	.343	.238319	.370	.264179
.290	.189048	.317	.213871	.344	.239268	.371	.265145
.291	.189956	.318	.214802	.345	.240219	.372	.266111
.292	.190865	.319	.215734	.346	.241170	.373	.267078
.293	.191774	.320	.216666	.347	.242122	.374	.268046
.294	.192685	.321	.217600	.348	.243074	.375	.269014
.295	.193597	.322	.218534	.349	.244027	.376	.269982
.296	.194509	.323	.219469	.350	.244980	.377	.270951
.297	.195423	.324	.220404	.351	.245935	.378	.271921
.298	.196337	.325	.221341	.352	.246890	.379	.272891
.299	.197252	.326	.222278	.353	.247845	.380	.273861
.300	.198168	.327	.223216	.354	.248801	.381	.274832
.301	.199085	.328	.224154	.355	.249758	.382	.275804
.302	.200003	.329	.225094	.356	.250715	.383	.276776
.303	.200922	.330	.226034	.357	.251673	.384	.277748
.304	.201841	.331	.226974	.358	.252632	.385	.278721
.305	.202762	.332	.227916	.359	.253591	.386	.279695
.306	.203683	.333	.228858	.360	.254551	.387	.280669
.307	.204605	.334	.229801	.361	.255511	.388	.281643
.308	.205528	.335	.230745	.362	.256472	.389	.282618
.309	.206452	.336	.231689	.363	.257433	.390	.283593
.310	.207376	.337	.232634	.364	.258395	.391	.284569
.311	.208302	.338	.233580	.365	.259358	.392	.285545
.312	.209228	.339	.234526	.366	.260321	.393	.286521
.313	.210155	.340	.235473	.367	.261285	.394	.287499
.314	.211083	.341	.236421	.368	.262249	.395	.288476
.315	.212011	.342	.237369	.369	.263214	.396	.289454

R	A	R	A	R	A	R	A
.397	.290432	.423	.316005	.449	.341788	.475	.367710
.398	.291411	.424	.316993	.450	.342783	.476	.368708
.399	.292390	.425	.317981	.451	.343778	.477	.369707
.400	.293370	.426	.318970	.452	.344773	.478	.370706
.401	.294350	.427	.319959	.453	.345768	.479	.371705
.402	.295330	.428	.320949	.454	.346764	.480	.372704
.403	.296311	.429	.321938	.455	.347760	.481	.373704
.404	.297292	.430	.322928	.456	.348756	.482	.374703
.405	.298274	.431	.323919	.457	.349752	.483	.375702
.406	.299256	.432	.324909	.458	.350749	.484	.376702
.407	.300238	.433	.325900	.459	.351745	.485	.377701
.408	.301221	.434	.326891	.460	.352742	.486	.378701
.409	.302204	.435	.327883	.461	.353739	.487	.379701
.410	.303187	.436	.328874	.462	.354736	.488	.380700
.411	.304171	.437	.329866	.463	.355733	.489	.381700
.412	.305156	.438	.330858	.464	.356730	.490	.382700
.413	.306140	.439	.331851	.465	.357728	.491	.383700
.414	.307125	.440	.332843	.466	.358725	.492	.384699
.415	.308110	.441	.333836	.467	.359723	.493	.385699
.416	.309096	.442	.334829	.468	.360721	.494	.386699
.417	.310082	.443	.335823	.469	.361719	.495	.387699
.418	.311068	.444	.336816	.470	.362717	.496	.388699
.419	.312055	.445	.337810	.471	.363715	.497	.389699
.420	.313042	.446	.338804	.472	.364714	.498	.390699
.421	.314029	.447	.339799	.473	.365712	.499	.391699
.422	.315017	.448	.340793	.474	.366711	.500	.392699



h = Height of Segment
D = Diam. of Boiler

Safety in the Reconstruction Period

It was Carlyle who made the assertion that the term "King" was a man who kenned; it is the business of both government and management to administer, have wisdom, discern tendency, intention and provide means to every end within their jurisdiction.

No man in a civilized community risks the lives of the mass of his fellow citizens by an attempt to pile up dollars for himself. It is the function of the state to so regulate his activity that he ceases to be a public menace.

Nations, like individuals, have to pay a price for safety. In the words of President Wilson, no price is too high to make the world safe—safe for mankind, safe for the peoples of the earth. There is justifiable pride in fighting for an unselfish cause. Descending from the loftier view, the price of safety *has* to be paid, whether it is paid in the consequences of accident, casualty or catastrophe, or paid as a premium in prevention.

In industry as in international politics none may be a public danger. This is the main issue of the war and the chief feature of the coming post-war industrial reconstruction. Why the two issues should be contemporary is a puzzle to numerous people, but in reality they are one and indissoluble. Reflection will show the reason.

There are new conceptions everywhere evident. A new renaissance is already at hand, and if one word may describe it more surely than any other it is "safety." Not merely "safety first," but safety last as well. Individual, unremitting vigilance is the only method to secure and maintain it.

Among Louisiana Boiler Shops

Handy Loading Outfit—Some Heavy Small Rolling—A "Tough" Cone-Rolling Job—Making Twelve-Inch Pipe

BY JAMES FRANCIS

Two miles by trolley from the heart of New Orleans the writer visited, not long ago, a shop which seemed to be ideally located for the manufacture of boilers and large metal plate work. It was by no means a modern shop, since electricity and traveling overhead cranes had not gone into this place to roost, yet the buildings were large, high and convenient for shipping by rail or by auto truck, by means of which all local distribution is taken care of here—the Murphy Boiler Works.

The laying out is done almost anywhere in the shop, as necessity may demand, but usually it is taken care of in a well-lighted place convenient to the large machines, punches, bending rolls, shear, etc. In fact, the shop carries two well-defined laying out places, one of which is devoted exclusively to heavy sheets, while the other laying out place, which is on the opposite side of the big shop, takes care of all the thin sheet metal work, the light tools also being located on this side.

Setting Up and Riveting

The shells are set up and riveted, as one might say, in the "heart of the shop." Here the big "squeeze" machines are located. It is typical of this shop that almost every one of the several buildings, all of which are built into one another as under the same roof, are high enough to accommodate the biggest boiler on end, no matter where the boiler might be standing. This is necessary on account of the great number of vertical tanks and tall sugar and syrup containers built here.

In fact, as the writer was informed, almost the entire output of the shop goes to the sugar-producing countries south of the United States. All kinds of sugar plantation boilers, stacks, crystallization tanks and the like go to make up the bulk of the shop's work, though there nevertheless is a whole lot of local work sandwiched in between the large export orders.

Need of Man Power

"The shop is full of work," said the foreman, "but we can't get men to do it. The orders are piled up and we have the stock on hand. All we need is manpower to turn out the largest volume of business the shop has ever handled."

It was true. The shop was dotted with excellent machines; there were piles of stock everywhere—great stacks of it—and there was a bale of orders in the office. But there were no men to do the work or to help the machines do it. In many operations carried out in this shop the necessary manpower had been reduced to its very lowest terms. Machinery did most all the work.

Yet there are lots of things which a machine can't do until the work has been prepared for the machine. The machine can't take sheets from a pile and turn them into a boiler—not yet—without someone to direct. But if there were a machine which would take work in at one end, a hopper full of sheets and tubes, say, while it delivered finished boilers and tanks at the other end, such a machine surely would be a godsend for this shop, and the organization surely would have such a machine forthwith and turn out boilers the same as a screw machine drops off screws and pins finished from a single bar of metal.

The boilers progress through the shop step by step until, when released from the testing ways, they are lying alongside a railroad track, car high, where it is only necessary to roll the boilers directly up on the cars ready for shipment. From the setting up and riveting bays the shells are sent to ways where the tubes are inserted. Then the shells are moved along a bit and the calking and testing is carried out, leaving the shells, as above stated, ready to be rolled directly up onto cars and sent to the river to be placed on board ship for destination.

The boilers lined up on the tubing ways were found to be made up with a very convenient staging at each end of

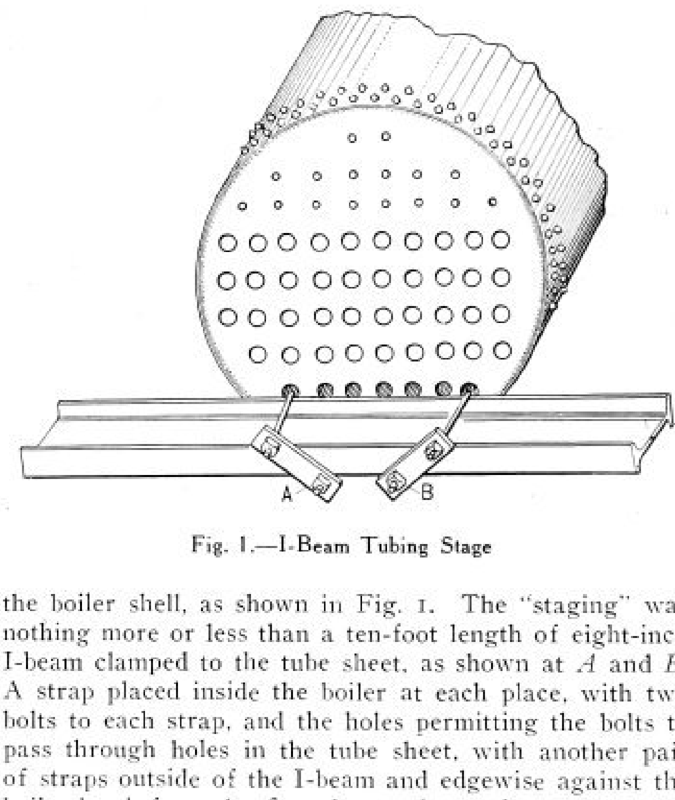


Fig. 1.—I-Beam Tubing Stage

the boiler shell, as shown in Fig. 1. The "staging" was nothing more or less than a ten-foot length of eight-inch I-beam clamped to the tube sheet, as shown at *A* and *B*. A strap placed inside the boiler at each place, with two bolts to each strap, and the holes permitting the bolts to pass through holes in the tube sheet, with another pair of straps outside of the I-beam and edgewise against the boiler head, formed a fine place to lay tools.

I-Beam Tubing Stage

The boiler maker not only used this stage to stand on while working at the upper rows of tubes, but also he found it a very convenient place upon which to place tools, rivets, the "air gun" and other articles necessary when placing and setting boiler tubes.

In this shop the ways, or runs, upon which the boilers were placed for tubing, calking, testing, etc., were at least two feet above the dirt floor, so that test pipes could be attached without trouble. In case of leaks beneath the boiler it is often necessary to dig holes or to roll the shell over to get at the leaks. Here, however, in addition to being placed high and dry on timbers well above the shop floor, the boilers were placed upon "roll-over trucks" in such a manner that there was not a rivet in the entire boiler which could not readily be gotten at without moving the shell. Therefore, the boiler being at some distance above the shop floor, the I-beam head-scaffold or stage was doubly a convenience. To be sure, the lower rows of tubes could not be inserted until after the stage had been removed, but with all the tubes in the upper portion of the boiler in place and finished, it was very easy to remove the stage and insert the few remaining tubes while the workmen stood on the shop floor.

A Yard "As Is" a Yard

The yard behind this shop sure would be a source of envy to almost any Northern concern. I will not say that there was quite thirty acres of land in the yard, but certainly there was a great deal of room out of doors where things could be spread around, comfortable like, with plenty of room to unload and load material. For many blocks—city blocks, and larger ones, too—the yard stretches away with used boilers, tanks and stacks piled semi-symmetrically over the landscape in a manner which makes the display rather attractive and without a trace of that mussed-up, mixed-up appearance which affects so despairingly most yards in which boiler shop "off-fall" has been stored.

Handy Loading Outfit

Just outside of the main rear or car track entrance to the shop there stands a heavy derrick. It is well supported by seven or eight wire cable guy lines and fitted with a long trussed boom operated by a double steam engine of the vertical type. The engine, as shown in Fig. 2, *C*, stands just inside of the big "gate-guarded" shop doors and is geared to the "one-end" gipsy-head, *D*, around which is passed four or five turns of the hauling line *E*. A pair of guide pulleys have been permanently attached to the shop floor, as shown at *F* and *H*, and the hauling line, which is 1¼-inch rope, passes between pulleys or guide rolls *F* and *H* and thence to the derrick outside of the shop. Whenever piles of material have to be placed between the derrick and the guide rolls *F H*, a snatch block is chained to the railroad track, convenient to the derrick, thus carrying the hauling rope past the piles of material.

A peculiarily shaped plate is shown at *G*. This is a piece of used tank steel about ten feet long and sheared

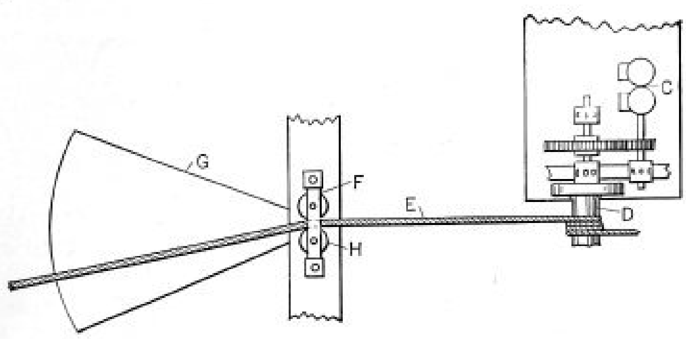


Fig. 2.—Shop Hoisting Tackle

to radial taper form and placed flat on the ground, as shown. The office of this plate is to keep the rope off the dirt just beyond guides *F H*, thereby preventing the rope from digging a big hole in the ground as the line flops around under stress of use.

The operator, standing by engine *C*, has his place very close to head *D* and can control the free end of rope *E* with one hand for a short time while operating the engine throttle with the other hand. The line *E* is also frequently used inside of the shop for hauling cars or moving boilers by "turn-buckling" them along the floor. For use inside of the shop, the line *E*, or probably some other line, is brought around roll either *F* or *H* and is led back into the shop to the work to be done.

Several jobs were going through the shop at the time of the writer's visit, or rather were waiting for workmen to take the jobs through, that looked mighty stubborn. Figs. 3 and 4 show a couple of these jobs that certainly tried the bending roll capacity of the shop to its limit. The illustration shows a suction dredge pipe, together with its connecting cone, the pipe being 20 inches in diameter and made of ⅝-inch steel plate. The cone, Fig. 4, was rolled up from the same thickness of material.

The great thickness of material, ⅝ inch, was not used because of any pressure which the pipe had to withstand. In fact, there was no pressure in the pipe at any time, a partial vacuum being maintained while the pipe was in use. The thickness was required the better to withstand

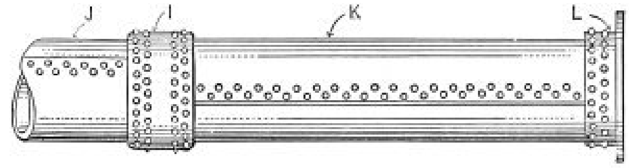


Fig. 3.—20-Inch Suction Pipe

the abrasive action of material passing through the pipe, as well as to sustain the pipe when extended cantilever-like—supported only at one end and filled with water and sand or mud.

The heavy set of rolls in this shop were 10 inches in diameter and 11 feet between housings, with power adjustment, and with the top roll fitted with an overhanging end whereby it could be supported when necessary to remove the housing, at one end of the rolls, in order to remove therefrom closed circular work.

Method of Rolling

The ⅝-inch plate was rolled necessarily in very small increments. It had to be passed many times through the rolls, and at one time the shop foreman even thought he would have to anneal the partly rolled sheets before he could bring them to close. Finally, however, he managed to bring the ends together, although it was all the rolls could handle.

The ends of the sheets proved to be "stickers." The usual stunt, that of stopping the sheet with an end projecting about 8 inches from the rolls while a heavy sledge was held under the edge and blows struck along the end of the sheet among the rivet holes, failed to give the required curve to the sheet ends. But they were finally brought to time by rolling the sheet until the ends nearly touched each other, then raising the top roll until the partially formed sheet hung clear of the lower rolls. And, next, the top roll being brought to bear just under the rivet holes of the sheet end, with vigorous sledge work upon the overhanging ends of the sheets, this soon brought the ends down to the curvature called for by the templet.

It will be noted from Fig. 3 that the pipes *J* and *K* are lapped and double riveted, but that they are also butted and double riveted into the couplings *I* and the flange *L*. The pieces of pipe are butted together inside of coupling *I*, which of itself is made with ends butted together and welded by the oxy-acetylene process.

The little cone, Fig. 4, although only 20 inches in diameter at its small end and less than 4 feet long, proved quite a problem in rolling. The shop foreman stated that they "got it" all right, and without much trouble, though the man who operated the 10-inch bending rolls said it was the toughest job he had ever handled, and that "more than once he was ready to quit!" They got the job done somehow, however. A right good-looking piece of work it was, too!

In this shop they set up hundreds of feet of steel pipe, less than 3/16-inch steel being used, with the pipe single riveted longitudinally and holes punched for 5/16-inch rivets. Rivets ¾-inch long are used and driven cold, being "backed in" by a belt-driven machine which sets rivets about as fast as the proverbial hen will pick up corn. The machine is of the "punch" order, with a projecting lower horn, over which the 4-foot lengths of pipe are slipped for riveting. The pipe sections are punched and rolled up in the usual manner. A couple of bolts are slipped into the longitudinal seams, about two holes distant from either end, and the holes "faired up" with a drift. The section is caught by the middle in a loop from the machine crane and then brought up level, one end resting upon the riveting lower die. The rivets are then slipped into the holes the entire length of the section, save the two holes occupied by the bolts. Next, the pipe section is moved ahead until the first rivet head comes directly under the upper die, the end of the section being raised by balancing the section over the loop in which the section is held by the crane. A single movement of the upper die presses the section down and the underneath die does the work of forming the inner head of the rivet. The operations are then repeated with each rivet in the row, until the middle of the section is reached, when a different method must be used.

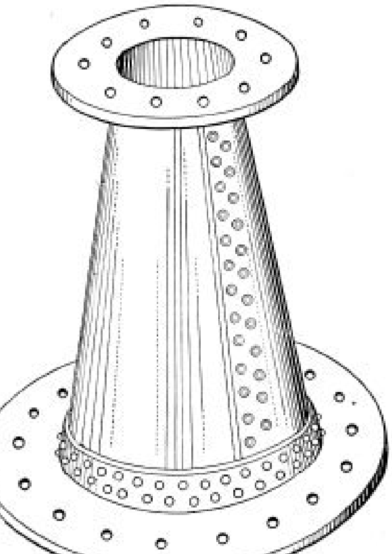


Fig. 4.—A Tough Rolling Job

Riveting the Middle Sections

At the middle of the section, when the workman can no longer balance the section over the crane hoist chain, he raises the outer end of the section, letting the inner end bear upon the horn of the machine. Naturally the operator rivets as many as he can with the section balanced over the loop, for it is not a very comfortable task to hold up the end of a pipe section by main strength until the punch knocks it down and then to drop the held-up end as fast as the die forces the section down during the riveting operation, which sure is "some" quick.

Just before the pipe sections are put together, each and every bit of surface which is to be lapped by other metal is given an "upon honor" coat of thick, well-mixed, red lead paint carefully spread and with every particle of the surfaces covered that are to be lapped. This is done with both the longitudinal laps and the section ends, and even the inside of each rivet hole receives its carefully applied coating of red lead.

Such precautions are vitally necessary in all pipe shipped to Southern countries, owing to the great amount of dampness there, the humidity of the air being something fearful at very frequent times.

Cause of Plate Corrosion

The writer was shown a lot of condemned worn-out sheets which were being loaded with a car full of scrap. The sheets were pitted almost as badly as a clay-bank surface after a shower, and it was laid to corrosion by dampness (sea-air dampness), but just then a flock of a million or so 'skeeters swooped down upon the writer, who then *knew* what caused the plate corrosion—it wasn't dampness.

Standard Boilers for Emergency Fleet

The standard watertube boilers for the 3,500-ton vessels of the United States Emergency Fleet are of the cross-drum type, having straight tubes expanded into steel headers. Their widths are 13 feet 4¾ inches; height to the center of steam drum, 11 feet 5½ inches; depth, 8 feet 10 inches. The total heating surface is 2,544 square feet, made up as follows: Tubes, 2,544 square feet; front header, 33 square feet; back header, 38 square feet; drum, 21 square feet. The grate is 6 feet 6 inches long by 11 feet 9 inches wide; area, 77.45 square feet; the ratio of heating surface to grate area being 33 to 1. The boilers are made for 200 pounds gage pressure, and output, under forced draft, of 15,000 pounds of water per hour, with feed at 200 degrees F., and combustion rate of 20 pounds of coal per square foot of grate per hour.

The Steam Locomotive of the Future

The steam locomotive may be said to be still in its infancy so far as economy per ton mile is concerned. The atomization and burning of liquid or solid fuels in suspension will enable the elimination of grates and other metal work from the combustion zone and permit of higher furnace temperatures and more complete and efficient combustion, which, in combination with higher steam pressures, compounding, higher superheating of both high and low pressure steam, utilization of waste gases and steam for feed water heating and purification, better boiler circulation, reduced cylinder clearances and back pressure, improved steam distribution, lower factor of adhesion, higher percentage of propelling to total weight, less radiation, elimination of unbalanced pressures and weights, application of safety and labor-saving devices and the greater refinement and perfection of general and detailed design, equipment and control throughout, will yet enable it to produce a drawbar horsepower hour for one pound of coal.

Possibility of Steam-Electric Locomotive

Furthermore, it is not inconsistent to now predict that a self-contained steam-electric articulated compound locomotive, combining the advantages of both steam and electric motive power, will shortly find a useful field in services where maximum power and efficiency at high speeds, greater utilization of existing waste heat, high-starting and low-speed torque and rapid acceleration are required and where an exclusive electrification system would not be permissible from the standpoint of first cost or justified on account of the combined expense for operation and maintenance.

Comparisons of Processes of Electric Butt Welding

Strength of Butt Weld—Application of Point and Spot Welding—Use of Resistance Process

BY J. B. CLAPPER*

Electric welding as distinguished from the old method of welding is merely making use of an electric current in the heating of the metal parts to be welded together, the current producing no effect in the metal other than the heating. Probably the first application of electricity in welding was made in the year 1881, when an electric arc was used in uniting parts of storage battery plates. The piece to be welded was placed on a table and connected to the positive side of an electric circuit; the negative side was connected to a carbon electrode, held in the hand of the operator, the arc being established by bringing the carbon into contact with the work piece on the table, then effecting the proper separation to maintain the arc. Thus it may be seen that what is to-day known as "arc welding" was the first method used in electric welding.

Special Features of Butt Welding

In order to distinguish more clearly between the process of butt welding and the former processes, it may be stated that many of the so-called arc welding operations of to-day are fusing rather than welding operations. Instead of a carbon electrode, as was used in the first welding operation cited, a metal electrode in the form of wire is much used, the molten wire being deposited on the work.

What is known as the Thomson process of electric butt welding was brought out in the year 1886 by Elihu Thomson. This method consists of passing through a closed circuit of which the pieces to be welded together are made to form part of an electric current of sufficient density to bring the work to a welding heat. To accomplish this, it is necessary so to arrange this welding circuit with reference to conductivity that the sections to be welded form a high resistance point in the circuit; the energy in the electric current traversing this point will then appear in the form of heat.

To-day this process is used extensively in the metal industries in the uniting of forged parts into one complete part which would be impracticable to make in one forging; the uniting of forgings to tubular and rod parts; welding wheel rims and bands; welding high carbon and alloy steels; welding the longitudinal seams of formed steel tubing; uniting of dissimilar metals, as steel and brass and the like.

Operations in Butt Welding

A complete electric butt weld, in bar or its equivalent, comprises three operations: (1) Polishing that portion of the work which is to be inserted in the welding machine clamps; (2) welding the parts together; (3) removing the burr or flash which is left after the welding.

In some cases this burr is not objectionable, and therefore need not be removed. In other kinds of work the sections to be welded together may be such as to require another operation prior to welding, as, for instance, the uniting of a solid section to a tubular section. In such a case, in order to make a perfect weld, it may be necessary to recess the solid part to conform to the tubular section.

* Plant engineer, Standard Welding Plant, Cleveland, Ohio.

Assuming that alternating current is to be used, the essential elements of an electric butt welding machine are four in number: (1) A transformer to convert the line current from a comparatively high voltage and low amperage to a correspondingly high amperage at a low voltage; (2) a means of connecting the pieces which are to be welded together into the secondary circuit of the transformer; (3) a means of making and breaking the primary circuit of the transformer; (4) a means of forcing the work pieces together when at welding heat.

The transformer is similar in electrical design to those used in power distribution systems; its construction, however, differs considerably, in that the secondary circuit usually consists of a single turn, which may be of either built-up copper ribbon or of copper casting.

The pieces to be welded are connected into the secondary circuit of the transformer by clamps, usually arranged for quick operating in order to facilitate the work. This is important, since otherwise the time consumed in setting up the work and removing it from the machine after welding would be greater than that consumed in making the weld. These clamps may be arranged for either manual or mechanical operation; if for the latter, either compressed air or water pressure may be used.

Transformer Control

For making and breaking the transformer (primary circuit), a quick break switch is used. This may be of special design to operate with a foot pedal or it may be a magnetic switch operated with a master switch. This latter makes a very convenient and safe arrangement. For effecting a union of the weld pieces at weld heat, one of the clamps is so arranged as to be movable through a distance which may be made adjustable, the other clamp being fixed. This clamp's travel, which is very short, may be effected by either manual or mechanical means. For small section welding a hand lever is usually employed. Machines for the heavier welding are arranged for accomplishing this movement with hydraulic power, pressures up to several thousand pounds per square inch being employed.

Details of the Operation

In general, the better welds are made by bringing up the heat quickly. On the other hand, sufficient time must be allowed to run the heat back a little ways from the joint. The importance of this will be understood when it is considered that butt welding is essentially an upsetting operation.

In making a weld, the cycle of operations is as follows: Insert pieces to be joined in machine clamps; bring them into a butting relation; apply the clamps; apply pressure to movable clamp; close transformer circuit switch and run up heat by continued pressure on the movable clamp; form the upset; release pressure on movable clamp; release clamps; remove work from machine. In medium and small section welding this sequence of operations is accomplished in a remarkably short period of time. Machines may be arranged to accomplish all these operations automatically.

So far as the welding operation is concerned, it could be done as well with direct current as with alternating current, were it feasible to generate and transmit the very heavy densities of current required. This is made simple by the use of a welding transformer with its one-turn secondary and many-turn primary winding. The voltage at the welding clamps may be varied within the range of approximately 2 to 6 volts. The resistance of pieces to be welded being low, the currents are of very large values, and may be upwards of 20,000 amperes. Such currents, to be transmitted without an excessive loss, require conductors of large section. The welding machine is so arranged with reference to the relative positions of the transformer and the welding clamps as to secure the shortest possible circuit for the welding current.

The welding transformer may be arranged for either air or oil cooling. The casting (secondary) of the air-cooled type is usually rectangular in form, though it may be of either rectangular or T section, while in the oil-cooled type the secondary is of hollow rectangular section. In some cases it is desirable to cool the oil in the transformer case by circulating it by means of a pump through a cooling coil submerged in water. The heating of the transformer is due not only to the current but to the absorption of heat from the welding clamps by conduction as well. The clamps become quite hot on account of the repeated welding heats between them, and water cooling is resorted to for removing this heat. The clamp die blocks, also the transformer terminals, have holes drilled in them through which a circulation of cool water is maintained.

Strength of the Butt Welding

The question of strength of the electric butt weld is sometimes raised. While all welds so made are not perfect in all respects, nor perhaps as strong as the section in the solid, yet the work has proven to be very satisfactory, and but a small percentage of welds suffer rejection on account of inferior welding. Electrically welded tubing is regularly tested for weld strength. An initial test is made immediately after welding by cutting test pieces from each lot welded and expanding them by forcing them over a tapered mandrel. The processing of this tube, such as drawing, bending, swaging and so forth will also show up defective welding. While butt welding work may be done to conform to certain overall dimensions, limits of the welded piece, practically no attempt is made to work to absolute dimensions. In the making of electric welded tube, the forming and welding is done to base dimensions, the finished size being produced by drawing or swaging. The stretching operation is an excellent test of the weld.

A special machine is used in the butt welding of tube seams. The machine electrodes are copper disks, varying in diameter from 12 to 15 inches. These make contact with the tube on either side of the seam and revolve idly, though under considerable pressure upon it. Their contact faces become rough and require refacing at frequent intervals, a special tool being used for the purpose. It will be readily understood that the contact thus formed is of necessity variable, which in turn results in a fluctuating heat at the weld, and as nothing as yet has been devised to automatically control the heat, the results to be obtained depend to a very large extent upon the skill and the attentiveness of the operator.

Removing of the burr after welding is necessary except in a few instances. The inside burr in welded tubing is, for some kinds of work, not objectionable and may be left in. Where it is desired to remove the burr, however, the burring operation may be accomplished in several ways. It is removed from tubing by passing the tube under several cutting tools and finished by grinding. Rod work is put in a lathe and turned off. The burr may be removed from bar welds by either a burring tool or a gas flame.

The amount of energy consumed in welding varies according to the conductivity of the metal, size and shape of section, etc. Other factors, such as the condition of the machine, the contact at the clamps, pressure at the welded joint, both electrical and mechanical, also affect the power consumption. In general, it may be stated that the more rapidly the work is done the less energy will be used.

In every field within its scope where electric resistance welding has become a competitor of other processes of welding it has been found more economical. Being free from objectional features of smoke, glare, soot and dirt, so common with other processes, a greater output per man can be obtained with less fatigue and less operating cost.

Point or Spot Welding

In later years, another radically different method of using the electric current has been discovered in the welding of sheet and plate metal as a substitute for riveting known as "point" or "spot" welding, opening a field even larger than that of butt welding. The distinguishing feature of the "spot" weld is that it is not intended to and does not weld the whole contacting area, but only the metal between the "points" of the electrodes. In the butt weld it is intended that all the contacting metal be welded, the electrodes not being in contact with the welded portion.

The product of the two processes is also very distinct. Spot welding is largely used in household ware, interior finish of steel passenger coaches, in automobile bodies, sheet steel boxes and cabinets, steel furniture and an infinite variety of articles made from sheet steel.

Lap or Seam Welding

Still another method of welding can be employed in sheet steel working—namely, in lap or seam welding of tubular or cylindrical forms and also plain sheets, especially thin sheets like coffee and tea pot bodies and spouts and a great variety of articles made from thin sheets where a seam weld is required. This weld might be distinguished by the name of "lap, seam or traveling weld." The old butt welding process has long been used in welding abutting edges of sheet steel of a thickness sufficient to use in tubing for mechanical purposes and for cylinders for kitchen boilers.

Extensive Use of Resistance Processes

Electric resistance processes are not only employed in the welding of the baser metals like iron and steel, but also in copper, brass and aluminum and the finer metals. By this process, welds are made in an infinite variety of forms and shapes of these metals which it would be entirely impracticable to weld by some of the other processes. The range of such welds is well illustrated by the delicate optical work and the heaviest truck wheel base.

The machines employed also illustrate the wide range in the practice of the art, greatly varying, as they do, in form and weight. Some of them weigh less than 50 pounds, while others weigh over 9 tons. It is obvious that there can hardly be any points of resemblance between two such machines. The amount of current required to operate such machines must also show striking contrasts. In the smallest machine, less than one kilowatt furnishes all the power required, while in the largest machine more than 250 kilowatts can economically be used.

Welded Seams Correct Faults in Converters*

Successful Experiments on Welded-Type Heaters—Difficulties in Welding Materials of Varying Thicknesses—New Cutting Machine

That it couldn't be done was the consensus of opinion at a meeting of engineers and expert boiler makers held a few fortnights ago to consider ways and means of overcoming serious faults which had developed in a battery of cotton converters manufactured by old riveting methods.

The joining of seams and connections on these converters had been done by time-worn riveting methods, the longitudinal seam being overlapped. While these heavy riveted joints could withstand any medium pressures—although much more expensive than if constructed by oxy-acetylene welding—their utter failure was caused by the soda solution used for washing the raw cotton. This would find its way through practically all the rivet holes and would also get between the plates along the overlapped seam, causing it to pit very quickly. When this action commenced, no means seemed successful in patching up the leaks

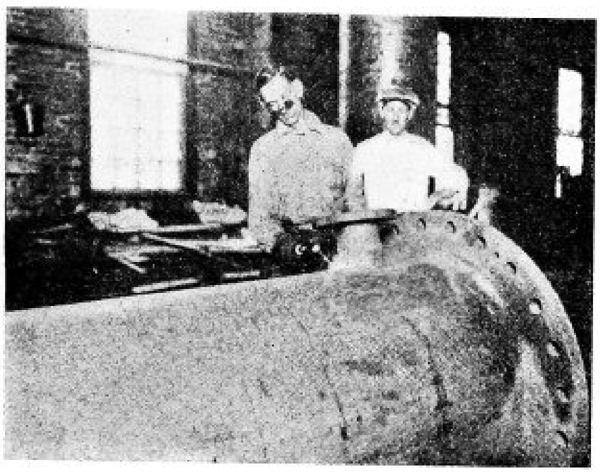


Fig. 1.—Welding an Inlet Nipple

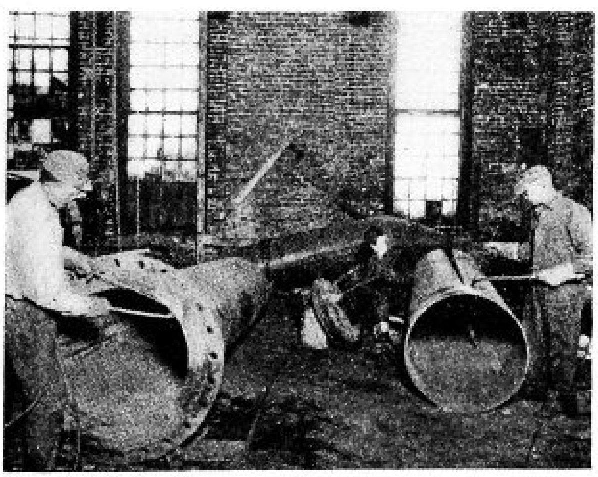


Fig. 2.—Welding Three Different Parts of Heaters

One of the engineers called in consultation to study the problem was W. D. Born, engineer of John Mohr & Son, Chicago, Ill., who assumed the contract for the supplying of the materials, and the assembling and testing of the new welded-type heaters. Having had experience with the dependability of oxy-acetylene welds, he was convinced that, if the latter type of joints were substituted for riveting, the difficulties mentioned above could be effectually eliminated. On his recommendation, F. J. Maeurer, superintendent of the Davis-Bournonville Company welding shop at Chicago, was called before the group of consultants to express his opinion on the practicability of welded seams and connections in this case. He claimed, after a thorough consideration of all the angles of the problem, that it could be done, thereby opposing the opinions of all the engineers, except that of W. D. Born.

Welding Materials of Varying Thicknesses

Judging from subsequent developments, it was done most successfully. The chief difficulty to be overcome in this whole operation lay in effectively combating the complications which are so well known to all in the trade who have tried to weld together different pieces of metal of great variance in thickness. In this particular case, an obstacle of this character was encountered in welding the set of 85 flues, with a wall of 3/16-inch thickness and a diameter of 1½ inches, to the tube sheet, which is 2½ inches thick. Having solved the initial problem of securing a tight joint at all these connections, the rest of the work seemed comparatively easy. It was this particular part of the operation that was under consideration when the referees had agreed on an unfavorable decision. Let us explain how successfully the recommendations of the minority report were carried out.

Fig. 3.—Welding a Flange on a Shell

Details of the Operation

By following the accompanying illustrations, the reader will get a clear idea of the details of the entire operation. In Fig. 1 an operator is shown welding an inlet nipple on the side of a heater. The illustration also shows the flange welded on, as well as the welded side seam and outlet connection at the bottom of the view. In this case, as is so often experienced in well-made oxy-acetylene welds, the improvement in appearance is also an indica-

* From *Journal of Acetylene Welding.*

tion of increased strength. These views also show the size of the heaters which were 11½ feet long and about 30 inches in diameter.

We see, in Fig. 2, three operators welding different parts of the heaters. The man on the right is welding the longitudinal seam on one of the shells, the man in the center is welding on an outlet flange, while the one at the left is welding the inside course of a flange.

In Fig. 3 is shown the welding of a flange to a shell. This flange was cut from 2½-inch steel, as illustrated in Figs. 5 and 6. These shells are of 7/16-inch material, the welding of which to the 2½-inch tube sheet once more brought up the complication of a joint of pieces of varying thickness. Later tests proved that the details of this operation were also wisely planned by Mr. Maeurer.

Finished Work on Flue Sheet

A head-on view of a flue sheet with the 85 flues welded in is shown in Fig. 4. The reader will note at first glance the finished appearance and uniformity in every one of these 85 joints and in the circular weld at the inner edge of the flange. At the time this view was taken, boiler maker Larson, of John Mohr & Son, was removing the improvised testing apparatus after the completion of the series of tests to which all these heaters have been rigidly subjected, including an air test of 110 pounds pressure

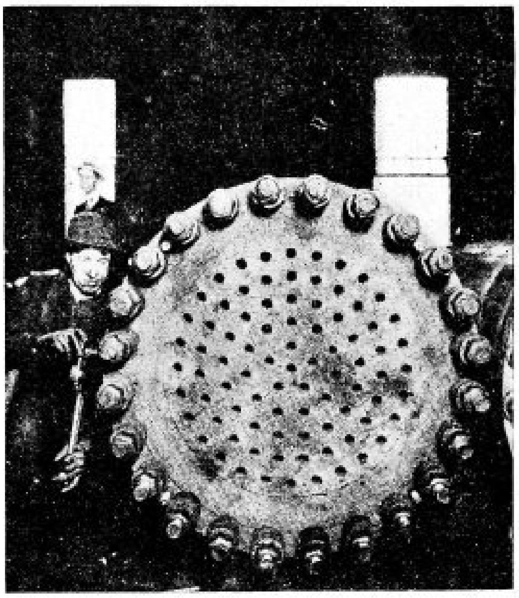


Fig. 4.—Flue Sheet with 85 Flues

and cold water tests of 280 pounds pressure. No leaks or faulty welds of any kind were located by these high pressure tests.

Use of the New Automatic Cutting Machine

Now we come to a point in this operation which well illustrates one of the most successful developments of recent years in the welding industry. It involves the automatic cutting by the Davis-Bournonville radiagraph, from 2½-inch stock steel plates, of the head plates and flanges required for this job. The circular plate shown at the right front in Fig. 5 has just been cut out by this method. The plate at the left front shows the automatic cutting machine just completing the inside cut. Note that the operator is merely waiting for the cut to be completed before turning off the gases and motor. Revolving about the center pin, the route of the cutting point is as exactly determined as that drawn by a compass, without the least assistance from the operator. In the photograph at the extreme left, leaning against the wall, is a completed flange. In the background are square plates before cutting.

The same automatic cutting machine is brought a little closer to the inspection of the reader in Fig. 6, which brings out the smoothness and precision of the cutting performed by this instrument. It is this particular operation that was approached so skeptically by the supervising engineers.

Remuneration in Uncle Sam's currency is not the only reward of the successful oxy-acetylene operator. It is of no little satisfaction to a welder to see the great improve-

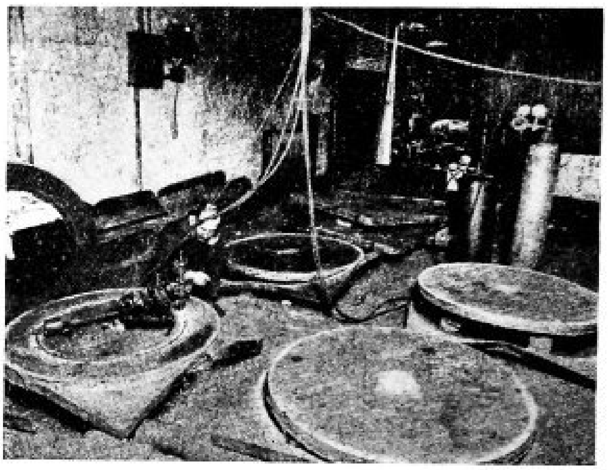


Fig. 5.—Circular Plate Cut From 2½-Inch Stock

ment in appearance which is so often effected by his work and to know that his knowledge and skill have effected material economies in time and expense and are constantly establishing still higher standards of fine workman-

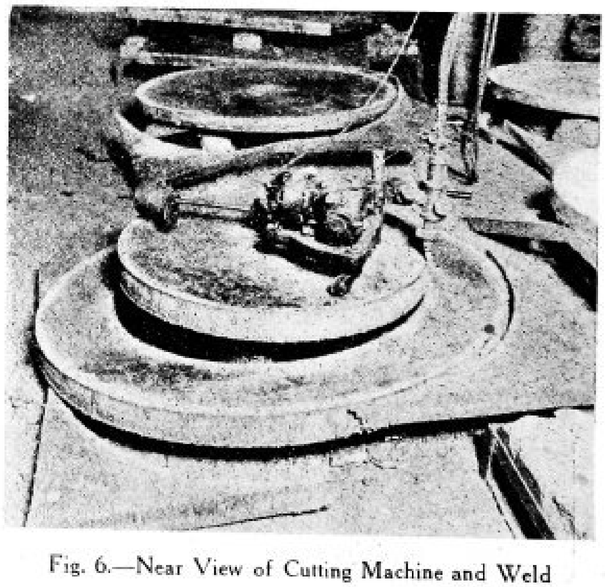


Fig. 6.—Near View of Cutting Machine and Weld

ship. But the outstanding success of all these operations lay in the strength of the welds, which eliminated entirely the harassing fault that had spelled almost total failure for the heaters.

