The Boiler Maker

VOLUME XXIX

JANUARY TO DECEMBER, 1929

PUBLISHED BY

SIMMONS-BOARDMAN PUBLISHING COMPANY

30 Church Street, New York, N. Y., U. S. A.

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Volume XXIX January, 1929 Number 1

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

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30 Church Street, New York, N. Y.

Chicago: 105 West Adams St. Cleveland: 6007 Euclid Ave.
Washington: 17th and H. Sts., N. W.
San Francisco: 215 Market St.

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THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

Request for change of address should reach us on or before the first day of the month preceding the issue with which it is to go into effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice. In sending us change of address, please be sure to send us your old address as well as the new one.

Contents

Boiler Failures

THE annual report of A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, for the fiscal year ending June 30, 1928, constitutes the best record ever made by the bureau. During the year, out of a total of 100,414 locomotives inspected, only 24,051 or 24 percent were found defective and only 1725 of this number were ordered out of service.

A total of 419 accidents occurred during the twelve months covered by the bureau's report. These resulted in 30 fatalities and injuries to 463 persons. Of these 419 accidents, 22 were boiler explosions of which 15 were crown sheet failures due to low water, for which no contributory causes were found, and seven were crown sheet failures, also due to low water, but for which contributory causes or defects were found. Sixteen deaths and 25 injuries were caused by the first classification of crown sheet failure named, and four deaths and 12 injuries were caused by the second. No accidents have been reported as being due to firebox failures such as defective staybolts, crown stays or sheets, since 1925.

The 22 accidents due to crown sheet failures constitute only a little over 5 percent of the 419 accidents reported. They were, however, the cause of 20 of the 30 fatalities caused by all classes of accidents, and this high proportion of the loss of life justifies giving special attention to their elimination.

The bureau itself has devoted a great amount of attention during the past few years to this subject and has brought about a marked improvement in water-level recording devices. The effect of these improvements may be traced in the records of accidents caused by crown sheet failures due to low water, with contributory causes or defects found. In 1924 the number of such accidents was 22; in 1925, 13; in 1926, 15; in 1927, 5, and in 1928, 7. There has been no such decline in the number of crown sheet failures due to low water where no contributory causes were found. The largest number of accidents in this classification during the five years just closed was 22 in 1926, and 15 such accidents occurred last year.

The efforts made in recent years by the Inspection Bureau, with the co-operation of the railway mechanical staffs, to improve the condition of locomotives, and boilers in particular, have borne fruit, but a still further reduction in the number of accidents is possible. The fatalities caused by crown sheet failures are greater this year than last, and, whatever the causes, they must be curtailed. If disasters of this character are due to carelessness in the shop in carrying out repairs, the individuals involved must be brought to a realization of their responsibilities. If, as seems more likely, the trouble is caused by operating conditions or by the failure of the engine crew to observe certain necessary precautions, means should be taken to check such practices and to insure that the proper margin of safety in water level is provided at all times.

Whatever the cause of such accidents, the boiler maker must at all times bear in mind the thought that the safety of many human beings depends on the care and skill with which he carries out his work. Then, if a locomotive disaster does occur on any of the engines coming under his charge, his conscience can be clear of any responsibility.

High Tensile Steel

IN discussing the possible future of steel, no less an authority than *Mechanical Engineering* in a recent issue states that there is no reason why ultimately plain carbon steel should not have a tensile strength of 1,000,000 pounds per square inch. In support of this statement, an analysis of the characteristics of carbon steel is given.

As the cross section of a piece of steel, rolled or drawn, decreases it becomes possible to increase its tensile strength rapidly. A wire rod properly annealed is stronger in tension than a rolled beam of the same material. Wire is still stronger in tension than the wire rod from which it is drawn, and the finer the wire the stronger it can be made.

Any steel piece is only as strong in tension as its weakest part. The strength of a coupling, a forging or a drawn or rolled product depends primarily upon its constitution, structure and uniformity. If a thin wire of a given composition has a tensile strength of 300,000 pounds per square inch, for example, there is no reason why a rolled section of the same composition which has undergone the same heat treatment should not have the same strength, and yet it does not. The explanation of this, of course, is that one of the above conditions has not been satisfied, which means that the section has not been subjected throughout its mass to the same treatment or is not of the same composition throughout. There is no doubt, however, that modern metallurgy is rapidly approaching the time when it will be possible to control the composition and physical characteristics of the larger sections in the same manner that they are controlled in wire drawing. When this comes to pass, steel of a tensile strength of the order of 1,000,000 pounds per square inch will become possible. What such metallurgical developments will mean to the boiler manufacturing as well as to other mechanical industries can hardly be estimated.

The Locomotive Works At Eddystone

THE short outline in this issue of the development of the new plant of the Baldwin Locomotive Works at Eddystone inaugurates a series of articles which will be devoted to detailed descriptions of all departments into which the boiler shop is subdivided.

Not only is the plant the greatest in the world, devoted to work of this character, but it represents the last word in mechanical efficiency. The arrangement of the plant, as a whole, has been carefully developed with production as the keynote. In each section the departments have been placed to fit into the production scheme to the best advantage. Machines within departments are so arranged that there is a minimum of lost motion.

From the details of the organization and work of this colossal boiler shop as they will be described later, it is believed that our readers will gain a great deal of practical information in locomotive construction, some of which they will be able to apply to their own work to advantage.

Communication

Laying Out Octagons

TO THE EDITOR:

In past issues of THE BOILER MAKER many interesting shop kinks and layout problems have appeared. These have doubtless been of value to the boiler maker or layout man, whose experience is derived from the practice at one boiler shop. A method for laying out octagons is set forth in subsequent paragraphs and may prove of value to some of your readers and of interest to others.

Half a dozen octagon plates were required of various widths from 10 to 24 inches and the layerout was seen to scratch his head several times before the job was done. Old time mill workers and shipbuilders used a kink which would have been of use to the layout man on the octagon plate job. The method was called "pricking the sevens" and was used when laying out lines for hewing octagon columns and masts. It was worked in this way: The timber, either tapered or with parallel sides, was worked out square and with fairly smooth sides and straight edges. Then the 24-inch blade of a steel square would be laid diagonally across the timber, close to one end, with the corners of the square blade just even with the opposite edges of the timber. With an awl the wood-worker then "pricked the sevens" by making a mark at 7 inches along the blade, and another mark at 17 inches well toward the opposite edge of the timber from where the 7-inch mark had been made. The operation was then repeated at the other end of the timber and a chalk line was then snapped the entire length of the timber upon the 7-inch marks and again over the 17-inch marks. The several operations above described were then repeated upon each of the four sides of the timber, after which the corners were hewn off down to the chalk lines and, when smoothed to a finish, the timber was octagonal, provided the laying out and dressing down had been properly done.

To apply this kink to the plates to be laid out octagonally, the layerout would first square the plate to size with fine lines, then place the blade of a steel square diagonally across the plate, the corners of the blade coming exactly fair with the edges of the plate. A light line, made by a slate or soapstone pencil, would then be made along the edge of the square blade and at 7 and 17 a mark would be made parallel to the edges of the plate, not square with the blade of the square. Lines would then be drawn through these marks, the lines being made parallel with the side edges of the plate and clear across to the end edges. The plate would then be turned a quarter way around and the operation repeated, two more lines being made from edge to edge of the plate which would then be found to have four lines crosswise upon it, two lines each way.

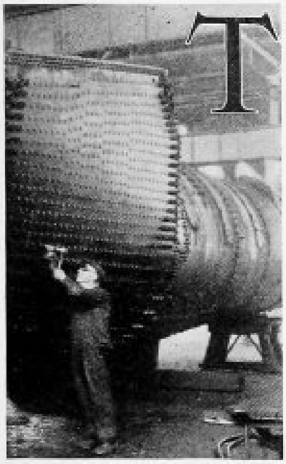
The layout man would then draw four short lines, one across each corner of the plate, connecting the ends of the four cross lines mentioned above. The plate, when sheared to the four corners and the outside square lines, would be so nearly octagon that it would meet all requirements.

In looking into the "why and wherefore" of this kink, the layout man would find, by checking up one of the 24-inch plates, that 7 inches of each corner was to be

(*Continued on page 8*)

The Baldwin Works at Eddystone

The story of the development of the greatest locomotive building plant in the world, that of the Baldwin Locomotive Works at Eddystone, Pa., has created considerable interest throughout the railroad field. The following outline of the history and growth of this plant is intended as an introduction to a series of articles, which will appear in later issues, giving detailed descriptions of the various departments into which the boiler shop is divided and the methods and equipment employed in each of them. The publication of this material has been made possible through the courtesy and co-operation of the Baldwin Company



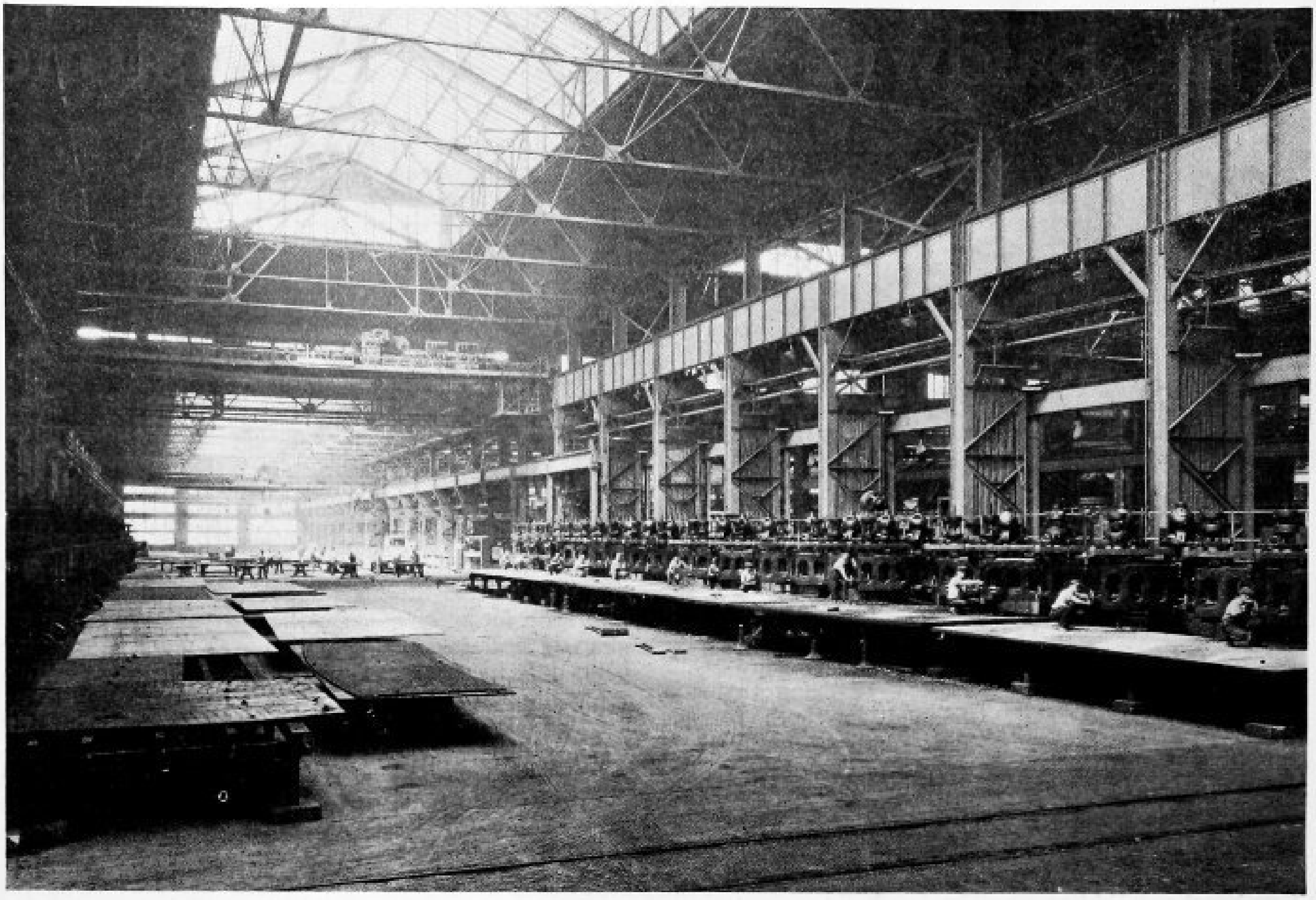
THE largest locomotive building plant in the world, and one of the largest of all industrial plants, has been developed at Eddystone, Pa., by the Baldwin Locomotive Works. The conception of this colossal plant had its beginning in 1906, when the board of directors, realizing that the demand for both foreign and domestic locomotives could no longer be adequately met in the congested business district of Philadelphia decided, after investigation, to purchase the plant of the Gruson Iron Works at Eddystone. The few buildings constituting this plant were unsuited to the requirements of a locomotive works and extensive changes were immediately started. A foundry and smith shop were erected and these departments moved from Philadelphia. The forgings and castings were shipped by rail to the main plant in the city where they were machined and assembled.

By 1907 locomotives had become so large that it was all but impossible to get them out of the Philadelphia plant. At times wheels had to be jacked up, side frames or doorways cut out and switch lamps removed in order that the engines could be moved to the railway for shipment. The erecting shop was congested and the movement of material slow and costly. To meet these conditions, a new erecting shop was designed and built at Eddystone. This building covered 7½ acres and was beyond the imaginative mind of the day. In this shop locomotives could be carried over other engines if necessary. Production was given a new impetus and the vision of an adequate plant for all future needs began to take form.

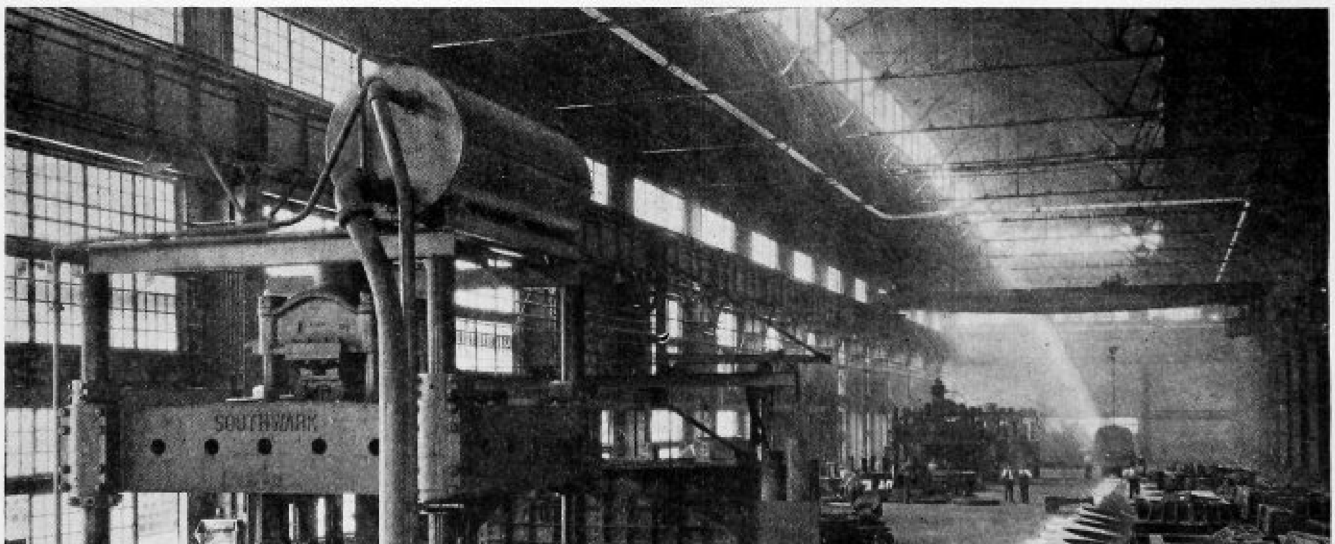
When in 1915 a building was constructed for the Remington Arms Company of Delaware, for the manufacture of rifles, the building proper was designed so that it could readily be converted into a boiler shop when rifles were no longer needed. The floor girders were so constructed as to be later used as cross-girders supporting crane runways. When the time came for changing, these girders could be re-erected without further fabrication. It was said to be the largest manufacturing building in existence under one roof. It covered a ground area of 17½ acres.

While rifles were being manufactured at the rate of 6,000 a day, there came a call for the manufacture of 3-inch shells. Two buildings and a power house were erected on swamp land along the river bank. The swamp was filled in and numerous temporary structures were erected to supplement the shell manufacture.

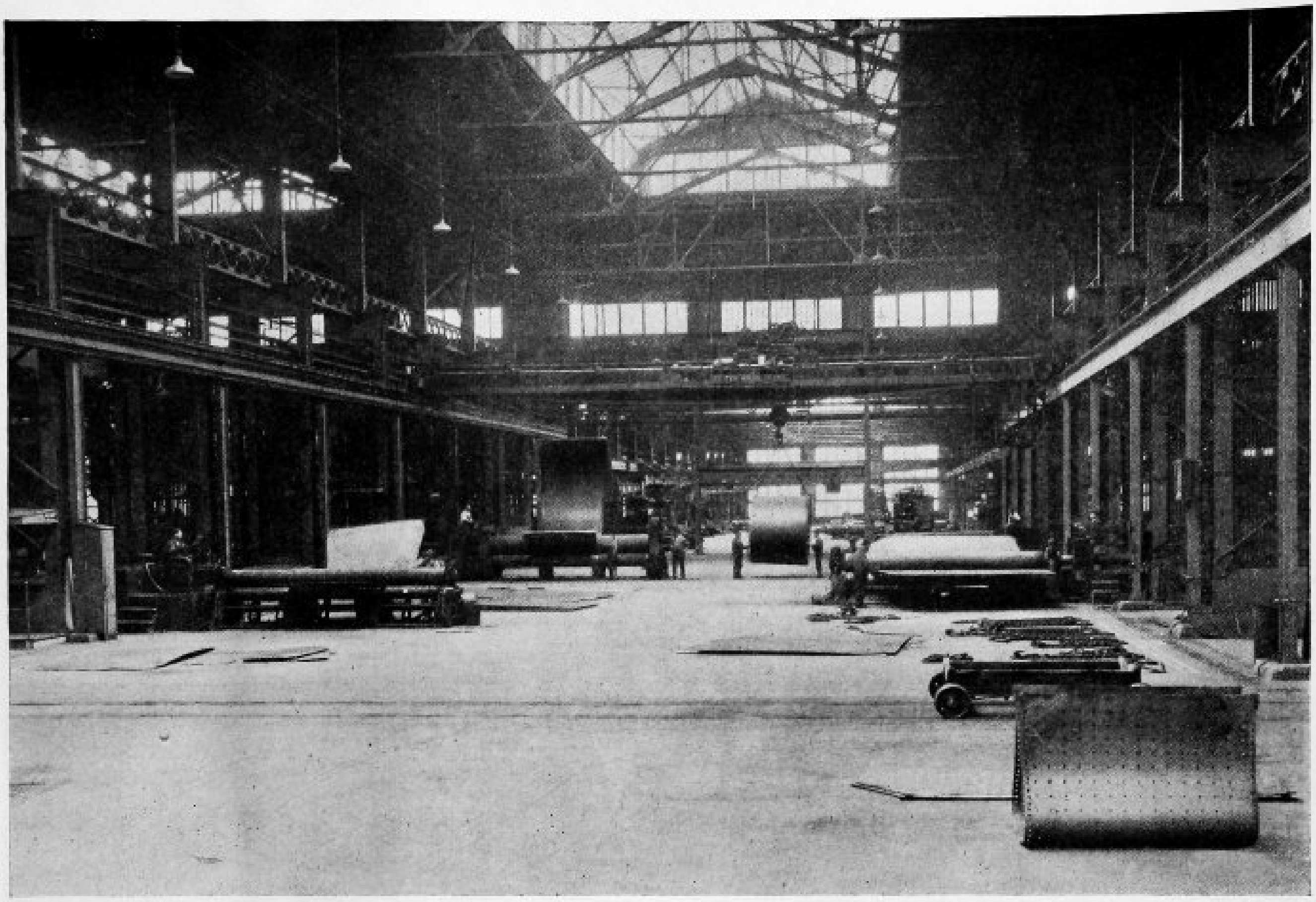
Airplane view of the Eddystone plant of The Baldwin Locomotive Works



Boiler drilling department at Eddystone

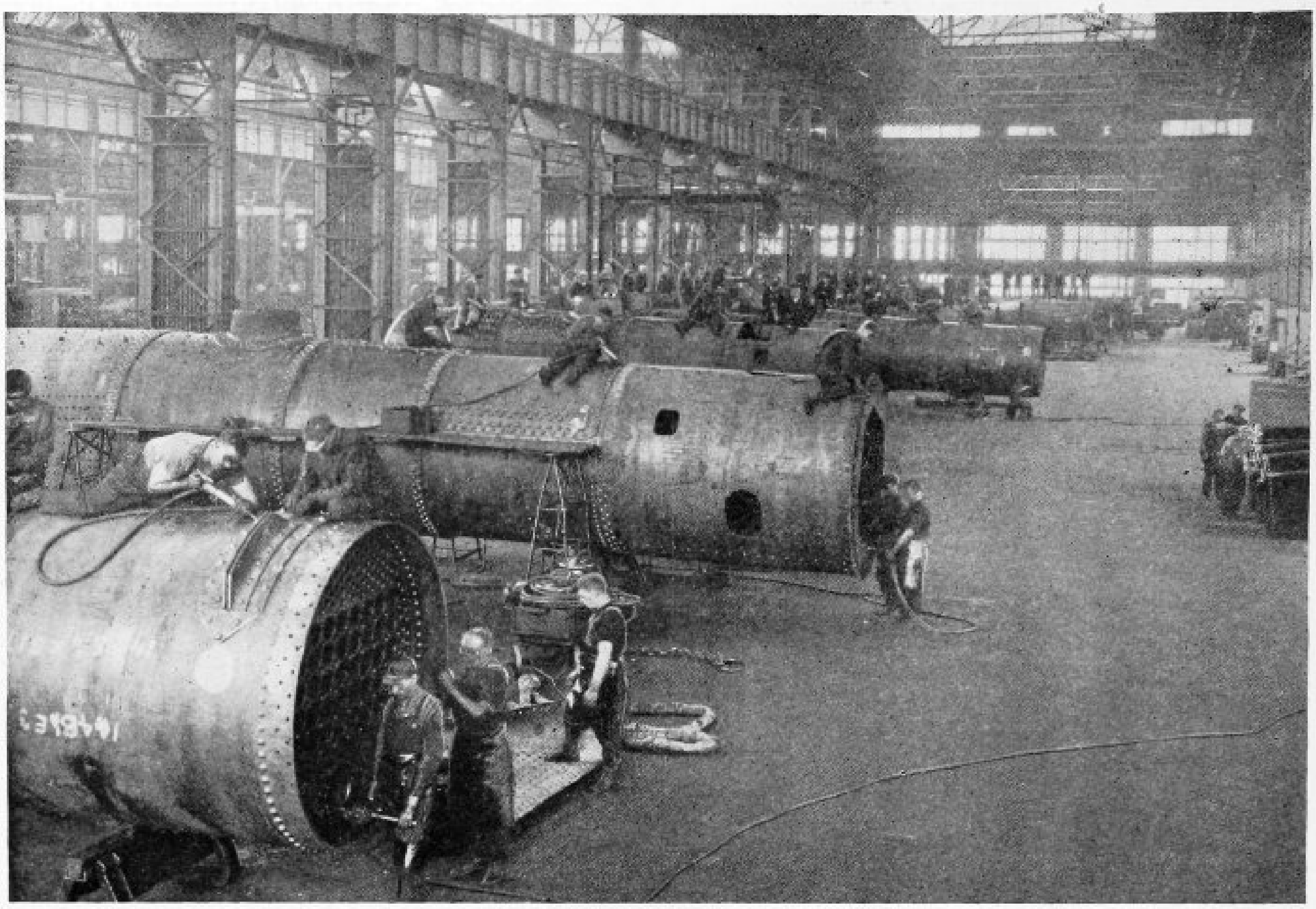


Heavy flanging department

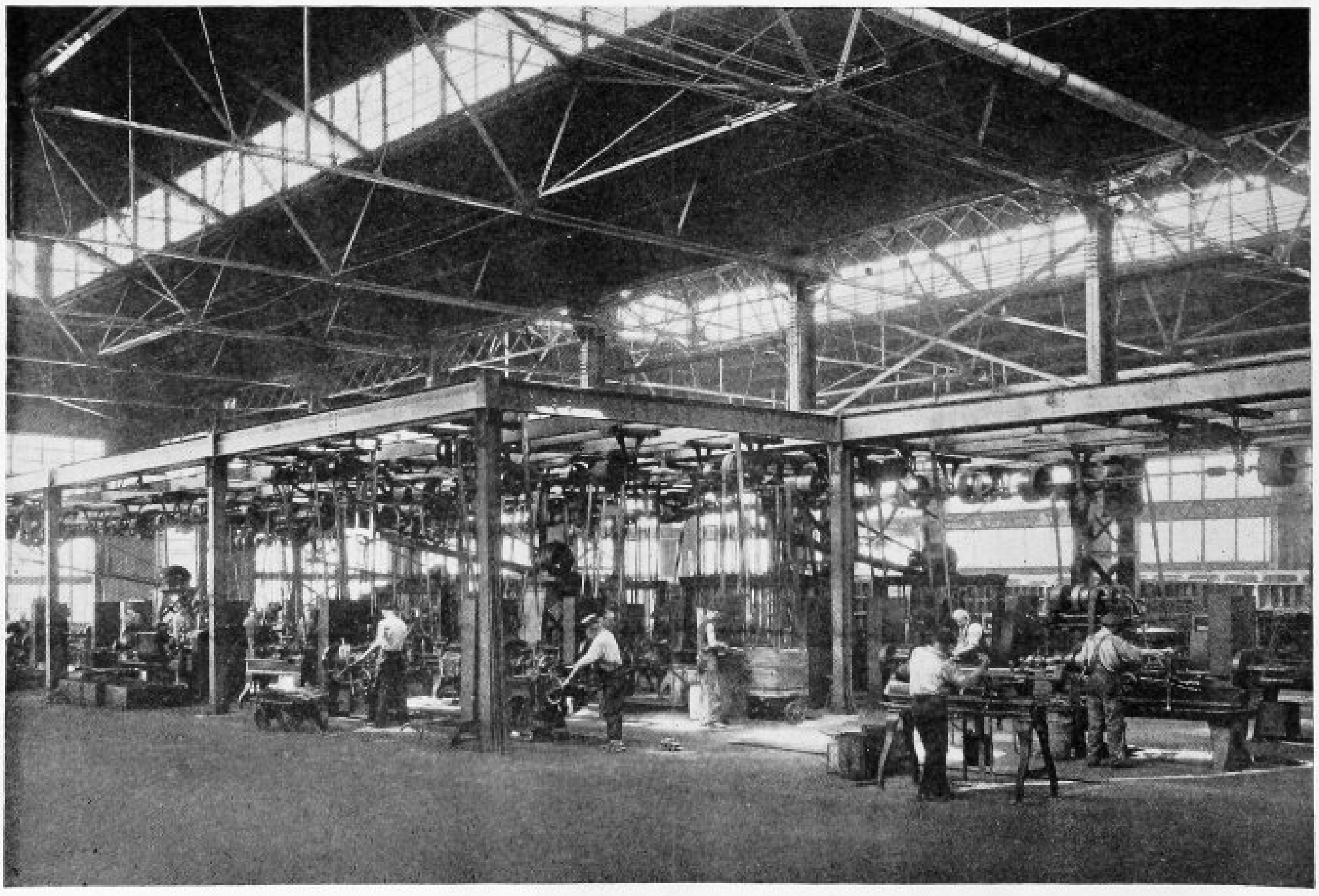


The plate rolls in this department accommodate any type and size of sheet

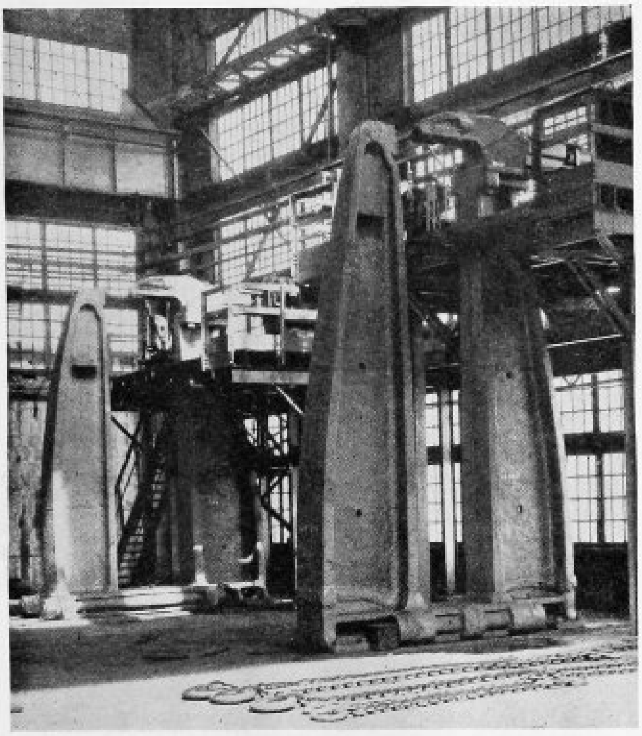
Riveting department



Finishing bay in the boiler shop



A well equipped small tool department is part of the shop



A pair of bull riveters

The close of 1918 saw the end of the rifle and munition work. The temporary buildings were cleared away and the great plan began to unfold. A new erecting shop was built, higher and roomier than the one erected in 1907; various machining departments were moved from the Philadelphia plant to the vacated permanent buildings. The progressive system of manufacturing governed the working plan of every installation.

An elevated plateau to the northeast, the site of an old race track, was chosen as the location of the tender shop and soon a modern building covering an area of 13½ acres was completed.

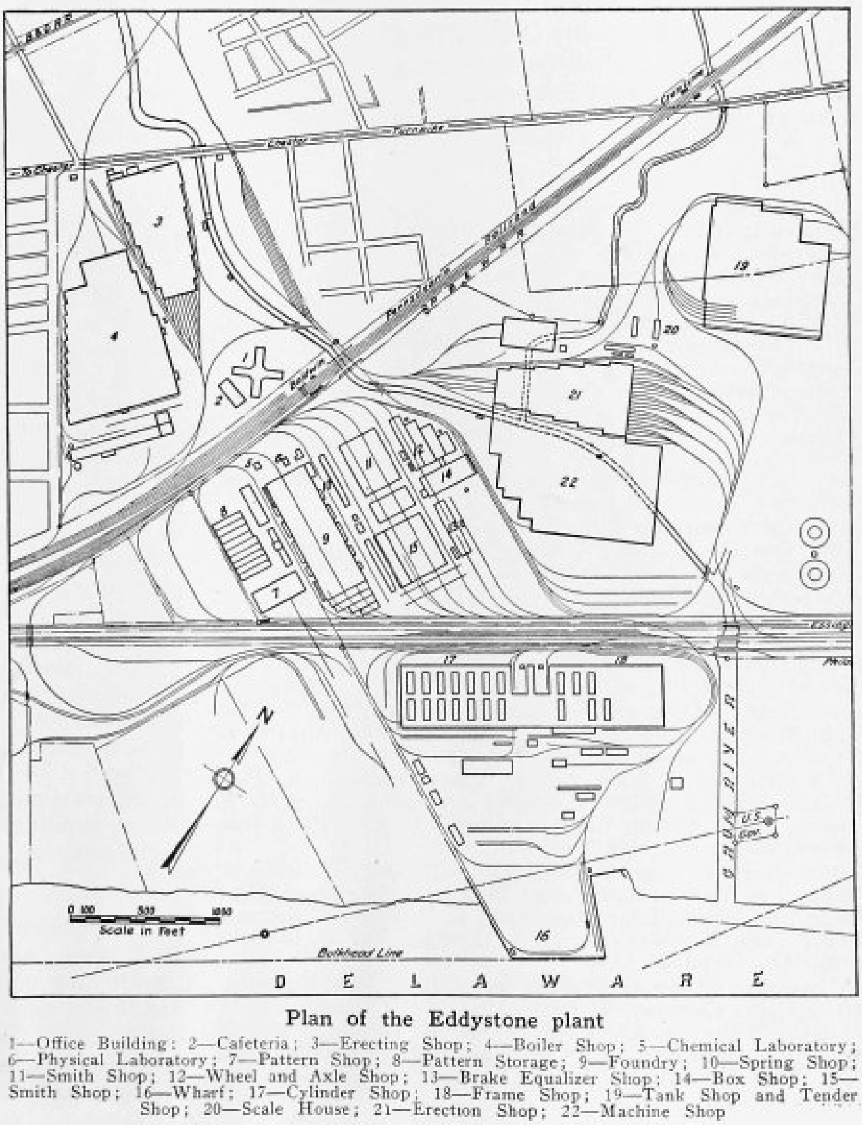
Events began to move very fast from this time. The boiler shop was moved to Eddystone. All that remained at the Philadelphia plant were the general offices, the brass foundry and machine shop, the motion work, bolt and stud shop and some few minor components. Since these manufacturing units delivered to the erecting shop it was decided to locate them so that they would feed directly into the bays as the locomotives moved through the progressive system. To the layman there was nothing especially difficult in this plan, but to the engineer it meant moving permanent roadways and bridges, changing the course of a river and building the shop directly over the river in order to get the necessary floor space and location.

This shop, known as Section D, took months in planning and consultations with the heads of the various departments. With a few minor alterations, the shop stands today as it was originally designed. It is built directly into the side of the erecting shop, making a single building covering an area of 25 acres.

When locomotives are completed, railroad specifications require that they be weighed with extreme accuracy. A scale of 900 tons capacity having a weighing beam of 450 tons was especially designed. The platform of the scale is 17½ feet wide by 405 feet long, upon which steelyards can be placed to determine the weight on each wheel. The track entering the scale house has a reverse curve of 15 to 18 degrees in order to try out the clearance of the locomotive before shipping it to the customer.

The scale on which the boiler shop is laid out may be termed colossal. The mere fact that 15 acres are under one roof does not convey an adequate idea of its tremendous scope or the magnitude of the operations. Like all the other branches of the plant, it conforms strictly to the progressive manufacturing system. Each bay represents a complete unit of operation and the sequences are arranged so that the least possible distance is traveled by the material. All the manufacturing bays are supplied with raw material from spurs running to a main ladder track outside the building.

Every machine is so placed in this shop that its operation does not interfere with any other machine.



Plan of the Eddystone plant

1—Office Building; 2—Cafeteria; 3—Erecting Shop; 4—Boiler Shop; 5—Chemical Laboratory; 6—Physical Laboratory; 7—Pattern Shop; 8—Pattern Storage; 9—Foundry; 10—Spring Shop; 11—Smith Shop; 12—Wheel and Axle Shop; 13—Brake Equalizer Shop; 14—Box Shop; 15—Smith Shop; 16—Wharf; 17—Cylinder Shop; 18—Frame Shop; 19—Tank Shop and Tender Shop; 20—Scale House; 21—Erection Shop; 22—Machine Shop

It is evident that when the preliminary bays are worked to their economical capacity, there will be a time when their output will be in excess of the immediate requirements of the assembly and fitting-up bays. There is always a certain amount of fluctuation of the output. To meet this condition, a bay is provided which acts as a storage reservoir.

In the next article, a complete general description of the boiler shop layout, machine equipment, departments and methods will be given.

American Boiler Manufacturers' Mid-winter Meeting

A NOTICE has been sent by the president of the American Boiler Manufacturers Association to all members that the mid-winter meeting of the association will be held in Cleveland, O., February 5. A complete program of this meeting will be sent out shortly. The various divisions of the organization will hold separate sessions in the morning for the discussion of problems pertaining particularly to their work. In the afternoon a general session for all active and associate members will be held. The meeting will be presided over by H. E. Aldrich of the Wickes Boiler Company, Saginaw, Mich., the new president of the association.

Standing Committees

The standing committees appointed since the last annual meeting are as follows:

SMOKE PREVENTION ASSOCIATION CONFERENCE COMMITTEE:—Geo. W. Bach, chairman, Union Iron Works, Erie, Pa.; H. A. Pillen, Stanwood Corporation, Cincinnati, O.; O. A. Rochlitz, Kroeschell Boiler Co., Chicago, Ill.

ENTERTAINMENT COMMITTEE:—C. W. Middleton, chairman, Babcock & Wilcox Co., New York city; J. H. Broderick, The Broderick Co., Muncie, Ind.; F. W. Chipman, International Engr. Works, Framingham, Mass.

MEMBERSHIP COMMITTEE:—S. G. Bradford, chairman, Edge Moor Iron Works, Edge Moor, Del.; S. M. Harrington, Frost Mfg. Co., Galesburg, Ill.; H. E. Seabold, The Brownell Co., Dayton, O.

COST COMMITTEE:—W. C. Connelly, chairman, The D. Connelly Boiler Co., Cleveland, O.; Starr H. Barnum, The Bigelow Company, New Haven, Conn.; C. W. Edgerton, Coatesville Boiler Co., New York city; J. S. Hammerslough, Springfield Boiler Co., Springfield, Ill.; L. V. Reese, Erie City Iron Works, Erie, Pa.

ETHICS COMMITTEE:—J. F. Johnston, chairman, Johnston Bros., Ferrysburg, Mich.; A. R. Goldie, Babcock-Wilcox-Goldie-McCulloch, Ltd., Galt, Can.; C. E. Tudor, Tudor Boiler Mfg. Co., Cincinnati, Ohio.

COMMITTEE ON AUXILIARY EQUIPMENT:—A. C. Weigel, chairman, Hedges-Walsh-Weidner, Co., New York city; G. W. Bach, Union Iron Works, Erie, Pa.; Owsley Brown, Springfield Boiler Co., Springfield, Ill.

A. S. M. E. BOILER CODE CONFERENCE COMMITTEE:—E. R. Fish, chairman, Heine Boiler Company, St. Louis, Mo.; C. E. Bronson, Kewanee Boiler Corp., Kewanee, Ill.

UNIFORM BOILER LAW SOCIETY COMMITTEE:—E. R. Fish, chairman, Heine Boiler Company, St. Louis, Mo.; M. F. Moore, Kewanee Boiler Corp., Kewanee, Ill.; A. G. Pratt, Babcock & Wilcox Co., New York city.

FEEDWATER STUDIES COMMITTEE:—J. B. Romer, chairman, Babcock & Wilcox Co., Bayonne, N. J.; Wm. Bradford, Edge Moor Iron Works, Edge Moor, Del.; C. E. Bronson, Kewanee Boiler Corp., Kewanee, Ill.; L. E. Connelly, The D. Connelly Boiler Co., Cleveland, O.

COMMITTEE ON BOILER PERFORMANCE:—E. R. Fish, chairman, Heine Boiler Company, St. Louis, Mo.; L. E. Connelly, The D. Connelly Boiler Co., Cleveland, O.; W. H. Jacobi, Springfield Boiler Co., Springfield, Ill.; A. G. Pratt, Babcock & Wilcox Co., New York city; A. C. Weigel, Hedges-Walsh-Weidner Co., New York city.

COMMITTEE ON FINANCE:—A. G. Pratt, chairman, Babcock & Wilcox Co., New York city; S. H. Barnum, The Bigelow Company, New Haven, Conn.; W. C. Connelly, The D. Connelly Boiler Co., Cleveland, O.

TRADE EXTENSION COMMITTEES:—General chairman, Geo. W. Bach, Union Iron Works, Erie, Pa.

WATERTUBE DIVISION:—W. C. Connelly, chairman, The D. Connelly Boiler Co., Cleveland, O.; S. G. Bradford, Edge Moor Iron Works, Edge Moor, Del.; Owsley Brown, The Springfield Boiler Co., Springfield, Ill.; C. W. Middleton, Babcock & Wilcox Co., New York city; L. V. Reese, Erie City Iron Works, Erie, Pa.; A. C. Weigel, Hedges-Walsh-Weidner Co., New York city; E. G. Wein, E. Keeler Co., Williamsport, Pa.

H. R. T. DIVISION:—C. E. Tudor, chairman, Tudor Boiler Mfg. Co., Cincinnati, O.; Starr H. Barnum, The Bigelow Company, New Haven, Conn.; C. W. Edgerton, Coatesville Boiler Co.,, New York city; J. G. Eury, Henry Vogt Machine Co., Louisville, Ky.; Wm. Heagerty, Oil City Boiler Works, Oil City, Pa.

HEATING DIVISION:—Homer Addams, chairman, Fitzgibbons Boiler Co., New York city; J. R. Collette, Pacific Steel Boiler Corp., Waukegan, Ill.; R. B. Dickson, Kewanee Boiler Corp., Kewanee, Ill.; C. W. Edgerton, Coatesville Boiler Co., New York city; W. A. Nevin, Heggie Simplex Boiler Co., Joliet, Ill.

VERTICAL DIVISION:—F. B. Metcalf, chairman, International Boiler Works, East Stroudsburg, Pa.; Jos. Doyle, Ames Iron Works, Oswego, N. Y.; J. F. Johnston, Johnston Bros., Ferrysburg, Mich.

OIL COUNTRY:—J. H. Broderick, chairman, The Broderick Co., Muncie, Ind.; Hugh Donovan, Donovan Boiler Works, Parkersburg, W. Va.; Sjoerd Mensonides, Farrar & Trefts, Buffalo, N. Y.

EXPORT:—A. C. Weigel, chairman, Hedges-Walsh-Weidner Co., New York city; W. S. Gregg, C. H. Dutton Co., Kalamazoo, Mich.

Laying Out Octagons

(Continued from page 2)

cut away, leaving a face of 10 inches for the octagonal side. He would also discover that this ratio applies to all sizes of octagons, and that the face is always 10/24ths of the side of an enclosing square.

The workman would also find that for plates less than 18 or 19 inches square, the blade of the square would overhang, the plate not being wide enough to receive the length of the square blade. When this happened, a straight edge of another plate would be laid beside the one being marked, and the square blade made even with the edge of the second plate. When the plates to be laid out were 12 inches or less in width, it was found that a 12-inch scale could be laid across and marks made at 3½ and 8½ inches instead of 7 and 17 as on the 24-inch scale.

Should the layout man ever be required to layout a plate for an octagonal column, he can use a modification of this kink, which may possibly help him in "getting somewhere" with the perplexing octagon problem.

Upon laying out an octagon upon piece of plate 18 inches square, it may be found that the width of the octagon face is 7½ inches. Thus the width of the plate necessary for making an 18-inch octagon column will be 8 x 7½, or 60 inches, plus 3 times the thickness of the plate and perhaps more or less for the "take-up" due to bending.

Indianapolis, Ind. JAMES F. HOBART.

The National Flue Cleaner Company, Inc., Groveville, N. J., manufacturer of the National soot blower for return tubular boilers, announces the appointment of three new Ohio sales representatives, namely, Craun-Liebing Company, of Cleveland; Dennis Engineering Company, of Columbus, and the Bishop Engineering Company, of Cincinnati.

A Notable Boiler Making Career

T. W. LOWE, ex-general boiler inspector of the Canadian Pacific Railway and recently elected an honorary member of the Master Boiler Makers' Association, was born in Montreal, Canada, March 31, 1858. He attended the public and high schools in Quebec City until he was 14 years old. Two years later he became a five year term apprentice in the boiler making trade at a marine and stationary boiler shop. Subsequently he was employed at the Grand Trunk Railway, Montreal shops for two years and then resigned to broaden his knowledge by travel and experience in the United States. After short stops at Troy and New York city he journeyed to Philadelphia, where he engaged as a boiler maker in a marine shop for about six months, later proceeding to Norristown, Pa., to work in Professor Lowe's Gas Meter Works. Resigning from this position he entered the Roanoke Machine works, Roanoke, Va., where he continued to work as a boiler maker until he married in that city November 15, 1883 and returned to Montreal, Canada with his bride.

In January, 1884, he entered the service of the Canadian Pacific Railway at Montreal, as a boiler maker on the construction of the first new engines built by that company at its own works. In the early part of the year 1885, he transferred from the main shops to acquire road experience, serving until 1890 when he resumed his duties as a boiler maker in the back shop at Winnipeg.

In April 1892, he was appointed boiler inspector of the western division of the Canadian Pacific with limitations, because there were insufficient duties to perform to warrant an unlimited appointment.

In 1894 the appointment was justified and became permanent with increased business and duties. In 1898 he was appointed general boiler inspector and in 1911 his duties were extended to include the coast and inland lake steamers.

Mr. Lowe retired from active service December 31, 1927 and is now a 44-year-service pensioner of the Canadian Pacific Railway.

That boiler making offers opportunities for success, is well demonstrated by the career of T. W. Lowe, former general boiler inspector of the Canadian Pacific Railways, who retired a short time ago, after 54 years of active service in the trade. Mr. Lowe was recently elected an honorary member of the Master Boiler Makers' Association, of which body he served as president in 1913. His election to honorary membership was made in recognition of the years of faithful and sincere interest in the welfare of the association extending back to the foundation of the organization in 1907, when the Master Steam Boiler Makers' and the Railway Master Boiler Makers' associations amalgamated under the present name. His long connection with the association and his activity in its work led to his being elected a member of the executive board and subsequently to the several vice presidencies, culminating in his election as president in 1913. The 1914 convention at which he presided, was the first ever held in the east, Philadelphia being selected as the meeting place. Since that time, Mr. Lowe has served on many committees and has contributed a fund of valuable data to the proceedings, covering the boiler practice of the Canadian Pacific Railway, which is acknowledged to be one of the most progressive roads on the continent. In these days, when it seems to be difficult to interest young men in following the trade of boiler making, a career such as that of Mr. Lowe's should serve as an incentive to all beginners; for success will follow earnest effort in this as in any other field of endeavor.

T. W. Lowe

Having been one of the pioneer employees of the Canadian Pacific Mr. Lowe takes great pride in relating how that company progressed during his 44 years of service, until now it has in operation over 15,000 miles of railway in Canada and about 5,000 miles in the United States. This rail service is also supplemented with about 20 inland lake and river steamers, which provide optional steamer transportation to suit the desires of those who like a break in long rail journeys. The west coast of British Columbia is also served with about 22 coastal steamers, some of these being exceptionally well appointed for comfort and pleasure. The Pacific and Atlantic oceans are served with about 25 ocean steamships which include the well known world-touring *Empress* ships.

On his retirement last March, the officers of the mechanical department of the Canadian Pacific Railway at Winnipeg, tendered Mr. Lowe a testimonial banquet at which a purse of gold was presented to him.

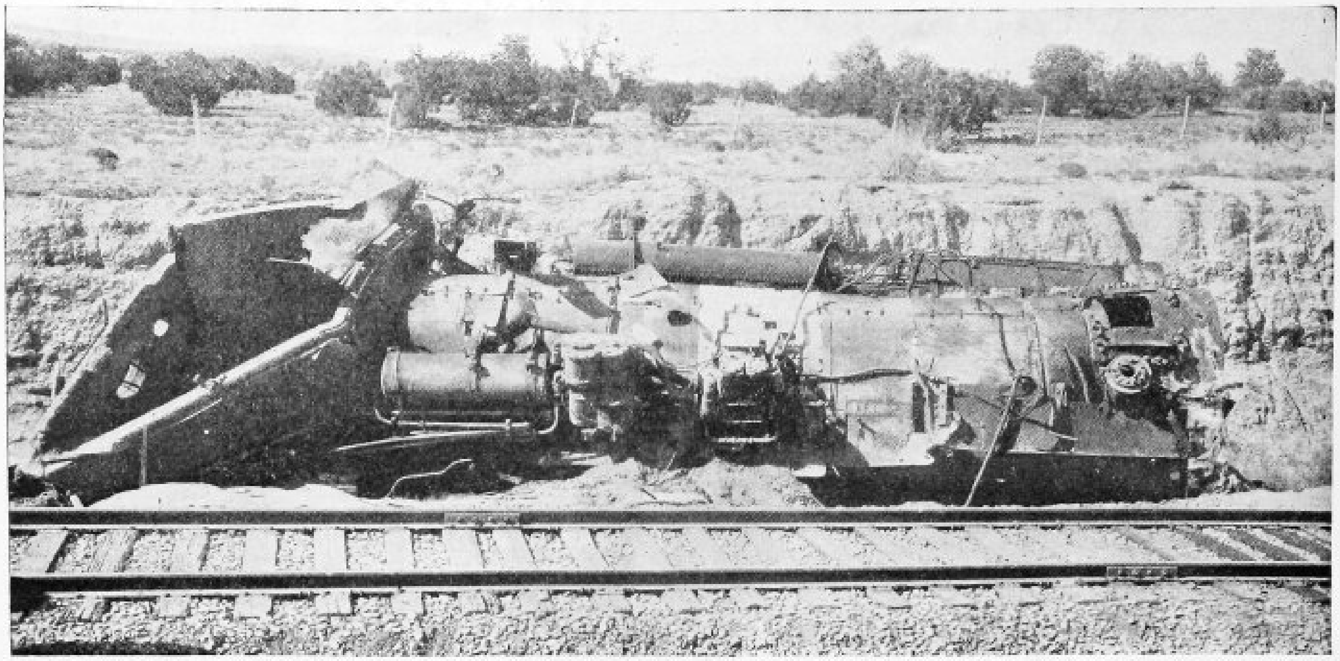


Fig. 1.—Disastrous result of a low water crown sheet failure

Locomotive Accidents During 1928

Chief Inspector of Locomotive Bureau reports 18.9 percent decrease in boiler disasters over previous year

By A. G. Pack*

THE seventeenth annual report of the Chief Inspector, Bureau of Locomotive Inspection to the Interstate Commerce Commission, covering the fiscal year ended June 30, 1928, contains summaries by railroads of all locomotive accidents. The tables contained in the report show the number of persons killed and injured due to the failure of parts and appurtenances of locomotives, as reported and investigated under section 8 of the locomotive inspection law, and those reported to the Bureau of Statistics under the accident report act of May, 1910, and not reported to this bureau as should have been.

The tables showing the number of accidents, the number of persons killed, and number injured as a result of the failure of parts and appurtenances of locomotives have been arranged to permit comparison with previous years as far as consistent. These tables also show the number of locomotives inspected, the number and percentage of those inspected and found defective, the number for which written notices withholding locomotives from service for repairs were issued in accordance with section 6 of the law, and the total defects found and reported. The data contained therein cover all defects on all parts and appurtenances of locomotives found and reported by our inspectors, arranged by railroads.

All accidents reported to this bureau, as required by the law and rules, were carefully investigated and action taken to prevent recurrences as far as possible. Copies of accident investigation reports were furnished to parties interested when requested, and otherwise used in an endeavor to bring about a decrease in the number of accidents on the railroads of the country.

A summary of all accidents and casualties to persons occurring in connection with steam locomotives compared with the previous year shows a decrease of 14.1 percent in the number of accidents, an increase of 7.1 percent in the number of persons killed, and a decrease of 10.4 percent in the number injured during the year.