The Director-General has forbidden the practice of officers and employes of the Railroad Administration receiving Christmas presents from shippers and supplymen. He states that the practice is objectionable, and it is the policy of the Railroad Administration that it be discontinued.

Tables for the Design of Pressure Tanks

Specifications for Cylindrical Pressure Tanks—Single-Riveted Lap Girth Seams—Safe Working Pressure—Pressure on Convex and Dished Heads

BY JOHN A. COLE

Table A gives the specifications for cylindrical pressure tanks of various diameters and working pressures. The thickness of plate, etc., given are the minimum allowable according to good engineering practice, and should be increased to take care of any special features in the design. (This table appears on page 350.)

Table B gives data for single riveted lap girth seams when rivets of same size are used in girth and longitudinal seams.

TABLE B

Single-Riveted Lap Girth Seams for Use When Girth and Longitudinal Seams Are the Same Size

Dia. of cold riv.	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"
Pitch (inches)	1 5/8	1 7/8	2 1/8	2 3/8	2 1/2	2 7/8

Table C gives the safe working pressures for cylindrical tanks of various diameters, thickness of shells and style of riveted longitudinal seams. For any one thickness of shell plate and style of joint, the safe working pressure is inversely proportional to the diameter. By making use of this principle, working pressures for intermediate diameters not given in the table can be obtained; *e. g.*—let it be required the specifications for a tank 45 inches in diameter and good for a working pressure of 120 pounds per square inch. This is equivalent to a tank 90 inches diameter by 60 pounds working pressure.

TABLE C

Safe Working Pressure in Pounds Per Square Inch

Shell	Joint	Rivets	Pitch	INSIDE DIAMETER OF SHELL - INCHES.												
				24	30	36	42	48	54	60	66	72	78	84	90	96
3/16"	S.R.L.	1/2	1 5/16	104	83	69	59	52	46	41	38	34	32	29	27	26
	D.R.L.	1/2	2 1/8	128	103	85	73	64	57	51	46	43	39	36	34	32
	T.R.L.	1/2	2 5/8	134	107	89	77	67	60	54	49	45	41	38	36	33
1/4"	S.R.L.	5/8	1 13/16	135	108	90	77	67	60	54	49	45	41	38	36	34
	D.R.L.	5/8	2 9/16	164	131	109	94	82	73	65	59	54	50	47	43	41
	T.R.L.	1/2	2 5/8	179	144	120	102	89	80	72	65	60	55	51	48	45
	T.R.L.	5/8	3	176	141	117	100	88	78	70	64	59	54	50	47	44
5/16"	S.R.L.	5/8	1 13/16	154	123	102	88	77	68	61	56	51	47	44	41	38
	S.R.L.	3/4	2	170	136	113	97	85	75	68	61	56	52	48	45	42
	D.R.L.	5/8	2 9/16	205	164	137	117	102	91	82	74	68	63	58	54	51
	D.R.L.	3/4	2 7/8	205	164	137	117	102	91	82	74	68	63	58	54	51
	T.R.L.	5/8	3	220	176	147	126	110	98	88	80	73	67	63	58	55
	T.R.L.	3/4	3 1/4	214	171	143	122	107	95	86	78	71	66	61	57	53
3/8"	S.R.L.	3/4	2	181	145	121	103	90	80	72	66	60	55	51	48	45
	S.R.L.	7/8	2 1/4	200	160	133	114	100	89	80	77	66	61	57	53	50
	D.R.L.	3/4	2 7/8	246	197	164	140	123	109	98	89	82	75	70	65	61
	T.R.L.	3/4	3 1/4	257	206	171	147	129	114	103	93	86	79	73	68	64
7/16"	S.R.L.	7/8	2 1/4	214	171	143	122	107	95	85	78	71	66	61	57	53
	S.R.L.	1	2 5/16	226	180	150	129	113	100	90	82	75	69	64	60	56
	D.R.L.	7/8	3 1/8	280	224	187	160	140	124	112	102	93	86	80	74	70
	T.R.L.	7/8	3 5/16	300	240	200	172	150	133	120	109	100	92	85	80	75
	D.R.B.	3/4	2 1/2	324	259	216	185	162	144	129	117	108	99	92	86	81
1/2"	S.R.L.	7/8	2 1/4	214	171	143	122	107	95	85	78	71	66	61	57	53
	S.R.L.	1	2 13/32	231	200	167	143	123	111	100	91	83	77	71	67	62
	D.R.L.	1	3 3/16	324	259	216	185	162	144	129	117	108	99	92	86	81
	T.R.L.	7/8	3 7/16	344	275	229	196	172	153	137	125	114	103	98	91	86
	D.R.B.	7/8	2 9/16	367	294	245	210	184	163	147	133	122	113	105	98	91
	T.R.B.	1	3 5/16	393	314	264	224	196	175	157	143	131	121	112	104	98
9/16"	D.R.B.	7/8	2 7/16	415	332	277	237	208	185	166	151	138	128	119	111	104
	T.R.B.	1	3 23/32	442	354	295	253	221	196	177	161	147	136	126	118	110
	Q.R.B.	7/8	3 29/64	485	388	323	277	242	215	193	176	161	149	138	129	121
5/8"	D.R.B.	1	2 1/4	461	369	307	263	230	205	184	168	154	142	132	123	115
	T.R.B.	1	3 3/8	494	395	329	282	247	219	197	179	164	152	141	131	123
	Q.R.B.	1	3 5/8	532	426	355	304	266	237	213	194	178	164	152	142	133
11/16"	D.R.B.	1	2 1/4	498	399	332	285	249	222	199	181	166	153	141	133	124
	T.R.B.	1 1/8	3 5/8	533	426	355	304	267	237	213	194	178	164	152	142	133
	Q.R.B.	1 1/8	3 25/32	581	465	388	332	291	258	232	211	194	179	166	155	145
3/4"	D.R.B.	1 1/8	3 3/32	548	438	366	313	274	244	219	199	183	169	156	146	137
	T.R.B.	1 1/8	3 11/16	577	462	385	330	289	257	231	210	193	178	165	154	144
	Q.R.B.	1 1/8	3 7/8	625	500	417	357	313	278	250	227	208	192	179	166	156

Table D gives the allowable working pressures on convex and concave dished heads of various thicknesses and diameters. It is based on the assumption that the heads are dished to a radius equal to the outside diameter of the head.

SYMBOLS

The meaning of the symbols used in these tables are as follows:

W. P. = safe working pressure in pounds per square inch,

Shell = thickness of shell plate in inches.

Longitudinal joints of various types are designated as:

S. R. L. = single riveted lap,
D. R. L. = double riveted lap,
T. R. L. = triple riveted lap,
D. R. B. = double riveted butt,
T. R. B. = triple riveted butt,
Q. R. B. = quadruple riveted butt.

All butt joints are of double butt strap construction. Pitch = pitch of rivets in row having shortest pitch (longitudinal seams). All girth seams are S. R. L. joints (see Table B for pitch).

TABLE D

Safe Working Pressure on Dished Heads

Thickness (inches)		Radius of Disk or diameter of shell - inches.												
		24	30	36	42	48	54	60	66	72	78	84	90	96
CONVEX HEADS Pressure on Concave side.	1/4	104	83	69	59	52	46	41	37	34	32	29	27	26
	5/16	156	124	104	89	78	69	62	56	52	48	44	41	39
	3/8	208	166	138	119	104	92	83	75	69	64	59	55	52
	7/16	260	207	173	148	130	115	104	94	86	80	74	69	65
	1/2	312	249	208	178	156	138	125	113	104	96	89	83	78
	9/16	364	290	243	208	182	162	145	132	121	112	104	97	91
	5/8	416	332	277	238	208	185	166	151	138	128	119	111	104
	11/16	468	373	312	267	234	208	187	170	156	144	133	125	117
	3/4	520	415	347	297	260	231	208	189	173	160	148	138	130
	13/16	572	456	381	327	286	254	229	208	191	176	163	152	143
	7/8	624	498	416	357	312	277	250	227	208	192	178	166	156
	15/16	676	539	451	386	338	300	270	246	225	208	193	180	169
	1	728	582	486	416	364	324	291	265	243	224	208	194	182
CONCAVE HEADS Pressure on Convex side.	1/4	62	50	41	35	31	27	25	22	20	19	17	16	15
	5/16	93	75	62	53	46	41	37	34	31	28	26	25	23
	3/8	125	100	83	71	62	55	50	45	41	38	35	33	31
	7/16	156	125	104	89	78	69	62	56	52	48	44	41	39
	1/2	187	150	125	107	93	83	75	68	62	57	53	50	46
	9/16	218	175	145	125	109	97	87	79	72	67	62	58	54
	5/8	250	200	166	142	125	111	100	90	83	76	71	66	62
	11/16	281	225	187	160	140	125	112	102	93	86	80	75	70
	3/4	312	250	208	178	156	138	125	113	104	96	89	83	78
	13/16	343	275	229	196	171	152	137	125	114	105	98	91	85
	7/8	375	300	250	214	187	166	150	136	125	115	107	100	93
	15/16	406	325	270	232	203	180	162	147	135	125	116	108	101
	1	437	350	291	250	218	194	175	159	145	134	125	116	109

Convex = thickness of convex head (inches),
Concave = thickness of concave head (inches),
Rivets = diameter of cold rivet (inches).

As a basis of calculation, values for the constant factors involved were reckoned as follows:

Tensile strength at 55,000 pounds per square inch; crushing strength at 95,000 pounds per square inch; single shear at 42,000 pounds per square inch; double shear at 78,000 pounds per square inch; factor of safety at 5.

In the formula for the thickness of the shell,

$$T = \frac{W.P. \times r \times F.S.}{T.S. \times E},$$

T = thickness of shell (inches),
$W\ P$ = safe working pressure — pounds per square inch,
$T\ S$ = ultimate tensile strength — pounds per square inch,
$F\ S$ = factor of safety,

TABLE A

Specifications for Cylindrical Pressure Tanks

W.P.	SPECIFICATIONS	DIAMETER OF SHELL & RADIUS OF HEAD - Inches.												
		24	30	36	42	48	54	60	66	72	78	84	90	96
50	SHELL	3/16	3/16	3/16	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	5/16	5/16
	JOINT	S.R.L.	S.R.L.	S.R.L.	S.R.L.	S.R.L.	S.R.L.	S.R.L.	D.R.L.	D.R.L.	D.R.L.	T.R.L.	D.R.L.	D.R.L.
	RIVETS	1/2	1/2	1/2	5/8	5/8	5/8	5/8	5/8	5/8	5/8	5/8	3/4	3/4
	PITCH	1 7/16	1 7/16	1 7/16	1 11/16	1 11/16	1 11/16	1 11/16	2 7/16	2 7/16	2 7/16	3	2 7/8	2 7/8
	HDS. CONVEX	3/16	1/4	1/4	1/4	1/4	5/16	5/16	5/16	5/16	3/8	3/8	3/8	3/8
	HDS. CONCAVE	1/4	1/4	5/16	5/16	3/8	3/8	3/8	7/16	7/16	1/2	1/2	1/2	9/16
75	SHELL	3/16	3/16	3/16	1/4	1/4	1/4	5/16	5/16	3/8	3/8	7/16	7/16	7/16
	JOINT	S.R.L.	S.R.L.	D.R.L.	S.R.L.	D.R.L.	T.R.L.	D.R.L.	D.R.L.	D.R.L.	D.R.L.	D.R.L.	D.R.L.	T.R.L.
	RIVETS	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	3/4	7/8	7/8	7/8
	PITCH	1 7/16	1 7/16	2 1/4	1 11/16	2 7/16	3	2 7/8	2 7/8	2 7/8	2 7/8	3 1/8	3 1/8	3 3/4
	HDS. CONVEX	1/4	1/4	5/16	5/16	5/16	3/8	3/8	3/8	7/16	7/16	1/2	1/2	1/2
	HDS. CONCAVE	5/16	5/16	3/8	7/16	7/16	1/2	1/2	9/16	5/8	5/8	11/16	11/16	3/4
100	SHELL	1/4	1/4	1/4	1/4	5/16	3/8	3/8	7/16	7/16	1/2	1/2	1/2	9/16
	JOINT	S.R.L.	S.R.L.	D.R.L.	T.R.L.	D.R.L.	D.R.L.	T.R.L.	D.R.L.	T.R.L.	T.R.L.	D.R.B.	T.R.B.	D.R.B.
	RIVETS	5/8	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	7/8	1	7/8
	PITCH	1 11/16	1 11/16	2 7/16	3	2 7/8	2 7/8	3 1/4	3 1/8	3 3/4	3 3/4	2 3/8	3 3/4	2 7/16
	HDS. CONVEX	1/4	5/16	5/16	3/8	3/8	7/16	7/16	1/2	1/2	9/16	9/16	5/8	5/8
	HDS. CONCAVE	3/8	3/8	7/16	1/2	9/16	5/8	5/8	11/16	3/4	13/16	7/8	7/8	15/16
125	SHELL	1/4	1/4	5/16	5/16	3/8	7/16	1/2	1/2	1/2	9/16	9/16	5/8	5/8
	JOINT	S.R.L.	D.R.L.	D.R.L.	T.R.L.	T.R.L.	D.R.L.	D.R.L.	T.R.L.	T.R.B.	D.R.B.	T.R.B.	T.R.B.	Q.R.B.
	RIVETS	5/8	5/8	3/4	5/8	3/4	7/8	1	7/8	1	7/8	1	1	1
	PITCH	1 11/16	2 7/16	2 7/8	3	3 1/4	3 1/8	3 5/8	3 3/4	3 3/4	2 7/16	3 25/32	3 7/8	3 7/8
	HDS. CONVEX	5/16	5/16	3/8	7/16	7/16	1/2	1/2	9/16	5/8	5/8	11/16	11/16	3/4
	HDS. CONCAVE	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1		
150	SHELL	1/4	5/16	3/8	7/16	7/16	1/2	1/2	9/16	5/8	5/8	11/16	3/4	3/4
	JOINT	D.R.L.	D.R.L.	D.R.L.	D.R.L.	T.R.L.	T.R.L.	T.R.B.	D.R.B.	D.R.B.	T.R.B.	T.R.B.	T.R.B.	Q.R.B.
	RIVETS	5/8	3/4	3/4	7/8	7/8	7/8	1	7/8	1	1	1 1/8	1 1/8	1 1/8
	PITCH	2 7/16	2 7/8	2 7/8	3 1/8	3 3/4	3 3/4	3 3/4	2 7/16	2 3/4	3 7/8	3 7/8	3 15/16	3 7/8
	HDS. CONVEX	5/16	3/8	7/16	1/2	1/2	9/16	5/8	5/8	11/16	3/4	13/16	13/16	7/8
	HDS. CONCAVE	7/16	1/2	5/8	11/16	3/4	13/16	7/8	1					
175	SHELL	1/4	5/16	7/16	1/2	1/2	9/16	9/16	5/8	11/16	3/4	3/4		
	JOINT	T.R.L.	T.R.L.	D.R.L.	D.R.L.	D.R.B.	D.R.B.	T.R.B.	T.R.B.	T.R.B.	T.R.B.	Q.R.B.		
	RIVETS	5/8	5/8	7/8	1	7/8	7/8	1	1	1 1/8	1 1/8	1 1/8		
	PITCH	3	3	3 1/8	3 5/8	2 3/8	2 7/16	3 25/32	3 7/8	3 7/8	3 15/16	3 7/8		
	HDS. CONVEX	3/8	7/16	1/2	1/2	9/16	5/8	11/16	3/4	13/16	13/16	7/8		
	HDS. CONCAVE	1/2	9/16	11/16	3/4	7/8	15/16	1						
200	SHELL	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	3/4				
	JOINT	D.R.L.	T.R.L.	T.R.L.	D.R.B.	D.R.D	D.R.B.	T.R.B.	T.R.B.	Q.R.B.				
	RIVETS	3/4	3/4	7/8	7/8	7/8	1	1 1/8	1 1/8	1 1/8				
	PITCH	2 7/8	3 1/4	3 3/4	2 3/8	2 7/16	2 3/4	3 7/8	3 15/16	3 7/8				
	HDS. CONVEX	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8				
	HDS. CONCAVE	9/16	5/8	3/4	7/8	15/16								
225	SHELL	3/8	7/16	1/2	9/16	5/8	11/16	3/4	3/4					
	JOINT	D.R.L.	D.R.L.	T.R.L.	D.R.B.	D.R.B.	T.R.B.	T.R.B.	Q.R.B.					
	RIVETS	3/4	7/8	7/8	7/8	1	1 1/8	1 1/8	1 1/8					
	PITCH	2 7/8	3 1/8	3 3/4	2 7/16	2 3/4	3 7/8	3 15/16	3 7/8					
	HDS. CONVEX	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8					
	HDS. CONCAVE	5/8	11/16	13/16	15/16									
250	SHELL	3/8	1/2	9/16	9/16	11/16	3/4	3/4						
	JOINT	T.R.L.	D.R.L.	D.R.B.	T.R.B.	D.R.B.	T.R.B.	Q.R.B.						
	RIVETS	3/4	1	7/8	1	1	1 1/8	1 1/8						
	PITCH	3 1/4	3 5/8	2 7/16	3 25/32	2 3/4	3 15/16	3 7/8						
	HDS. CONVEX	7/16	9/16	5/8	11/16	3/4	13/16	7/8						
	HDS. CONCAVE	5/8	3/4	7/8	1									

E = efficiency of longitudinal joint,
r = inside radius of shell — inches.

In the formula for thickness of dished heads,

T = thickness of plate — inches,
P = maximum allowable working pressure — pounds per square inch,
R = radius to which head is dished.

For convex heads, that is, when pressure is exerted on concave side,

$T = 0.00005\ P\ R + 1/8$ inch.

For concave heads, that is, when pressure is exerted on convex side,

$T = 0.00008333\ P\ R + 1/8$ inch.

APPLICATION OF USE OF TABLES

Example.—Required the specifications for an air receiver, 48 inches in diameter, for a safe working pressure of 100 pounds per square inch, to be made with one convex head and one concave head.

Solution.—Referring to Table A, under 100 pounds working pressure and 48 inches diameter, we find specified 5/16-inch shell with double riveted lap longitudinal seams, 3/4-inch diameter rivets at 2 7/8-inch pitch; 3/8-inch for convex head, and 9/16-inch for concave head. Referring to Table B, under 3/4-inch diameter rivets, we find 2 1/8-inch pitch specified in circular seams. Referring to Table C, under 90-inch diameter, the nearest value is found to be 65 pounds working pressure.

This gives a 3/8-inch shell, double riveted lap joint, and 3/4-inch rivets at 2 7/8-inch pitch. Thickness of heads may be assumed (on the side of safety) to be the same as heads for a 48-inch diameter tank for the same pressure and obtained directly from Table D, which would give a 7/16-inch convex head or 5/8-inch concave head. The size may also be obtained from the formula given above.

Tube Failure in Watertube Boilers*

Time and experience have pretty well demonstrated that liability to complete disruption, with the destruction of property and loss of life that attends an old-fashioned boiler explosion, is much reduced in the watertube boiler. The casualty statistics, however, show this type to be quite liable to local injury by rupture of the tubes, the bursting of a watertube being a much more frequent mishap than the collapse or failure otherwise of a firetube. While most cases of bursting watertubes undoubtedly result from overheating on account of oil or sediment preventing proper water contact, still there have been many such accidents that were apparently due to a breakdown of the strength and durability of the material under the stresses of long service. The latter cause may be wrongly ascribed for a tube failure on the strength of an absence of foreign matter from the surface of the tube, as revealed by an inspection following the explosion. The fact that no incrustation is found inside an exploded watertube is no indication that the rupture was not due to overheating. The shock at the instant of the explosion is pretty certain to jar the deposits loose, allowing the current of water and steam rushing at high velocity toward the opening to thoroughly wash them out.

When a tube failure results from overheating, the rupture is preceded by a softening and bulging of the overheated area and a consequent distention of the metal, so that when it finally rips open, the edges of the fissure are drawn down to a knife edge. Of course a thin edge along the rip might also indicate a wasting away of the material by corrosion and abrasion; but if such be the case there will be corroborative signs that will be absent if the injury has resulted simply from overheating. One of these signs is that if the tube is measured roundabout from edge to edge of the rupture, the distance will be found to equal the normal circumference of the tube. If the failure has resulted from overheating, the preliminary stretching to which the metal was subjected will be shown by the measurement roundabout at the place of rupture being greater than the normal circumference.

A particularly insidious cause of injury to watertubes is the oil that gets into the boilers in plants where proper means are not used to separate the oil from the exhaust steam that goes to heat the feed water. A very small quantity of oil thus misplaced can do an immense amount of damage. It may also prove very elusive. It may spread out on the metal surface in a film so tenuous, or may combine so unobtrusively with the solid impurities to form sledgy deposits, as to escape even the practical eye and touch of the inspector. Overheating on account of oil usually extends over a larger area, and the resulting rupture is more violent in its effects than where the destructive agent comprises simply the ordinary scale-making ingredients, and these indications furnish the only guide in assigning the true cause of failure in many cases.

Scrupulous care should be exercised to keep oil out of steam boilers. Very often those responsible appear to be lacking in appreciation of the injury it can do, if one is to judge by the indifference manifested toward the oily scum that is to be seen on top of the water in many gage glasses. When a grease line shows in the water glass, it is high time to do some industrious figuring on the problem of purifying the exhaust steam before it mingles with the feed water. Oil-extracting apparatus is to be had, which, if intelligently installed and cared for, will eliminate danger from this source.

But the tubes of a watertube boiler may be free from scale and oily deposits, and still burning and bagging will develop by reason of the extremely hot fires commonly carried in large power stations. The bottom rows of tubes invariably suffer in such service, notwithstanding extreme vigilance to keep them clean. It is possible that the water coursing through these tubes is heated so rapidly that it cannot pass out quickly enough to carry away the globules of steam as fast as generated, with the result that they gather momentarily in pockets next the surface of the tube, thus excluding the water from contact with the metal. It is presumed, of course, that the accumulation of steam bubbles is of very short duration; but with the fierce heat of the furnace impinging directly upon the tubes with the concentrated intensity of a blow torch, it requires but little time to soften the thin area of exposed metal to the bulging point, and a bag is the immediate result. Often a tube is found bagged along the sides. This seems to substantiate the theory of burning on account of steam pockets, since the natural precipitation of foreign particles in the water would evidently result in bags due to this source appearing along the bottom of the tube.

A variety of causes may contribute to the deterioration of watertubes. Of these the corrosive action of acids in the feed water internally and of sulphurous compounds externally are perhaps the most common. The fine fly ash that collects around the ends of the tubes and works in beneath the baffle tiles is also a prevalent source of decay. Removal of these deposits is an item that is generally neglected when the boiler is gone over at cleaning time. Great care will be observed to keep the insides of the tubes clear of corrosive agents, but little attention will be given to the outside. With some makers of watertube boilers the water that is splashed around while washing out works in between the headers and through hollow stay-

* From *Power*.

bolts, thus saturating the deposits of fine ash and initiating a rapid process of corrosion, perhaps utterly spoiling some of the tubes if the boiler stands idle for a considerable space of time. Instances have also been reported of baffled tubes having been worn dangerously thin by rubbing on the tiles due to the constant changing of form in the boiler.

Sometimes a watertube lets go on account of an imperfect weld. In such cases there can be no room for conjecture, the evidence of deficiency in a broken weld being so plain that the cause of the failure is never in doubt. There can be no absolute certainty about the security of a weld. Despite the utmost precaution in the manufacture of lap welded tubes and rigid inspection of the product as it comes from the mill, defects in the welding will now and then crop out. Instances of imperfectly welded tubes continuing in service for months before bursting open have been reported.

The fluctuation of pressure and temperature in the ordinary working of a boiler, by producing a succession of molecular stresses that tend to crystallize the material, is also an active cause of deterioration, although its effects are never manifest to ordinary inspection. Loss of tenacity and ductility, and of the essential property of resilience or springiness, is the inevitable penalty of age in a steam boiler. In watertube boilers the tubes have practically the whole burden of service, since they comprise almost the entire heating surface of the structure; they fulfill, in fact, so far as absorption of heat is concerned, the same purpose as the more substantial furnace sheets of firetube boilers. The tubes should therefore be the objects of critical inspection. As the boiler ages, even though the tubes be kept free from oil and scale and show no visible signs of decay, it might still be the part of prudence to cut one out once in a while, so as to determine by test just what the condition of the material may be.

The most unfortunate thing about a watertube explosion is that it generally means death or painful injury by scalding to the fireman or stoker attendant, and perhaps to others who may be nearby; the damage to the boiler and setting in most cases is small and easily repaired. The menace to human life that is involved is certainly the outstanding reason why every precautionary measure available should be applied to minimize these accidents.

Reconstruction of American Business

(Continued from page 338)

portation and seems inclined to tighten its grip rather than loosen it. Now, transportation is a mighty interesting and important feature in business. The rate on a commodity is to be reckoned with, in buying and selling.

Labor and Wages

The attitude of labor is unknown, but must be reckoned with. It is very evident that labor can neither be paid what it is now receiving, nor can it go back to what it was paid before the war. The government, by fixing the rate in the shipyards, virtually established a rate that the industries in that section had to meet. The tendency seems to be to increase wages on government work. The second Sunday in November, one particular shipyard mechanic made $25. I happen to know of this instance; there may be many others that parallel it.

Just as soon as over-time was cut off, unrest began to manifest itself and strikes appeared. Labor leaders insist that there must be no material reduction in wages. If in the operation of these laws wages begin to seek a lower level, will it be accepted philosophically by labor?

Capital must necessarily be an important factor in getting back to a peace basis. The money of the country has been at the command of the government for the past eighteen months, and it will be needed still more. Renewed industrial activity will also need capital. How much the government will need nobody knows, but it will get what it needs, and the floating of new enterprises and re-financing of old ones will have to wait until the Capital Issues Committee ceases to do business. How long before capital will be so plentiful that financing of industries, utilities and building operations can be done at a reasonable interest rate? How much longer will it be necessary for the government to keep a controlling hand on capital? More bond issues are coming. When and how much?

All of these questions are raised, not that they can be easily answered, but because they enter into the reconstruction period ahead. How they are solved and upon the application of the solution policy depend whether business reacts and lags, or continues with unabated energy.

There is another feature that may be important, although not much has been said about it so far. Undoubtedly, if reports are true, the government has many millions of all kinds of unused supplies. It has been a liberal buyer in everything. These ought not to go to waste. Neither should they be thrown on the market in such a manner as to cause a disturbance in price.

Legislative Work for the Business Man

Any reconstruction policy must of necessity be made effective by appropriate legislation. This policy ought to be formulated by business men and not by theorists or politicians. The average legislator at the National Capitol does not come from the productive industrial ranks; he cannot have the same viewpoint of cause and effect on business as the business man.

That there is to be an extension of government participation in trade and industry is the statement of Burwell S. Cutler, of the Bureau of Foreign and Domestic Commerce, Department of Commerce. He ventures the assertion that there seems to be practically a unanimous opinion that the war will bring about a great extension of government control of, or participation in, trade and industry in the belligerent countries.

Temporary Necessity for Government Monopoly

Even in circles where such extension of government powers is regarded as harmful, there is to be noted an implied admission of its inevitability, not only for the period of reconstruction, when it may be necessary, for the protection of industry and commerce from a too sudden transition to normal existence, but also as a part of the normal economic life of the country. This is largely due to the realization that the ordinary sources of revenue will be insufficient to bear the enormous fiscal burden and that the government will have to go into business to pay for the war. The old objections to government monopoly have lost some of the strength, partly on account of the recent tendencies toward combinations under private control, and also because of the anticipated need of industry and trade during the period of readjustment after the war.

The above views of Mr. Cutler pertain to the European governments rather than to our own. Up to the present time the United States has not formulated a reconstruction policy. The attitude of the European governments, however, must necessarily exercise an influence upon our own government and also upon American business.

The solving of reconstruction problems seems to be put squarely up to the American business men to work out.

How to Design and Lay Out a Boiler—II

Calculation of Proper Tube Expansion—Purpose of Beading—Use of Scant Tube Lengths—Figuring the "Line-Up"

BY WILLIAM C. STROTT*

The exact distance from center to center of girth seams we will now proceed to find. This is dependent upon the length of the tubes as they come from the mill. As will soon be seen, the actual length from face to face (outside) of the heads, or tube sheets, should be at least 1 inch shorter than this.

The tubes must project at least 3/16 inch over each tube sheet to permit of their being expanded into the heads and the ends of tube beaded over. The tube-holes are reamed 1/64 inch large and the edges of plate around the holes rounded to about 1/32 inch to eliminate the cutting action of the tube sheet during the process of expanding the tube into place, as would be the case if the edges around tube holes were left sharp. The tool for this purpose is known as the Rose reamer. Tube expanding is done in two different ways, the most universal method being by means of the "dudgeon" roller expander. The other, and probably by now an obsolete method in commercial work, is done by means of the Prosser, or sectional-spring tube

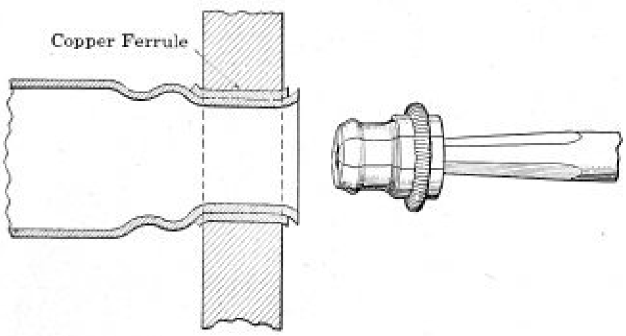


Fig. 5.—Expanding the Tube Into Place by Means of a Prosser Expander

expander. Figs. 5 and 6 illustrate the tools and work performed by the "Prosser" and "Dudgeon" expanders, respectively.

In either method of placing tubes, the fundamental process is the same; the tube is flared at the ends and tightly forced against the tube sheet, so that the resulting friction and nothing else is what gives each tube its great holding power, and, of course, prevents leakage. To the author's mind, the "Prosser" method has nothing to recommend it. Up to a few years ago it was very largely used in first-class locomotive boiler construction, it being presumed that the extra bead on the inside gave the tube additional holding power. Copper ferrules are sometimes interposed between the tubes and tube plates. They serve as cushions against which to roll the tube and are claimed to give a tighter joint.

After the tubes are carefully expanded into place, the projecting 3/16 inch or ¼ inch about which we are speaking is peened over against the tube plate and neatly finished with a beading tool. This tool (shown in Fig. 7) is placed in the pneumatic riveter or "air gun," the same as for a rivet set, and a small groove carefully run around the surplus end of the tube until a neat half-round "bead" is formed. Beading improves the appearance and also is quite effective in protecting the ends of the tubes from the products of combustion. The bead should not be made too thick, else we defeat the very end which we are trying to attain. There will then be too much metal exposed to the fire, and the bead will "burn off." Also, if much more than 3/16 inch of the tube is left projecting (particularly if the gage of the tube is heavy), the beading will be likely

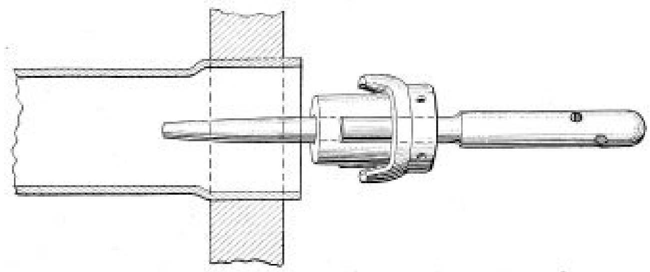


Fig. 6.—Tube Expansion with a Dudgeon Expander

to show many fine cracks, caused by the surplus metal crumpling over upon itself. On commercial work, both front and rear ends of the tubes are beaded, but in locomotive practice only the firebox end of the tubes is beaded. In watertube boilers, beading is never resorted to, since the ends of the tubes are neither exposed to view nor to fire, hence appearance is not paramount.

Another factor with which we have to deal is scant tube length. Some of the tubes may come ½ or 1 inch over the length ordered, while some of them may be even ¼ inch short, or their ends mutilated. It is evident, therefore, that if in laying out the shell we made no further allowance than that required for beading, these scant tubes would have to be scrapped. The only other alternative to pursue, if it were insisted upon that the boiler be exactly 18 feet long, would be to order tubes not less than 18 feet 1 inch long. But tubes of such length might only be gotten on special order and require weeks for delivery.

We will make the shell 17 feet 11 inches long over the heads, thus providing ample allowance for the conditions cited. The distance from the face of the head to the centerline of the rivet circle known to boiler makers as "line-up," should be arrived at as shown in Fig. 8. This

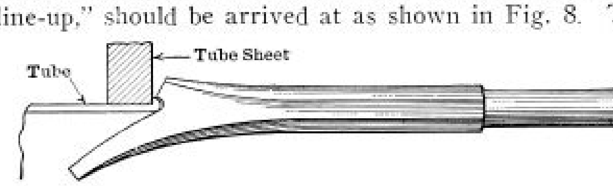


Fig. 7.—Usual Type of Beading Tool

dimension depends on the thickness of the tube sheets, the inside radius of the flange (which should in no case be less than 1 inch), and the rivet gage (*i.e.*, the distance from the centerline of the rivets to the edge of the plate *before calking*, since the latter operation reduces the rivet gage about ⅛ to ¼ inch).

TABLE 3

When the diameter of tube sheet is—

42 inches or under	⅜ inch
Over 42 inches to 54 inches	7/16 inch
Over 54 inches to 72 inches	½ inch
Over 72 inches	9/16 inch

* Designer, Blaw-Knox Company, Pittsburg, Pa., formerly boiler designer, Union Iron Works, Erie, Pa.

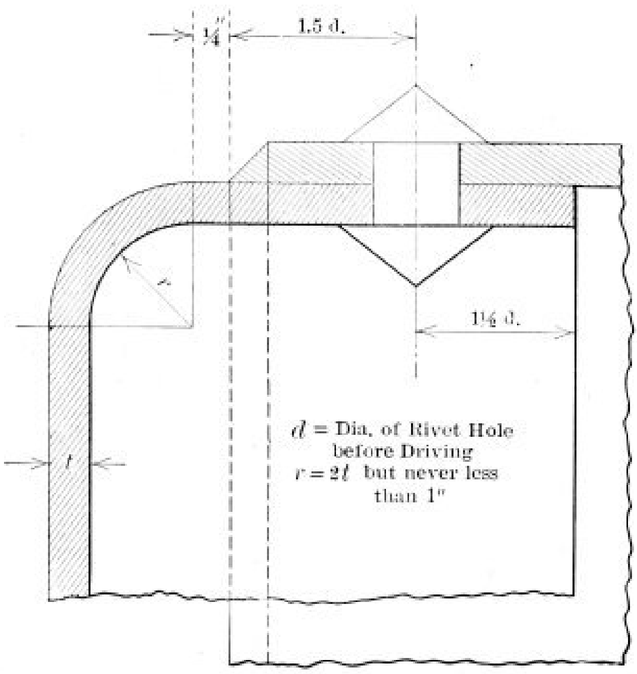


Fig. 8.—Calculation of Distance From Face of the Head to the Center Line of the Rust Circle

Table 3 gives the minimum thickness of tube sheets allowed for different diameters of boilers. The lightest we can use in our boiler is ½ inch, but it is common practice to make them 1/16 inch heavier than the shell. Having figured on 17/32-inch shell plate, the tube sheets ought to be 19/32 inch, but there is really no necessity, however, of a 1/32-inch extra thickness in this instance, so a nominal gage of 9/16 inch will be chosen. Later, after the tube layout has been made and the heads braced, it will be necessary to check this figure by means of a certain formula devised for that purpose. Theoretically, on account of the staying value of the tubes and the diagonal, and through-rod bracing placed in the segments of the heads above and below the tubes, comparatively light plates would be permissible, but the reason certain minimum tube sheet thicknesses are specified is to provide for substantial tube bearing surface in the tube sheet.

The rivet gages must in all cases be made one and one-half times the driven diameter of rivets. The smallest size rivet that should be used with any given thickness of plate is found by the formula:

(3) $d = 1.2 \sqrt{t}$ in which

d = diameter of rivet in inches;
t = thickness of plate in inches.

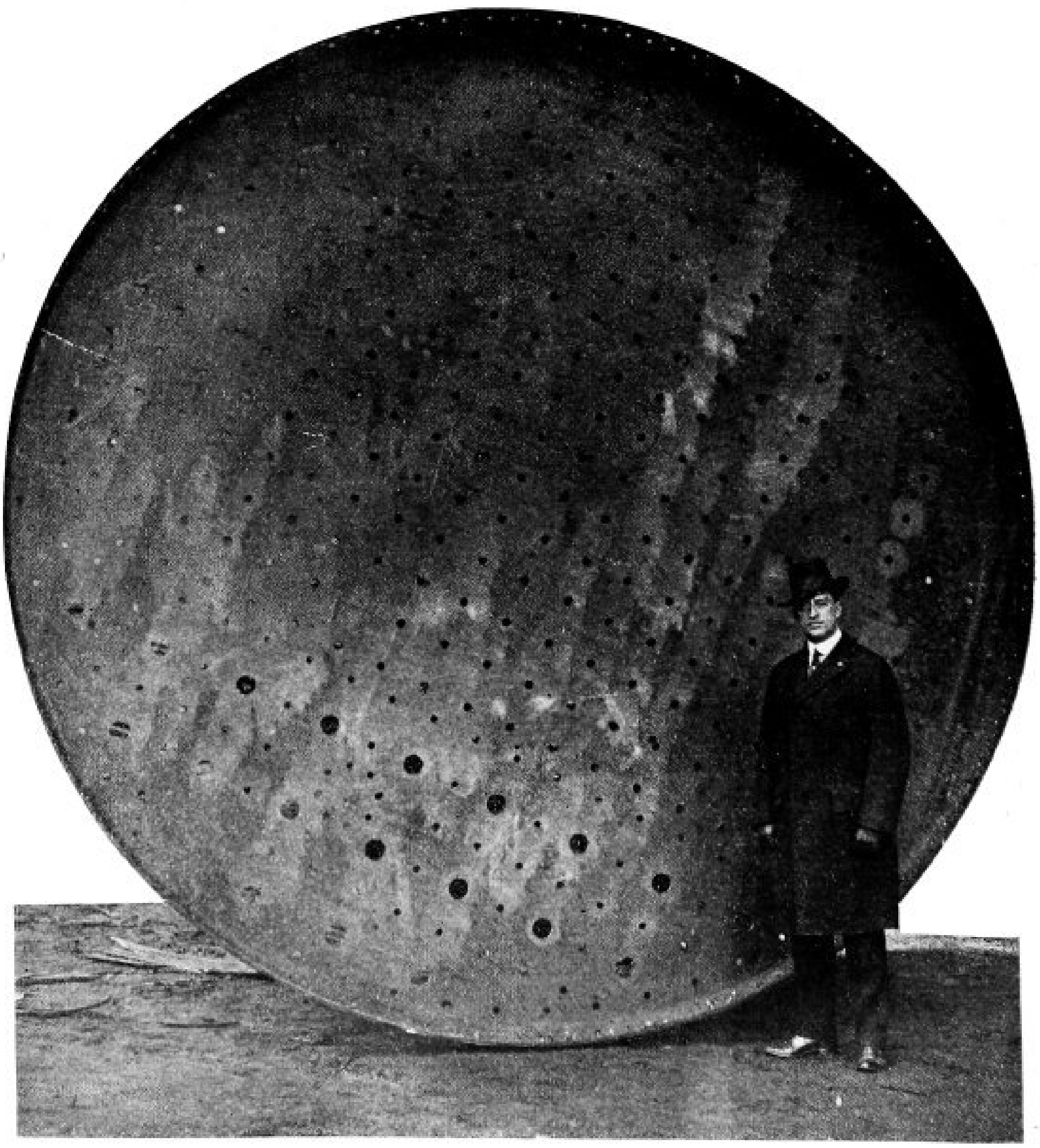
Substituting, we have:

$$d = 1.2 \sqrt{.53125} = 1.2 \times .73, \text{ or } .876 \text{ inches.}$$

We shall use ⅞-inch diameter rivets, which is also in accordance with Table 1. The diameter of the rivet holes must be 15/16 inch, since, if the holes were made the exact size of the rivet, the latter would not enter the holes, due to the expansion of the rivets on being heated. But on being driven they are upset, thus completely filling the hole. The driven rivet diameter is therefore always 1/16 inch greater than that before driving.

The rivet gage is found to be 1.5 × .9375, or approximately 1 7/16 inches. Referring again to Fig. 8, adding up the dimensions found, gives a "line-up" of approximately 1 7/16 inches. Referring again to Fig. 8, adding the calking edge of the plate well back onto the flat surface of the flange, at least ¼ inch. This is desirable, as it offers a good bearing surface for the nose of the calking tool and permits of its proper use, thereby resulting in good workmanship.

(To be continued)



Largest Boiler Head Made From a Single Plate—13 Feet in Diameter and 1 3-16 Inches Thick. This Scotch Boiler Is One of the Type Being Installed Upon *Sea Bird* and Other Trailers by the Portland Shipbuilding Company

The Boiler Maker

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During the war American industries were stimulated to giant tasks. The spirit of the nation was awakened. The flame of endeavor swept through the land. All other considerations were subordinated to the supreme need of the country. How splendidly the great army of industrial workers have done their part is shown by the quick ending of the war. Superhuman efforts have brought miraculous results. All honor to the great industries of the United States for the part they have played in this noble crusade!

But with the return of peace the business of these great industries assumes a new aspect. New conditions must be faced. No longer can the manufacturer depend upon the Government to furnish him with materials and contracts. He must get out and hustle for business as in the days before the war. Now, however, he is saddled with all the bequests of a strenuous war-time period. Prices are high, wages are high, and the cost of living is high. More than likely his plant has suffered from the wear and tear of his ceaseless efforts to supply war needs. Economy of production may not be at the same high level as profits. During the war it was a case of produce the goods in hitherto undreamed-of quantities and ship the finished product almost before the paint was dry. Now it is time to take stock carefully and plan wisely.

The period of reconstruction should not be viewed with alarm. It does not necessarily mean a loss of opportunities. On the contrary, the opportunities in all probability will be greater. Opinions that are worth listening to point to a period of great activity and prosperity. The United States enters upon the era of reconstruction as the richest and most powerful nation in the world. Not only are the men in the shops and the business leaders filled with the vigor of an awakened people but they are heirs to the priceless compensations of a period of sacrifice and common endeavor. Lessons have been learned that will have a permanent influence upon industrial relations. Abuses have been disclosed for which a remedy must be found. New opportunities for business expansion have been developed by the growth of foreign trade—something like $10,000,000 has been added to the yearly income of the boiler making industry from this source alone in the last few years—and this expansion has only just begun.

Boiler manufacturers are alive to this situation. The first steps have already been taken to bring about unity of action in solving the reconstruction problems. A special meeting of the American Boiler Manufacturers' Association will be held at the Hollenden Hotel, Cleveland, on December 16 for the discussion of a programme of action outlined by the Executive Committee of the Association, which has been in attendance at the reconstruction conference of the National Chamber of Commerce in Atlantic City early this month and is prepared to offer some definite lines of action which will be of the greatest importance to every boiler manufacturer in the country. Here is a chance for all to have a hand in shaping the future progress of the boiler making industry. The opportunity is too great to be neglected, and every boiler shop in the country should be represented in the movement to readjust trade and business relations on a more normal basis.

One of the first recommendations made by the iron and steel industry to meet the changed business conditions is a moderate reduction in the scale of maximum prices for their commodities, commencing January 1. This recommendation is made with a view of aiding in sustaining the business equilibrium of the country, and, as the iron and steel industry is commonly regarded as the barometer of trade, the effect of its action will be far-reaching. In announcing this proposed action at a recent meeting of the American Iron and Steel Institute, Judge Gary, chairman of the board of directors of the United States Steel Corporation, sounded a keynote of optimism. He predicted that the next five years in this country will be the most progressive, prosperous and successful of our history, and that the results will astonish even the most optimistic of to-day. Everyone realizes that during the past year prices generally throughout the country have been abnormal and unreasonable. Costs of production will probably be gradually reduced, although it is not expected that they will be brought to the former low levels. Many no doubt will consider that the quickest way to reduce costs is to reduce the wage rate. This, however, does not seem to be the intention of the iron and steel industry, for it is assumed that manufacturers will not favor reduction in the wage rates unless it shall become absolutely necessary. A cut in steel prices, however, will be an initial step in the right direction.

The importance of high grade workmanship in boiler making is well illustrated by the success attained by the large British firm of boiler makers whose work is described in the leading article this month. They have been pioneers in the movement to raise the standards of workmanship; their shops and equipment represent the best modern engineering practice; but, above all, there is a degree of perfection reached by the men who have been trained in these shops that leaves its mark on their work wherever they may be subsequently employed. Good workmanship is not always the result of using good tools; it depends on the man and how he uses them. The example set by this British firm can be copied with profit.

Questions and Answers for Boiler Makers

Information for Those Who Design, Construct, Erect, Inspect and Repair Boilers—Practical Boiler Shop Problems

This department is open to subscribers of THE BOILER MAKER *for the purpose of helping those who desire assistance on practical boiler shop problems. All questions should be definitely stated and clearly written in ink, or typewritten, on one side of the paper, and sketches furnished if necessary.*

Address your communication to the Editor of the Question and Answer Department of THE BOILER MAKER, *6 East 39th street, New York City.*

Punching the Stock for Rings

Q.—Would the bending action about the neutral diameter of a 6-inch or 8-inch ring be the same as in a plate? Would the stretch in the outer flange equal the "upset" in the inner flange? If the action is equal,, I could punch these rings while straight and bend after.

"BUCKER UP."

A.—The neutral line of the stock is supposed to retain its length under all conditions. It is not likely that the inner and outer surfaces of curved work have the same amount of change when the material is distorted. In some cases the stretch of the outside may be much greater than the upset of the inner surface. The smaller the diameter the greater will be the distortion. It would be possible for you to punch the rings by making a proper allowance on the dimensions of the stock so as to form the finished work according to specifications. This could be done by making a layout of the theoretical requirements, and then performing a test, after which the corrected punch and die could be made for producing duplicate work. The problem is one that would have to be considered in all its details, and full data must be secured before the problem can be worked out.

How to Lay Out Pipe Connection

Q.—Please give a layout of pipe connections shown in accompanying drawings. Fig. 4 gives the working drawing in question. E. C.

A.—A general idea of the pipe arrangement is shown in Fig. 3. It will be seen that pipes *A* and *C* lie in the same plane, and that *A* and *B* are in the same plane. The axes *a′ b′ d′*, Fig. 1, and *a b c d*, Fig. 2, are drawn in the same relationship as on the working drawing, Fig. 4. The true angle between pipes *A B* and *C* are found in Fig. 1, before the patterns are laid off and in this manner:

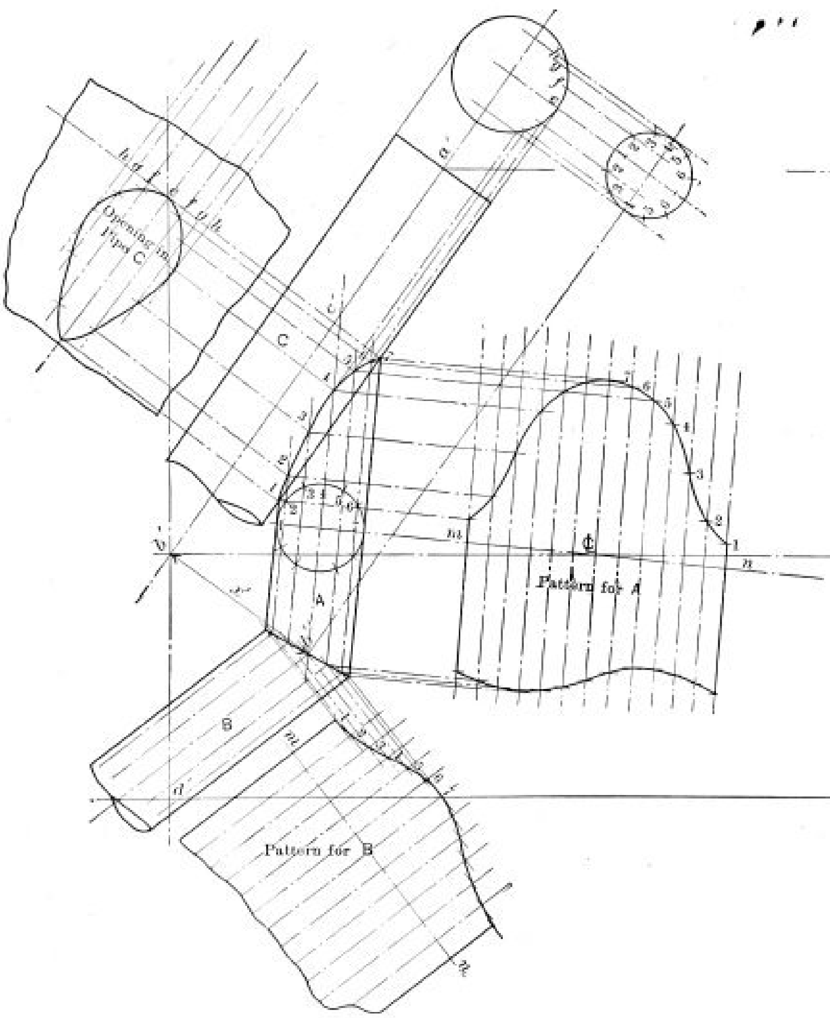


Fig. 1.—Showing Complete Laying Out of Pattern

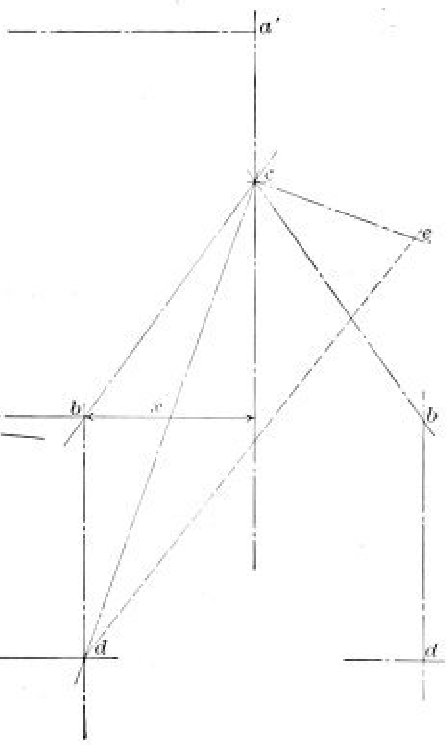


Fig. 2.

At right angles to line *a′ b′* and from point *b′* draw the line *b′ b″*; make *x′* equal to *x* of Fig. 2, and connect *b″ c′* with a straight line. Before the angle *d′b″ c′* is laid off draw the right angle triangle *c d e* in Fig. 2. The base line *c d* connects the extremities of the pipe axes *A* and *B* in this view, and *c-c* equals the distance *x*. The line *e-d* is the true length of *c-d*. Using the line *e-d* and *b-d*, Fig. 2, the angle between pipes *A* and *B* is found as follows:

With *c'* as a center, Fig. 1, and using *e-d*, Fig. 2, as a

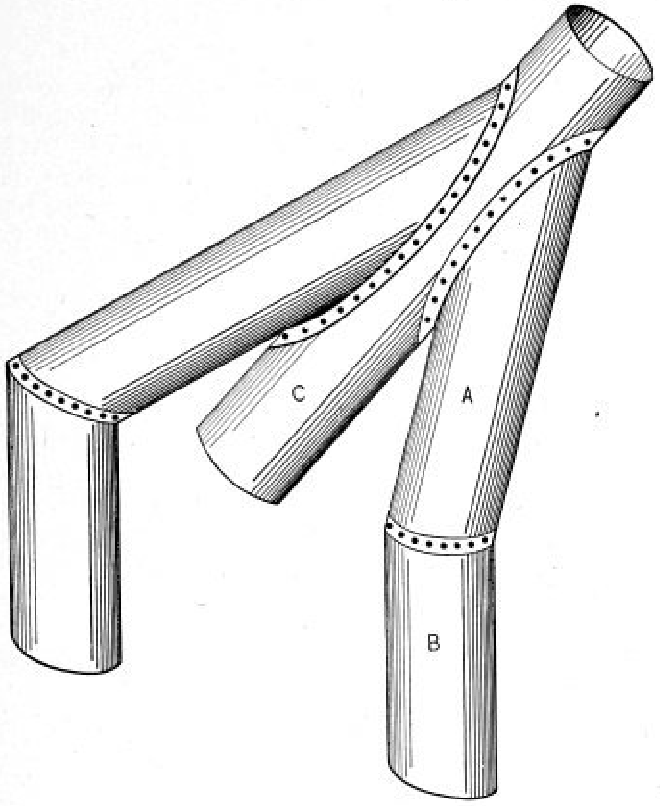


Fig. 3.—Showing General Arrangement of Pipes *A*, *B* and *C*

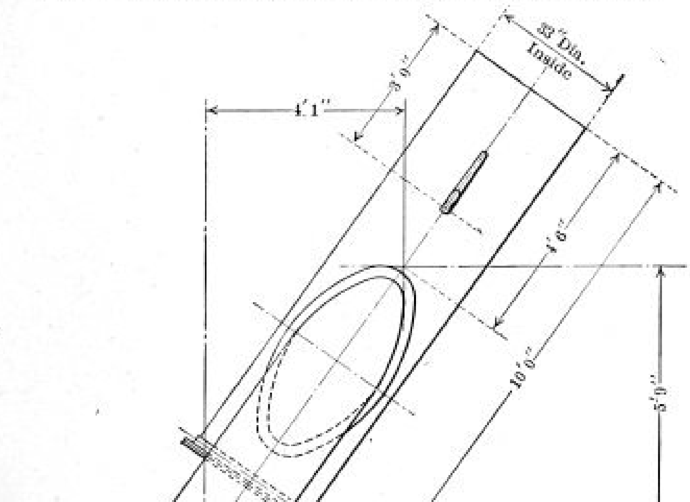


Fig. 4.—Showing Working Drawing of Pipe Connection

radius, describe an arc; with *b-d*, Fig. 2, as a radius and *b''*, Fig. 3, as a center, describe an arc intersecting the one previously drawn in point *d*. Bisect the angle *d b'' c'* and draw in the pipe outlines in the usual way. At right angles to *a' b'*, Fig. 1, draw an end view for pipes *A* and *C* as shown, and draw the miter between them. Pattern for *A* is laid off in this case at right angles to *b'' c'*, but, at the end connecting pipe *B*, the layout is swung around an angle of 90 degrees, so as to have the pipe *B* in its proper position when the pipes are assembled.

Forming Bowling Hoop

Q.—Will you kindly answer the following question through your important journal? What would be the best way of rolling to shape the section of a "Bowling" hoop as per sketch, Fig. 1, and also the best way of fitting it to a boiler; that is, connecting two rings, the hoop being used as a patch? J. H. T.

A.—These hoops could be rolled, but unless a very large

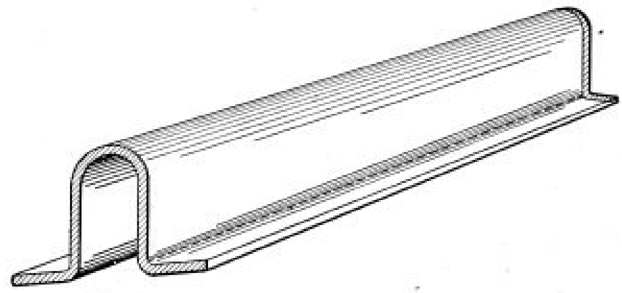


Fig. 1.—Form of Bowling Hoop Required

number are to be made it would be more practical to press them. Use a horizontal press or bulldozer, fitted with cast iron dies. A pair of dies something like that shown in Fig. 2 would be necessary. These are cast hollow, so as to reduce their weight, and they should be strengthened by several rows of ribs. In case the dies must be used continuously, water cooling would be necessary. In order to do this it would be necessary to enclose some of the

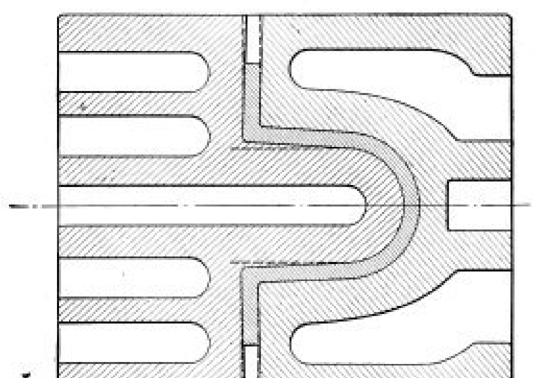


Fig. 2.—Cast Iron Bulldozer Dies for Forming Bowling Hoops—Cross Section

cavities and arrange for a circulation of water through them. The surface of the die for the flanges should recede slightly so as to allow for the spring of the plate when the plunger is withdrawn. The dies would have to be about four feet long.

The designer of the buoys which the Government used in the harbors of the Atlantic coast for supporting the submarine nets, Thomas Duckworth, became chief engineer of the Earl C. Maxwell Company, Brooklyn, N. Y., on December 1. Mr. Duckworth, who was formerly contrating engineer for the Franklin Machine & Steam Boiler Works, is an expert in complicated plate and tank work. He was one of a commission of five engineers called to Washington to design and standardize the tanks mounted upon the military motor trucks.

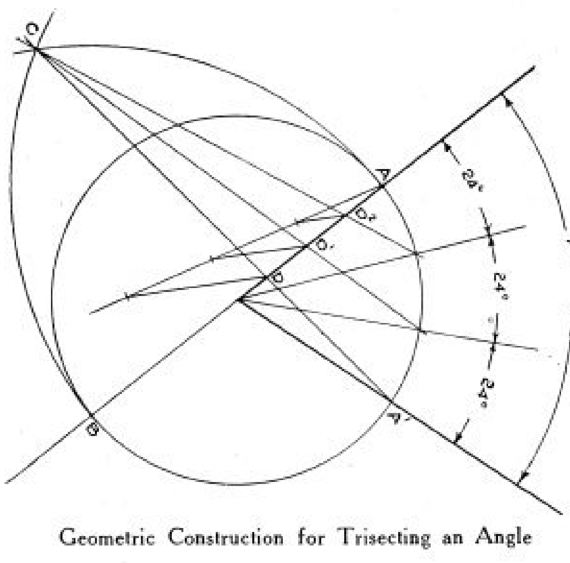
Letters from Practical Boiler Makers

This Department is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

Trisecting an Angle

Under the above heading in the August, 1917, number of The Boiler Maker your correspondent, N. G. Near, asserts the trisection of an angle cannot be done geometrically. I trust you will forgive me for making reference to an article which appeared so far back. The fact is that very often one does not bother about these things until a job comes along in which the particular problem has to be faced. As I was put in this position with the above problem, I thought I would have a try to overcome the difficulty. Now, I think you will agree, after perusal of the solution, that I have found a really good method, which is the essence of simplicity and one which is of a purely geometrical construction.

The solution is based on the following geometric construction. Given any semi-circle it is possible to divide it into any number of parts by the means cited below. Opening the compass to the length of its chord, and with each end of the chord taken alternately as center, strike off two intersecting arcs. Then by dividing the chord,



Geometric Construction for Trisecting an Angle

in this case the diameter, into the same number of parts as we wish to divide the semi-circle, and by drawing lines from the point where the two arcs intersect through these points of division and producing them until they cut the semi-circle, it will be found that the latter is also divided into the same number of equal parts. Any part of the semi-circle or arc can be similarly divided. Hence, if we draw an arc contained in the angle to be trisected, by dividing the arc into three equal parts the points obtained will also trisect the angle, if lines are drawn in from these points to the apex of the given angle.

Here is the method to trisect a given angle: With the apex as center, draw a circle of any radius to cut the two limbs of the angle, as AA^1 in the sketch. Produce one of the limbs to cut the circle at *B*. With *B* as center and *AB* as radius, strike an arc; with the same radius and *A* as center strike another arc, intersecting at *C*. Join A^1 to *C*, cutting *AB* at *D*. Next divide *AD* into three equal parts. To do this, draw a line of any length at any angle from *A*. Mark off three equal divisions (any convenient size, as long as they are all equal). Join the point marking the last division to *D*, and draw parallel lines to this through the other two divisions, cutting *AB* at D^1 and D^2. Then by drawing lines from *C*, passing through D^1 and D^2, and produced to cut the arc contained in the angle, this will give the two points through which the trisecting lines will pass. Join through the intersections to the apex, and these lines trisect the angle.

It will be seen at a glance that by the above method it will be possible to divide an angle into any number of equal parts by simply dividing *AD* into the required number of parts and drawing lines from *C* to pass through each of the points in the same manner as above.

England. R. Price.

How to Lay out a Boiler Hood

To lay out a piece with a round top and rectangular base having a straight side—a pattern commonly called a boiler head or breeching—lay down the plan as indicated in Fig. 1, marking off points *A*, *B*, *C*, *D* and dotted lines *E-I* and *J-G*

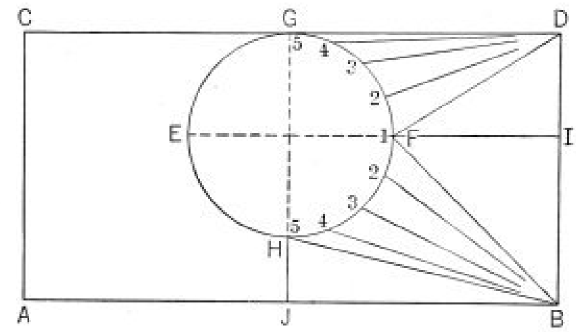


Fig. 1.—Plan

at right angles. With the intersecting point, *O*, as center, scribe a circle, cutting the line *E-I* at *F*. Divide the arc *F-G* into four equal parts; likewise arc *F-H*, marking the points 1, 2, 3, 4, 5 as shown. Work out the development as indicated in Fig. 2. Drawing lines *A-B* and *G-D* at right

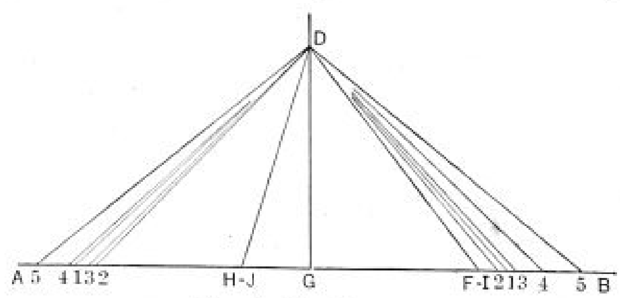


Fig. 2.—Development

angles, mark off lengths on the line *G-B*, Fig. 2, equal in length to *F-I*, *D*1, *D*2, *D*3, *D*4, *D*5, Fig. 1, using *G* as center; also lengths *H-J*, *B*-1, *B*-2, *B*-3, *B*-4, *B*-5 on line *G-A*, using *G* as center.

To lay out the pattern, measure off line *B-D* as indicated in Fig. 3. Laying off the distance of line *D-I*, Fig. 1, upon this line, erect a line perpendicular to *B-D* at this point, *I*. Measure off on the perpendicular, Fig. 2, the height *G-D*, Fig. 5. Connect this point with *F-I*, 1, etc. Now, taking *D*1, thus found in Fig. 2, cut an arc at *F*, Fig.

3. With dividers set to equal spacing on the circle, Fig. 1, and using 1, Fig. 3, as a center, strike an arc. With the line *D2*, Fig. 2, as a radius, and *D*, Fig. 3, as a center, cut an arc through point 2. Do likewise for 3, 4, 5, cutting the arcs with the points previously found as centers. To get the end, take a line the length of line *G-D*, Fig. 2, as a radius, and with point 5, Fig. 3, as center, scribe an arc.

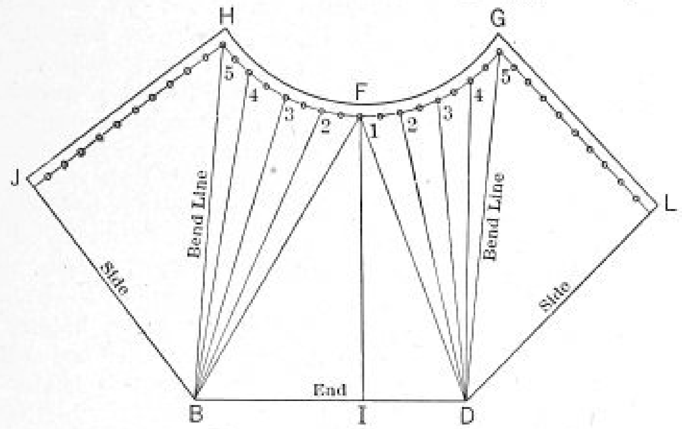


Fig. 3.—Half of Pattern

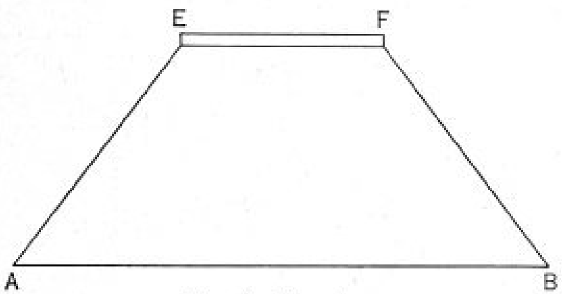


Fig. 4.—Elevation

With the length of line *G-D*, Fig. 1, as a radius and *D*, Fig. 3, as center, scribe another arc. The intersection of these arcs, *L*, connected with point 5, will give the line for the rivet holes, allowing suitable lap.

This completes one-quarter of the pattern. *B1*, *B2*, on the second quarter are laid out in the same manner. Point *J* is likewise found by using distance *D-HJ*, Fig. 2, as radius, and point 5, Fig. 3, as center, and scribing another arc which cuts the arc found by using *B-J*, Fig. 1, as radius, and point *B*, Fig. 3, as center. This completes the laying-out of one-half of the pattern. The circumference should be checked up to see that there is no variation.

CHARLES MILLER.

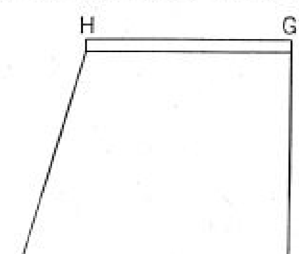


Fig. 5.—Elevation End

Boiler Joint Bolts and Studs

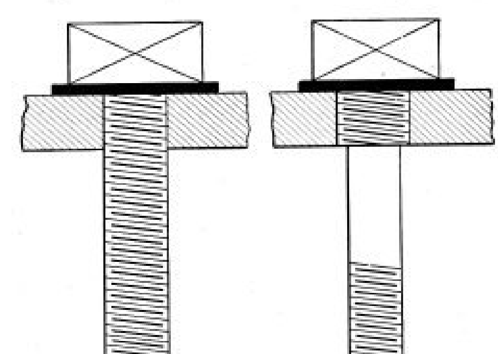
Screwed studs possess many drawbacks. Only the mechanic who has wrestled with refractory specimens is qualified to appreciate their peculiarities. Liable to fracture on small provocation, having a thread which burrs at a touch, rarely if ever axially parallel when congregated in numbers, these studs present annoyances, the chief virtue of which is the patience they develop in the breast of their manipulator.

The average stud "at home" in boiler plate so grows to like its environment that eviction is usually a slow and tedious process. Fractured studs in this connection are the worst of all. In removal it is necessary and essential that the thread in the plate be left intact; if not, a larger stud or a special type having two diameters has to be employed. In fact, so close is the union and so difficult the separation that "two souls with but a single thought" is an appropriate quotation to meet the case. Added to which, unless the eviction or divorce is clean and absolute, the substitute may out of perennial grief weep continually for its discarded relative.

There have been boiler makers who shell out a broken stud with the aid of a set punch and a flogging hammer. Such gentle persuasion has deplorable effects. It is more troublesome to drill out a refractory specimen, but such treatment has a "quality of mercy not strained." Proper removal without heroic remedy obviates the "gentle dew" aforesaid—Shakespeare evidently had some idea of boilers, and more especially of studs, when he coined these phrases.

Drilling, therefore, an eighth less in diameter and cutting a groove just to miss the thread, using a rather blunt cape chisel round the circumference of the amputated stud, should, if the operator is skillful and fortunate, collapse the shell and leave the original clean tapped hole. Yet the strategy sometimes fails. In any event, coaxing and kindness are essential. It is, of course, better to avoid fracture, for studs are a clear case of prevention being better than cure, however ingenious the remedy. Luring a broken stud from its habitation is always a feat, especially in boiler plate, where its lease of the premises seems perpetual.

There are cases where studs cannot be applied, others where an alternative is desirable. There are many connections where a different fastening would be very useful. The problem is to provide a bolt which shall ensure a tight joint. Bolts have this advantage—removal and replacement are the work of a few seconds only. No one pities the repair hand, no one hears his epithets; as a consequence, plain studs will persist to vex him on periodical overhaul when studs invariably meet with casualty, suffer amputation and replacement.


Figs. 1 and 2.—Stud Bolts Which May Be Easily Removed

Where the circumstances of the case admit—and these are numerous—the stud-bolt shown in Fig. 1 has decided advantages. It is more expensive than a plain stud, but, since it is screwed in from the reverse side of the plate on a copper washer, it can be replaced at small trouble, or if a duplicate is not available, a twin diameter stud may take its place. If threaded throughout as in Fig. 2, a regular stud can be used in replacement.

A joint bolt for use in positions where studs cannot be applied is shown in Fig. 3. Where thin plates have to be joined, as in some special small boilers, means must be provided for quick replacement. This rules out regular studs, since the corrosion is severe and the reverse end of the bolt is inaccessible when making the point. The design shown has certain drawbacks and is now more or less obsolete. No matter how tightly the reverse nut is pulled up, there is often a tendency to leak at the joint.

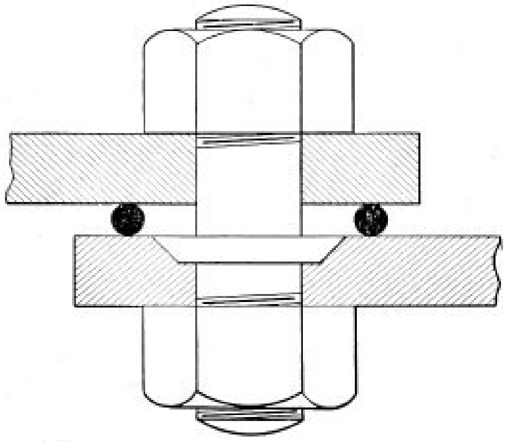


Fig. 3.—Joint Bolt Design for Thin Plates

The more the spanner is used to tighten externally, the worse the job becomes; the two pulls are opposite, consequently the collar does not seat properly.

In portable engines where the steam cylinder is fastened directly to the boiler shell, the casting, because of its radial shape, cannot be placed by studding to the shell. For this work, the type of bolt shown in Fig. 4 is satisfactorily employed. The plate holes are reamed with a tapered reamer. When the bolt is placed in position there should be a clear sixteenth under head which, under the persuasion of the spanner, will pull the head right home flush with the inside of the plate.

A similar construction is illustrated in Fig. 5; such a joint is steam tight against high pressure in a small steaming boiler with thin plates. Actually, this particular case is identical with Fig. 3, for which it is now substituted, the variation from Fig. 4 being the shape of head. The

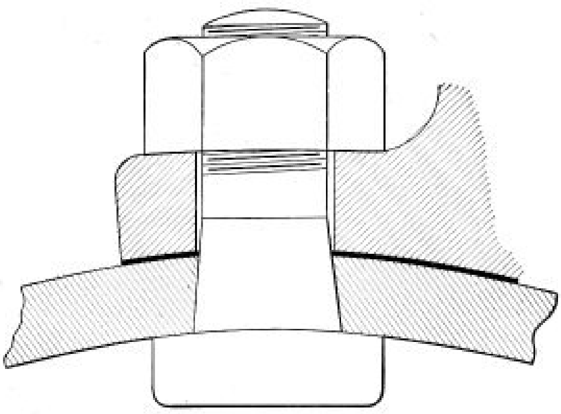


Fig. 4.—Bolt Designed for Boilers of Radial Shape

holes are close up to the limb of angle and the projection of head lodges, thus making the bolt non-rotating in a positive manner.

Attention is invited also to the manner of jointing Figs. 3 and 5 by soft copper wire rings inside and outside of the studs, which give a particularly good, effective metallic joint; needless to add, both faces are machined. This is a type of joint which is coming into vogue where very high pressures are in question. For diameters up to 24 inches, joint rings, unbrazed and dead soft, are now marketed, and for a permanent joint are unequaled. They are little used in boiler work, but in refrigeration practice (in CO_2 work, where the test pressure is 1,500 pounds per square inch) they are universally used and are in many respects the only successful joint. Hydraulic engineers are also coming to use this type of joint for pressures up to two tons per square inch or higher. Boiler pressures are certain to get higher as the number of joints get greater in the watertube and other component types. The copper joint ring has manifold advantages in the connection indicated, provided the flanges themselves are stiff enough to deform the ring.

Returning to the matter of studs, there are remedies to obviate trouble worth adoption. It is to be regretted, from the repair point of view, that they are so rarely applied. Indeed, it is only where studs are distinctly ruled out that an alternative is used. This is the repair man's misfortune, perhaps, for studs cause no end of trouble on periodical overhaul, and so probably, as long as boilers are made, the art of shelling out a fractured stud will never be lost. Lest futile remedies of withdrawal should be cited, the writer mentions that he is aware that by drilling a hole and using a hardened parallel square drift, it is sometimes possible to start out a broken stud.

But no device as yet marketed is of much use for a

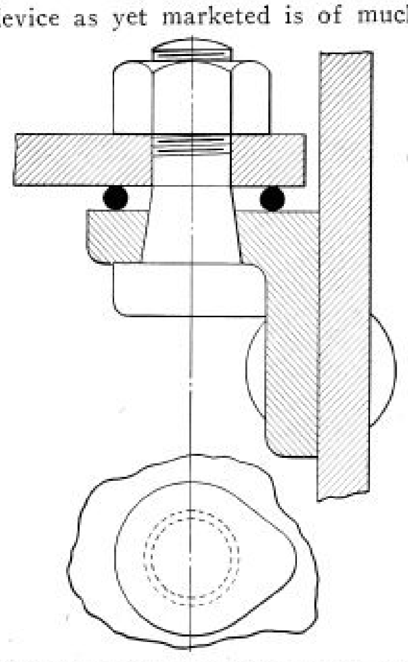


Fig. 5.—More Practical Joint Bolt Design for Thin Plates

machine steel stud in machine steel plate where these have been married for any length of time. Extracting a broken machine steel stud out of a casting is one thing; diverse materials used together separate more readily. Wrought iron studs in machine steel plate or machine steel studs in wrought iron plate—these part company more easily.

A good maxim for the designer is to be generous both in number and size of studs, and also in the scantling of the jointing flange itself. A small fitting secured by a couple of ⅜-inch studs and a weak oval flange is a continual sore place.

Further than this, all mountings should be secured upon pressed steel pads riveted to the shell; screwing direct to the latter should not be permitted under any circumstances. Finally, a joint should be the full size of the flange, unless the mounting flange is itself of steel. The practice of jointing inside studs causes distortion to the flange and distress to the studs.

London, England. A. L. HAAS.

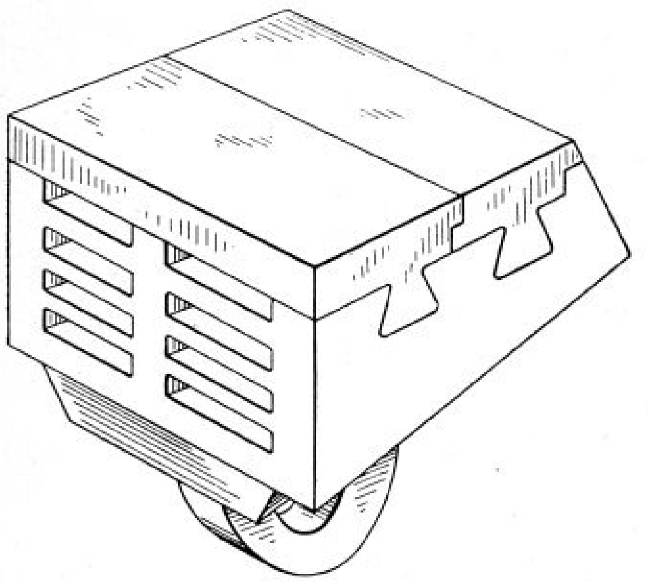
Selected Boiler Patents

Compiled by
GEORGE A. HUTCHINSON, ESQ., Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

Readers wishing copies of patent papers, or any further information regarding any patent described, should correspond with Mr. Hutchison.

1,274,563. FUEL SUPPORT FOR FURNACES. WILLIAM J. KUNZ, OF MILWAUKEE, WIS.

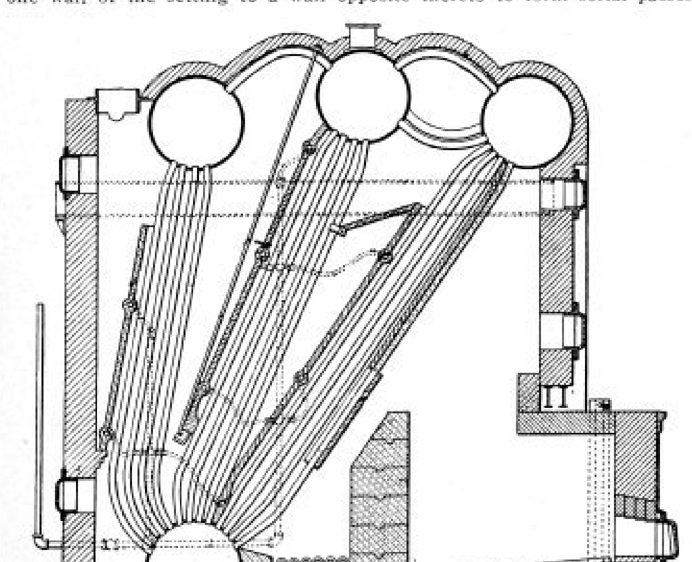
Claim 1.—A fuel support for furnaces, comprising an open body having solid end and back walls and a perforated front wall, the upper edges of the end walls formed with alined dovetailed seats having parallel and in-



clined bottoms, and a closed top having spaced, depending, dovetailed bearings conforming to the seats of the end walls and secured in position by the inclined bottoms thereof, and a transverse central support for the top consisting of a bar-like member extending from the front to the back wall and disposed in a plane above the end wall seats to limit the sliding movement of the top downwardly of the inclined seat bottoms. Two claims.

1,275,366. WATERTUBE BOILER. JOHN E. BELL, OF NEW YORK, N. Y.

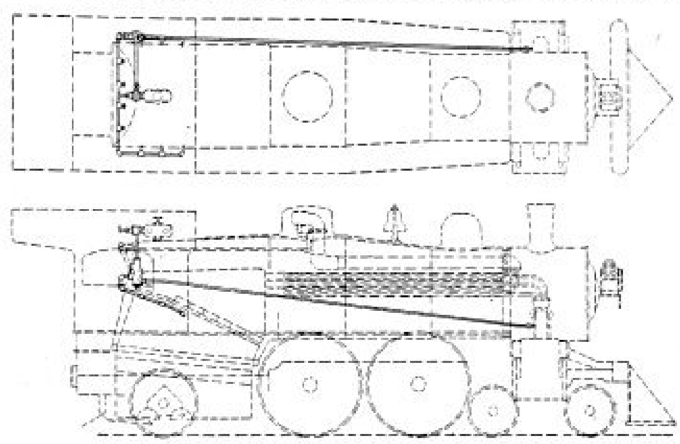
Claim 1.—A boiler setting having a plurality of drums, sets of tubes connecting said drums, a baffle between the sets of tubes extending from one wall of the setting to a wall opposite thereto to form serial passes



for the gases over the tubes, an outlet to the stack from the last pass, a blower pipe in said baffle extending approximately the full width thereof, a plurality of jets extending from the blower pipe on opposite sides thereof, said jets being spaced along the length thereof, and extending in the general direction of the path of the gases to assist the draft and blow the soot toward the outlet, substantially as described. Three claims.

1,275,056. SMOKE-ABATING SYSTEM FOR LOCOMOTIVES. RALPH M. LICKLEY, OF EAST CLEVELAND, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE TALMAGE MANUFACTURING COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

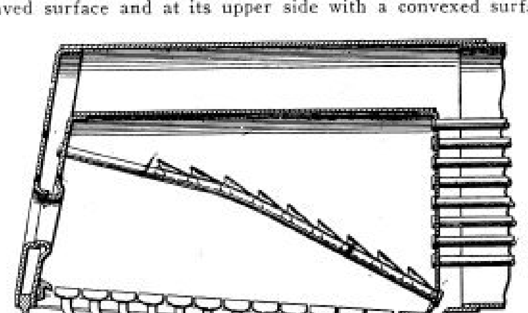
Claim 1.—The combination in a locomotive of a firebox, fire tubes communicating therewith, a boiler, a steam chest, a dry pipe connecting



the boiler with the steam chest, a portion of said dry pipe consisting of a set of pipes located within the fire tubes and constituting a superheater, nozzles discharging into the firebox, a conduit leading to the nozzles, a conduit leading from the supply of saturated steam, a conduit leading from the supply of superheated steam, a valve casing communicating with said three conduits, and a movable valve member in said casing adapted to connect the nozzle conduit with either the superheated steam conduit or the saturated steam conduit. Three claims.

1,275,386. LOCOMOTIVE ARCH-BRICK. EDWARD M. CARROLL, OF PORT TAMPA CITY, FLA.