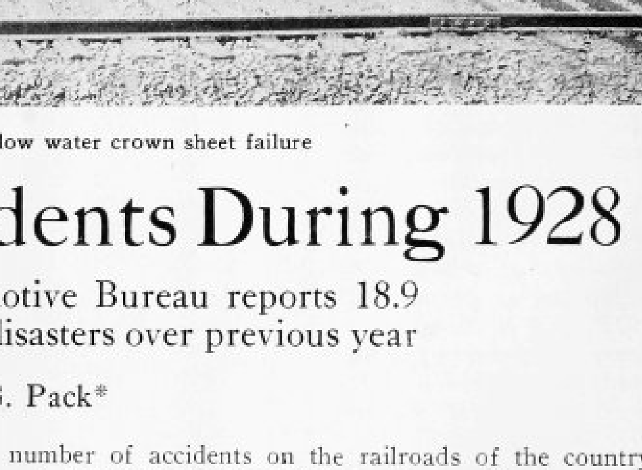


Fig. 2.—Chart showing relation of defective steam locomotives to accidents and casualties, resulting from locomotive failures

There has been a substantial decrease in the percentage of locomotives inspected by our inspectors found defective; for instance during the year 24 percent of the locomotives inspected were found with defects or errors in inspection that should have been corrected before being put in use, as compared with 31 percent

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for the previous year, 40 percent for the fiscal ended June 30, 1926, 46 percent for the year 1925, 53 percent for the year 1924, and 65 percent for the year 1923, when there occurred 1348 accidents, resulting in the death of 72 persons and the serious injury of 1560 others—when prosecutions in the courts for the more flagrant violations of the law were begun—as compared with 419 accidents during the current year, resulting

TABLE 1.—REPORTS AND INSPECTIONS—STEAM LOCOMOTIVES

	1928	1927	1926	1925	1924	1923
Number of locomotives for which reports were filed	65,940	67,835	69,173	70,361	70,683	70,242
Number inspected	100,415	97,227	90,475	72,279	67,507	63,657
Number found defective	24,051	29,995	36,354	32,989	36,098	41,150
Percentage inspected found defective	24	31	40	46	53	65
Number ordered out of service	1,725	2,539	3,281	3,637	5,764	7,075
Total number of defects found	85,530	112,008	136,973	129,239	146,121	173,840

TABLE 2.—ACCIDENTS AND CASUALTIES CAUSED BY FAILURE OF SOME PART OF THE STEAM LOCOMOTIVE, INCLUDING BOILER, OR TENDER

	Year Ended June 30—					
	1928	1927	1926	1925	1924	1923
Number of accidents	419	488	574	690	1,005	1,348
Percent of increase or decrease from previous year	14.1	14.9	16.8	31.3	25.5	[1] 117
Number of persons killed	30	28	22	20	66	72
Percent increase or decrease from previous year	[1] 7.1	[1] 27.3	[1] 10	69.7	8.3	[1] 118
Number of persons injured	463	517	660	764	1,157	1,560
Percent increase or decrease from previous year	10.4	21.6	13.6	33.9	25	[1] 120

[1] Increase

TABLE 3.—ACCIDENTS AND CASUALTIES CAUSED BY FAILURE OF SOME PART OR APPURTENANCE OF THE STEAM LOCOMOTIVE BOILER

	Year Ended June 30—							
	1928	1927	1926	1925	1924	1923	1915	1912
Number of accidents	150	185	247	274	393	509	424	856
Number of persons killed	26	20	18	13	54	47	13	91
Number of persons injured	174	205	287	315	447	594	467	1,005

TABLE 4.—REPORTS AND INSPECTIONS—LOCOMOTIVES OTHER THAN STEAM

	1928	1927
Number of locomotives for which reports were filed	1,034	951
Number inspected	1,119	604
Number found defective	169	174
Percentage inspected found defective	15	29
Number ordered out of service	9	9
Total number of defects found	411	423

in the death of 30 persons and the serious injury of 463 others. The percentage of defective locomotives this year reached the lowest point ever recorded.

While there has been a substantial decrease in the total number of accidents and casualties to persons with a substantial decrease in the number of defective locomotives, our investigations indicate that a further

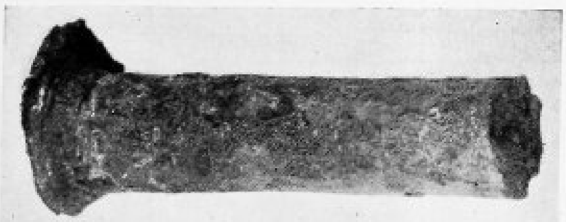

Fig. 3.—Part of a broken reduced-body staybolt that blew out of firebox sheet

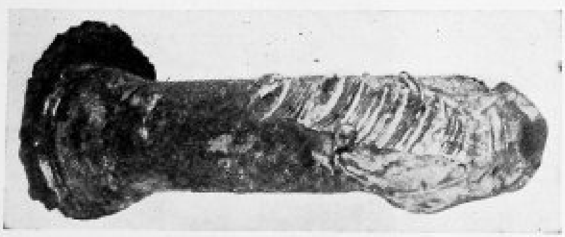

Fig. 4.—Another reduced-body staybolt removed from same firebox as the bolt shown in Fig. 3

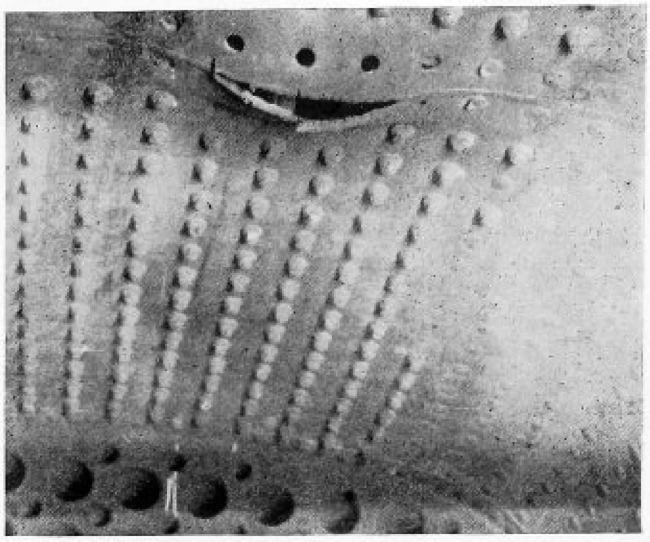

Fig. 5.—Crown sheet failure caused by low water

reduction would have resulted had more thorough inspections been made by some of the carriers and the requirements of the law and rules been complied with in respect to the proper repair of defects in equipment that affect safety; and while there has been a very general substantial improvement in the inspection and maintenance of locomotives and tenders, there are some railroads whose records do not compare favorably and where more exertive action may be required in bringing about the purpose and intent of the law.

Table 5 shows the various parts and appurtenances of steam locomotives and tenders which through failure have caused serious and fatal accidents. If the information contained in this table is taken advantage of and proper inspections and repairs made in accordance with the requirements of the law and rules many accidents will be avoided.

The graphic chart Fig. 2 shows the relation between the percentage of defective steam locomotives and the number of accidents and casualties to persons resulting from failure thereof, and illustrates the effect of operating locomotives in a defective condition from the viewpoint of safety.

Reduced Body Staybolts

In my fifteenth and sixteenth annual reports attention was called to the danger resulting from the use of reduced body staybolts having telltale holes which do not extend into the reduced section at least ⅝ inch. Accidents resulting in serious and fatal injuries continue to occur with this type of bolt because of the telltale holes not being of sufficient depth to perform the function for which they are intended.

Many of these bolts are improperly applied, the bolts being too long to permit full engagement of the threads on the enlarged ends with the threads in the holes in the sheets. This condition is indicated by persistent leakage after the bolts are installed and attempts to stop the leakage result only in thinning and flattening the heads. Figs. 3 and 4 show typical examples of bolts of this type.

Boiler Explosions or Crown Sheet Failures

As in former years, boiler explosions caused by crown sheet failures were the most prolific source of fatal accidents. Sixty-six and six-tenths percent of the fatalities during the year were attributable to this cause.

There was an increase of 15.8 percent in the number of boiler explosions or crown sheet failures, and an increase of 17.6 percent in the number of fatalities from this cause as compared with the previous year. Explosions may be expected to increase in violence with the increasing size of locomotive boilers and the higher pressures carried therein, and accidents of this nature may well be expected to increase as the duties and responsibilities of enginemen become more complex and exacting; therefore, the best thought and efforts of the various agencies concerned with design, construction, maintenance, equipment, and operation must necessarily be exerted and all practical safeguards provided if this class of accidents is to be reduced and maintained at a minimum.

Two hundred and thirty-four applications were filed for extensions of time for removal of flues, as provided in rule 10. Our investigations disclosed that in 14 of these cases the condition of the locomotives was such that extensions could not properly be granted. Sixteen were in such condition that the full extensions requested could not be authorized, but extensions for shorter periods of time were allowed. Thirty-eight extensions were granted after defects disclosed by our investigations had been repaired. Nine applications were canceled for various reasons. One hundred and fifty-seven applications were granted for the full periods requested.

TABLE 5.—ACCIDENTS AND CASUALTIES RESULTING FROM FAILURES OF STEAM LOCOMOTIVES AND TENDERS AND THEIR APPURTENANCES

Part or appurtenance which caused accident	Year ended June 30— 1928			1927			1926			1925			1924		
	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured
Air reservoirs	..	...	...	3	...	3	3	...	5	4	...	4	2	...	2
Aprons	5	...	5	6	...	6	11	...	11	4	...	4	11	...	11
Arch tubes	1	...	1	2	...	5	...	...	...	3	...	5	5	...	8
Ash-pan blowers	1	...	1	2	...	2	...	...	...	3	...	3	9	...	9
Axles	5	...	8	6	...	7	7	1	12	8	...	24	10	...	16
Blow-off cocks	7	...	7	10	1	9	10	...	10	13	...	13	18	...	18
Boiler checks	3	...	4	2	...	2	8	...	8	8	...	8	8	...	8
Boiler explosions:															
A. Shell explosions	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...
B. Crown sheet; low water; no contributory causes found	15	16	25	14	14	14	22	11	33	9	5	18	20	25	19
C. Crown sheet; low water; contributory causes or defects found	7	4	12	5	3	12	15	6	30	13	5	22	22	20	37
D. Firebox; defective stay bolts; crown stays, or sheets	..	...	...	...	...	...	...	...	...	6	2	9	1	...	3
Brakes and brake rigging	14	...	14	25	1	26	13	...	21	31	3	33	38	...	45
Couplers	13	1	14	15	...	16	15	...	19	21	1	20	24	1	27
Crank pins, collars, etc	8	...	8	3	...	4	8	...	10	8	...	10	12	...	13
Crossheads and guides	3	...	3	7	...	7	5	...	7	3	...	3	11	...	13
Cylinder cocks and rigging	6	...	6	3	...	3	...	...	...	3	...	3	8	...	8
Cylinder heads and steam chests	1	...	1	4	...	4	9	...	11	2	...	2	8	...	14
Dome caps	1	...	1	...	...	...	...	...	...	2	...	3	..	...	...
Draft appliances	1	...	2	2	...	2	1	...	1	4	...	8	4	...	5
Draw gear	2	...	2	5	...	6	2	...	2	6	...	6	13	2	11
Fire doors, levers, etc	8	...	8	6	...	6	11	...	11	12	...	12	16	...	16
Flues	17	...	21	23	1	26	26	...	31	36	...	42	41	1	54
Flue pockets	..	...	...	...	...	...	...	...	...	...	...	...	1	...	2
Footboards	11	...	11	10	...	10	9	1	8	11	...	11	24	...	24
Gage cocks	..	...	...	...	...	...	...	...	...	2	...	2	...	...	...
Grease cups	1	...	1	1	...	1	3	...	3	7	...	7	8	1	7
Grate shakers	25	...	25	29	...	29	38	...	38	57	...	57	96	...	97
Handholds	12	...	12	12	1	11	14	...	14	13	...	13	21	1	20
Headlights and brackets	3	1	2	6	1	5	2	...	2	5	...	5	6	2	4
Injectors and connections (not including injector steam pipes)	7	...	7	12	...	12	19	...	22	20	...	20	35	1	36
Injector steam pipes	3	...	3	4	...	5	8	...	9	12	...	15	16	...	20
Lubricators and connections	8	...	8	7	...	8	12	1	11	16	...	16	12	...	12
Lubricator glasses	1	...	1	...	...	...	3	...	3	6	...	6	5	...	5
Patch bolts	..	...	...	...	...	...	...	...	...	...	...	...	2	...	3
Pistons and piston rods	2	...	2	4	1	3	3	...	3	4	1	4	7	...	7
Plugs, arch tube and washout	1	2	1	6	1	8	4	...	5	5	...	6	17	6	19
Plugs in firebox sheets	..	...	...	1	...	2	...	...	...	...	...	...	...	...	...
Reversing gear	35	...	35	30	...	30	37	...	37	49	...	49	83	...	83
Rivets	1	...	1	2	...	2	3	...	3	1	...	1	7	...	8
Rods, main and side	11	1	13	16	1	18	20	...	24	23	1	25	21	1	21
Safety valves	1	...	1	...	...	...	...	...	...	...	...	...	3	...	3
Sanders	2	...	2	5	...	5	...	...	...	3	...	3	5	...	5
Side bearings	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Springs and spring rigging	10	1	11	14	...	18	16	...	16	25	1	26	19	1	18
Squirt hose	32	...	33	33	...	33	51	...	51	53	...	53	66	...	66
Stay bolts	5	2	4	8	...	8	4	...	4	5	...	6	2	...	3
Steam piping and blowers	7	1	10	11	...	11	7	...	7	5	...	6	23	1	27
Steam valves	2	...	2	6	...	6	4	...	4	7	...	8	15	...	15
Studs	1	...	1	3	...	3	7	...	9	1	...	1	4	...	5
Superheater tubes	1	...	2	5	...	7	7	...	10	3	...	3	4	...	6
Throttle glands	1	...	1	2	...	2	...	...	...	1	...	1	1	...	1
Throttle leaking	1	...	1	...	...	...	3	...	3	2	...	2	8	...	9
Throttle rigging	3	...	3	6	1	6	12	...	12	10	...	10	13	...	14
Trucks, leading, trailing or tender	3	...	4	4	1	4	7	...	23	6	...	14	17	3	85
Valve gear, eccentrics and rods	8	...	9	22	...	23	13	...	13	16	...	16	27	...	27
Water glasses	13	...	13	10	...	11	12	...	12	8	...	8	14	...	14
Water-glass fittings	1	...	1	2	...	2	3	...	3	7	...	7	10	...	11
Wheels	5	...	13	5	...	6	6	...	7	7	...	10	8	...	10
Miscellaneous	84	1	87	69	1	68	81	2	82	101	1	101	124	...	133
Total	419	30	463	488	28	517	574	22	660	690	20	764	1,005	66	1,157

Specification Cards and Alteration Reports

Under rule 54 of the Rules and Instructions for Inspection and Testing of Steam Locomotives, 872 specification cards and 8321 alteration reports were filed, checked, and analyzed. These reports are necessary in order to determine whether or not the boilers represented were so constructed or repaired as to render safe and proper service and whether the stresses were within the allowed limits. Corrective measures were taken with respect to numerous discrepancies found.

Under rules 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, 154 specifications and 40 alteration reports were filed for locomotive units, and 74 specifications and 8 alteration reports were filed for boilers mounted on locomotives other than steam. These were checked and analyzed and corrective measures taken with respect to discrepancies found.

Suits for Penalties

Five suits for penalties, involving 79 counts for alleged violations of the Locomotive Inspection Law and Rules, were pending in the various district courts at the beginning of the year. Information of violations was lodged with the proper United States attorneys in seven cases, involving 87 counts. Judgments in favor of the Government were obtained in eight cases, involving 134 counts, penalties imposed on 84 counts in the sum of $8,400, and 50 counts dismissed, by stipulation or agreement. There were no adverse decisions of courts. Four cases, involving 32 counts, were pending in the district courts at the end of the year.

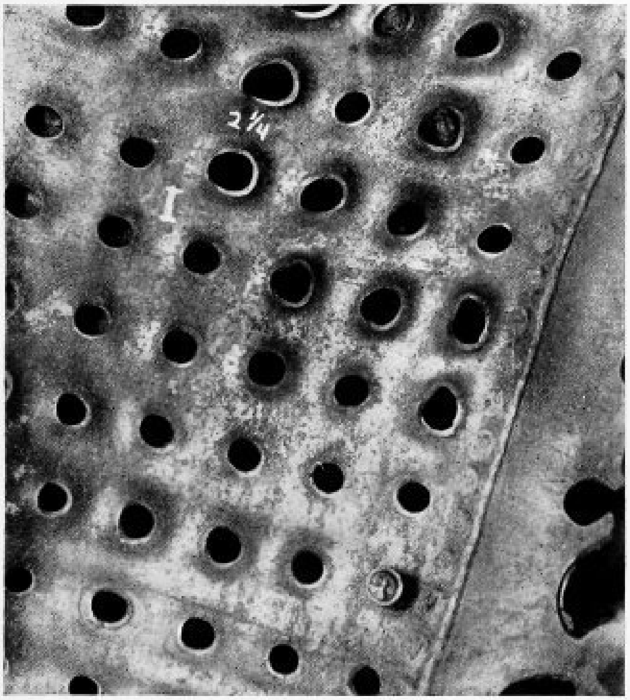

Fig. 6.—Water side of crown sheet that pulled away from 280 crown stays

This section of the report concludes with a reiteration of recommendations for the improvement of service which have appeared in previous reports.

Fig. 3 shows part of a broken reduced body staybolt which blew out of an inside firebox sheet, fatally scalding a boiler maker while he was inspecting the firebox. The bolt broke near the root of the fillet joining the reduced body and outer end; the telltale hole was not of sufficient depth to serve the purpose for which it was intended. The bolt was too long; the threaded end did not engage the firebox sheet more than two threads when applied, the threads being subsequently eroded and practically destroyed. The head had been excessively hammered and flattened in attempts to stop leakage.

Fig. 4 shows a reduced body staybolt which was removed from the same firebox as the staybolt illustrated in Fig. 3. The head of this bolt had been excessively hammered and flattened in attempts to stop leakage due to the almost complete absence of threads, and the bolt is fractured at the root of the fillet joining the reduced body where practically all rigid bolts of this type break.

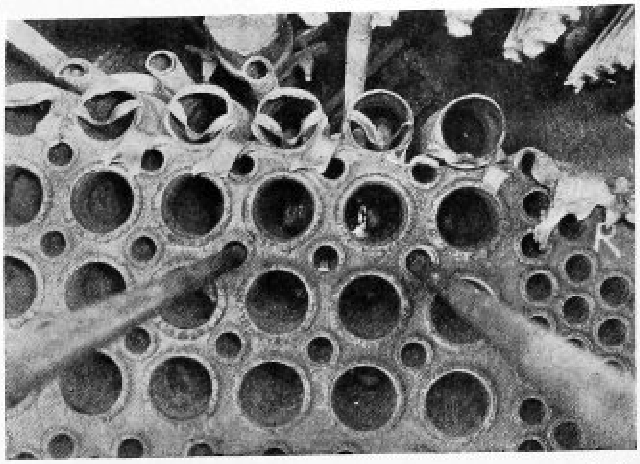

Fig. 7.—Fire side of a flue sheet after a low water explosion

Fig. 5 shows a crown sheet failure caused by low water in which the fusion welded seam joining the firebox and combustion chamber crown sheet failed, resulting in the death of the brakeman and the serious injury of the engineer and fireman. The water was estimated as being 4½ inches below the front end of the crown sheet at the time of the accident.

Fig. 6 shows the water side of a crown sheet, with portion of flue sheet attached which pulled away from 280 crown stays due to being highly overheated because of low water. The line of demarcation on the flue sheet was 9 inches below the top of the crown sheet. The enlarged holes in the crown sheet were caused by the sheet becoming sufficiently plastic to pull over the button heads. This boiler was not thrown from the frame. This accident resulted in the death of the fireman and serious injury to the engineer. Fig. 7 shows the fire side of flue sheet, the top portion of which remained attached to the crown sheet as illustrated in Fig. 6.

Fig. 8 shows the result of a crown sheet failure caused by low water, the explosion resulting in the seri-

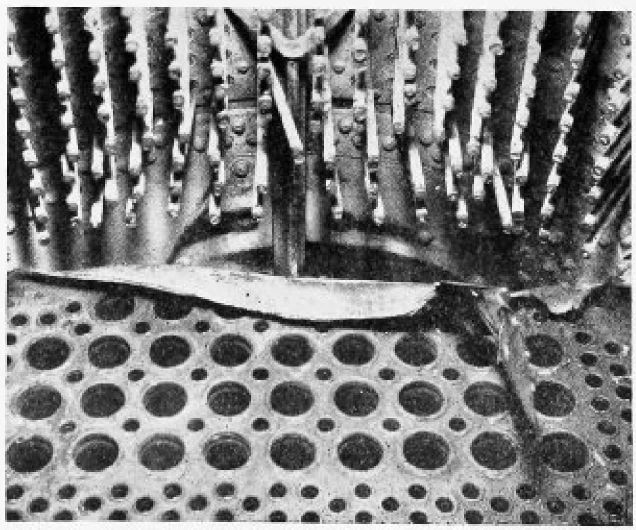

Fig. 8.—This explosion caused the serious injury of three of the crew

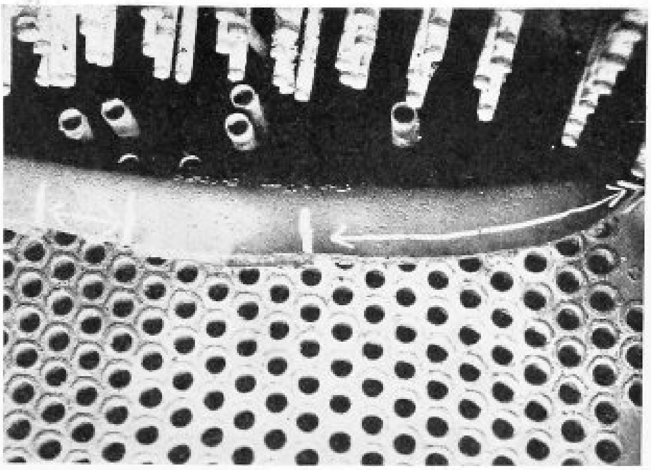

Fig. 9.—In this case the crown sheet, parts of the side sheets and door sheet pulled away from the stays

ous injury of the engineer, fireman, and brakeman. The force of the explosion raised the rear of the locomotive and the front of the tender, derailing all driving wheels, breaking the trailing truck radius bar and wedging the trailing truck back against the front tender truck. The front tender truck was turned upside-down under the tender and rear tender truck wheels derailed.

A woven wire fence on the right side was blown down for a distance of 200 feet and a flat car standing on a sidetrack on the left was turned on its side and the track forced 14 inches out of alinement. Had this boiler not been securely attached to the frame, the results of the explosion would, no doubt, have been much more serious.

This firebox was what is known as 3-piece construction, with flue and door sheets welded to crown and side sheets.

Fig. 9 shows the result of a crown sheet failure due to low water which caused the death of two and the serious injury of three employees. The entire crown sheet, together with parts of the side sheets and door sheet, was pulled from the stays. The force of the explosion tore the boiler from the frame and smokebox, hurling it forward 227 feet from the point of the accident.

Figs. 1 and 10 show the result of an explosion caused by low water, which resulted in the death of the engineer and fireman, with an estimated property damage of $32,500. The estimated line of water at the time of the accident was 4⅜ inches below the front end of the crown sheet, which was 3 inches higher at the front end than at the back end. Fig. 10 shows the fusion welded seam joining the firebox and combustion chamber crown sheet which failed for a distance of 64 inches, where the initial rupture evidently took place.

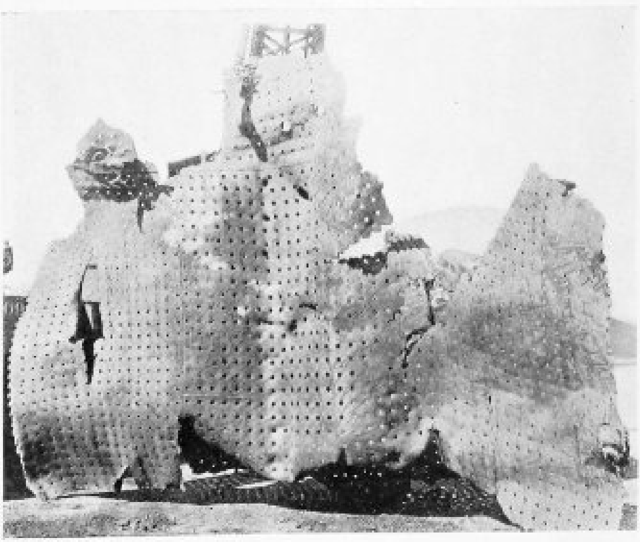

Fig. 11.—This low water accident in which the crown sheet failed resulted in two fatalities

Fig. 11 shows the result of an explosion caused by a crown sheet failure due to low water, which resulted in the death of the engineer and fireman and serious injury to the flagman, who was in the caboose. This locomotive was of the Mallet type, carrying 225 pounds steam pressure, engaged in pusher service on a 2.2 percent ascending grade. The explosion tore the boiler loose from the frames and high-pressure cylinders, hurling it upward and forward over the caboose, where it landed in front of the caboose on a car loaded with stock, and fouled the two adjacent tracks. The force of the explosion tore the entire back end loose from the barrel, blew out the entire firebox, and scattered parts of the boiler and machinery into the densely wooded section in the vicinity of the accident. The line of water was approximately 6 inches below the highest part of the crown sheet at the time of the accident. Fig. 11 shows the inside firebox sheets as they were after being blown out.

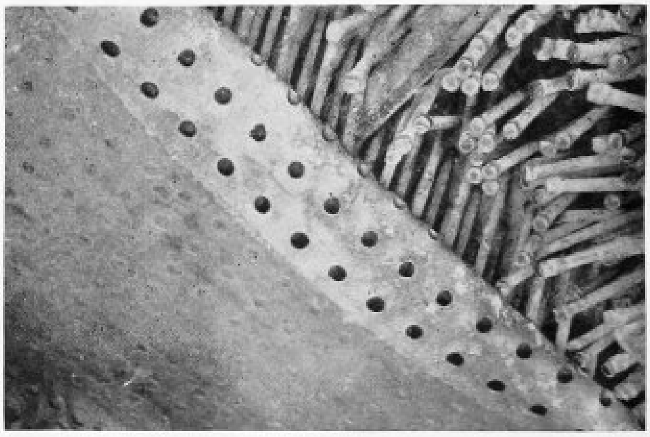

Fig. 10.—At the time of this low water failure, the water was 4⅜ inches below the crown sheet at the front end

Fig. 12 shows a damaged crown sheet, equipped with two thermic syphons, caused by overheating due to low water. The sheet pulled away from 64 radial stays and pocketed to a maximum depth of 3¾ inches, covering an elliptical area 28 inches in width by 52 inches in length. The line of demarcation usually caused by overheating was indefinitely defined, therefore could not be determined. Since there was no damage to the crown sheet or stays other than within the pocketed area, it appears evident that the syphons supplied sufficient water to the crown sheet to prevent it from becoming overheated over any considerable area prior to the failure shown.

This locomotive was of the 2-8-8-2 articulated type, single expansion, carrying 240 pounds boiler pressure, with firebox 218 inches in length by 108 inches in width; weight in working order 649,000 pounds, tender 343,500 pounds, total 992,500 pounds.

Boiler explosions are caused by the sudden release of pressure; therefore, the quicker the release of pressure the greater the resulting damage. The results

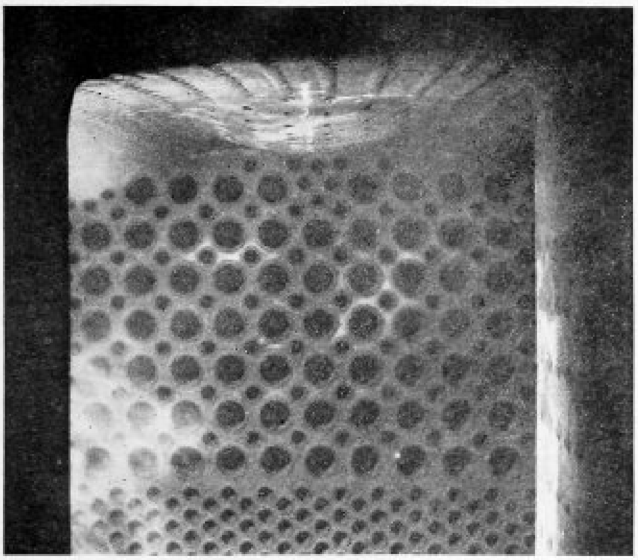

Fig. 12.—Damaged crown sheet which pocketed to a depth of 3¾ inches

from a boiler explosion are dependent upon surrounding conditions and the violence of the explosion is dependent upon the volume and temperature (steam pressure) of the water in the vessel, the ability of the entire fabrication to withstand severe shocks and strains to which every part may be subjected and the size and suddenness with which the initial rupture takes place.

Fig. 13 shows fusion welding applied to the outside of a boiler in an attempt to repair a crack in the barrel. Engineering authorities recognize the potential danger introduced by the application of welding on barrels of boilers when unsupported by other construction of known value that will carry the stress with an ample factor of safety. Many enthusiasts are apparently indifferent to the results that may accrue from the use of unsafe methods of construction and repair. No doubt a serious accident was avoided by the action of our inspector in ordering this locomotive out of service when the condition was disclosed.

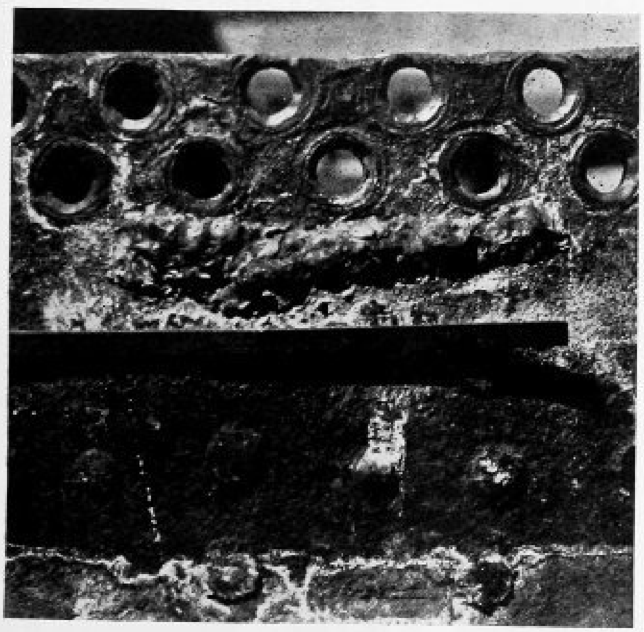

Fig 13.—An attempt to repair a crack in a boiler barrel by fusion welding

The Löffler High-Pressure Steam Power Plant

IN the Löffler system of steam generation, the boiler is a horizontal cylindrical vessel to which the heat is supplied not by the combustion of the fuel in contact with it, but by forcing highly superheated steam through the water by means of a pump. Pressures of the order of 100 atmospheres (1470 pounds) and over can be produced by this system. A plant having an output of 2000 kilowatts has been installed by the Vienna Locomotive Works and has now been in operation for nearly a year, working for about 2500 hours during that period. It comprises two reciprocating engines supplied with steam at a pressure of 1700 pounds per square inch and a temperature of 900 degrees F. Each of the engines has an indicated output equivalent to 400 kilowatts. Steam is exhausted at a pressure of 170 pounds per square inch and a temperature of 390 to 445 degrees F. to another type of engine developing 1200 kilowatts. Each of the high-pressure engines has one double-acting cylinder of 6¾ inches bore with a piston stroke of 17¾ inches, and runs at about 300 revolutions per minute with a mean effective pressure of 570 pounds per square inch. Steam is distributed by valves located in the cylinder ends and operated by eccentrics on a layshaft driven from the crankshaft through gearing and a vertical shaft.

The Löffler boiler used with the installation comprises two drums, each 31½ inches in diameter and 23 feet in length, and is capable of generating 16,500 pounds of steam per hour at the pressure and temperature previously mentioned. The grate area is 80.7 square feet, and the air for combustion passes through a heater having a heating surface of 2153 square feet, in which its temperature is raised to between 300 degrees and 390 degrees F. The feed heater is of the same area as the air heater, viz., 2153 square feet, and the area of the superheater is 1776 square feet. It is claimed that the plant has a thermal efficiency of 30 percent, which is about equal to that of a Diesel engine; but since the Löffler plant uses coal instead of oil, the fuel costs are very considerably lower. The first cost of the installation is also stated to be not greatly in excess of one of the same capacity operating at a moderately high pressure of some 400 pounds to 700 pounds per square inch. —*The Mechanical Engineer.*

General Machinery Corporation Absorbs Two Concerns

THE business of The Niles Tool Works Company, formerly owned by the Niles-Bement Pond Company, and The Hooven, Owens, Rentschler Company, both of Hamilton, O., are now consolidated under the ownership of the General Machinery Corporation. This consolidation is significant because it brings under one management the entire engineering and manufacturing resources of two companies that have been in existence for 60 and 83 years respectively, manufacturing heavy machinery of all kinds. The plants, modern in every way, located in Hamilton, O., are equipped with excellent machinery and unsurpassed foundry facilities. G. A. Rentschler is president and Walter A. Rentschler is secretary and treasurer of the General Machinery Corporation.

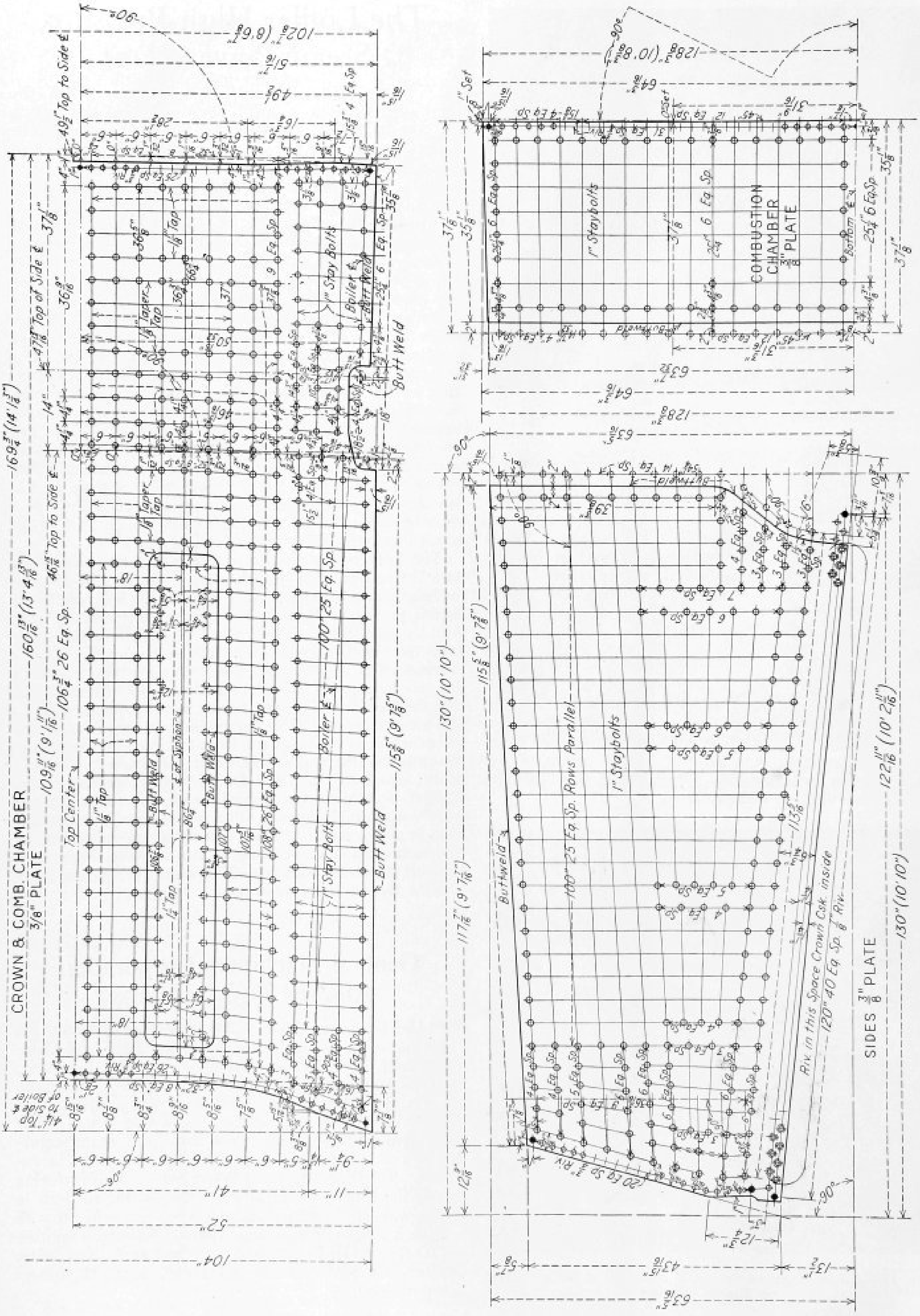

Fig. 24.—Development of four-piece crown, sides and combustion chamber sheet. Connected together with butt-welded seams. Also showing cuts in the crown sheet for the application of two Nicholson thermic syphons

Locomotive Boiler Construction -VI*

Layout of firebox crown, sides and combustion chamber sheet—Roof sheet and back sheet layout

By W. E. Joynes†

THE development plate drawing of a firebox crown, sides and combustion chamber sheet, constructed of four separate plates, butt welded together, is shown in Fig. 24.

The crown, including the extension for the combustion chamber top is made in one piece. Each side is a separate plate, and the bottom half of the combustion chamber is also a separate plate, making four separate plates to be welded together in one fabricated sheet.

Since the introduction of electric welding, the method of constructing firebox crown and sides sheets in separate pieces is again becoming the practice. Whereas, previous to the practice of welding stayed plates of locomotive boilers, the separate crown and sides sheet construction was discouraged, except in cases where the desired size of the crown and sides plate exceeded the size that could be rolled at the mill.

Before the electric-welding method of joining separate crown and sides plates, the single riveted lap seam was used.

A few answers to the question "why are crown and sides sheets made of separate plates instead of in one piece plate" may be given here. First, large size plates or plates with dimensions that are below certain mill-rolling sizes are sold at a lower cost to the boiler manufacturer.

Finding surface defects in a large one-piece crown and sides sheet is a disadvantage because of the loss to the rolling mill. In cases where under-surface defects are discovered in fabricating the sheet, it becomes a more serious problem to the boiler manufacturer, in the loss of time and money, to replace the plate in time to meet the scheduled boiler output and which, of course, would not be so costly if the sheet was to be constructed in three or four pieces, instead of in one piece.

Questions of opinion as to how the direction in which the plate has been rolled should be placed in the firebox to give the best results in strength, length of life, etc., have a bearing in the construction of the firebox.

Replacing the crown or sides when repairs are needed instead of a whole one-piece crown and sides sheet, is also an item of cost to be considered with reference to crown and sides construction.

The labor required for building crown and sides sheets of separate plates is increased and is made more difficult due to the work necessary in making the development plate drawing to the finished fabricated firebox. The increase of the shop labor begins with: More plates to lay out; more plates to handle for drilling; extra edges to plane or bevel shear; and more plates, with extra operations, to roll into shape and the difficulty experienced in assembling the plates, lining up, fitting and welding together of the same. This increase of labor is of interest in comparing the one or more piece crown, sides and combustion chamber construction.

Layout of One-Piece Crown and Sides Sheet

The instruction as given for laying out one-piece crown and sides sheet together, with the following remarks concerning the layout of separate-plate constructed crown and sides sheets, should be sufficient information for the layout of all types of crown, sides and combustion chamber sheets.

First, each plate is dimensioned complete and independent of the other plates. The crown stays and staybolts are spaced off on the developing lines.

It will be observed from Fig. 24 that the cutout for the inside throat sheet connection is also a butt-welded joint. The developing lines for the welded construction are taken on the vertical rows of staybolts in the throat sheet; therefore, it is only necessary to project (90-degrees to the developing line) the few staybolt hole locations, in the sloped part of the throat, to the side sheet staybolt line, which are not on the developing line.

The combustion chamber staybolt holes are not projected at right angles to the developing lines, onto the front and back staybolt line, but are drawn directly across the plate from the divisions as spaced on the developing lines. The front developing line is taken at the edge of the sheet. The back developing line is taken at the back edge of the sheet for a riveted seam throat connection only.

The long narrow opening shown in the crown sheet is for the application of two Nicholson thermic syphons. Only half of the crown sheet is shown on the drawing. The opening is the same in the left half of the sheet. The opening is laid out as dimensioned, but the plate is not cut out until after it is rolled to shape.

When duplicate plates are wanted, the front and back end of the syphon opening is burned out for a length of about 5 inches, so the opening location can be marked off on the duplicate plates. After the tack holes have been marker punched and the ends of the syphon opening marked off on the duplicate plate, a straight edge is used for drawing in the side lines of the openings. The opening line is then marker punched all around.

Layout of the Radial Stay Holes within the Syphon-Flange Opening

A piece of sheet metal cut to the size of the syphon-flange opening, minus an allowance for welding the syphon flange to the crown, is laid on the opening location when the radial stays are being laid out, so that the stay holes within the opening can be laid out on the sheet-metal template, to be used as a pattern, for marking the location of these stay holes in the flange of the syphons and for marking off the syphon-flange outline.

The plates should be squared accurately and all dimensions on the drawing followed closely, in order that the fitting up work may be facilitated, and to insure the stays pulling square and radial to the firebox when assembled in the boiler.

The machine work in connection with these plates is similar to the same work for a one-piece crown and sides plate. The straight welded edges are planed bevel for welding, on a plate-edge planing machine.

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* The first instalment of this series appeared on page 218 of the August issue, the second on page 253 of the September issue, the third on page 291 of the October issue, the fourth on page 321 of the November issue, and the fifth on page 353 of the December issue.

† Boiler designing department, American Locomotive Company, Schenectady, N. Y.

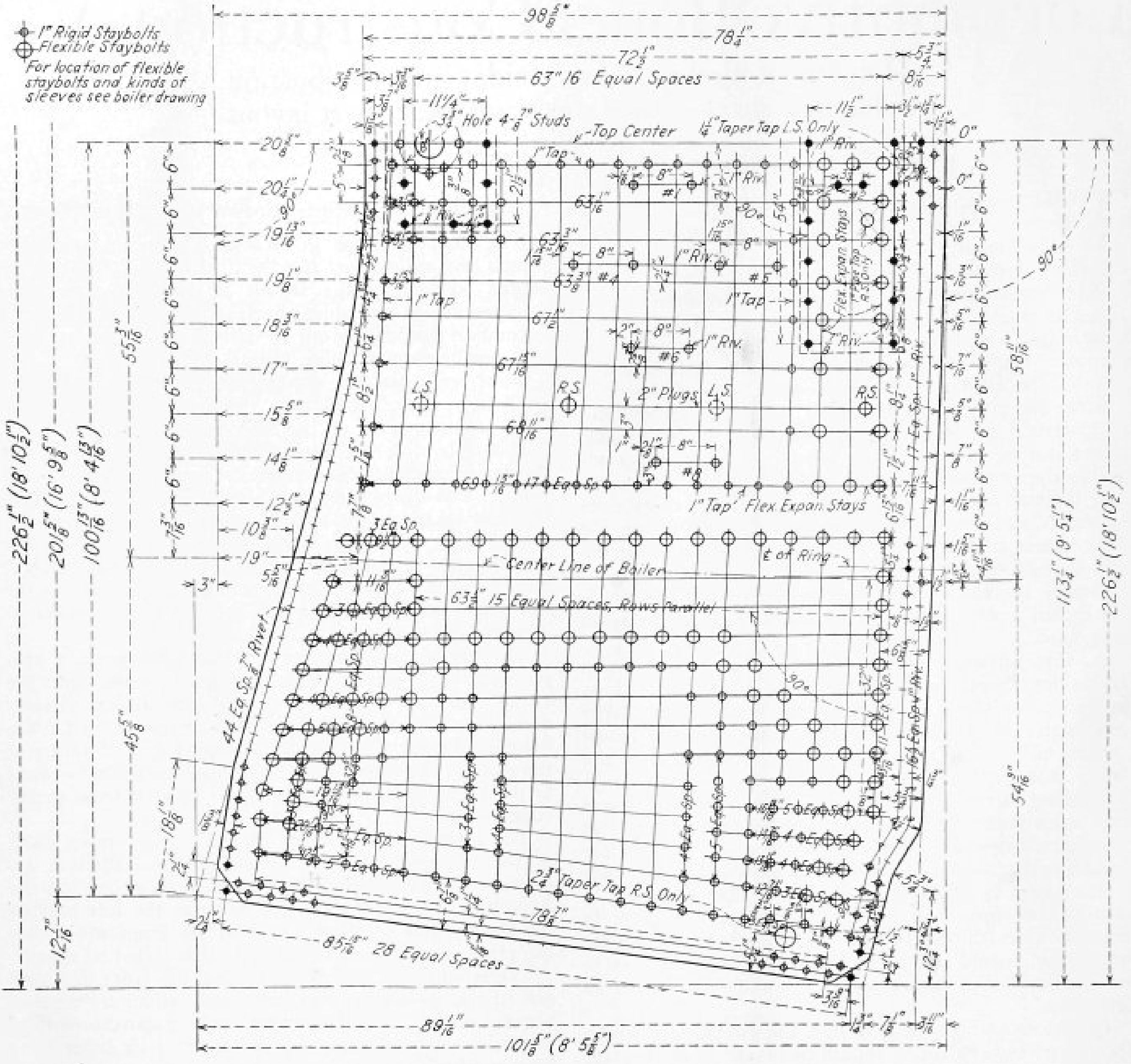


Fig. 25.—Developed roof and side sheet

The plates are rolled to shape before being assembled and welded together.

Roof Sheet Layout

Fig. 25 is the developed plate drawing of a roof and sides sheet which was used in connection with the same boiler as the crown and sides sheet, Fig. 21, (page 353, December 1928 issue).

The layout of the outline and the stays in this sheet is similar to the crown and sides sheet layout.

The longitudinal lines for the radial stays are drawn directly from the divisions as spaced on the developing lines.

The staybolt holes are spaced on the developing lines and projected onto the front and back stay lines, at right angles to the developing lines.

The longitudinal spacing of the stays, as spaced on the metal strips for marking off the stay spacings on the crown and sides sheet, is now used for marking the same spacings on the roof and sides sheet. The broken up or odd spacing of staybolt holes at the front and back ends are spaced off directly on the plate.

The dimensions as given on the roof sheet drawing for the broken up staybolt spaces should check with the stayholes as laid out on the crown side sheet. When the crown sheet has been laid out, measure these dimensions and mark them on the roof sheet blue print, which will verify the location of the holes, as dimensioned on the roof and side sheet drawing. All rivet holes in the front and back seams, all firebox ring rivet holes, brace feet and liner rivet holes, cab turret dry pipe hole, holes for safety valve extension tap, holes for washout plug tap, blow-off cock holes and all other holes that are to be in the roof sheet, except stud holes, are to be laid out and drilled before the sheet is rolled to shape. The rivet holes in the roof-front seam, top to boiler center line, should be laid out on the developing line and bisected onto the rivet lines.

The location of rivets, stay cab turret, safety valve holes, etc., in roof sheet liners are marked directly from the rolled roof sheet.

Rivet holes on or near the top center are laid out and punched in the liner. The liner is then rolled to a radius slightly larger than the inside radius or radii of the roof sheet, after which it is bolted to the roof sheet through the holes that have been punched along the center and also clamp-bolted around the edge, through stay or other holes that may be convenient for this purpose.

The rivet and rigid stay holes are now centered on the liner with a marker punch. Holes for flexible stay sleeves and larger holes are marked off with a soap stone.

Unless the drawing calls for the stays to have threaded connections in the liner and roof sheet, the liner holes are drilled large enough to allow the stay or sleeve to clear the liner hole.

Firebox Back Sheet and Backhead Layout and Machine Work

Fig. 26 is the developed plate drawing of a firebox back sheet.

All staybolt holes, arch-tube holes and the fire-door

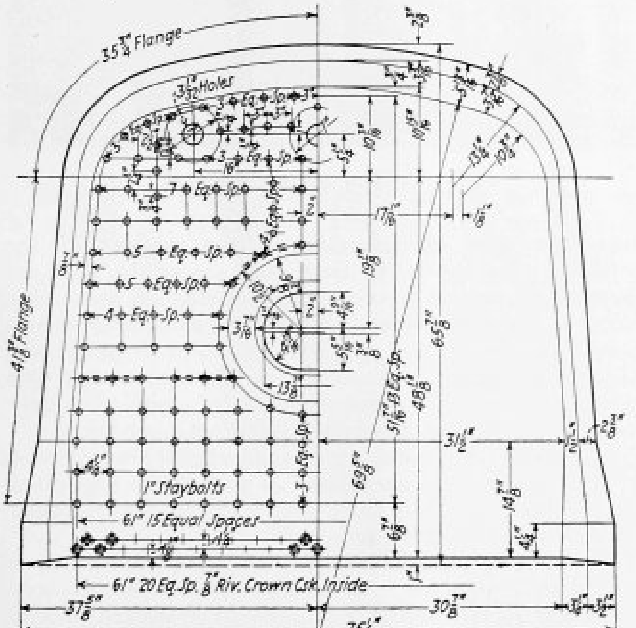


Fig. 26.—Firebox back flange development

hole are to be laid out and put in the plate before it is flanged to shape.

The first lines to lay down on this plate would naturally be a base line for the bottom edge of the sheet, the vertical center line of the plate and the boiler center line.

Lay in the door-hole opening next and the staybolt line around the same.

Omit the two developing lines shown between the door opening and the staybolt line. These developing lines are used for finding the size of the opening only, and are not of any value on the metal plate.

Measure 10 15/16 inches above the boiler center line and scribe a 69⅝-inch inner bend line radius from that point; then the 10¾-inch corner radii. Continue laying out the bend line below the boiler center line as dimensioned on the developed plate drawing. Omit the outer bend line, which is of no value on the metal plate. The outline of the plate can now be drawn in as dimensioned.

Lay in the center lines for the arch-tube holes and the staybolt circle around these holes.

The staybolt arrangement is now laid out and spaced off as dimensioned and shown.

Begin by locating the bottom horizontal staybolt line, and a point at the plate center line for the top staybolt line. Scribe an arc from this point. Draw the side staybolt lines as dimensioned from the bend line. Scribe the corner radii to connect the side lines and the top arc. The corner radius equals the bend line radius, minus the dimension given for the side staybolt line off the bend line. The center of the radius will rise slightly above the bend line corner radius for this staybolt layout.

The equal vertical staybolt spaces are spaced off on a straight edge or on vertical lines which are to be drawn at each side of the plate for this purpose. The horizontal staybolt-hole lines are then drawn across the plate, as shown, from these points. The holes on these lines are spaced off with the dividers, for one half of the plate. The spacing, on each line, is marked off on the other half of the plate before the divider set is changed.