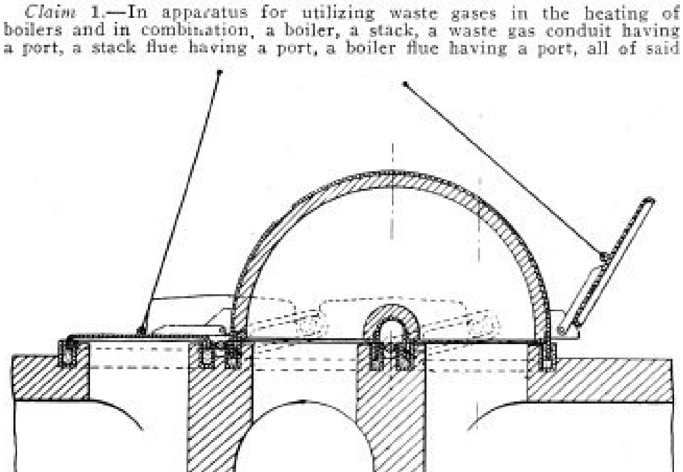
Claim 1.—A brick comprising a body provided at its under side with a concaved surface and at its upper side with a convexed surface, said



surfaces being disposed at an acute angle with relation to each other longitudinally of the body, the under portion of the body being chamfered at one end, and the upper convexed surface having a depression formed therein. Five claims.

1,276,421. MEANS FOR HEATING BOILERS BY WASTE GASES. LAWRENCE S. SCHMIDT, OF PITTSBURG, PA.

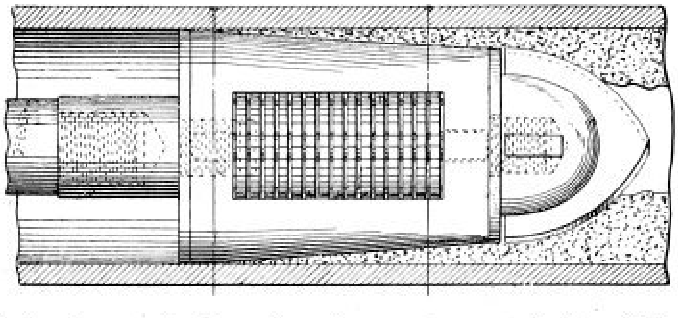
Claim 1.—In apparatus for utilizing waste gases in the heating of boilers and in combination, a boiler, a stack, a waste gas conduit having a port, a stack flue having a port, a boiler flue having a port, all of said



ports arranged in the same horizontal plane and having their axes approximately parallel,; and a reversing valve mounted above said ports for connecting the waste gas conduit with the boiler flue port or the stack flue port at will, the movement of said valve to establish connection with one of said ports acting to produce a total break in the continuity of the connections to the other port. Five claims.

1,275,437. BOILERTUBE CLEANER. LEE E. JILLSON, OF HARTFORD, AND ELIJAH WILLIAMS, OF NEW HAVEN, CONN.

Claim.—A cleaner comprising an elongated externally tapered and internally chambered body, the chamber of which is unobstructed, said body having slots leading from the chamber and extending to the periphery thereof, groups of independently rotative toothed cleaning members, independent shafts on which the groups of cleaner members are respectively mounted, the shafts extending longitudinally of the



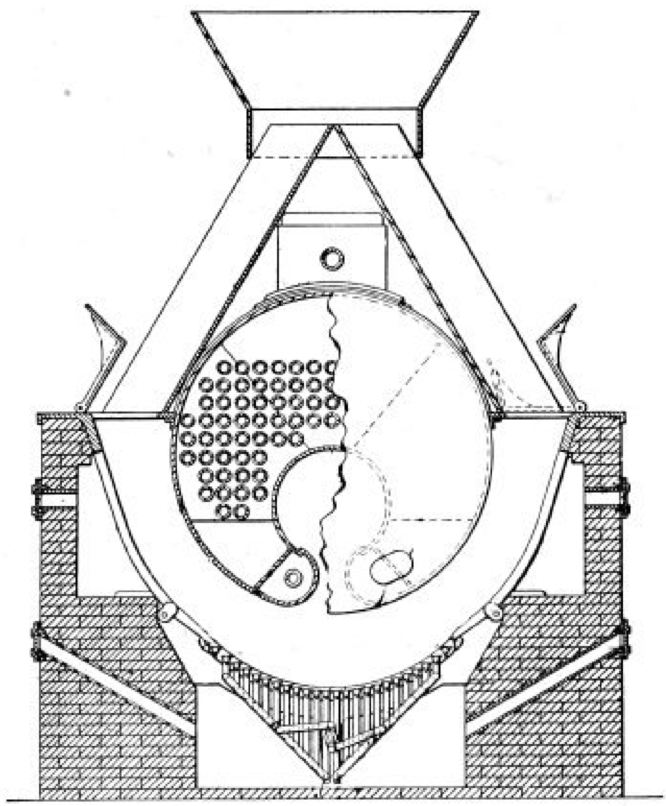
body and converging forwardly on lines agreeing approximately with the angularity of the taper of the body, each of said shafts being movable transversely of the body at both ends thereof and the cleaner members being located practically wholly within the body and their toothed portions extending a short distance across the periphery thereof. One claim.

1,275,986. FURNACE. THOMAS F. F. LEE, OF BROOKLYN, N. Y., ASSIGNOR TO GERTRUDE M. LEE, OF NEW YORK, N. Y.

Claim 1.—In a fuel burning apparatus, a combustion chamber through which the fuel is given a traveling movement, said combustion chamber having fuel confining walls, a refuse discharging area and a gas outlet for the escape of products of combustion, means to substantially confine the combustion supporter and gases to the body of the fuel and to cause them to travel in the direction of movement of said fuel to the said outlet and discharging area, means for feeding the combustion supporter in regulatable quantities to the fuel at intervals along the path of movement thereof, the quantities of the said fuel and of the combustion supporter being so regulated and proportioned relative to each other that the fuel is substantially completely burned. Twenty-five claims.

1,276,395. BOILER FURNACE. ABRAM C. MOTT, JR., OF PHILADELPHIA, PA., ASSIGNOR TO ABRAM COX STOVE COMPANY, OF PHILADELPHIA, PA., A CORPORATION OF PENNSYLVANIA.

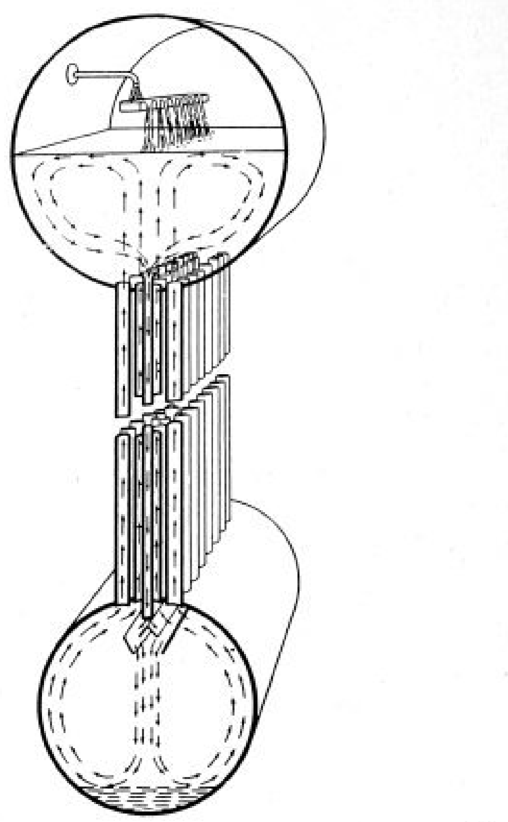
Claim 1.—The combination in a boiler, of a cast metal fire pot section having a water chamber therein; a cast metal dome section made hollow and forming a water chamber and having a contracted neck and an extended base arranged to fit on the upper end of the fire pot section; an



opening at one side of the fire pot section communicating with the water chamber of said section and an opening in the dome section at one side of the center; and means for coupling the two sections together at the openings so that the water will circulate through both sections, leaving the bottom of the dome section exposed to the products of combustion. Six claims.

1,270,621. STEAM BOILER. PAUL KESTNER, OF LILLE, FRANCE.

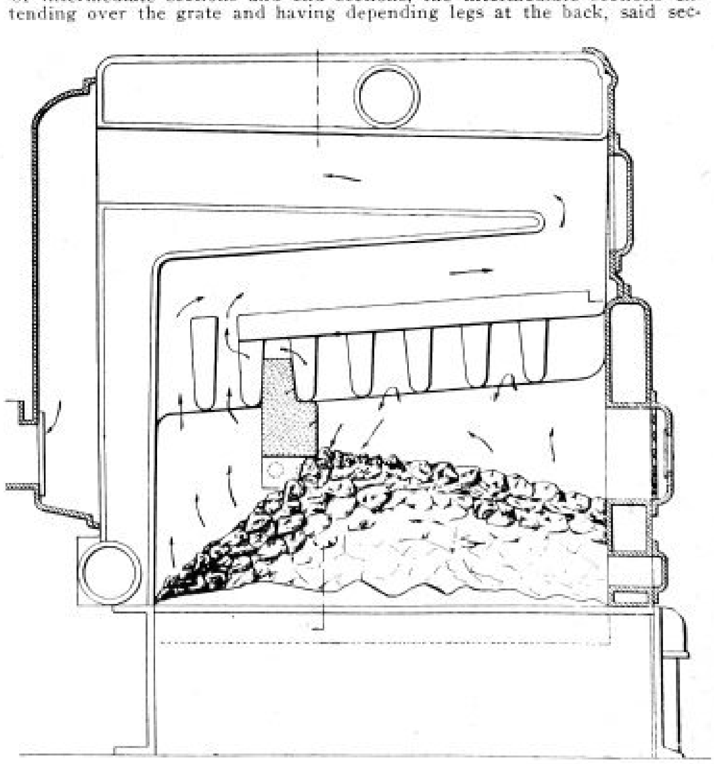
Claim 1.—In a steam generator comprising superposed drums and heated evaporation tubes and non-heated return tubes connecting them, means located within the lower drum whereby each rapidly downward



flowing column of water as this enters the lower drum is converted into a slowly moving column whose direction of flow toward the bottom of the drum is maintained, all for the purposes set forth. Five claims.

1,276,490. BOILER FURNACE. THOMAS D. CASSERLY, OF CHICAGO, ILL., ASSIGNOR TO ABRAM COX STOVE COMPANY, OF PHILADELPHIA, PA., A CORPORATION OF PENNSYLVANIA.

Claim 1.—The combination in a sectional boiler, of a grate; a series of intermediate sections and end sections, the intermediate sections extending over the grate and having depending legs at the back, said sec-



tions having horizontal flues for the passage of the products of combustion in that portion extending over the grate; a separate transverse arch located in the combustion chamber under the overhanging portions of the boiler and extending to a point directly above the grate and spaced from the rear of the boiler formed by the depending legs to form a vertical flue which communicates with the horizontal flue. Three claims.

TRADE PUBLICATIONS

Recuperative Gas Oven Furnaces are described in Bulletin 160, which has just been published by Tate-Jones & Company, Inc., Pittsburg, Pa. "This bulletin is devoted to a complete description of the Tate-Jones recuperative type of furnaces as well as an explanation of their advantages and the economy derived from their use."

"A Quick and Easy Way to Cut Rivets" is described in illustrated Booklet No. 2, published by the Rivet Cutting Gun Company, 220 East Second street, Cincinnati, Ohio. "The flexible rivet cutting gun offers you the quickest, most economical method of cutting rivets. It avoids the slow, expensive work with sledge and cutting bar. It cuts the rivets off cold, thus avoiding damage caused by excessive heat. It reaches the top tie braces on a high top gondola without a scaffold. It cuts rivets in out of the way places under a car or difficult corners where there is little room to work on bridge and structural jobs. It does the work quicker, reduces cost and does not damage the plates."

Automatic Pumps and Receivers are described in Bulletin B-1301, published by the Worthington Pump & Machinery Corporation, 115 Broadway, New York. "Water of condensation in heating systems and in machinery using steam is a source of inefficiency as well as of considerable annoyance; free and unobstructed circulation of steam is desirable, and hammering or pounding in piping due to entrained water may work damage. Furthermore, by allowing this condensate to lose its heat, energy is wasted; prompt withdrawal of this water from the system and the returning of it to the boiler supplying steam introduce an unquestionable economy into the operation of the plant equipment. In this bulletin are illustrated and described a number of types of apparatus manufactured by The Deane Works of the Worthington Pump & Machinery Corporation for the purpose of accomplishing the ends outlined above. This apparatus comprises a receiver or tank into which is drained the discharge from piping or machinery, a pump (steam or electric) which draws the water from the receiver and pumps it back into the boiler under pressure, the necessary automatic devices for regulating these operations and the necessary water and steam or electric connections."

"Little David" Tools are described in a catalogue published by the Ingersoll-Rand Company, 11 Broadway, New York. "Speed of production is the paramount demand being made upon every manufacturing plant. Old tools whose production capacity cannot be speeded up must give way to better tools. Many manufacturers are deriving the advantages of the superior performance of their 'Little David' tools, standardizing on them to the exclusion of all others."

Outside-packed plunger pattern pumps for general service are described by the Worthington Pump & Machinery Corporation, 115 Broadway, New York, in a catalogue just issued. "The outside-packed plunger pattern is designed for rough and heavy services for which the pumps illustrated in the piston pattern bulletin are not suitable. Packed plunger pumps should be employed on all work where the water to be handled contains considerable quantities of sand and grit, where the working pressure to be pumped against is over 140 pounds per square inch, and where it is important that the moving parts are repacked quickly, as in mine pumping plants. In each side of the outside-packed pump there is a plunger working through two deep stuffing-boxes into two water cylinders. This arrangement makes it possible to pack the plungers from the outside without opening up the pump; also any leakage is at once apparent, making it necessary to keep the machine always at its highest pumping efficiency. The valve areas and water passages of these pumps are unusually large, and special care is taken to have all of the water valves easily accessible for inspection and repair. All the moving parts are made to gage and may be readily replaced. The water valve seats, guards and springs are always of composition, and the valves of rubber or of composition metal as may be specified. We have always made a specialty of pumping machinery of this type, and the line of designs and patterns accumulated during many years affords opportunity for the selection of a size and construction best suited for any one of the almost numberless services to which packed plunger pumps are applied. Therefore, when installing a Worthington pump of any capacity, it is never necessary to use a pattern a little too large or too small, a little too heavy or too light, or which has not the valve area and construction which precisely correspond to the requirements. The capacity ratings given in this bulletin are maximum and computed with no allowance for slip. For continuous service these pumps should be operated at 25 to 50 percent less than listed speed."

Kennedy Valves are the subject of a catalogue just published by the Kennedy Valve Manufacturing Company, Elmira, N. Y. "For pressures greater than the ordinary, Kennedy 'Lenticular Type' steam valves have been found decidedly the best. They are made for working pressures up to 250 pounds steam, and are well able to withstand the added expansion stresses of superheat. The greatly increased safety factor figured into their design affords complete protection against strain of metal and possibility of leakage from expansion, contraction, settling of pipes, water hammer, etc. Other Kennedy valve types are designed and constructed for safety, service and convenience, and cover all valve requirements for the handling of steam, water, gas, oil, acids, etc. Five hundred types and sizes from which to make your selection."

Bolt, Nut and Forging Machines are described and illustrated in a 220-page booklet published by the Acme Machinery Company, Cleveland, Ohio. "The Acme die head, because of its correct mechanical principles, has met without exception all demands that have been made upon it for precision, durability and efficiency. Many improvements have been made during the years of its manufacture, all of which have materially added to its working life and efficiency. The design, however, is substantially the same. The Acme die head is made in two types, viz.: The 'Regular' Acme die head and the 'Special Adjustment' Acme die head. They will interchange with Acme bolt cutters of even size and design, and also may be applied to bolt cutters of other makes when the machine design is similar to the Acme machine. The dies interchange in our heads of even size. While the mechanical principle remains the same, the 'Regular' and 'Special Adjustment' die heads differ radically in the method in which the dies are adjusted to size, in that, while the regular die head must be stopped to be adjusted, the special adjustment die head may be adjusted while running at any speed. In the catalogue which follows we have fully explained all the advantages derived from the latest improvements embodied in this head. We shall continue the manufacture of both types of die head. The special adjustment die head will be applied to all new machines unless otherwise ordered, and also kept in stock to replace die heads of the same type. The regular die head will be for sale to parties using bolt cutters of our old type who wish to replace their old heads, or to apply to machines of other makes."

"Reclaim Old Narrow Firebox Engines" is the title of a circular published by the American Arch Company, 30 Church street, New York. "We don't recommend stud supported arches when arch tubes can be used. We do recommend them for narrow firebox engines where stud-supported arches can be securely applied. They protect the flues and staybolts; they reduce boiler work in the roundhouse; they reclaim old, narrow firebox engines into useful power units."

The Brinell Hardness Testing Machine is described in a 12-page bulletin published by the Scientific Materials Company, 711 Forbes street, Pittsburg, Pa. "The importance of the hardness of metals is well known, and specifications for metal products to meet exacting needs almost invariably carry hardness requirements. However, there are different methods of obtaining this hardness value, and there are also different ways in practice of carrying out the same general method. The apparatus with which such tests are made also varies, so that it is often impossible for manufacturer and buyer to get corresponding results for the same piece. Another factor which has been introduced is that of speed; it is not possible to complete hardness tests on 6,000 or 7,000 shells per day by any tedious method, unless a large force is employed at such work. As a solution of the problem of both accuracy and speed the following method and apparatus with which to carry it out is offered. The principles used by Brinell in the method which he originated in 1900 for making hardness tests of metals are those employed, but the manner of carrying out the method has been changed. Brinell's method was that of measuring the indentation made by a hardened steel ball when pressed by a given pressure into the metal to be tested and a hardness numeral calculated, which was the ratio of the pressure on the sphere to the area of the spherical indentation produced. This method is used in preference to the 'rebound method,' in which a pointed hammer falls from a definite height upon the metal to be tested and the height to which the hammer rebounds is noted. Tests showed that the presence of elements which are generally supposed to contribute toughness, materially affected the rebound and registered as hardness. For example, an alloy of 90 percent copper and 10 percent tin tested harder than tool steel by the rebound method."

"Welding solved this crankshaft repair problem," according to an illustrated circular published by the Prest-O-Lite Company, Inc., 818 Speedway, Indianapolis, Ind. "The quick repair of this broken crankshaft is an excellent example of the all-around usefulness of the oxy-acetylene process of welding and cutting. It was next to impossible to effect a permanent repair on this crankshaft by ordinary repair methods. With oxy-acetylene welding it was a simple matter—a new length of shaft was welded on at the break, making the crankshaft good as when new, saving not only the cost of a new shaft but much valuable time. On all kinds of work, in boiler repairs and manufacturing, the oxy-acetylene process has unlimited possibilities for savings. In many classes of work it is rapidly displacing the rivet, bolt and expensive hand cutting. By means of this portable welding outfit hundreds of jobs that were handled at considerable expense by older methods can be done quickly and easily—and at a profit."

"Let Daylight Speed Production" is the title of a bulletin issued by the Asbestos Protected Metal Company, First National Bank building, Pittsburg, Pa. One of the illustrations in this bulletin shows how the Packard Motor Company, of Detroit, makes the most of daylight hours and speeds up production by the maximum diffusion of light to every part of the working floor space, through the use of Waugh Glazing Construction. "This skylight area of 11,600 square feet is but one of the many Waugh installations in this company's plant. An initial sale may result either from good salesmanship or low price—but repeat orders are invariably based upon satisfactory service. Waugh skylights successfully meet all of the objections usually made to other systems of overhead lighting. They practically eliminate glass breakage, as the supporting bar is a standard rolled steel beam, designed in each case to carry the required loads without deflection. The asphaltic glass cushion offers a resilient bed for the glass, and together with the cap-filler of the same material, adheres to and seals the glass against leakage—a perfect waterproof, permanent joint. And all metal parts, including the exposed cap on top, are rust-proofed by the APM process—they never require painting. The first cost is the only cost. Let us show you how Waugh glazing can increase your production and profits. Bulletin 5812 gives details and shows important installations that offer convincing evidence. Send for it to-day."

The Scully Flue Hole Cutter is one of the boiler makers' tools described in a catalogue published by the Scully Steel & Iron Company, 2364 South Ashland avenue, Chicago, Ill. "Made of steel throughout with tool steel knives and reamers. Knives are made of high-speed steel. They are 4½ inches long, and are the same shape and size throughout their entire length and can be ground on the end until quite short. The knives are held firmly in the body by set screws, which also are set into the body. No projecting parts."

"Ideal" Automatic Governors are described by the Ideal Automatic Governor Company, Newark, N. J., in a circular just issued. "Ideal automatic governors are oil-controlled, piston-actuated, pressure-controlling valves for governing pumps for salt and fresh water, oil, ammonia, air, gas, etc. They are extremely sensitive, with the patented exclusive feature of an oil body in the hydraulic pressure cylinder, against the lower head of the hydraulic-pressure-actuated piston which operates the valve in the power line to the pump. This body of oil prevents the liquid being pumped from reaching the hydraulic pressure cylinder, and thus prevents any sticking of the piston from corrosion or on account of grit or sediment in the liquid being pumped. An oil trap provides for settling of foreign matter, etc., and for retaining a sufficient body of oil in the cylinder to constantly bathe the cylinder walls, piston and packing in lubricant. The material used in constructing governors for high duty service is Navy composition bronze or steel; for less exacting service, steam composition or cast iron. 'Ideal' automatic governors are constructed either to maintain a constant pressure (Style A), or to permit of variation of the pressure maintained as desired (Styles B, B-1, B-2), and are used for controlling automatic fire sprinkling system pumps, elevator pumps, turbine step bearing pumps, hydraulic pumps, ammonia, gas and air compressors, and any other apparatus requiring sensitive, reliable automatic pressure control of steam, water or pneumatic power. They have been approved and adopted by the United States navy and by the National Board of Supervising Inspectors of Steam Vessels, for controlling salt water fire pumps, salt water sanitary pumps, bulkhead collision door pumps, fresh water pumps, clutch pumps, hydraulic pumps, ash pumps, forced feed lubricating pumps, ammonia and air compressors, etc."

Horizontal Punches are among the boiler makers' tools and machinery described by the Hilles & Jones Company in a circular recently issued. These punches are "built with throat depths and capacities to suit requirements—belt or motor drive. Many types of cast steel die holders can be furnished, so that a great variety of flanged or straight plate work, as well as structural work, can be conveniently handled on these tools. The flywheel and gearing are below the top of machine, thus making the handling of irregular work more convenient."

Something New in Staybolt Taps.—The past five years have been devoted by W. L. Brubaker & Bros., 50 Church street, New York, to the tempering of a staybolt tap that would stand up under all conditions. "At last we have succeeded in producing a special temper in our staybolt taps that will give you better and greater service. Twenty percent more holes is guaranteed per tap and cutting is easier, due to our special method of relieving. Special temper prevents breakage. Will be to size, 'one to size, all to size,' and will allow greater speed in motor. Prompt deliveries—five days for regular sizes, ten days for special sizes."

"Not as Serious as It Looks" is the caption of a picture of a broken gear wheel in Bulletin No. 300, published by the Oxweld Acetylene Company, Newark, N. J. "An appalling accident, yes—but it took place in an up-to-date factory where all broken machine parts are quickly repaired with an Oxweld blowpipe. It took the welder on the job less than six hours to make this big gear wheel as good as new. With this Oxweld blowpipe and equipment, built for the purpose, he saved hundreds and possibly thousands of dollars that would have been lost waiting for a new casting to come from the foundry. Such accidents are common in factories of all sorts. Your turn may be next. When it comes will you be prepared? Why not write and ask us to-day for Bulletin Series 300, a compilation of facts and figures covering the earnings of Oxweld equipment in factories operated by your competitors?"

BUSINESS NOTES

The Army and Navy Staff Departments continue to demand men of engineering experience, especially in industrial lines. At present the outlook is that this demand will continue throughout the period of the war. In calling attention to this the United States Public Service Reserve, Washington, D. C. (where records of men willing to serve when called will be kept on file), points out that a man of engineering experience has a rare combination of opportunities open to him, which are not open to the average patriotic American, as follows: 1. To serve the country in his most effective capacity. 2. To keep in touch with his own profession, with the result that his patriotic service will not have caused him to become rusty by the time peace returns. 3. To become a commissioned officer and receive much better pay than the average man who has wholly subordinated personal interests and now works for the national good. 4. To perform his service usually without leaving the United States.

New Organization for Little Giant.—After an existence of nine years as a department of the Chicago Pneumatic Tool Company, the motor truck interests of the company were on January 1 taken over by a new organization known as The Little Giant Truck Company. From small beginnings the motor truck department of the tool company had grown to such proportions that a separate organization to handle its many and varied interests became absolutely necessary—this growth was particularly marked during the past year. A good staff of active dealers, eager to ally themselves with a twenty-five-year-old concern—a complete line of motor trucks from 1 to 5 tons capacity—the Duntley Gas Generator, which permits the use of cheap fuels, such as kerosene and distillate, as an exclusive feature—have helped to build up the prestige of the Little Giant truck, and to practically double the volume of business during 1917. As to the outlook, the factory at Chicago Heights has an amount of business on its books that will take months to complete, notwithstanding increased facilities for manufacturing which have recently been added. Just at present, slippery streets, the rising cost of horseflesh and horsefeed, the shortage of labor, the unqualified endorsement of motor trucks by the railroads in the present traffic congestion, are factors which spell optimism for the motor truck business. The Little Giant Truck Company is owned and controlled by the Chicago Pneumatic Tool Company, and the officers are the same—W. O. Duntley, president; W. B. Seelig, secretary; L. Beardsley, treasurer, with T. J. Hudson, sales manager. The headquarters will remain in the Little Giant building, 1615 Michigan avenue, as heretofore.

TRADE PUBLICATIONS

Taps, Dies and Reamers are the subject of a profusely illustrated booklet of 112 pages, which has just been published by W. L. Brubaker & Bros., 50 Church street, New York. This catalogue covers a complete list of the company's tools of sizes and dimensions that are considered standard. W. L. Brubaker & Bros. also manufacture any special style of taps, reamers, dies, etc., to sketch or blue print.

Cleveland Punches are described in a catalogue published by the Cleveland Punch & Shear Works Company, Cleveland, Ohio. "Cleveland punches speak for themselves. What we have put into them, in the way of design, material and construction is your gain as well as our own. Every Cleveland punch is of solid semi-steel frame construction, only a core being left through which the shaft revolves. This offers extra strength where strength is needed. There's an adjustable eccentric clutch release. The bearings are polished and ground to size; hammered steel main shaft; protected external gearings which forestall accident. Cleveland punches are essential to best work in the fabricating of iron and steel. We make this claim and our customers have proved its fairness."

"Could We Make War on Germany Without Welding and Cutting Blowpipes?" is the question asked in a circular published by the Oxweld Acetylene Company, Newark, N. J. Take the oxy-acetylene process away from the iron and steel industries and this is what would happen: The Liberty Motor programme would have to be cut in two, the German ships now carrying our boys to Europe would still be in our shipyards, and tens of thousands of foundries, mills, shops and factories would be unable to fill their contracts. The facts and figures covering results in many thousands of different applications are now available in bulletin form. We shall be pleased to send you the copies of special interest to your own industry. Oxweld equipment and service is playing a mighty part in all this great programme. Readers of this journal will find the data and figures well worth studying and we will be pleased to send them on request."

Boiler Corrosion is the subject of a circular published by the Bird-Archer Company, 90 West street, New York. "Where pitting or corrosion takes place in boilers there is present one or more preventable causes. Chief among these causes are galvanic action and acid action. Galvanic action is the continuous dislocation of particles of metal from tubes or sheets by minute electric currents. Acid action is oxidization of the metal by chemical process, usually under scale. Either or both of these actions can be immediately interrupted by using 'Polarized.'"

"Yale Hoists Ease Labor and Increase Efficiency," according to a catalogue issued by the Yale & Towne Manufacturing Company, 9 East Fortieth street, New York. "The Yale spur-geared block conserves the time and energy of the operator, lessening the effort required to handle materials to and from machine; increasing his working capacity, assuring his safety. The Yale spur-geared block adds to the output of each machine, saving time in each operation of placing and removing the job, adding to production capacity of the individual worker and the machine.

"Flexible as a Giant Whiplash" is the title of a folder published by the National Tube Company, Pittsburg, Pa. This folder describes the wonderful experience of 500 feet of 4-inch "National" rotary pipe blown out of a well belonging to the Ada Bell Oil Company, Batson, Texas. "This well was 2,000 feet deep, when they commenced to pull out the pipe to change the bit. They had all the pipe out of the ground except 26 lengths, when the gas began to show up. They screwed the swivel in the pipe to try and hold the pressure down, but the gas got the best of them and blew the pipe completely out of the well without making a sign of a break in a single joint of the 26 lengths. The swivel on top of the pipe struck the ground about 75 or 80 feet from the bottom of the derrick. The rest of the pipe continued to elbow right on through the side of the derrick, making a loop, or, in other words, just like cracking a whip. The bit landing farthest from the derrick was in the neihborhood of 350 feet from the swivel. This is the most marvelous thing that I have ever seen in the oil fields, and has caused considerable talk among oil drillers in South Texas oil fields."

The use of "Thor" pneumatic tools in shipyards is the subject of a bulletin published by the Independent Pneumatic Tool Company, 1307 Michigan avenue, Chicago, Ill. "When a workman hears that a pneumatic tool or an electric drill is built by Thor, he is usually satisfied that it is just the tool he wants. He knows that the tool will have excess power and speed, extreme light weight, ease of operation and low upkeep cost. Also, that it will be on the job continuously and not in the repair shop at a time when it is most needed. Thor tools are especially in demand among piece-workers, who will have nothing but the best."

The "Quickwork" Rotary Shear is described in Catalogue 50 issued by the Quickwork Company, 807 Scotten avenue, Detroit, Mich. "This Type 4A 'Quickwork' rotary shear cuts ⅜-inch steel and lighter gages to reverse radii of 3 inches or 6-inch diameter hole without cutting in from edge of sheet. This is an exclusive 'Quickwork' feature. It has three changes of speed, any one of which is instantly controlled by lever. Started and stopped at any point of cut. Upper cutter is raised and lowered by worm gear. Forty-eight-inch throat, weighs about 8,000 pounds. Constructed of the very best of material throughout. Fully guaranteed. Send for sample cuttings executed on this shear. Write for new Catalogue 50."

The Breakage of Staybolts is the subject of a circular published by the Flannery Bolt Company, Vanadium Building, Pittsburgh, Pa. "Staybolt breakage, sheet cracking, seam and flue leakage and flange cracking are largely due to unequal expansion of the firebox owing to rigid staying. Compensation should be introduced for the causes that tend to disintegrate, and finally rupture the material connections to the firebox construction. It is not a question of material, as ordinary staybolt iron is the best that can be secured for the purpose. But no material will withstand stresses that exceed its strength. It's a question of compensating for expansion. The firebox is subject to untimely failures due to the stress of unequal expansion between the firebox and wrapper sheet when rigidly stayed. The Tate flexible staybolt is rapidly proving the futility of the rigid staybolt. It affords flexible connections. It accommodates the difference in expansion between plates. It can be adjusted to suit the difference in sheet expansion. It raises the value of the locomotive as an earning factor in prolonging the life and reducing the maintenance cost of the firebox."

The Value of Oxy-Acetylene and Davis-Bournonville apparatus is set forth in a circular published by the Davis-Bournonville Company, Jersey City, N. J. "Exclusive developments in mechanical cutting and welding with oxy-acetylene and oxy-hydrogen have been of invaluable assistance to metal workers, coupled with highest efficiency in results and lowest operating cost. The Radiagraph cuts from ½ inch to 20 inches steel plate, in straight lines or circles. The Oxygraph cuts in any direction, according to pattern or drawing, along straight lines, curves or sharp angles. Speed from 3 to 18 inches per minute, according to thickness. Davis apparatus has been continuously and effectively developed from the time the company brought the positive, independent pressure system of oxy-acetylene welding and cutting to the United States ten years ago, and is backed by the longest practical experience, greatest development, and widest application, providing portable hand welding and cutting outfits or the most complete installations with aceylene and oxygen and hydrogen producing and compressing plants."

"Doing Their Bit" is the title of a circular describing "Imperial" welding equipment, published by the Imperial Brass Manufacturing Company, 1204 West Harrison street, Chicago, Ill. "Every day Imperial welding and cutting equipment is being relied on to speed up production and cut costs in hundreds of American factories, machine shops, shipyards, garages and in out-of-the-way lumbering camps and mines. When heavy, important machinery breaks, the possession of an Imperial outfit insures against the halting of plant operations to wait for a replacement with new parts. A competent mechanic with an Imperiad cutting torch can repair the most serious fracture in a minimum of time. To manufacturers of anything in metal, Imperial equipment is indispensable. Costly, inefficient, old-fashioned processes of riveting and bolting to join metal to metal are done away with. As a reclaimer of scrap metal piles an Imperial outfit is a miracle worker. Millions of dollars are being saved by renewing the life of old machinery which a few years ago would have been cast aside as junk. First in speed, economy, safety and convenience, every Imperial outfit at work will earn its original cost several times over in the course of a year. Write us to-day for complete information, data regarding actual work done, etc."

A Stock List of Cutters has been published by the Cleveland Milling Machine Company, Cleveland, Ohio. "On the following pages we list our standard cutters which are in stock and from which immediate shipment can be made. In ordering, state whether high speed steel or carbon steel is desired. We are equipped for the production of special tools and are always ready to submit specifications and prices upon application."

"Little David" Pneumatic Tools are described in a "Little David" catalogue published by the Ingersoll-Rand Company, 11 Broadway, New York. According to the manufacturer, "'Little David' pneumatic tools have definitely proved that their use is marked by a saving in air consumed and a decrease in the cost of tool maintenance. These economies are directly due to the perfected design of 'Little David' tools and the high standard of Ingersoll-Rand workmanship. 'Little Davids' are simpler than others and individual parts are relatively stronger and less liable to defection. You will profit by adopting 'Little Davids' as standard."

Kelly Boiler Fronts are described in illustrated Catalogue "G," published by the Kelly Foundry & Machine Company, 623 Ninth street, Goshen, Ind. "During the past thirty years we have accumulated a large variety of patterns covering many styles and sizes. This enables us to furnish special work on short notice and at a nominal cost for patterns. Our catalogue shows our complete line of boiler fronts and trimmings, rocking and dumping and stationary grates, firebox and upright boiler castings, etc. Price list and full description in catalogue 'G,' mailed on request."

The "Combination" Tube Hole Cutter, manufactured by Mooney & Baumann, 159 Linwood street, Brooklyn, N. Y., is described by the manufacturer as follows, in a circular recently published: "Shipbuilders and boiler makers save money by using our 'Combination' tube hole cutter. Strongest, best and cheapest on the market. Patent pending. Try one and be convinced. A hole finished each minute through ½-inch plates. We guarantee it to the limit. Three tools combined in one; it cuts perfectly round holes, reams them and removes edges all in one operation and leaves them true to size. Show this to your foreman. Experienced men can judge at a glance. Send for catalogue now."

"Standard Specifications" (sixth edition) is the title of a 168-page pamphlet published by the Carnegie Steel Company, Carnegie Building, Pittsburg, Pa. This booklet covers specifications of steel for locomotives, boilers and rivets, ships, bridges, buildings, concrete reinforcement, wheels and gear blanks, axles and shafts, etc. It is an invaluable booklet of its kind and should be in the hands of the purchasing agent of every boiler and locomotive shop and shipyard in the country.

Globe, Angle and Cross Valves are described by The Lunkenheimer Company, Cincinnati, Ohio, in Booklet 570-BE. Speaking of these valves the booklet states: "Their reliability has been proved under all service conditions. They incorporate many improvements in design, including the well-known Lunkenheimer 'seat guard,' which aids in preserving the seating faces and keeping them clean. The seating surfaces are regrindable; bearings are bushed to reduce wear, and all parts, including the seat ring and disk, are renewable. The materials used and the workmanship are of that high quality which characterizes all Lunkenheimer products; standard pattern for 125 pounds; heavy for 175 pounds, and extra heavy for 250 pounds working steam pressure. Buy the best—they are the cheapest."

Extracts from Smooth-On Instruction Book No. 16 are published in vest-pocket size by the Smooth-On Manufacturing Company, Jersey City, N. J. Smooth-On Iron Cements, Nos. 1 and 2, are described as follows: "Smooth-On Iron Cements Nos. 1 and 2 are chemically prepared iron compounds made and sold in a powder form and used by mixing with water to the consistency of stiff putty. No. 1 is quick hardening. No. 2 is slower hardening and hydraulic. When in this putty state they must be applied immediately, because the metallizing action of these cements is rapid, acting without heat, and in a few minutes the putty will get too stiff to work or manipulate. These cements are unequaled for stopping leaks of steam, water, fire or oil, because they become metallic iron that has the same expansion and contraction as iron, thus keeping the joint tight at all temperatures, and joints can easily be taken apart. While metallizing these cements expand in bulk, and it is this action that makes them valuable for mechanical uses. Sold in blue labeled tins like the above. Not sold in bulk."

Tube Cutters are described and illustrated in a circular published by the Scully Steel & Iron Company, 2364 South Ashland avenue, Chicago, Ill. Of the "Ideal" self feed cutter, the circular states: "This is the only cutter on the market that has solved the problem of cutting off new steel tubes with a bevel, ready for beading, without cracking them. The Ideal will cut off tubes either inside or outside of boiler head. The same circular illustrates the Thornton flue cutter for use in connection with reversible air drills.

"Two Men Able to Do the Work of Ten" is the statement made in Catalogue A, just published by the Rivet Cutting Gun Company, 230 East Second street, Cincinnati, Ohio. "Speed and economy are two of the most important factors in shipbuilding just now. It is difficult to secure men, and costs must be kept down. Where rivets can be cut off on the inside of ships 14⅞ rivets can be cut off in one minute with a flexible Rivet Cutting Gun. The above illustration shows a gun at work in one of the biggest shipbuilding plants in this country, where it is used to cut rivets and back countersunk rivets out. The gun paid for itself in a few days. Catalogue A will interest you. Send for it to-day."

The Alinder Power Hammer is described by the Alinder Hammer Company, First National Bank building, Milwaukee, Wis., in a bulletin recently issued. "In designing and perfecting the Alinder Hammer our sole aim has been to offer a power hammer corect in principle and design—properly proportioned—incomparable in performance—a hammer that will meet the requirements of those who want the very best equipment. Every necessary and desirable function of a power hammer has been perfected. All undesirable mechanisms have been eliminated—we do not use leather straps, rubber cushions, wooden arms, links, rollers or weak springs. The ram comes down on the work with full force and remains for an instant, allowing a fraction of a second for the forging to absorb the full effects of the blow. The ram does not lift off of the forging until the full force of the blow has been completely used in useful work. Alinder hammers are universal in their application to all kinds of work—while the power is there to forge heavy stock, a knife blade can easily be forged without changing the adjustment. The stroke is snappy, alive and positive—the ram comes down against the die in all positions, whether set for long or short strokes. Both the wide and narow sides of flat bars can be forged with the utmost facility and without any adjustment. The 'Alinder Action' makes this wide range possible. Set for long stroke, die forging is easily accomplished; for such work and heavy forging the power of the blow is remarkable. Work per heat is what counts with the practical and progressive smith. What can be done in a single heat amazes, often as much as with two or three heats when using inferior hammers. Each stroke is under perfect control—if desired, a single blow only may be struck. The control compares favorably with steam hammers, and is superior to the control possible with other power hammers."

High-Speed Tools—drills, reamers, countersinks—are th subject of a supplementary catalogue published by the Wm Brewster Company, Inc., 30 Church street, New York. "Th high-speed twist drills we are offering are made by Th Rich Steel Products Company, Battle Creek, Mich., Mr George R. Rich, president. We do not believe that we nee any lengthy foreword to this supplementary catalogue, fo the reason that Mr. George R. Rich is too well known in th forged twisted drill industry. We solicit your business on quality plus service basis."

HELP, SITUATION AND FOR SALE

IMPORTANT NOTICE

All advertisements under this heading must be paid for in advance. We make a merely nominal charge for them and cannot afford to open ledger accounts for such items.

Advertisements are inserted under this heading at the rate of 4 cents per word for the first insertion. But no advertisements will be inserted for less than 75 cents. For each subsequent consecutive insertion the charge will be 75 cents. Replies may be sent to our care if desired, and they will be forwarded without additional charge.

All answers to advertisements in this column will be forwarded promptly, but we cannot guarantee replies. Concerns advertising for help do not wish their identity revealed, and only reply to such correspondents as they think best to answer.

Machine and Boiler Shop in Southern Wisconsin for sale. A good growing business. Building, tools and stock invoice $26,000. Address *F. O. Ambrose,* Janesville, Wis.

Wanted—Drop-head plate roller, ⅜-inch plate, splitting shear and punch for ⅜-inch plate, second hand. Give description and price. Address *Marine Iron Works,* Galveston, Texas.

Estimator Wanted—With experience in plate work, boilers and structural work, also with sale experience in above lines, to work part time in office and part time traveling. Address *Estimator,* care of THE BOILER MAKER.

Position Wanted as superintendent of boiler shop, building boilers, tanks, stand pipes, stacks and all classes of sheet metal work. Have worked twenty-eight years at this business, eighteen years as superintendent. Shop employing from two to three hundred men. Thoroughly understand estimating labor for shop or knock down work; also erection work. Address *Superintendent,* care of THE BOILER MAKER.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated; paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1734 West Madison street, Chicago, Ill.

Valves and Fittings are described by the Kelly & Jones Company, Greensburg, Pa., in Catalogue "O," just published. "We make valves and fittings for every purpose that do the work a little better than was expected. Reliability and long, efficient service is guaranteed by our trade mark. Our Catalogue 'O' contains everything you should know about valves and fittings. Send for it to-day. No obligation."