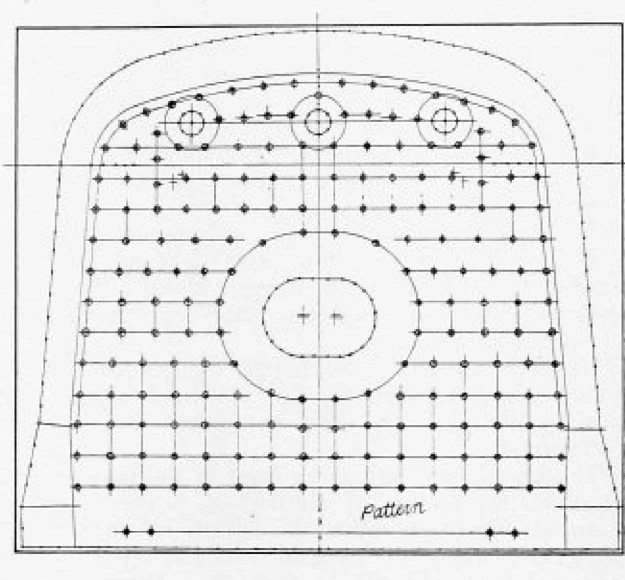


Fig. 27.—Firebox back sheet layout, ready to be drilled (when drilling sizes have been shown) and trimmed

The dropped corners of the plate, at the bottom, is unusual in the design of this back sheet; this is due to the ends of the firebox ring not being in the same plane with the sides of the ring. The extra material gained by extending the plate at the bottom corners, allows the bottom edge of the flanges to reach the sides of the ring, which slope down toward the front end of the firebox.

The firebox ring rivet holes are spaced off on a metal template and then punched.

Locate and draw the lower firebox ring rivet line on the plate.

Transfer the template to this line and marker punch the location of the third and fourth rivet holes from each side. These holes are used for drift pins and bolts, when fitting the sheet and when assembling the whole firebox. The remaining firebox ring rivet holes are marked off from the ring when the sheet has been correctly fitted.

Fig. 27 is the pattern plate layout for the firebox back sheet as described above, from the plate development drawing, Fig. 26.

The layout should now be thoroughly checked. The firehole location is important, and no less care should be taken in verifying the location of the staybolts and the plate outline.

The bottom edge of the plate is not cut out to allow for the lowered corners until after the plate has been flanged and fitted to the firebox ring.

Center punch and soapstone, (freehand), circle all of the staybolt holes and the arch-tube holes. Center punch the fire-door hole opening and around the plate outline.

The fire-door opening can now be burned out. The four fire-box ring rivet holes are punched and one staybolt hole right and left, near the top, are also punched.

The plate outline is punched and sheared off; the plate is then returned to the marking-off section for marking off the fire-hole location, the plate outline and tack holes, for duplicate plates.

The plates are now ready to be drilled, the fire hole punched out and the outline punched and sheared off, after which the plates are flanged.

Shearing and punching plate outlines and openings can be done at a lower cost than burning. Pattern-plate (flanged plates) outlines and openings are removed with a burning torch for smooth marking-off purposes.

Openings are burned out of all plates and liners, when the burned finish is the only finish required, as dome openings, smokebox steam pipe and cylinder openings, etc.

The flange dimensions given outside of the plate outline, on the development plate drawing, are for checking the shape of the flanged sheet. These dimensions are stamped on the plate for the flanger's information.

The correctness of the flange dimensions can be verified by the layerout. Lay down, full size, the flanged outline of the sheet as shown on the boiler cross section.

The dimension locating the bend in the boiler sides, just above the bottom of the firebox, is not a vertical measured dimension when the bottom of the firebox slopes, and when the dimension is the same at the front and back end of the fire box. Therefore this dimension should be measured at right angles to the bottom of the firebox, when the side bends are parallel to a straight sloping firebox ring.

The cross section is conveniently laid down on the back sheet, pattern plate, and wheeled off from the top center to the side center. An allowance for the slope position of the sheet in the longitudinal view must be added to the wheeled dimension.

The sloped position of the sheet should be laid down on a separate plate. The difference between the vertical and the measured sloped dimension, above the boiler center line, is the allowance to add to the wheeled dimension. The flanged dimension below the boiler center line is found in a similar way.

(To be continued)

CALENDAR.—The Reading Iron Company, Reading, Pa., manufacturers of Reading genuine puddled wrought iron pipe, has issued its 1929 calendar. The illustration on this work represents the "puddler" in the act of agitating the pig iron with the rod known as a "rabble."

BOILERS.—The Murray Iron Works Company, Burlington, Iowa, has issued catalogue 92 in which the Duplex internally-fired boilers are described. These boilers are self-contained, requiring no brick setting.

The Boiler Maker in the Physical Laboratory*

By E. N. Treat

THE value of boiler as well as other plate so far as strength is concerned is rated in pounds per square inch. However this rating is usually stamped upon the plate in thousandths of pounds. An

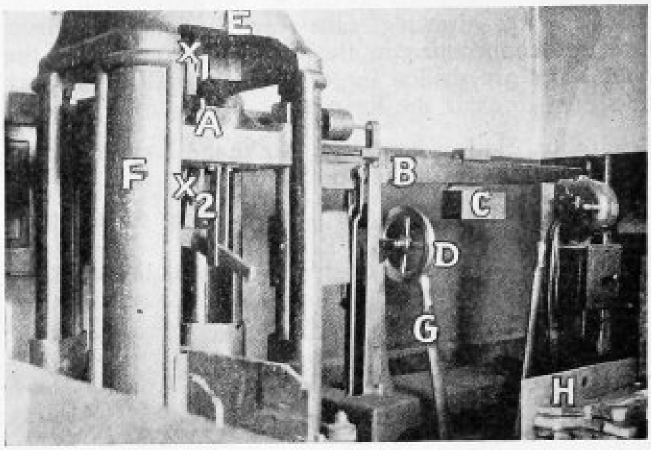


Fig. 1.—The testing machine

important part of inspection is the witness of the breaking of coupons cut from such material. It is the inspector's duty to pass upon the results of such tests. Records are established from these results, which must justify the safe use of the material. For these reasons the manufacturer of steel plate maintains at his own expense a physical testing laboratory where the qualities of his product are determined and recorded.

In a previous article, the procedure for the selection of test pieces from each plate as rolled was explained, but in this article we shall deal with the actual procedure of testing plate coupons.

The testing machine is an important device upon which much depends. In its essentials, it is similar in operation to the ordinary household steelyard, but of course in construction it must differ. As in the use of the steelyard, the material is placed upon the short arm and the weight moved along the beam until balanced, and the result read in units of pounds. The difference in principle of the test machine is that instead of the object to be weighed being applied, the test coupon is adjusted at the point of the short arm, and then by mechanical means a drawing load is applied and increased gradually until the coupon is torn apart.

The result of a test is determined by the beam reading which is graduated as is the steelyard, but in larger proportions in accordance with the capacity of the testing machine. Usually the readings are made in hundredths and thousandths of pounds.

The reader may more readily understand the workings of the testing machine by referring to Fig. 1, on which F indicates one of four vertical metal columns, supporting the fixed head E. These supports are bolted to the base of the machine. The top clasp indicated by X_1, in which the coupon is held, is attached to the supporting head E. The lower clasp X_2, which is attached to the lower end of the coupon, is connected to the movable draw head A upon which the load is applied after both ends of the coupon are grasped by clasps.

* Continuation of a series of short articles on boiler material inspection of the steel mills, which have appeared in recent issues.

Letter *G* indicates the starting lever, and *D* a wheel by which the weight *C* is moved along the beam *B*. The letter *H* indicates a truck loaded with coupons for testing. In Fig. 2 is shown a coupon before being broken.

The procedure in making the tests is orderly and rapid. As an example of the procedure, the testing machine operator may announce in a loud clear voice, "I have the John J. Jones order, number 5247. The chemical analysis of which is as follows: Carbon 0.34 percent; sulphur 0.031 percent; manganese 0.45 percent; phosphorus 0.024 percent." The inspector and recorder at once know what material is to be tested, and by the chemical analysis, the inspector may be aided in making his decisions before accepting the material represented by those tests. The chemical analysis may be verified at the expense of the manufacturer if the inspector should doubt the correctness of the submitted analysis. It is rare that such a procedure is taken by the purchaser's inspector.

The test machine operator next gages the width and thickness of the test coupon, and announces, "The thickness is 1.384 inches, and the width is 1.365 inches." The area is then computed by the recorder who advises that the product is 1.889 square inches. The recorder, a man whose duty it is to compute the work in connection with the tests, is assisted in his calculating by means of a specially constructed slide rule shown in Fig. 3.

The test machine operator next adjusts the ends of the coupons in the clamps. The lever *G* is moved forward and a downward movement of the head *A* may be observed slowly applying a strain on the coupon. The beam rises as the strain is applied, and the weight *C* is advanced on the beam until it balances the load applied. The stretch of the test coupon may be noted after which the beam rises; the weight is moved again and the load applied until the coupon breaks.

The test machine operator announces the result as having been 121,000 pounds beam reading. This result

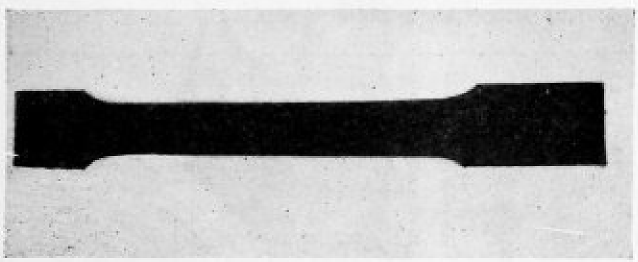


Fig. 2.—The coupon before testing

is divided by the area, 1.889 square inches, which gives a resultant tensile strength of 64,500 pounds per square inch of tested section of coupon.

The broken ends of the test coupon are next removed from the clasps and the edges where the fracture occurred are placed together. The length of the coupon between the 8-inch scribe marks is measured to determine the amount it has stretched. The operator announces the stretch or elongation as 2.32 inches or 29 percent in 8 inches.

The final measurements of the coupon are next taken at the point of fracture which is somewhat reduced. "The reduced width is 1.0 inch and the reduced thickness is 0.80 inch," the operator announces, and the recorder gives the reduced area as 0.80 square inch. This reduced area subtracted from the area before testing denotes the amount the test coupon has drawn down during the application of the load. The remainder after subtracting is divided by the first area which gives the percentage of reduction of area. This denotes the ductility of the material from which the coupon was taken.

The next test coupon is made ready as was the first, and the procedure is again repeated. The lowest tensile strength of the tests is taken as that representing the plate. The manufacturer usually stipulates a minimum and maximum tensile strength though frequently only the minimum tensile strength is specified.

Present-day methods of plate testing fairly represent the strength of the plate. The results obtained by

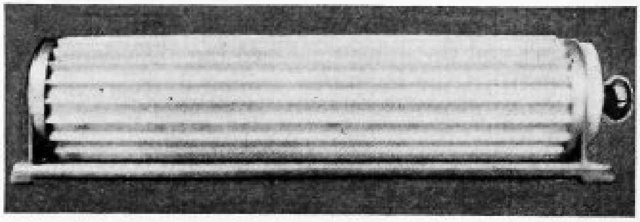


Fig. 3.—The special slide rule for computing test results

breaking top and bottom test pieces from one plate do not assure that such tests are the lowest that might be obtained from such a plate were the entire plate cut into test coupons and tested. In mild steel ingots weighing a ton or more a variation of 5000 pounds per square inch has been found, but the present methods appear satisfactory for determining safe working loads.

Test coupons are more often selected from the top and bottom sides of the rolled plate for tension test pieces. The bending test is often taken from the transverse middle of the top. This practice is intended to give a fair value of the extreme ends representing the top and bottom of the ingot. It is not uncommon however for tests to vary 10,000 pounds or more, and manufacturers in taking orders insist that the maximum and minimum stipulations of tensile strength allow that range.

Hand-Hole Plate Repair

THE eye-bolt was broken from a small hand-hole plate which could not be duplicated and must be repaired. A hole was drilled and tapped; an eye-bolt forged, fitted, and screwed into the hole and riveted on the inner side of the plate. However, the plate leaked around the new eye-bolt and no amount of riveting or calking would make it tight.

At the first opportunity which offered, the plate was removed, the eye-bolt riveting chipped off, and the bolt removed and thrown away. A new bolt was forged with a shoulder to fit against the plate, which was counterbored smooth around the threaded hole. A hollow punch was driven over the bolt against the shoulder, which was thereby cupped a bit, so that thin, true edges fitted squarely down against the counterbore. A disk of copper-asbestos packing, or gasket material, was cut to fit the counterbore and slipped over the eye-bolt. This was screwed home as tightly as its size would stand. A ½ inch of the inner end of the eye-bolt was then riveted down upon the plate and no leakage, or sign of "seeping" was ever seen around the new eye-bolt.

Two New Drilling Devices

By H. A. Lacerda

THE illustration Fig. 1, shows a special shop kink employed as an aid to drilling. This device has been adopted at the Colonie Shops of the Delaware & Hudson Railroad, Watervliet, N. Y., and simplifies the drilling operation as well as speeds up production.

When a man drilled holes on a locomotive frame where there were no holes to fasten the "old man," it was formerly necessary to use a "U" screw clamp as shown in Fig 2. It was a two-man job to fasten the "old man" to the frame. One man had to hold the "old man" and the other tightened the "U" clamp.

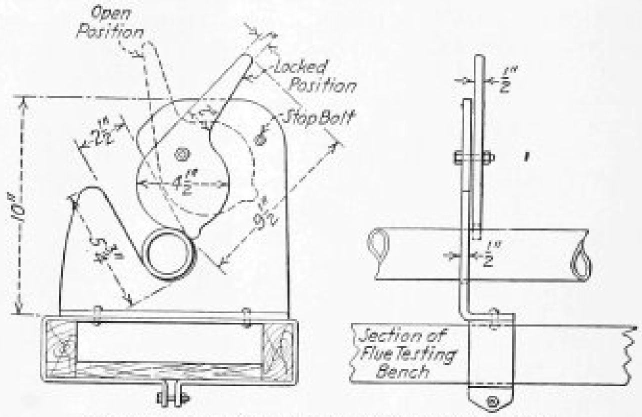
By means of the improved drilling device, it is possible for one man to fasten the apparatus to the frame in either a vertical or horizontal position. This device is a modification of a monkey wrench and is constructed according to Fig. 1. A T-bar is bent at right angles and a 2¼-inch tube is slotted and welded to the T-bar as shown. A sliding jaw is constructed as shown in section *A-A;* a threaded block is welded to the T-bar and a ⅜-inch bolt is passed through the block for adjusting purposes. The vertical arm is a piece of T-bar attached to a tube sliding over the wrench tube and tightened to the same by means of a wheel screw.

Fig. 3 shows another type of "old man" which permits the drilling of the entire back head of a boiler for stud holes or staybolt holes at one setting. This device is fastened in the firebox door hole. A 2½-inch tube is slotted and bolted to a steel bar and allowed to swing. Two bolts are also fastened to the bar and allowed to swing. This enables the bar and rod to be placed in the firebox door with ease. A strongback shown in detail *B* rigidly holds the tubing in a position at right angles to the plane of the boiler back head. A large piece of hardwood fastened to the tube as shown completes the construction of this convenient device.

Flue Safety Lock

By J. B. Becker

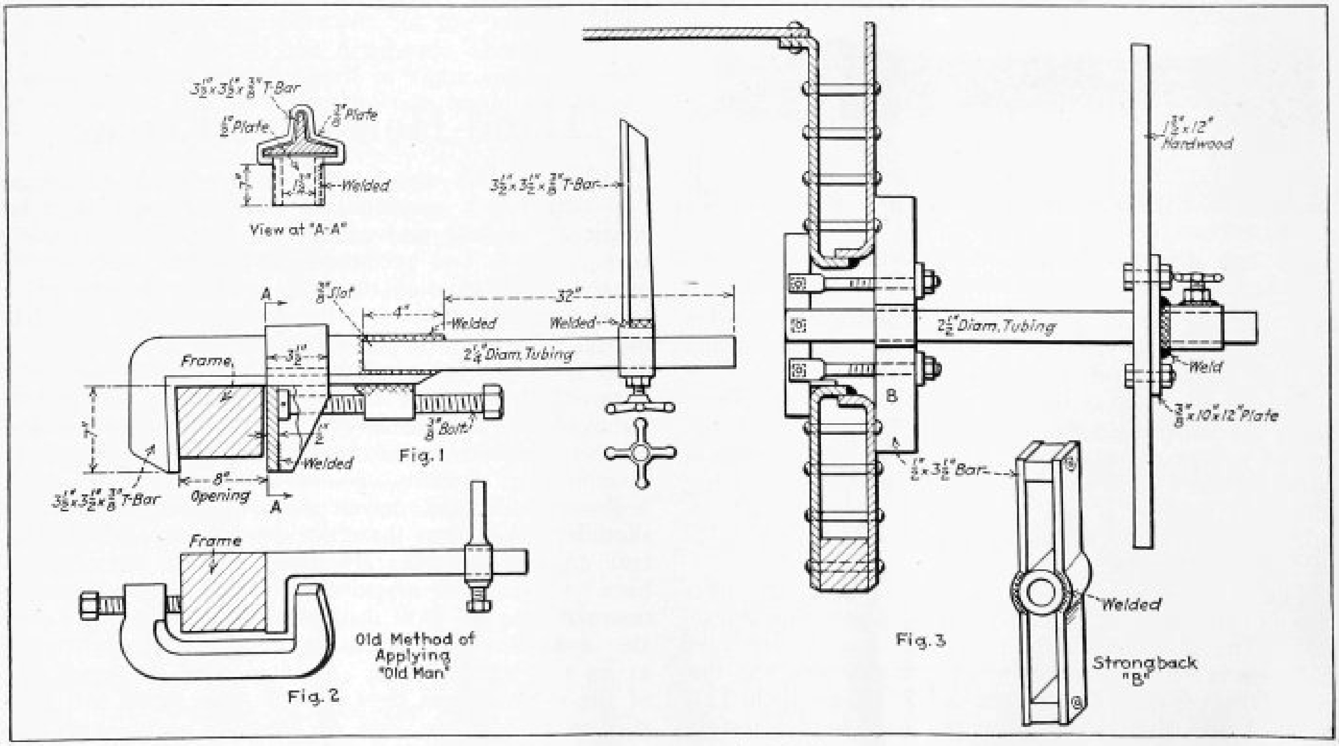
THE accompanying illustration represents a safety device that is applied to the testing of boiler flues. This device is attached to the hydraulic flue-testing machine that is found in most boiler shops. By means of this kink, the flue may be locked in position so that when pressure is applied the flue remains straight. This prevents the flue from bending or flying out of the machine and avoids the possibility of injuring the operator or anyone that may happen to pass close by.



Safety device for use in testing boiler flues

The device is simply constructed, consisting of two pieces of ½-inch boiler plate, cut according to the indicated shape and bolted together, as shown. A stop bolt prevents the handles of the locking piece from interfering with the operation of inserting the flue. The device is fastened to the flue-testing bench by means of a plate clamp riveted to the base.

The apparatus may be easily constructed from scrap material found in a boiler shop.



Two types of "old man" for use in drilling operations

Revision and Addenda to Boiler Construction Code

IT is the policy of the Boiler Code Committee to receive and consider as promptly as possible any desired revision of the rules and its codes. Any suggestions for revisions or modifications that are approved by the committee will be recommended for addenda to the code, to be included later on in the proper place in the code.

The Boiler Code Committee has received and acted upon a number of suggested revisions which have been approved for publication as addenda to the code. These are published below, with the corresponding paragraph numbers to identify their locations in the various sections of the Code, and are submitted for criticisms and comment thereon from any one interested therein. Discussions should be mailed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York, N. Y., in order that they may be presented to the committee for consideration.

After 30 days have elapsed following the official publication, which will afford full opportunity for such criticism and comment upon the revisions as approved by the committee, it is the intention of the committee to present the modified rules as finally agreed upon to the council of the society for approval as an addition to the Boiler Construction Code. Upon approval by the council, the revisions will be published in the form of addenda data sheets, distinctly colored pink and offered for general distribution to those interested, and included in the mailings to subscribers to the Boiler Code interpretation data sheets.

For the convenience of the reader in studying the revisions, all added matter appears in small capitals and all deleted matter in smaller type.

PAR. P-332. Revise that section which appears on page 75 of the Code to read:

[1 Registered number.]

1[2] A.S.M.E. serial number which may be the manufacturer's serial number.

2[3] Name of manufacturer.

3[4] Maximum allowable working pressure when built.

4[5] Water heating surface in square feet.

5[6] Year BUILT [put in service].

[Items 1, 2, 3, 4, and 5 to be stamped at the shop where built.]
[Item 6 is to be stamped by the proper authority at point of installation.]

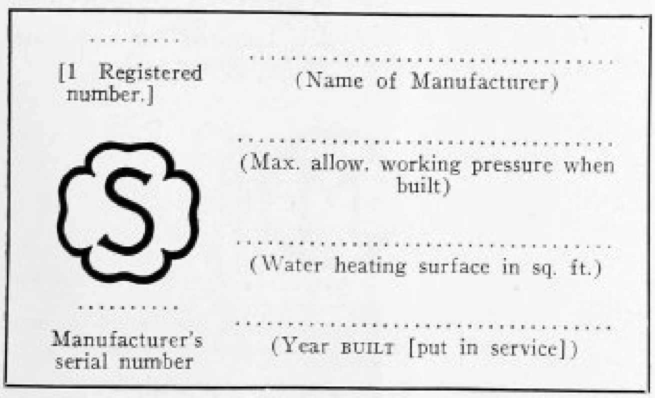


Fig. P-22 Form of stamping

[Manufacturers, before using the A.S.M.E. symbol, shall be given a registration number by The American Society of Mechanical Engineers. This number shall be stamped directly on the boiler or placed on a non-ferrous plate. The registration number shall be placed not more than 1/ inch above the symbol and centering on it. Inspection jurisdictions shall be furnished by the Society with a list of registered manufacturers, with the corresponding registration numbers issued.]

Stamps for the official symbol shown in Fig. P-21 are obtainable from THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

FIG. L-5. Replace letter "S" in symbol by the letter "L."

FIG. L-6. REVISED:

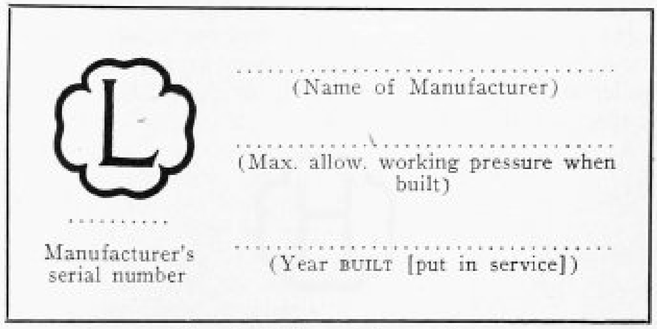


Fig. L-6 Form of stamping

PAR. L-82. Revise that section beginning on page 31 to read:

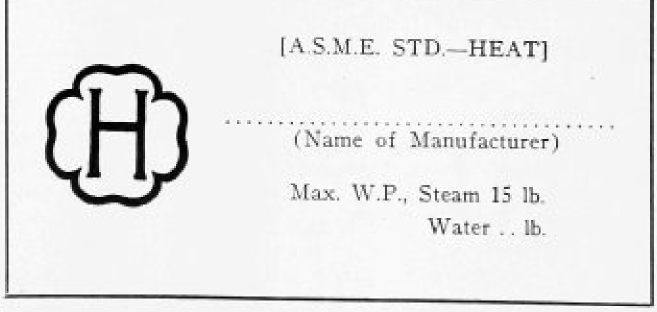
1. A.S.M.E. serial number which may be the manufacturer's serial number.
2. Name of manufacturer.
3. Maximum allowable working pressure when built.
4. Year BUILT [put in service].

[Items 1, 2, and 3, to be stamped at the shop where built.]
[Item 4 to be stamped by the proper authority at point of installation.]

Stamps for the official symbol shown in Fig. L-5 are obtainable from THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

PAR. H-68. REVISED:

H-68. All boilers built according to these rules and no other boilers shall be STAMPED WITH THE SYMBOL AS SHOWN IN FIG. H-2A [marked A.S.M.E. Std.—Heat.], with the manufacturer's name and maximum allowable working pressure. These markings shall be stamped with letters and figures at least $\frac{5}{16}$ inch high on some conspicuous portion of the boiler proper, preferably over or near the fire door. Boilers suitable for use for both steam and water shall have the stamps arranged substantially as follows:



Boilers suitable for use for water only shall have the stamps arranged substantially as follows:

[A.S.M.E. STD.—HEAT]

H

....
(Name of Manufacturer)

Max. W.P., Water ..... lb.

These stamps shall not be covered with insulating or other material. STAMPS FOR THE OFFICIAL SYMBOL SHOWN IN FIG. H-2A ARE OBTAINABLE FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. [The symbol authorized for use on power boilers shall not be used on heating boilers, nor shall any] NO accessory or part of a [the] boiler MUST be marked A.S.M.E. or A.S.M.E. Std. unless so specified in the Code.

Fig. H-2A Official symbol for stamp to denote the American Society of Mechanical Engineers Standard

PAR. H-120. REVISED:

H-120. All boilers shall be plainly and permanently marked with the manufacturer's or distributor's name and the maximum allowable working pressure. All letters and figures shall be at least $\frac{5}{16}$ inch high.

The maximum allowable working pressure shall be stamped, cast, or irremovaby attached to the front and rear cored sections of vertical sectional cast-iron boilers and on the dome section of horizontal sectional cast-iron boilers. The marking of maximum allowable working pressure on cast-iron boilers suitable for use for steam or water shall be as follows:

H

Max. W.P. .... lb.
Steam 15
Water ....

Boilers suitable for use as water boilers only shall be marked as follows:

H

Max. W.P. .... lb.
Water ....

All boilers built according to these rules, and no other boilers, shall be EITHER marked OR CAST WITH THE SYMBOL AS SHOWN IN FIG. H-2A [A.S.M.E. Standard as follows:

A.S.M.E. STD.

The symbol authorized for use on power boilers shall not be used on heating boilers.] STAMPS FOR THE OFFICIAL SYMBOL SHOWN IN FIG. H-2A ARE OBTAINABLE FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

When an insulating or other form of covering is used, that portion of the front cored section of vertical sectional cast-iron boilers, and the dome cored section of horizontal sectional cast-iron boilers bearing the foregoing marking, shall either be provided with a removable cover plate or be left uncovered.

PAR. M-19. REVISED:

M-19. All boilers referred to in this section shall be plainly marked with the manufacturer's name, maximum allowable working pressure, which shall be indicated in arabic numerals, followed by the letters "lb.," and the serial number. All boilers built according to these rules shall be STAMPED IN THE PRESENCE OF THE INSPECTOR WITH THE SYMBOL SHOWN IN FIG. M-1 [marked A.S.M.E. Std.—Miniature]. STAMPS FOR THE OFFICIAL SYMBOL SHOWN IN FIG. M-1 ARE OBTAINABLE FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. [The symbol authorized for use on power boilers shall not be used on miniature boilers built according to these rules, nor shall any], NO accessory or part of the boiler MUST be marked A.S.M.E. or A.S.M.E. Std., unless so specified in the Code. THE MARKINGS REQUIRED ON A BOILER SHALL BE STAMPED WITH LETTERS AND FIGURES AT LEAST $\frac{3}{16}$ INCH IN HEIGHT ON SOME CONSPICUOUS PORTION OF THE BOILER PROPER.

[A.S.M.E. Std.—Miniature]

M

....
(Name of Manufacturer)

....
(Serial number)

..................................lb.

Sample of marking

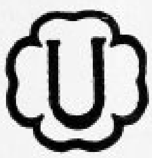
Individual shop inspection is required for miniature boilers in the same manner as for power boilers.

Fig. M-1 Official symbol for stamp to denote the American Society of Mechanical Engineers Standard

A data sheet shall be filled out for each boiler and signed by the manufacturer, this data sheet to include the most important items and to be numbered. In addition to this, the complete data sheet required for power boilers shall be filled out and preserved by the manufacturer for each lot of steel and each lot of boilers manufactured therefrom. The complete data sheet shall be marked to indicate to which boilers it applies and the manufacturer shall furnish copies of this complete data sheet when requested to do so by the owner of any one of the boilers. In requesting the complete data sheet the owner shall forward the number of the boiler which is stamped thereon in order that the manufacturer may readily identify the complete data sheet applying to the boiler.

PAR. U-66 REVISED:

U-66. Each such pressure vessel shall be STAMPED [marked] in the presence of the inspector WITH THE SYMBOL AS SHOWN IN FIG. U-2A, [A.S.M.E. STD. P.V.] and with the manufacturer's name and serial number and working pressure. These markings shall be legibly stamped with letters and figures at least $\frac{5}{16}$ inch high on some conspicuous portion of the vessel, preferably near a manhole, if any, or handhole, or on a name plate brazed or otherwise irremovably attached to the shell plate. These stamps shall be arranged substantially as follows:



[A.S.M.E. Std. P.V.]

....
(Name of Manufacturer)

....
(Max. allow. working pressure)

Manufacturer's number

....
(Serial number)

The stamping shall not be covered permanently with insulating or other material. STAMPS FOR THE OFFICIAL SYMBOL SHOWN IN FIG. U-2A ARE OBTAINABLE FROM THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. [The symbol authorized for use on power boilers shall not be used on pressure vessels.]

(A sample data report sheet appears opposite page 4.)

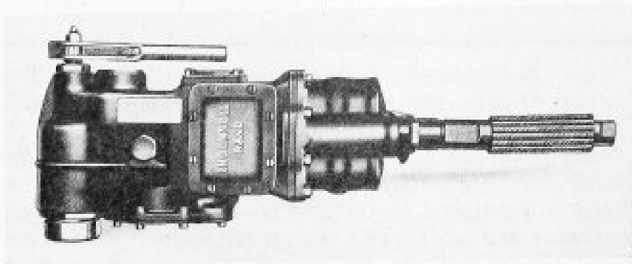
Fig. U-2A Official symbol for stamp to denote the American Society of Mechanical Engineers Standard

New Close-Quarter Drill

A NEW gear driven close-quarter drill with a two-cylinder double-acting air motor has been developed by the Ingersoll-Rand Company, 11 Broadway, New York city.

This piece of equipment has been brought out for general drilling, reaming and tapping in close quarters. It develops approximately 20 percent more horsepower and has 10 percent higher stalling power than older types of close-quarter drills.

Minimum thickness of the machine has been secured by making it flat, the drill being practically the same thickness from the spindle to the cylinders. It can therefore be readily used in very cramped places. Smooth operation has been secured by arranging the pistons to act at right angles to and in a plane with the spindle. This is accomplished by using counter balanced crank and by using special gears for the drive. The gears are ruggedly built, their size and strength being increased as the load increases, until the final drive on the spindle is through a heavy herringbone



New Ingersoll-Rand size 90 close-quarter pneumatic drill

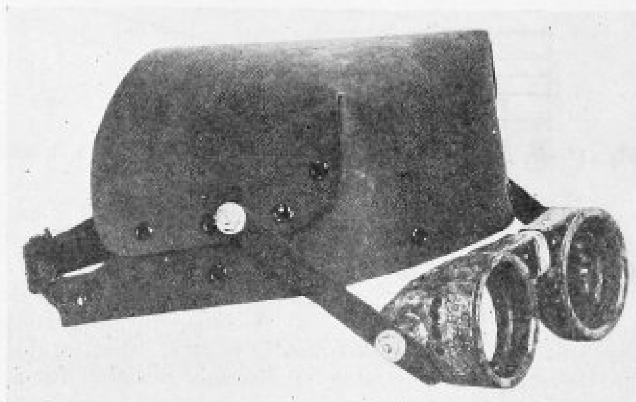
gear which gives a smooth and steady driving action. Anti-friction bearings of the ball or roller type are used throughout.

Three different spindles can be furnished: The standard spindle having a No. 4 Morse taper socket; a threaded spindle $1\frac{11}{16}$ inches in diameter, 12 threads per inch, to take square socket chucks or the Rich chuck; and the Use-Em-Up spindle which has a No. 4 Use-Em-Up taper.

Helmet Goggles

THE Oxweld Acetylene Company, New York, N. Y., has developed the Oxweld cap and skeleton-type helmet goggles for use as accessories for welding and cutting.

The cap-type goggles consist essentially of a strong fiber cap to which a pair of goggles are attached by means of fiber links. The goggles can be readily raised over the forehead or lowered over the eyes with one hand. The bridge is adjustable and is covered with rub-



Helmet-type goggles for use in welding operations

ber insulation. Replaceable lenses, plain or in colors, are used, the colored lenses being protected by cover lenses of clear glass. The skeleton-type goggles are the same except that the goggles are attached to a lattice skeleton cap. Both styles are provided with leather straps at the rear for head-size adjustment.

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Circumferential Length of Boiler Courses

Q.—Sometime ago I purchased the book, "Laying Out for Boiler Makers," and of course find it very helpful. One thing I have been unable to find, however, and that is the correct circumferential length of a boiler course or smoke arch where they are not heated before applying. Your book gives a method to find it as a plain cylinder and heat the end until it expands over the end of the other course, but here we have no method for heating courses and I would like to know how much to allow to the circumferential length of the neutral diameter of the developed course so that one course will slip over the end of another without heating, and so it can be laid up and a good snug job be done. I found the allowance for stacks and small sheet iron jobs, but I do not know about the heavier jobs of 3/8-inch to 3/4-inch plates. P. L. F.

A.—When a sheet is changed from a flat to a curved surface the sheet at one and the same time is subjected to both compression and stretching. Since one is directly the opposite of the other, it follows that the foregoing must be considered when figuring the circumference for a given diameter.

In Fig. 1 the distances *a*, *b* and *c* are the same. However, curve the sheet as shown in Fig. 2, and the distance *a* increases, while the distance *c* decreases. Every circle regardless of the diameter, has 360 degrees and,

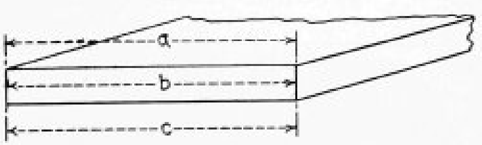


Fig. 1.—In a flat piece of boiler plate, dimensions a, b and c remain the same

as will be noticed, while the distance *a*, *b* and *c* each have the same number of degrees, each has a different diameter; hence, a different length.

Since rolling the sheet causes the distance *a* to increase and the distance *c* to decrease in proportion, there naturally is a point that is neutral; that is, does not lose or gain. Practice has brought out that for all practical purposes this point can be considered as in the middle of the plate; hence, the expression, neutral diameter, as shown in Fig. 2.

With very heavy plate 1½ inches or more in thickness, a slight V opening, as shown in Fig. 3, will occur. This, however, is cared for by slightly beveling the sheets prior to rolling. This feature may not be considered with commercial sizes, say 1¼ inches, and less in thickness.

Many boiler makers figure out the circumference by multiplying the constant 3.1416 by the inside diameter, and add three thicknesses of plate for the take-up in rolling. Others multiply the constant 3.1416 by the outside diameter, and take off three thicknesses of plate for the gain in rolling. Neither of these rules is well to use, the better practice being to multiply the con-

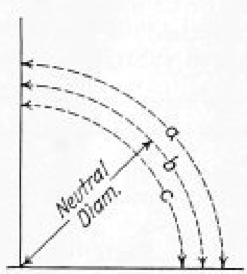


Fig. 2

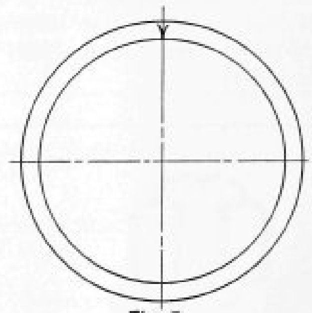


Fig. 3

Figs. 2 and 3.—Effect of curvature on dimensions a, b and c; b alone remains unchanged. In heavy plates the resulting V opening is shown at the top of Fig 3.

stant 3.1416 by the neutral diameter, which is readily found by adding to the inside diameter of the structure one thickness of the plate.

The latter is the best as it is as nearly accurate as possible, and further, the circumference ascertained requires no additions or deductions, except such allowances as are made for a loose fit.

A plate is naturally rough, and its thickness not uniform. The variation in the thickness may be inappreciable, though every plate is thicker in the center than at its edge. This is due to the spring in the rolls: The greater the width of the sheet and the less the thickness, the greater the variations.

Commercial sheet nowadays does not vary to the extent that a special rule is necessary in every case. With steam-tight work and a two or more course structure, the circumference for both the large and small course may be figured out by multiplying the constant 3.1416 by the respective diameters. Then, to permit the courses to be readily connected together, a slight addition to the large course or a small deduction from the small course might be made, but made prior to spacing off the rivet holes in the girth seam.

In structures, such as stacks, stand pipes, etc., a greater allowance may be made than in the foregoing case. The difference in the circumference of the large and the small courses, when said circumferences are found by the neutral diameter method, is 6.28 times the thickness of the plate, the assumption being that both plates are the same thickness. In steam-tight work this may be made as great as 6.5 and in stack work as great as 7 times the thickness of plate.

For instance, assuming the circumference for a boiler or structure to be 191.6376 inches for the large course, ½-inch plate, the circumference for the small course may be found for a very tight fit by merely subtracting from 191.6376 inches, 6.28 x 0.5 = 3.1416 inches, thus 191.6376 — 3.1416 = 188.496 inches, say 188.5 inches. Ordinarily this would be written 191.6376 — (6.28 x 0.5) = 188.496 inches.

If a reasonably loose fit is desired, raise the constant from 6.28 to 6.5 making a deduction of 6.5 x 0.5 = 3.25 inches, instead of 3.1416 inches, or if a very loose fit is desired raise the constant 7, making a deduction of 7 x 0.5 = 3.5 inches, instead of 3.1416 inches.

With the foregoing allowances and by omitting longitudinal seam rivets at the ends of the courses until after the courses are in place, little trouble should be experienced in fitting the courses together.

Setting for a Horizontal Tubular Boiler

Q.—We will appreciate your valuable assistance in connection with the setting of a horizontal tubular boiler. The boiler is 66 inches diameter by 18 feet long and constructed for 125 pounds pressure. It is proposed to build the brick setting in the usual way and to fill the air space with asbestos. An answer to the following questions will be of considerable help to us:

1. What are the advantages and the disadvantages of this method?
2. What would be the maximum thickness for the best results?
3. Should sheet asbestos or bulk asbestos be used?
4. What would be the probable saving, if any, with this design?
5. Has this method been used to any extent?
6. What is your opinion of a solid wall without air space?

In connection with the same boiler which is located in a plant where there is an intermittent demand for large quantities of steam, it is noted that the pressure falls rapidly before the fires can be accelerated. To overcome this undesirable feature, it is proposed to attach a steam drum for storage space. The drum will be 30 inches diameter and 8 feet long. In this connection it will aid us to have the following questions answered:

7. Will this drum provide any real advantages above its extra cost?
8. What type and thickness of insulation should be used to reasonably overcome the condensing effect of such a drum?
9. Should this drum be connected to the boiler at one or two openings and if two openings, should they be connected to one ring of the boiler or to two rings?

The letting of the contract for this installation is being held up pending a decision as to the type of setting and addition of boiler drum to be used and this writer will certainly appreciate your judgment on these inquiries at an early date.—M. A. E.

A.—(1). In the conventional type of boiler setting for a horizontal tubular boiler using an air space between the inner and outer walls, the air space has no value as an heat insulator. The filling of this space with asbestos would give additional insulation to the boiler.

The disadvantage of this method would be the possibility of the asbestos becoming packed solid between the two walls, transmitting the stresses set up in the inner wall to the outer wall and thus defeating the original purpose of the air space.

This space was originally filled with sand, but was discontinued for this reason.

(2) A maximum thickness of 2 inches should be sufficient. Asbestos for this purpose being approximately 85 percent efficient at this thickness.

(3) Bulk asbestos properly applied would have less air leakage, there being no necessity for joining as with the use of sheet asbestos. Although with present-day methods of applying there should be but slight difference, if any, between the two methods.

(4) The probable saving would be slight as the total loss of heat due to radiation is about 5 percent.

(5) I do not believe this method has been used to any extent. I do not find its use being recommended by the manufacturers.

(6) In a setting of the solid-wall type without the use of an air space, the cracks which develop due to heat will extend clear through the brick work thus increasing the probability of air leaks with a resulting excess of air and a lower furnace efficiency.

(7) The use of steam drums as outlined in the question for use with horizontal tubular boilers has been practically discontinued. However, under the conditions mentioned, the addition of the steam drum would give the necessary reserve of steam.

Were a new boiler being installed it would be more advisable to increase the size to the required maximum capacity in lieu of the steam drum.

(8) Any suitable asbestos or magnesia lagging of good quality approximately 2 inches thick should answer this purpose.

(9) For a drum of this size one opening 18 inches to 20 inches diameter should be sufficient.

When using two openings for connections of this type, it is always advisable to connect each opening to a separate ring of the boiler.

Boiler Patch Bolts

Q.—Please let me know the proper way to install boiler patch bolts. —H. L.

A.—To apply a patch bolt, as shown in Fig. 1, first drill a hole in the sheet, countersinking the outside sheet for the size of the patch bolt being used.

Then tap out the hole (patch bolt taps are modified form of taper boiler taps, but are shorter). The size

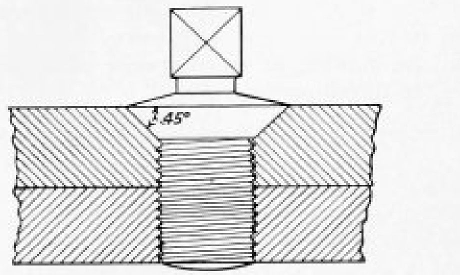


Fig. 1.—Application of a patch bolt to boiler plate

line is located ⅝-inch from the large end of the thread.

Next apply the patch bolt pulling same up tight, care being taken to see that the countersunk head is tight in the sheet. The square head of the bolt is then broken off. The bolt is then calked all around. When using the calking tool, it should be worked in the direction of the threads so as to tighten the bolt.

Welding in Heating Boilers

Q.—Would you consider it safe to weld sections of heating boilers that have been cracked in three or four places by low water? Has the A.S.M.E. Boiler Code Committee any rule against welding such sections? A reply at your earliest possible convenience would be appreciated.—T. C. H.

A.—Par. 186 as found in the Addenda to the A.S.-M. E. Boiler Construction Code with regards to welding, is as follows:

P. 186. Welded joints. The ultimate strength of a joint which has been properly welded by the forging process, shall be taken as 35,000 pounds per square inch; with steel plates having a range in tensile strength of 45,000 to 55,000 pounds per square inch.

Autogenous welding may be used in boilers in cases where the stress or load is carried by other construction which conforms to the requirements of the Code and where the safety of the structure is not dependent upon the strength of the weld.

Joints between the door-hole flanges of furnace and exterior sheets may be butt or lap welded by the fusion process, provided these sheets are stayed or otherwise supported around the door-hole opening and provided the distance from the flange to the surrounding row of stays or other supports does not exceed the permissible staybolt pitch as per Par. 199. If such joints are lapwelded the exterior sheet flange should preferably be placed on the outside or next to the door opening and the firebox sheet flange on the interior next to the water.

Autogenous-welded construction may be used in lieu of riveted joints in the fireboxes of internally-fired boilers, provided the welds are between two rows of staybolts, or in the case of flat surfaces the weld is not less than one-half of a staybolt pitch from the corner.

From this paragraph, welding is permissible for tightness provided the safety of the structure is not dependent upon the strength of the weld.

Breeching Layout

Q.—Please send me the layout of a breeching where the stack goes on as soon as possible. Thanking you for past favors and hoping to hear from you.—J. F. D.

A.—The sketch submitted was not clear as to the construction of the breeching. I have therefore completed same in the conventional method for this type of breeching as shown in Fig. 1.

To make a development of the stack section marked *S* it will first be necessary to draw a plan view of this piece.

Draw the horizontal line *M-N* through the plan, thus dividing the object into two symmetrical halves. It will now be seen that if a development is made of the lower portion, as shown in the plan, a duplicate of the resultant figure will be a complete development.

Divide *F G H* in the plan into any number of equal spaces, in this case ten, numbering them 1 to 11. The greater the number of equal spaces taken, the more accurate the development.

Parallel to the line *B-C* of the elevation draw lines through the points 2 to 10 in the plan, extending them down so as to cut the lines *A-B* and *C-D-E* of the elevation.

The development of the plate *S* could be drawn from either the elevation or the end view, since the true lengths of the parallel line *1-1'*, *2-2'*, *3-3'* are the same in either view. For convenience in projecting, the elevation is used for the development.

The vertical distances between the lines *A-B* and *C-D-E* for each line as *1-1'*, *2-2'*, *3-3'* etc., will be the true length of these lines in the development.

To make the development, draw the line *O-P* and at *P* erect a perpendicular. Then set a pair of dividers equal to the distance *1-2*, *2-3*, *3-4*, etc., in the plan and with the point *P* as the first center step off the spaces along the line *P-O* numbering them the same as in the plan as *1* to *11*. At each point erect a perpendicular to the line *O-P*.

Then with the dividers set equal to the distance *B-C* in the elevation and with *P* as a center scribe an arc cutting the perpendicular erected at *P*, and at the point *2* as a center with the dividers set equal to the distance *2-2'* in the elevation, scribe an arc cutting the perpendicular erected at point *2* and in the same manner at the point *3*, *4*, *5*, *6*, etc.

Connect the intersection points thus obtained and one-half of the development will be complete; for the complete development duplicate the half development as shown.

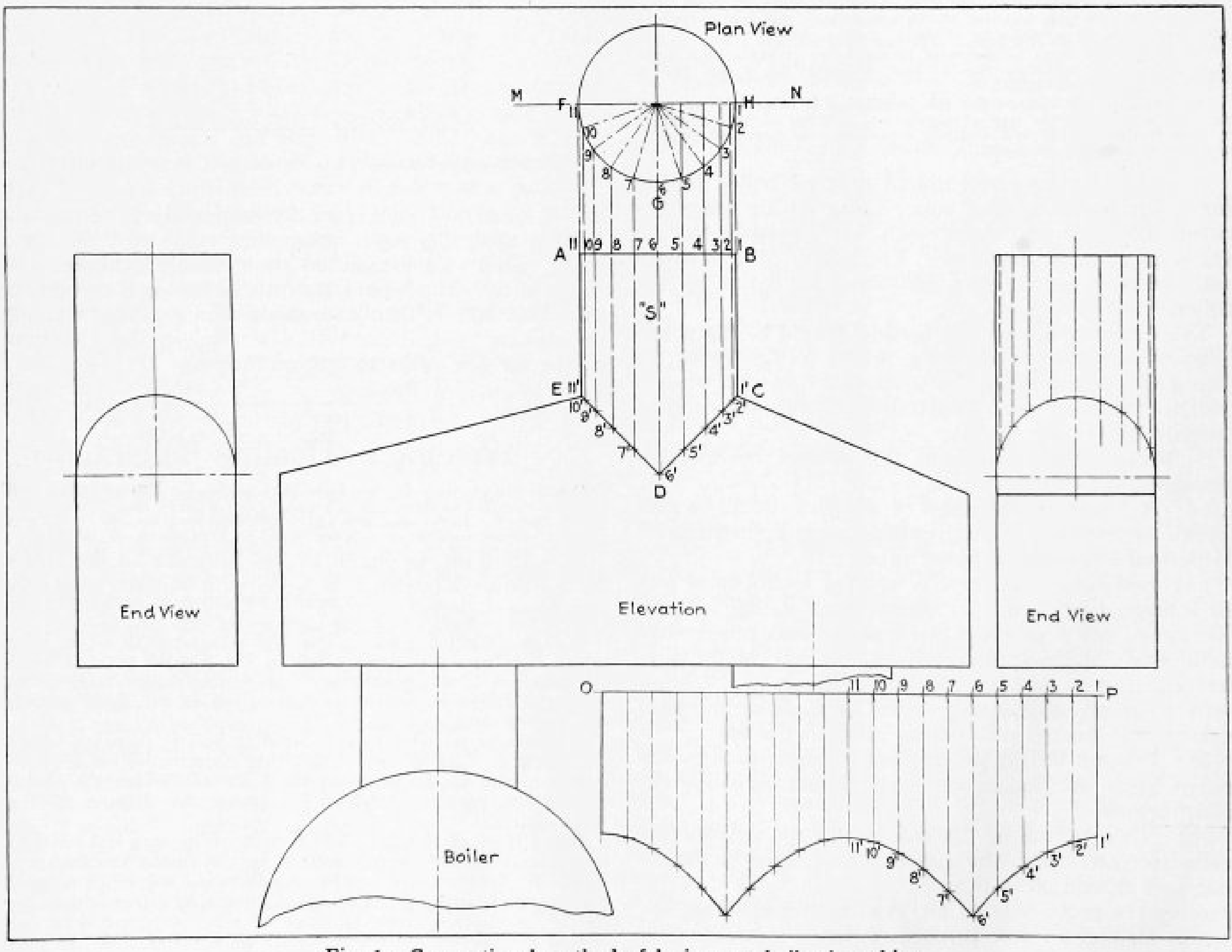


Fig. 1.—Conventional method of laying out boiler breeching

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Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

Steamboat Inspection Service of the Department of Commerce

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Boiler Code Committee of the American Society of Mechanical Engineers

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International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.

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States and Cities That Have Adopted the A. S. M. E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Memphis, Tenn.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

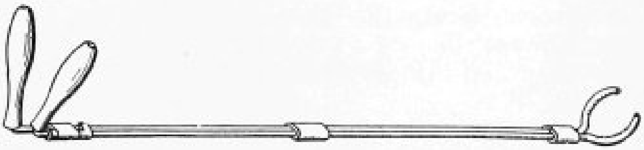
Compiled by
DWIGHT B. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

1,692,077. RADIAL STAY TONGS. ARTHUR A. COCHRAN, OF CHANUTE, KANSAS.

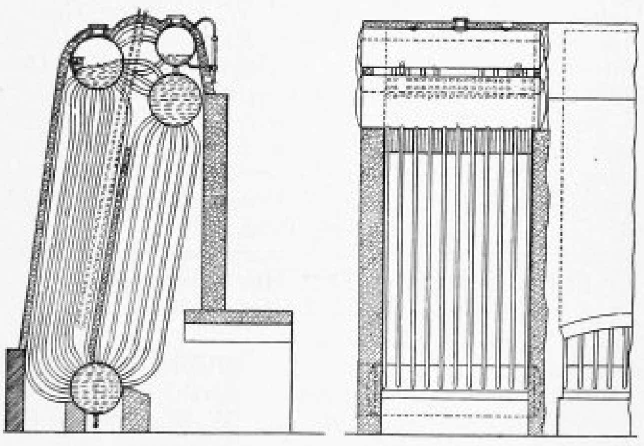
Claim.—To provide a tool for handling objects through small openings, where the same can not be reached by hand, said tool comprising a pair of elongated shank members, having jaws on the ends thereof, and means



for rotating one of said shank members about its axis to move one of said jaws toward and away from the other jaw, and furthermore, to provide such a tool with means for holding the jaws thereof in closed position, said means being located so as to be readily accessible to the operator. Two claims.

1,666,567. RADIANT-HEAT STEAM BOILER AND SETTING. CHARLES GILBERT HAWLEY, OF CHICAGO, ILLINOIS.

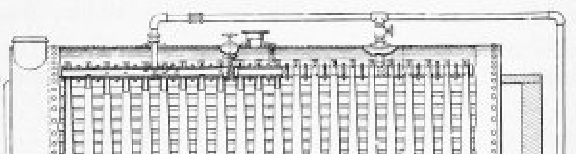
Claim.—A steam boiler of the water-tube type comprising a submerged head drum, in combination with a steam-and-water drum thereabove and in free water and steam communication therewith but remote in the



direction of gas flow, a rate gaging drum above and in copious water connection with the top of said submerged drum and having its lower part in more restricted water communication with the lower part of said steam-and-water drum. Five claims.