"Solving the Scale Problem" is the title of a circular published by the Wm. B. Pierce Company, 45 North Division street, Buffalo, N. Y. The use of the Dean Tube Cleaner for Watertube Boilers is described as follows: "The illustration shows the Dean operating in a watertube boiler. The striking surface of the vibrator taps the tube wall just back of the scale at a tremendous speed, loosening the grip of the scale and breaking it up into small pieces, which are easily blown out by the exhaust. The Dean method of cleaning insures thorough scale removed from watertube boilers, because it gets all the scale out in solid pieces, and does not grind it out in powder form by layers. In watertube boilers, the Dean is really two cleaners in one—it removes scale from the inside and soot from the outside of the tubes in the same operation! No other tube cleaner performs this double function. Don't confuse the Dean with cleaners that grind or scrape the scale off. These devices simply remove the soft, spongy outer layers, leaving a hard, thin surface on the tube to burn it out. The Dean cleans out every bit of scale."

American Boiler Manufacturers' Association

President—M. H. Broderick, care of Broderick Boiler Company, Muncie, Ind.
Vice-President—C. V. Kellogg, director Kewanee Boiler Company, 419 West Eighteenth street, Chicago, Ill.
Secretary and Treasurer—H. N. Covell, works manager the Lidgerwood Company, Dikeman street, Brooklyn, N. Y.

Master Boiler Makers' Association

President—Hon. D. A. Lucas, general foreman boiler maker, Chicago, Burlington & Quincy Railroad, Havelock, Neb.
First Vice-President—John B. Tate, foreman boiler maker, Pennsylvania Railroad, Altoona, Pa.
Second Vice-President—Charles P. Patrick, foreman boiler maker, Erie Railroad, Cleveland, Ohio.
Third Vice-President—Thomas Lewis, general foreman boiler maker, Lehigh Valley Railroad, Sayre, Pa.
Fourth Vice-President—T. P. Madden, general boiler inspector, Missouri Pacific Railroad, St. Louis, Mo.
Fifth Vice-President—E. W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul Railway, Dubuque, Iowa.
Secretary—Harry D. Vought, 95 Liberty street, New York.
Treasurer—Frank Gray, foreman boiler maker, Chicago & Alton Railroad, Bloomington, Ill.

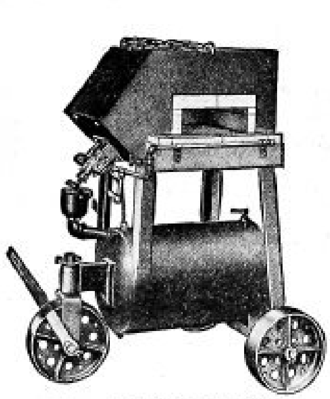
Boiler Makers' Supply Men's Association

President—B. A. Clements, Rome Merchant Iron Mill, New York.
Vice-President—Charles B. Moore, Oxweld Railroad Service Company, Chicago, Ill.
Secretary-Treasurer—George Slate, THE BOILER MAKER, New York.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

President—J. A. Franklin, Room 15, Law Building, 721 Minnesota avenue, Kansas City, Kan.
Secretary-Treasurer—F. P. Reinemeyer, Rooms 10 to 12, Law Building, Kansas City, Kan.
Editor-Manager of Journal—James B. Casey, Room 9, Law Building, Kansas City, Kan.
First Vice-President—A. Hinzman, Room 15, Law Building, Kansas City, Kan.

Connelly Watertube marine steam boilers are described by the D. Connelly Boiler Company, Cleveland, Ohio. "Connelly boilers have several distinguishing features, including unrestricted circulation, gases thoroughly sweep the heating surface, large steam storage capacity, mud settling chamber at bottom of front header, compactness, and deliver steam slightly superheated. Adaptable for various kinds of fuels."



RUBBER? NO!

IT'S A PIECE OF 8-INCH "NATIONAL" PIPE

¶ This piece of "NATIONAL" Pipe, with walls about 5-16th of an inch thick and weighing in the neighborhood of 28 pounds per foot, was subjected to a twisting force of 713,000 inch-pounds without a sign of fracture in wall or weld

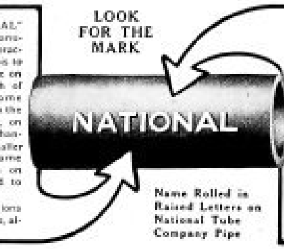
¶ The tremendous force distorted this heavy pipe until it resembled twisted rubber, and the result illustrates in a unique manner the quality of "NATIONAL" material.

¶ While the test shown was not applied to a "NATIONAL" Boiler Tube, yet it demonstrates the "punishability" of "NATIONAL" Boiler Tubes, by virtue of the fact that "NATIONAL" tubular material in general possesses the same characteristics shown by this unusual specimen, namely—Extraordinary Ductility; Uniformity, High Tensile Strength, Good Welding Qualities

¶ To readily identify "NATIONAL" material and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each few feet of every length of welded pipe the name "NATIONAL" (except on the smaller butt-weld sizes, on which this is not mechanically feasible on these smaller butt-weld sizes the name "NATIONAL" appears on the metal tag attached to each bundle of pipe).

¶ When writing specifications or ordering tubular goods, always specify "NATIONAL" pipe, and identify as indicated.

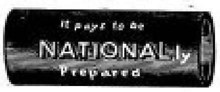
LOOK FOR THE MARK



Name Rolled in Raised Letters on National Tube Company Pipe

¶ In addition, all sizes of "NATIONAL" welded pipe four in. and under are subjected to a roll-knobbling process known as Spellerizing to lessen the tendency to corrosion, especially in the form of pitting. This Spellerizing process is peculiar to "NATIONAL" pipe, to which process National Tube Company has exclusive rights.

¶ "NATIONAL" pipe was awarded the GRAND PRIZE (highest possible award) at Panama Pacific International Exposition, 1915.



NATIONAL TUBE COMPANY

General Sales Offices, Frick Building PITTSBURGH, PA

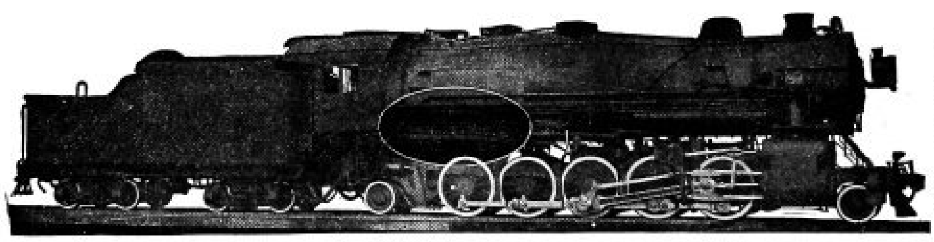
DISTRICT SALES OFFICES:

Atlanta Boston Chicago Denver New Orleans New Yor
Philadelphia Pittsburgh St. Louis St. Paul Salt Lake City

PACIFIC COAST REPRESENTATIVES:—U. S. Steel Products Company, San Francisco Los Angeles Portland Seattle

EXPORT REPRESENTATIVES:—U. S. Steel Products Company, New York City

Apply in your own shops and reduce costs

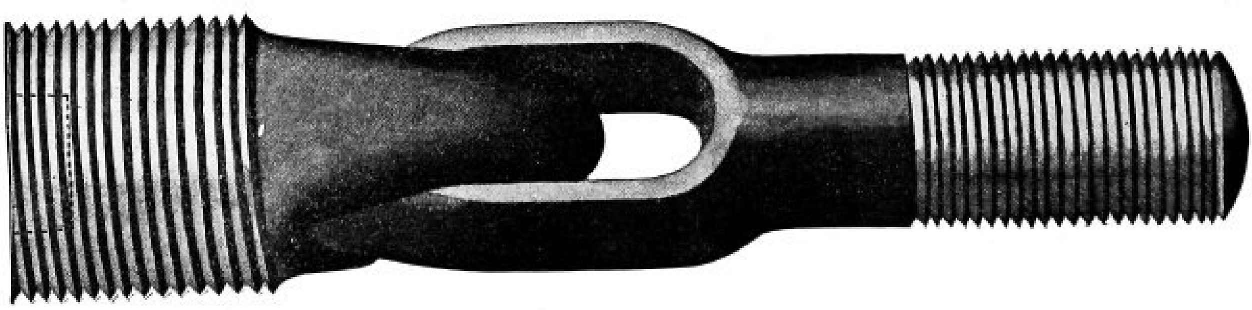


Apply in your own shops and reduce costs

2-10-2

Equipped with Break-less Staybolts

300,000 IN USE



Installation cost same as rigid stay.
Sheets always parallel.

No adjustment necessary.
Inspection by hammer test.

The Breakless Staybolt Company

PITTSBURGH, PA.

TRADE PUBLICATIONS

Imperial Oxy-Acetylene Equipment is described and illustrated in a catalogue published by the Imperial Brass Manufacturing Company, 1204 West Harrison street, Chicago, Ill. "In the severest competitive tests the unrivaled safety, economy and efficiency of Imperial welding and cutting equipment have been demonstrated. The Imperial welding torch, exceptionally compact, efficient and low in gas consumption, will out-cut all other torches. Speed your work by making use of the best tools it is possible to get."

Hydraulic machines and fittings are described in an illustrated catalogue of 124 pages published by the Southwark Foundry & Machine Company. "This catalogue is devoted to the leading hydraulic machinery and fittings manufactured by us. While the various cuts are typical of our product, we are constantly adding to our line, and if the machine that you require is not illustrated our engineering staff will gladly cooperate with you in designing and building the equipment desired. Quotations, unless otherwise specified, cover delivery f. o. b. our works. Shipments are made via the nearest route, but we prefer to have explicit shipping instructions to accompany the order, stating whether to ship by freight or express and by what route. We are prepared to furnish complete hydraulic equipments and to give helpful suggestions as to arrangement and operation. At the same time inquiries or orders for single tools or fittings receive our careful attention. When special machinery is required inquiries should cover the nature of the work to be done, the necessary clearances of tools and capacity if possible. A rough sketch of the tool or the work to be done thereon will effect a saving in time and correspondence. Before leaving our plant all hydraulic machinery and valves are carefully inspected and are thoroughly tested at from 25 percent to 35 percent higher pressure than working pressure. All our products are guaranteed for the period of one year against defective material and workmanship."

"Tin-Roof Paint would try a saint sometimes," admits the Joseph Dixon Crucible Company, of Jersey City, N. J. Tin to-day is not what it used to be in weight and metal. The acids, gases and dust in the air, etc., are greater than what it used to be. Or it may be the tin was not properly put in painting condition to receive the paint, according to directions on paint label. There are sometimes failures; again there are remarkable instances of long service. In its monthly house organ, *Graphite*, for November, 1917, the Dixon Company reproduces roof testimonial telling of twenty years' paint service. This concern also distributes an illustrated tin-roof booklet of much interest to factory owners and the general trade.

Staybolt iron and chain iron, made by the Burden Iron Company, Troy, N. Y., are the subject of circulars just issued by that company. "Experts differ as to the exact cause of corrosion, but all agree that iron resists corrosion far better than steel. Steel is made at a high temperature, causing the metal to be very fluid, and during the cooling the impurities still left in the metal, such as carbon, manganese, sulphur, etc., segregate, leaving the solid steel irregular chemically, which produces a lack of uniformity in resisting corrosion. Wrought iron is made at a much lower temperature, and the small granules of iron, as they become purified in the puddling furnace, partly congeal in a bath of liquid cinder, which covers them like an envelope. As the wrought iron is squeezed and rolled out, whatever impurities remain are evenly distributed, including cinder, which is elongated with the granules, giving the whole a fibrous structure. The enclosed cinder covering consists principally of silicate of iron, which acts as a protector of the metal throughout the bar. Thus corrosion in wrought iron, due to segregation, is impossible on account of the cinder covering and the plastic state of the mass, and that is one of the best reasons why iron is infinitely superior for staybolt and through-brace iron. Burden staybolt iron and through-brace iron are puddled new iron. No scrap is used. Made to pass all the severe requirements of Lloyd's Bureau Veritas and American Society of Testing Material. Thousands of tons of Burden chain iron are now being furnished to the United States Government for use on new battleships. The United States Navy test is unusually severe, and the fact that Burden chain iron was selected proves beyond doubt its superiority. Made in all sizes."

The Lincoln Arc Welder is the subject of Welding Bulletin No. 104-O, just issued by the Lincoln Electric Company, Cleveland, Ohio. "Hundreds of actual shop tests by different manufacturers, and many investigations by impartial technical men, have shown beyond doubt that arc welding costs far less than the oxy-acetylene process. The Lincoln arc welder does welding work at lower costs than any other process or equipment, because it delivers at all times the exact voltage needed for welding and no power is wasted in resistances. At the right are the results secured in a few representative cases."

"The Stock List and Reference Book," published by the Scully Steel & Iron Company, Chicago, Ill., is a publication which should be in the hands of every one interested in boiler making and any branch of the iron and steel business. The company states that it is the only publication of the kind which contains valuable information, as well as a statement of stock in hand. In issuing this book, which consists of 144 pages, it is the company's purpose to give the trade something which will aid them in figuring on jobs, as well as giving complete information in reference to stock in hand. A copy of this book will be sent to any of our readers free upon request. Following is a list of some of the products handled by the Scully Steel & Iron Company: Boiler, tank, bridge and universal plates; Scully wrought steel floor plates; black and galvanized sheet steel; planished iron, Wellsville polished; terns and electrical sheets; corrugated sheets and roofing steel; lapwelded and seamless steel and charcoal iron boiler tubes; boiler, structural and sheet iron rivets; beams, channels, angles and tees; steel bars, bands, hoops and tires; cold rolled and turned steel shafting; merchant bar iron, Norway iron and staybolt iron; machine, carriage and boiler bolts; lag screws, turnbuckles and bolt ends; hot pressed, cold punched and semi-finished nuts; wrought, cast and malleable washers; Scully weldless steel boiler braces; lugs, hangers, buckstays and ferrules, flanges, staybolts, etc.; "Everlasting" blow-off valves; tube expanders, tube cutters, tube cleaners; iron workers' and boiler makers' hand and power tools; iron workers' and boiler makers' hand and power machinery; vises, anvils and jacks; chain, electric and pneumatic hoists; rivet forges and blowers; pneumatic tools, etc.

Instruments of precision, drawing materials, planimeters slide rules, pantographs and surveying and engineering instruments, are described in a catalogue published by F. Weber & Company, 1125 Chestnut street, Philadelphia, Pa.

For War-Time Service the use of Tate flexible staybolts in all locomotive boilers is recommended in a circular issued by the Flannery Bolt Company, Vanadium building, Pittsburg, Pa. "Use Tate flexible staybolts in all locomotive boilers and resolve to obtain the greatest ton mileage at the least expense in firebox maintenance. The railroads of the United States have passed through many severe winters with locomotive boilers equipped with Tate flexible staybolts. They know what the real value of the Tate bolt is—by what it has accomplished in keeping their engines in service. Broken staybolts are responsible for pulling more engines out of service than any other known defect, for the safety of the boiler largely depends on the security of the stayed connections. The railroads that show the lowest breakage of staybolts yearly are those that have the Tate bolts applied to the greatest number of locomotives. In these times do not experiment but use the strongest and most suitable staybolt to give prolonged service to the complete firebox assemblage."

Extracts from Smooth-On Instruction Book No. 16 are published in vest-pocket size by the Smooth-On Manufacturing Company, Jersey City, N. J. Smooth-On Iron Cements Nos. 1 and 2, are described as follows: "Smooth-On Iron Cements Nos. 1 and 2 are chemically prepared iron compounds made and sold in a powder form and used by mixing with water to the consistency of stiff putty. No. 1 is quick hardening. No. 2 is slower hardening and hydraulic. When in this putty state they must be applied immediately, because the metallizing action of these cements is rapid, acting without heat, and in a few minutes the putty will get too stiff to work or manipulate. These cements are unequaled for stopping leaks of steam, water, fire or oil, because they become metallic iron that has the same expansion and contraction as iron, thus keeping the joint tight at all temperatures, and joints can easily be taken apart. While metallizing these cements expand in bulk, and it is this action that makes them valuable for mechanical uses. Sold in blue labeled tins like the above Not sold in bulk."

The "Favorite" Wrench is described in an illustrated circular published by Greene, Tweed & Company, 109 Duane street, New York. "The war, while demanding from your plant an increased output, is at the same time taking from you your skilled mechanics. In your training of women and otherwise unskilled labor you will need to supplement their lack of skill with the most improved labor-saving tools. On nut turning the 'Favorite' (reversible ratchet) wrench will offset the lack of trained skill, and you cannot at this time afford to overlook the advantage to be secured from its use."

Yale Hoists are described in a catalogue just issued by the Yale & Towne Manufacturing Company, 9 East Fortieth street, New York. "Yale hoists help labor, save time, increase output. The plant installing Yale spur-geared blocks insures labor producing maximum output in minimum time, under the best and safest operating conditions. These are facts of greatest importance right now to manufacturers confronted with the necessity of maintaining maximum output in the face of labor shortage. The Yale spur-geared block is designed to give maximum service under exceptional conditions. With assured safety to operator, machine and product, valuable time is saved in handling rough and finished work. Each Yale spur-geared block is tested to 3360 pounds to the rated tone—the guarantee is in the block itself."

"Selecting the Filler for the Work" is the subject of Supply Catalogue No. 3, published by the Oxweld Acetylene Company, Newark, N. J. "Our intensely interesting supply catalogue and text book describes fifteen different sorts of filler rods—all made to meet our own laboratory specifications and tests covering every quality and factor of chemical composition. The same booklet describes six different fluxes—as scientifically made as the rods. The selection of the right rod and right flux for each application is always one of the big factors in the success of the weld. The surest and quickest way to solve the problem is to see that your welders are using genuine Oxweld supplies in accordance with the advice and instruction of our field service department experts. We guarantee Oxweld supplies, when used by competent welders, to give better results than any others known to the art."

"Palmetto" Packing is the subject of a circular published by Greene, Tweed & Company, 109 Duane street, New York. This circular states that "'Palmetto' is a packing made from a grade of asbestos ordinarily regarded as too good for packing, but experience has shown that the great tensile strength necessary to long service under hard conditions cannot be secured from lower grades. Each separate strand of 'Palmetto' packing is subjected to a process that forces graphite grease lubricant into its very center, so that each strand acts as a reservoir of lubricant, thus adding greatly to the life of the packing. 'Palmetto' packing is braided with a layer-upon-layer construction, insuring great structural strength."

Rome Hollow Staybolt Iron is described in a circular issued by the Rome Iron Mills, Inc., 30 Church street, New York. "How much is it costing you to drill telltale holes in your staybolts? How many dozen high-speed drills are you using in your shop every month? How many staybolts are you cutting out of your boilers because drills have been broken or burned off in them? Do you know the cost of motors, machines, hose, oil air and labor for drilling staybolts? How often have you had engines delayed at the round-house because pipes, brackets and other interfering parts made drilling telltale holes a long, tedious job. Staybolts with shallow telltale holes fill up quickly. They must be repeatedly opened up to a depth of 1¼ inches. Grit and sand they accumulate burns and breaks many drills. Rome hollow iron has a telltale hole al the way through the bar. It saves the cost of motors and drills; it saves your air and oil and the big cost of labor; it saves the time required for the operation; it gets your engine from boiler shop to erecting shop sooner, because scaffolding and men drilling telltale holes do not keep other mechanics from working. Use a bolt you can put back of brick work and grate bearers, that eliminates monthly hammer test and meets the requirements of the Federal inspection law. Use a bolt you can put in from the inside or the outside, whichever is the most convenient; and when cut off, always have a telltale hole ready-made. Use a bolt that you know always has a telltale hole through the center—this is only possible with hollow iron. Conditions to-day call for hollow staybolts. They save men and increase service hours."

The Loop Hand Chain Guide, a feature of the chain hoist manufactured by the Ford Chain Block & Manufacturing Company, 144 Oxford street, Philadelphia, is described in Catalogue 3, just issued. "The loop hand chain guide has proved so effective in increasing chain hoist life and decreasing operating troubles that it has become the envy of the trade. For mutual protection know that the loop hand chain guide is a patented feature that no manufacturer has the right to embody in a chain hoist without license from us. The guide is an endless steel loop having fixed guiding strips adjacent to the flanges of the wheel, extending from one guide to the other and conforming to the circumference of the wheel. It effectually prevents 'gagging' of the hand chain and damage to the working parts or block, and permits rapid travel of the hand chain without overriding the flange of the hand wheel."

"Standardize on Kennedy Valves" is the advice given by the Kennedy Valve Manufacturing Company, Elmira, N. Y., in a circular just issued. "Standardize on Kennedy Valves and you will have a good variety to pick from. You can buy valves by haphazard choice, but the far-sighted engineer knows that a single valve accident or shut-down, or the cumulative expense of excessive repacking, or the cost of a new part and its installation, or the annoyance of constant leakage, usually make a cheap valve cost too much even if it could be had for nothing. The following reasons for making Kennedy valves your standard equipment are too important to neglect. Consider them carefully: 1. A good line for all marine requirements and usually a choice of several very satisfactory types for any given work. 2. A variation in design and materials with special adaptations as to pressure, temperature, accessibility, operating power requirements, etc. 3. Free engineering advice when desired from valve designers and engineers, under whose direction thousands of valves have been made to squarely meet the demands of America's largest industrial plants. The liberal guarantee and fair treatment of a firm that has always been eager to make its product give absolute satisfaction."

Starrett Hack Saws are described in a circular issued by the L. S. Starrett Company, Athol, Mass. They are also one of the great number of tools described in Catalogue 21-L, published by the same company. "There's every reason now why inefficiency in metal cutting must go—time is precious to the human race; every manufacturing minute counts, and time costs money. If a piece is to be sawed the mechanic's time must be conserved, and this calls for quick labor-saving cutting. When you have occasion to sell hack saws, you could start the selection in the mind of your customer by saying: 'Starrett Hack Saws.' This will make it easy, for he already associates the name 'Starrett' with fine tools. Next help him select the right Starrett hack saws. He probably realizes that if a new, sharp saw is put into a frame or machine, it will not necessarily do efficient cutting. It may clog, dull or snap because not suited to the shape or kind of metal. The teeth may be too small or too large, with too little or too much set, or the saw may be too soft or too hard. But every Starrett hack saw has a number, and it is just as important that the machinist use the right numbered Starrett as it is to use the right lathe tool or the right file. The right saw chases away that word 'inefficiency.' But the right selection is not difficult. Turn to page 208 of the Starrett Catalogue No. 21-L. There you will find the numbers that correspond to most efficient usage. Remember that using the right numbered Starrett is the utmost in hack saw thrift, for such a blade cuts quicker—lasts longer."

Plate and Angle Heating Furnaces are described in Bulletin 8, issued by the Metals Production Equipment Company, 165 Broadway, New York. "The furnaces we illustrate in this bulletin are in successful operation for various duties. Their most extensive use is for heating plates, angles, bars, etc., for shaping and bending, for shipbuilding and ship repair work. They are also used in boiler shops, railroad repair shops, locomotive shops, etc., for heating boiler heads for flanging, and in the manufacture of agricultural implements for heating sheets for hot pressing. The bar heating type is particularly adapted for the continuous heating of rods for the manufacture of rivets, bolts, spikes, etc."

BUSINESS NOTES

INCREASED FACILITIES.—Anthony Carlin, Cleveland, Ohio, manufacturer of the "Perfection" rivet, has recently increased the capacity of his plant 50 percent, and now has an increased capacity of 100 percent, making his possible output of rivets 150 tons a day.

HELP, SITUATION AND FOR SALE

IMPORTANT NOTICE

All advertisements under this heading must be paid for in advance. We make a merely nominal charge for them and cannot afford to open ledger accounts for such items.

Advertisements are inserted under this heading at the rate of 4 cents per word for the first insertion. But no advertisements will be inserted for less than 75 cents. For each subsequent consecutive insertion the charge will be 75 cents. Replies may be sent to our care if desired, and they will be forwarded without additional charge.

All answers to advertisements in this column will be forwarded promptly, but we cannot guarantee replies. Concerns advertising for help do not wish their identity revealed, and only reply to such correspondents as they think best to answer.

For Sale—Kane & Roach No. 1 straightener. Never used. Make offer. *The E. T. Burrowes Company,* Portland, Me.

Machine and Boiler Shop in Southern Wisconsin for sale. A good growing business. Building, tools and stock invoice $26,000. Address *F. O. Ambrose,* Janesville, Wis.

Layer-out Wanted—Experienced in all kinds of tank and boiler work. Address *Layer-out,* care of THE BOILER MAKER.

Wanted—Mechanical Draftsman familiar with boiler construction and design. Give age, experience and salary. *E. G. Rhoads,* 1423 McCormick Building, Chicago.

Layer-out, experienced in horizontal tubular, locomotive, return tubular and upright boilers, desires to make a change. Address *Ambition,* care of THE BOILER MAKER.

Wanted—Estimator and Salesman for contract boiler shop in a small town in the Pittsburg district. State age, experience and salary desired. Also how soon available. Address *Estimator,* care of THE BOILER MAKER.

Wanted—Good layer-out for boiler shop employing 80 to 90 men, and doing general boiler, tank and blast pipe work. States age and experience. Steady job for right man. Address *Drake-Williams-Mount Company,* Omaha, Neb.

Works Manager, Production Engineer, Chief Engineer or Chief Estimator, position wanted by technical man, ten years' experience as designer and estimator on tank, steel plate construction, structural and cement machine work, etc. Thirty years old; married. Address *Manager,* care of THE BOILER MAKER.

Wanted—Boiler Shop Foreman, who can get results from a moderate-sized contract boiler shop located in the Youngstown district. State age, experience, salary desired and how soon available. Address *Boiler Shop,* care of THE BOILER MAKER.

Roundhouse Repair Man, to take charge of locomotive and make running repairs. Good wages for reliable man. Must be strictly sober. *Winfield Railroad Company,* Second National Bank Building, Pittsburg, Pa.

Mechanical Engineer—Live, growing concern, located about 60 miles from Pittsburg, has an opening for a first-class man, designing and estimating all classes of steel plate work. Must be experienced and familiar with shop practice so that he can make up bills of material. Knowledge of material and labor costs not essential. Good future for a good man. State experience, age, salary expected. Address *Box 55,* care of THE BOILER MAKER.

American Boiler Manufacturers' Association

President—M. H. Broderick, care of Broderick Boiler Company, Muncie, Ind.
Vice-President—C. V. Kellogg, director Kewanee Boiler Company, 419 West Eighteenth street, Chicago, Ill.
Secretary and Treasurer—H. N. Covell, works manager the Lidgerwood Company, Dikeman street, Brooklyn, N. Y.

Master Boiler Makers' Association

President—Hon. D. A. Lucas, general foreman boiler maker, Chicago, Burlington & Quincy Railroad, Havelock, Neb.
First Vice-President—John B. Tate, foreman boiler maker, Pennsylvania Railroad, Altoona, Pa.
Second Vice-President—Charles P. Patrick, foreman boiler maker, Erie Railroad, Cleveland, Ohio.
Third Vice-President—Thomas Lewis, general foreman boiler maker, Lehigh Valley Railroad, Sayre, Pa.
Fourth Vice-President—T. P. Madden, general boiler inspector, Missouri Pacific Railroad, St. Louis, Mo.
Fifth Vice-President—E. W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul Railway, Dubuque, Iowa.
Secretary—Harry D. Vought, 95 Liberty street, New York.
Treasurer—Frank Gray, foreman boiler maker, Chicago & Alton Railroad, Bloomington, Ill.

Boiler Makers' Supply Men's Association

President—B. A. Clements, Rome Merchant Iron Mill, New York.
Vice-President—Charles B. Moore, Oxweld Railroad Service Company, Chicago, Ill.
Secretary-Treasurer—George Slate, THE BOILER MAKER, New York.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

President—J. A. Franklin, Room 15, Law Building, 721 Minnesota avenue, Kansas City, Kan.
Secretary-Treasurer—F. P. Reinemeyer, Rooms 10 to 12, Law Building, Kansas City, Kan.
Editor-Manager of Journal—James B. Casey, Room 9, Law Building, Kansas City, Kan.
First Vice-President—A. Hinzman, Room 15, Law Building, Kansas City, Kan.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated: paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

CO-ORDINATION OF THE ADMINISTRATIVE WORK of the Greenfield Tap & Die Corporation, Greenfield, Mass., has been successfully accomplished by the opening of the company's new administration building. Heretofore each plant has maintained its own office and shipping room. Now these functions are centralized in the new building, which gives employment, in the office alone, to 125 persons.

CHANGES IN THOR SELLING ORGANIZATION.—R. S. Cooper, vice-president of the Independent Pneumatic Tool Company, manufacturer of pneumatic tools and electric drills, who for many years was the manager of the company's Eastern branch in New York City, has assumed the duties of general sales manager as well as those of vice-president, and will maintain his headquarters at the general offices of the company, Thor building, Chicago, Ill. Mr. R. T. Scott, the former Pittsburg branch office manager, has been promoted to the office of Eastern manager, with headquarters at 170 Broadway, New York. Mr. H. F. Finney, who formerly traveled the Chicago and St. Louis territories, has been placed in charge of the company's branch office at Pittsburg, Pa.

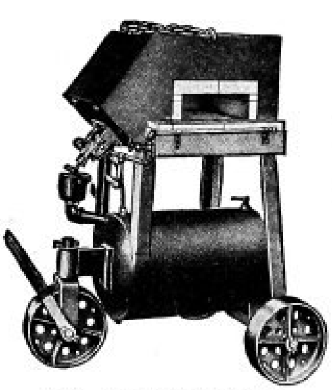
TRADE PUBLICATIONS

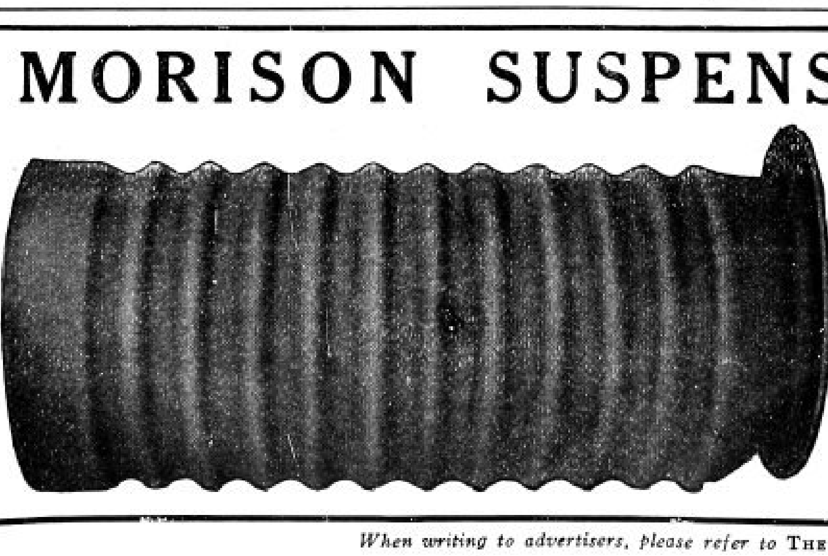
Rules and Regulations for Shipping Castings, machine parts, shafting, pipe, rods, bars and other metal articles have been published in the form of a circular by the Express Traffic Association, Room 318, 61 Broadway, New York. We quote as follows: "Marking Requirements: (*a*) Each package, bundle or loose piece in a shipment must be plainly, legibly and durably marked, showing the name of only one consignee, and of only one station, town or city and State to which destined. (*b*) Shipments wrapped in paper, or packed in boxes, crates, barrels, corrugated paper or fiberboard containers must be marked with pen, brush, stencil, waterproof crayon, or by label securely attached with glue or equally good adhesive. Such shipments must not be accepted when marked only with tag except as provided below: Shipments of iced goods, such as fish, oysters, etc., must be marked with brush, stencil or waterproof crayon, or with two tags securely tacked, one of which must be sunk in a groove in the box or case, or otherwise protected in such manner as to prevent becoming detached or defaced by contact with other articles or surfaces. Containers which are customarily used several times for transportation of goods by express, such as bread boxes or dog kennels, which cannot be satisfactorily marked with brush, stencil, waterproof crayon or label, may be accepted when bearing two address tags securely attached to the package. (*c*) Castings, machine parts, shafting, pipe, rods, bars and other metal articles: 1. When boxed, barreled, crated or trussed, must be marked in compliance with paragraph '(*b*).' 2. When not boxed, barreled, crated or trussed, and there is sufficient smooth surface for the purpose, the address must be plainly marked on the article with durable paint. Such shipments must not be accepted unless marks are thoroughly dry. 3. When not boxed, barreled, crated or trussed, or when not possible to mark as provided in preceding paragraph, shipments must be marked with not less than two wooden, leather, metal, cloth, rope stock or sulphite fiber-tag-board tags. Rope stock of sulphite fiber-tag-board tags must test not less than 14 point, 50 percent rope, have reinforced metal eyelets, and must be attached by wire not less than 23 gage, or strong, tarred cord. Tags must be attached wherever possible to unexposed parts of the article, in order that they may not become detached in handling. 4. Rods, shafting, bars, iron bed sides, automobile springs and other articles of like character marked with tags as provided in paragraph '3,' must have the tags securely wired to the article, and in addition a concealed tag bearing the same address must be bound to the article with burlap covering, the latter securely wired at each end. 5. When metal articles are shipped in sacks the address must be shown on tag conforming to the specification in paragraph '3,' attached either by wire or strong cord, and an additional tag bearing the same address must be enclosed in the sack."

Structural and Plate Workers' Tools are described and illustrated in Catalogue No. 7, just published by the Cleveland Steel Tool Company, Cleveland, Ohio. "The remarkable advances which have been taking place in the science of punching metals has made it necessary to produce tools which will do the work required by present specifications of mechanical engineers. But a few years ago fabricators followed the rule 'that steel could not be punched that was thicker than the diameter of the punch.' This condition now, however, is greatly changed. The new Bethlehem H sections came into use with very heavy webs and flanges. The use of old rail steel or rerolled shapes became quite general. This material is 70 to 80 carbon, and exceptionally hard. Drilling made the cost so great that use of the steel was discarded in a number of places. Special punching machines were designed for handling the Bethlehem sections. United States Government specifications read, 'Punches must be capable of punching not less than fifty holes through 85 carbon steel whose thickness is one and one-quarter times the diameter of the punch.' Our company manufactures this class of tools exclusively, and it was absolutely necessary that we be able to furnish punches which would meet the above conditions. In our punches we are offering the highest quality that science and modern methods can produce. We control very closely the three most important elements, viz.: the use of chemical laboratory, physical testing apparatus and microscopic laboratory we determine to the finest practical point the analysis, the strength of tools and structure of the steel."

"**The Locomotive Furnace**" is the title of an illustrated 16-page booklet just published by the American Arch Company, 30 Church street, New York. This bulletin, the first of the series, gives a general outline of the problems met with in firebox and boiler design. Succeeding bulletins will treat in detail such subjects as combustion, or the generation of heat; the transfer of heat by radiation, convection and conduction; heat absorption, evaporation and kindred subjects having a direct bearing upon the design of the locomotive furnace and boiler. A copy will be sent free upon request.

"**Pipe Tools**" is the title of a 72-page illustrated catalogue which has just been published by the Greenfield Tap & Die Corporation, Greenfield, Mass. This catalogue describes the complete line of pipe tools made by the various divisions of the Greenfield Tap & Die Corporation, a history of which is published in the catalogue. We quote as follows: "The Greenfield Tap & Die Corporation is an amalgamation of six concerns, Wells Bros. Company, Wiley & Russell Manufacturing Company, F. E. Wells & Son Company, A. J. Smart Manufacturing Company, Nutter & Barnes Company and Bickford Machine Company. There are five separate and distinct plants housing these companies as well as a drop-forging shop and a woodworking plant for the manufacture of screw plate boxes, tool cabinets, etc. In addition the corporation maintains a Canadian plant at Galt, Ontario—Wells Bros. Company of Canada, Ltd. Of the six concerns making up this corporation, the first four have always been leaders in the manufacture of taps and dies. The Wells Bros. Company, Wiley & Russell Manufacturing Company and F. E. Wells & Son Company are all pioneers in this branch of manufacture. Wiley & Russell Manufacturing Company was established in 1872, and ever since has put out the highest grade of screw-cutting tools, machines and reamers. They were among the first to manufacture machine-relieved taps. The E. F. Reece Company was founded in 1874, and markeeed the original round, adjustable or button die, also a line of screw plates, die stocks, taps, tap wrenches and reamers. This company was later consolidated with the F. E. Wells & Son Company, who were then making a full line of pipe and machine tools, including grinders, lathes, hand screw machines, etc. The machine tools were formerly made by the Automatic Machine Company, which was bought out by the F. E. Wells & Son Company in 1907. Wells Bros. Company, organized two years later, 1876, developed into the largest tap and die concern in the country, if not in the world. The enviable reputation created by this company's products in every civilized country is one of the corporation's greatest assets. The A. J. Smart Manufacturing Company is the youngest of the corporation members. It was founded in 1906 to produce taps, dies and reamers of exceptionally high grade. This company's factory is used by the corporation for special work only. The Nutter & Barnes Company, formerly of Hinsdale, N. H., was organized in 1887 for the production of high-speed cutting-off machines for bars and pipe and automatic saw and cutter sharpeners. The Bickford Machine Company was incorporated in 1908, for the manufacture of machine tools for grinding, milling, threading and tap manufacture, and for special machine tool work. The Greenfield Tap & Die Corporation is capitalized at $3,000,000. It employs approximately 2,000 men, and manufactures besides the pipe tools listed in this catalogue nearly every conceivable screw-cutting tool, machine or appliance, as well as gages for any manufacturing operation, metal cutting-off machines, saw and cutter sharpeners, lathes, grinders, etc. Visitors are always welcome. They are invited to inspect our factories and the tools in the making."





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Machine and Boiler Shop in Southern Wisconsin for sale. A good growing business. Building, tools and stock invoice $26,000. Address *F. O. Ambrose,* Janesville, Wis.

Position Wanted as boiler shop foreman, or would consider a first-class laying-out job. Age 35, thoroughly competent, familiar with boiler and general plate work. Address *Box K,* care of THE BOILER MAKER.

Wanted—A Boiler Maker. One capable of laying out work in a locomotive plant. Only experienced men need apply. Steady work and good wages. Address *Locomotive,* care of THE BOILER MAKER.

Wanted—A Draftsman who has had experience in laying out tanks, boxes, piping and plate work for shop in Philadelphia. Address, stating experience and salary, *Box 704,* care of THE BOILER MAKER.

Wanted—Plate Shop Foreman for a small-sized shop located in the vicinity of New York. Only those fully experienced and able to get results from small-sized shop need apply. State age, experience and salary desired, present employment, and how soon you could begin work. Address *New York,* care of THE BOILER MAKER.

Wanted—Gang Boss by large Michigan boiler manufacturers. Government work; modern shop; good working conditions. Write, fully stating age, past experience, references and salary expected to start. Address *Gang Boss,* care of THE BOILER MAKER.

For Sale—Cold-drawn seamless boiler tubes, 360 3-inch, 16 feet; 1,179 3-inch, 18 feet, eleven gage; also hot rolled seamless tubes, 295 3¼-inch, 16 feet; 207 3¼-inch, 18 feet, ten gage. Tubes were made for export but cannot be shipped. Will sell all or part, make an offer. Address *Tubes,* care of THE BOILER MAKER.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated; paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

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Secretary and Treasurer—H. N. Covell, works manager the Lidgerwood Company, Dikeman street, Brooklyn, N. Y.

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Third Vice-President—Thomas Lewis, general foreman boiler maker, Lehigh Valley Railroad, Sayre, Pa.

Fourth Vice-President—T. P. Madden, general boiler inspector, Missouri Pacific Railroad, St. Louis, Mo.

Fifth Vice-President—E. W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul Railway, Dubuque, Iowa.

Secretary—Harry D. Vought, 95 Liberty street, New York.

Treasurer—Frank Gray, foreman boiler maker, Chicago & Alton Railroad, Bloomington, Ill.

Boiler Makers' Supply Men's Association

President—B. A. Clements, Rome Merchant Iron Mill, New York.

Vice-President—Charles B. Moore, Oxweld Railroad Service Company, Chicago, Ill.

Secretary-Treasurer—George Slate, THE BOILER MAKER, New York.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

President—J. A. Franklin, Room 15, Law Building, 721 Minnesota avenue, Kansas City, Kan.

Secretary-Treasurer—F. P. Reinemeyer, Rooms 10 to 12, Law Building, Kansas City, Kan.

Editor-Manager of Journal—James B. Casey, Room 9, Law Building, Kansas City, Kan.

First Vice-President—A. Hinzman, Room 15, Law Building, Kansas City, Kan.

BUSINESS NOTES

THE D. CONNELLY BOILER COMPANY, Cleveland, Ohio, has awarded contracts for an addition to its main boiler shop. The addition will be 140 feet by 80 feet, of steel construction, brick and glass walls. The runways for the three present overhead traveling cranes will be extended into the addition. This company is now installing a new set of plate bending rolls, which are said to be the longest and heaviest machine of this kind in any boiler manufacturing plant in America. It has also installed two 6-foot radial drills and has several more on order.

THE BORDENTOWN STEEL & TUBE CORPORATION, Bordentown, N. J., has been recently reorganized, with a capital of $250,000, and placed under new management. New equipment has been installed, and the plant is now working on the production of cold-drawn seamless steel tubing for Government airplanes. It has a capacity from ten draw benches, ⅜ inch to 2 inches, of 100,000 feet per week. H. S. White, formerly with the old Pope Tube Company, Shelby Tube Company, and Detroit Tube Company over a period of twenty-two years, has been elected president. V. P. Jackson is secretary, and C. P. Fuller, for eleven years connected with both the Shelby Tube Company and Detroit Tube Company, has been made superintendent.