1,656,796 CLEANER FOR STEAM BOILERS. ALFRED RICHARDSON, OF NELSONVILLE, OHIO.

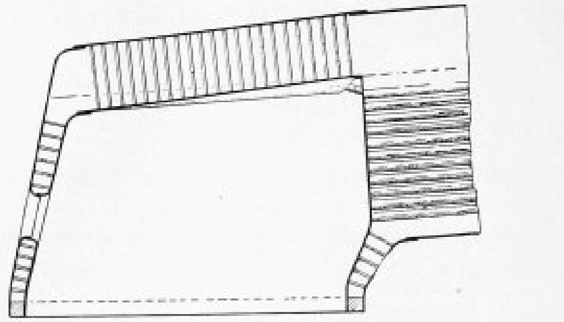
Claim.—In a boiler, means for removing mud from the bottom of the boiler comprising a valve casing extending the length of the boiler, pipes suspended from the valve casing and in open communication with the same, a pair of rotary valves in the casing and provided with spirally arranged and spaced ports, said casing having spaced openings with which the ports in the valves are adapted to be alined successively, a gear lo-



cated between the valves and secured thereto, discharge pipes connected with the valve casing and in open communication therewith, said valves having passages for placing the said valves in open communication with the discharge pipes where said pipes are connected to the casing, a pair of plates rotatably mounted on the adjacent ends of the valves, a weighted pawl pivotally mounted on the plates and adapted to engage the gear, and means for rocking the plates for causing rotation of the valves. Two claims.

1,667,112. LOCOMOTIVE BOILER. CHARLES GILBERT HAWLEY, OF CLEVELAND, OHIO, ASSIGNOR TO LOCOMOTIVE FIREBOX COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

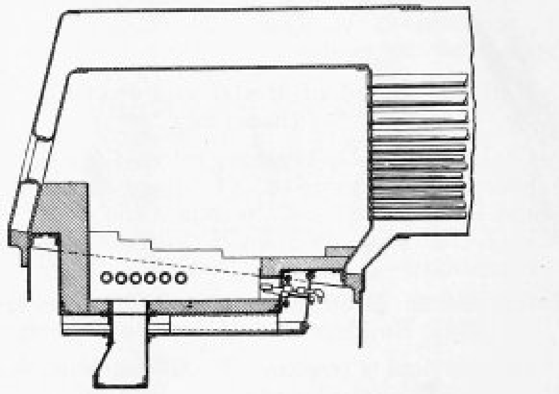
Claim.—A locomotive boiler embodying therein, a firebox including a crown sheet and a flue sheet, said crown sheet being formed to provide



channels therein terminating short of the flue sheet and a conduit opening at one end into the channel and at its other end through the flue-sheet. Two claims.

1,664,099. OIL-BURNING LOCOMOTIVE FURNACE. HARRY A. ATWATER, OF KANSAS CITY, MISSOURI.

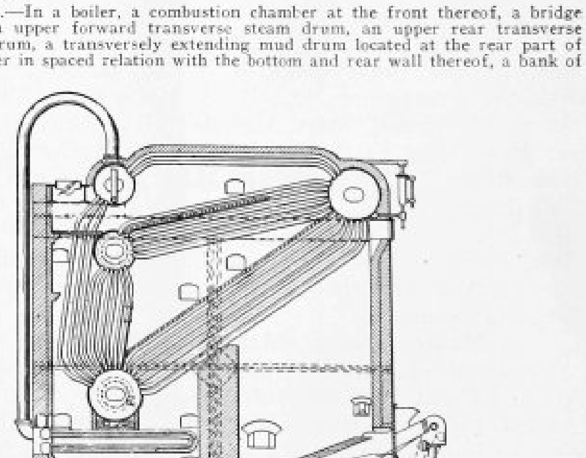
Claim.—In an oil-burning locomotive firebox construction, a fire pan comprising side shelf portions and a longitudinally extending depressed portion providing a flame channel between and below the level of said shelf portions, exterior side and bottom walls spaced from the sides and bottom



of said depressed portion and co-operating therewith to form an air-preheating passage, and a burner compartment forming a communicating passage between said flame channel and one end of said preheating passage, the bottom or floor of said depressed portion being closed as regards communication with said preheating passage. Five claims.

1,663,034. BOILER. RALEIGH J. ADAMS, OF CHICAGO, ILLINOIS.

Claim.—In a boiler, a combustion chamber at the front thereof, a bridge wall, an upper forward transverse steam drum, an upper rear transverse steam drum, a transversely extending mud drum located at the rear part of the boiler in spaced relation with the bottom and rear wall thereof, a bank of



tubes extending forwardly from the mud drum to the front part of the boiler above the combustion chamber and connecting the mud drum and the forward upper steam drum, banks of tubes connecting the rear steam drum to the forward steam drum and to the mud drum, baffling means for directing the heated gases from the combustion chamber beneath the mud drum, and a superheater arranged below the said mud drum and extending adjacent the rear wall of the boiler, the superheater being connected with the upper rear steam drum. Four claims.

The Boiler Maker

Name registered U. S. Patent office

Volume XXIX | February, 1929 | Number 2

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

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THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Testing the Ductility of Welds

THE ever-increasing use of welding in the manufacture of pressure vessels has brought with it the need of a suitable means for testing the thoroughness with which the weld is made and the ability of the operator. A great deal has been said in the past relative to the desirability of a periodic examination of welders to determine the consistency of the work of these men. It is only by these periodic examinations that the quality of welded joints can be determined with any degree of accuracy, when so much depends upon the human factor.

Small manufacturers have been at a loss for a convenient means for determining the quality of the workmanship of their employees due to the fact that elaborate and expensive testing apparatus has been financially out of the question. Therefore, with the idea of helping the small manufacturer in the matter of welding production, the simplified method for testing welds for ductility has been published in this issue.

While this method does not give accurate information as to the strength of a welded joint, one of the most important qualities of a metal, namely, its ductility, may be determined with a fair degree of accuracy. As explained in the article, a specific figure for the percentage of elongation of the weld metal may be obtained.

In addition to its economy in application, this method has certain advantages over the usual angle bend test. The angle bend test in many cases gives information regarding the plate metal, while the weld metal is disregarded. By means of the simplified method, the weld metal alone enters into the final analysis.

Every shop contains equipment with which to carry out its own testing. A vise, a machinist's hammer and a flexible metal scale, graduated in hundredths of an inch, are the only devices needed, after the test piece has been prepared.

The simplicity of the apparatus necessary for obtaining such reliable results makes the method worthy of the consideration of any manufacturer doing welding on a large or small scale.

Master Boiler Makers' Convention

ARRANGEMENTS are already actively under way for the Master Boiler Makers' Association convention, which will be held this year at the Hotel Biltmore, Atlanta, Ga., May 21 to 24. Every effort is being made by the association, as well as by the Boiler Makers Supply Men's Association, to insure a record attendance and the best group of exhibits that has ever been assembled for the benefit of the members.

Notices have been sent to all members of the Supply Men's Association calling attention to the necessity of reserving space for exhibiting their products. A great many have already selected their locations and the remaining companies should do so as soon as possible.

For information in connection with the exhibits, address W. H. Dangel, secretary of the Supply Men's Association, at the Lovejoy Tool Works, Chicago, Ill.

Boiler Manufacturers' Meeting

IT was not possible to include a report of the midwinter meeting of the American Boiler Manufacturers' Association in this issue but details of it will be published in the March number.

The meeting was held at the Hotel Cleveland, Cleveland, Ohio, on February 5. The morning session was devoted to meetings of the various groups into which the association is divided, including the horizontal return tubular boiler, the watertube boiler, the heating boiler, the vertical boiler and the oil-country boiler divisions. These group meetings were in the nature of closed sessions but in the afternoon a general meeting of the entire association was held. This session was devoted to reports of various standing committees and to a discussion of matters of interest to the industry as a whole.

Boiler Orders for 1928

THE annual report of the Department of Commerce, covering the sale of steel boilers during the year 1928, has recently been issued. For the entire year, new orders amounted to 19,672 boilers as compared with 19,108 in 1927. The report was compiled from information received from 81 manufacturers, comprising most of the leading firms in the industry.

Although the total number of boilers ordered was greater in 1928 than the previous year, the size of these boilers was very slightly less. In 1927, the total square feet of heating surfaces of all boilers amounted to 17,796,272 square feet, while last year the total was 17,684,811 square feet.

The following table, showing the types of boilers ordered, gives an excellent picture of the conditions in each branch of the industry:

Stationary Boilers

Type	Number	Heating Surface Square Feet
Watertube boilers	1,315	6,909,982
Horizontal return tubular	1,513	1,884,401
Vertical firetube	1,726	495,674
Locomotive (not railway)	392	263,201
Steel heating	12,685	6,152,393
Oil country	956	900,317
Portable	680	462,627
Miscellaneous	174	76,285
Total	19,441	17,144,880

Marine Boilers

Type	Number	Heating Surface Square Feet
Watertube	99	467,084
Pipe	3	3,623
Scotch	112	59,649
Two and three-flue	13	5,577
Miscellaneous	4	3,998
Total	231	539,931

As compared with the previous year, the total of watertube boilers, representing developments in the power generating field, was slightly less in numbers and in heating surface. Approximately 300 fewer horizontal boilers were ordered, with a drop of nearly 400,000 square feet in heating surface, while the locomotive type, (not railway) and steel heating boilers increased, the latter jumping nearly 1,000,000 square feet in heating surface.

Statistics, although in general rather dull, do serve to indicate trends, and from the Department of Commerce report it is evident that the demand for standard power boilers may be expected to continue with little fluctuation. The advance in the steel heating boiler field will undoubtedly be maintained and, where shops are equipped to handle this type of construction, the opportunities of developing a lucrative business in this line are greater than ever before. Prospects in the shipbuilding field are better now than for many years past and orders for marine watertube boilers especially, will undoubtedly be better than at any period since the war.

Communications

Applying Patch Bolts

To the Editor:

Referring to the question on page 27 of the January issue of The Boiler Maker, concerning the application of patch bolts, I would like to make a few suggestions.

The holes in the patch must be a size larger than those in the boiler. There must be no thread in the patch or it will not draw up tight.

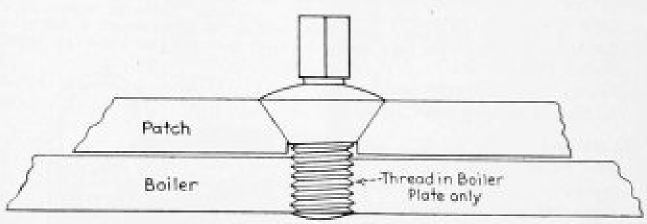
Each bolt must be worked down separately before cutting off the square heads. The forward bolt must be tightened as you go along. This procedure must be followed as it is too late to tighten up bolts after the heads are cut off.

Olean, N. Y. George A. Jones.

Boiler Patch Bolts

To the Editor:

In the January issue of The Boiler Maker, on page 27, is shown a patch bolt and a description which is not correct. The patch bolt is shown with the thread engaging with the patch and boiler plate whereas it should only engage with the thread in the boiler plate. The hole in the patch should be made large enough for the bolt to pass through easily, so that when the bolt is



The correct method of applying patch bolts

screwed tight, it will draw the patch close to the boiler plate. A few blows with the hand hammer on the patch near the bolt should be given while tightening the bolt, and, if the job is done correctly, it will be found that the square part can be twisted off, after which the countersunk part of the bolt should be hammered to make sure of its filling the countersunk part of the patch, then calked with what we term the thumb tool. A drawing of the patch bolt and application of same are shown herewith.

I was also interested in reading James F. Hobart's article in the January issue of The Boiler Maker and was surprised at his remark, "The perplexing octagon problem."

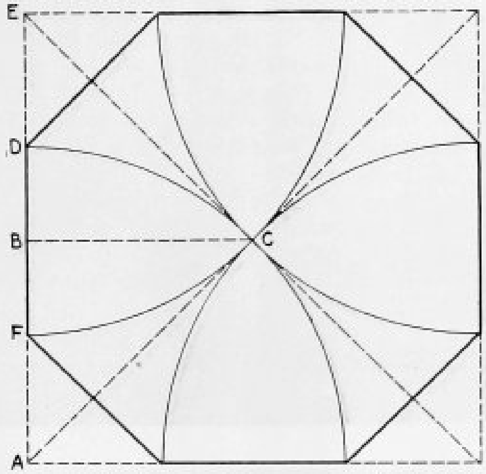
To layout an octagon is a very elementary geometrical problem and I would expect it to be known to most layout men.

The first part of his article deals with the method employed, to my knowledge, more than 50 years ago but instead of the figures being 7 inches and 17 inches, they are 7 inches plus 1/32 inch and 17 inches minus 1/32 inch which are usually employed, as he correctly says, in making wooden masts, yards, booms, bowsprits, etc.

It is a good reliable method although a very old one. It is just as easy to remember the figures 7 plus 1/32 and 17 minus 1/32 as it is to remember 7 and 17.

To layout the plate for an octagonal column, I would proceed as follows:

Suppose the column to be 18 inches, to use Mr. Hobart's figures, and made up of two plates in the circumference, and the 18 inches we will suppose to be the *inside* measurement. I say *inside* because no allowances have to be considered if the plates are thin, and very little even if they are thick, as the plates would be



Geometrical development of an octagon

bent in the brake, and the allowance for bending is not the same as for plates rolled to a circle. Each bend would be at an angle of 45 degrees.

I have described an octagon geometrically in the accompanying figure which is so simple to follow that it needs no explanation here, except that I am using it to explain how I would use it mentally.

The side of a square is to its diagonal as 1 is to 1.4142. Therefore since half the side $AB = 9$ inches, this, multiplied by $1.414 = 12.726$ inches $= AC$ or AD. The total distance AE or 18 inches minus AD or 12.726 $= ED$ or 5.274 inches. The distance AD or 12.726 inches minus ED or 5.274 inches $= DF$ or 7.452 inches or one-eighth of the octagon; $7.452 \times 8 = 59.616$ inches = the total circumference of the plates or say 59⅝ inches. It will easily be seen that although the inaccuracy of Mr. Hobart's figures is not great when the octagon is small, it increases as the size of the octagon increases; therefore it is not safe to use the proportions 10/24ths that he mentions.

Detroit, Mich. I. J. Haddon.

Patch Bolt Application

To the Editor:

It is so rarely that we find a query in The Boiler Maker as to the method of applying patch bolts that we felt unusually interested both by the query and also the solution. As many hours of my boiler-making days have been spent in the fabrication and application of all kinds of patches applied with patch bolts, a short description of the method used may be of interest.

Assuming that the sheet is prepared for the patch and the patch is marked off for drilling, have the holes in the patch drilled 1/16-inch larger than the patch bolt. Thus if you are using ⅞-inch patch bolts have holes in the patch drilled 15/16 inch. The reason for this is that if you are to draw the patch up solid with the sheet there must not be any thread in the holes in the patch. The holes in the patch are countersunk to conform to the head of the patch bolt.

While the patch is being drilled, a few scattered holes may be tapped out in the sheet. Be sure that the holes are not tapped too large; a snug fit all the way in is best for patch bolts, but not so tight as to crush the thread.

Apply the patch with a few scattered patch bolts; draw these up tight; lay up the sheet all around; and then tap out and apply all patch bolts.

In tightening up bolts, I prefer to start with a center bolt in any one row. Tighten this one and also the two adjacent bolts on each side of the one selected. Lay up the adjacent bolts good, and tighten; then tighten the first bolt. If the neck of the bolt is not too heavy, the square should twist off; this is more to be desired than knocking them off or cutting them.

Finish this bolt by calking before proceeding with the next one. Better results are obtained by finishing each bolt as you go along, and before calking one bolt tighten up on the next and so on.

The neck of a ⅞-inch patch bolt should be turned down to about ¾-inch diameter at the junction of the square and bolt head. With good threads in the sheet, these squares should twist off and leave the patch solidly up against the sheet. A gooseneck wrench, 18 inches in length, makes a good wrench for a job of this kind.

Lorain, Ohio. Joseph Smith.

A Flue Plug Accident

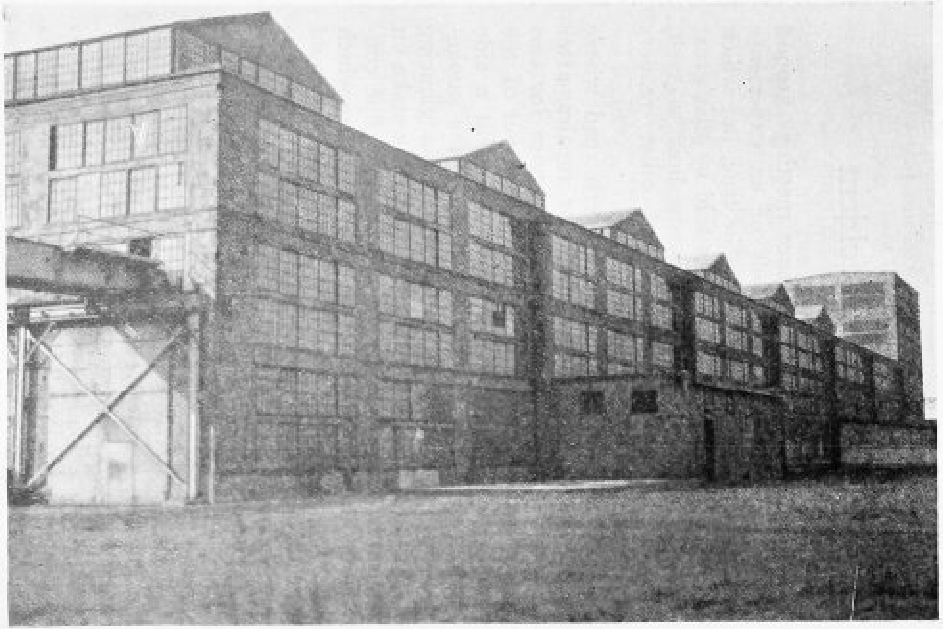
To the Editor:

In the daily noon hour experience meetings around the flange fire, one old-timer tells of an experience which he swears by all the gods to be true, but which sounds to me like one of those tales told by that great German liar whose name I don't know how to spell. Perhaps you can enlighten me and other readers whether it is truth or fiction.

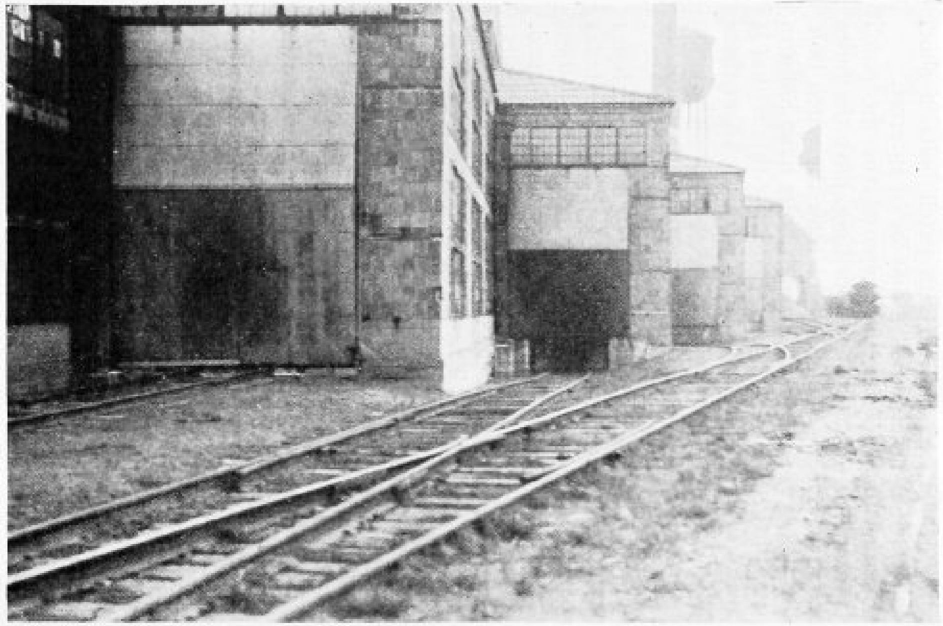
He mentions an instance on a western road where an engine was taken into the shop for repairs, after being on the storage track and out of service for two years. In knocking some of the flue plugs out of the front tube sheet, one of them, upon being hit a side blow with a hammer, flew out the front of the smokebox, hit the door jamb of the roundhouse a glancing blow, continued on and took a chip out of the stake on the turn-table. The supposition was that the flue contained some kind of stored-up gas under pressure which gave the plug its momentum. Do you think this could happen and if so what would cause the gas to accumulate in the flue? An answer in The Boiler Maker will be appreciated.

Chicago, Ill. M. Feeney.

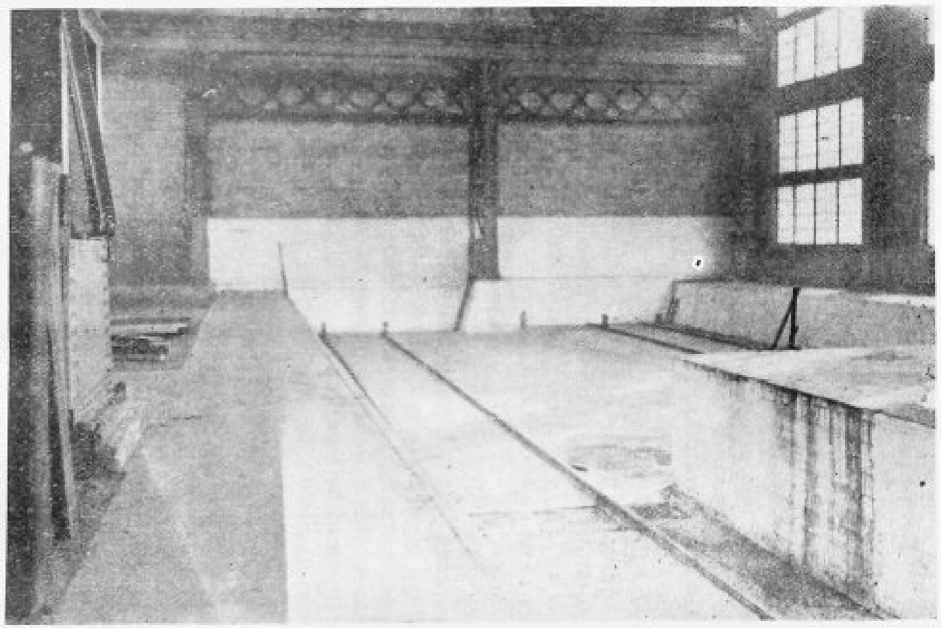
C. E. Lester, formerly assistant boiler foreman of the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has been appointed assistant to the shop superintendent of the Broderick Company, Muncie, Ind., manufacturers of oil country boilers.



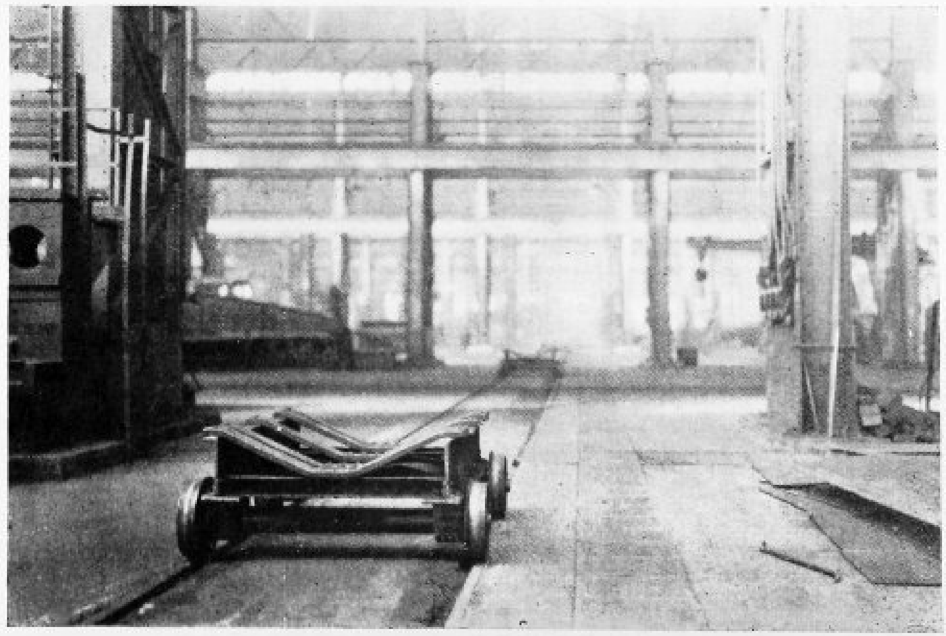
Northeast side of the boiler shop, showing type of construction



The southwest side of the shop is stepped back to provide for service tracks



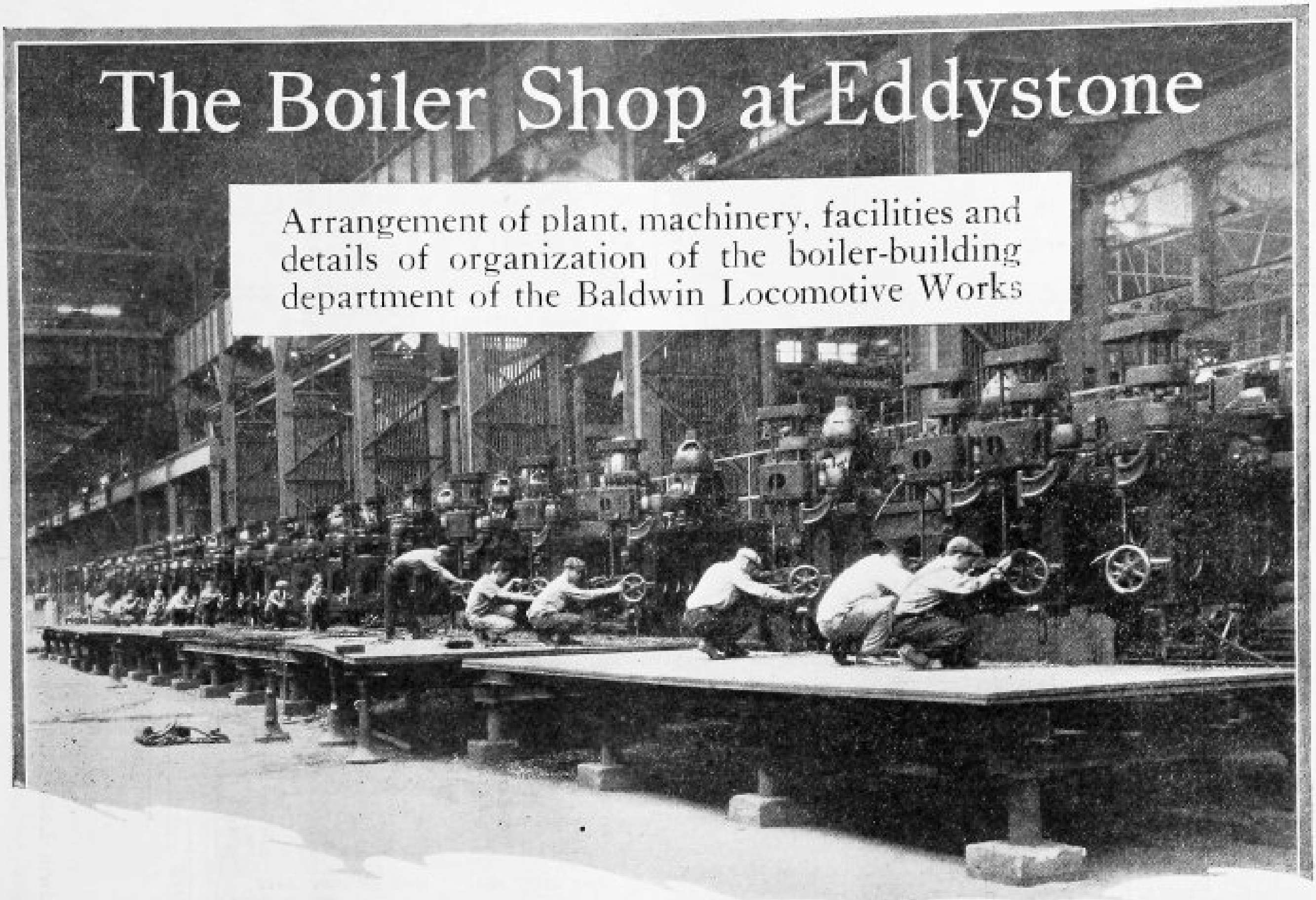
Material receiving pits in bay No. 12



Shop service track in panel No. 9, showing trucks used for transporting material

The Boiler Shop at Eddystone

Arrangement of plant, machinery, facilities and details of organization of the boiler-building department of the Baldwin Locomotive Works



Battery of multiple plate drills in action in the boiler shop

AT the Eddystone, Pa., plant of the Baldwin Locomotive Works one of the most important factors entering into the construction of locomotives is the boiler shop since on it, to a large extent, depends the production rate of the entire plant. From the brief outline of the development of this great organization which appeared in the January issue, it was learned that the building in which the shop is housed was constructed in 1915 as a rifle manufacturing plant of the Remington Arms Company. After the need for war material had passed, the plant was converted to its present use.

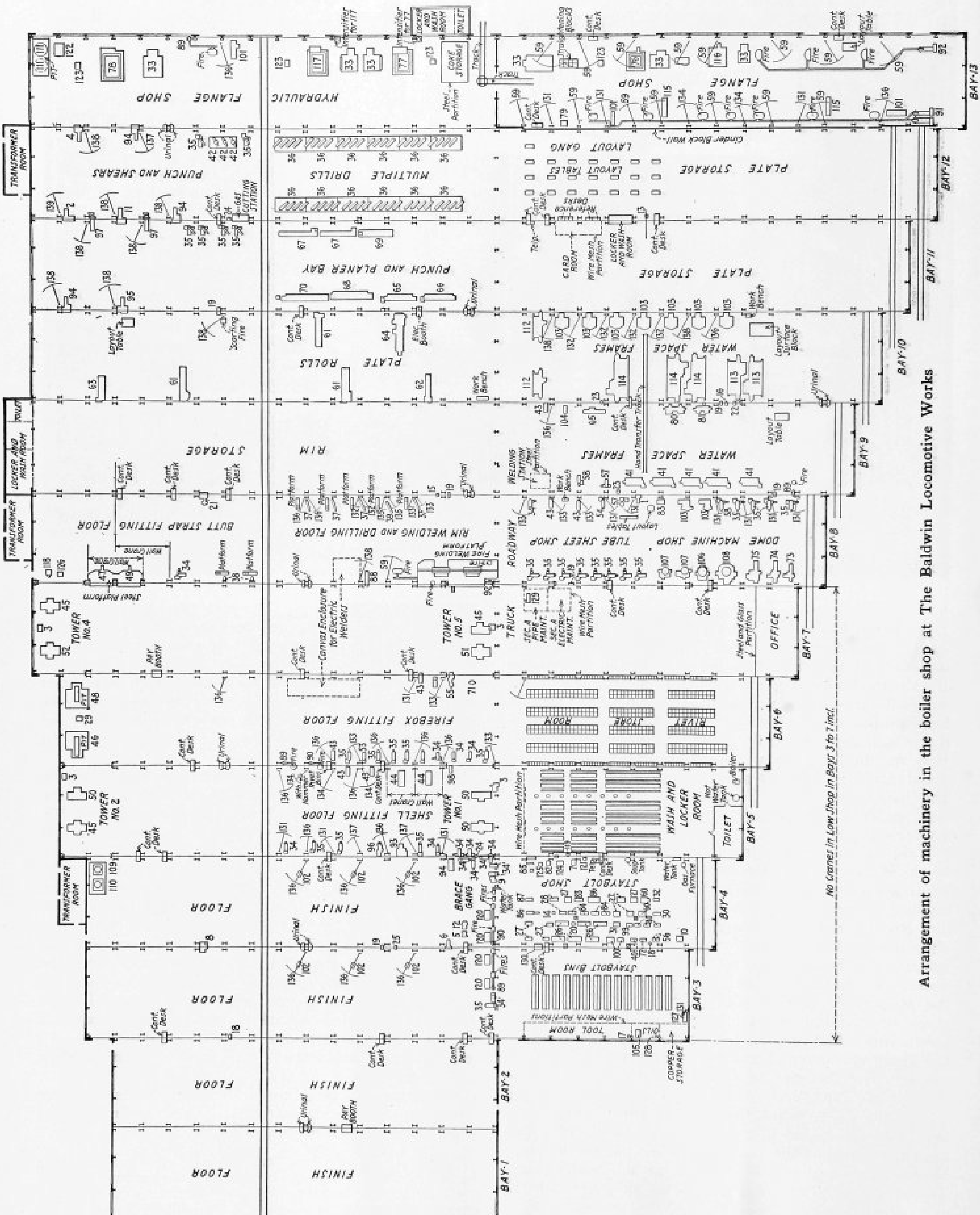
Referring to the shop layout shown on page 36, it will be noted that the boiler plant consists of 13 bays which extend transversely of the building. Longitudinally the building is divided into panels which at the widest part, bay No. 13, number up to 34. Since one side of the shop is served by incoming tracks, arranged on a ladder system, the building on this side is stepped back as shown by the illustration on page 34. Each bay in the shop is 80 feet in width, which for the 13 bays gives the building a total length of 1080 feet. The panels into which the shop is divided are designated by the center-to-center distance between supporting columns. The distance between columns is 24 feet so that in bay No. 13 the shop has a width of 816 feet. This is the widest point, while bay No. 1, in which there are 14 panels, is 336 feet in width. Between these two bays the width of the shop varies because of the step-back arrangement which provides for the ladder track. The total ground area covered by the shop is nearly 17 acres.

The building is constructed of brick and tile with steel sash windows to provide excellent natural lighting inside the shop. As originally used for arms manufacture, every second bay was arranged with three floors. To properly light these floors, which were open all around, the adjacent bays used for assembly were fitted with glass roofs. With no interfering floors, as the shop is now arranged, the shop is nearly as bright as the daylight itself.

The only break in the uniform appearance of the building is where riveting towers, of which there are four, are located. Two of these towers are in bay No. 5, one at panel No. 2 and the other at panel No. 16, while the remaining towers in bay No. 7 are also located in these same panels. Panel No. 18 divides the shop into what are known as the low and the high bays. The low side is so designated because the crane clearance for the bays in this section is only 20 feet, while in the high side the clearance is 35 feet. At only one point in the shop, bay No. 12, do the cranes from the low side extend into the high. It will be seen from the arrangement of the various departments into which the shop is divided that the fabrication of smaller parts is carried out in the low bays while the handling of heavy and the large plate assemblies is dealt with in the high bays.

The scheme of production can best be understood by a summary of the departments. These include in the order of bays the following:

Bay No. 13.—A complete flanging shop for both hand flanging and hydraulic flanging. Incidentally, the building adjacent to this department includes a complete die-making plant. A die storage yard is also located outside the building at the side of the flange department.



Arrangement of machinery in the boiler shop at The Baldwin Locomotive Works

Machine Tool Equipment in the Boiler Shop

No.	Name of Machine
1	⅜-inch plate shear
2	36-inch shear
3	No. 1 rivet shear
4	60-inch shear
5	No. 1 bar shear
6	26-inch plate shear
7	No. 0 staybolt shear
8	Special rivet shear
9	Special shear
10	1¼-inch bar shear
11	No. 8 open-throat shear
12	No. 2 bar shear
13	Shear for templates
14	8-inch emery wheel
15	16-inch double emery wheel
16	9-inch emery wheel
17	12-inch double emery wheel
18	Double emery wheel
19	42-inch grindstone
20	10-inch emery wheel
21	No. 3 shears
22	24-inch emery wheel
23	6 WFA emery wheel
24	4 LA double emery wheel
25	6 LA emery wheel
26	Staybolt threader
27	Double-staybolt cutter
28	Single-staybolt cutter
29	18-inch die dresser
30	16-inch rounder
31	Double rounder
32	1-inch rounder
33	Furnace
34	48-inch radial drill
35	60-inch radial drill
36	4-spindle radial drill
37	72-inch radial column drill
38	Column drill
39	84-inch radial column drill
40	4-spindle multiple drill
41	8-spindle multiple drill
42	72-inch radial drill
43	Horizontal drill press
44	50-ton bull riveter
45	177-ton bull riveter
46	74-ton bull riveter
47	68-ton bull riveter
48	162-ton bull riveter
49	123-ton bull riveter
50	154-ton bull riveter
51	200-ton bull riveter
52	170-ton bull riveter
53	52-inch reaming machine
54	72-inch reaming machine
55	¾-inch horizontal punch
56	Centering machine
57	48-inch tapping machine
58	60-inch tapping machine
59	3-ton hydraulic crane
60	Staybolt turner
61	16-foot bending rolls
62	12-foot bending rolls
63	No. 3 bending rolls
64	25-foot bending rolls
65	28-foot plate planer
66	20-foot plate planer
67	22-foot plate planer
68	25-foot plate planer
69	No. 1 Bp. plate planer
70	30-foot plate planer
71	Fire-door hole facer
72	4-spindle drill press
73	42-inch by 7-foot radius planer
74	40-inch radius planer
75	54-inch radius planer
76	236-ton flanging press
77	530-ton flanging press
78	1160-ton flanging press
79	¾-inch plate-flanging press
80	25-inch double-head shaper
81	18-inch shaper
82	No. 2 shaper
83	Lathe
84	Crown-bolt lathe
85	Radial staybolt lathe
86	Turret lathe
87	Forming lathe
88	100-ton gusset flattener
89	No. 5 blower
90	No. 6 blower
91	No. 7 blower
92	No. 8 blower
93	1-inch plate punch
94	No. 5 punch
95	No. 11 punch
96	No. 3 punch
97	No. 6 punch
98	48-inch post goose-neck drill
99	2-spindle multiple drill
100	Squaring press
101	Sectional flanging press
102	Hydraulic riveter
103	60-inch vertical milling machine
104	60-inch slotter
105	30-inch universal grinder
106	100-inch boring mill
107	76-inch boring mill
108	120-inch boring mill
109	2000-pound accumulator
110	14-inch by 14-inch accumulator
111	15-inch accumulator
112	3-foot by 3-foot by 12-foot open-side planer
113	16-inch by 49-inch by 60-inch open-side planer
114	5-foot by 5-foot by 18-foot open-side planer
115	150-inch hydraulic plate clamp
116	445-ton hydraulic press
117	790-ton hydraulic press
118	100-ton butt-strap press
119	6-inch twist drill grinder
120	No. 2 hammer
121	Single-staybolt saw
122	16-inch capstan
123	5-horsepower winch
124	Double-staybolt saw
125	Chaser grinder
126	Scarfing furnace
127	1-ton hoist
128	No. 2 oil pump
129	2-inch pipe machine
130	Platform scales
131	1-ton hand jib crane
132	1¼-ton hand jib crane
133	1½-ton hand jib crane
134	2-ton hand jib crane
135	½-ton hand jib crane
136	3-ton hand jib crane
137	4-ton hand jib crane
138	6-ton hand jib crane
139	7-ton hand jib crane

Bay No. 12.—Material-receiving pits, plate storage, layout department, multiple drilling department, punching and shearing section.

Bay No. 11.—Punching and planer section.

Bay No. 10.—Plate rolls and water space frame or mud-ring fabrication. This department extends into bay No. 9 in the low side of the shop.

Bay No. 8.—Dome machining shop, tube sheet shop, rim welding and drilling floor, butt-strap fitting floor.

Bay No. 7.—Bull riveting towers.

Bay No. 6.—Rivet storeroom, firebox fitting floor and bull riveter pits.

Bay No. 5.—Wash room and locker room, shell fitting floor, bull riveting towers.

Bay No. 4.—Staybolt shop, brace fitting gang, finishing floor.

Bay No. 3.—Staybolt shop, finishing floor.

Bays Nos. 1 and 2.—Reserve finishing floor.

The basis of the production scheme as employed at this shop is for materials to move transversely in each department by means of the shop cranes to panel No. 9 where a shop service track runs the entire length of the plant. All longitudinal movement between bays is by means of this track. Materials and parts are placed on special trucks, and either moved by hand or by gasoline tractors to the proper bay for their next operation, whence a crane in that bay spots them where required.

For the comfort and convenience of the personnel, three wash rooms and locker rooms are provided at central locations in the shop. In addition, numerous lavatory and fountain stations are installed near the various departments. Distances in this plant are so great that every effort has been made to concentrate all facilities and equipment for each department so that lost motion is avoided. The same is true of the production scheme. All material and parts in process of fabrication move from bay to bay in logical sequence without back-tracking. There are a few exceptions to this, which will be noted later.

Personnel in Boiler Shop

The normal production of the shop is 40 complete locomotive boilers a week. This production, of course, depends largely on the personnel which, in normal times, numbers about 2700 men. The piece-work system is employed.

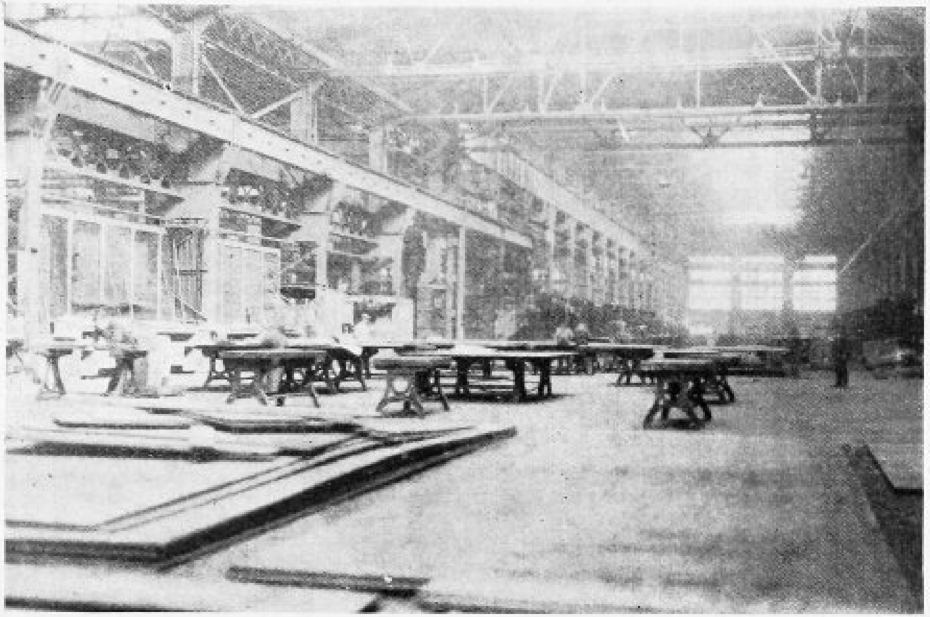
The shop is organized under the head of a superintendent to whom report two general foremen. Each general foreman has under him three foremen who are in charge of the main departments into which the shop is divided. Within the departments the staff is divided into gangs with a leader in charge of each. There are 21 of these leaders. The entire personnel organization is shown schematically in the illustration on page 40.

Machine Equipment

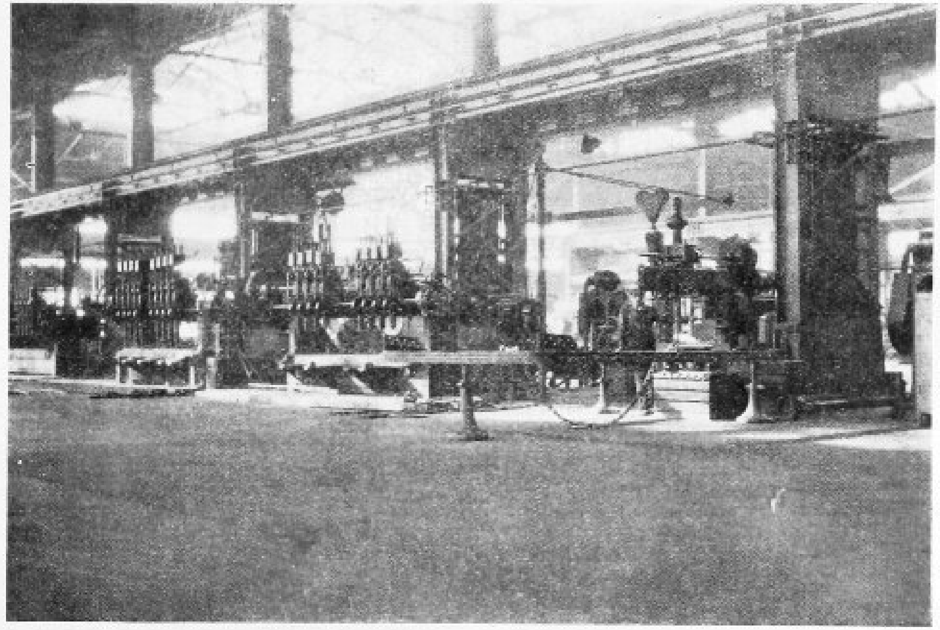
The machinery arrangement and general floor plan is shown on page 36 while the shop crane layout with the sizes and capacities of each is shown on page 40.

Some general statistics of the number and sizes of the principal machines will be of interest at this point:

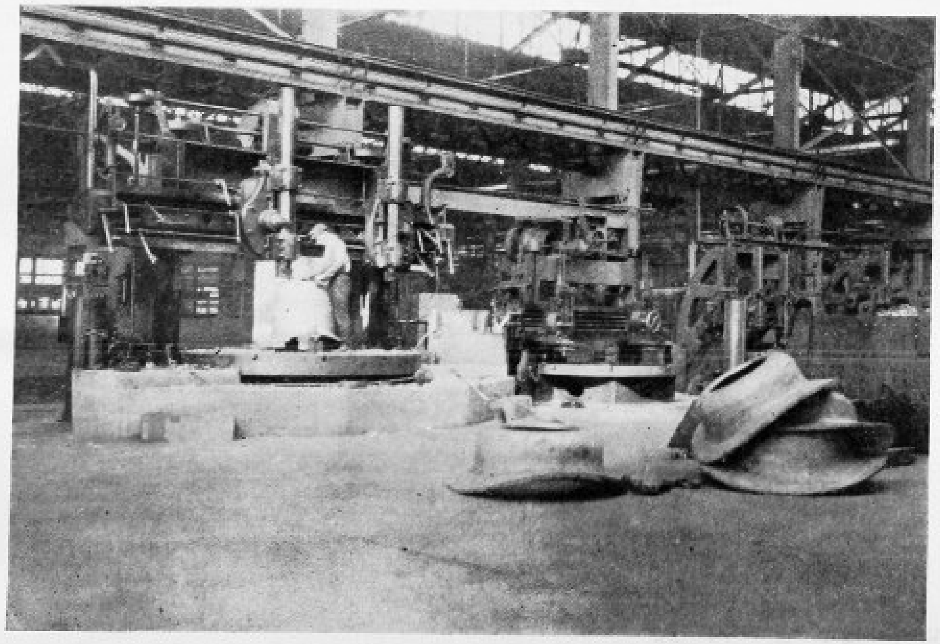
Serving the shop transversely are 32 overhead electric cranes ranging in capacity from 10 to 100 tons. In addition, special cranes are located in the riveting towers in bays Nos. 5 and 7 and over the riveting pits in bay No. 6. These cranes include: One 50-ton Niles; two 25-ton Milwaukee-Niles; three 25-ton Niles; one 25-ton Niles-Sellers; one 50-ton Pawling & Harnischfeger and one 50-ton Morgan. At all points in the shop where plates must be handled many times during fabrication, such as to serve the radial drills, shears, planers, and the like, hand-operated, hydraulic or electric wall



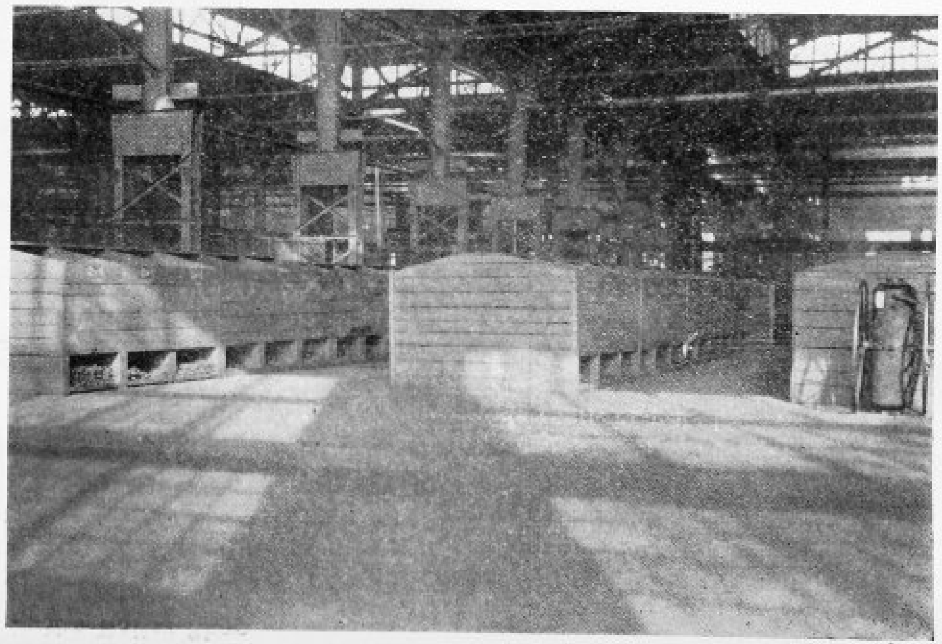
Laying out department in bay No. 12



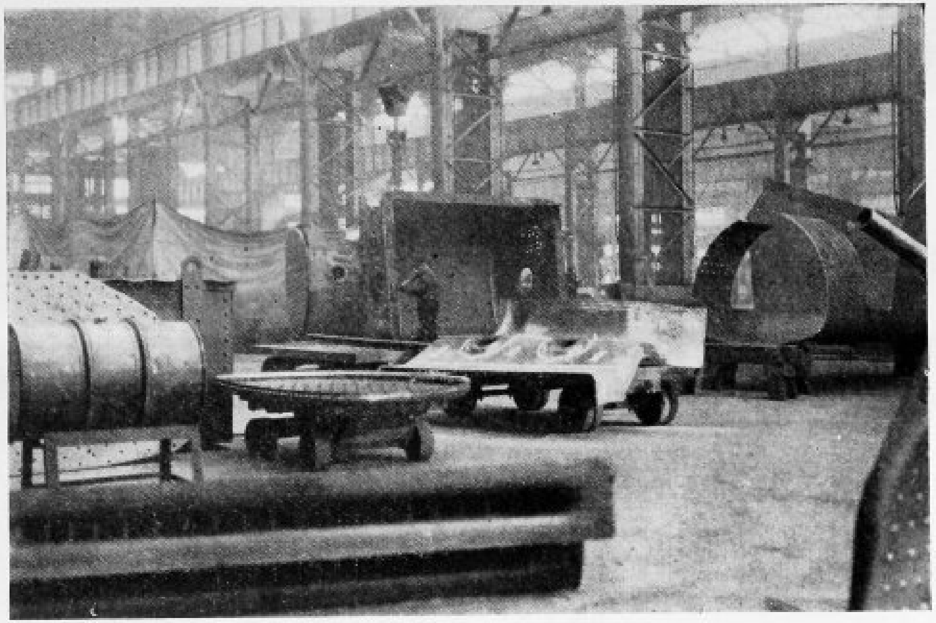
Fabricating water space frames



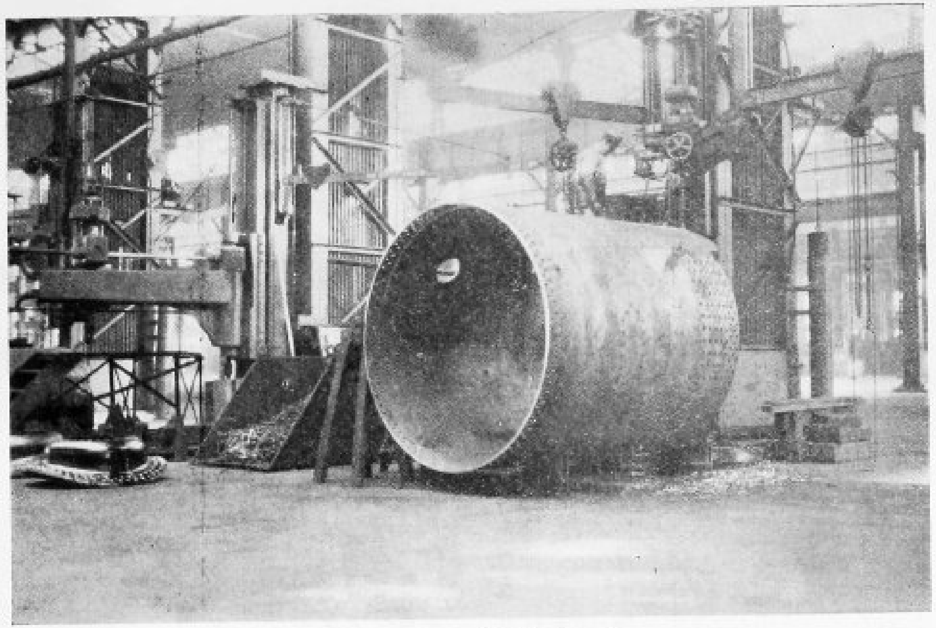
Machining domes



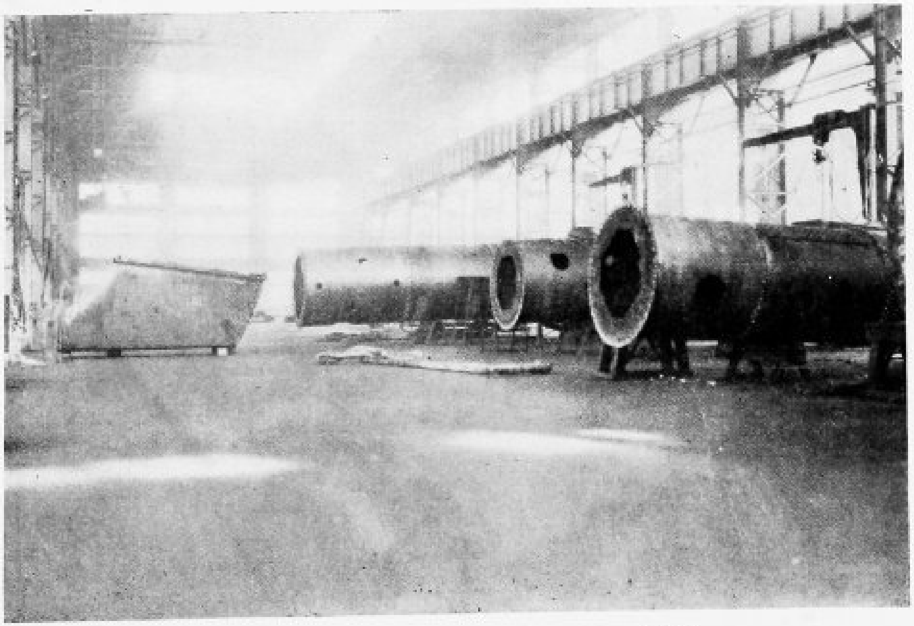
Rivet storage bins near hydraulic riveting department



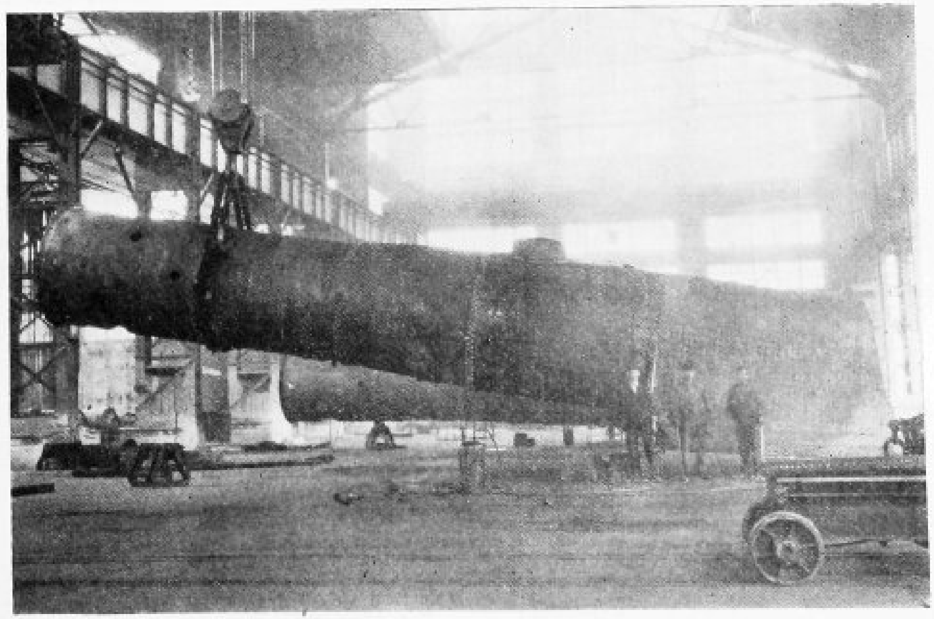
At work in the firebox assembly section



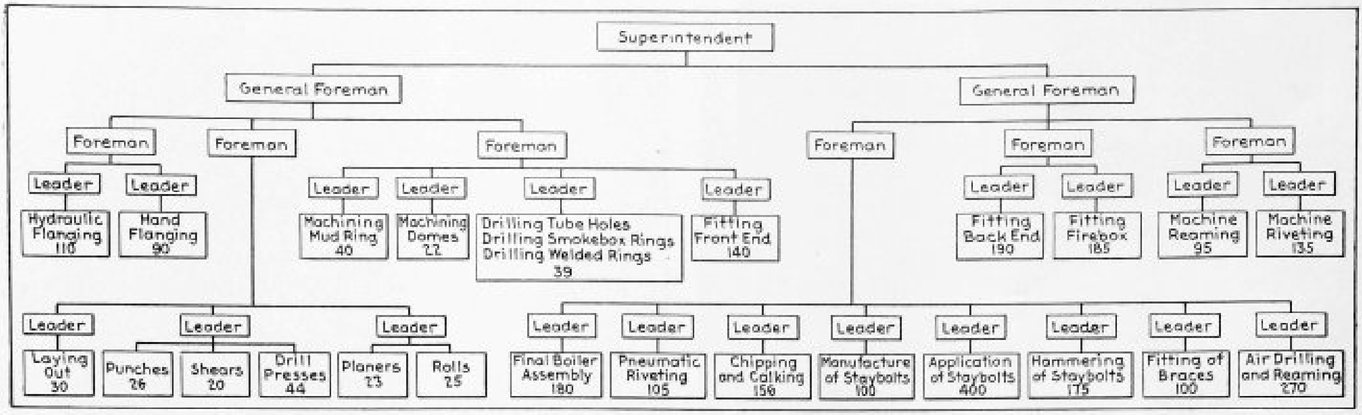
Drilling a boiler barrel course



Department where boiler barrels are assembled



A view in the finishing department



General scheme of personnel organization in the boiler shop, showing number of men in each gang

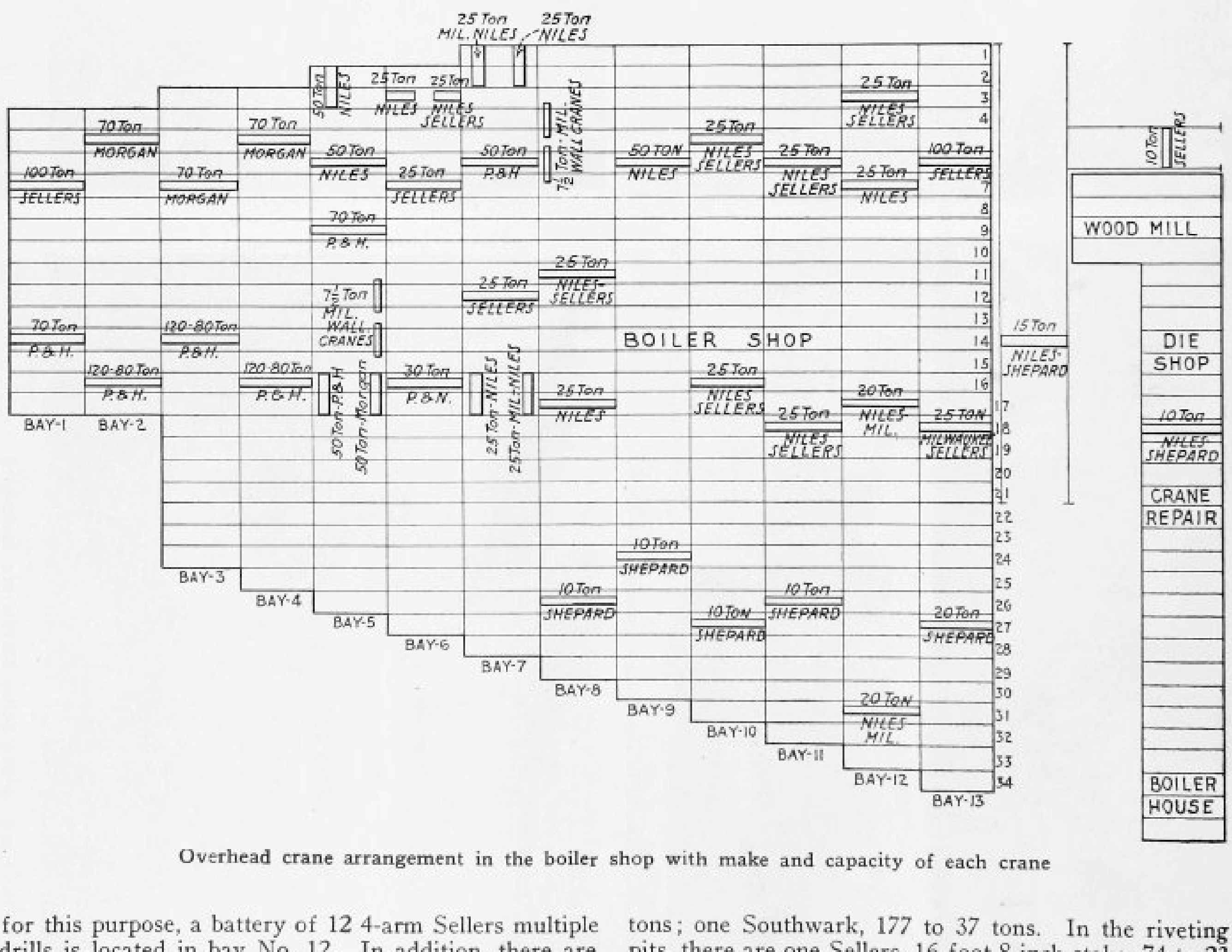
cranes are located. Approximately 75 cranes of these types are installed.

All rivet heating is done by Berwick electric heaters, of which there are about 25 in the shop. The heaters are moved to the job wherever required by the shop cranes.

Practically all holes in boiler sheets are drilled, and, for this purpose, a battery of 12 4-arm Sellers multiple drills is located in bay No. 12. In addition, there are many radial, vertical-spindle and other types of drills located in all departments where they are required.

In the riveting towers there are 8 bull riveters, while two more are located in the pits of bay No. 6. In the riveting towers there are one Chambersburg, 17-foot 1-inch stake riveter of 177 to 38 tons pressure; one Bement, 17-foot stake, 170 to 63 tons; one R. D. Wood, 18-foot 6-inch stake, 154 to 37 tons; one Bement, 17-foot 1-inch stake, 200 to 49 tons; one Southwark, 20-foot stake, 154 to 37 tons; one R. D. Wood, 17-foot 1-inch stake, 177 to 48 tons; one Southwark, 154 to 37 tons; one Southwark, 177 to 37 tons. In the riveting pits, there are one Sellers, 16-foot 8-inch stake, 74 to 23 tons and one Bement, 17-foot 1-inch, 162 to 54 tons.

In the rolling department the following plate rolls are included in the equipment: One Hilles & Jones, 16-foot rolls; one Bement, 12-foot 1-inch rolls; one Bement-Pond, 16-foot rolls; one Southwark rolls, 25-inch



Overhead crane arrangement in the boiler shop with make and capacity of each crane centers; one No. 3 Hilles & Jones rolls and one Southwark, 16-foot, rolls.

The principal plate-planing machines installed include the following: One Bement, 28-foot planer; one Bement, 20-foot planer; one Southwark, 25-foot planer; one Southwark, 30-foot planer; two Hilles & Jones, 22-foot planers.

The foregoing gives only a faint idea of the extremely complete machine equipment of this great plant. In general, it may be said that the mechanical facilities available can accommodate practically every operation that might occur in the fabrication of any type of heavy or light plate work and would be equal to any demand of quantity boiler production.

An interesting side light on the arrangement of machines is that, so far as possible, they are placed along the lines of columns or near the walls of the shop. This enables the use of the jib and wall cranes mentioned to serve the individual machines. It also ensures clear floor space for all assembly work, the transportation of materials and the storage of materials in each department until they are needed.

Boiler Fabrication

An idea of the production system may be gained from an outline of the various fabrication processes, from the time material comes into the shop until it is finally assembled.

Material is brought into the shop on the ladder track at the left side of the building. To accommodate large plates and to aid in handling them, receiving pits are located in bays Nos. 11 and 12. If many orders are on hand, the plates for each of them are piled flat on the storage floor, which is located at the receiving end of these bays. If required three or four cars of material can be accommodated at one time in the receiving pits. Extremely large plates, such as for one-piece crown and side sheets, are transported in well cars. The crane clearance for unloading is sufficient to handle such plates without difficulty.

From the storage section the material is taken to the laying out floor which is in bay No. 12 just beyond the storage space. All layout work is done by a skilled shop force which maintains a complete file of all boiler cards and all plate developments in a special storage room in this department.

From this point the plates are picked up by the shop crane and moved to the multiple drill presses further along in bay No. 12. After the holes are drilled, the sheets are trimmed to size at the shears or by means of the cutting torch. This department is located at the extreme end of this bay beyond the service track. Sheets intended for the flange shop, either to be hand or hydraulically flanged, are then moved to bay No. 13 along the shop track in panel No. 9. This is one instance where the material is diverted from the forward movement of the production system.

After the plates which do not require flanging are trimmed, they are moved along the shop track to bay No. 11 where they are planed. The next movement of this material is to bay No. 10 where the courses of the firebox and wrapper sheets are rolled to shape.

Bay No. 9 is held in reserve for periods of heavy production. From bay No. 10, therefore, the sheets used for boiler barrel courses move to bay No. 8 where they are assembled. Here also the longitudinal straps are riveted on the short stake bull machines. There are two of these bull riveters in this department; one Sellers, 10-foot stake, 68-ton pressure and one R. D. Wood, 12-foot 3-inch stake, 123 to 35 tons pressure. Rim fabrication drilling and welding are done here. The rim connections are made to the barrel courses in the bull riveters in bays Nos. 5 and 7. The courses are also connected on the bull machines in these bays.

In the case of firebox sheets, after leaving the rolling department, they are taken to bay No. 6 where the firebox fitting floor is located. The flanged sheets for the firebox assembly are brought from the flanging department in bay No. 13 first to the laying out floor for marking on the block and thence to the firebox fitting floor. The sheets assembled in this department include the firebox tube sheet, inside throat and door sheets, while the outside throat and backhead are taken to the shell assembly in bay No. 5.

The flanged sheets are not trimmed or drilled until they reach this point in the fabrication of the boiler. The firebox assembly is completed on the pit-type bull riveters in bay No. 6, with the exception of the door sheet which is riveted by hand.

The final stage in completing the boiler is the assembly of the various units, which is carried out in finishing bays Nos. 3 and 4. Here the braces are installed, the backhead fitted, all of which is done before the firebox is dropped into place. At this point too the entire boiler is lined up to see that the firebox and other parts fit properly. Close tolerances are very rigidly maintained. The staybolts are applied and then the mud-ring is fitted. In this department the boiler is completed with the exception of the tube installation. For production reasons this is done in the erecting shop.

While the fabrication of the principal boiler sheets is going forward, the auxiliary operations, such as the flanging of sheets, the machining of water space frames, the domes, staybolt production, miscellaneous fittings, and the like, are all brought along together so that, when required in the assembly department, they are available without delay.

Another point in this connection, as will be noted from the arrangement of departments, is that all supplementary and supply sections are located as closely as possible to the departments where such materials or tools are mainly used. For example, the rivet storage is located near the bull riveting department and the finishing floor. This is true of the staybolt department. Since hand tools, taps, reamers, air tools, and the like, are principally needed in the finishing department, the tool room is located at this point. Following this same line of thought, the fabrication of small parts and the lesser sheets and mud-rings is carried out in the low bays of the shop where the crane clearance is ample to accommodate the work; thus leaving the high bays free for the movement and storage of larger sheets and assembly units.

This general outline of the boiler shop, as a whole, will be followed in later issues by detailed descriptions of the tools and methods employed in each of the departments into which the shop is divided.

The Milburn Sales Corporation and the Milburn Paint Spray Corporation were incorporated on December 31, 1928, under the laws of the State of Maryland, to carry on the sale of a number of the products manufactured by The Alexander Milburn Company, Baltimore, Maryland. The Milburn Sales Corporation has taken over the selling of all equipment manufactured by The Alexander Milburn Company with the exception of the paint spray equipment and air guns for greasing purposes.

Simplified Method of Testing Welds for Ductility*

Vise bend test of welded specimens requires no extra machinery and gives good results

FIRMS which use welding are always receptive to suggestions of simple methods for the periodic testing of the work of their employees and the character of the raw materials used in fabrication. The bend test outlined here is easy to carry out in the shop. It has been devised to demonstrate the actual ductility of weld metal in a joint—not the strength of the weld nor the angle to which a sample can be bent. The only equipment necessary is a vise, a hammer, a marking punch, and a flexible steel rule scaled to hundredths of an inch. Large or small, every shop has these tools available.

The results of the test are given in the actual percentage of elongation of the weld metal, usually on a 1-inch gage length. Controls of the test can be kept by first bending coupons of the plate before it is welded and by comparing the results of these tests with the outcome of the investigations made on welded specimens. It tests the weld metal itself and not a portion of the plate, as is often the case when a tensile testing machine is used; the break in this bend test should come in the weld metal to make it a satisfactory test.

It is very nice to have tensile testing machine results, but in most work it is difficult to get them, and even when obtainable they take time. It is also true that the angle bend test formerly employed, if incorrectly made, which is sometimes the case, does not tell anything as to the amount of ductility of the weld, the bend occurring for the most part in the plate, especially if the latter is soft and ductile. A poorly welded coupon may show a considerable bend angle, though the bending may be all in the plate. The elongation bend test here described, however, shows clearly the ductility of the weld metal in any case, giving a specific figure for its percentage of elongation.

The test proper is made by preparing two plates, usually 3/8-inch thick, bevelling each on one side to make a vee, and welding them together. If possible the operator should not be aware that the weld is to be tested. The plate is next cut into coupons about 1 inch or 1½ inches wide by 5 or 6 inches long. Coupons may be made as short as 3 inches, but a little more length makes them easier to bend. After experimenting for a short time, coupons the proper length for different thicknesses may be readily determined.

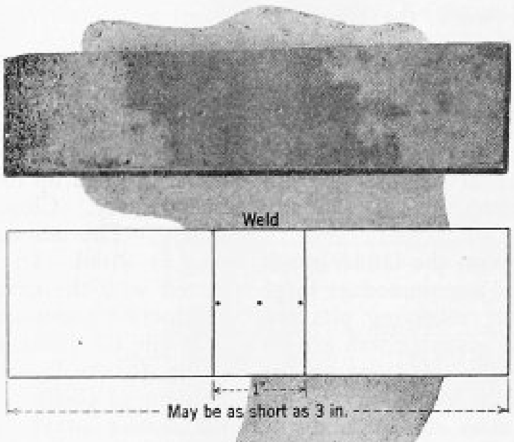


Fig. 1 (above).—How to lay out the coupons

Fig. 2 (left).—Coupon bent in test

These test coupons are first prepared by grinding or smoothing down the weld, especially if it has been reinforced, then laying off the weld and adjoining metal very carefully as is shown in Fig. 1, using center punch marks. For ordinary procedure it is sufficient to make a mark ½ inch on each side of the center of the weld, as is shown on the coupon in Fig. 1. This coupon is about 5 inches long.

The sample is next placed in an ordinary machinist's vise, the jaws of which should come about 1 inch from the punch mark, and is struck with a hammer and bent over at an angle of about 10 degrees (Fig. 3). The coupon is then reversed and the same procedure takes place on the opposite end (Fig. 4). It is best not to get the jaws of the vise too far from the weld metal in this hammering test because the metal outside the weld will bend and the weld metal itself remain unaffected, thus making the test worthless. It is always necessary for the greatest part of the bending to come in the weld metal itself. The coupon as it stands ready for bending is shown in Fig. 4. It is then bent in the vise as shown in Fig. 5. This allows the bend to occur freely, which is essential for accurate and consistent results. In case the vise does not extend enough to take the coupon endwise in its jaws, the coupon can be placed between the two jaw shanks to start. If the coupon does not start to bend immediately, a good plan is to exert pressure by means of a length of pipe slipped over the vise handle to give extra length and leverage.

As soon as the first crack in the weld metal is observed, the bending is stopped and the distance between the marks measured with a flexible steel scale reading to hundredths of an inch (Fig. 7). When the original

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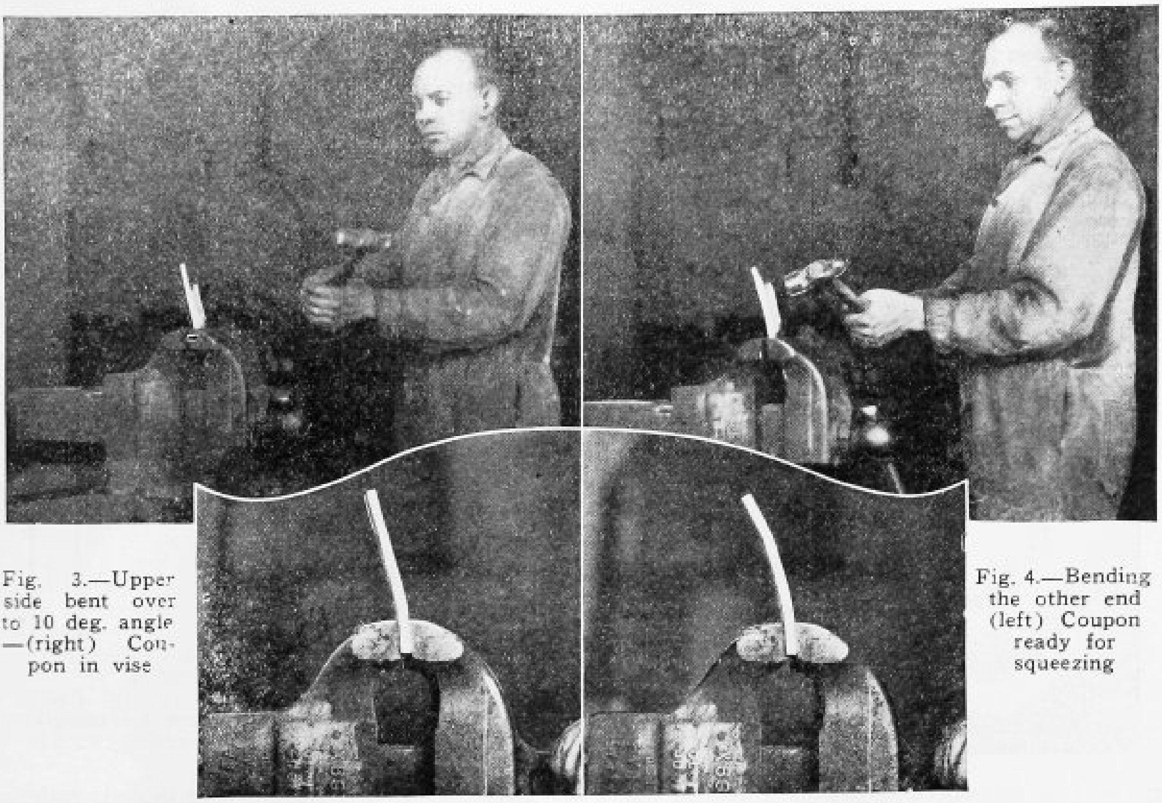


Fig. 3.—Upper side bent over to 10 deg. angle —(right) Coupon in vise

Fig. 4.—Bending the other end (left) Coupon ready for squeezing

distance between the marks is 1 inch, the percent of elongation is identical with the number of hundredths of an inch in excess of 1 inch in the final measurement. Thus in one specimen the first measurement between the points was 1 inch and the final measurement was 1.17 inches; therefore the elongation was 0.17 inch or 17 percent. Results of some of the tests are shown in Fig. 9. This figure also shows that the usual way of measuring the angle to which a sample is bent is not a measure of the ductility of the weld, because the same percent of elongation is obtained with 90-degree bends (Nos. 3 and 4) as with 180-degree bends (Nos. 8 and 9).

There is in the angle bend test this possibility of the results being misinterpreted. In Fig. 8 appears what is apparently a good bend, but there has been very little bending of the weld metal, most of it coming in the plate.

The careful measuring of the weld metal elongation by the new method will show exactly the amount of ductility in the joint. Cracks should appear first in the weld metal of a specimen in which the base metal and the weld metal have been properly fused, and the coupon correctly prepared for the bending test.

For purposes of comparison, and to judge the ability of welders, the following results have been taken at random from some test coupons. This series of welds, made with a mild steel rod in boiler plate 3/8 inch thick, ran from 26 to 30 percent elongation, with an average elongation of about 28 percent. Welds made with rod for high strength welds (No. 1 high test rod), while stronger, were a little less ductile, showing an elongation of from 15 to 20 percent, with a general average of about 15 percent. These welds were the ordinary run of good welders' work, and can be considered of high standard as to ductility. In most cases the coupons can be bent much in excess of the percent noted.

Ductility Tests

Ductility tests, in conjunction with tensile tests, are used at the present time in testing all types of metals and for all types of joints in production work. One of the greatest factors in adapting welding for production work has been the use of testing and procedure control. In the construction of welded pressure vessels, where strength and ductility are vital necessities, the results of an organized system of testing welds has had

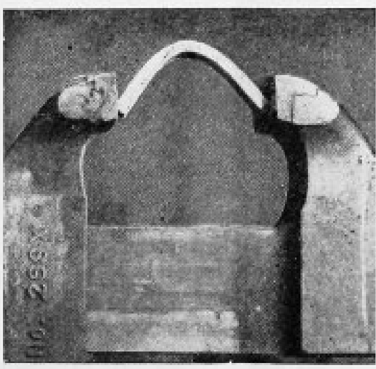


Fig. 5. Bending in the vise

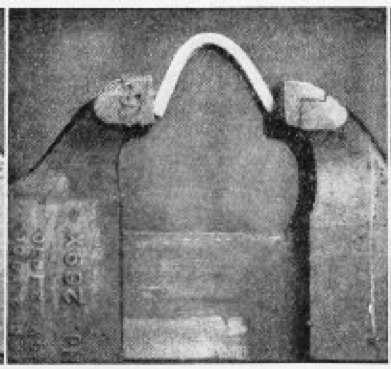


Fig. 6.—The bend progressing

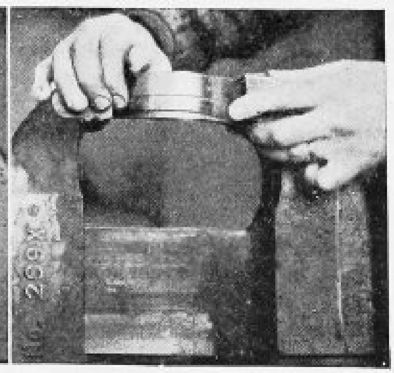
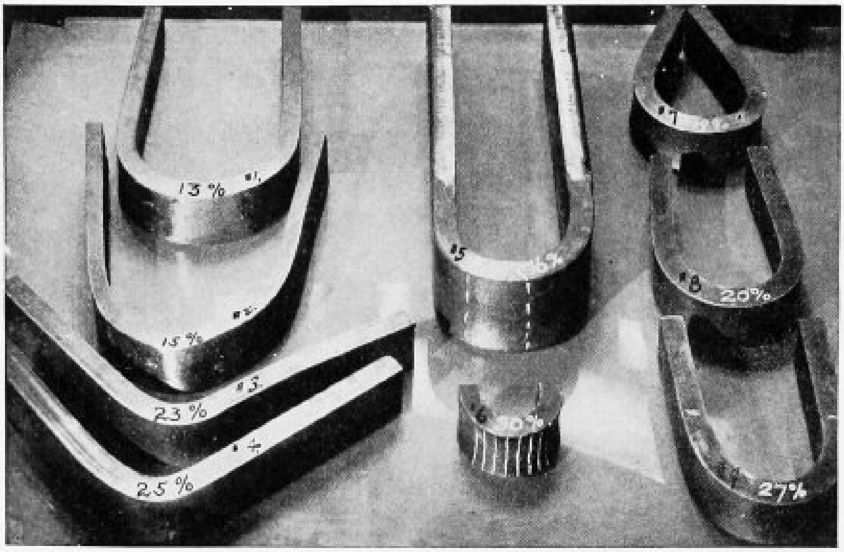


Fig. 7.—Taking the measurement

remarkable results. The success attained over a period of years has proved that testing methods have been sound and that if properly used for periodic tests will produce the best possible finished article.

Every welding shop or welding department, no matter how small, should have someone, either the proprietor, foreman, or a person specially assigned to this work, whose duty it would be to see that every welder should undergo a periodic test in which his welds would be submitted to a tensile test and also to a ductility test. In this way it will be possible to be sure that the welds produced by the men are of the best quality. Every operator will be obliged to watch each weld he makes to be sure that he is consistently getting complete fusion and penetration. The operator will not be careless about these matters because it will be necessary, from time to time, for him to make test welds which will be examined to see that his work is always up to standard.



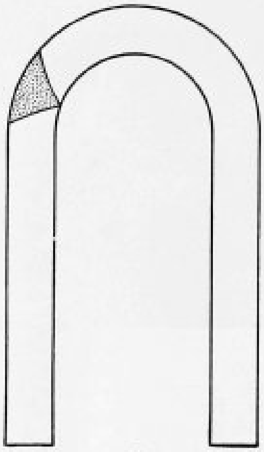


Fig. 8.—Incorrect bending
Fig. 9 (left).—Coupons bent for examination

Testing, together with proper design, material, and welding technique, are items which should be supervised closely by all executives whose shops or plants are engaged in welding. Close attention to these factors will result in the best welded joints which can be produced for any purpose.

Revisions and Addenda to the Boiler Construction Code

It is the policy of the Boiler Code Committee of the American Society of Mechanical Engineers to receive and consider as promptly as possible any desired revision of the Rules and its codes. Any suggestions for revisions or modifications that are approved by the committee will be recommended for addenda to the code, to be included later on in the proper place in the code.

During the past two years the Boiler Code Committee has received and acted upon a number of suggested revisions which have been approved for publication as addenda to the code. These are published below, with the corresponding paragraph numbers to identify their locations in the various sections of the code, and are submitted for criticisms and comment thereon from any one interested therein. Discussions should be mailed to the Secretary of the Boiler Code Committee, 29 West 39th St., New York, N. Y., in order that they may be presented to the committee for consideration.

After sufficient time has elapsed to afford full opportunity for such criticism and comment upon the revisions as approved by the committee, it is the intention of the committee to present the modified rules as finally agreed upon to the council of the society for approval as an addition to the Boiler Construction Code. Upon approval by the council, the revisions will be published in the form of addenda data sheets, distinctly colored pink, and offered for general distribution to those interested.

For the convenience of the reader in studying the revisions, all added matter appears in small capitals and all deleted matter in smaller type.

PAR. P-186. REVISED:

P-186. *Welded Joints.* The ultimate strength of a joint which has been properly welded by the forging process, shall be taken as 35,000 lb. per square inch, with steel plates having a range in tensile strength of 45,000 to 55,000 lb. per sq. in. Autogenous welding may be used in boilers in cases where the stress or load is carried by other construction which conforms to the requirements of the code and where the safety of the structure is not dependent upon the strength of the weld. Joints between the doorhole flanges of furnace and exterior sheets may be butt or lap welded by the fusion process, provided these sheets are stayed or otherwise supported around the doorhole opening and provided the distance from the flange to the surrounding row of stays or other supports does not exceed the permissible staybolt pitch as per Par. P-199. If such joints are lap welded the exterior-sheet flange should preferably be placed on the outside or next to the door opening and the firebox-sheet flange on the interior next to the water. Autogenous-welded construction may be used in lieu of riveted joints in the fireboxes of internally fired boilers, provided the welds are between two rows of staybolts, or in the case of flat surfaces the weld is not less than one-half of a staybolt pitch from the corner.

ELECTRIC RESISTANCE BUTT WELDING, WHERE THE ENTIRE AREA

IS WELDED SIMULTANEOUSLY, MAY BE USED AND THE ULTIMATE STRENGTH OF THE JOINT TAKEN AS 35,000 LB. PER SQ. IN. AS IN THE CASE OF FORGE WELDING, OR IF THE FOLLOWING PROVISIONS ARE MET, IT MAY BE GIVEN A HIGHER RATING THAN FOR FORGE-WELDING, UP TO 100 PERCENT OF THE MINIMUM TENSILE STRENGTH OF THE MATERIAL:

A—THE STEEL USED SHALL CONFORM TO THE CODE SPECIFICATIONS FOR THE PARTICULAR SERVICE TO WHICH THE PART IS TO BE APPLIED.

B—AN AUTHORIZED INSPECTOR MAY DEMAND A TEST OF ANY OF THE WELDED ARTICLES HE MAY SELECT FOR THE PURPOSE, AND, IF AFTER WITNESSING SUCH TEST, HE SHALL DOUBT THE ADVISABILITY OF GRANTING AN INCREASED RATING FOR THE WELD, THE MATTER SHALL BE REFERRED TO THE BOILER CODE COMMITTEE FOR ITS DECISION.

PAR. P-268. REVISED:

P-268. *Threaded Openings.* All pipe threads shall conform to the American Pipe Thread Standard, and all connections 1-inch pipe size or over shall have not less than the number of threads given in Table P-10. For smaller pipe connections there shall be at least four threads in the opening.

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 composition flange, or plate, so as to provide the required number of threads.

When the maximum allowable working pressure exceeds 100 lb. per square inch, outlet connections over 3 inch pipe size shall not have screwed joints, BUT flanged fittings shall be used, riveted directly to the shell or head, or a fitting with a raised flat face on the boiler side may be connected directly to the boiler or head of the boiler by means of studs.

If studs are used they must be not less than ¾ inch in diameter and must have not less than ten threads per inch. The thickness of the boiler plate must be not less than the diameter of the studs. The allowable tensile stress on these studs must not exceed the stresses indicated by the bolted connections given in Table A-6.

PAR. S-252. REVISED:

S-252. *Chemical Composition.* The steel shall conform to the following requirements as to chemical composition:

		Class 1	Class 2
Carbon, maximum, percent		0.35	0.50[0.45]
Manganese, percent			0.40–0.70[0.30–0.65]
Phosphorus, maximum, percent	Basic		0.035
	Acid		0.05[0.04]
Sulphur, maximum, percent			0.05[0.04]

PAR. S-257. REVISED:

S-257. *Bend Tests.* The test specimen shall [with] stand being bent cold through 180 degrees, [around a pin 1 inch in diameter] without cracking on the outside of the bent portion, AS FOLLOWS:

FOR CLASS 1 MATERIAL—AROUND A PIN 1 INCH IN DIAMETER;

FOR CLASS 2 MATERIAL—AROUND A PIN 1½ INCHES IN DIAMETER.

Work of the A. S. M. E. Boiler Code Committee

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Any one desiring information as to the application of the code is requested to communicate with the Secretary of the Committee, 29 West 39th St., New York, N. Y.

The procedure of the committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the Secretary of the Committee to all of the members of the committee. The interpretation, in the form of a reply, is then prepared by the Committee and passed upon at a regular meeting of the Committee. This interpretation is later submitted to the council of the society for approval, after which it is issued to the inquirer and published.

Below are given records of the interpretations of the committee in Cases Nos. 585 (Reopened), 602 (Reopened), 607, 609-612 as formulated at the meeting on October 26, 1928, all having been approved by the council. In accordance with established practice, names of inquirers have been omitted.

Case No. 585 (Reopened). *Inquiry:* Request is made for revision of the requirement in Par. U-20 of the code which limits the maximum allowable unit working stress in seamless shells to 9000 pounds per square inch. It is pointed out that for the drawing of seamless steel vessels, 55,000 pounds per square inch material is commonly and very successfully used, so that an allowable unit working stress of 11,000 pounds per square inch should be allowed.

Reply: This value of 9000 pounds for the maximum allowable unit working stress came from the table in the Power Boiler Code for piping and is conservative in view of the fact that the piping is provided for use up to a maximum temperature of 750 degrees F. It is the opinion of the committee that for temperatures up to 600 degrees, one-fifth of the minimum of the specified range of the ultimate strength can be used. This matter is under consideration for revision.

Case No. 602 (Reopened). *Inquiry:* Is it permissible to use a constant of 135 in the formula given in Par. H-21 of the code for ordinary staybolts welded into plates forming the water leg of a boiler? It is pointed out that these staybolts do not exceed 6 feet in length.

Reply: It was the intent to limit the use of 135 for the constant *C* to stays over 120 diameters in length, and it is proposed to revise Par. H-21 to include this limitation.

Pending a revision of the code that will clarify this feature and will limit the use of 135 for the constant *C* to stays over 120 diameters in length, the constant 135 may be used for steam-heating boilers and hot-water boilers for pressures not to exceed 30 pounds per square inch for welded-in stays and for staybolts which are screwed through the plates with their ends riveted over. For hot-water heating boilers carrying pressures over 30 pounds per square inch, the constants for welded-in stays should correspond to those given in the code for the ordinary screwed staybolts.

Case No. 607. *Inquiry:* Is it permissible, under the Code for Unfired Pressure Vessels, to construct a spherical shell with lap joints, or it is required that butt strap joints be used?

Reply: While there is nothing in the present code applying to the construction of spherical vessels, it is the opinion of the committee that lap joints may be safely used in the construction thereof if the plate thickness does not exceed ½ in. A revision has been proposed to this effect which will be published for incorporation in the code.

Case No. 609 (In the hands of the Committee).

Case No. 610 (In the hands of the Committee).

Case No. 611. *Inquiry:* Is it necessary, under the Rules of the Code for Unfired Pressure Vessels, that pipe material obtained under the Specifications of Section II of the code shall be marked as called for in Par. U-122? Pipe material is apparently permitted by Par. P-9 for power boilers, even though there is no requirement in the specifications for marking thereon.

Reply: Markings are not required by any of the pipe-material specifications in Section II of the code, in the manner prescribed for steel boiler plate, and it is the opinion of the committee that such marking is not required for pipe material when used for pressure parts of boilers or unfired pressure vessels.

Case No. 612 (In the hands of the Committee).

Locomotive Boiler Construction—VII*

Layout and fabrication of backhead and firebox tube sheet—Throat and front tube sheets

By W. E. Joynes †

FIG. 29 is the pattern plate layout for the backhead shown on the development plate drawing, Fig. 28.

The layout of the backhead is similar to that of the firebox back sheet, with respect to the fire door hole, plate bend line and outline, and the firebox ring rivet holes.

The dimensions shown on the bend line for locating the brace tee rivet holes, are run off with a measuring wheel. The rivet holes are then laid out and spaced as shown.

The two bottom rows of staybolt holes are laid out on the backhead sheet. The bend in the firebox back and backhead, which is just above the firebox ring, allows these sheets to slope toward the front end of the firebox. The bend in these sheets causes the two bottom rows of staybolts to be at a greater distance from the bottom of the backhead than the same two rows are from the bottom of the firebox back sheet.

The location of all staybolt holes in a backhead, except those which have a different location than the holes of the firebox back sheet, are marker punched directly from the back sheet, when the staybolt holes in the back sheet have been drilled. The back plate is laid on the backhead for marking off the staybolt holes.

The arch tube plug holes have the same location, with respect to the staybolt holes, as the firebox back sheet arch tube holes.

The plug centers and the stay-circle around it are usually laid out on the backhead to check the location of the holes, when the back plate is laid on the backhead for marking off the staybolt holes.

All stud holes, water column or water gage holes are laid out in the locomotive erecting shop.

The layout for verifying the flange dimensions is similar to the back sheet flange dimension layout.

After the backhead plate has been drilled and the outline punched and sheared off, the bottom side edges are scarfed, under a power hammer, to fit the firebox ring.

The vertical plate center line and the boiler center line are center punched near the plate edge, top and bottom, right and left; for the flanger to locate the plate on the flanging die.

The center lines on the firebox back sheet are also center punched near the plate edges for the flangers information.

The plate is now ready to be flanged.

Fig. 30 is the developed plate drawing of a firebox tube sheet. All staybolt holes, arch-tube holes, brace holes, tube and superheater flue holes are to be laid out and put in the sheet before it is flanged.

When a drilling jig is to be used in connection with the drilling of the tube and flue holes, these holes (except as noted below) are not put in the sheet until after the sheet has been flanged. Four of the tube holes, one top and bottom, one right and left, are laid out and

* The first instalment of this series appeared on page 218 of the August, 1928, issue, the second on page 253 of the September issue, the third on page 291 of the October issue, the fourth on page 321 of the November issue, the fifth on page 353 of the December issue, and the sixth on page 17 of the January issue.

† Boiler designing department, American Locomotive Company, Schenectady, N. Y.

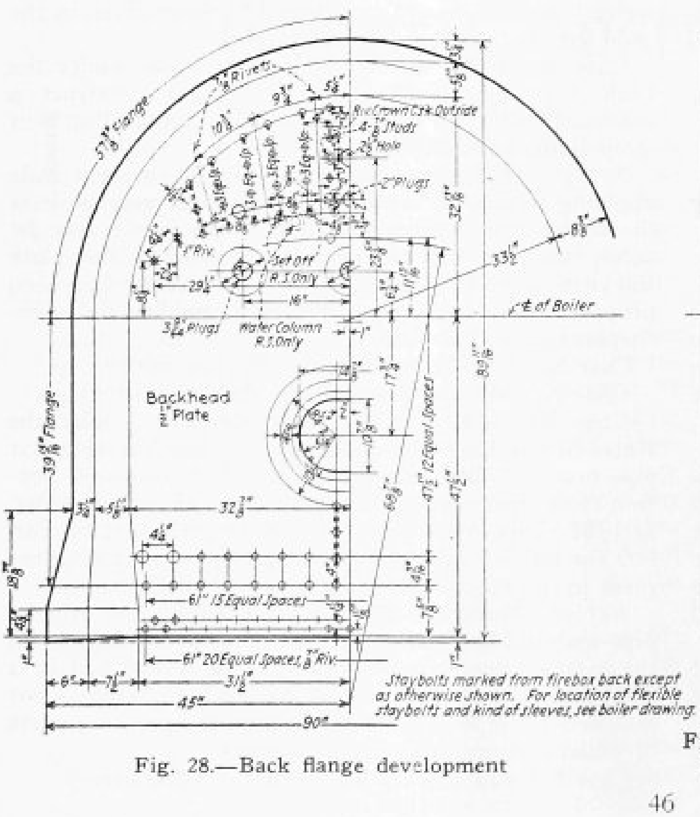


Fig. 28.—Back flange development

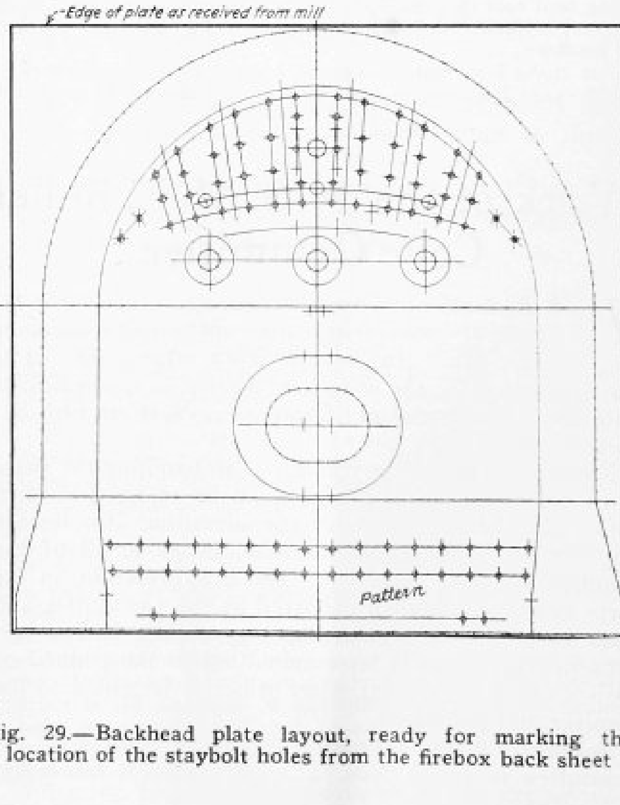


Fig. 29.—Backhead plate layout, ready for marking the location of the staybolt holes from the firebox back sheet

punched in the sheet, for bolting the drilling jig to the sheet.

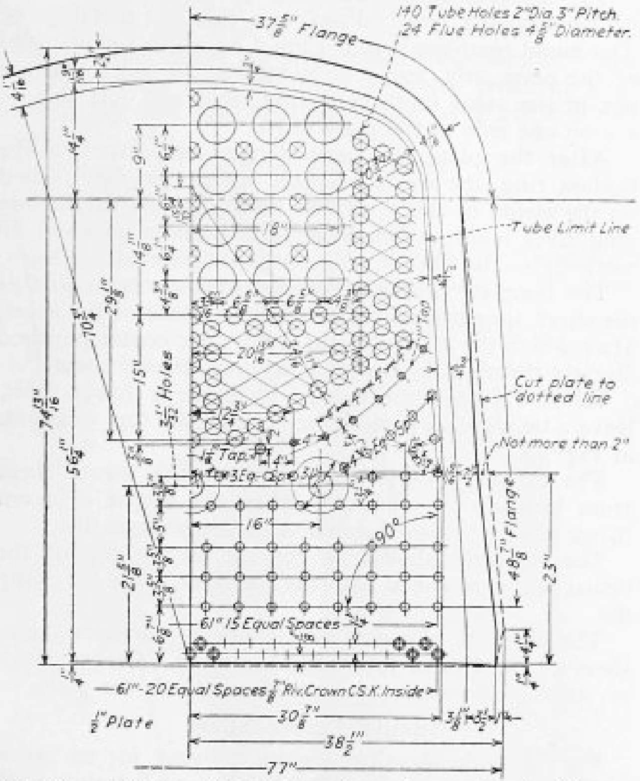


Fig. 30.—Firebox tube sheet. Type-A superheater flue arrangement

When a drilling jig is not to be used, all of the tube and flue holes are laid out and punched in the sheet before it is flanged.

If the tube and flue hole arrangement is a new design, a drilling jig is made to facilitate putting the holes in the sheet, when more than two boilers are to be built.

The inner bend line and the plate outline are laid out first, as dimensioned. The outline should be laid out to include the extra allowance at the sides and bottom as shown by the dotted lines. The allowance is to assure enough material for the proper trimming of the sheet, after it has been flanged.

Four firebox ring rivet holes are marker punched from the template onto the bottom rivet line as has been explained for the back flanges.

If the tube holes are to be laid out and punched, paint the tube and flue space with a thin white mixture, so it can be drying while the staybolt holes are being laid out.

Locate the arch-tube centers and scribe the staybolt circle around the same. Scribe an arc for the tube-sheet brace holes and the top row of staybolt holes. Lay out the remaining staybolt holes, as shown.

The tube and flue holes are next carefully laid out and scribed into the white coating, which assures an accurate layout and the correct punching of the lead holes for drilling the tube and flue holes.

Check the layout, stamp the flange runs on the plate and mark the drilling and punching sizes.

Remove the plate to a punching machine; punch the four firebox ring rivet holes and also a lead hole for all of the tube and flue holes, when a drilling jig is not to be used.

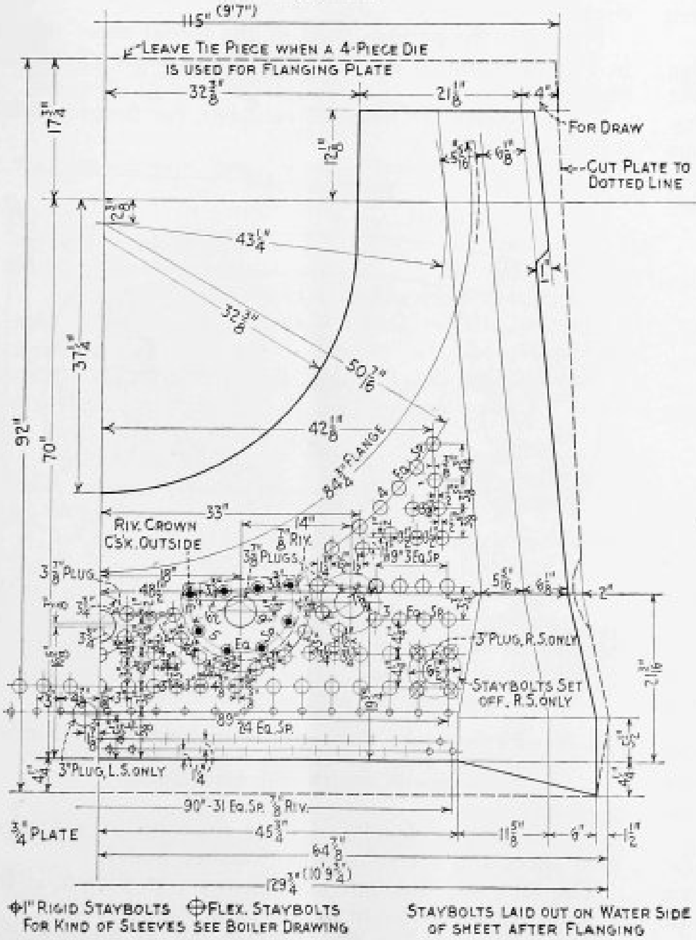


Fig. 31.—Outside throat sheet

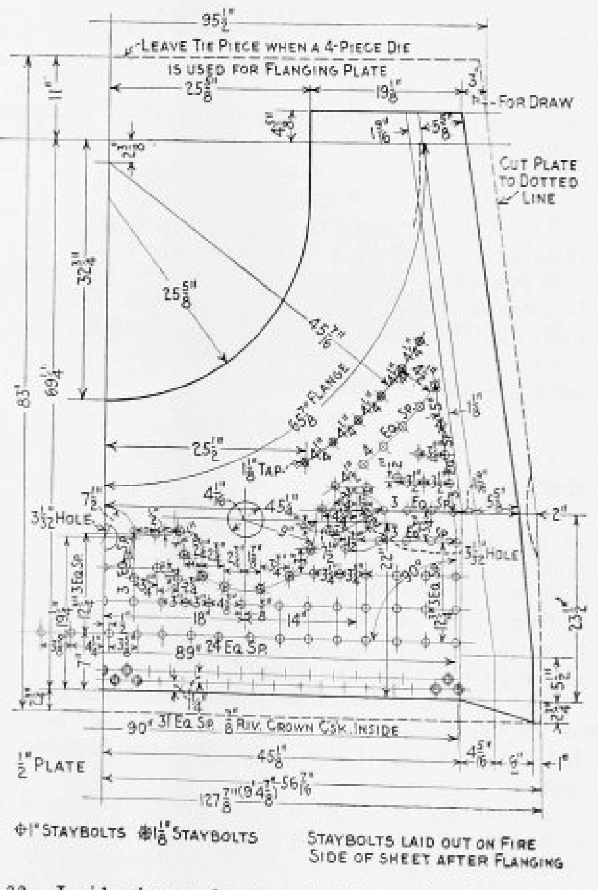


Fig. 32.—Inside throat sheet used with combustion chamber boiler

When a drilling jig is to be used, the four tube holes which have been laid out for bolting the jig to the plate are punched.