TRADE PUBLICATIONS

"Does Your Shop Know About Rivets?" is the title of a circular published by the Bourne-Fuller Company, Cleveland, Ohio. "Do you know why rivets of guaranteed high quality—Climax rivets—are actually cheaper to use, as well as more satisfactory, than rivets of unknown quality and unmarked origin? Do you know that every Climax rivet is signed by us with a C stamped on its head, as our promise that it's as good a rivet as you can buy? Are you willing to look into the rivet question, with a view to finding out positively whether you would, or would not, make savings of both time and money by using Climax boiler and tank rivets? Then write us."

The Levin Generator is described in Bulletin G, published by the Electrolytic Oxy-Hydrogen Laboratories, Inc., 15 William street, New York. "The method of decomposing water by means of an electric current into its component parts, oxygen and hydrogen, has been known for many years. The process was perfected and first applied for commercial purposes, however, only a generation ago; and it was only during the last decade that the electrolytic generator was introduced into the United States by Mr. I. H. Levin. Mr. Levin made an extensive study of all generators in use in Europe and selected for the American market the very best he found. But Europe's best, both from the mechanical and electrochemical standpoint, failed to satisfy the requirements of our highly developed commercial standards. Within a short time the foreign machine was so greatly modified by Mr. Levin as to become in its improved form the most accepted type of electrolytic generator in the United States. Further research and experimentation resulted in the creation of new elements of design and new applications of materials, and made possible the present superior and improved Levin generator. The Electrolytic Oxy-Hydrogen Laboratories, Inc. ('Electrolabs') are the owners of the patents on the latest type of generator, and manufacture the same under the personal supervision of Mr. Levin, technical director of the company.

"Safety First" Cutting and Welding Torches are described in a circular just published by the Campbell Machinery Company, 35 West Thirty-ninth street, New York. According to this circular these torches possess the following new and patented features: "(1) Absolute insurance against back firing; (2) unique construction of head; (3) rapid interchangeability of tips; (4) all joints threaded and hard soldered, making leakage impossible; (5) accessibility of working parts, making replacements possible in a few minutes; (6) perfect and sensitive control of high-pressure valves. All the above features place the 'Safety First' torches in a distinct class by themselves, and have been proven by exhaustive tests under the most trying conditions."

"The Evolution and Manufacture of Modern Boiler Tubes" is described in an illustrated circular published by the National Tube Company, Frick building, Pittsburg, Pa. "To secure the desired uniformity of material in both seamless and lap-welded boiler tubes, the National Tube Company controls every step of manufacture from ore to finished tube. The high-grade iron ore from the famous Missabe range is smelted in the company's own blast furnaces, and all subsequent operations, from converting the crude iron into mild steel, to the crushing, beading and flattening tests given the crop ends of all tubes, are likewise performed in the company's mills under the supervision of a unified organization of highly trained men. Lap-welded boiler tubes are given a special treatment in rolling known as spellerizing. Spellerizing is a special process of treating metal which consists in subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surfaces, then to the action of smooth-faced rolls, and repeating the operations whereby the surface of the metal is worked so as to produce a uniform dense texture, better adapted to resist corrosion, especially in the form of pitting. Only National lap-welded boiler tubes are spellerized. As a result of employing highly trained men, modern methods and efficient machinery, the structure of the metal is uniformly homogeneous, providing many desirable qualities—such as high bursting strength, ductility, resistance to corrosive influence and general durability—and these qualities stand as good witnesses to the care and foresight used in producing National lap-welded and Shelby seamless boiler tubes."

The Sixteenth Edition of the Smooth-On Instruction Book has just been published by the Smooth-On Manufacturing Company, Jersey City, N. J. This book will be interesting reading to engineers, as it shows by illustrations how the different Smooth-On iron cements are used for repair purposes. The book contains 144 illustrated pages.

A Combination Lathe, Boring and Milling Machine, "a real universal machine tool," is described in a circular issued by George W. Fleming Company, 16 Broadway, Springfield, Mass. The general description is as follows: "Three machines in one, combining all the facilities of 16-inch engine lathe, horizontal boring mill, plain milling machine, with the additional feature of sliding bed gap lathe. Each unit is as complete and distinct as the same machines individually and gives the same range and capacity. When in use each unit can be operated as readily as the same machine were it a separate and distinct machine. The base carrying the sliding member is strongly ribbed, and supports the lathe bed without vibration and permits of doing heavy work, and in addition the milling machine table acts as a support for sliding bed when same is closed. The sliding lathe bed is strongly ribbed and the ways are scraped true to alignment for both carriage and tail stock. Lathe carriage is made with bridge on end towards headstock, and extends out over the face of the apron to permit of compound rest being used up to full swing of 25 inches for work in gap. Headstock is made with four step cone pulleys and is single back geared. Has hollow spindle and bearings are scraped to running fit. Proper means for taking up wear are provided both laterally and radially. Milling machine table, saddle and knees are of rigid construction scraped to accurate fits on all moving surfaces. Table is elevated on face of column by means of helical gears and screw. Crank for operating same is located on face of column in convenient position for operator. The standard machine is equipped with hand feed to milling machine table. The horizontal boring mill is the platen and table type, boring bar is 1½ inches in diameter, and is provided with power feed, deriving its power from lathe change gears. Regular equipment includes countershaft, large and small face plates, steady rest, change gears, one milling machine arbor and wrenches. The following extras can be furnished: Power longitudinal feed to milling machine table, taper attachment, milling machine vise, dividing head for milling machine."

BUSINESS NOTES

THE CHICAGO OFFICE of the Mahr Manufacturing Company, Minneapolis, Minn., has been moved from 1504 Lytton building to 812 Hearst building.

INDEPENDENT PNEUMATIC TOOL COMPANY REORGANIZATION.—A reorganization has been effected of the Independent Pneumatic Tool Company, a New Jersey corporation, and the Aurora Automatic Machinery Company, which is incorporated in Delaware. Both companies were owned by the same interests, the Independent Pneumatic Tool Company representing the selling division for the Thor pneumatic and electric tools, and the Aurora Automatic Machinery Company being the manufacturing department. The latter company also manufactures and sells Thor motorcycles and gasoline engines. The combining of the two companies under one corporate name is for convenience in handling business. Under the reorganization plans the company is known as the Independent Pneumatic Tool Company, incorporated in Delaware for $3,000,000. Ten directors will serve on the board as follows: John P. Hopkins, former Mayor of Chicago, chairman; John D. Hurley, James J. McCarthy, William A. Libkeman, Leonard S. Florsheim, Edward G. Gustafson, Robert T. Scott, Ralph S. Cooper, August Gatzer and Fletcher W. Buchanan. The officers are John D. Hurley, president; Ralph S. Cooper, vice-president; Fletcher W. Buchanan, secretary, and Edward G. Gustafson, treasurer. The general offices of the company are in the Thor building, at 1307 South Michigan Boulevard, Chicago. Branches are maintained in New York City, Pittsburgh, Pa., Detroit, Mich., Birmingham, Ala., San Francisco, Cal., Toronto, Ontario and Montreal, Quebec. The pneumatic and electric tool factory is located in Aurora, Ill., and the motorcycle and gasoline engine plant is at 361 West Superior street, Chicago, Ill.

HELP, SITUATION AND FOR SALE

IMPORTANT NOTICE

All advertisements under this heading must be paid for in advance. We make a merely nominal charge for them and cannot afford to open ledger accounts for such items.

Advertisements are inserted under this heading at the rate of 4 cents per word for the first insertion. But no advertisements will be inserted for less than 75 cents. For each subsequent consecutive insertion the charge will be 75 cents. Replies may be sent to our care if desired, and they will be forwarded without additional charge.

All answers to advertisements in this column will be forwarded promptly, but we cannot guarantee replies. Concerns advertising for help do not wish their identity revealed and only reply to such correspondents as they think best to answer.

Wanted—One 150- to 200-ton hydraulic sectional flanging press and one 8- to 10-foot stake bull riveter, air or hydraulic. Address *Flanging Press*, care of THE BOILER MAKER.

Wanted—A Layer-Out on light tank work and structural iron work. Address, giving experience and salary wanted, *J. S. Thorn Company*, Twentieth and Allegheny avenue, Philadelphia.

Wanted—Estimator and Salesman for contract boiler shop in a small town in the Pittsburgh district. State age, experience and salary desired. Also how soon available. Address *Estimator*, care of THE BOILER MAKER.

Position Wanted as boiler shop foreman, or would consider a first-class laying-out job. Age 35, thoroughly competent, familiar with boiler and general plate work. Address *Box K*, care of THE BOILER MAKER.

Wanted—Boiler Shop Foreman, who can get results from a moderate-sized contract boiler shop located in the Youngstown district. State age, experience, salary desired and how soon available. Address *Boiler Shop*, care of THE BOILER MAKER.

Wanted—Gang Boss by large Michigan boiler manufacturers. Government work; modern shop; good working conditions. Write, fully stating age, past experience, references and salary expected to start. Address *Gang Boss*, care of THE BOILER MAKER.

Wanted—Boiler Shop Foreman for a medium-sized shop. One who understands laying-out. State age, experience, salary desired, present employment, and how soon you could start work. Only those fully experienced and able to get results from a medium-sized shop need apply. Address the *Grupe Drier & Boiler Company*, Davenport, Ia.

Wanted—By one of the largest and best equipped boiler shops in Pennsylvania, two layers-out, one for sheet iron and light plate work, and the other on boiler work. To steady, sober, experienced men we can offer first-class wages, with a 10 percent bonus and permanent employment. Address *Pennsylvania*, care of THE BOILER MAKER.

Wanted—Plate Shop Foreman for a small-sized shop located in the vicinity of New York. Only those fully experienced and able to get results from small-sized shop need apply. State age, experience and salary desired, present employment, and how soon you could begin work. Address *New York*, care of THE BOILER MAKER.

Foreman Sheet Metal Department Wanted—Medium weight work. An able man to take charge of making tanks, cylinders, gasometers and similar work, utilizing 1/8-inch to 3/8-inch iron. Must be able to handle men, have knowledge of up-to-date machinery, and preferably familiar with oxy-acetylene in above construction. Address *President*, P. O. Box 15, Station P, Baltimore, Md.

American Boiler Manufacturers' Association

President—M. H. Broderick, care of Broderick Boiler Company, Muncie, Ind.

Vice-President—C. V. Kellogg, director Kewanee Boiler Company, 419 West Eighteenth street, Chicago, Ill.

Secretary and Treasurer—H. N. Covell, works manager The Lidgerwood Company, Dikeman street, Brooklyn, N. Y.

Master Boiler Makers' Association

President—Hon. D. A. Lucas, general foreman boiler maker, Chicago Burlington & Quincy Railroad, Havelock, Neb.

First Vice-President—John B. Tate, foreman boiler maker, Pennsylvania Railroad, Altoona, Pa.

Second Vice-President—Charles P. Patrick, foreman boiler maker Erie Railroad, Cleveland, Ohio.

Third Vice-President—Thomas Lewis, general foreman boiler maker Lehigh Valley Railroad, Sayre, Pa.

Fourth Vice-President—T. P. Madden, general boiler inspector, Missouri Pacific Railroad, St. Louis, Mo.

Fifth Vice-President—E. W. Young, general boiler inspector, Chicago Milwaukee & St. Paul Railway, Dubuque, Iowa.

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First Vice-President—A. Hinzman, Room 15, Law Building, Kansas City, Kan.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated; paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

Superintendent Wanted for boiler and machine shop employing about 100 men; building watertube boilers and some engine work. Desire technical man about 35 years old with broad acquaintance and ability who can handle men. A man who has had actual experience in similar work. Exclusively Government contracts. Excellent opportunity for advancement. State age, nationality, salary, present employment, reference and when available. Also want assistant superintendent for outside erection work. Address *Advancement*, care of THE BOILER MAKER.

WESTINGHOUSE EMPLOYEES RAISE TWO MILLIONS FOR LIBERTY LOAN.—A total of $2,144,800 subscribed by employees is the record of a ten-day Liberty Loan campaign in the organization of the Westinghouse Electric & Manufacturing Company. With 30,384 subscribers from the company's various plants and district offices, the "bogie" set for this and the total subscription figures was largely exceeded. Mass meetings at the noon hour, addressed by four-minute speakers recruited from the shop employees, were an important feature of the campaign. At one such meeting, held at East Pittsburgh works, several thousand people listened to Sousa's band, and were addressed by Major Watt, of the Gordon Highlanders. The Westinghouse and Scotch Kilties bands played at other similar meetings. Due to the general enthusiasm, and particularly to the efforts of the campaign committees, many departments were able to display "100 percent" signs; where one or two persons hung back the force of public opinion quickly brought them into line.

TRADE PUBLICATIONS

Among the Materials for the Boiler Maker listed in the *Monthly Stock List* published by the Bourne-Fuller Company, Cleveland, Ohio, are the following: "Boiler plate, boiler tubes, Climax boiler and tank rivets (½ to ¾ inch, cold made), blue annealed sheets, staybolt iron, flanged and dished boiler heads, channels, bars, beams, angles, hand punches, steel hoops, plate steel, pressed steel boiler braces, sheared plates, sheet steel, steel shafting, tees, tool steels, etc." Any of our readers who will write to the Bourne-Fuller Company, and mention THE BOILER MAKER, will receive this stock list free of charge.

Cleveland Air Tools are described in Bulletins 29, 34, 36 and 37, published by the Cleveland Pneumatic Tool Company, Cleveland, Ohio. "Cleveland chipping and calking hammers are preferred for boiler work on account of their high speed and steadiness in operation, particularly in calking, as it is important in this class of work that the hammer be free from vibration and recoil. Cleveland hammers are made in nineteen styles and sizes with inside or outside latch, as preferred, and are equipped with round or hexagon tool noses as required. The new Cleveland pocket-in-head riveting hammers are the most powerful riveting hammer made. They are shorter over-all, hit a harder blow, use less air in operation, have higher speed with less recoil in operation than any riveting hammer on the market. Accurate meter tests show a net saving of 25 percent in air consumption. The new Cleveland is made in fifteen sizes with outside or inside latch, driving capacity ¾-inch to 1¼-inch rivets. They are ideal for field erection and heavy boiler construction, as they operate equally well on high or low air pressures. Cleveland center spindle air drills are made in sixty-one types and sizes for all classes of metal drilling or wood boring. Corner drills save time and money drilling in close quarters where the center spindle machine cannot be used."

"Punching and Shearing Machinery That It Pays to Buy" is the title of a circular published by the Hilles & Jones Company, Wilmington, Del. The following is given as explanation of the title of the circular: "Because it is the least expensive in the long run, for it gives steadier service, does faster work and lasts longest. Hilles & Jones' punching and shearing machinery is the product of sixty-four years' specialization in the manufacture of this class of machinery alone. In important boiler shops, structural steel works, railroad and car shops in every section of the country, you will find Hilles & Jones machines giving complete satisfaction. Cut shows Hilles & Jones Double Ended Punch and Shear, 48-inch throats, of capacity to punch 1¼-inch holes in 1-inch or shear 1-inch plate."

The Injector Type of Blowpipe and the low-pressure generator in oxy-acetylene welding is described in a bulletin published by the Oxweld Acetylene Company, Newark, N. J. "The evidence is overwhelmingly in favor of the injector type of blowpipe and the low-pressure generator. In all cutting or welding operations this system maintains an absolutely constant pressure that is as unvarying as the power in a Packard Twin Six. There are no wires to connect or get out of order. Cool generation keeps the blowpipe from getting clogged. The Oxweld syphons all the gas from the cylinders—no other type does. We can send you figures showing what Oxwelds are saving for others in your line of business—no matter what it is; figures that will surprise you. They save so much that the cost is hardly considered."

"A Treatise on the Merits and Demerits of the Various Processes of Pipe Flanging" is the subject of a circular published by the Lovekin Pipe Expanding & Flanging Machine Company, Philadelphia Bank building, Philadelphia, Pa. "In the process of engineering development there has been a steady increase of pressures, and as a result the ingenuity of the leading pipe flanging companies of this country has been severely tried, owing to the lack of an economical and safe means of attaching flanges to wrought pipe of all characters. Screw joints, so universally used heretofore, are rapidly being replaced by more reliable and safer methods. This is owing to the many defective and unmechanical features of the screw flange. The principal reasons for the engineering profession discarding it are as follows: First, since the cross-section area of the pipe has been reduced by cutting a thread upon it, we have by just this same amount reduced its strength against longitudinal stresses. These longitudinal stresses are the main ones to be dealt with where great variations in temperature are experienced, and these stresses frequently exceed the internal bursting pressures which have to be considered. Second, it is very seldom possible in practice to send the screw flange entirely home upon the pipe owing to the liability of bursting the flange by forcing it on to the taper of the thread. If the flange is not entirely home, that portion of the thread back of the flange hub is left exposed. This becomes a constant source of weakness against the principal enemies of the pipe joints, viz.: vibrations and corrosion. During a long period of investigation it has been our experience that where screwed flanges failed in the face of longitudinal strains and vibrations failure took place at the back of the flange hub. It is because of these faults or weaknesses that the engineering world has advanced from the screw thread to a joint of greater strength, just as the single engine is being displaced by engines of compound and triple expansion variety. The catalogues of the various large pipe flanging concerns of this country show the unrest and dissatisfaction of engineers with the screwed joint. In these catalogues will be noted joints of the turned-over type, the Van Stone method, shrunk joints, hand-pened joints and joints of the single- and double-riveted class, hot rolled joints and the welded joint; you will not note, however, any joint of the cold rolled variety—this process belonging exclusively to our method. The welded joint is, in our opinion, the most expensive and unsatisfactory of them all, if viewed from the point of reliability. We have all had our own troubles with welds of various description, as encountered in the different branches of the profession; and their failure at the time of sorest need has cost many an engineer his reputation. The riveted joint makes a rather substantial connection, but it at once diminishes the effective diameter of the pipe by twice the thickness of the rivet head. This in most cases means cutting down the effective area from 10 percent to 20 percent. From a standpoint of economy and weight, this fault puts the riveted flange "out of the running," without considering the difficulty of keeping the rivets tight against high pressures. The shrunk joint can, of course, never enter largely into the pipe flanging field, as its holding power can by no process of methematics ever be accurately ascertained. All of the tests upon this character of joint have demonstrated its holding powers vary between the limits of zero and infinity, according to the state of health and humor of the mechanics at the time of its making. The hand-pened joint, if it were not for the enormous expense attending this method, would seem to us to most properly fulfill the requirements of a substantial and in every way mechanically good connection, as is attested to by its general use in high-class high-pressure installations. In the Lovekin method we present to the engineering world a joint produced by a means which has all the economical advantages of the screw thread joint and a positive holding power beside, which is only limited by the ultimate strength of the pipe itself. By the Lovekin method the metal in the pipe is extruded into the recesses machined in the flange hub. This is done by the cold rolling process, which improves the metal 15 percent, as demonstrated by actual tests. The Lovekin method requires no heat, hence the possibilities of crystallization and incalculable strains arising from unequal contraction.

The Thomson Process of Electric Welding is described in Bulletin No. O-O, just published by the Thomson Electric Welding Company, Lynn, Mass. Under the title of "Electric Welding Machines; What They Are and How They Do It," appears the following: "Butt welding. Electric welding machines are designed for the manufacturer who has a large quantity of one kind of work to do; where there are many thousand pieces of one kind to weld. They are not intended to replace the blacksmith for general repair work where there are a few pieces of various sizes to be welded. It is purely a quantity and quality proposition, where a volume of work is to be turned out at a minimum of cost. Under these conditions a welding machine will pay for itself in a short time, as an inexperienced boy can turn out more work, and better work, in a given time, than a dozen blacksmiths. Skilled labor is not required, and boys and girls operate many of the smaller machines, turning out thousands of welded pieces per day. When butt welding, two pieces of metal are placed in the clamping jaws of the machine with only 1/8 to 1/2 inch of metal extending beyond the jaws. The ends of the metal touch each other. The electric current is turned on by means of a switch, and the abutting ends of the metal instantly begin to heat. The boy operating the welder quickly learns to judge when the welding temperature is reached; when he sees the metal is hot enough, he pulls a lever and forces the two ends of the partially molten metal into each other, and the weld is made. Time required—from 3 seconds for ¼-inch rods to 35 seconds for a 1½-inch bar. The metal is in full view of the operator all of the time, instead of being hidden by the coal in a forge fire. No smoked glasses or goggles are needed any more than they would be by the blacksmith. There is no scarfing to be done, and, due to the way the metal is forced together, there is no oxidization such as there would be in an open fire, and, consequently, no welding compound is used. In a forge fire a thin film of oxide forms on the metal, which must be removed by a welding compound before a good weld can be made. Thorough tests have been made on the tensile strength of electrically-welded bars, which prove they are practically as strong at the welded joint as at any other cross section of the metal. This is not the case with welds made in forge fires; the formation of a deleterious scale, and the difficulty of applying the heat uniformly and welding quickly enough after taking from the fire, prevents the ideal conditions under which electric welds are made. With electric welds the heat is first developed in the interior of the metal, consequently it is welded there as perfectly as at the surface. When welding in a forge, the outer surface is heated first, and very often the inner part does not reach the welding heat —the result being an imperfect weld. There can be no blistering or scaling of the metal when welding electrically, and no energy or heat is wasted in heating more of the material than is required to make a weld. The operator has complete control of the electric current by means of his current regulator and switch; he can obtain any heat desired, from a dull red to the melting point of the metal, by turning the current on and off. The instant the weld is made the expense for current stops. Owing to the low voltage employed (only 3 to 5 volts) there is not the slightest danger of injury to the operator, as he cannot even feel the current in case he should come in contact with it. With electric welding it is not necessary to specially prepare the metal, although when very rusty or covered with blue scale, the rust and scale should be removed sufficiently to allow good contact of clean metal on the copper dies, as both scale and rust are poor conductors of the electric current. The parts to be welded can be kept in accurate alinement by the clamping jaws, which can be given almost any shape desired to hold the work. We are often asked if the electric current has any effect on the welded metal. This question arises from the fear that there may be some mysterious quality connected with electricity that will change the characteristics of the metal after welding. The answer is no—the only effect of the electric current being to heat the metal. The underlying principle of the electric welding machine is very simple, and is an adaptation of the well-known fact that a poor conductor of electricity will offer so much resistance to the flow of current that it will heat. Copper is a good conductor, and a bar of iron, being a comparatively poor conductor, when placed between the heavy copper conductor of the welder becomes heated in attempting to carry the large volume of current; the degree of heat depending upon the amount of current and the resistance of the conductor. When the ends of two pieces of metal are brought together, this is the point of greatest resistance in the electric circuit, and the abutting ends instantly begin to heat. The hotter this metal becomes the greater the resistance to the flow of the current; consequently, as the edges of the abutting ends heat, the current is forced into the adjacent cooler parts, until there is a uniform heat throughout the entire mass, all of this being accomplished in an entirely automatic manner. Electric welding machines are made in a great variety of forms—their type depending on the size and shape of the metal to be welded. They can be made to do the work automatically, or can be semi-automatic, hand-operated or foot-operated, as conditions require. The capacity of the machine is fixed by the maximum and minimum sizes of stock to be welded. Rapidity of work will depend largely on the operator, the size and shape of the pieces to be welded, and the kind of machine used. There is a wide range between the heavy pieces requiring careful alinement in the clamping jaws, and the light pieces which can be rapidly and easily handled. In some of the smaller machines several thousand pieces can be turned out per day, while in the larger ones only a few hundred can be welded. The Thomson machines are designed to get the maximum output at a minimum cost of labor and current. In other words, they are high efficiency machines. There are several different methods of electric welding commonly employed, viz.: lap welding, butt welding, tee welding, spot welding, etc. Lap welding is limited in its application, and is not as commonly used as the others mentioned. In this method two pieces of metal are overlapped, and when brought up to a welding heat are forced together by passing through rollers, or under a press, thus leaving the welded joint practically the same thickness as the balance of the stock."

HELP, SITUATION AND FOR SALE

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Wanted—Gang Boss by large Michigan boiler manufacturers. Government work; modern shop; good working conditions. Write, fully stating age, past experience, references and salary expected to start. Address *Gang Boss*, care of THE BOILER MAKER.

Wanted—First-Class Layer-Out for a boiler shop in the Central West; preferably one who has knowledge of water-tube and tubular boilers. Good opportunity for the right man. Address *Watertube*, care of THE BOILER MAKER.

Wanted—Young man with some knowledge of laying out, with good technical education, to work under an experienced layer-out and ultimately have charge of department. Address *Department* 5, care of THE BOILER MAKER.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated; paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

Quickwork Rotary Shears are the subject of a catalogue published by The Quickwork Company, St. Mary's, Ohio. According to this catalogue, Quickwork shears cut out 90 percent of plate cutting expense. "Cut straight lines as well as curved and irregular lines. Also cut opening in a sheet without cutting in from the side. In all cases the metal is left flat and smooth, with square, true edges. The cut is made at one passage of the metal through the machine. Quickwork Rotary Shears have three changes of speed. Changes can be made instantaneously. Power driven and controlled throughout. All bearings bushed. All gears have cut teeth and the main casting is of semi-steel. Cut plate 3/4 inch thick and lighter."

American Boiler Manufacturers' Association

President—M. H. Broderick, care of Broderick Boiler Company, Muncie, Ind.
Vice-President—C. V. Kellogg, director Kewanee Boiler Company, 419 West Eighteenth street, Chicago, Ill.
Secretary and Treasurer—H. N. Covell, works manager the Lidgerwood Company, Dikeman street, Brooklyn, N. Y.

Master Boiler Makers' Association

President—Hon. D. A. Lucas, general foreman boiler maker, Chicago, Burlington & Quincy Railroad, Havelock, Neb.
First Vice-President—John B. Tate, foreman boiler maker, Pennsylvania Railroad, Altoona, Pa.
Second Vice-President—Charles P. Patrick, foreman boiler maker, Erie Railroad, Cleveland, Ohio.
Third Vice-President—Thomas Lewis, general foreman boiler maker, Lehigh Valley Railroad, Sayre, Pa.
Fourth Vice-President—T. P. Madden, general boiler inspector, Missouri Pacific Railroad, St. Louis, Mo.
Fifth Vice-President—E. W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul Railway, Dubuque, Iowa.
Secretary—Harry D. Vought, 95 Liberty street, New York.
Treasurer—Frank Gray, foreman boiler maker, Chicago & Alton Railroad, Bloomington, Ill.

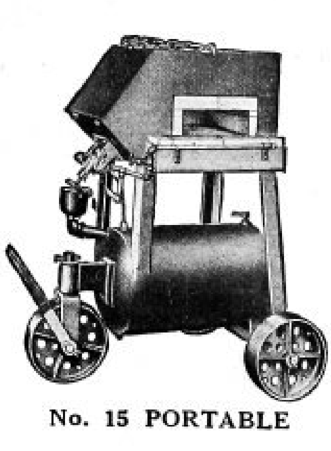
Boiler Makers' Supply Men's Association

President—B. A. Clements, Rome Merchant Iron Mill, New York.
Vice-President—Charles B. Moore, Oxweld Railroad Service Company, Chicago, Ill.
Secretary-Treasurer—George Slate, THE BOILER MAKER, New York.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

President—J. A. Franklin, Room 15, Law Building, 721 Minnesota avenue, Kansas City, Kan.
Secretary-Treasurer—F. P. Reinemeyer, Rooms 10 to 12, Law Building, Kansas City, Kan.
Editor-Manager of Journal—James B. Casey, Room 9, Law Building, Kansas City, Kan.
First Vice-President—A. Hinzman, Room 15, Law Building, Kansas City, Kan.

Tate Flexible Staybolts and their adaptability to locomotive boiler service, where they are now in use on 650 railroads, are the subject of a circular published by the Flannery Bolt Company, Vanadium building, Pittsburgh, Pa. "Twelve years' experience with the Tate flexible staybolt in locomotive firebox practice, under all conditions of service, has enabled the railroads of this country to rightly judge its practical usefulness and the ultimate economy resulting in the application of same to all high-pressure boilers. For all new boilers we recommend a suitable installation of Tate flexible staybolts, feeling confident that the benefits that will be derived will fully justify the investment, for the service records of all fireboxes that have Tate bolts applied show a lower staybolt breakage and a less cost for firebox repairs and maintenance than were formerly obtained by the complete use of the rigid staybolt."



TRADE PUBLICATIONS

Stationary Forges are described and illustrated in section No. 108 of the catalogue published by the Buffalo Forge Company, Buffalo, N. Y. In addition to forges the company makes the following: Blowers; exhaust fans; disk fans; drills; punches; shears; bending machines; tire setters; combination woodworking machines; steam engines and turbines; fan system apparatus for heating, ventilating, drying and mechanical draft; air washers; humidifiers; dehumidifiers.

The "American" Staybolt is described by the American Flexible Bolt Company, Union Bank building, Pittsburgh, Pa., in a catalogue just issued. "The American Flexible Bolt Company has developed a new principle in bolt construction whereby greater flexibility of the structure prolongs the life of bolts subjected to lateral as well as direct tensile stresses, such as is the case particularly with boiler staybolts. The results of tests and service conditions covering many thousands of American staybolts on a large proportion of the railroads of the United States and some abroad give confidence in the ability of the company to fulfill the claims made in these pages. Much more important than staybolt life, in maintenance and locomotive availability, is additional fire-box life, which is contributed to by the body flexibility of American staybolts. Anything that will decrease staybolt leakage and the buckling of the fire-box sheets will add to fire-box life, and it is well known that the rigidity of solid body staybolts is responsible for leakage and the buckling action which is followed by cracking and failure of fire-box sheets. The term 'flexible' in the case of American staybolts is not to be construed in the same sense as in that of jointed bolts and others composed of two or more parts, but a very considerable increase of flexibility, as compared with any solid bodied bolts, is obtained by our method of construction, although a completed bolt is of one piece, as shown above. Careful and exhaustive tests of these bolts in comparison with solid bolts have demonstrated this fact, both by the respective number of vibrations necessary to break down the structure, also the power required to effect such vibrations, and this without loss of tensile strength as compared with solid bolts."

"The Solution of Your Flanging Problems" is given in a catalogue published by the McCabe Manufacturing Company, Lawrence, Mass.: "The answer—two men and a 'McCabe.' Every shop has flanging problems. It may be that you cannot get good men to stand this hard back-breaking work; or it may be that your work is delayed because your flanging gang does not turn out enough work; or it may be that you have some special shape flanging which requires several pieces to be all exactly alike. All these problems are easily solved with the 'McCabe.'"

Steam Specialties are described in a cloth-bound catalogue of 318 pages, published by the D. T. Williams Valve Company, Cincinnati, Ohio. "Back of the Williams line of specialties there is not only an experience of twenty-five long years in making and selling valves, but there is a conscience, a settled business policy, a reputation for consistent fair-dealing, as well as business methods that no customer has yet found wanting. Quality is the slogan of the Williams organization. Quality and quality only is unflinchingly and everlastingly insisted upon in the manufacture of our products. Strict adherence to this policy constitutes the basis upon which we, in a comparatively short time, have founded a business and engineering success that ranks as one of the most formidable in the valve industry, and to-day the reputation of Williams specialties has come to be worldwide. In presenting this catalogue to you, we respectfully call your attention to the new specialties added to our line, as well as the meritorious changes and improvements in some of our other products. Where changes or improvements have been made, they have been dictated by experience and our constant endeavor to refine, even to the most trivial considerations. We thank our many customers and friends for their patronage, and to those who have not made our acquaintance we extend an earnest invitation to investigate the claims made for the Williams product. If we could but visit you—show you samples, demonstrate and discuss the meritorious features of the Williams product, we feel sure you would believe in its value and the spirit and purpose of the organization which makes and stands back of it. Since we cannot talk to you personally, we must depend on this book to tell our story, both for you and for us—simply and completely for you, truthfully for us."

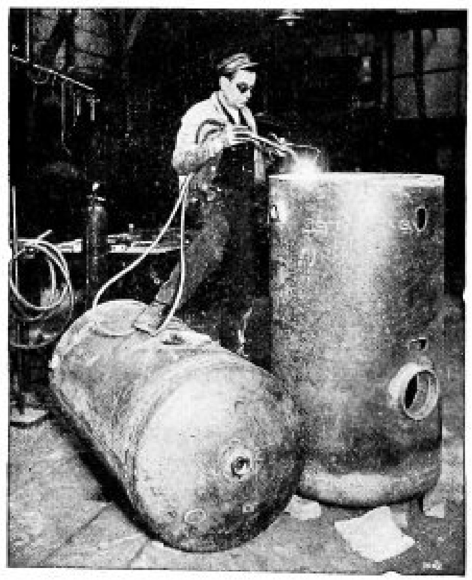
Oil Fuel Riveting Forges, flue welding and superheater furnaces and pneumatic flue welding machines for swaging, scarphing and welding, plate heating furnaces, angle heating furnaces and portable oil burners, are described in Catalogue F-B, published by The Macleod Company, Bogen street, Cincinnati, Ohio. The company states that it has constantly on hand over twenty different sizes and types of oil riveting furnaces, and promises quick delivery. According to the catalogue also, more "Buckeye" riveting furnaces, manufactured by The Macleod Company, are in use than all other types of riveting furnaces combined.

"Two Adjacent Staybolts Broken Cuts an Engine Out of Service" is the statement made in a bulletin published by Rome Iron Mills, Inc., 30 Church street, New York. "Half of each twenty-four hours an engine is in the hands of the mechanical department. This is a lot of time considering the large money investment involved and the urgent need for power. Every broken staybolt has its effect on this time, and therefore on the ton-mile capacity of every engine. That's why quality in staybolt iron counts so much in the hauling capacity of the road. That's why Rome Superior Box Piled twice-made staybolt iron counts so much in the hauling power of engines."

"Cleveland Air Tools" is the title of a catalogue just published by the Cleveland Pneumatic Tool Company, Cleveland, Ohio. "In presenting this, our fourteenth annual catalogue of Cleveland pneumatic tools and appliances, we would invite your attention to the completeness of our line, which embraces air tools for every general and detailed purpose. The catalogue is a practical text book of pneumatic tools, their care and use; there are engineering tables of the duty and capacity of air tools of varying types and sizes, all of which have been compiled from performances under actual working conditions. Cleveland air tools are the finished product of an efficient and progressive manufacturing system, which safeguards their construction through the various stages of manufacture until final assembly, each machine being rigidly tested for extreme service on mechanically-operated testing and recording machines before leaving the works. Cleveland air tools have an enviable reputation for efficiency and prolonged life; their great success has been achieved through quality, durability and economical up-keep in service."

"Beaver" Cutting and Treading Tools for Pipe are described in an illustrated catalogue just issued by The Borden Company, Warren, Ohio. "In the early days of The Borden Company, while experimenting with separate threading chasers held in a plate that allowed the dies to move in and out, it occurred to the operator that if these dies were started on the pipe at full depth and gradually opened up while cutting, the thread would be tapered, even if the die had but a single tooth. For many years it was considered necessary to cut tapered pipe threads with a tapered die. It is evident that a tapered die is an inverted wedge, and it must cut harder with each turn, because in addition to the labor of cutting the thread each succeeding revolution adds the unnecessary friction due to dies binding tighter on the pipe. This, then, is the very essence of the Beaver principle—the dies are practically without taper and yet they cut an absolutely perfect tapered thread, because they automatically move away from the pipe during the threading operation, the dies removing less metal each turn, and consequently each turn of the die stock becomes easier, right up to the finish of the thread."

High-Speed Twist Drills, reamers, countersinks, flue cutters and lathe tools are described in a 92-page illustrated catalogue, issued by the Clark Equipment Company, Buchanan, Mich. "The Clark Equipment Company is the pioneer in the manufacture of high-speed twisted drills. We originated and perfected the twisted drill, and our efforts have since been devoted to the manufacture of drills and other tools by the twisting process. Since the first twisted high-speed drill was placed on the market by this company, it has been conclusively proven that tools so made possess distinct advantages over those milled from the solid. The forging or rolling of our sections to shape before twisting, tends to densify the metal and produces tools which cannot be excelled for strength and cutting qualities. We were the first to recognize that high-speed drills must have ample chip clearance and extra large shanks to accomplish the work for which they are intended. Our success in producing thoroughly efficient tools is attested by our large and constantly growing business. We are represented by high-class dealers in all of the large cities, who carry our tools in stock at all times. In issuing this new and complete catalogue we wish to extend our appreciation to all those who have purchased from us in the past, and to those who have not we bespeak an opportunity to demonstrate the value of our product."



Tools for Hard Work are the subject of a circular published by the Scully Steel & Iron Company, Postoffice Box 814, Chicago, Ill. "If you want good tools they will have to be made of good material. They must be forged slowly and tempered right. Our Arrow tools (hand and pneumatic) will reduce costs. We will guarantee each and every tool worth two of the ordinary kind, and we will replace defective tools or refund the price to any dissatisfied customer."

A Stocklist of Cutters is issued on the 15th of every month by the Cleveland Milling Machine Company, Cleveland, Ohio. "On the following pages we list our standard cutters, which are in stock and from which immediate shipment can be made. In ordering, state whether high-speed steel or carbon steel is desired. We are equipped for the production of special tools, and are always ready to submit specifications and prices on application."

Colburn Heavy Duty Drill Presses are described by the Colburn Machine Tool Company, Franklin, Pa., in bulletins just issued. "The manufacturing heavy-duty type of drill dress has been designed to meet the need for a high-grade heavy type drill press of simple design with as few parts as possible, suitable for manufacturing operations where duplicate pieces in large quantities are to be machined. The ordinary type of drill press has a large range of speeds and feeds, necessitating a lot of gears, shafts, bearings, etc. When the machine is run for long periods without changing, as is often the case, most of these parts are running idle and consuming extra power. This new manufacturing drill press is so designed that just the right speeds and feeds for the work in hand are available, and there are no extra gears or bearings in the machine. This arrangement gives the greatest possible efficiency, and on account of the few parts in motion the power consumed is reduced to the minimum. While the design of this machine is extremely simple, its range of speeds and feeds is practically unlimited, for by means of a patented, ingenious arrangement of transposing gears any combination of speeds or feeds desired may be obtained in a few seconds."

"Ductility of Shelby Tubes" is the title of a circular published by the National Tube Company, Frick building, Pittsburgh, Pa. "The remarkable ductility of 'Shelby' seamless steel boiler tubes is shown by the illustration. The fact that 'Shelby' seamless steel boiler tubes lend themselves to manipulation, distortion and 'punishment,' by virtue of this characteristic, accounts in some measure for their use on many large railroads in this country and on many foreign systems. 'Shelby' seamless steel boiler tubes combine great strength and uniformity with ductility, due to the high-grade material used and the thoroughly modern methods of manufacture pursued. Nothing has been neglected to insure as well as to establish 'Shelby' quality. As an instance, it may be cited that the production of 'Shelby' seamless steel boiler tubes, from ore to finished tube, is controlled by one self-contained organization. Recognition of 'Shelby' quality was given by the Superior Jury of Awards, Panama-Pacific International Exposition, 1915, when it awarded the Grand Prize to 'Shelby' seamless steel boiler tubes among other 'National' tubular products for representing 'the highest development of the art.'"

"Foster Valve Specialties" is the title of Catalogue 30, published by the Foster Engineering Company, Newark, N. J. "In our last edition, our Catalogue No. 20, we recalled the attention of our friends to the growth of this company throughout our years of successful business from a very humble start. It is interesting to note the number of competitive concerns that have entered the market since the Foster Engineering Company first appeared in the field. How many, many, have eventually passed to oblivion, or have been replaced by others, all in their frantic efforts to obtain their share! We have progressed steadily onward, continuing to maintain our position pre-eminently as the leading engineers engaged in the manufacture of specialties of the nature of ours, still unassailable, enduring to the end. In this book we invite your attention to many of your old friends in our line, and we introduce several new, following our usual method of improving and increasing our line to present our specialties at all times in keeping with modern and up-to-date engineering practice. In addition to those that are entered into in this catalogue we have a large number of specialties, applicable for high and low pressures under various service conditions, each of them obtaining some special advantages and designed for certain special duties, and which cannot be incorporated in this book without vastly increasing its size. We aim to present to our friends the majority of our standard specialties, but, as before, and as has been our invariable custom, we will be pleased to consult and advise on any requirement in keeping with our line that may be presented, extending the same courteous and immediate treatment as has been assured in the past."

HELP, SITUATION AND FOR SALE

IMPORTANT NOTICE

All advertisements under this heading must be paid for in advance. We make a merely nominal charge for them and cannot afford to open ledger accounts for such items.

Advertisements are inserted under this heading at the rate of 4 cents per word for the first insertion. But no advertisements will be inserted for less than 75 cents. For each subsequent consecutive insertion the charge will be 75 cents. Replies may be sent to our care if desired, and they will be forwarded without additional charge.

All answers to advertisements in this column will be forwarded promptly, but we cannot guarantee replies. Concerns advertising for help do not wish their identity revealed, and only reply to such correspondents as they think best to answer.

Wanted—Several first-class boiler makers. Only good workmen need apply. Address *P. O. Box* 647, Charleston, W. Va.

For Sale—One Sellers Riveting Bull, operated by steam or air, 50 tons capacity, 100 pounds air, 72-inch throat, 5-inch stroke, capacity 1-inch rivets. Machine is in good operating condition. *Industrial Service Company,* Lincoln, N. J.

Wanted—A Layer-out on horizontal, return tubular and locomotive type portable boilers. Give experience and salary wanted in first letter. Address *The Brownell Company,* Dayton, Ohio.

Wanted—Layer-out for general tank work on from 3/18-inch gage upwards. Young, ambitious man preferred. State age, experience and wages expected. Address *Wayne Oil Tank & Pump Company,* Ft. Wayne, Ind.

Position wanted by superintendent boiler maker, experienced on all classes of marine and stationary boilers. Philadelphia preferred. Address *Box* 250, care of THE BOILER MAKER.

Wanted—Layer-out for Plate Shop, building small tanks, breechings, stacks, gear guards and a general line of special fabricated work, most of which is direct or indirect Government work. Address *Heltzel Steel Form & Iron Company,* Warren, Ohio.

Wanted—Layer-out and Assistant Foreman for boiler shop in Middle West. A splendid opportunity for an able, ambitious man. State age, experience and salary desired. Address *Box* 300, care of THE BOILER MAKER.

Wanted—Gang Boss by large Michigan boiler manufacturers. Government work; modern shop; good working conditions. Write, fully stating age, past experience, references and salary expected to start. Address *Gang Boss,* care of THE BOILER MAKER.

American Boiler Manufacturers' Association

President—M. H. Broderick, care of Broderick Boiler Company, Muncie, Ind.
Vice-President—C. V. Kellogg, director Kewanee Boiler Company, 419 West Eighteenth street, Chicago, Ill.
Secretary and Treasurer—H. N. Covell, works manager the Lidgerwood Company, Dikeman street, Brooklyn, N. Y.

Master Boiler Makers' Association

President—Hon. D. A. Lucas, general foreman boiler maker, Chicago, Burlington & Quincy Railroad, Havelock, Neb.
First Vice-President—John B. Tate, foreman boiler maker, Pennsylvania Railroad, Altoona, Pa.
Second Vice-President—Charles P. Patrick, foreman boiler maker, Erie Railroad, Cleveland, Ohio.
Third Vice-President—Thomas Lewis, general foreman boiler maker, Lehigh Valley Railroad, Sayre, Pa.
Fourth Vice-President—T. P. Madden, general boiler inspector, Missouri Pacific Railroad, St. Louis, Mo.
Fifth Vice-President—E. W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul Railway, Dubuque, Iowa.
Secretary—Harry D. Vought, 95 Liberty street, New York.
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Editor-Manager of Journal—James B. Casey, Room 9, Law Building, Kansas City, Kan.
First Vice-President—A. Hinzman, Room 15, Law Building, Kansas City, Kan.

Wanted—Layer-out and Assistant Foreman, for sheet metal, light structural iron and high-pressure tank work. Metal varies from No. 20 gage to 3/8-inch plate. Applicant must be a high-class mechanic and layer-out, with ability to handle a department employing 50 men, year around. This is a permanent position with good pay for the right man. Shop up to date and delightfully located. In applying give age, nationality, experience and salary expected. All replies treated confidential. Address *Sheet Metal,* care of THE BOILER MAKER.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated; paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

TRADE PUBLICATIONS

The Scully Flue Hole Cutter is one of the boiler makers' tools described in a catalogue published by the Scully Steel & Iron Company, 2364 South Ashland avenue, Chicago, Ill. "Made of steel throughout with tool steel knives and reamers. Knives are made of high-speed steel. They are 4½ inches long, and are the same shape and size throughout their entire length, and can be ground on the end until quite short. The knives are held firmly in the body by set screws, which also are set into the body. No projecting parts."

Bolt, Nut and Forging Machines are described and illustrated in a 220-page booklet published by the Acme Machinery Company, Cleveland, Ohio. "The Acme die head, because of its correct mechanical principles, has met without exception all demands that have been made upon it for precision, durability and efficiency. Many improvements have been made during the years of its manufacture, all of which have materially added to its working life and efficiency. The design, however, is substantially the same. The Acme die head is made in two types, viz.: The "Regular' Acme die head and the 'Special Adjustment' Acme die head. They will interchange with Acme bolt cutters of even size and design, and also may be applied to bolt cutters of other makes when the machine design is similar to the Acme machine. The dies interchange in our heads of even size. While the mechanical principle remains the same, the 'Regular' and 'Special Adjustment' die heads differ radically in the method in which the dies are adjusted to size, in that, while the regular die head must be stopped to be adjusted, the special adjustment die head may be adjusted while running at any speed. In the catalogue which follows we have fully explained all the advantages derived from the latest improvements embodied in this head. We shall continue the manufacture of both types of die head. The special adjustment die head will be applied to all new machines unless otherwise ordered, and also kept in stock to replace die heads of the same type. The regular die head will be for sale to parties using bolt cutters of our old type who wish to replace their old heads, or to apply to machines of other makes."

Welding and Cutting Equipment is described in literature published by the Scully Steel & Iron Company, 2364 South Ashland avenue, Chicago, Ill. "These torches have a new method of control after the operator gets the correct flame. A master key enables the operator to extinguish or light the gases always at the correct flame. The mixing chamber is near the burner tip, and the gases have no chance of becoming separated when passing through the tip. The head is so constructed there is absolutely no chance for backfire."

Stationary Forges are described and illustrated in section No. 108 of the catalogue published by the Buffalo Forge Company, Buffalo, N. Y. In addition to forges the company makes the following: Blowers; exhaust fans; disk fans; drills; punches; shears; bending machines; tire setters; combination woodworking machines; steam engines and turbines; fan system apparatus for heating, ventilating, drying and mechanical draft; air washers; humidifiers; dehumidifiers.

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"Not as Serious as It Looks" is the caption of a picture of a broken gear wheel in Bulletin No. 300, published by the Oxweld Acetylene Company, Newark, N. J. "An appalling accident, yes—but it took place in an up-to-date factory where all broken machine parts are quickly repaired with an Oxweld blowpipe. It took the welder on the job less than six hours to make this big gear wheel as good as new. With this Oxweld blowpipe and equipment, built for the purpose, he saved hundreds and possibly thousands of dollars that would have been lost waiting for a new casting to come from the foundry. Such accidents are common in factories of all sorts. Your turn may be next. When it comes will you be prepared? Why not write and ask us to-day for Bulletin Series 300, a compilation of facts and figures covering the earnings of Oxweld equipment in factories operated by your competitors?"

"A Quick and Easy Way to Cut Rivets" is described in illustrated Booklet No. 2, published by the Rivet Cutting Gun Company, 220 East Second street, Cincinnati, Ohio. "The flexible rivet cutting gun offers you the quickest, most economical method of cutting rivets. It avoids the slow, expensive work with sledge and cutting bar. It cuts the rivets off cold, thus avoiding damage caused by excessive heat. It reaches the top tie braces on a high top gondola without a scaffold. It cuts rivets in out of the way places under a car or difficult corners where there is little room to work on bridge and structural jobs. It does the work quicker, reduces cost and does not damage the plates."

Electric Tools are described in Bulletin No. 101, published by the Stow Manufacturing Company, Binghamton, N. Y. Among the numerous tools illustrated and described is a heavy-duty drill. "Our special heavy-duty drill, made especially to withstand severe service. Bronze bearing for the motor, a ball thrust bearing on the spindle and special treated steel gears, encased in a grease-filled housing insure long life and low upkeep. All parts of the drill are equally balanced, making it especially easy to handle. Planetary gearing, so well adapted to this class of work, is provided. With this system, power is transmitted equally from opposite points on each gear, and the wear on the gear is reduced to a minimum. Can be supplied with Pratt or Jacobs chuck, as desired."

Brubaker special tempered relieved staybolt taps are the subject of a bulletin published by W. L. Brubaker & Bros., 50 Church street, New York. "The past five years have been devoted to the tempering of a staybolt top that would stand up under all conditions, and at last we have succeeded in producing a special temper in our staybolt taps that will give you better and greater service. Brubaker staybolt taps give 20 percent more holes per tap, and cutting is easier, due to our special method of relieving. Special temper prevents breakage; will be to size, 'one to size, all to size,' and will allow greater speed in motor. Prompt deliveries, five days for regular sizes, ten days for special sizes. Send for samples. If unsatisfactory, return them and no charge will be made."

The Ford "Tribloc" is described in Catalogue No. 3, published by the Ford Chain Block & Manufacturing Company, Second and Diamond streets, Philadelphia, Pa. Among the uses for which the Ford "Tribloc" is especialy adapted is for piling stock. "A hand chain hoist for stock room use possesses advantages that are impossible with larger and more complex hoisting machines. Though small in size, and thus admitting of higher and more compact piling, a Ford Tribloc chain hoist is capable of handling heavy stock. Loads up to 50 tons are handled with comparative ease, due to the efficient planetary gearing. They are handled safely, too, because all working parts of the hoist are of steel and are constructed and tested for liberal overloading."

"Stop That Leakage" is the title of a bulletin published by the Homestead Valve Manufacturing Company, Homestead, Pa. "With the present high price of coal even a small leakage past a single boiler blow-off valve may represent a direct money loss amounting to several hundred dollars per year. Why put up with this condition? You can stop that leakage with the Hovalco-Homestead combination blow-off valve. The result of many years' experience in valve building. Guaranteed to be tight under 300 pounds working pressure. Every part is quickly accessible for repairs when necessary. Both the seat and disk may be reversed, reground or renewed. That means just double the service given by other designs. Seat made of a special non-corrosive metal. All trimmings are made of the best steam bronze."

"What You Know" is the title of a circular published by the Rome Iron Mills, Inc., 30 Church street, New York. "You know that the tell-tale hole in a staybolt is important; you know that the Federal law requires it; you know that it is the only sure way to tell a broken staybolt; you know that you break and burn a large number of high-speed drills in drilling out and cleaning tell-tale holes in solid bolts; you know that when you break or burn a drill in a solid staybolt you must replace the staybolt; you know that when you are in a hurry for a locomotive, and you find broken staybolts close to firebox flange or back of arch tubes in fireboxes, that you have to put the replaced staybolt in from the outside, and that if you have broken bolts in cab or down near the running board it is impossible to drill a tell-tale hole in them from the outside. Then, why not use hollow iron? When you do you always have a bolt with a tell-tale hole in it, and one that meets the requirements of the law. You can put one in from the inside or outside of the firebox and always be sure of a tell-tale hole. Government or railway inspectors will not find staybolts without tell-tale holes in them. It costs less in the long run."

Wrought Pipe Boiler Tubes, cast iron fittings, malleable iron fittings, brass pipe and fittings, iron and brass valves and cocks, and other supplies and specialties for steam, water and gas, are described in an illustrated catalogue of 322 pages, published by Cornell & Underhill, Spring and Greenwich streets, New York.

Tools for Hard Work are the subject of a circular published by the Scully Steel & Iron Company, Postoffice Box 814, Chicago, Ill. "If you want good tools they will have to be made of good material. They must be forged slowly and tempered right. Our Arrow tools (hand and pneumatic) will reduce costs. We will guarantee each and every tool worth two of the ordinary kind, and we will replace defective tools or refund the price to any dissatisfied customer."

The Catalogue of Valves and fittings for all pressures and purposes, published by Crane Company, 836 South Michigan avenue, Chicago, Ill., is a 776-page, cloth-bound volume, profusely illustrated, that lists a full line of Crane products. The goods have been classified, grouped and arranged in such a way that they may be easily located. The valves are grouped, first according to the material of which they are made, then the type of valve, and finally the working pressure. The fittings are first divided into screwed and flanged sections, then according to materials and their working pressures.

Gages, Valves, Indicators, Steam Traps and other engineering specialties are described in a catalogue published by the American Steam Gauge & Valve Manufacturing Company, 208 Camden street, Boston, Mass. "As the pioneer manufacturers of pressure gages in the United States under the Bourdon patent, this company has very naturally followed carefully the ever increasing call of the engineering world for measuring and controlling devices that would at all times perform accurately and economically the necessary functions. For indicating or recording pressures of vacuum, the Bourdon gage is to-day—as it was sixty-five years ago—the most practical and efficient instrument that has yet been invented. This gage is produced in two types—single and double spring, respectively. A third type—called the auxiliary spring style—has been used to some extent, but it has met with questionable success; and as all severe service is more satisfactorily performed by the double tube type, we have discarded the auxiliary spring style entirely. On the few pages next following we describe briefly in a general way the construction of the single and double tube types, the single tube type being used almost wholly for various classes of stationary service, where dial graduations are required in pounds or some equivalent. This arrangement of our catalogue eliminates descriptive matter on the individual gages, where space is devoted especially to classes of service, styles, price lists, etc. We are prepared to furnish British standard pipe thread on all gages if desired, without extra charge."

Punching and Shearing Machines for metal workers, blacksmiths and repair shops are described by the Little Giant Punch & Shear Company, Sparta, Ill., in a catalogue just issued. "The 'Little Giant' combined punch and shear is not a new machine, but has been on the market for over fifteen years. It is a tool that has won on its merit, and we devote the next seven pages in illustrating and describing it in detail. This machine we designate as our Style A, in sizes Nos. 1, 2 and 3. The 'Little Giant' combined punch and shear is, as its name implies, a giant in power, strength and durability, and for all classes of work has given universal satisfaction. There are over 4,000 in use to-day in blacksmith and repair shops, by contractors, manufacturers and the United States Government. We export them to twelve foreign countries, and can furnish testimonials which will prove beyond a doubt that the 'Little Giant' stands on the market to-day without an equal. The machine is very simple in construction, there being only two pieces of casting in it. The balance is of steel. The upper shear blade is made of the best tool steel, held in place by two bolts. The lower shear blades, one for flat and one for round iron, are held in groove by keys. The dies are machine-made, of the best tool steel, square, with bevel edges, crowned on top and held in place by keys, which makes the changing of them a matter of a few seconds. The punches are made of extra special tool steel, properly tempered and held in place by a locknut screwed to the plunger, and can be changed from one size to another in an instant. All punches are furnished 1/32 inch over size, and are made chisel point, although can furnish point center if specified. The advantage of the chisel point is that it can be easily ground when worn. The stripper, as shown at bottom and left of cut on page 3, is a malleable casting, and is placed in the two lugs (one on each side of the locknut), and being slightly tapered, slides into its place as a dovetail, no bolts or other fastenings being required. It is as rigid as the casting itself."

HELP, SITUATION AND FOR SALE

IMPORTANT NOTICE

All advertisements under this heading must be paid for in advance. We make a merely nominal charge for them and cannot afford to open ledger accounts for such items.

Advertisements are inserted under this heading at the rate of 4 cents per word for the first insertion. But no advertisements will be inserted for less than 75 cents. For each subsequent consecutive insertion the charge will be 75 cents. Replies may be sent to our care if desired, and they will be forwarded without additional charge.

All answers to advertisements in this column will be forwarded promptly, but we cannot guarantee replies. Concerns advertising for help do not wish their identity revealed, and only reply to such correspondents as they think best to answer.

Layerout and Assistant Layerout wanted for boiler shop in Western New York. Good wages will be paid to steady men. Address *Room* 506, 39 *Cortlandt Street*, New York City.

Position wanted by superintendent boiler maker, experienced on all classes of marine and stationary boilers. Philadelphia preferred. Address *Box* 250, care of THE BOILER MAKER.

For Sale—One 260-horsepower Hyde Vertical Watertube boiler, tested to 125 pounds working steam pressure; good as new. Address *Box* 714, care of THE BOILER MAKER.

For Sale—A Dallet Boiler Shell Drill with two heads. Also a Fitchburg Machine Company's Boom Drill. Apply to *The Hodge Boiler Works*, East Boston, Mass.

Wanted—A first-class flange turner who is capable of operating a sectional flanging press on heavy boiler work. Good wages to right man. Address *Flanger*, care of THE BOILER MAKER.

Wanted—Experienced boiler shop foreman, capable of laying out and handling about thirty men; state experience and salary expected. Address *P. O. Box, No.* 329, Birmingham, Ala.

Wanted—A Layer-out on horizontal, return tubular and locomotive type portable boilers. Give experience and salary wanted in first letter. Address *The Brownell Company*, Dayton, Ohio.

Wanted—Foreman-Superintendent for modernly equipped boiler and tank works, manufacturing and erecting line of light and heavy plate work. Located in Oklahoma. Applicant must be experienced A-1 man. State full particulars, references and salary expected. Address *Box* 50, care of THE BOILER MAKER.

American Boiler Manufacturers' Association

President—W. C. Connelly, president, The D. Connelly Boiler Co., Cleveland, O.

Vice-President—C. V. Kellogg, president, Kellogg-Mackay Co., Chicago, Ill.

Secretary-Treasurer—H. N. Covel, works manager, Lidgerwood Co., New York.

Master Boiler Makers' Association

President—Hon. D. A. Lucas, general foreman boiler maker, Chicago, Burlington & Quincy Railroad, Havelock, Neb.

First Vice-President—John B. Tate, foreman boiler maker, Pennsylvania Railroad, Altoona, Pa.

Second Vice-President—Charles P. Patrick, foreman boiler maker, Erie Railroad, Cleveland, Ohio.

Third Vice-President—Thomas Lewis, general foreman boiler maker, Lehigh Valley Railroad, Sayre, Pa.

Fourth Vice-President—T. P. Madden, general boiler inspector, Missouri Pacific Railroad, St. Louis, Mo.

Fifth Vice-President—E. W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul Railway, Dubuque, Iowa.

Secretary—Harry D. Vought, 95 Liberty street, New York.

Treasurer—Frank Gray, foreman boiler maker, Chicago & Alton Railroad, Bloomington, Ill.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

President—J. A. Franklin, Room 16, Law Building, 721 Minnesota avenue, Kansas City, Kan.

Secretary-Treasurer—F. P. Reinemeyer, Rooms 10 to 12, Law Building, Kansas City, Kan.

Editor-Manager of Journal—James B. Casey, Room 9, Law Building, Kansas City, Kan.

First Vice-President—A. Hinzman, Room 16, Law Building, Kansas City, Kan.

Position Wanted as Boiler Shop Foreman by experienced boiler maker who has had complete charge of small contract shop. Experienced on locomotive and stationary boilers and plate work. Prefer Middle West location. Address *Foreman*, care of THE BOILER MAKER.

Foreman Boiler Maker desires change; thirty-four years of age, with fifteen years' experience. Anyone wishing the services of a steady, sober and reliable man, address *Reliable*, care of THE BOILER MAKER.

Wanted—Layer-out and Assistant Foreman, for sheet metal, light structural iron and high-pressure tank work. Metal varies from No. 20 gage to 3/8-inch plate. Applicant must be a high-class mechanic and layer-out, with ability to handle a department employing 50 men, year around. This is a permanent position with good pay for the right man. Shop up to date and delightfully located. In applying give age, nationality, experience and salary expected. All replies treated confidential. Address *Sheet Metal*, care of THE BOILER MAKER.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated; paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

TRADE PUBLICATIONS

"Rome Hollow for Emergencies" is the title of a bulletin published by the Rome Iron Mills, Inc., 30 Church street, New York. "Right now when every locomotive is needed to the limit delays are costly and serious. Renewing broken staybolts takes a lot of time. In many places they must be put in from the outside. If solid iron is used much tearing down must be done for drilling tell-tale holes. Rome Hollow is ready for these emergencies by having a tell-tale hole clear through—made when the iron is made. This removes the need of drilling and speeds the boiler makers' work. This is mighty important right now."

"It Isn't Trade Marked." This is the title of a circular issued by the Bourne-Fuller Company, Cleveland, Ohio. "The biggest thing the Bourne-Fuller Company has to sell isn't trade marked. You can't identify the Bourne-Fuller material in a boiler or an office building, or a lake steamer or a manufacturing plant. But the service and the satisfaction which the buyer of bulk material gets from Bourne-Fuller are very real advantages; and they are the only things which can be added to materials to give the buyer more for his money. Those things—service and satisfaction—are really what the Bourne-Fuller Company sells."

The Edison Storage Battery, for use in electric trucks for commercial delivery, is described in a bulletin issued by the Edison Storage Battery Company, Orange, N. J. "The electric truck for commercial delivery service is the vehicle. The Edison battery, covered by the Edison ten-year guarantee, enables you to figure operating and upkeep costs over the period of the guarantee. The adoption of the Edison battery will eliminate all past and present battery troubles, as it is a battery made of steel and has a non-acid solution, which makes it a battery of unquestionable economy and dependability. The small maintenance cost of the Edison battery is a feature which we wish to bring to your attention. If you are interested we shall be glad to have our representative call and give you facts."

The Sixteenth Edition of the Smooth-On Instruction Book has just been published by the Smooth-On Manufacturing Company, Jersey City, N. J. This book will be interesting reading to engineers, as it shows by illustrations how the different Smooth-On iron cements are used for repair purposes. The book contains 144 illustrated pages.

"Where the McCabe Pneumatic Flanging Machine Will Pay Dividends in Your Shop" is the title of a circular issued by the McCabe Manufacturing Company, Lawrence, Mass. "Machine production eliminates uncertainty and loss from inefficient hand work. The McCabe saves time lost in heating sheets, saves fuel and requires less men to handle your flanging work. Flanges sheets cold up to and including ½ inch in thickness. Sheet is clamped by pneumatic chuck, which insures accuracy in shape. Easy to operate, powerful and quick in action. Provides for maximum production with the minimum of fatigue. May we describe in detail what the McCabe will save on some of your flanging jobs?

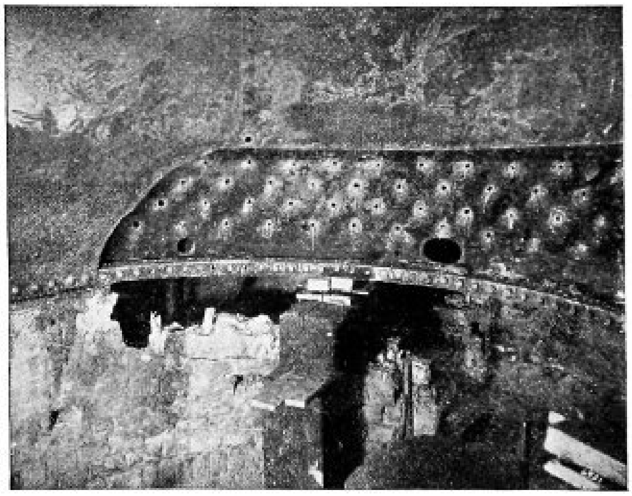
"Let Us Help You Serve Effectively" is the title of a bulletin published by the General Electric Company, Schenectady, N. Y. "Service is vitally necessary in business to-day that we may pull together to accomplish our common aim. The General Electric Company has located industrial power experts at all large cities in this country to serve industry's electrical requirements. For instance, experienced textile mill electrical engineers will be found in all textile centers. Among other industries so served are the iron and steel, coal and metal mining, cement, clay and glass, lumber and woodworking, grain and sugar, canning, packing and refrigeration, shoes and rubber, paper and wood pulp, tobacco and cigars, chemicals and gas, and the construction and shipbuilding. These experts are prepared to co-operate with industrial engineering firms to show the best way to drive a machine or a factory to get maximum production of highest quality at minimum power cost. Back of these experts is the experience gained in supplying much of the electric power equipment now used in American industry and a corps of scientists with research facilities for pioneer work. Call on us to help perfect your service to American business."

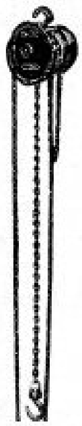
"Condensers, Pumps, Cooling Towers, Etc.," is the name of Bulletin 112-A, just published by the Wheeler Condenser & Engineering Company, Carteret, N. J. Readers contemplating the installation of a condenser will be interested in a discussion in this bulletin entitled "Choice of Kind of Condenser," and in the remainder of the bulletin, which illustrates and describes other Wheeler condensing machinery in detail. The bulletin embraces large and small surface condensers, showing typical complete installations; rectangular and cylindrical types; jet condensers; barometric condensers; Wheeler Edwards air pumps; Wheeler rotative dry vacuum pumps; the Wheeler turbo-air pump; centrifugal pumps for circulating water; natural and forced draft cooling towers. In addition a page is devoted to the Wheeler feed-water heater and two pages to Wheeler multiple-effect evaporators and dryers.

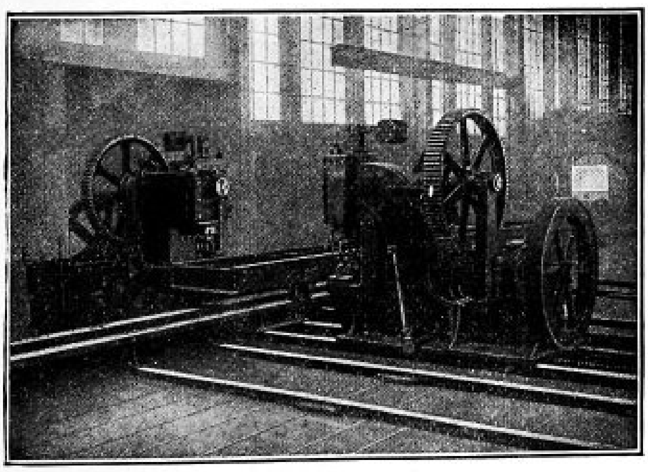
The "Monogram" Bronze Gate Valve is described by the Star Brass Manufacturing Company, 108 East Dedham street, Boston, Mass., in a folder recently published. "The name 'Monogram,' derived from our registered trade mark, stands for the latest ideas in gate valve construction. The form or design of the body, we believe, is superior, same being of the well-known globe shape, acknowledged to be in advance of the older forms in general use, both in strength and durability, also design. The wedge is of the solid, double-faced type, guided in its upward or downward travel by guides or extensions, which are a part of the body casting. The guides are of different thicknesses, and each fits into a corresponding slot or groove in the sides of the wedge, preventing undue wear to the faces of the wedge or seats when valve is opened or closed; also due to the different widths of guides, it is impossible to replace the wedge incorrectly after valve has been taken apart for examination. Valves are of the stationary spindle type. The metal used in their manufacture is of our special steam bronze. We guarantee all these valves for use on steam pressures up to and including 150 pounds, and test each valve to 600 pounds hydrostatic pressure before shipment."

Winans' New Idea Vise.—The Barnett Foundry & Machine Company, Irvington, N. J., has just brought out a machinists' bench vise under the name of Winans' New Idea Vise, that embodies many novel features. The old-fashioned screw and lever has been replaced by a pawl and rack. This is actuated by a handle on an eccentric shaft, which will exert a pressure many times that possible with a screw. The adjustments from O to maximum are made instantly with one sliding movement. The pawl eccentric and sliding jaw form a toggle joint, bringing the greatest pressure to bear on the top part of the jaws, causing the work to be clamped tightest at the working part. The moving member of the vise slides away from the operator, and there is no handle between operator and the vise. The gripping plates are hardened and ground, and the rack and pawl are also hardened steel. A feature of especial importance is that the whole vise may be removed from its swivel base and taken to surface plate, drill press or milling machine for continuous operations, since the base of the vise is accurately machined to right angles with the jaws. These vises are made in standard sizes of jaws from 3 inches to 8½ inches, and openings of 3½ inches to 12 inches. The whole design is such that it will stand up under the most trying conditions.

"A Simple Plan That Works" is set forth in a bulletin published by the Linde Air Products Company, Forty-second Street building, New York. "For the manufacturer the difficulty of obtaining important supplies under normal conditions does not lessen as time goes on. If he does his share in maintaining Linde service he is able to meet these conditions as regards one highly important item—oxygen. The matter of promptly returning empty cylinders is becoming one of increasing importance. Not all manufacturers appreciate how particularly vital it is in times like these. Some of the largest consumers of oxygen make use of a very simple system that enables them to tell at a glance the daily oxygen consumption, whether more should be ordered, and how many empty cylinders are waiting to be returned. Manufacturers now paying a rental charge for cylinders could, by adopting such a simple system, save money. If you care to see the details of the plan we will gladly send them on request. A plan that is helping others may very well help you. The Linde organization from coast to coast has never been so well equipped to render the intelligent service which is the ambition of everyone in our employ, but Linde service, with its hundreds of thousands of cylinders, demands your co-operation. Help us to help you by returning the empties promptly."







Welding and Cutting Outfits are described in an illustrated catalogue published by the Waterhouse Welding Company, Boston, Mass. "Welding equipment, whether in the small shop at the cross roads or in the big factory in the metropolis, will show a saving greatly in excess of its purchase price. The customer receives more in return than he will have to forfeit to get possession of a welding equipment. It may be that he will not understand this new device. It may be strange to him, and he will want to have it explained to him. He may want to know its disadvantages as well as its advantages, and to explain all this we have salesmanship. To back it up we have the article. To keep it backed we have service. Upon maintaining it depends our good will. The combination of all is good business."

The Stow Electrically-Driven Portable Drill is described in Bulletin No. 101, just published by the Stow Manufacturing Company, Binghamton, N. Y. "For drilling the many holes in castings and metals of all kinds, we have designed these drills. They will be found to be very effective for such work and great time savers over the old hand drills. The drills are driven at much higher speed than is possible by hand, decreasing with increased pressure for larger drills. The operator can give his entire attention to guiding the drill and can keep at it, as his strength is not exhausted by turning a crank. They will save their cost in a short time and no shop can afford to be without them. Tools are complete with spade, two side handles, breast plate, cord and plug. All our portable drills are made with offset drill spindle, a very great advantage when close corner work is to be done. Cooled by fan; grease encased gears; handles removable; ball bearing spindle and armature. Spindle is made from high-grade steel, heat treated, turned and ground. Heat-treated nickel steel gears."

"A Twenty-Year Paint User" is the title of a bulletin published by the Joseph Dixon Crucible Company, Jersey City, N. J. "We are proud to quote the following testimonial from the Claflin Machinery Company, Waterville, Me.: 'It occurred to me that you would be interested in the remarkable results we have secured for the past twenty years with Dixon's silica-graphite paint. We have used this paint on our own work, including boilers, tanks, smokestacks and other iron work. We have recently seen some boilers painted with Dixon's silica-graphite paint thirteen years ago. The paint stood the severe test remarkably well. As we sell a great number of boilers, both new and used, we want a clean surface on used as well as new boilers, and take Dixon's silica-graphite paint, black, which is decidedly the best paint for this purpose for interior work on tubes as well as exterior work. We recommend Dixon's silica-graphite paint as the cheapest paint on the market, not alone on account of its great covering capacity and the ease with which it is applied, but on account of its lasting or wearing qualities, which save the expense of frequent repainting. We strongly recommend Dixon's silica-graphite paint to anyone needing a first-class paint at an economical price. Please find enclosed order for another supply. Claflin Machinery Company, Mark T. Claflin, mechanical engineer.'"

"You Should Know These Facts About Armco Welding Rods." This is a statement made in a circular published by the Page Steel & Wire Company, 30 Church street, New York. "Better welding rods than Armco never were made and are not going to be—simply because the highest grades of (so called) Norway and Swedish Iron are no more uniform than Armco Iron. Before putting Armco rods on the market the metallurgists and specialists of the American Rolling Mill Company cencentrated years of profound study upon welding requirements. Together at the furnace, at the microscope, in actual applications, and in ways that had never been attempted before, these engineers developed a metal peculiarly free from slag, sulphur, oxides, phosphorus and other impurities harmful to a uniformly strong, efficient weld. Further, under their able direction this filling material has been standardized in two grades, one for oxy-acetylene and another for electric welding, both of which do well what has heretofore required a choice of one from many grades. Armco rods are therefore the logical material for successful welders who seek to protect alike their own reputations and their customers' or employers' best interests. Armco rods stand the tests of the man who must be shown, and to those who can grasp the opportunities of an expanded welding field, will be found one of the best investments that any welding shop can make. If you want to know just what Armco rods will do under specific conditions, and where Armco rods are meeting like requirements with absolute satisfaction, tell us about your present methods. Our engineers will gladly advise you if improvement is possible and to what extent."

HELP, SITUATION AND FOR SALE

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Wanted—A layer-out on tank and flue work. An exceptional opportunity for a capable man in a modern, growing boiler shop. Address *Box* 709, care of THE BOILER MAKER.

Wanted—Man to take charge of sheet iron department who has knowledge of laying-out. *John O'Brien Boiler Works Company*, St. Louis, Mo.

Wanted—Superintendent for boiler and tank shop; location Western Pennsylvania. Permanent position and good pay for a high-grade man. State fully your experience, references and salary expected. Address *Box M*, care of THE BOILER MAKER.

Wanted—A first-class flange turner who is capable of operating a sectional flanging press on heavy boiler work. Good wages to right man. Address *Flanger*, care of THE BOILER MAKER.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated: paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

"Thor" Pneumatic Tools are described by the Independent Pneumatic Tool Company, 1307 Michigan avenue, Chicago, Ill., in a bulletin recently published. "Thor" pneumatic tools "are built in accordance with the most modern practice in steam and gas engine construction—mechanically correct. There are air tools made which are designed expressly for your work, and by their selection you can save time, labor and air."

American Boiler Manufacturers' Association

President—W. C. Connelly, president, The D. Connelly Boiler Co., Cleveland, O.

Vice-President—C. V. Kellogg, president, Kellogg-Mackay Co., Chicago, Ill.

Secretary-Treasurer—H. N. Covel, works manager, Lidgerwood Co., New York.

Boiler Makers' Supply Men's Association

President—B. A. Clements, Rome Merchant Iron Mill, New York.

Vice-President—Charles B. Moore, Oxweld Railroad Service Company, Chicago, Ill.

Secretary-Treasurer—George Slate, THE BOILER MAKER, New York.

Master Boiler Makers' Association

President—Hon. D. A. Lucas, general foreman boiler maker, Chicago, Burlington & Quincy Railroad, Havelock, Neb.

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Fifth Vice-President—E. W. Young, general boiler inspector, Chicago, Milwaukee & St. Paul Railway, Dubuque, Iowa.

Secretary—Harry D. Vought, 95 Liberty street, New York.

Treasurer—Frank Gray, foreman boiler maker, Chicago & Alton Railroad, Bloomington, Ill.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

President—J. A. Franklin, Room 15, Law Building, 721 Minnesota avenue, Kansas City, Kan.

Secretary-Treasurer—F. P. Reinemeyer, Rooms 10 to 12, Law Building, Kansas City, Kan.

Editor-Manager of Journal—James B. Casey, Room 9, Law Building, Kansas City, Kan.

First Vice-President—A. Hinzman, Room 15, Law Building, Kansas City, Kan.

Electric Hoist Controllers are described in a bulletin published by the Electric Hoist Manufacturers' Association, 9 East Fortieth street, New York. We quote as follows: "The rapidly increasing use of electric monorail hoists and the widened field of application will bring with it a proportionate increase in complaints regarding motor and other kindred trouble, much of which will be caused by the lack of knowledge on the part of the operator, or the disregard of ordinary precaution in using the electric hoist. As the operator must manipulate the hoist by means of the controller, it is essentially necessary that he should have some knowledge of this most important part. To this end, the following is offered as the purpose of the controller. * * *"

TRADE PUBLICATIONS

A Heavy Pattern Punch and Shear is described in a catalogue published by the J. J. McCabe Punch & Shear Company, 149 Broadway, New York. "36-inch and 50-inch throats; punching capacity, 2-inch hole through 1-inch plate; shearing capacity, 1½-inch plate (complete data on latest bulletin). Would call your particular attention to the cam and roller feature in the head, which, in our opinion, is absolutely the most modern and efficient improvement in punch and shear construction, as it just doubles the power during the working stroke and eliminates friction and wear. Operation of clutch through hand lever or two foot levers, one of which is always instantly accessible and convenient to the operator. This extra convenient foot lever is one of the many McCabe features found on no other machine built. These machines are being used now by the prominent iron and steel, shipbuilding and steel car plants throughout the country."

Small Compressors for boiler shop service are the subject of several bulletins published by the Ingersoll-Rand Company, 11 Broadway, New York. "Boiler shop service makes severe demands on an air compressor. To give satisfactory service the machine must be efficient, inexpensive to operate and dependable. It should be of completely enclosed construction to exclude dust and grit, should be automatically lubricated and independent of constant attendance. If you are looking for a machine to meet these requirements your choice will naturally fall to the Ingersoll-Rand Class 'ER' and Class 'FR.' These small compressors fully meet the above requirements and have additional features of decided advantage. Ingersoll-Rand standards of manufacture and precise workmanship are assurance of freedom from structural faults. You install an I-R compressor with every confidence that it will give continuous service every day in the week. Bearing surfaces are of ample area, automatically flooded with lubricant and easily adjustable to take up wear. On the steam-driven Class 'FR' a perfectly balanced piston steam valve permits the use of high pressure or superheated steam. Superior economy with high or low pressure is effected by the use of an automatic cut-off governing device."

General Electric Welders are described in bulletins issued by the General Electric Company, Schenectady, N. Y. "Steady flow of metal assured by efficient and simple G-E welders. G-E constant energy arc welding sets are used to assure a steady flow of metal into the weld and high operating efficiency. A constant flow of metal is assured by the inherent automatic regulation of the energy in the welding circuit throughout the welding range for metal electrodes. The distribution of welding current between the two units comprising the set and practically dispensing with external resistance in series with arc, assures high efficiency. One small panel and the set illustrated are all the equipment needed for a one-man outfit where operator has mask and electrode with flexible cable—if 125-volt direct current is available. Consistently perfect welds are being produced in essential war industries by the use of this equipment. We are prepared to demonstrate these sets and make good deliveries."

Armco Welding Rods are described by the Page Steel & Wire Company, 30 Church street, New York, in a recently published catalogue. "A distinctly American product and a decided improvement over the now unobtainable genuine Norway and Swedish irons. Because of their exceptional purity and even density, Armco iron welding rods flow freely, weld evenly, and give a joint that lends itself perfectly to hammering, forging and where necessary to annealing and quenching. Two standard compositions, one for oxy-acetylene and another for electric welding, do well what has heretofore required a choice of one from many compositions. This means that with a much smaller investment in, and stock of, filling material, the shop is fully prepared to handle the usual run of steel and iron welding jobs. The difference in cost between Armco iron rods, which assure safe, dependable work, and those which do not, is insignificant—in fact, an infinitely small proportion of total welding costs. The use of Armco rods exclusively in your work would give you a good talking point and a protection obtainable in no other way. Armco rods for both oxy-acetylene and electric welding are packed in convenient bundles, and readily obtainable from supply depots, conveniently located in all industrial centers. Jobbers and Supply House: Our distribution is not yet complete. If you have or can develop a trade in welding materials let us make you an interesting proposition."

The Lagonda Reseating Machine.—Bulletin G-1. This machine consists of an emery or carborundum cloth wheel, which is driven at high speed by an electric or water motor, or by one of the special Lagonda air- or steam-driven motors. Eight pages; illustrated. Lagonda Manufacturing Company, Springfield, Ohio.

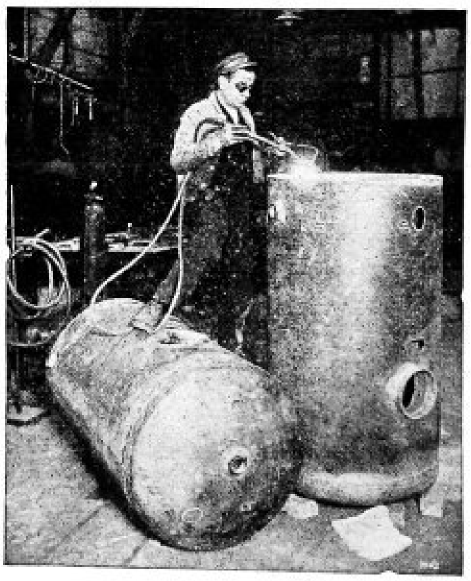
Oxy-Hydrogen Generators are the subject of Bulletin 20, just issued by the International Oxygen Company, 115 Broadway, New York. "If you must compare oxy-hydrogen generators, remember this: An I. O. C. Type 4-1000 Generator plant will give you three times as much gas per unit of floor space as any other generator. The least space, the purest gas, the lowest generating cost—there's the I. O. C. economy awaiting your adoption."

The Oxweld Injector Type of welding and cutting blowpipes are described in bulletins published by the Oxweld Acetylene Company, Newark, N. J. "Oxweld injector type welding and cutting blowpipes are the most efficient and economical, regardless of the source of your acetylene gas supply. Where for portability or other reasons compressed acetylene is used from cylinders, Oxweld injector type blowpipes utilize far more of the contents of the cylinders than will any other type of blowpipe. Oxweld low-pressure acetylene generators possess advantages that are possible only in a generator of the low-pressure type—namely, simple and automatic action, operation at a pressure of less than ½ pound per square inch, and delivery of a constant flow of acetylene to the blowpipes at unvarying pressure."

"Every Man in Your Shops is a Soldier To-day," according to a circular published by the J. Faessler Manufacturing Company, Moberly, Mo. "Have you equipped him to do his best? We are fighting Germany in our shops and factories just as surely as in Flanders and France. Tools are as important in winning the war as big guns and good ammunition. Don't send your men into this fight with equipment that handicaps their efforts, but speed up their work and increase their efficiency with tools that make every second count. Faessler sectional and roller expanders, superheater flue cutters, flue expanders, etc., are man-power boosters that every boiler shop should own. All are noted for exceptional sureness and speed. Those boiler shops which are doing big things in speeding up production have long been users of Faessler tools. To-day they are buying more Faessler equipment than ever before. We will be glad to have your first order."