Punch and shear off the stock outside the outline.

Return the plate to the marking-off section if duplicate plates are required. Marker punch the drilling-jig bolting holes or one tube hole, right and left, near the top for tack holes, if all of the tube and flue holes have been punched. Marker punch the firebox ring rivet

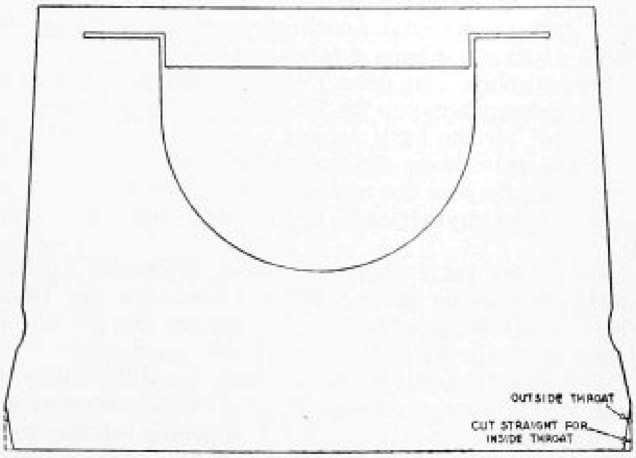


Fig. 33.—Throat pattern plate of Fig. 31—trimmed ready for flanging and for marking off duplicate plate. Tie piece shown at top is used in connection with a four-piece, single-heat, double-operation die

holes and center punch around the outline with an air gun.

A lead hole for the tube and flue holes is now drilled in the duplicate plate when all of these holes have been punched in the pattern plate.

All plates are drilled, after flanging, when a drilling jig is to be used for the tube and flue holes. Drill the staybolt holes and a lead hole for the arch-tube holes.

The exact location of the holes for a tube and flue layout is obtained when they are punched in the pattern plate, which assures the maintainance of the small bridge metal between the holes.

The plate is now ready to be flanged.

The flue arrangement, as shown in Fig. 30, is for the installation of the old or type-A superheater units.

When more than two and not more than five or six boilers are to be built, a plain plate-drilling jig is usually made for the tube and flue holes. When more than this number are to be built, a plate jig with hard steel bushings is made.

Throat Sheet

Fig. 31 is the developed drawing of a sloped throat sheet.

This drawing, of course, shows the developed outline of the plate as it is to be laid out before it is flanged and also the developed staybolt holes arrangement as laid out for the flat plate.

Due to the severe flanging which throat sheets have to withstand, it is not possible to put any holes in these plates before they are flanged.

The extra material allowance at the sides and bottom of the plate, as shown by the dotted line, is to allow for the drawing of the material in the flanging operation.

The staybolt arrangement, as shown in Fig. 31, is for a boiler firebox equipped with Nicholson thermic syphons and arch tubes. The liner shown on the inside of the sheet with a plug hole in the center of the liner is opposite the syphon. The syphons are welded to the tube sheet or to the inside throat sheet on combustion chamber boilers.

The staybolt holes and other holes, as dimensioned on the drawing, are laid out on a thin flat metal sheet. The metal template layout should be made for one half of the plate only, and with notations for holes that are not in the same location on the right and left side or are on one side of the plate only.

After the plate has been flanged and fitted to the firebox ring, the metal staybolt layout template is laid on the inside of the sheet and lined up with the firebox ring rivet holes, which have been marker punched directly from the firebox ring on the outside of the sheet.

The template is screw clamped to the bottom part of the sheet, then hammered to fit the contour of the sheet, after which the staybolt hole centers are center punched directly through the template onto the throat sheet.

When a 4-piece die is used to flange a throat sheet, leave a tie piece as part of the plate, at the top, as shown in Fig. 33.

The tie piece keeps the wings of the throat sheet from bending out of shape when the throat or front flange is being pushed down with the plunger die.

The tie piece should be cut out, at the top of the throat wings to check with the location of the tie clamp die.

The tie piece also acts as a guide in placing a throat sheet on the 4-piece type of flanging die. Center punch or other guide marks are not necessary on the plate.

Inside Throat Sheet

Fig. 32 is the developed plate drawing for an inside or firebox throat sheet. The layout and flanging work on inside throat sheets is the same as for outside throat sheets.

Fig. 33 is the pattern plate of the throat sheet shown in Fig. 31 trimmed for marking off duplicate plates for flanging.

Throat sheets are trimmed complete for flanging with a burning torch.

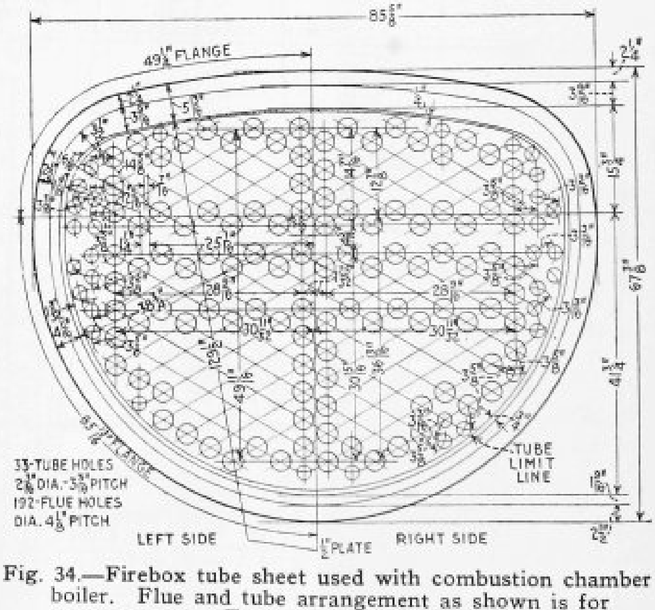


Fig. 34.—Firebox tube sheet used with combustion chamber boiler. Flue and tube arrangement as shown is for a type-E superheater installation

Fig. 34 is the developed plate drawing of a firebox tube sheet for a combustion chamber boiler.

The tube and flue hole arrangement, as shown, is for what is known as the new or type-E superheater.

The outline of the plate is laid out as dimensioned and sheared off for flanging.

The tube and flue holes are laid out and punched in the pattern plate before the plate is flanged, or lead holes are drilled after flanging—when a drilling jig is used, as has been explained in connection with the firebox tube sheets for non-combustion chamber boilers.

The center lines are usually center punched at the sides, top and bottom of the plate as a guide for the flanger.

Front Tube Sheet

The developed plate drawing of a front tube sheet is shown in Fig. 35.

The material for the front tube sheets is ordered to the correct diameter for flanging, therefore, it is only

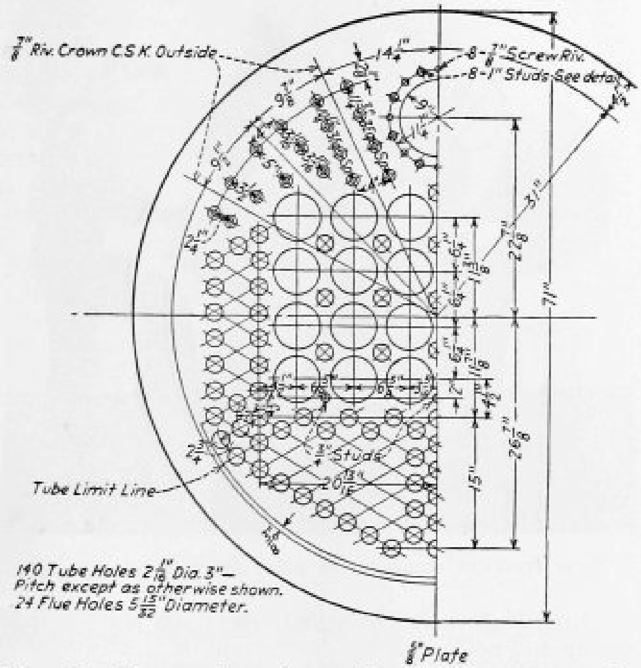


Fig. 35.—Front tube sheet. Type-A superheater flue arrangement

necessary to lay out the bend line for wheeling the brace tee rivet locations and scribing the tube limit line.

The center of the plate is first found with the trammels. Set the trammels to approximately one half the diameter of the plate; center at the edge (four quarters) of plate and scribe short arcs about the center. The center of the scribed area will, of course, be the center of the plate.

Holes to be tapped for the tube sheet ring and a lead hole for cutting out the dry pipe opening are drilled in the plate before it is flanged.

The tube and flue layout and drilling is, of course, handled in the same way as explained for back or firebox tube sheets.

The flat plate being round, guide marks are not required on the plate to enable the flanger to place the same at a given point on the flanging die.

(To be continued)

Cutting Holes in Gaskets

It was necessary to partially take down the boiler shop air compressor at frequent intervals. A new gasket was required each time this was done. The foreman cut the holes in the gaskets with a ball peen-hammer in the time-honored way, and, as time went on, the edges of the bolt holes became more and more rounded through constant hammering while cutting the gaskets. The foreman desired a better way of cutting the holes. He also wished to cut them a little smaller than the stud-bolts, instead of about 1/8-inch larger.

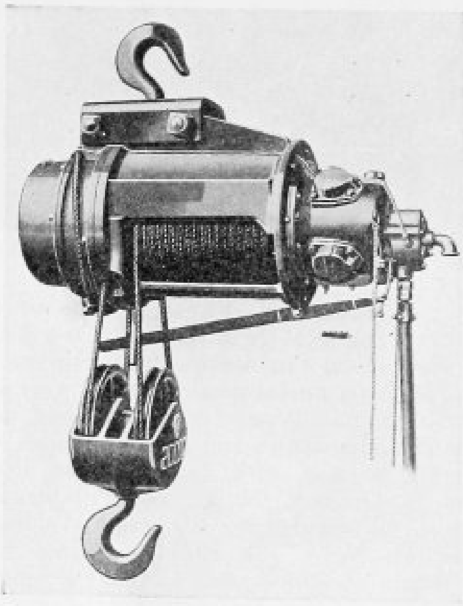
One day the foreman came across several samples of cold-drawn, seamless steel tubing from 1/2-inch in diameter upward. He sent away and got a lot more sample pieces from 3 to 8 inches long. He selected three of these pieces having varying wall thickness, but which would each fit snugly in the bolt holes for which the gasket holes were to be cut. The foreman ground a nice long bevel on each piece of steel tubing, making a regular "wad-cutter" similar to that used to cut shot-gun wads.

The next time a gasket had to be cut for the air compressor, the foreman placed the sheet of gasket material on a smooth hardwood plank, laid the casting on top and selected a sharpened tube with a wall thickness which would make holes as small as he desired. With the piece of tubing and a hammer, the gasket bolt holes were cut in short order, and of size desired, to fit the stud-bolts closely.

Air-Motor Hoist of 10 Tons Capacity

A NEW air-motor hoist of 20,000 pounds capacity is now being furnished by the Ingersoll-Rand Company, New York city. In railroad shops this hoist is used for heavy lifting work which would ordinarily tie up a crane.

The hoist construction employs a powerful four-cylinder air motor geared to a rope drum and all enclosed in a compact and dirt-proof housing. The gears are



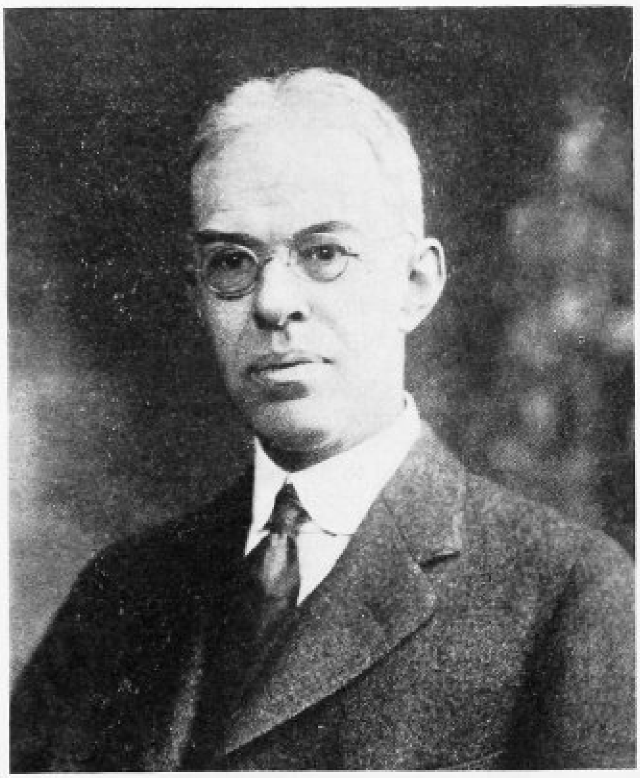
I-R air-motor hoist of 10 tons capacity

made of special steel and are heat treated to insure extra strength and wearing qualities. They operate in a bath of semi-fluid grease, completely enclosed. Ball bearings or bronze bushings are provided at all points where experience has indicated that they will add to the efficiency and life of the hoist.

Instant and complete control of the hoist movement is obtained by a graduated throttle and a well-balanced motor. The latter is practically without vibration. The cylinders are renewable and interchangeable, making it easy and inexpensive to renew the cylinders if worn after long service.

Samuel W. Miller, Welding Expert, Dies

SAMUEL WYLIE MILLER, consulting engineer of the Union Carbide & Carbon Research Laboratories, Inc., of Long Island City, N. Y., well known both in the United States and in Europe as a pioneer in oxy-acetylene welding and an authority on its application, died on February 3 at his home in



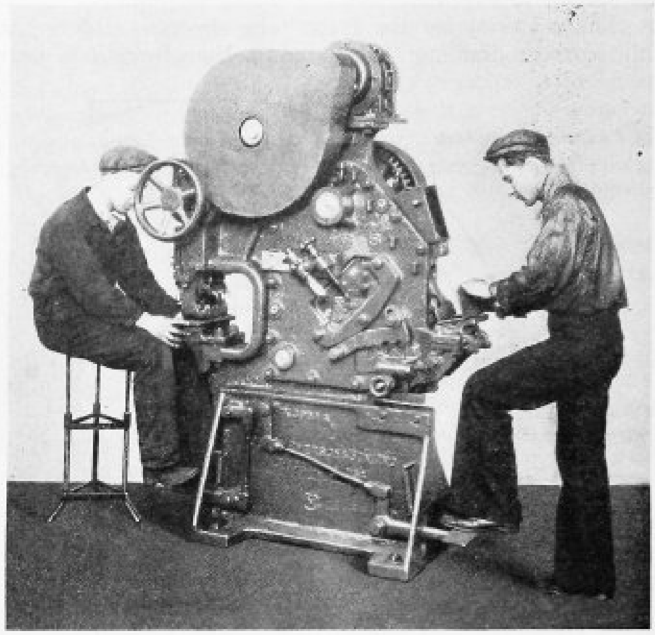
S. W. Miller

Hollis, Long Island, N. Y., at the age of 62. Mr. Miller was a native of New York and received his degree in Mechanical Engineering from Stevens Institute in 1887. His first professional activities were as master mechanic for the Pennsylvania Railroad plants at Logansport, Indianapolis, Ind., and Columbus, O. Following this he was with the American Locomotive Company at Dunkirk, N. Y., and Providence, R. I., after which he founded the Rochester Welding Works at Rochester, N. Y. In 1921 he joined the newly formed Union Carbide and Carbon Research Laboratories, Inc.

In all engineering circles Mr. Miller has been recognized as an outstanding figure in the advancement of oxy-acetylene welding ever since its inception as a commercial process. He was a past president of the American Welding Society and a prominent and active member of the American Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers, American Society for Steel Treating, British Iron and Steel Institute, Institute of Metals and other scientific and engineering organizations.

Combination Shear, Punch and Coper

JOSEPH T. Ryerson & Son, Inc., Chicago, Ill., has developed a small combination shear, punch and coper which is suitable for the shop handling a varied class of work on the smaller steel sections. The one machine can accomplish punching, plate and bar



New Ryerson combination plate fabricating machine

shearing, angle and tee cutting, angle and tee mitering, coping and notching.

The punch has a deep throat and is capable of handling most varieties of structural shapes within its capacity of 11/16-inch hole through ½-inch material. The operation of this punch is not interfered with in any manner by the other units built into the machine. The shearing end of the machine is constructed so that a single slide handles the angle shearing, bar cutting, plate shearing, and coping. The angle shear attachment handles both inside and outside miter cutting as well as straight shearing. The blades in this unit are made in sections for cheap and easy replacement. The bar cutting blades are located directly below the angle shear blades. These cutters handle both round and square sections and consist of two blades only. Directly below the bar cutter are located the plate shearing blades. They will handle plates of any width or length and up to ⅜-inch thickness.

The coping device is built at the shear end of the machine and is extended out from the frame and located at a convenient height for operation. The coping device is regularly furnished in the V-notch type, but the square notching feature can be provided.

The drive is taken through all steel gears to alloy steel eccentric shafts. The clutches are of the two-jaw type, giving the operator a chance to engage the clutch every half revolution of the clutch gear. The main frame of the machine consists of a one-piece alloy steel casting, extending from the feet up to the motor shelf. The bearings throughout are bronze bushed and special care has been taken to provide proper lubrication. The working heights of the various attachments have been made such that the base of the machine can be placed directly on the floor, thereby eliminating the necessity of building up a concrete pier in order to bring the machine to a proper working height. This arrangement makes the machine portable.

The Significance of the Bend Test*

By E. N. Treat

A COUPON from a steel plate is a section 2 inches wide and 15 inches long which before testing is milled down to 1 inch at the central portion, leaving the ends the original width. Coupons are taken from the plate as it is first rolled from the slab or ingot. In a previous article the tensile test coupons and their use were described; but other tests must be made to determine the distortion qualities of the plate from which the coupon was taken. Hence we have the bend test taken from the middle of the top of the plate representing the top section of the slab or ingot.

The coupon for bending is taken at that part of the plate which is supposed to contain the greatest amount of impurities that are detrimental to the value of the plate as concerns its qualities of formation in the finished structure. This point is at the middle of the top of the ingot, and it is at this point that the bend test is taken.

As an example, let us fill a mold with melted tallow into which is stirred minute foreign elements. It will be observed that the tallow solidifies first at the outside edges of the mold. This solidification continues until the surface becomes fixed; the center tallow may yet be fluid. As cooling continues, contraction takes place, and the center of the molded tallow lowers below the outer surface height. It is at this lowered center section that circulation last ceases. Escaping gases and impurities seek the lines of least resistance and flow towards the center and upward until solidification prohibits their escape. The result is that such gases are hemmed in at the center of the top of the molded section.

It may be seen, upon removing the ingot from the mold, that the edge at the top is higher than the center surface, and in a molded section of steel it is not an easy matter to eliminate this material which must be discarded. Even though this discard be made to the surface of the center of the ingot there is yet a section beneath the top surface in which the gas bubbles have left cells.

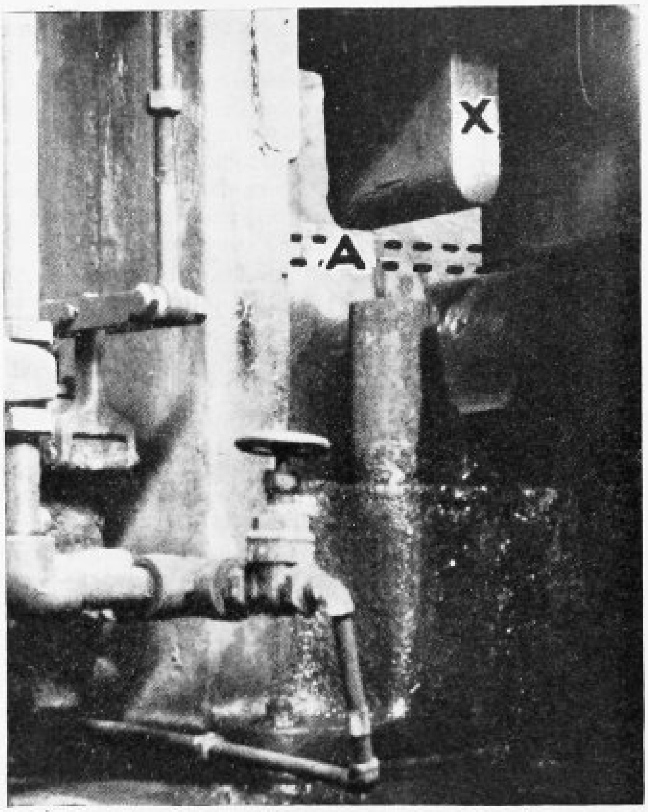
Various defects in the finished plate may be traced to these gas cells. It is at the top edge that elongated seams may be found most frequently. These seams are the result of pressing through the rolls a section containing a gas cell. These cells may contain a surface coating of impurities and no amount of rolling will cause the walls of such a cell to weld.

At times the bend test coupon may be found defective, and if circumstances warrant, the inspector may allow another bend test to be made from that plate. Frequently a seam may be found in the coupon which does not exist in the plate. This is because the coupon included the extreme elongation of a gas cell which terminated at the point between the coupon and the plate.

Bend test coupons are prepared in the same manner as the tensile test coupon, but as a final preparation before making the bend test, the sharp knife edges of the coupon are removed by filing. This practice is generally permissible for a sharp edged coupon will usually develop small cracks at such edges.

Forming the bend is done in several ways. A steam hammer may be used, or the bend may be formed by a steady pressure exerted by the hydraulic method as shown in Fig. 1. This latter method is more desirable. Unlike the steam hammer which strikes a sudden shock blow, the pressure method applies a gradually increasing load which may be regulated by the operator.

Coupons up to 1 inch in thickness are usually bent to one and one-half times the thickness. Coupons up to 2 inches in thickness are bent to three times the thickness; and coupons over 2 inches are bent to four times the thickness. In forming bends it is good practice to use a short bar the diameter of which is equal to the total number of thicknesses required.



Bend being made in hydraulic machine

When coupons are bent under hydraulic pressure the coupon is placed beneath the plunger, where it is supported at each end by suitable rests. The pressure is then applied at *X*, the proper curvature being formed by means of the bar held crosswise over the test coupon *A* indicated by dotted lines beneath the plunger *X*.

* Continuation of a series of short articles on boiler material inspection of the steel mills, which have appeared in recent issues

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J. E. Durstine has been promoted to district sales representative of the Lincoln Electric Company, Cleveland, O., for the southeast territory with headquarters at Birmingham, Ala.

The Shepard Electric Crane & Hoist Company, Montour Falls, N. Y., and Niles Crane Corporation, Philadelphia, Pa., have combined under the corporate title of the Shepard-Niles Crane & Hoist Company with general offices at Montour Falls, N. Y.

Control of Unfired Pressure Vessels*

Action taken by California Industrial Accident Commission to increase safety of air tanks

By F. A. Paget†

ABOUT five or six years ago the California manufacturers of unfired pressure vessels became dissatisfied with conditions found in this field. Keen competition had brought out vessels designed with various types of joints and heads, some of questionable efficiency and strength. This latter construction worked a considerable hardship on the reputable manufacturers.

This created a condition that was unsatisfactory to both the manufacturer and the consumer. The manufacturer faced the choice of two evils: To lose business, or to take chances on comeback losses and dissatisfied customers. The consumer got less than he paid for, in that had his vessel been built to the Unfired Pressure Vessel Code, he would, for an extra 25 percent to 30 percent in original cost, have had a vessel that would have given him 200 to 300 percent longer service. Thus, all concerned were injured in some way by these unregulated conditions.

On request from various interests, the Industrial Accident Commission in 1924 decided to undertake the revision of the old Air Pressure Tank Safety Orders, and if possible to extend them to include other unfired pressure vessels.

In the latter part of that year, a tentative set of orders was prepared by the engineers of the commission for the guidance of the revision committee, which was appointed in January, 1925. This committee was made up of representatives of all interests concerned.

At the first meeting of this committee, certain interests were able to limit the revision of the orders to air pressure tanks *only*. The representatives of the manufacturers opposed this attitude but for business reasons they soon found themselves forced to accede to the wishes of the opposing interests. The majority of manufacturers then strenuously opposed the demands of the welding industry for high stresses in fusion welds. It may be of interest to know that a number of the representatives of the manufacturers, who opposed the high stresses demanded, were also operators of reputable welding shops and they believed that to allow the high stresses called for, would be inviting explosions of air tanks, especially of those built by the so-called cross-road welding shops. This would bring the welding industry into disrepute and thereby occasion serious reactions against a new, growing and necessary industry. The manufacturers felt that much could and would be done in improving fusion welding, but that the time had not yet arrived to turn the whole pressure vessel manufacture over to the welding industry.

Committee and sub-committee meetings were held at short intervals for nearly three years. By far the greater part of their work was to adjust the permissible stresses for fusion-welded joints. Numerous propositions were advanced to register either the foreman of the shop or the individual welders, by the Industrial Accident Commission. This procedure did not meet with approval.

Rules for welding procedure were advanced, and after a number of committee meetings, the various types of welds were segregated and stresses tentatively agreed upon, with the understanding that the whole matter would be submitted to the American Society of Mechanical Engineers Boiler Code Committee, which did not care to become a party to the controversy. However, after some time we received from the secretary of the Boiler Code Committee what we considered a possible solution to the problem. This was a letter in which certain limitations were recommended in connection with fusion welding. These limitations were accepted and a maximum stress of 7200 pounds for butt double V longitudinal welds was agreed upon by the revision committee. After three years consideration of this matter the committee submitted their conclusions to the Industrial Accident Commission with the recommendation that the same be favorably acted upon.

The co-ordination of the work of the San Francisco and Los Angeles committees was then undertaken and tentative orders were printed governing the construction of air pressure tanks. These tentative orders were generally distributed and adjustments in them were made pursuant to advice given at public hearings. At the public hearings an attempt was again made by some interests to not only raise the allowable stress on fusion-welded joints, but also to raise the allowable stress on riveted construction from 11,000 to 14,000 pounds. After a long discussion, a compromise was finally agreed on to raise the allowable stress on the butt double V longitudinal welds from 7200 to 8000 pounds, leaving all the other stresses as previously agreed upon by the revision committees.

Through action of the commission, these recommended orders became effective on January 1, 1928, as the Air Pressure Tank Safety Orders, Part I to govern new construction; Part II to cover tanks built and installed before January 1, 1917; and Part III covering tanks built and installed after January 1, 1917, and prior to January 1, 1928.

The new orders call for the registering and filing of agreement by air pressure tank manufacturers wishing to manufacture California standard air pressure tanks.

Shop inspection certificates, signed by a certified inspector, preferably one holding a National Board Certificate, covering air pressure tanks built in conformity with the A.S.M.E. Unfired Pressure Vessel Code, will be accepted in lieu of such registration, provided that the requirements of the California orders, which call for the stamping of the thickness of metal in the shell, in addition to the regular A.S.M.E. stamping requirements, be complied with and that heads be provided with test holes at least ⅛-inch pipe size, fitted with brass plugs. These holes are for the purpose of determining the head thickness as well as noting the thinning of heads through corrosion.

Several of the California air tank manufacturers have adopted all-riveted construction, claiming that the difference in cost between welding and riveted construction is practically nil. In fact, in some sizes of tanks the riveted construction cost has been found cheaper.

* Paper read at the annual meeting of the National Board of Boiler and Pressure Vessel Inspectors.

† Chief Boiler Inspector, Division of Industrial Accidents and Safety, State of California.

The air tank situation now appears to be far more satisfactory than before the orders became effective. Manufacturers have willingly registered and filed their agreements and are endeavoring to comply with the orders in every way. So far no friction has been noticed between the manufacturers and the commission, or with the consumer, although the price of tanks has been advanced slightly. However, the gain in years of service, of the new code tank over that of the old, will no doubt compensate the user three to one or more.

The situation concerning unfired pressure vessels, other than air tanks, is still unsatisfactory. The recommendation in the appendix of the Air Pressure Tank Safety Orders, "That, in lieu of any formally adopted orders covering vessels of this kind, the Unfired Pressure Vessel Code of the A.S.M.E. be recommended as the basis of construction," is not bringing desired results for the reason that this code has not been formally adopted.

No doubt at some not distant date, we shall be compelled to adopt orders covering unfired pressure vessels, other than air pressure tanks, and then let us hope that the rules adopted will be those of the A.S.M.E. Unfired Pressure Vessel Code in full.

Drumless Boilers

DRUMLESS or "series" boilers have been developed by the Babcock & Wilcox Company. This name applies to boilers which either have no steam or water drums at all or employ small drums arranged as shown in Fig. 1. This type has a natural circulation. The unit under consideration was made up of 2-inch tubes and the steaming economizer of 1-inch tubes; the surface of the economizer was 3.7 times that of the heating surface of the boiler.

This experimental boiler was used in the development of the Calumet boiler. Use of higher pressures made it later desirable to carry out experiments on a drumless boiler provided with forced circulation, Fig. 2.

Feedwater was fed continuously to the boiler, first passing through the tubes, which acted as an economizer,

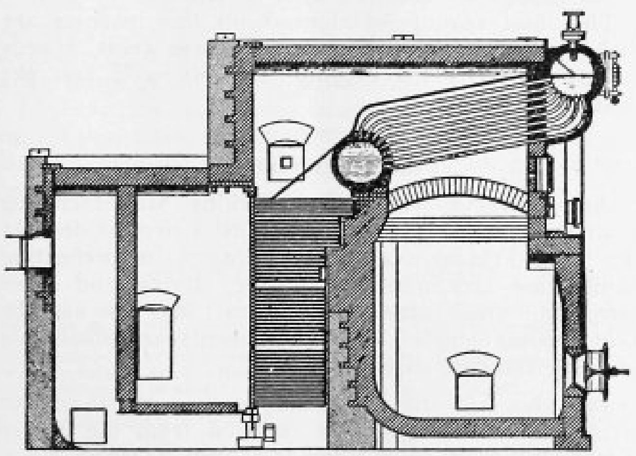


Fig. 1.—One of the boilers used in the tests leading up to the development of the Calumet boiler

and then to the tubes in which steam was formed. The steam with some excess water was then passed through a separator fitted with a gage glass and drain. The water was drained continuously from the separator, and the rate at which the boiler was fed was adjusted so as to hold the height of the water in the gage glass within a given range. Steam from the separator passed through a superheater placed so that there were 17 rows of drumless-boiler tubes between it and the furnace.

There was no trouble with the operation of the boiler, which was run at from 600 to 650 pounds working pressure for a maximum of about 500 percent of rating,

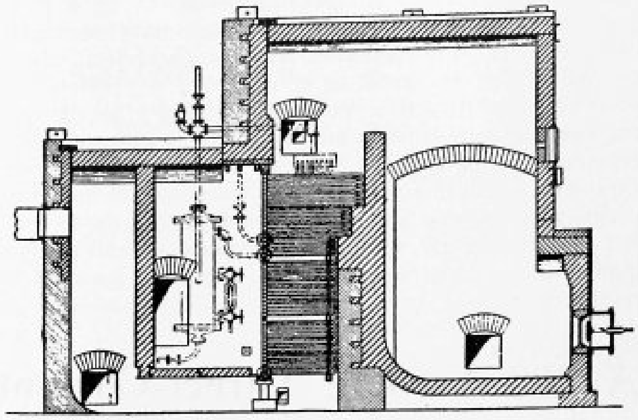


Fig. 2.—This boiler, upon which tests were made, has no drums but consists of the economizer part of the boiler shown in Fig. 1

based upon the entire surface, including that part acting as an economizer. There was trouble with the brickwork in the oil-fired furnace, but with a water-cooled furnace this difficulty would disappear, and a boiler of this sort might successfully be used for certain classes of work.

In the series boilers which were tested, the following elements were embodied: First they were arranged to have comparatively no frictional resistance to the flow of steam and water, this amounting to about 20 pounds per square inch in the boiler shown in Fig. 1, operated at about 550 percent of its rated capacity on the basis of 10 square feet of total boiler, economizer, and heating surface to the rated horsepower; second, arranged with tubes of the proper diameter so they could be cleaned internally; and third, so that the water in the boiler could be drained out.

Looking into the future and considering possible developments of the drumless boiler, it is evident that by departing from one or another of these features embodied in the experimental boilers it may be possible to build a boiler of cheaper construction. Nobody can say what the ultimate solution will be should drumless boilers come into use for high pressures. In all such boilers the problems of starting up and stopping, and sudden changes of the rate at which steam is used, are much more difficult to handle than in ordinary boilers.

(Abstract of a paper, presented by Dr. D. S. Jacobus, before the Engineers' Society of Western Pennsylvania in October, 1928.)

New York State Boiler Inspectors' Examinations

THE civil service department of the State of New York will in the near future hold examinations for the position of boiler inspector in the Department of Labor, at Albany, N. Y. The requirements for this position are as follows:

Department of Labor, Division of Boiler Inspection; $1,800 to $2,400 per year. Two immediate appointments are expected at $1800; age limits 25 to 40 years; waist measurement not over 38 inches (measurement must be written at top of application blank). The duties are to inspect boilers in various parts of the state. Candidates must have had not less than three years of practical experience as a journeyman boiler maker, or three years of practical experience as a boiler inspector, holding a certificate of competency, or five years of practical experience as operating engineer of a high-pressure steam boiler plant, either stationary or marine of more than 50 horsepower capacity. Technical education will be given credit as equivalent to experience in proportion to its value, graduation from a mechanical engineering course for which a degree is granted being accepted as two years of the required experience. Subjects of examination; written examination including practical questions and calculations pertaining to boilers, relative weight 4; training, experience and general qualifications, relative weight 6. An interview will be required.

A 200-Ampere Direct-Current Arc Welder

A RECENT development of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., is the 200-ampere DC-DC welding set, designed to meet the requirements of shops where only direct current is available for driving the welder motor.

The driving motor and generator have a common frame, and a common shaft, supported by ball bearings. The motor-starting rheostat with low-voltage protection is mounted on the top as a part of the frame and is protected by a sheet steel cabinet. Three roller-bearing wheels attached to the frame make the set readily portable and give a welder with small overall dimensions and a low center of gravity. For stationary use, the running gear can be omitted.

The unit is rated at 200 amperes, 1 hour, 50 degrees rise in a resistance load at 25 volts which conforms to the standard rating of the National Electric Manufacturers Association. The welding range is 60 to 300 amperes.

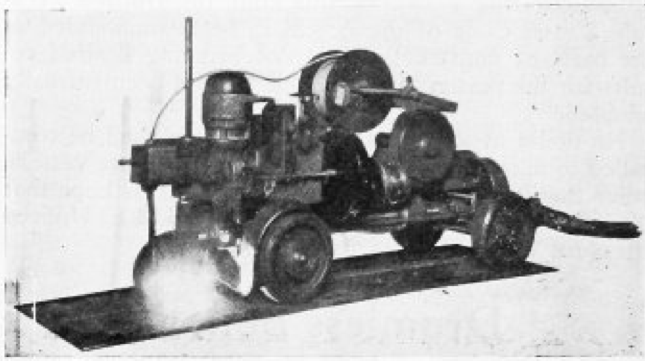
Westinghouse 200-ampere D.C.—D.C. arc welding set

The driving motor of the set is compound wound for either 230 or 550 volts and maintains a constant speed with a voltage fluctuation of not more than 10 percent.

The generator is a single-operator, constant-current differentially-compound-wound type and is separately excited from the motor supply line. The field rheostat of the generator gives a one-dial adjustment over the entire welding range.

Tractor Type Automatic Welder

AN automatic, tractor-type, arc welder utilizing the electronic tornado principle and used for making lap welds and butt welds on large tank bottoms and roofs, large pipes and similar work, has been developed by the Lincoln Electric Company, Cleveland, Ohio. The machine, as shown in the illustration, consists of an electronic tornado head mounted on a self-propelled four-wheel-drive carriage. Power is supplied through a flexible cable and all that is necessary is to line up the machine over the seam to be welded and to start the arc; the electrode and fibrous autogenizer are fed automatically as the tractor travels forward.



Automatic tractor-type electronic tornado welder

In making lap welds with this machine, no additional filler metal is used. The heat of the carbon arc fuses the edge of the top plate into the lower plate making a leak-proof joint. A filler strip is laid over the seam to be welded when a butt weld is desired.

The chief advantages claimed for this machine are high welding speeds and smooth uniform welds. Speeds on ¼-inch lap joints varying from 50 to 75 feet per hour are obtained.

Trade Publications

AIR HEATERS.—The Shaw-Perkins Manufacturing Company, Pittsburgh, Pa., has issued a circular describing Shaw-Perkins oval-type air heaters for preheating combustion air, industrial heating, drying and other purposes. Oval tubes keep the draft loss low and the heat recovery high. Heating elements are obtainable in forty standard sizes.

DRILLS.—A leaflet describing a new spiral groove structural reamer has been received from the Morse Twist Drill & Machine Company, New Bedford, Mass. The principal points that are emphasized are its wide grooves, giving large chip areas; shearing cut with graduated taper, and ability to stand up under difficult conditions of use.

WELDING RODS.—The Chicago Steel & Wire Company, Chicago, Ill., has issued a folder in which Weldite welding rods are described. Twelve types of Weldite rod are manufactured for electric welding while four types are available for gas or oxy-acetylene welding.

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Camber of Conical Courses

Q.—Please tell me how the camber of the plate in the two taper sheets, shown in Figs. 14 and 15 on pages 293 and 294 of the October, 1928, issue of THE BOILER MAKER is obtained. E. G.

A.—The dimensions of the cambers of the conical courses are obtained from actual developments of the courses.

It is customary with some locomotive builders to have all the plate developments made in the drafting room. The draftsman does the actual development work and from his layouts makes what is known as the development plate of each particular course.

These drawings, as illustrated in Figs. 14 and 15 of the October issue, are furnished to the shop completely dimensioned so as to eliminate the necessity of the shop layerout developing the sheet.

Mr. Joynes has not attempted in this series of articles to show the method of developing the various sheets, but rather, the method of laying out the work in the shops from the development plate drawings as furnished to the shops by the drawing room.

I believe this explanation answers your question, however, if you desire the actual method of developing these sheets, please request same and I will show a development in an early issue.

Values of Riveted Joints

Q.—As I am connected with a boiler inspection department, discussion has arisen at various times regarding the values to be applied in each case to the following joints, namely: The chain joint and the zigzag joint, both of the triple riveted type; as a matter of information, I would appreciate being advised of the theoretical value on these types of joints so as to be able to talk intelligently on this matter.

In the meantime, I will appreciate any information that you may have on this matter and wish to thank you in advance for your kind attention and reply. J. B. V.

A.—In chain riveting the rivets are placed in rows exactly opposite each other.

In zigzag riveting, the rivets are arranged in a zigzag manner, thus forming double rows.

Fig. 1 shows a triple-riveted seam using zigzag riveting.

Fig. 2 shows a triple-riveted seam using chain riveting.

The theoretical value of either of these seams is the same, both seams failing in the following ways:

1. Tearing of plate between rivet holes in the outer row.
2. Tearing of plate between rivet holes in the second row and shearing one rivet in single shear in the outside row.
3. Shearing one rivet in single shear in the outside row and four rivets in double shear in the second and third rows.
4. Tearing of plate between rivet holes in the second row and crushing the welt strip in front of one rivet in the outside row.
5. Crushing the plate in front of four rivets in the second and third rows and in front of one rivet in the welt strip in the outside row.
6. Crushing the plate in front of four rivets in the second and third rows and shearing one rivet in single shear in the outside row.

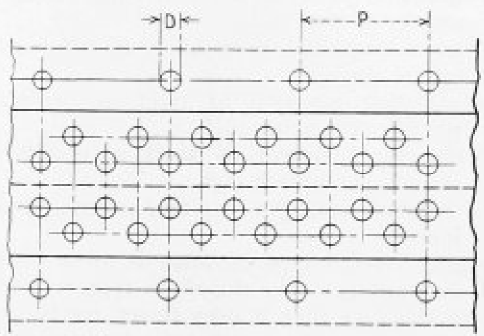


Fig. 1.—Triple-riveted seam using zigzag riveting

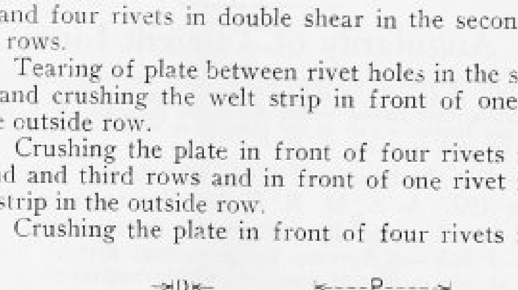


Fig. 2.—Triple-riveted seam using chain riveting

Resistance to Failure

1. $$\frac{(P\text{-}D) \times TS \times t}{P \times TS \times t}$$

2. $$\frac{(P\text{-}2D) \times TS \times t + A \times s}{P \times TS \times t}$$

3. $$\frac{A \times s + 4A \times S}{P \times TS \times t}$$

4. $$\frac{(P\text{-}2D) \times TS \times t + (D \times B \times c)}{P \times TS \times t}$$

5. $$\frac{4D \times t \times c + D \times B \times c}{P \times TS \times t}$$

6. $$\frac{4D \times t \times c + A \times s}{P \times TS \times t}$$

Efficiency equals the least value obtained in *1, 2, 3, 4, 5* or *6*. When:

TS = tensile strength of plate, pounds per square inch.
t = thickness of shell plate, inches.
B = thickness of welt strips, inches
P = pitch of rivets, inches, on row having greatest pitch.
D = diameter of rivets after driving, inches = diameter of rivet hole.
A = cross sectional area of rivet after driving, square inches.
s = shearing strength of rivet in single shear, pounds per square inch.
S = shearing strength of rivet in double shear, pounds per square inch.
c = crushing strength of plate, pounds per square inch.

The zigzag riveted type of seam is more commonly used. Its advantages over the chain type riveted seam are due to the fact that it uses fewer rivets and is a much narrower seam, because of the back pitch on the zigzag type seam being less than on the chain type seam.

Angularity of Tangent Lines

Q.—I am in need of information concerning the proper applications of that portion of Par. P.-199 that is found on page 25, A. S. M. E. code, 1927 edition, that applied to Sec. C. P-212, page 31. Is it proper to neglect the angularity part of the formulae to extract the square root in finding the pitch of stays? C. M. C.

A.—For the benefit of those who do not have a copy of the 1927 A. S. M. E. Boiler Construction Code at hand, I will quote the paragraphs questioned:

Par. P-212c.—A furnace for a vertical firetube boiler, 38 inches or less in outside diameter, which requires staying, shall have the furnace sheet supported by one row of staybolts, or more, the circumferential pitch not to exceed 1.05 times that given by the formula:

$$L = \left(\frac{220 \times T^2}{P \times R}\right)^2$$

where,
L = longitudinal pitch of staybolts.
T = thickness of furnace sheet in sixteenths of an inch.
P = maximum allowable working pressure, pounds per square inch.
R = outside radius of furnace, inches.

When values by this formula are less than the circumferential pitch, the longitudinal pitch may be as large as the allowable circumferential pitch.

The stress per square inch in the staybolts shall not exceed 7500 pounds and shall be determined in the way specified in section *d*.

Par. P-199. Page 25.—For stays at the upper corners of fireboxes, the pitch from the staybolt next to the corner to the point of tangency of the corner curve shall be (see Fig. P-7):

$$p = \frac{90\sqrt{C\dfrac{T^2}{P}}}{\text{Angularity of tangent lines } (\beta)}$$

where,
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, inches.
P = maximum allowable working pressure, pounds per square inch.
T = thickness of plate in sixteenths of an inch.
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 with ends riveted over.
β = angularity of tangent lines.

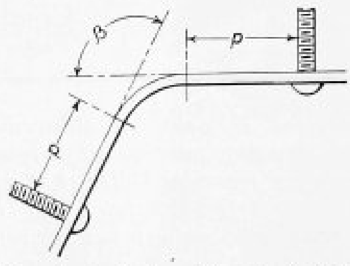


Fig. P-7.—Pitch of staybolts adjacent to upper corners of fireboxes

It would not be correct to omit the angularity part of the formula for the conditions as shown in Fig. P-7 that would be applicable to section *c* Par. P-212.

An analysis of the formula would perhaps clear up this question.

$$p = \frac{90\sqrt{C\dfrac{T^2}{P}}}{90}$$

$$p = \sqrt{C\frac{T^2}{P}}$$

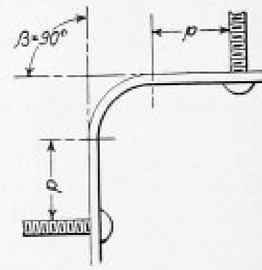


Fig. 1

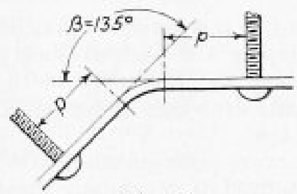


Fig. 2

$$p = \frac{90\sqrt{C\dfrac{T^2}{P}}}{135}$$

$$p = \frac{2\sqrt{C\dfrac{T^2}{P}}}{3}$$

$$p = \frac{90\sqrt{C\dfrac{T^2}{P}}}{180}$$

$$p = \frac{\sqrt{C\dfrac{T^2}{P}}}{2}$$

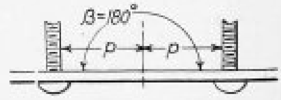


Fig. 3

Figs. 1, 2 and 3 show clearly the effect that the angularity of the tangent lines has upon the formulae.

In Fig. 1, showing a 90-degree corner, p had its greatest or full value.

In Fig. 2, showing a 135-degree corner, the value of p is reduced as the sheet tends to flatten out, the value received from the strength of the corner becoming less.

In Fig. 3, showing a 180-degree corner, which is a flat plate, the value of p is the least, the pitch of the staybolts receiving no support from the corner.

From these three figures it can readily be seen that the angularity of the tangent lines is the determining factor as to what extent the value of the strength of the corner influences the pitch of the staybolts.

Layout of Elbow

Q.—I shall be pleased if you will publish in THE BOILER MAKER at an early date a good layout for an elbow of less than 90 degrees. F. S. H.

A.—To lay out an elbow of less than 90 degrees it is necessary to construct the elevation as shown in Fig. 1, incorporating the desired angle and the diameter of the pipe. The number of sections is optional with the designer.

The intermediate sections should be made uniform, likewise the end sections, thereby making only two patterns necessary.

Bisect intermediate section *B* at points *1*, *9* and line thus found will be the center line of the intermediate section and pattern.

Draw semicircle *1-5-9* and divide into a convenient number of equal parts, eight in this case, and through the points of division draw the lines *2, 3, 4, 5, 6, 7, 8* parallel to lines *1-G* and *9-P*. Then through intermediate section *B* draw lines parallel to lines *Q-G* and *Y-P* intersecting the points *H, I, J, K, L, M, N* on junction line *G-P*.

To develop half pattern of end section *A*, as shown in (a) draw line *1'-9'* equal in length to half the circumference of the pipe and divide this line into the same number of equal parts as used in dividing the semicircle *1-5-9*. Draw lines at *1', 2', 3', 4', 5', 6', 7', 8', 9'*, at right angles to the line *1'-9'*. Measure off length of lines *1'-G', 2'-H', 3'-I'*, same lengths as the lines *1-G, 2-H, 3-I* in the elevation, etc. Then draw edge line *G'-P'* through points *H', I', J', K', L', M', N', P'*, completing the pattern as required for the finished elbow.

To develop the pattern for the intermediate section *B* as shown in (b), follow the same procedure as for the end section except the length of lines *G"-Q', H"-R', I"-S'* etc., are measured from the center line.

Area Supported by a Staybolt

Q.—Would you kindly advise how to determine the area supported by staybolt A when the bolts are spaced in the manner shown in Fig. 1. W. C. D.