"Factors in National Tubular Service" is the title of a bulletin published by the National Tube Company, Frick building, Pittsburgh, Pa. "Spellerizing reaches its full significance as a factor in National tubular service when it is remembered that this process is entirely mechanical, and tubes treated by it possess an inherent advantage which should not be confused with those other methods of minimizing corrosion, which are as auxiliary precautions to an already finished product. Spellerizing cannot be seen, felt or 'scraped off.' It is an integral part of National Spellerized locomotive boiler tubes, as is uniformity, ductility, high tensile strength, etc. Spellerizing may be likened to the kneading of dough. The process consists in subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surfaces, then to the action of smooth-faced rolls, and repeating the operations, whereby the surface of the metal is worked so as to produce a uniformly dense texture better adapted to resist corrosion, especially in the form of pitting. Only National tubular material (4 inches and under) is spellerized."

"Let Us Help You Serve Effectively" is the title of a bulletin published by the General Electric Company, Schenectady, N. Y. "Service is vitally necessary in business to-day that we may pull together to accomplish our common aim. The General Electric Company has located industrial power experts at all large cities in this country to serve industry's electrical requirements. For instance, experienced textile mill electrical engineers will be found in all textile centers. Among other industries so served are the iron and steel, coal and metal mining, cement, clay and glass, lumber and woodworking, grain and sugar, canning, packing and refrigeration, shoes and rubber, paper and wood pulp, tobacco and cigars, chemicals and gas, and the construction and shipbuilding. These experts are prepared to co-operate with industrial engineering firms to show the best way to drive a machine or a factory to get maximum production of highest quality at minimum power cost. Back of these experts is the experience gained in supplying much of the electric power equipment now used in American industry and a corps of scientists with research facilities for pioneer work. Call on us to help perfect your service to American business."



Superior Drop Forgings.—162 pages; profusely illustrated; published by J. H. Williams & Company, 63 Richard street, Brooklyn, N. Y., manufacturer of iron, steel, copper, brass and aluminum drop forgings.

"Wire Rope" is the title of a 42-page booklet published by the Hazard Manufacturing Company, 552 West Adams street, Chicago, Ill. The catalogue states that Hazard wire ropes have stood for quality for seventy years, and that they are made from the best obtainable iron, cast steel and plow steel rods in the markets of the world.

Pratt & Cady Check Valves are among the marine specialties described in a catalogue published by the Pratt & Cady Company, Inc., Hartford, Conn. "The many annoyances resulting from the use of the ordinary check valves are avoided by using P & C straightway swinging check valves. They have rotating disc, work freely and never stick on the seat. They are reliable, tight, and are thoroughly tested and guaranteed. Unequaled for use in connection with steam traps, inspirators, injectors, pumps, etc."

"Rome Hollow for Emergencies" is the title of a bulletin published by the Rome Iron Mills, Inc., 30 Church street, New York. "Right now when every locomotive is needed to the limit delays are costly and serious. Renewing broken staybolts take a lot of time. In many places they must be put in from the outside. If solid iron is used much tearing down must be done for drilling tell-tale holes. Rome Hollow is ready for these emergencies by having a tell-tale hole clear through—made when the iron is made. This removes the need of drilling and speeds the boiler makers' work."

"Three Men Can Do the Work of Ten" by using the Flexible Rivet Cutting Gun, according to the Rivet Cutting Gun Company, 116 East Third street, Cincinnati, Ohio. "The labor shortage throughout the country makes it absolutely imperative that every boiler shop utilize labor-saving devices to as great an extent as possible. The Flexible Rivet Cutting Gun cuts rivets from boilers, tanks, tank cars, ships, railway cars, structural work, etc., ten times as fast as two men can cut them with bar and sledge, and many times faster than they can be burned off, as a greatly reduced cost. Your shop needs this gun. Let us send you further details and we are sure you will be convinced that it is one of the best investments you could make."

Continuous service with minimum upkeep is claimed for "Renewo" valves, which are described in a catalogue published by the Lunkenheimer Company, Cincinnati, Ohio. "The seating disc—the part subjected to the most wear—is made of Lunkenheimer 'Valve Nickel,' a material which gives exceptional results in service; the seating surfaces are regrindable, and all parts, including the seating and disc, are renewable. Take advantage of these features, peculiar to the 'Renewo,' and repair or replace a worn or broken part rather than discard the entire valve. To repair means to conserve. To conserve means to economize. Conservation and economy are absolute essentials to our success in the war."

"The Chain Hoist That Lightens the Labor of Lifting" is described in Catalogue 3, published by the Ford Chain Block & Manufacturing Company, Second and Diamond streets, Philadelphia, Pa. "The planetary spur gearing of a Ford Tribloc Chain Hoist lightens the labor of lifting. Eighty percent of the power applied to the hand chain is converted into lifting energy, making it possible for one man to lift a ton with an 82-pound pull. Lightening the labor, however, doesn't mean lightening the hoist. The Ford Tribloc is constructed of the heaviest and most suitable materials throughout. It has steel working parts and is steeled against developing trouble."

"Boilermakers: Attention!" is the title of a circular published by the Independent Pneumatic Tool Company, 1307 Michigan avenue, Chicago, Ill. "The demand for Thor air tools is increasing so rapidly, and so many large orders are coming in daily from the shipyards, that we earnestly urge you to get your orders in for your requirements this year at the earliest possible moment. You will, undoubtedly, need additional pneumatic tool equipment. Look your plant over now and send us your order for the sizes and different types you will require and the date you will need them. We make a complete line of pneumatic tools, consisting of Thor piston air drills, reversible and non-reversible, for drilling, reaming, tapping, flue rolling; locomotive valve setting, wood boring, tightening nuts and staybolt work; portable grinding machines; close quarter drills; turbine drills; pneumatic riveting, chipping, calking, flue beading and scaling hammers; self-supporting hammers for driving staybolts; pneumatic sand rammers; air hoists; holders-on; flue expanders; pneumatic tool hose and hose couplings."

HELP, SITUATION AND FOR SALE

IMPORTANT NOTICE

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Advertisements are inserted under this heading at the rate of 4 cents per word for the first insertion. But no advertisements will be inserted for less than 75 cents. For each subsequent consecutive insertion the charge will be 75 cents. Replies may be sent to our care if desired, and they will be forwarded without additional charge.

All answers to advertisements in this column will be forwarded promptly, but we cannot guarantee replies. Concerns advertising for help do not wish their identity revealed, and only reply to such correspondents as they think best to answer.

Boiler Shop Layer-Out wanted for Jobbing Shop. Must be rapid and accurate; location, Philadelphia. Permanent position to satisfactory man. State age, experience and salary desired. Address *Box* 405, care of THE BOILER MAKER.

Wanted—A first-class flange turner who is capable of operating a sectional flanging press on heavy boiler work. Good wages to right man. Address *Flanger*, care of THE BOILER MAKER.

Position Desired—A layer-out, having eight years' experience in all classes of sheet metal work, desires a position. Can furnish references if necessary. Address *Layer-Out*, care of THE BOILER MAKER.

Wanted—Superintendent for boiler and tank shop; location Western Pennsylvania. Permanent position and good pay for a high-grade man. State fully your experience, references and salary expected. Address *Box M*, care of THE BOILER MAKER.

Wanted for Large, Modern Plate Shop in Southern Ohio, layers-out, machine hands, fitters and riveters. Prefer men experienced in construction of tanks up to 200 feet in diameter. Plant will soon be devoted to production of ship plates and other essential work. Splendid opportunity for men of right type to become permanently connected with a concern that believes in developing and advancing employees. State experience, references and salary expected. Address *Box S* 74, care of THE BOILER MAKER.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated; paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

TRADE PUBLICATIONS

Equipments for Welding and Cutting are described by the General Welding & Equipment Company, 107 Massachusetts avenue, Boston, Mass., in an illustrated catalogue just issued. The company makes the following claims for its standard acetylene regulators: "Perfect, forcible and frictionless alignment; differential spring action produced by a double diaphragm system; quick, sensitive and accurate regulation; no straining or buckling of main diaphragm, therefore quick and reliable reseating."

The "Improved Vulcan" Chain Pipe Wrench is described in a catalogue issued by J. H. Williams & Company, 63 Richards street, Brooklyn, N. Y. "Each and every flat link chain is 'proof-tested' to two-thirds of its listed catalogue strength in a standard testing machine. To each chain so tested is attached the gray leaden seal, illustrated above, and every flat link chain leaving our works must bear this seal—the proof of quality—as evidence that it has passed our standardized 'proof tests.' Look for this mark of proof, for it is proof of quality—it guarantees uninterrupted severe service as well as safety to the operator. Williams' wrenches—'Vulcan' and 'Agrippa'—are the only wrenches which offer this certified assurance."

The Lysholm Patented Plate Punch Table, manufactured by the Norbom Engineering Company, Denckla building, Philadelphia, Pa., is claimed by the manufacturer to be able to punch 4,000 holes per day in steel plates. "Rapid production in punching holes in boiler plate is made possible on this machine by means of a roller table. Lateral and sidewise movements are under the lever control of the operator. The tables are built with roller bearings to facilitate rapid movement of the work. Plates up to 30 feet by 8 feet from ¼ inch to 1⅛ inches in thickness may be handled readily. Various shipyards and plate shops have reported records that average 4,000 holes per nine-hour day; 6,700 holes in a nine-hour day is a common occurrence. Full information on request."

A Catalogue of Hoists is published by the Ford Chain Block & Manufacturing Company, Second and Diamond streets, Philadelphia, Pa. "Anything that can be hung directly on a hook or held in a container that will hang on a hook is safely and speedily lifted by a Ford Tribloc Chain Hoist. No danger of spilling things hoisted by the Ford Tribloc. It is equipped with the patented loop and chain guide, that makes hoisting or lowering smooth, through preventing 'gagging' of chains in the blocks. Steel working parts, too, add to their safety."

Hanna Riveters are described in a catalogue published by the Vulcan Engineering Sales Company, 1755 Elston avenue, Chicago, Ill. "They drive absolutely tight rivets. For increased production there is no riveter like the Hanna. They save time and give hydraulic results at one-third power cost. Made in 120 sizes and types. They will bear the investigation of the shipbuilding industry. Up in Pittsfield, Mass., Hanna riveters are hard at work helping the General Electric Company turn out its high-grade products. An illustration shows a Hanna pneumatic riveter at work there riveting a large transformer tank."

High-Speed Twist Drills, reamers, countersinks, flue cutters and lathe tools are described in a 92-page illustrated catalogue issued by the Clark Equipment Company, Buchanan, Mich. "The Clark Equipment Company is the pioneer in the manufacture of high-speed twisted drills. We originated and perfected the twisted drill, and our efforts have since been devoted to the manufacture of drills and other tools by the twisting process. Since the first twisted high-speed drill was placed on the market by this company it has been conclusively proven that tools so made possess distinct advantages over those milled from the solid. The forging or rolling of our sections to shape before twisting tends to densify the metal and produces tools which cannot be excelled for strength and cutting qualities. We were the first to recognize that high-speed drills must have ample clearance and extra large shanks to accomplish the work for which they are intended. Our success in producing thoroughly efficient tools is attested by our large and constantly growing business. We are represented by high-class dealers in all of the large cities, who carry our tools in stock at all times."

The Canady Undergrate Draft Controller is the subject of Bulletin No. 10, published by the Canady-Blaisdell Corporation, 90 West street, New York. "The Canady undergrate draft controller is not an experiment. It has been tried and is operating successfully in many plants. It is sensitive in its operation and accomplishes the results for which it is designed. Before going on to the main question of how to obtain and maintain proper furnace conditions, let us glance over the methods of producing draft. This is done in either of two ways—by 'natural' or 'chimney' draft and by 'mechanical' draft. The advantages in boiler operation of mechanical or undergrate draft over natural or chimney draft are many and important, this being true in a much greater sense when the mechanical draft is controlled automatically."

Cleveland Wall Radial Drills are described by the Cleveland Punch & Shear Works Company, Cleveland, Ohio, in a catalogue just published. "The Cleveland wall radial drill is a drilling, reaming and countersinking machine adapted to steel fabricating shop use, and is especially valuable to structural iron workers, bridge builders, ship builders and boiler makers, it being designed to meet the requirements of modern structural fabrication. It has capacity to drill 1½-inch hole in cast iron or soft steel, has a wide range and can be operated easily and rapidly. The horizontal arm can be swung readily by hand, and is made in lengths from 6 feet to 20 feet, as required. The carriage is mounted on trolleys having roller bearings. The spindle is provided with a vertical travel of 8 inches or 12 inches as specified. For reaming and countersinking the drill is built with lever feed only and with hand wheel or automatic feeds with quick return for drilling. The lever feed is always included with the hand wheel feed, and the automatic feed includes both lever and hand wheel feeds. The No. 3 machines are equipped with power-raising and lowering device. The No. 1 and No. 3 machines can be furnished with either direct-connected motor drive or belt drive with countershaft, as desired."

The Electric Arc Cutting & Welding Company, 222 Halsey street, Newark, N. J., describes its apparatus in a circular just published. "Cutting and welding apparatus offered for sale previous to the advent of alternating-current machines employed direct current at the arc. The machines manufactured by this company are designed for use with alternating current, and consist of a special transformer with no moving parts. It will last indefinitely, and do all that D-C machines accomplish and a great deal more. Three types are furnished—cutting, welding, and cutting and welding. The temperature and the amount of heat at the arc can be varied to suit the proper melting points of nearly all metals. The ideal condition for electric arc welding is the absolute control of heat conditions, and this is accomplished with our alternating-current machine, automatically and unchangeably, for any given setting through the use of an easily moved shunt in the magnetic circuit. This enables the operator to take care of conditions requiring various amounts of heat at varying temperatures. The efficiency of this type of electric arc machine is higher than that secured from any other type of electric cutting and welding machines. The loss in power wasted is minimum. The alternating-current machine will deposit metal more cheaply than other types of electric or gaseous welders. Long arc cannot be drawn, which prevents metal spattering and being burned."

"Steel for Service" is the title of one of several booklets published by the Carnegie Steel Company, Pittsburgh, Pa. "Taking 100 as a basis for a cast steel gear, a prominent gear cutter places his case-hardened forged steel gears cut from Carnegie Blanks at 500. Other large gear cutting concerns also use these blanks from which to make their highest grade gears. They are formed from discs, sheared from rolled cylindrical blooms. They are forged by hydraulic pressure, then revolved by steam power and subjected to rolling and forging action simultaneously. The same process is used in the manufacture of Carnegie rolled steel turbine discs, and the result is a product of great excellence. These discs are being used by engine builders as rapidly as Carnegie Steel Company mills can produce them, but this fact in itself is not necessarily a proof of good quality being appreciated by users, since in times like these all mills that can produce equipment for use in the construction of ships are generally crowded to capacity. As far as possible, however, it should be the aim of all shipbuilders or concerns who furnish any parts for a ship to select the very best equipment obtainable. The best built ship in these emergency times will (barring accidents) be the best at a later date when conditions are on a more normal basis."

"The Advantages of a Hollow Bolt with the Durability of Ulster Special" are set forth in a circular issued by Joseph T. Ryerson & Son, Chicago, Ill. "Made from the original solid finished bar of identical Ulster Special that is standard for staybolts on majority of leading railroads—no change in process of its manufacture. Self-inspecting—hole perfectly round and true. Guaranteed not to split in threading or driving, which increases output and reduces shop cost. Will pass all railroad and other standard staybolt iron specifications. Furnished in lengths and sizes used; saves time and cost of cutting; eliminates crop ends and facilitates handling. Once tried the results will justify its continued use. Further information, price, delivery, etc., will be furnished on request."

The Lincoln Arc Welder for Speedy Production is described in Arc Welding Bulletin No. 104-0, published by the Lincoln Electric Company, Cleveland, Ohio. "The answer to the urgent call for speedy production is found in the Lincoln arc welder. The complicated corners that formerly meant slow hand riveting and expensive flanging are now welded by this labor-saving tool in a fraction of the former time. The troublesome calking work that used to bulk so large on the timesheets is unnecessary when the seam is welded up solid with the plates. The tedious 'marking out' on special jobs for the drill press operator is eliminated—there are no rivet holes to drill. Not only does the Lincoln arc welder reduce costs by 50 percent or more but it gives you results 35 percent stronger than single riveting and gets them in less time. Investigate the Lincoln arc welder now. Write for our new bulletin on Arc Welding No. 104-0."

Armco Iron Welding Rods meet U. S. Government needs, according to a circular published by the Page Steel & Wire Company, 30 Church street, New York. "The Emergency Fleet Corporation specifications demand that welding wire shall contain not over .18 percent of carbon, .55 percent phosphorus, ..5 percent sulphur, and .08 percent silicon, and that the wire be of uniform homogeneous structure, free from segregation, oxides, pipes, seams, etc., as proven by microphotographs. Armco iron welding wire has been tested by the Emergency Fleet Corporation for use in its work and far more than complies with the above specifications. Comparison of chemical composition with these specifications shows that even if Armco iron welding rods had fifteen times as much carbon, nine times as much phosphorus, eighteen times as much manganese, eighteen times as much sulphur, and twelve times as much silicon, as they actually do contain, they would still pass the specifications with a liberal margin. Armco iron welding rods are the Page Steel & Wire Company's answer to demands for the all-American product—provided by American resources and American ingenuity—to replace the imported. Page ideals demand square and unequivocal support of the United States Government, now and always. National service and 100 percent Americanism have therefore led us to give over as much and as freely of our plants as the Government desires—and the indulgence which we must ask of our customers temporarily will be well repaid by the progressive improvement and bettered service which we will be able to offer when normal conditions are restored."

The "Red Devil" Rivet Cutter is described by the Rice Manufacturing Company, Fletcher Savings & Trust building, Indianapolis, Ind., in a 32-page illustrated booklet just published. "The 'Red Devil' rivet cutter is a tool which has been successfully developed over a period of years by practical steel car men co-operating with a manufacturer of wide experience in this field. While the principle is simple—that of a plunger driven in a long barrel by compressed air, striking a chisel head—the amazingly hard blows which it strikes are due to the 'Red Devil' method of construction. These exclusive features allow every ounce of air to do full duty. The 'Red Devil' is successful because of the tremendous power which it puts into every blow. These terrific blows will cut 1¼-inch rivets—cold—in an average of ten seconds. One-inch rivets are cut out in from three to five blows. The operation of the 'Red Devil' is simplicity itself. Only three men are necessary to operate the tool. The operator takes hold of the left side handle with his left hand, and rocks the valve handle with his right. Another man holds the right-side handle, while the third holds the chisel on the rivet. Turning the valve handle up opens the air port, which instantly permits the full force of the air to act on the plunger—driving it down the barrel and striking the chisel head. The valve handle is then thrown down to exhaust, and the plunger returns to the head of the tool ready for the next blow. A very little experience will enable the operator to strike light or heavy blows at will. When the rivet is nearly off a light blow can be struck."

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For Sale—One Close-Quarter Drill. In good working condition. For sale cheap. Address *Reinhold Betterman*, Johnstown, Pa.

Position Wanted as Layer-Out. Conversant on miscellaneous problems. Address *Ambition*, care of THE BOILER MAKER.

Layer-Out Wanted for Marine Boilers. Apply *Heipershausen Bros.*, 43-53 Tompkins street, New York City. Telephone Orchard 229.

First-Class Layer-Out for Boiler and Tank Wanted. State fully experience, references and salary expected. *Pacific Steel & Boiler Company*, Tacoma, Wash.

Position Wanted as Boiler Foreman in Railroad. I have had 18 years' experience as boiler foreman, and desire to make a change. Address *Boiler Foreman*, care of THE BOILER MAKER.

Wanted—A First-class Layer-Out. Man capable of reading blue prints for boiler and plate work. Permanent position. Reference required. State salary. Apply to *John H. Murphy Iron Works*, Postoffice Box 1465, New Orleans, La.

Wanted—A first-class flange turner who is capable of operating a sectional flanging press on heavy boiler work. Good wages to right man. Address *Flanger*, care of THE BOILER MAKER.

Position Wanted by man capable of running boiler shop. Has had sixteen years' experience, would like to hear from someone that needs a superintendent, erecting engineer or layer-out. Can furnish references. Address *Box* 908, care of THE BOILER MAKER.

Wanted for Large, Modern Plate Shop in Southern Ohio, layers-out, machine hands, fitters and riveters. Prefer men experienced in construction of tanks up to 200 feet in diameter. Plant will soon be devoted to production of ship plates and other essential work. Splendid opportunity for men of right type to become permanently connected with a concern that believes in developing and advancing employees. State experience, references and salary expected. Address *Box S* 74, care of THE BOILER MAKER.

For Sale—Copies of "Boiler Rules and Formulas," compiled by the Master Steam Boiler Makers' Association and containing rules and formulas pertaining to scientific boiler construction from every known authority. 186 pages; illustrated; paper covered. Former price, $1.00; present price, 50 cents. Send all orders to Mrs. T. C. Best, 1738 West Madison street, Chicago, Ill.

A Renewable Extra Heavy Bronze Globe and Angle Valve is described in a circular issued by the Star Brass Manufacturing Company, 104 East Dedham street, Boston, Mass. "Some of our special features are enumerated below: All castings of our special bronze mixture, made from metal patterns on pneumatic molding machines. All parts made with special tools, insuring absolute uniformity. Body of a special rugged design; steam is not retarded in its flow owing to body's form—it is so designed that metal is distributed where most needed for severe use. Seat and disc are both renewable and extra heavy; the bevel or taper of both are at a sharp angle, with a very light bearing, insuring less liability of foreign matter lodging on seat when valve is closed, also less chance of wire drawing and cutting. Seat rings are of a patented form with special taper seat where screwed in body. This design insures a perfect joint and absence of liability to distortion from lack of care in installation or unequal expansion in use. The bonnet is novel in design, having many unique features. First, it is absolutely self-draining, thereby eliminating all liability to freeze when used in cold positions; has extra large and deep packing space, gland and nut. Long thread in body, insuring strength and tightness. Stems, or spindles, are extra heavy, made with large Acme quick-opening threads. Valves can be repacked under pressure when wide open, as top of disc seats against bottom of bonnet, making steam-tight joint. Hand wheel is fastened to stem with hexagon nut, and can readily be removed and replaced. For extreme high temperatures and pressures, or where the water is such as to cause a scaling or corrosive action, we furnish, when specially ordered, seats and discs of our special nickel mixture."

TRADE PUBLICATIONS

"Dollars at Work" is the title of Zelnicker's Bulletin No. 220, published by Walter A. Zelnicker Supply Company, 325 Locust street, St. Louis, Mo. "Hundreds of purchasing agents and officials who are paid for spending money intelligently—both in the United States and Canada—have long ago learned the dollars-and-cents value of filing their Zelnicker bulletins for reference. These bulletins are not designed as pieces of interior decoration for your waste basket—no, indeed! Put them in the upper right-hand drawer of your desk—on top. Then when you're in need of rails, cars, locomotives, cranes, tanks, steel piling, air compressors, hoists, boilers, heavy machinery, pumps, generators and motors, take them out—you'll have before you the most efficient mediums in the country for putting your dollars to work—profitably."

Taps for boiler shops and railroad use are described in a complete catalogue which has just been published by the J. M. Carpenter Tap & Die Company, Pawtucket, R. I., a copy of which will be sent free to any of our readers on request. In this catalogue is given an account of the winning of a competitive test by Carpenter taps. "The work was threading staybolt holes, one of the meanst tapping jobs any shop can produce. The test was made by a large Eastern railroad with taps of different makes. Carpenter taps won out. Here are the winning figures: Taps No. 1, 11/16 inches diameter, running at 210 revolutions per minute, tapping 15/16-inch diameter holes through ¾-inch boiler steel (an old boiler), tapped 400 holes before becoming too dull to cut. Tap No. 2, 15-/16-inch diameter, 210 revolutions per minute, holes 13/16-inch, ¾-inch new boiler steel, 451 holes. No. 3, 15/16-inch diameter, 210 revolutions per minute, 13/16-inch holes through ¾-inch new boiler steel, 351 holes before giving out. Taps that make good on staybolt tapping can handle anything. Give them a trial. The complete Carpenter catalogue sent on request."

Bolts, Nuts, Rivets, etc., are the subject of a very complete and fully illustrated catalogue of 176 pages, which has just been published by Russell, Burdsall & Ward Bolt & Nut Company, Port Chester, N. Y. "With a view of illustrating the styles of bolts and nuts now most generally used, and to afford to our customers a medium suggestive of what may meet their requirements, we have carefully prepared this catalogue and illustrated it with correctly proportioned cuts of some of our leading varieties. In order to promptly meet the needs of our customers we keep a stock of these varieties on hand."

Brass Goods and Iron Specialties are described in a profusely illustrated cloth-bound catalogue of 470 pages, which has just been published by the Kelly & Jones Company, Greensburg, Pa. This catalogue is an invaluable one, and should be in the hands of all users of brass and iron goods and specialties for steam, gas, water, air and oil. "Having been engaged for many years prior to the beginning of our career as manufacturers in the erection of steam power and heating plants, as well as plumbing and hydraulic work, we acquired a knowledge of the wants of the trade, which has been of inestimable value to us in designing and manufacturing the line of goods which we illustrate in this catalogue. Our extensive factories, which we are enlarging from time to time, as the growth of our trade demands, are located in the center of the great iron and fuel-producing section of the United States, with superb facilities for shipping goods to all parts of the world, and equipped with the very latest and best automatic machinery, much of which has been designed by us for various special purposes. In every department of our works—from foundries to finishing shops—we employ none but the most skillful workmen, who are directed by capable superintendents in each department. All our work is subjected to the most thorough inspection and test during the process of manufacture and after completion. We are thus fitted for the economical manufacture of goods of a quality unexcelled in the world. To this we attribute the remarkable growth of our business; and it is our highest ambition to continue to deserve the patronage of the trade by not only maintaining the high standard of our work, but, wherever possible, to make improvements; and we will, from time to time, add to our line such articles as may be demanded by the continued development of engineering science."

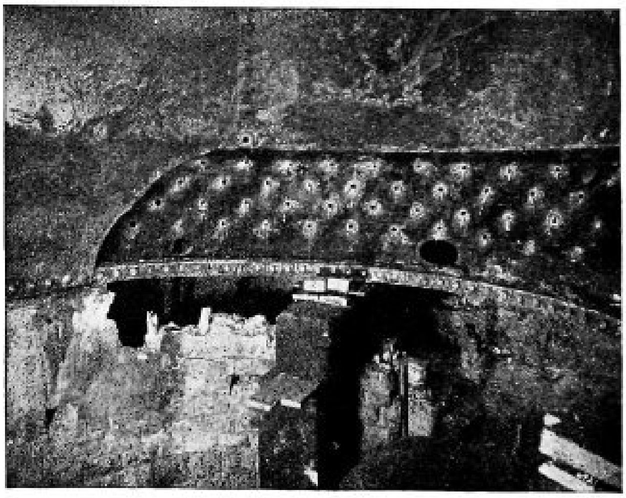
Improved Pneumatic Flue Welders are described by the Draper Manufacturing Company, Port Huron, Mich., in a circular recently issued. "The Draper improved pneumatic flue welders for scarfing, welding and swedging all sizes of boiler flues up to 6 inches diameter. The Draper flue reclaiming attachments for welding long ends on flues, and used in connection with the Draper improved pneumatic flue welders."

Hand Tools for Iron Workers are described by the Scully Steel & Iron Company, 2364 South Ashland avenue, Chicago, Ill., in a bulletin just issued. These tools are forged—not pressed. The company states that it carries in stock a complete line of cold cutters, backing-out punches, sledges, chisels, snaps, hammers and other hand tools, and that it guarantees them for active service. The company guarantee these tools as follows: "If you decide they are not worth the price after a thorough test will refund the sum upon return of tools, provided they have not been in the fire for redressing." The Scully Steel & Iron Company also carries chisels, rivet sets, etc., for pneumatic hammers.

A triple or six-power hydraulic riveter is described by the Southwark Foundry & Machine Company, 400 Washington avenue, Philadelphia, Pa., in a bulletin just published. "The illustration shows our stardard type 150-ton, 18-foot capacity hydraulic riveter. The cylinders can be of either triple-power or six-power type. The cyilnders are so arranged that pressure water may be applied either to the small ram or to the annular area of the large ram, or to both rams, depending upon the power required to drive the rivets. The variation of pressure is easily gotten by setting a special distributing valve. For the triple-power arrangement, the pull-back is operated on constant-pressure water; on the six-power arrangement, the pressure water from the large pull-back capacity can be exhausted with every stroke. The cylinder is of the flush top type. All rams are outside packed and easily accessible. These riveters are built in size from 75 to 200 tons, and with gaps ranging from 5 feet to 28 feet. The standard opening between the stakes is 24 inches, but it can be arranged to suit any class of work."

"The Monthly Stock List," published by the Bourne-Fuller Company, Cleveland, Ohio, will be sent free to any of our readers upon request. "In issuing from month to month our stock list of materials on hand for immediate shipment, it is our purpose to have the list as accurate as possible and representative of the condition of our stocks. However, the daily shipments from same result in constant fluctuations in the stocks, and due to the present unusual demand following delayed deliveries from the mills, the fluctuations are at this time greater than usual. At the same time our stocks are being constantly replenished; and while we may be short or out of certain items at the time reference is made to the list, we will also probably have on hand material in addition to that shown in the list. We will appreciate, therefore, inquiries for prompt warehouse shipments of any or all sizes usually carried; but for reasons mentioned above, we must ask the trade to appreciate that the list as issued is necessarily subject to change and that the materials are offered subject to prior sale."

Complete Electrical Equipment for Cranes is the subject of a bulletin published by the General Electric Company, Schenectady, N. Y. "G-E engineers have studied crane requirements and designed electrical apparatus to meet known operating conditions. Every requirement for stopping or starting, and the entire operating cycle is fully met by specially designed apparatus. Inter-pole motors, capable of standing heavy overloads, are manufactured in any speed or horsepower needed. These motors have split frames and large handholes for accessibility, and can be disassembled without disturbing back gearing. G-E crane motors are furnished with automatic solenoid brakes which work without jar or shock and make automatic compensation for brake-shoe wear. Brake shoes made of metalized asbestos compound give a high co-efficient of friction with but little wear. The G-E standard for crane equipments is to supply all resistor sections of uniform size, which reduces the number of spare parts needed to a minimum. The design of the cast iron grid resistance units is such as to avoid the danger of short circuits by vibration and double insulation protection against grounding as provided. Protective devices are furnished in small panel units which can be attached in any convenient place. A push knob on master panel opens line in an emergency, and overload protection is afforded at all times. Horizontal or vertical handle controllers are furnished which are absolutely reliable and very accessible. They are equipped with magnetic blowouts, are chute protecting covers, and many refinements which twenty years of controller building suggested."



"Built for Service" is the title of a circular published by the Cleveland Punch & Shear Works Company, Cleveland, Ohio. "Cleveland punches are built for sevice. The solid semi-steel frame is cast solid—only because experience has taught us that this type of frame means strength, rigidity and durability. So it is with the various parts that enter into the finished machine, each is made of material best adapted for the particular purpose for which it is used and designed to give a maximum of service. Every Cleveland machine is subjected to a rigid test and careful inspection before being shipped."

"The Advantages of the Hollow Bolt with the Durability of Ulster Special" are set forth by Joseph T. Ryerson & Son, Chicago, Ill., in a bulletin recently published. "Made from the original solid finished bar of identical Ulster Special that is standard for staybolts on majority of leading railroads—no change in process of its manufacture. Self-inspecting—hole perfectly round and true. Guaranteed not to split in threading or driving, which increases output and reduces shop cost. Will pass all railroad and other standard staybolt iron specifications. Furnished in lengths and sizes used, saves time and cost of cutting, eliminates crop ends and facilitates handling. Once tried the results will justify its continued use."

"For Speedy Production" is the title of Arc Welding Bulletin No. 104-O, published by the Lincoln Electric Company, Cleveland, Ohio. "The answer to the urgent call for speedy production is found in the Lincoln arc welder. The complicated corners that formerly meant slow hand riveting and expensive flanging are now welded by this labor-saving tool in a fraction of the former time. The troublesome calking work that used to bulk so large on the time-sheets is unnecessary when the seam is welded up solid with the plates. The tedious 'marking out' on special jobs for the drill press operator is eliminated—there are no rivet holes to drill. Not only does the Lincoln arc welder reduce costs by 50 percent or more, but it gives you results 35 percent stronger than single riveting and gets them in less time."

"They Say Seeing is Believing" is the title of a circular issued by the J. Faessler Manufacturing Company, Moberly, Mo. "That's why we want you to try out one of our Faessler safety sectional expanders and see for yourself how one man using it can do twice as much work as two men with ordinary equipment. All Faessler tools are built on the same principle —to make labor lighter and to increase working speed. Those boiler shops who have tried them are using them in preference to all others, and the increased output they have been able to show in spite of the reduction of working forces is convincing proof that Faessler tools are faster tools. Prove this for yourself. Our sixty days' free trial offer is open to you. We build everything in boiler-making tools and special tools for special uses if required."

"Factors in National Tubular Service" are set forth in bulletins published by the National Tube Company, Frick building, Pittsburgh, Pa. We quote as follows from Bulletin No. 4: "National Spellerized locomotive boiler tubes withstand severe 'punishment' and manipulation because, in addition to unique ductility, they possess high tensile strength. This great strength is obtained by uniformity, purity and homogeneity of material—the results of modern methods of manufacture, employment of improved processes and supervision by a highly skilled organization. National boiler tubes, both lapwelded and seamless, are thoroughly tested and minutely inspected. Their great strength and general high quality are maintained by a conscientious striving to improve National Tubular Service—that concrete activity which has benefited users of 'National' tubular products in practically every industrial field."

The Barr Pneumatic High Speed Hammer is described by H. Edsel Barr, Engineers, Erie, Pa., in a folder just published. "This highly successful tool was developed to meet an economic need existing in hundreds of otherwise well equipped plants. Its purpose is the elimination of most of the hand work in doing all kinds of light tool dressing, forging, blacksmithing and similar work of production or maintenance. Its further purpose is to provide a tool readily movable to the work and independent of mechanical operating means, a characteristic of great practical value in the shipyard, mine, quarry, railway or car shop and on general construction operations. The Barr pneumatic hammer is, undoubtedly, the ideal light power hammer, and it has proven to be one of the most profitably useful tools possible to place in any plant, and regardless of or accessory to any larger power hammer in use. By its general mechanical excellence and resulting record of never a broken frame or piston rod in four years on the market—and by its adaptability as a saver of time, wages and labor tie-up at moderate investment cost—this tool has won the favor of the most progressive plant men in the country."

HELP, SITUATION AND FOR SALE

IMPORTANT NOTICE

All advertisements under this heading must be paid for in advance. We make a merely nominal charge for them and cannot afford to open ledger accounts for such items.

Advertisements are inserted under this heading at the rate of 4 cents per word for the first insertion. But no advertisements will be inserted for less than 75 cents. For each subsequent consecutive insertion the charge will be 75 cents. Replies may be sent to our care if desired, and they will be forwarded without additional charge.

All answers to advertisements in this column will be forwarded promptly, but we cannot guarantee replies. Concerns advertising for help do not wish their identity revealed, and only reply to such correspondents as they think best to answer.

For Sale—One Close-Quarter Drill. In good working condition. For sale cheap. Address *Reinhold Betterman,* Johnstown, Pa.

Position Wanted as Layer-Out. Conversant on miscellaneous problems. Address *Ambition,* care of THE BOILER MAKER.

Wanted—Experienced Boiler Erectors for road work. Address all inquiries to *Erie City Iron Works,* Erie, Pa.

For Sale—1,000 to 1,200 pieces Iron Boiler Tubing, 60 inches long and 2⅞ inches inside diameter. Will be sold at a bargain. Address *Box* 1184 *City Hall Station,* New York.

Wanted—Estimator for growing contract shop. Opportunity for rapid advancement for a man of ability. State age, experience, salary expected, etc. Address *Box* 75, care of THE BOILER MAKER.

Wanted—Layer-Out in modern boiler shop. Must be capable of working from blue prints and to have had experience in watertube, marine and tubular boilers. State monthly salary expected and name of last two employers. Married man with family preferred. Address *Box* 694, care of THE BOILER MAKER.

Wanted—First Class Layer-Out for shop in Western Pennsylvania, manufacturing tanks, stacks and miscellaneous plate work. Essential industry; permanent position with good salary to right man. Address *Western Pennsylvania,* care of THE BOILER MAKER.

Wanted—One Bending Roll, electric driven, 16 feet wide by 1½ inches plate capacity; one plate planer, electric driven, 20 feet to 24 feet capacity 1½-inch plate; one electric hammer, 1 to 1½-ton capacity. New or second-hand machines in good condition. State name of maker, price and when can be had for delivery. Address *Box* 996, care of THE BOILER MAKER.

Wanted—Boiler Shop Foreman, one acquainted with the manufacture of watertube, return tubular and marine boilers. Married man preferred. Must know how to handle men to the best advantage. Open shop. Factory equipped with the best tools; in a city of about 100,000 inhabitants. Give last two positions and monthly salary expected in application, which will be treated strictly confidential. Address *Box* 694, care of THE BOILER MAKER.

Wanted for Large, Modern Plate Shop in Southern Ohio, layers-out, machine hands, fitters and riveters. Prefer men experienced in construction of tanks up to 200 feet in diameter. Plant will soon be devoted to production of ship plates and other essential work. Splendid opportunity for men of right type to become permanently connected with a concern that believes in developing and advancing employees. State experience, references and salary expected. Address *Box S* 74, care of THE BOILER MAKER.

Wanted—Refinery Boiler Shop Foreman. To take charge of new refinery boiler shop near Chicago. Must be a first class layerout. Must have had experience on oil refinery repair and construction work. State full particulars of reference. Give references and state salary expected. Address *Refinery,* care of THE BOILER MAKER.

Wanted—Superintendent for plant manufacturing tanks, stacks, standpipes, riveted pipe and similar line of plate work. Location, Western Pennsylvania. Modern shop, employing about 60 men; 100 percent essential work; attractive proposition for a producer. Give full information regarding experience, salary expected, etc. Address *Tanks,* care of THE BOILER MAKER.

"What Surgery Has Done for Wounded Soldiers, the Airco Process of Oxy-acetylene Welding and Cutting has Done for Metal Surgery," according to a bulletin published by the Air Reduction Sales Company, 120 Broadway, New York The Airco process of oxy-acetylene welding and cutting is stated to be especially adapted for boiler shop repairs, shipyard construction repairs, railroad equipment and track repairs and for general manufacturing.

"America's Super-Gun" is the title of a bulletin issued by the Keller Pneumatic Tool Company, Grand Haven, Mich. "Measured in terms of war-winning achievement, the gun here illustrated can lay just claim to the title of 'America's Super-Gun.' Its length is only 17 inches, its calibre 1 1/16 inches, its weight 14 pounds—but it has a range of 3,000 miles. Operated by compressed air, it is capable of striking blows for democracy at the rate of over one thousand per minute. It is the Keller-Master riveting hammer, a veritable air gun that multiplies rivet-driving man pofer, performing a vital and indispensable part in the great shipbuilding drive against the menace of the Hun. Of the importance of ships and shipbuilding equipment, Secretary Baker recently said: 'Ships are indispensable. The shipbuilders have indeed done well, but they will do better. The army will be ready when the ships are ready.' Secretary Daniels says: 'Every man who drives two rivets where one has been driven before is a public benefactor.' Chairman Baruch says: 'Ships are vital essentials.' We of the Keller organization, as Americans, are proud of the response which the shipyards of America have made to this urgent call for 'ships and still more ships'; and we are proud, too, of the fact that in a constantly-increasing number of yards Keller-Master riveting hammers are standard equipment."

The First Completed United States Standard Locomotive, light Mikado type, made by the Baldwin Locomotive Works for the Railroad Administration, is described and illustrated in a recent issue of *Staybolts,* published by the Flannery Bolt Company, Vanadium building, Pittsburg, Pa. This publication always contains articles of interest, and any of our readers who will write to the Flannery Bolt Company will be put on the free mailing list if they will mention THE BOILER MAKER. We quote as follows from the above-mentioned article: "The first of the United States Standard types of locomotives designed for the Railroad Administration was completed July 1, 1918, by the Baldwin Locomotive Works for service on the Baltimore & Ohio Railroad. This locomotive is of the Light Mikado type, and from all accounts should render exceptionally good service. April 30, 1918, orders were placed by the Railroad Administration for a total of 1,025 locomotives, and later 390 additional locomotives were ordered, which brought the total up to 1,415 for completion in 1918, of which 575 are the Light Mikado type, as shown in the illustration. This order for 1,415 was divided between the Baldwin Locomotive Works, the American Locomotive Company and the Lima Locomotive Works, Inc., the latter company receiving sixty of the additional order. The Baldwin plant is to be congratulated on the rapid and successful completion of this engine in so short a period. It was a marvelous undertaking in view of the enormous amount of work going on constantly through their plant, and from the fact that only one of a distinct new type of locomotive could be so quickly manufactured and assembled under these conditions. Baldwin Circular No. 2500 deals with the above locomotive, giving full information of dimensions, weights, etc., and in regard to the design of all standard types of locomtives, the circular contains the following statement: These locomotives are designed as far as practicable with interchangeable parts, so that when a railroad is using several different types a minimum amount of stock need be carried for their maintenance. They all use superheated steam, are equipped in accordance with the most recent practice for their respective types, and can be adapted to the use of either bituminous coal or oil as fuel."