A.—The area supported by the staybolt *E* as shown in Fig. 1 is determined by the application of paragraphs P-220 (a) and P-204 of the 1927 A. S. M. E. Code, which are as follows:

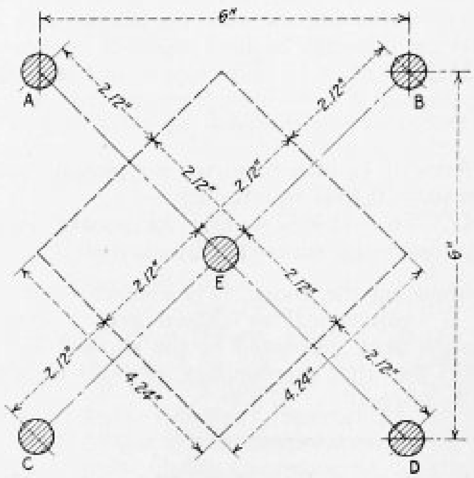
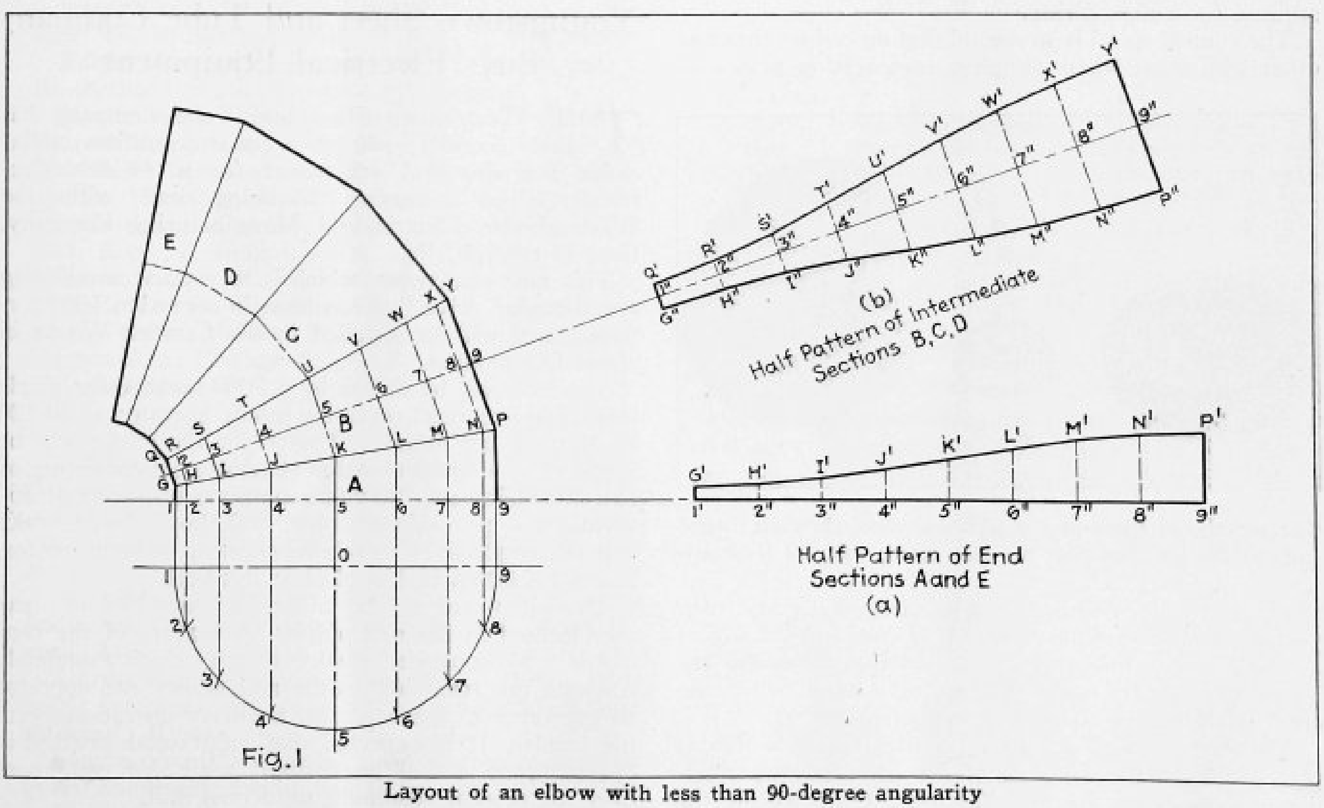


Fig. 1.—Area supported by staybolt E

P-220 (a).—The full pitch dimensions of the stays shall be employed in determining the area to be supported by a stay, and the area occupied by the stay shall be deducted therefrom to obtain the net area. The product of the net area in square inches by the maximum allowable working pressure in pounds



Layout of an elbow with less than 90-degree angularity per square inch, gives the load to be supported by the stay.

P-204.—The formula in Par. 199 was used in computing table P-6. Where values for screwed stays with ends riveted over are required for conditions not given in Table P-6, they may be computed from the formula and used, providing the pitch does not exceed 8½ inches. Where the staybolting of shells of boilers is unsymmetrical by reason of interference with butt straps or other construction, it is permissible to consider the load carried by each staybolt as the area calculated by taking the distance from the center of the spacing on one side of the bolt to the center of the spacing on the other side.

Referring to Fig. 1 which illustrates the question, and applying paragraph P-204 of the code:

AD and $BC = \sqrt{6^2 + 6^2} = 8.48$ inches. The center of the staybolt pitch EB would be 2.12 inches from E and for the staybolt pitch EC would be 2.12 inches from E, the same also for the staybolt pitches EA and ED thus making the area to be supported by the staybolt $E = 4.24 \times 4.24 = 17.9776$ square inches. Assuming that the staybolt E is ⅞-inch diameter and applying paragraph P-220 (a) of the code we then have:

Area of ⅞-inch diameter staybolt at root of thread = 0.4637 square inch.

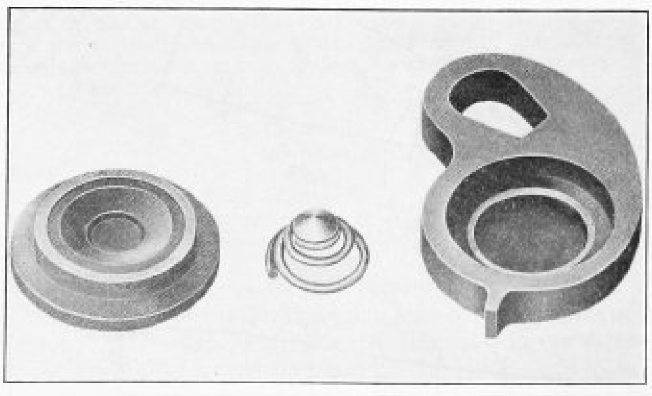
$17.9776 - 0.4637 = 17.5139$ square inches, net area to be supported by staybolt E.

In computing the above, it is assumed that the staybolting is symmetrical as shown over a considerable area, as the area supported by the staybolt E would be affected if the other surrounding staybolts were not symmetrically pitched.

Changes in the Everlasting Blow-off Valve

THE Everlasting Valve Company, One Exchange Place, Jersey City, N. J., has produced a blow-off valve in which a helical spring has been substituted for a disk spring.

The conical spiral is so wound that no coil touches any other coil, even when complete compression places all



The redesigned parts of the blow-off valve showing, beginning at the left, the disk, the disk spring and the lever arm

the coils of the wire in the same plane. This has made possible a much greater spring pressure, and the use of a much larger diameter wire, without increasing the length of the valve body. The spring is made of chrome steel, flashed with nickel, and copper plated.

The disk spring, with its spherical apex which is placed against the disk, materially increases the rotating movement of the disk. To permit the use of the disk spring, the design of the disk and the lever arm had to be modified. The base of the spring fits into a recess in the lever arm.

Yarrow High-Pressure Boilers for S. S. Duchess of York

By G. P. Blackall

THE boilers of the new Canadian Pacific liner *Duchess of York*, which was recently launched from the Clyde yard of John Brown & Co., Ltd., were designed by Yarrow & Co., Ltd., and built by the shipbuilders under agreement. They closely resemble the boilers of the new P. and O. liner *Viceroy of India*.

There are six high-pressure patent Yarrow boilers in the new Canadian Pacific steamer, consisting of a steel drum connected to three water drums by straight tubes. Between two of the water drums is the superheater. The gases from the boilers all pass up the superheater side as the boiler design is of the new single flow type. The working pressure is 370 pounds per square inch and the temperature of the steam at the boilers approximately 700 degrees Fahrenheit.

It is interesting to note that the first of the "Duchess" class of vessels to be completed has been running very high boiler efficiency under service conditions. J. Johnson, superintendent engineer of the company, recently stated that the consumption of oil per shaft horsepower for turbines only was 0.6 pound per shaft horsepower per hour, and for all purposes 0.64. This high efficiency is very largely due to the boilers, which are operating at an efficiency of 85 per cent. The boilers are similar to those of the *Duchess of York*.

Youngstown Sheet and Tube Company Buys Electrical Equipment

THE Youngstown Sheet and Tube Company has just recently placed a quarter-million dollar order for electrical equipment for a 44-inch electrically-driven reversing blooming mill with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

This new equipment, which is to replace an existing steam-engine drive that has been in operation for fourteen years, will be installed in the Cambell Works in about five months.

The mill will be driven by a 7000-horsepower single unit, direct-current, reversing motor operated at 50-120 revolutions per minute. Power for the motor will be supplied by a flywheel motor generator set consisting of two 3000-kilowatt, 700-volt generators operating at 360 revolutions per minute; one 5000-horsepower 6600-volt, three-phase, 60 cycle alternating current motor, and a 140,000-pound steel-plate flywheel.

The equipment will be under the control of an operator located in the mill pulpit. A feature of the control is a foot-operated master switch, which completely controls the reversing motor and allows the operator to take care of some of the auxiliary operations with his hands. It is expected that substantial savings in operating costs will be realized with this equipment over the present steam-engine driven mill.

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Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

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Assistant International President—William Atkinson, suite 522, Brotherhood Block, Kansas City, Kansas.

International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.

Editor-Manager of Journal—John J. Barry, suite 524, Brotherhood Block, Kansas City, Kansas.

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States and Cities That Have Adopted the A. S. M. E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Memphis, Tenn.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

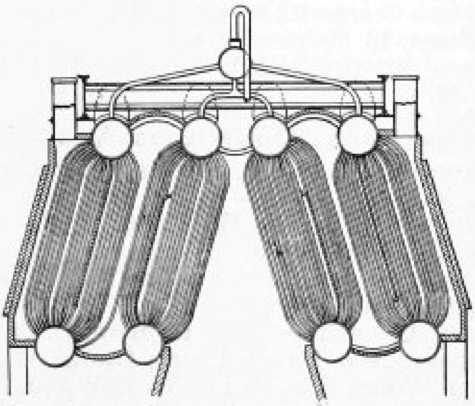
Compiled by
DWIGHT B. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

1,666,659. BOILER. GEORGE T. LADD, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO LADD WATER TUBE BOILER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

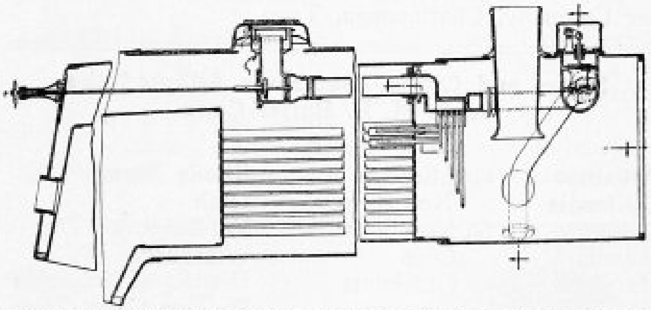
Claim.—A boiler installation having in combination a metal frame, a setting enclosed by the frame, two generating units, each consisting of



upper and lower drums and connecting tubes, pivotally suspended from the frame, and means carried by the frame for holding the lower drums in such positions that the axes of the lower drums will be outside of vertical planes coincident with the axes of the upper drums. Three claims.

1,662,841. LOCOMOTIVE. WILLIAM E. WOODARD, OF FOREST HILLS, NEW YORK.

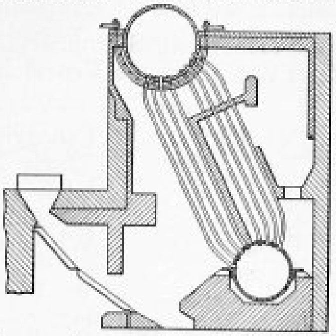
Claim.—The combination in a locomotive having a smokebox and an inside steam supply line including a superheater, of a main normal control



throttle in the smokebox on the chest side of the superheater through which all steam to the chests must pass, an outside operating connection therefor leading to the cab. Four claims.

1,665,664. WATER-TUBE BOILER. WILHELM HOFF, OF KIEL, GERMANY, ASSIGNOR TO FRIED. KRUPP GERMANIAWERFT AKTIENGESELLSCHAFT, OF KIEL-GAARDEN, GERMANY.

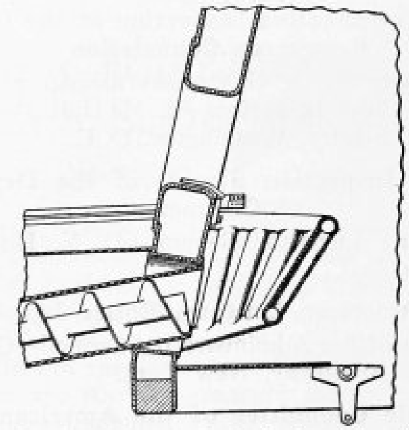
Claim.—In a watertube boiler comprising upper and lower drums, watertubes connecting said drums, and a protecting shell arranged concen-



trically below said upper drum consisting of longitudinally running strips provided with recesses for the watertubes, supporting means for said shell comprising straps running transversely of said shell and suspended at both sides of the drum, said strips lying free upon said straps. Two claims.

1,665,748. LOCOMOTIVE STOKER. NATHAN M. LOWER AND EDWIN ARCHER TURNER, OF PITTSBURGH, PENNSYLVANIA, ASSIGNORS TO LOCOMOTIVE STOKER COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

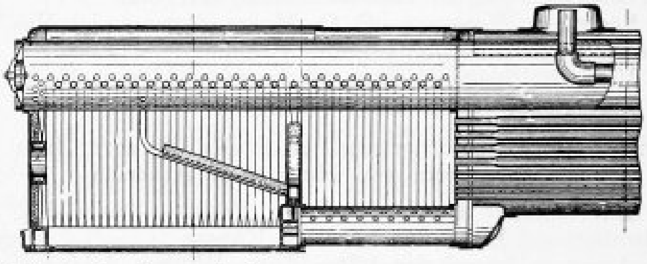
Claim.—In a locomotive firebox, a hollow back-head having an aperture adjacent the grate, a fuel delivering conduit discharging through such



aperature, a U-shaped wall formed of tubes having their ends in communication with the chamber of the back-head and inclosing the aperature, and means above the wall for projecting fuel thereover upon the grate. Nine claims.

1,682,692. LOCOMOTIVE BOILER. ALFRED W. BRUCE, OF NEW YORK, N. Y.

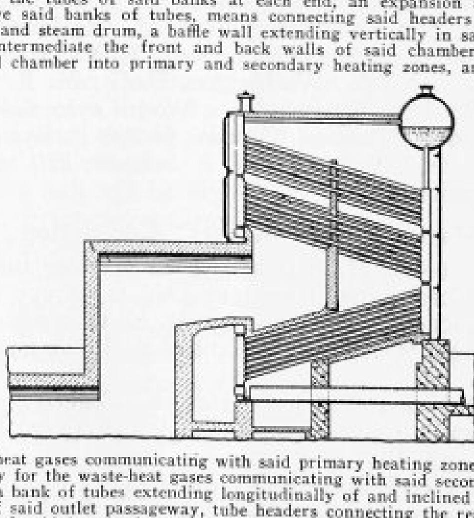
Claim.—In a locomotive boiler, the combination of a barrel; a firebox, comprising a combustion chamber and a fire chamber; a back head, having a rigid outer sheet and closing the rear of the fire chamber; a drum, supported, and fitting freely, in the back head, and extending forwardly therefrom into the barrel; water tubes forming the sides of the fire and combustion chamber; a hollow mud ring, communicating with the watertubes



of the fire chamber; a tube sheet secured to the barrel and closing the rear of the steam space thereof: a feedwater communication, leading from the barrel to the mud ring and communicating with the combustion chamber watertubes; and a wrapper sheet, secured to the barrel and to the fire box, and performing the functions of rigidly connecting said members together, and forming a housing covering the roof of the firebox. Eight claims.

1,666,276. BOILER. GEORGE L. WELLER, OF ELYRIA, OHIO, ASSIGNOR TO NATIONAL TUBE COMPANY, A CORPORATION OF NEW JERSEY.

Claim.—A waste-heat boiler comprising a heating chamber, a plurality of banks of tubes inclined from front to back of said chamber, tube headers connecting the tubes of said banks at each end, an expansion and steam drum above said banks of tubes, means connecting said headers with said expansion and steam drum, a baffle wall extending vertically in said heating chamber intermediate the front and back walls of said chamber so as to divide said chamber into primary and secondary heating zones, an inlet for



the waste-heat gases communicating with said primary heating zone, an outlet passageway for the waste-heat gases communicating with said secondary heating zone, a bank of tubes extending longitudinally of and inclined from back to front of said outlet passageway, tube headers connecting the rear ends of the tubes of said last bank and communicating with the tube headers connecting the rear ends of the tubes of said first named banks of tubes, other tube headers connecting the forward ends of the tubes of said last named bank of tubes and a combined feedwater and blow off drum communicating with all of the tube headers connecting the forward ends of the tubes.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX | March, 1929 | Number 3

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Master Boiler Makers' Committee Reports

COMMITTEES of the Master Boiler Makers' Association preparing papers to be presented at the convention in May should without fail submit their composite reports to the secretary of the association, as required, not later than April 1. In order for such reports to be included in the program of the meeting, it is necessary to establish a closing date for the receipt of material, which the executive board has fixed as above. Since the value of the convention depends in large measure on these reports and their discussion, it is the duty of every committee member to complete his investigations in ample time to permit the work being included. Where photographs or drawings accompany the report, care should be taken that clear prints or tracings be submitted so that the engravings made from them will show what the committee intended and not be subject to errors in interpretation.

From all indications the convention this year will be of unusual interest to members of the association, and will give them an opportunity to enjoy the hospitality of the south. Hotel reservations should be made at the earliest possible time because it is understood that conventions of other associations are scheduled in Atlanta for the same dates.

The convention will be held at the Hotel Biltmore, Atlanta, Ga., May 21 to 24 inclusive.

Preventing Accidents

ACCIDENT prevention in yards and shops has been made the subject of Bulletin No. 96 issued by the Interstate Commerce Commission. This report indicates that for 1927, on all railroads, 51 deaths and 6693 reportable injuries were caused by falls of employees in non-train accidents. That a substantial proportion of these casualties were chargeable to falls from elevations, such as temporary scaffolds, cannot be doubted.

Many of these falls could have been avoided by adopting the policy of moving the job in hand to a permanent scaffold instead of taking a temporary scaffold to the work. For many operations in the boiler shops of this country, the practice of utilizing permanent scaffolds, as is done in many foreign shops, might advantageously be adopted. One such system is described in an article in this issue outlining the modernization of the Great Western Railway shops at Swindon, England. Such improvements as this come within the scope of the boiler shop staff and do not involve any great expense. Very suitable scaffolds can be made from old boiler tubes welded together to give them the desired form and adequate strength. The use of split or limber planks should be avoided. If space will permit and the work is adapted to their application, the erection of permanent scaffolds will quickly repay the effort involved in erecting them by an increased safety to the men on the job.

Where temporary scaffolds must be employed it is a distinct responsibility of the foremen by inspection, example and discipline if necessary, to make sure that sufficient care and time are taken in the erection of such scaffolds. He must be certain that such structures afford reasonable assurance that they will not cause falls which result in loss of time by employees, loss of service to railroads and expense all round.

Open pits, broken flooring or gratings, air or steamline connection pits, where they occur, and unguarded holes in general are an ever present source of danger from falls. Laxness in repairing covers over pits or in providing guard railing or other means of preventing accidents of this type should be condemned by the shop management. Numerous falls occur due to stumbling over scrap, misplaced material and the like. Such conditions reflect not only on the men but on the supervision as well for permitting disorder in the shop.

In discussing this subject at a meeting of the National Safety Council last fall, Z. B. Claypool, assistant director of accident prevention for the St. Louis & San Francisco Railroad suggested the following methods of preventing accidents due to falls in the shop: First, by providing sufficient and efficient scaffolds; second, by safeguarding openings and third by clean housekeeping.

Laying Out Work

IN order for boiler makers to have a well-rounded knowledge of their trade, which unfortunately is more or less threatened by the present practice of specialization, they should at least be familiar with the fundamental principles of laying out. The series of articles on "Locomotive Boiler Construction" now appearing in THE BOILER MAKER indicates the practical application of laying out methods in the shop, as followed by one prominent locomotive builder. A more general article on the laying out practice at The Baldwin Locomotive Works boiler shop is also published in this issue.

Articles of this character are presented with the thought that since laying out boiler sheets is the basic operation in the construction of a boiler, every man interested in increasing his knowledge of the art of boiler making should begin his studies at this point. For the boiler maker, laying out work constitutes a practical boiler design course. In other words, it is the execution of the designing engineer's theory. Developed sheets as they leave this department form a picture of every operation through which these sheets must progress to the finished product.

In most shops, training courses in boiler work are not available and, with the present trend of specialization, the all-round boiler maker is in the minority. Nevertheless, it is possible for each individual to correct this condition in some measure by studying all operations in the shop on his own account. The management and shop supervisory staff should encourage initiative of this kind, and wherever possible, assist their men to a better understanding of boiler operations as a whole.

Those who intend seriously to broaden their knowledge of the craft of boiler making should bear in mind that all boiler work in the shop starts at the laying out bench, so this is the logical place to commence any organized study of the subject.

Communications

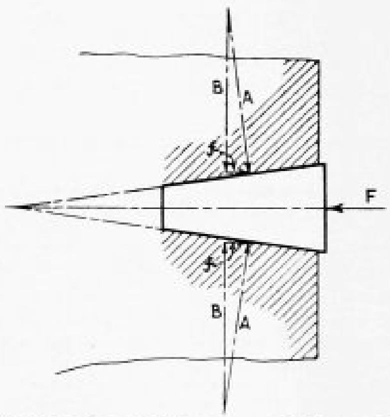
Wedge Action of Flue Plugs

TO THE EDITOR:

I was sufficiently interested in Mr. Feeney's communication in the February issue of THE BOILER MAKER, entitled "A Flue Plug Accident," to venture a probable, if not an actual, solution of the mystery.

I must assume, however, that the plugs referred to were cylindrical forgings or castings slightly tapered so that they would, by blows from a hammer, be wedged tightly in place in the ends of the flues.

Naturally, as is the case with any wedge tightly driven, there exists considerable pressure between the edge of the hole and the wedge, and it will require but a comparatively slight blow to loosen the wedge. By means of mechanics—that branch known as the composition and resolution of forces—it can be shown that there exists a horizontal component force due to the normal force or pressure between the edge of the hole and the wedge. This horizontal component of the force tends to push the wedge out of the hole, and is theoretically equal to the force applied when driving.



Efficiency of a wedge as a splitting medium

I have seen a drift pin, used in fitting up plate and structural work, fly ten feet in the air when the pin was slightly loosened by a tap from the hammer. Not so many weeks ago, the writer saw a small piece of flat steel, that had been taper-forged at one edge, while being used as a temporary wedge during some fitting-up work, suddenly fly out and spin pin-wheel fashion 10 feet when one of the workmen was trying to remove the wedge by tapping it from side to side. The flying bit of steel came within an eyelash of killing his helper.

Nothing can so well explain the theory involved here better that that which takes place when one shoots a watermelon seed between his thumb and index finger. The attached sketch illustrates the forces existing between the sides of the hole and wedge in any case. This diagram also shows, incidentally, the great efficiency of a wedge as a splitting medium. Note that the sum of the horizontal component forces f are equal to the driving force F. But note also the comparative magnitudes of the other component forces A and B. Force A represents the magnitude of the pressure normal to the edges of the hole and wedge, while force B represents the magnitude of the pressure tending to split the piece being driven into.

Erie, Pa. WM. C. STROTT.

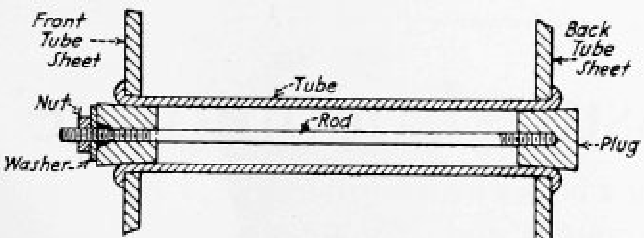
Fitting Flue Plugs

To the Editor:

Mr. M. Feeney's flue plug accident, described in the February issue, helped me to enjoy my breakfast while reading about it because of a similar case with which I am familiar. I am of the same opinion as Mr. Feeney, I would like to be shown.

I was sent to renew a 3-inch diameter tube in a horizontal return tubular boiler. When I arrived at the plant the engineer told me that some time ago, one of the tubes being pitted right through, had to be plugged, because they only had this one boiler and it was their busy time of the year. After he decided to plug it, he bought two solid plugs, put plenty of red lead on each and drove them in, one on each end, with a sledge. They held for some time until one morning he heard an awful report and found that the plug in the back end had blown out.

After shutting down the boiler so that we could renew the tube, we went into the back of the boiler looking for the plug. We couldn't even find a scratch on the rear wall. There was no way for the plug to get



Method of plugging tubes

away. We looked everywhere, but couldn't find it. I realized that there was power enough to drive it out; but the question was, where did it go to, as the boiler was located inside of a small building with the door closed.

This story leads to my method of plugging tubes when we had to. The plugs when in position are connected by a rod. The plugs on the fire end should never be drilled right through. Leave ¼ inch to ⅜ inch besides the taper on the drill; tap the plug to a snug fit on the rod thread; put the rod through the tube then put the plug on the rod and take two Stillson wrenches and tighten the plug on the rod. Put some good red lead on the plug and drive it in tight. There will thus be no nuts or threads to burn off in the fire or even to be exposed to the fire.

The plug on the opposite end should have a tapered hole, about one-third the plug length on the large end of the plug. By this means asbestos wicking can be made into gummets and soaked in red lead and a plate washer can be used that will fit the rod fairly tight. While pulling on the nut rap both plugs with a hammer, if you can get someone to help you.

These plugs can be cast with holes ready to receive the tap or with a tapered hole for asbestos.

New Haven, Conn. E. Williams.

Lessons from an Old-Timer

To the Editor:

Back in the old days of the boiler-making industry, which, by the way, appears to most of the graduates of today as being a time in which brains were lacking, a certain amount of pride was taken in the performance and finish of any job assigned to the student boiler maker. We had watched the old-timers and held the torch for them for many weary hours and we could not quite understand why the old-timer should be so careful in scarfing down for a patch; or why he should evince such an interest in the drilling of the holes for a patch. We did not understand why he should be so particular in fitting up a patch, especially a flanged patch; and we doubted the necessity of filing flue holes smooth before applying the copper ferrules. We also wished the job of filing the firebox end of the flue was in Jericho and we wondered what the heck the old-timer saw in laying up the iron between every hole. Oh, we were the wise lads in those days!

Yes, we did. The old-timers' teachings stayed with us, and some of us were more particular than the old-timers ever were. Do you remember the first job the boss gave you? say a patch on a side sheet. Didn't you hug that job? Wasn't it in your thoughts to the exclusion of all others? Ah, and in your dreams, too? How carefully you went over it, and, as the finish came, didn't you just a wee bit fear having the water turned in? and then, as the water crept higher you stood ready with a fine fuller to check any little sweat, and, Oh Boy, when she was full, and the Boss had looked at it and grunted "All right," no matter if he had not praised your workmanship, or asked you down to the house, you still felt as though you had the world by the ears!

I'll tell the world, those were the days! You had to slug and hammer, but it had its recompense; for you could go home at night after ten hours of knocking off rivet heads with a sledge and quote "Something accomplished, something done" has earned a night's repose. There was both truth and poetry in that old expression.

My first set of flues in the firebox end were rolled, turned over and beaded down. It was no air-hammer job either, just old "arm-strong" and, as you had to use the hammer right and left-handed, there was a sore finger or two before you got done. I looked on my work, and found it good, but I wanted the opinion of an old-timer, so I called Mike Ryan in. He looked them over, felt of the beads for smoothness, then the verdict,—"Well, Joe, they look good but the water will tell on you," and if any of the readers want a sermon, there's food for thought in that.

Lorain, Ohio. Joseph Smith.

Circumference of Boiler Plate

To the Editor:

In the January issue of The Boiler Maker, I noticed that one of the readers asked for a method to determine large and small circumferences of heavy and light plate. I herewith submit a method I have used for several years. We will take ½-inch plate 72 inches in diameter for example:

To find the large circumference:—

$$(72+\tfrac{1}{2}) \times \frac{22}{7} = 227.85 \text{ or } 227\tfrac{55}{64} \text{ inches}$$

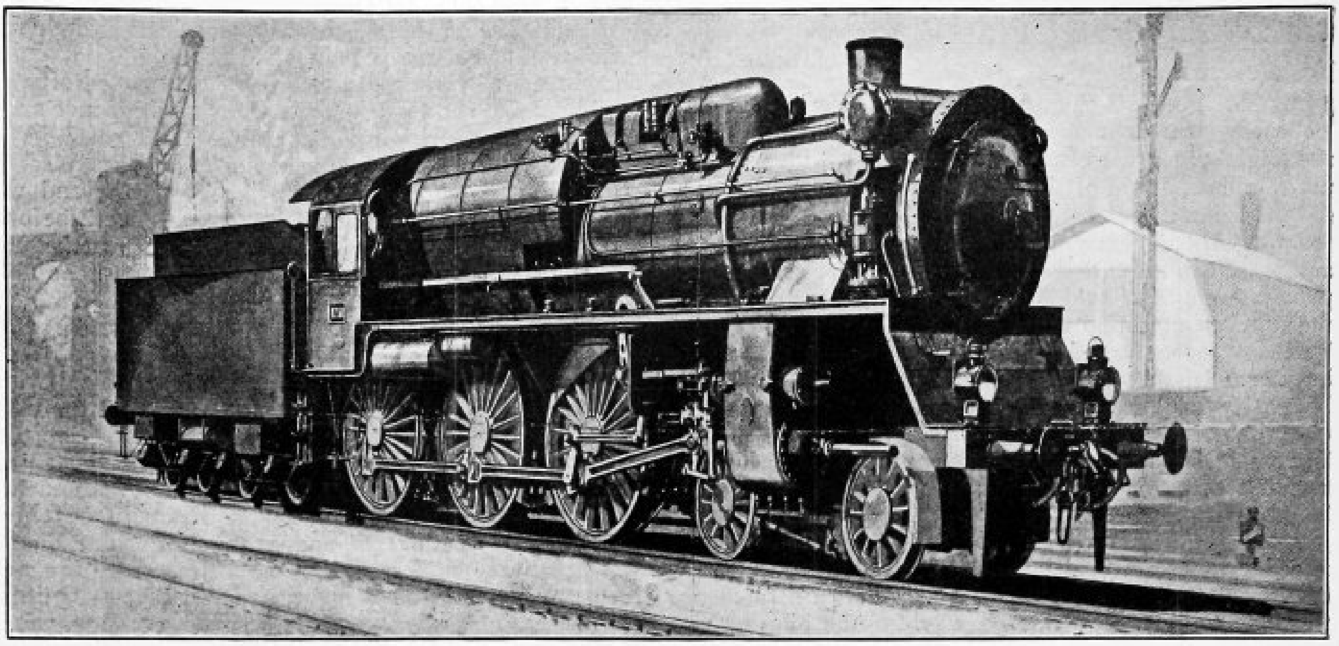
To find small circumference:—

Deduct 6½ times the thickness of the plate, this figure being determined as follows:

$$\frac{13}{2} \times \frac{1}{2} = \frac{13}{4} \text{ or } 3\tfrac{1}{4}$$

Thus the large circumference, $227\tfrac{55}{64}$, less 6½ times the thickness of the plate, 3¼, equals $224\tfrac{39}{64}$ inches.

A. F.



The first Schmidt high-pressure locomotive

Schmidt High-Pressure Locomotive*

Details of locomotive having a boiler which generates steam at pressures of 850 pounds and 205 pounds

By R. P. Wagner†

THOUGH it is by no means an easy task to deal with a subject whose development is not yet completed, the author will nevertheless venture to give a somewhat condensed outline of the present state of deevlopment and the latest test results of the Schmidt high-pressure locomotive in service on the German State Railway Company.

Although this locomotive has been mentioned in engineering publications at various times, it nevertheless seems best to preface the description of its present status with an account of the Schmidt process of generating and utilizing high-pressure steam. This is all the more desirable in that it discloses the ingenious way in which the late Dr. Schmidt and his successors evolved a steam-generating method which allowed the use of very high pressures without either calling for unattainable qualities of material or increasing the weight of the boiler to such an extent as to make it useless for locomotive purposes. It would have been an easier task had he been contented with two-thirds of the possible gain and set the limit at 600 pounds boiler pressure, as the general features of the present locomotive boiler could then have been maintained. Overstepping this limit means the necessity for developing a novel type of boiler, yet it opens the way not only to higher economy, but also to higher efficiency per pound of weight.

The high evaporation temperatures at high pressures (525 degrees F. at 850 pounds and 588 degrees at 1500 pounds) made it advisable not to expose the most sensitive part of the boiler, the drum, to direct radiation, where its walls might become heated above the evaporation temperature. This Schmidt accomplished by introducing his system of indirect heating, Fig. 2. A tube system *a* is exposed to hot combustion gases or preferably to radiant heat. This system is filled with distilled water, and the steam generated therein rises into the cooling coil *B* in the high pressure boiler *A*. In this coil the steam is condensed transferring its heat to the water of the boiler, and the condensate flows to the bottom of the system through downcomers not exposed to the heat. The system is self-contained and the quantity of water in it never varies except in case of leakage. When the boiler water reaches the boiling point and further heat is transmitted to it, naturally steam is generated and pressure is developed. As the heating system is continuously receiving heat from the furnace and is entirely enclosed, the pressure in it rises higher than that in the boiler, and the difference between the two pressures is such as to provide for a sufficient drop in temperature between the cooling coil and the boiler water. Thus a certain pressure in the heating system (about 1360 pounds) is co-ordinated with a boiler pressure of 850 pounds for a given area of coil surface and a given quantity of heat transferred. No safety valve is necessary in the heating system, because if more heat is absorbed by it than intended, the pressure rises

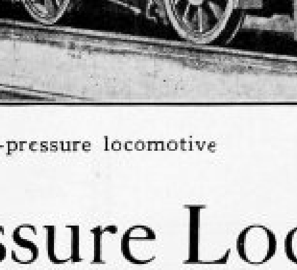


Fig. 2.—Scheme of indirect heating system

* Abstract of paper presented at the annual meeting of the American Society of Mechanical Engineers, Railroad Division.

† Superintendent, locomotive department, Deutsche Reichsbahn-Gesellschaft,, Berlin, Germany.

slightly above 1360 pounds and consequently the temperature increases, the result being that more steam is generated in the boiler, which is either consumed in the cylinders or blown off through the boiler safety valve.

Application to Locomotive Firebox

This steam-generating system, which owing to its simplicity is less subject to failure than most other circulating systems, lends itself very advantageously to the design of a locomotive firebox. Referring to Fig. 3 the heating system forms the walls of a watertube firebox; the tubes rise vertically from water chambers at the bottom up to the level of the crown sheet. There half of them discharge the rising mixture of water and steam into collecting chambers parallel to the boiler, while the others are bent horizontally, and discharge into the collecting chambers on the opposite side. Firebrick are laid over this archwork to prevent radiant heat and combustion gases from reaching the boiler drum, which is arranged longitudinally above the firebox. In the collecting chambers the steam is separated from the entrained water, and from their upper tubes lead to the coils inside the boiler. The tubes carrying the condensate back to the water chambers at the bottom are so arranged as not to be exposed to radiation and gas circulation.

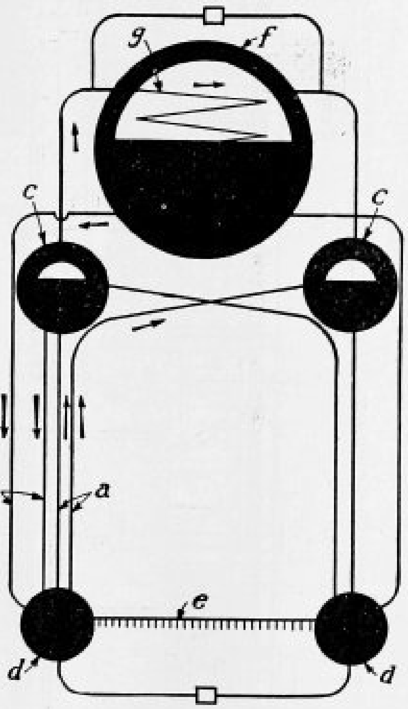


Fig. 3.—Diagram showing arrangement of Schmidt high-pressure locomotive firebox

a—steam generating tubes; b—downcomers; c—upper collecting chambers; d—bottom water chambers; e—furnace; f—850-pounds pressure boiler drum; g—heating units.

This system has proved itself to be a thoroughly reliable one for heating a high-pressure boiler, but it should be borne in mind that it is a far cry from a heating system to a locomotive ready for service.

A high-pressure boiler in the present state of development must be designed as a long, narrow drum which will not permit of the usual amount of scale accumulating in it. No one on the designing staff, however, cared to incur the troubles of condensation merely for the sake of feeding clean water into the boiler, and to clean a long drum by blowing off only seemed hopeless. So, on the advice of the Schmidt Superheater Company to the author's department the locomotive was provided with a tubular low-pressure boiler, into which the feedwater is first pumped. This boiler is of the ordinary tubular type and carries 205 pounds pressure. In it the feedwater is heated far enough above the temperature at which scale is precipitated to insure practically complete precipitation. From this boiler the feedwater is pumped over into the high-pressure boiler, carrying with it only a small percentage of suspended matter which forms a harmless mud that can be easily removed from the coils by blowing off.

Cleaning the feedwater, though, is not the only advantage of the tubular boiler. Instead of a throat sheet its rear end is a circular tube plate, and the combustion gases are sent through a system of flues like those of an ordinary locomotive boiler into the front end. Their heat is partly used for raising steam at 205 pounds pressure, and partly for superheating both the high-pressure and low-pressure steam. A pressure of 850 pounds necessitates the use of a compound engine and re-superheating of the receiver steam; on the other hand, a receiver superheater would accumulate more or less lubricating oil entrained from the high-pressure cylinders and clog up with oil coke. For this reason the low-pressure boiler has been designed so as to produce about 40 percent of the total steam generated. A small portion of this steam is used for the auxiliaries, which it seemed wise to run on low pressure. The

General Description of Locomotive

Engine	
Cylinder diameters:	
High-pressure	11 7/16 in.
Low-pressure (2 cylinders)	19⅝ in.
Stroke	24¾ in.
Cylinder-volume ratio (1 l.p. cyl., 2 l.p. cyls.)	1:6.5
Diameter of drivers	79 in.
Diameter of truck wheels	39 7/16 in.
Rigid wheelbase	15 ft. 5 in.
Total wheelbase	30 ft.
High-Pressure Boiler	
Steam pressure (exact)	853.5 lbs. per sq. in.
Diameter of firebox tubes (internal and external)	1⅝ in., 2 in.
Heating surface of firebox (external)	217.8 sq. ft.
Diameter of evaporating coils in boiler (internal and external)	1¼ in., 1½ in.
Heating surface of coils (external)	426.3 sq. ft.
Length of boiler	16 ft. 11 in.
Diameter of boiler (internal)	3 ft.
Water oontent at lowest level	62.5 cu. ft.
Height of low-water level above center line	4 in.
Number of hp. superheater units	30
Hp. superheater heating surface	430.6 sq. ft.
Low-Pressure Boiler	
Steam pressure	205 lb. per sq. in.
Diameter of boiler	5 ft. 7 in.
Length of tubes	13 ft. 9 in.
Number of tubes	116
Diameter of tubes (internal and external)	3 in., 3¼ in.
Heating surface (internal)	1265 sq. ft.
Water content at lowest level	127.1 cu. ft.
Number of l.p. superheater units	56
Diameter of l.p. superheater tubes (internal and external)	23/32 in., ¾ in.
L.p. superheater surface	426.3 sq. ft.
Grate	
Length	9 ft. 1 in.
Width	2 ft. 11¼ in.
Area	26.5 sq. ft.
Surface of feedwater heater	146.4 sq. ft.
Weight of locomotive empty	190,000 lb.
Weight of locomotive in service	204,000 lb.
Weight on drivers	133,900 lb.

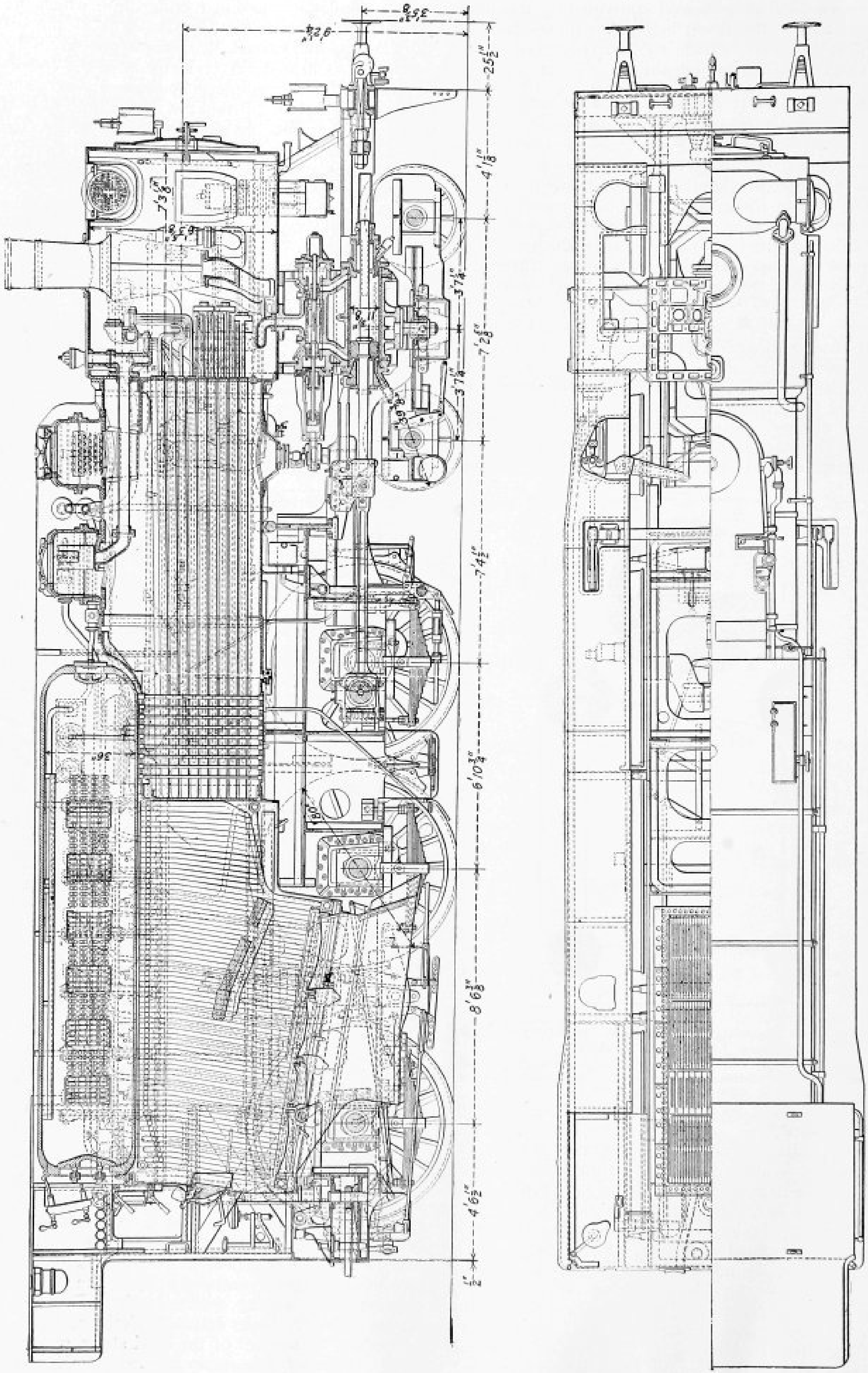


Fig. 4.—Sectional plan and elevation of Schmidt high-pressure locomotive

major part, however, is highly superheated and mixed with the fairly well saturated exhaust from the high-pressure engine, thus re-superheating it without sending it through a superheater.

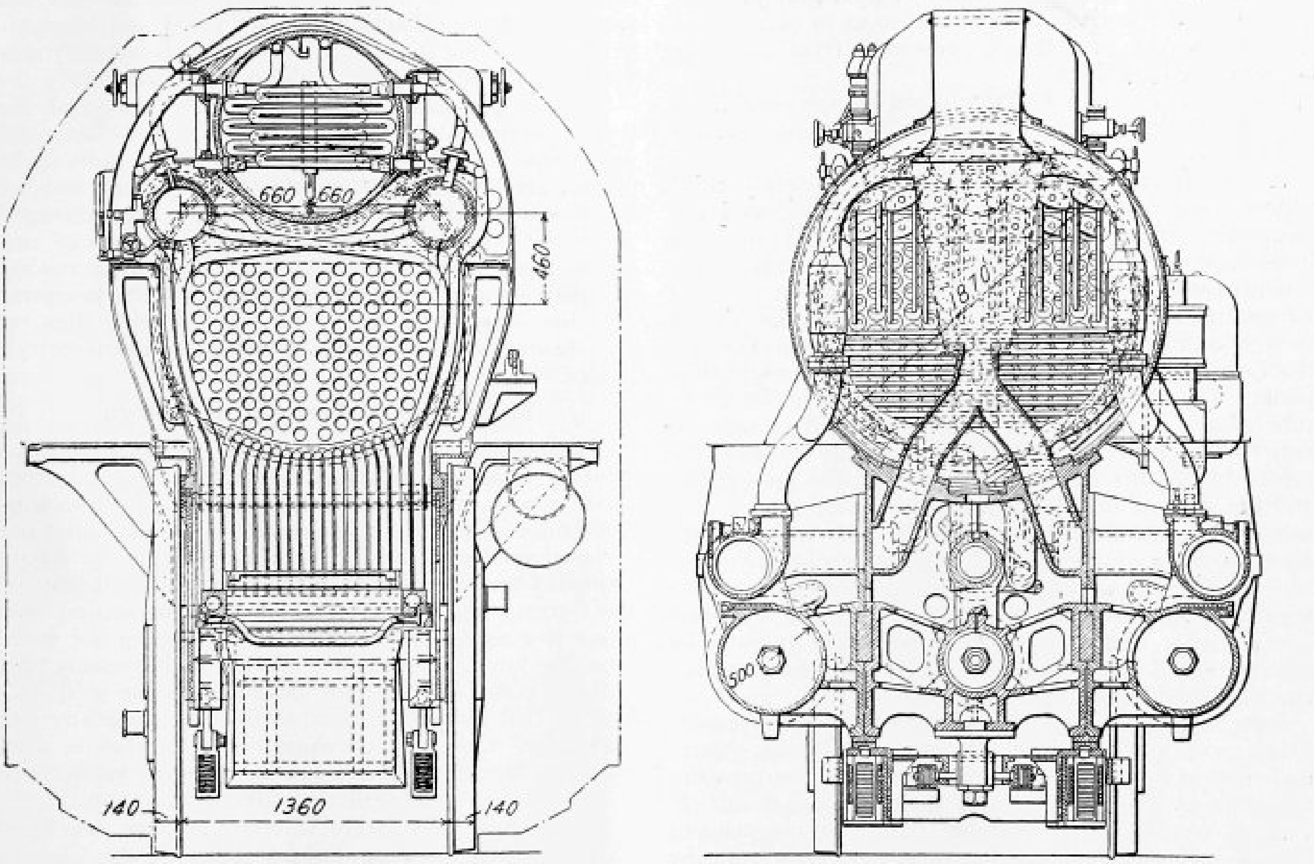
It was along these lines that the final design of the locomotive was built in the shops of Messrs. Henschel & Sohn, Cassel, Germany. For testing the system it seemed sufficient to put a test boiler upon an existing locomotive. One of the older types of the German State Railway Company, a 4-6-0 high-speed passenger locomotive, seemed especially suitable, as it carried three cylinders and could be easily compounded by converting one of them into a high-pressure cylinder. As two-thirds of all the steam is generated at high pressure and roughly half of the steam energy is utilized in the high-pressure part of a compound engine, one-third of the entire work should be performed by the high-pressure cylinder. For this reason a three-cylinder locomotive was chosen for conversion.

Figs. 4 to 6, inclusive, show the general outline and appearance of the finished locomotive. From these it is seen that the space occupied by the high-pressure part of the boiler is practically identical with that of the firebox of any locomotive of the usual design. As the performance and qualitative value of the heating system when applied to intense radiation were not fully known at the time when this locomotive was planned, it seemed wise to subdivide the heating system. By doing so the quantity of steam and water set free by an explosion or leakage would be reduced to a fraction of the total water content. Consequently the heating system was subdivided into six parts which are clearly visible in Fig. 3. This meant also subdividing the collecting chambers and coils.

The bottom chambers are arranged all around the grate in place of a mud ring, the sections being clamped to each other so as to form a rigid frame structure. Each chamber consists of a steel block forged and bored hollow.

From these chambers the heating tubes extend upward, forming the four walls of the firebox; the front-wall tubes are bent forward so as to form a combustion chamber. The tubes are fastened in the chambers by rolling. Welding is not employed, as the joints are subject to bending stresses.

The two upper collecting chambers are 11 inches in diameter and at the bottom enter alternately the heating tubes of their own and of the opposite side; it is here where each individual system is filled with water at the beginning. A bull's-eye water gage indicates the water level when the boiler is cold.



Figs. 5 and 6.—Vertical cross sections of Schmidt high pressure locomotive

The high-pressure boiler consists of a 3 percent nickel-steel drum forged over a steel mandrel. By choosing this heat-resisting though soft material it was found possible to keep the thickness of the walls down to 1 13/16 inches. A drum of this kind is first forged in the form of a thick-walled tube; it is then roughly machined inside and out, and if no fissures or segregations are found, both ends are shaped in another heat. After that it is machined to size. On the outside the heads of the drum are turned on the outside on a lathe, but the tubular part is machined lengthwise on a shaper because of its departure from a circular contour due to reinforcement at tube connections. All connections of the heating system are arranged on the outer side of the drum so that joint leakage will not empty one of the systems into the drum.

The front-end manhole is just large enough to permit machining the drum inside; the rear one is made as large as possible; and here the coils are inserted, and the boiler inspected and cleaned.

One of the chief aims in designing was to retain the boiler as the backbone of the locomotive, i.e., to retain the rigidity of the ordinary locomotive boiler. A rigid connection has been attained between the front end of the drum and the low-pressure boiler placed ahead. The drum and the comparatively heavy upper collecting chambers are supported by a number of rigid structural frames extending down to the locomotive frame; these structures are connected with each other by cross-ties, and the structure, as a whole, slides on the frame.

The structural frame supporting the high-pressure boiler makes it easy to provide an airtight sheet-metal casing for the firebox. The tubes of the heating system are loosely suspended in the frame so as to permit free vertical expansion, and are prevented from swinging horizontally by guides.

The plate frame of the locomotive, though considered an obsolete design, was retained so as to make the rebuilding as inexpensive as possible.

It was found easier to develop a sufficiently solid connection between the high-pressure system and the locomotive frame than between the high-pressure and low-pressure boilers, both being tubular. Since the low-pressure boiler was to be fitted into an existing locomotive it had to retain some features of the former though obsolete design, e.g., the original diameter and the L-iron connection between the front sheet and tube plate. The throat sheet was replaced by an ordinary tube plate. To obtain an absolutely rigid connection between high-pressure and low-pressure boilers the center line of the former was raised as far as possible, and the shell of the latter was dished inward for a distance of 5 feet from the rear end. The narrow radii on both sides of the inward bulging are heavily reinforced and their tops machined into horizontal faces extending 3 feet lengthwise. This part of the low-pressure boiler is reinforced against the inside pressure by a longitudinal row of vertical staybolts and by scythe-shaped plates across the top of the boiler.

Determining the heating surface of the low-pressure boiler was another point of interest. If the steam-distribution gear of the high-pressure and low-pressure cylinders was to be fixed at a definite ratio of cut-off (which seemed more desirable than two independent cut-offs), the relative quantity of steam taken from the low-pressure boiler was bound to vary to a certain extent, at various cut-offs; consequently for a given cylinder ratio the capacity of the low-pressure boiler was so determined as neither to drop too low at a long cut-off (which would mean a useless pressure drop of the exhaust of the high-pressure cylinder), nor to rise beyond the pressure the safety valves were set for, as in this case they would not only blow off the surplus steam raised at 205 pounds but also part of the exhaust high-pressure steam.

Calculation pointed to a heating surface of around 1200 to 1300 square feet (exposed to combustion gases), and one of 1265 square feet was obtained by choosing for the boiler the type E superheater and putting into it 116 tubes of 3-inch inside diameter.

All of the feedwater enters the steam space of the low-pressure boiler close to the top of the forward steam dome, and is sprayed on loosely piled-up grates made from V-sections which form small troughs. In trickling down from layer to layer the water is quickly heated to a temperature above that at which scale is precipitated. The greater part of the scale is thus deposited upon these racks, and the remainder washed down with the water, remains in suspension, as an innocuous mud which slowly settles down on tubes and boiler plates but never forms a hard, adherent scale. This scale-precipitating device has nothing to do with the design of the high-pressure locomotive; it is part of the standard practice of the German State Railway Company, and is put into every new locomotive fitted with a feedwater heater. In this case it is doubly useful as it insures fairly clean feedwater for the high-pressure boiler.

The high-pressure superheater occupies 60 tubes of the lower half of the boiler. The live steam enters a cast-steel chamber on the left-hand side of the smokebox. From this chamber 30 units or elements, each inserted into two tubes, lead horizontally across the front end to the collecting chamber placed on the right-hand side. This chamber admits the steam directly into the valve chamber of the high-pressure cylinder.

The low-pressure superheater, which is also of the type E, occupies the upper 56 tubes of the boiler. All units have a single return bend only, so 56 units in 14 groups are connected with both the saturated and the superheated chambers of a regulation header arranged above the superheater. From this header each of two steam pipes lead, inside the front end, to a mixing chamber, in which hign-pressure exhaust and low-pressure live steam are mixed (the former being thus re-superheated), and then on further to both outside cylinders.

Miscellaneous Features of Design

An important part of the design of the locomotive was the task of developing the feed pumps and other boiler accessories for such a pressure. The low-pressure boiler is chiefly fed by means of a piston pump and a closed feedwater heater, both supplied by the Knorr Company and identical with the standard equipment of the German State Railway Company; the second feed pump is a regulation injector. For pumping the water from the low-pressure boiler into the high-pressure part a piston pump seemed more desirable, as the small volume of that part made accurate feeding imperative, so the Knorr Company developed a high-pressure feed pump on the same lines as their standard pump, with two compound steam cylinders arranged in tandem.

Boiler check and safety valves have been developed on very much the same lines as those of the German standard locomotives, and it is believed that these parts, when properly dimensioned, will give very little trouble at high pressure.

A serious problem at first was the developing of a satisfactory water gage. It soon became obvious that for direct connection with the high-pressure boiler, nothing but a bull's-eye gage would do, so one of this kind was developed. Even then great care had to be taken not to expose the individual glasses to any uneven pressure due to the heat expansion of the enclosing material.

Road Tests

Such was the design and status of the Schmidt high-pressure locomotive when, after a number of preliminary runs, it underwent a series of road tests carried out by means of one of the very complete dynamometer cars of the German State Railway. This first series of tests was run in February and March, 1927, on the Magdeburg division, and covered a distance of 101 miles in most cases. The fuel consumption during the tests ranged at all times between 2 and 3 pounds of coal per drawbar horsepower-hour, with a minimum of 2.25 pounds.

After the tests were completed and had proved that the danger of an explosion of the heating systems was no worse than in any other type of boiler, the locomotive was returned to the makers and they were advised to connect all heating systems with one another so as to equalize the action of the coils. This they did very excellently by replacing the subdivided lower and upper collecting chambers by one extending over the whole length of the firebox. The time in the shop was also utilized to extend both high-pressure and low-pressure superheater units closer to the firebox tube sheet, i.e., to 8 inches distance, as the superheat had been somewhat low.

A general inspection showed that the high-pressure boiler contained no solid scale at all. The only residue was a very thin layer of mud deposited upon the coils and the boiler shell. This mud is naturally entirely inactive and is washed off by the turbulent motion of the water. When dried it forms a thin film of dust which is blown off easily. This shows that the boiler-feeding process chosen by the Schmidt Company works to satisfaction, and that condensing operation need not be resorted to in a high-pressure locomotive provided the feedwater is purified first in a low-pressure boiler or feedwater heater.

After completing the alterations mentioned and some minor repairs, the makers returned the locomotive to the Locomotive Testing Department of the State Railway Company, and another series of dynamometer tests was run during the months February and March, 1928, most of them on the same division as before with highly satisfactory results.

Work of the A.S.M.E. Boiler Code Committee

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Any one desiring information as to the application of the code is requested to communicate with secretary of the committee, 29 West 39th St., New York, N. Y.

The procedure of the committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the secretary of the committee to all of the members of the committee. The interpretation, in the form of a reply, is then prepared by the committee and passed upon at a regular meeting of the committee. This interpretation is later submitted to the council of the Society for approval, after which it is issued to the inquirer and published.

Below are given records of the interpretations of the committee in Cases 609 (Reopened), Nos. 610 (Annulled), and 612-616 as formulated at the meeting on December 13, 1928, all having been approved by the Council. In accordance with established practice, names of inquirers have been omitted.

Case No. 609 (In the hands of the Committee)

Case No. 610 (Annulled)

Case No. 612. *Inquiry:* Is it permissible, under Par. P-268 of the Code, to attach either couplings, one-half couplings or nipples on to boiler plates for blow-off and feedwater connections, by fusion welding, and without tapping the boiler plates and screwing the couplings or nipples in with required number of threads, the strength of such connection being dependent on the strength of the weld?

Reply: Such a nipple or fitting as described may be welded into a boiler plate, if it has a retaining flange or shoulder to rest against the inner surface and sustain the stress due to steam pressure. A hole cut in a drum for such a nipple or fitting cannot be larger than 6 inches in diameter and the fittings cannot be used for larger than 3-inch pipe size except as provided for in Par. P-268. The Power Boiler Code does not permit a fitting or attachment to be welded where the safety of the structure is dependent upon the strength of the weld.

Case No. 613. *Inquiry:* Is it necessary, under Par. P-264 of the Code, to insert manhole openings in all locomotive-type boilers over 40 inches in diameter? Is not the exception for internally fired boilers under 48 inches in diameter applicable to this type of boiler?

Reply: The boiler commonly known as the locomotive type is an internally fired boiler and it is therefore the opinion of the committee that if the diameter or width of such locomotive-type boiler is not in excess of 48 inches the manhole requirement does not apply.

Case No. 614. *Inquiry:* Do the requirements of Par. P-324 of the code apply to horizontal return tubular boilers when they are set in a steel frame which consists of a firebox directly underneath the boiler and the frame work bolted to the sides thereof? It is pointed out that where the insulating lining has not been properly maintained the plates and supports have buckled and allowed the boiler to lower in the setting.

Reply: The requirements in Par. P-324 contemplate settings which are essentially of brick construction, but it is the opinion of the committee that in any case where the supports are of structural steel they should be so insulated that their supporting strength cannot be impaired from the heat of the furnace.

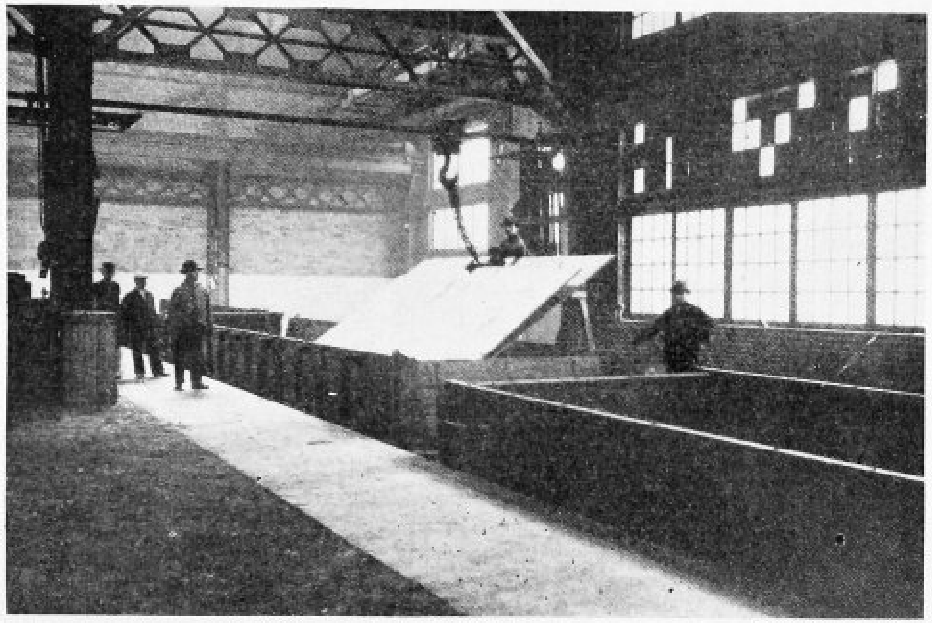
Case No. 615. *Inquiry:* Is it necessary, under the requirements of Par. P-301 of the Code, that the stop valve nearest the boiler shall be located directly at or upon the boiler nozzle? Is it not permissible for pipe connections or fittings to be inserted between the nozzle and the first stop valve as reflected in the second sentence of Par. P-302?

Reply: It is not necessary that the first stop valve be located directly at or upon the nozzle of a boiler. Par. P-301 permits of intervening pipe or connections, but indicates a preference for the shortest and most direct connection possible between them.

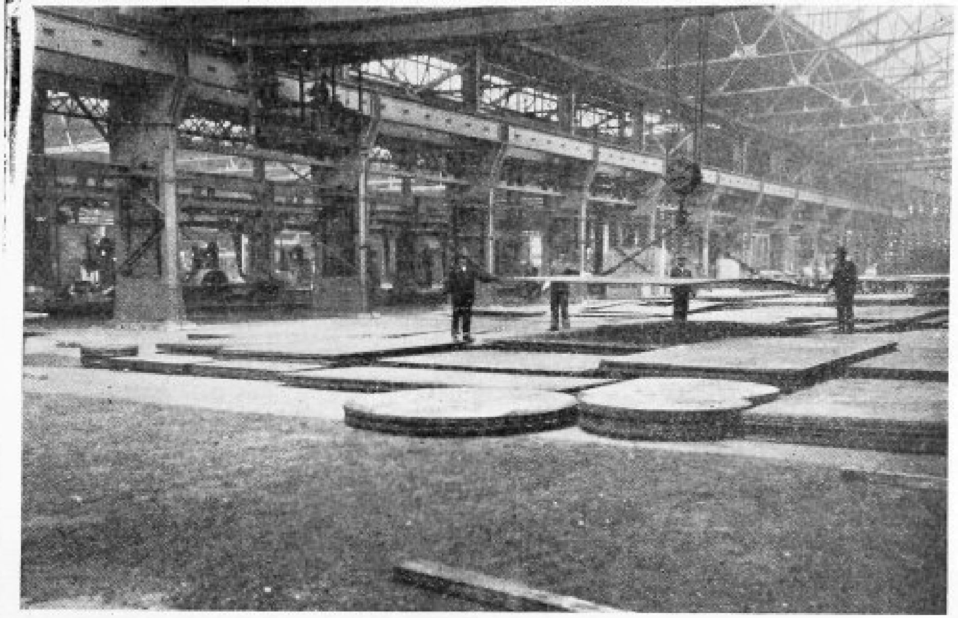
Case No. 616. (In the hands of the Committee.)

Heating Engineers Elect President

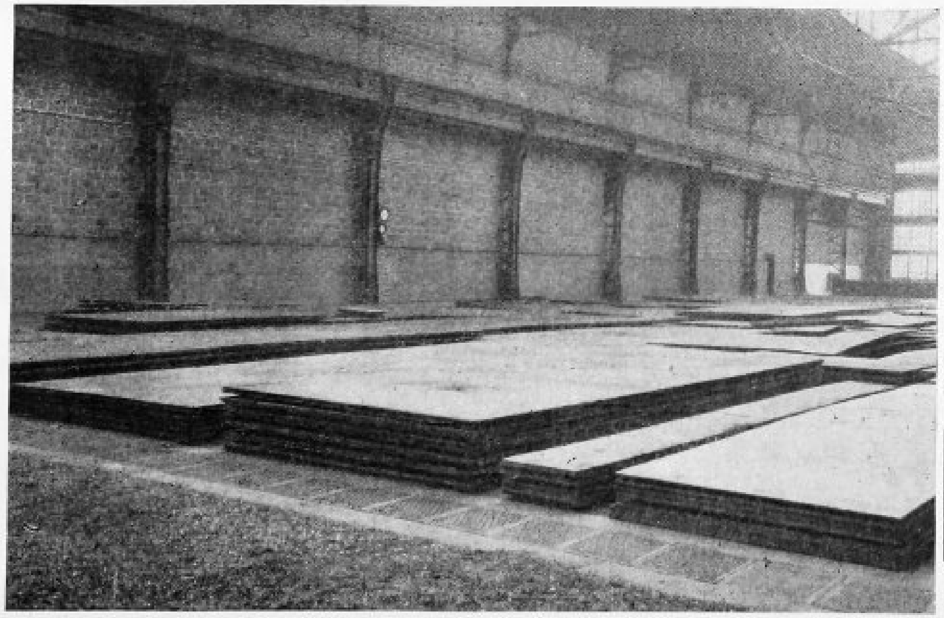
THORNTON LEWIS, Philadelphia, Pa., was elected president of the American Society of Heating and Ventilating Engineers at the 35th annual meeting, Chicago, Ill., January 28. Since 1923, Mr. Lewis has been a member of the council, and has been one of the most energetic members in the advancement of the society. His work on several technical committees has been outstanding. He was chairman of the committee on research, and a member of the committee to determine maximum boiler output, while his accomplishments, when he headed the important general committees of the council, such as the finance and executive committees are well known.



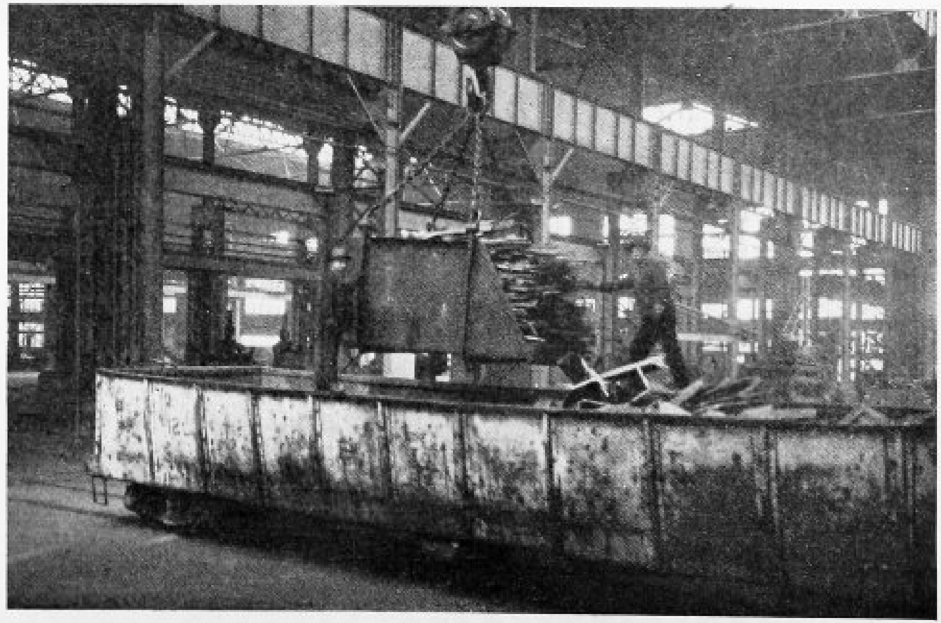
Unloading plate from freight cars in bay No. 11



Method of handling plate in the storage department



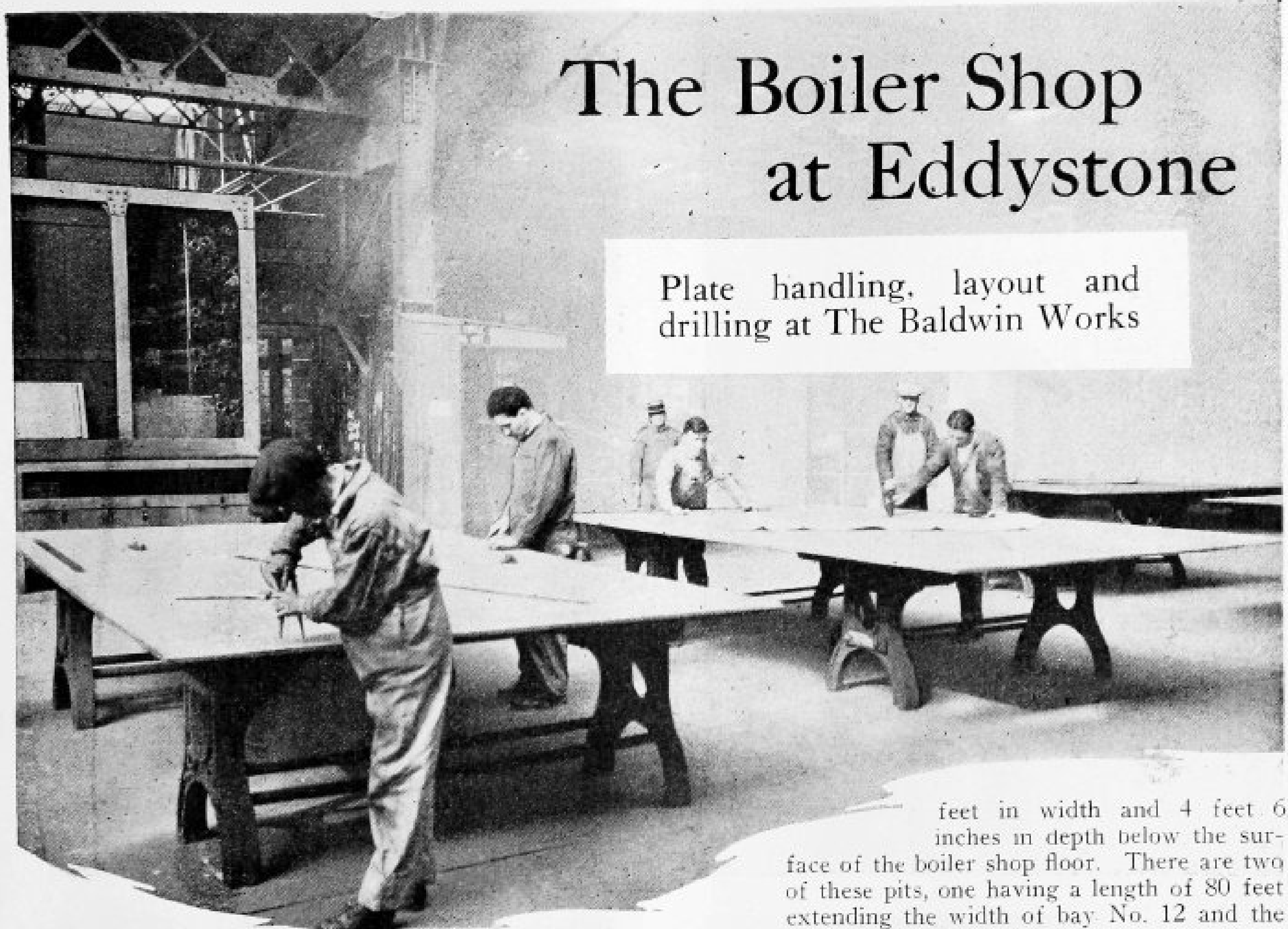
Storage of boiler plate in bay No. 12



Loading scrap material on freight cars by means of skips

The Boiler Shop at Eddystone

Plate handling, layout and drilling at The Baldwin Works



THE flow of materials through the boiler building department of the Eddystone, Pa., plant of The Baldwin Locomotive Works follows an orderly procedure, requiring the least amount of material handling and clerical work. The layout of the shop, described in a previous article, provides the basis for the efficient employment of all equipment.

To obtain an idea of the course followed by material from the receiving platform, the requisition will be traced from the design department where the order for material originates. When the drawings for a locomotive boiler have been completed to the stage where material may be procured, the drafting department issues an order to the purchasing department for the required material. The purchasing department in turn orders the plates from the rolling mill, where they are rough cut to size and inspected by a representative of The Baldwin Locomotive Works. At the rolling mill, each plate is marked with a number corresponding to that on the bill of material, the serial number, the size of plate, and thickness, in addition to the steel mill's identification marks.

The material and shipping department advises the boiler shop of the material to be shipped from the steel mill each day. By this means, the shop is notified in advance of the actual receipt of material and is able to plan the work accordingly. When the material enters the boiler department, the car is traced by the traffic department and spotted in the receiving pits.

The receiving pits are located in the south end of the boiler shop and are served by the ladder track which enters the building by means of doors located at the southwest ends of bays Nos. 11 and 12. The pits are 11 feet in width and 4 feet 6 inches in depth below the surface of the boiler shop floor. There are two of these pits, one having a length of 80 feet extending the width of bay No. 12 and the other having a length of 162 feet, extending through both bays Nos. 11 and 12. The two receiving pits will permit the spotting of five cars at a time.

The door openings at the west end of the receiving pits are 18 feet 7 inches in height and 16 feet in width allowing ample clearance for the largest plates that require handling in the shop. A plate 197½ inches in width may be handled with ease through these doors when carried in a well car.

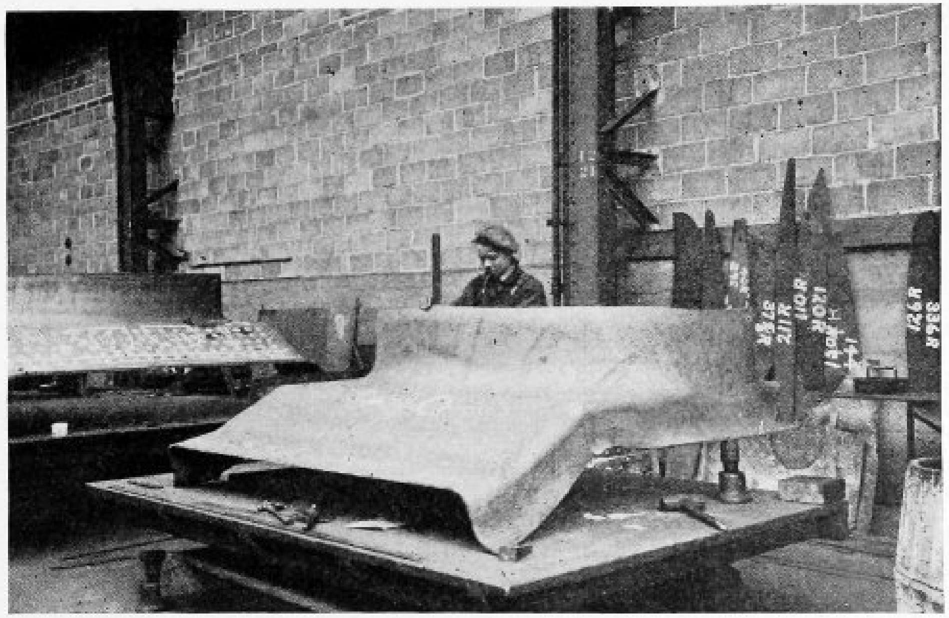
The receiving door is of the folding type built in three pieces with the hinges horizontal. The lower portion of the door is the same size as the width and depth of the receiving pit while the two upper portions are 16 feet in width. A hand-operated chain hoist is employed to raise and lower the doors, the lower corners of the second section running in a vertical track located on each side of the door opening. When being raised, the hinged portion is thrown outward.

The unloading and storing of materials comes under the charge of a contractor who is responsible for supplying material to the various departments in the boiler shop. In addition to all the overhead traveling cranes in the shop, this contractor has charge of the operation of two tractors, six trailers and six rail trucks.

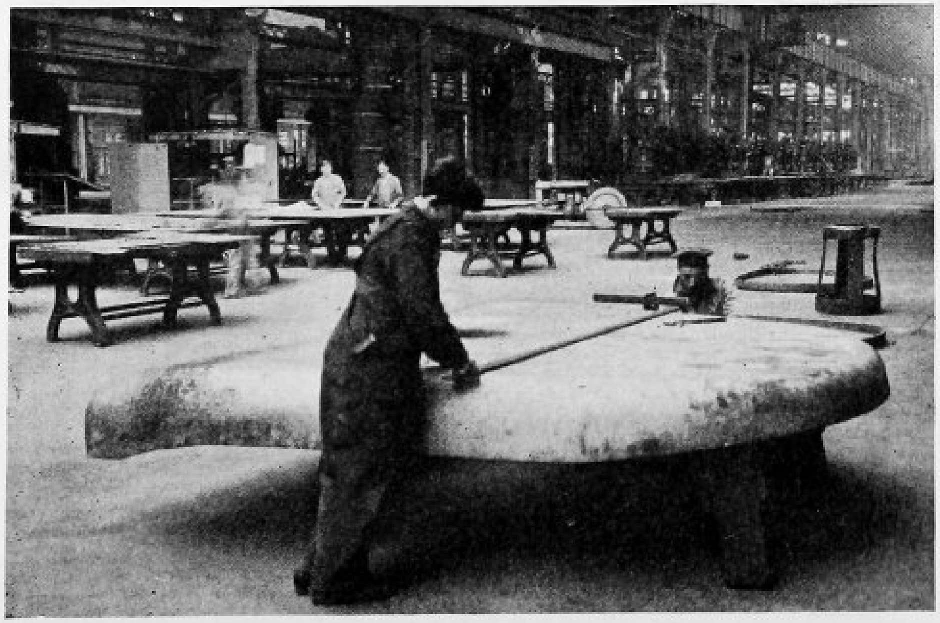
Cars spotted in bay No. 11 are served by one 10-ton Shepard crane and one 25-ton Niles-Sellers crane. Bay No. 12 is equipped with two 25-ton Niles-Milwaukee cranes that may serve the receiving pits. All sizes of plate clamps and safety dogs for each shape or weight of plate are available.

Boiler plate is stored between piers 24 and 31 in the south end of bay No. 12 adjacent to the receiving pits. Plates that do not require laying out, but require flang-

Laying out an outside throat sheet on the large surface block after flanging

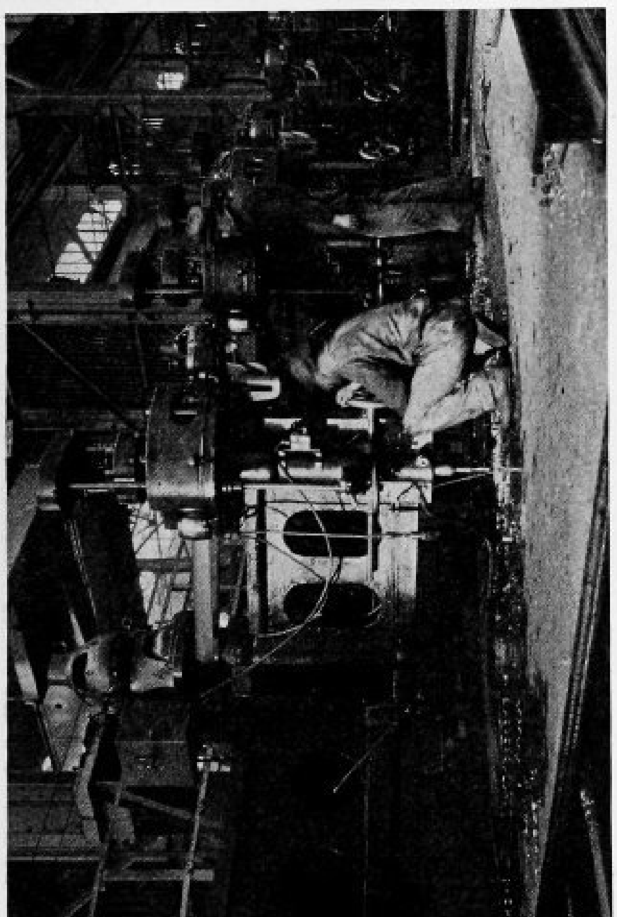


An inside throat sheet mounted on small surface block for complete layout

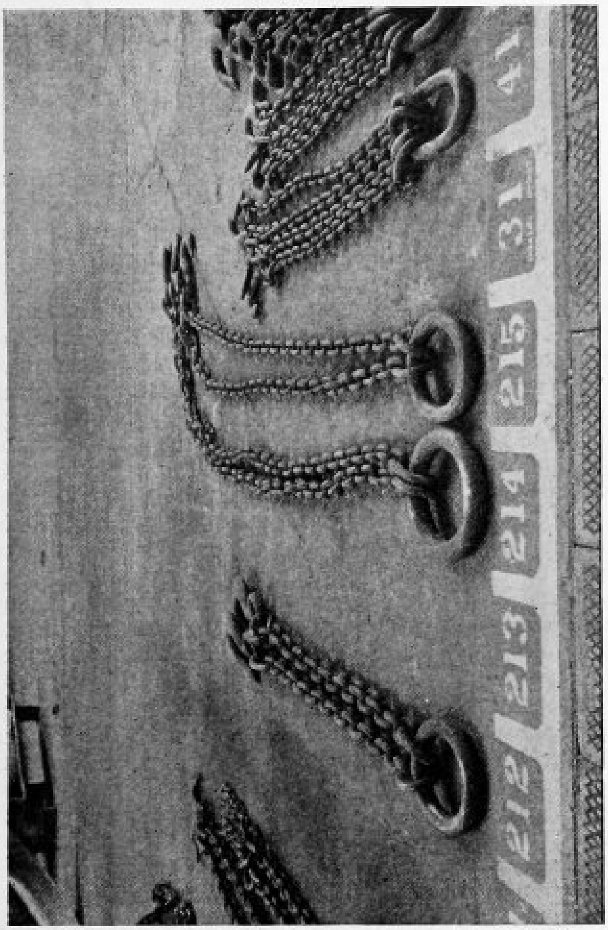


Leveling up a backhead after flanging

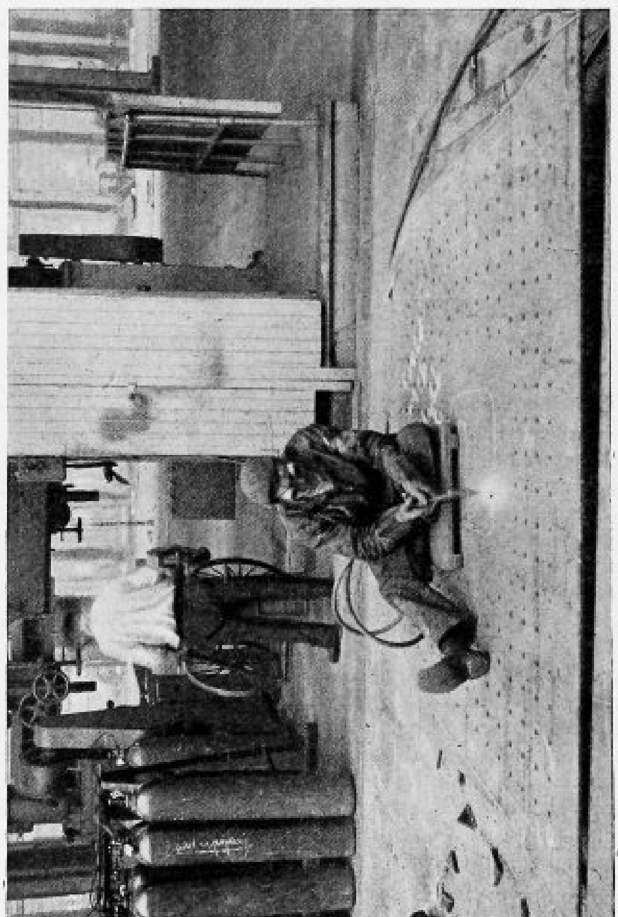
Interior of card room showing method of storing boiler cards



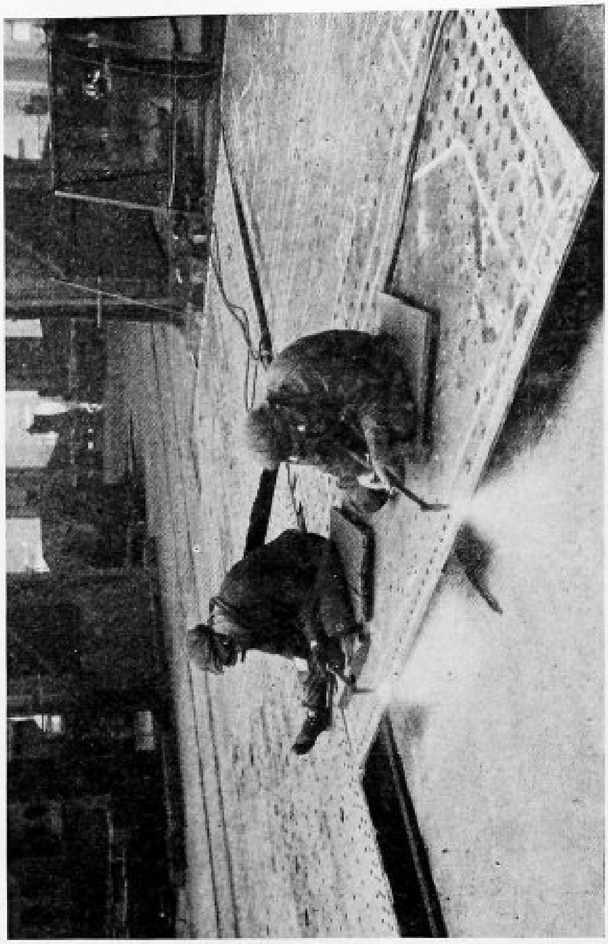
Drilling holes in five crown and sides sheets on the 4-spindle, radial drills



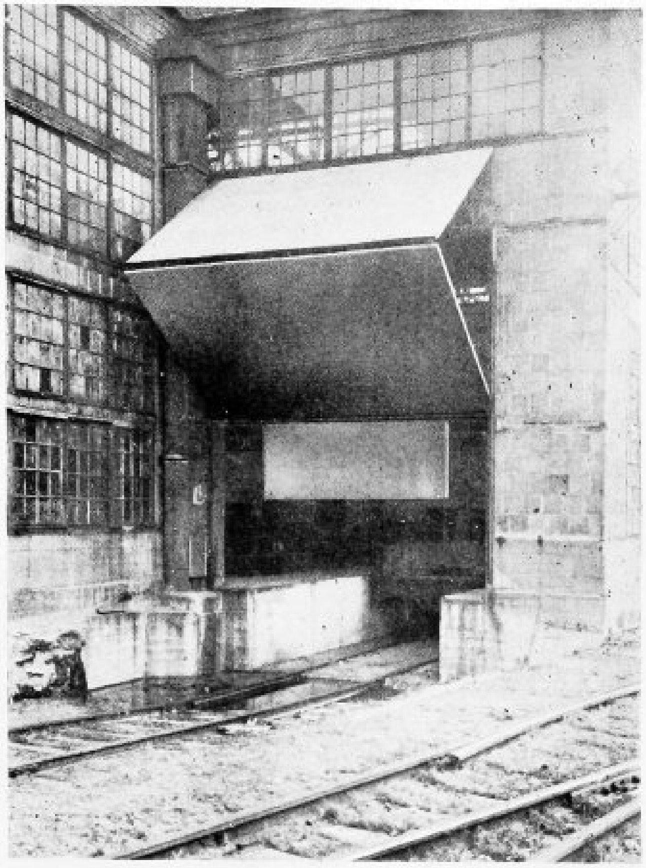
Chain storage in pier No. 17



Cutting the firedoor hole in the firebox back sheet



Cutting the edges of a roof top and side sheet before planing



Hinged door at the west end of the receiving pits

ing are sent directly to the flange shop in bay No. 13 This class of material includes sand box tops, domes, cylinder head covers, steam chest covers, smokebox fronts, smokebox front doors and other similar plates. Other material is stored in bay No. 12 in separate piles. Each group of sheets for one type of boiler is stored together in a separate section. Each type of plate in the given class of boiler is piled in a separate pile; for large plates, wooden spacers are placed between the sheets to facilitate handling.

As each plate is required for laying out, the contractor in charge of this work verbally orders the material from the contractor in charge of material storage. By this means a great deal of inter-department red tape is eliminated.

Layout Department

The layout department is located in bay No. 12 between piers 18 and 24. The shop equipment employed in this department consists of 23 tables, each 29 inches wide by 80 inches long and 32 inches high, constructed of 3-inch wooden planks mounted on cast-iron legs. In addition, there are two surface blocks, one 10 feet by 14 feet and the other 7 feet by 10 feet.

A small template shearing machine (illustrated) is located in pier 23. This is a piece of shop-made apparatus, consisting of an electric hand motor mounted on a bench constructed of plate and angle bar. The motor is placed with the shaft horizontal. Two 1¼-inch blades are mounted, one in a fixed position to the bench and the other on a ring which is set in motion by means of an eccentric mounted on the horizontal shaft. The shears are self feeding.

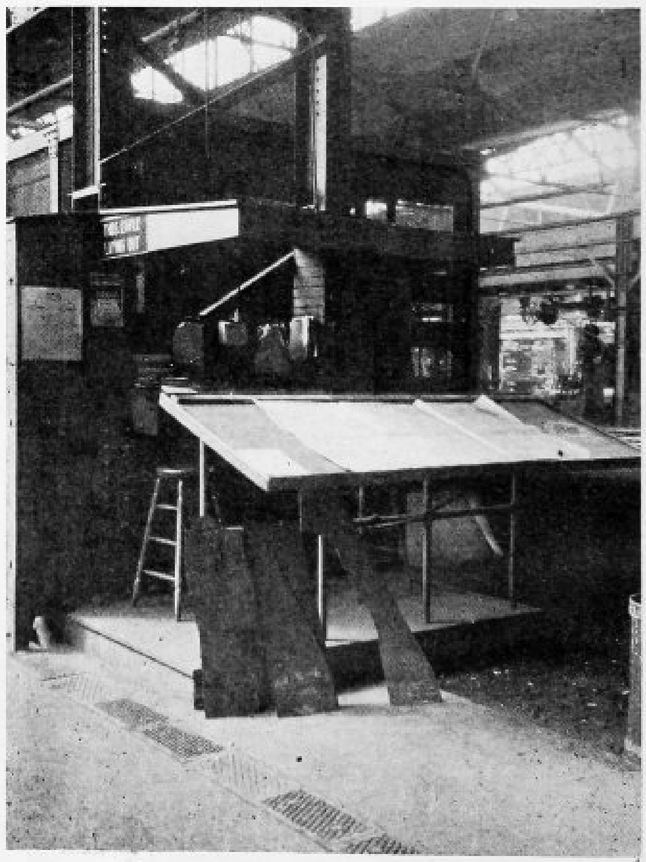
The layout of a complete boiler proceeds in the following order: Smokebox and smokebox liner; No. 1 ring, butt straps and liners; No. 2 ring, butt straps and liners; No. 3 ring, butt straps and liners; dome liner and dome: top and sides sheets and crown and sides sheets; front tube sheet; outside and inside throat sheets; back tube sheet; back firebox sheet; and backhead of boiler. The dome cap and smokebox front are the last sheets to be laid out.

Boilers are laid out full size in the shop by the layer-outs working in teams of two men each. When a drawing is first delivered to the layout department, one of the men draws a full-size working plan of the boiler from which all plates are developed on the bench. After it has served its purpose, the working plan is numbered and filed in the card room making it possible to duplicate a boiler or any sheet in it at any time. Boiler cards are also stored in the card room where they are filed in bins. Twenty-four cards are stored in each bin which is numbered according to the cards it contains. A record of all cards filed in the card room, together with the location and number, is kept in a large book for this purpose.

All plates that do not require flanging are laid out in complete form on the laying out table. This includes the layout of rivet holes, staybolt holes, flue holes, fitting holes, finished outline, etc. Every sheet is laid out by the laying out department with the exception of the front tube sheet which is fitted by the dome and front tube sheet contractor.

Flanged plates are laid out in reference to shape and contour only before being sent to the flange shop. After flanging, they are returned to the layout department where they are mounted on the surface block and checked for any discrepancy in flanging. They are then laid out complete.

Outside and inside throat sheets on being returned to the layout department are leveled up by means of screw jacks and fitted to a plan drawn on the surface block. This is done by means of a steel square projecting the



The contractor's desk in the layout department plan from the surface block vertically to the throat sheet. With the throat sheet in this position, the rivet lines are laid out and the rivet holes are located by means of templates taken from the side sheets along the waterleg of the boiler. A template made from the connecting boiler course is used to locate the rivet holes around the belt of the throat sheet. The staybolt holes and the water-space rivet lines are laid out from the plan on the surface block.

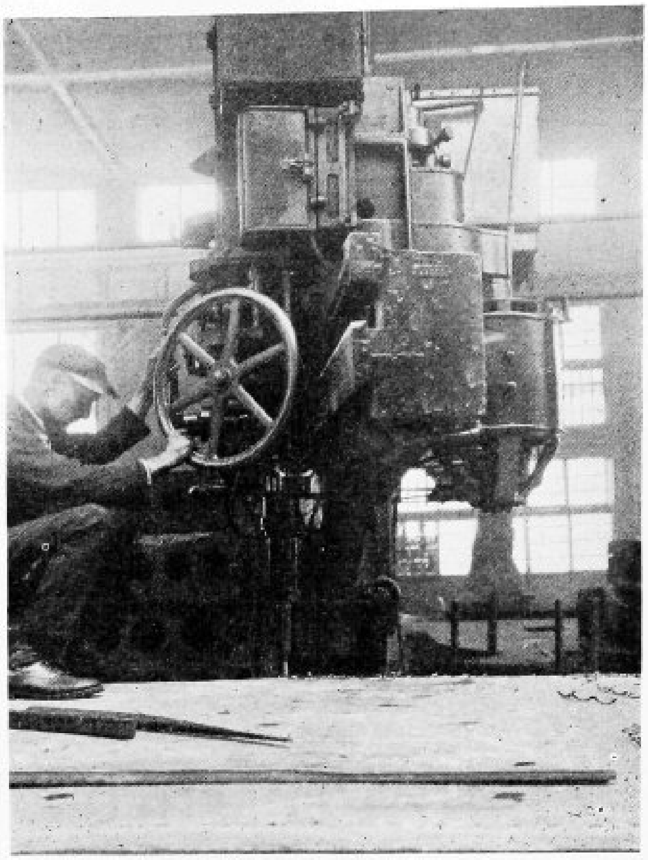
After the rivet holes are located, the plate cutting line is drawn and center punched. The staybolt holes and rivet holes are center punched and the sizes marked in white lead after which all staybolt holes are free-hand circled with white lead.

Before each plate leaves the layout department, it is stamped with the number of the boiler, serial number and sizes of washout holes. In the case of taper courses, the circumferences of the front and back are stamped but on all courses the front and back are indicated.

Drilling Department

After being laid out, the plates pass along the original line of material flow to the drilling and shearing department located in the same bay, between piers 1 and 16. For a distance of 168 feet are located 12 batteries of Sellers four-spindle multiple radial drills each having four arms and four motors. Operating at full capacity, 48 holes may be drilled at one time. Tables for drilling, running the full length of six batteries of drills, consist of five horizontal 8-inch I-beams raised to a height of 38 inches above the shop floor. The I-beams are spaced about 2 feet on centers.

The sheet as marked in the layout department is used as a pattern plate for drilling additional sheets of a similar design. The pattern plate is placed on the radial drill table and the holes are spotted. This is done by running a small drill slightly into the plate at each center-punch hole. By this means, the drill operator may operate two or more machines at a time due to the fact that a great deal of time is saved in eliminating the necessity for catching the center punch holes in the final drilling process. Where the hole has been started, the drill becomes self-centered.



A 72-inch radial drill in action

Cutting a template on a shop-made template-shearing machine

After the pattern plate holes are spotted, a series of duplicate plates to be drilled are placed upon the table with the pattern plate uppermost. About a dozen tack bolt holes are drilled in the plates which are assembled by means of tack bolts and a large H-beam is clamped to the edge of the plates to prevent warping. Four or five plates with a total thickness of about 3 inches are drilled at one time depending on the thickness of the plates.

After all the plates have been drilled, the duplicate plates are spread out on layout benches for lining up, layout of lap and outline, and stamping the plates with the number of the boiler, serial number and sizes of washout holes. The plates are then carried by crane to either the shears or to the oxy-acetylene burning table for trimming.

The flue holes and staybolt holes of flanged plates, such as backhead and furnace tube sheets are drilled on the 60-inch and 72-inch radial drills located in piers 7 and 8. This equipment consists of one 3-spindle battery of Sellers 72-inch radial drills, one Harrington 60-inch radial drill, and one Baush 60-inch radial drill. Rivet holes in the flange sheets are drilled on horizontal drill presses located in bay No. 8. In all plates, plug holes and other holes 2 inches in diameter and over are cut on the 60-inch and 72-inch radial drills.

Where sheets are less than ½ inch in thickness, they are generally trimmed by means of shears. Material is awkward, is trimmed by means of the oxy-acetylene over this thickness or shaped so that the shearing process burning process. Firedoor holes and large openings are generally burned.

The gas-cutting apparatus is located in bay No. 12 in pier 8 and consists generally of a manifold, connecting 24 bottles of oxygen, and a smaller manifold for acetylene. For every 5 bottles of oxygen, one bottle of acetylene is used though only one bottle of acetylene is employed at a time.

Three motor-driven shears are located in the north end of bay No. 12 and are each served bv hand jib cranes. Two shears are located in pier 2. On the west side, is a 36-inch Bement-Miles shear served by a 7-ton hand jib crane having a maximum reach of 17 feet 5 inches. On the east side of pier 2 is located a 60-inch Bement-Miles shear which is served by a 6-ton hand jib crane having a reach of 19 feet. In pier 4 is located one No. 8 Southwark open-throat shear and a 6-ton jib crane having a reach of 18 feet 9 inches.

The only sheet in which countersinking is done by the drilling department is the smokebox.

A motor-operated Hisey-Wolf double emery wheel, having wheels 12 inches in diameter with 1½-inch faces, is located in pier 8.

The entire drilling and shearing department is served by one 25-ton Niles-Sellers and one 25-ton Niles traveling crane. By this means manual material handling is reduced to a minimum.

An interesting innovation in the method of storing crane chains (system illustrated) is employed in the boiler shop. The contractors having the use of hoisting chains store them on the floor at the side of the bay. In bay No. 12, chain is stored in piers 7 and 17. Each chain is numbered. Marked on the shop floor in large white numerals is the corresponding number of the chain. The chain is stored opposite this number in such a way that it is displayed for inspection at all times. Adjacent to the row of numbers corresponding to the chain numbers is the number of the contractor who is responsible for all chains thus stored. By this method of storage, loss of chain is prevented and each contractor is better able to account for his property. Skips conveniently located throughout the shop are employed to collect scrap material and turnings. When filled, these skips are transported by means of cranes to pier 9 where the scrap is dumped into cars and removed from the shop by way of the track running through pier 9. Empty skips are stored in the north end of bay No. 12.

The next issue will contain a detailed description of the equipment and methods employed in the flanging department.

High-Pressure Watertube Boilers

Progressive circulation and economizer used to reduce mechanical difficulties

By Louis A. Rehfuss

HIGH steam pressure versus condensing back pressures has been a debatable subject for those interested in advancing the thermal efficiency of the steam locomotive. Both have their advocates and there is unquestionably much to be said on either side. The fact that the condensing principle has so far only been applied to European locomotives need not detract from its essential interest to the American railway fraternity.

The employment of the condensing principle is recognized as likely to give a greater increment in heat utilization than higher steam pressures, but it is also true that it does this only at the expense of far more radical changes in design than are involved in the use of higher pressures. Such changes as the substitution of turbine for reciprocating drive, the use of expensive high-speed gears with reduction ratios of 20 to 1, the employment of high capacity condensers with limited cooling agencies available, and the use of mechanical draft, all illustrate the complexity of the problem involved. The power required for mechanical draft, condenser fans and other auxiliaries constitutes a charge on the gain in thermal efficiency that leaves the net thermal gain but little greater than the gain possible by a proper utilization of the high-pressure principle.

Critics of high steam pressures in their comparisons of steam at different pressures usually state conditions which do not give the higher pressures the same benefits from superheating that they give the lower pressures. Because of the advisability of restricting the steam temperature to a reasonable limit, such as 700 degrees F., the comparison is made to show only 29 percent gain in the Rankine cycle efficiency in increasing the steam pressure from 250 to 750 pounds per square inch, where the steam temperature is restricted to 700 degrees F. in each case. Since this assumption means a high superheat in the case of the low-pressure steam and a low superheat for the high-pressure steam, the comparison is somewhat misleading. However, since high-pressure engines are designed compound in order to get the expansion ratio required for efficiency, compound superheating may also be utilized, which introduces a gain not ordinarily considered. Because of the high pressure of the initial steam, the intermediate-pressure steam has sufficient pressure and hence sufficient density to make its superheating an attractive and feasible proposition without employing an abnormally large superheater, where it would not be considered at lower pressure ranges with their excessive steam volumes.

The further objection to high pressures in the decreased boiler efficiency resulting from the lower temperature head between the high temperature boiler water and the furnace gases can of course be met, as has been suggested several times, by the employment of an economizer, or feed-water preheating section next the smokebox.

On the other hand, the use of high pressure involves far less changes in locomotive designs than does the condensing operation. A watertube boiler, compound drive and preferably the use of poppet valves would be required. By the use of the latter, limited cut-offs with extensive steam expansion may be employed with a minimum of wire drawing of the steam. Of these changes the design of a satisfactory all-watertube boiler offers probably the greatest problem.

In the locomotive field where bad waters are frequently met, the problem of cleaning the individual watertubes seems to have been the main objection to its greater use, despite the fact that the swift water circulation causes far less scaling than that obtained in a fire tube locomotive boiler. Either purer feed water, a system of feed-water purification, the use of less handhole plugs, or a combination of the three is needed to advance the use of such boilers in railway service.

All-Watertube Boiler

The writer proposed in the December, 1927 issue of THE BOILER MAKER the use of an all-watertube boiler with inclined straight tubes in the barrel. Since the publication of the article it has been felt that the proposed design did not adequately take care of the cleaning difficulty, since the boiler required a plug for every tube and no particular provision was made for feed-water purification or feed-water heating.

In order to overcome these difficulties another principle has been evolved, which can be called the principle of progressive circulation, in which every drop of water must pass successively up and down, through each of a series of cross-drum tube sections before it finally arrives at the firebox zone. The manner in which this may be accomplished will be better understood from the illustrations, the details of which are not to be taken as a finished design. They are only suggestive, but they demonstrate the principles involved.

An economizer or high temperature, feed-water, heating section is placed next to the smokebox. Feed water is normally furnished to the economizer at 200 degrees F. by a pump such as the Worthington, and is heated in successive passes 350 degrees higher, before it is pumped into the high-pressure or evaporative system. The economizer consists of four inclined, cross-box tube units, and the water flowing into the bottom cross-box of the first unit flows up the inclined tubes to the upper cross-box, and thence down side tubes (out of the gas path) to the bottom of the second unit, up the second unit, and so on. The water becomes progressively hotter with each pass. From the top of the last economizer unit the water is led to the boiler feed-water pumps for admission to the evaporative system.

Five cross-drum tube units, located next to the economizer, together with the firebox form the evaporative system. The hot water from the economizer is pumped into the lower drum of the first unit and flows upward to the upper drum, down by a side tube to the lower drum of the second unit, up the second unit and so on. Steam formed in these cross-drum units passes out by a common escape pipe at the top, but the water itself must flow progressively up and down each unit until it arrives in the firebox zone in the rear. This direction of flow is not only due to the inflowing feed water, but to the use of smaller tubes for upflow than for downflow. The former in the active heat zone naturally set up a rising circulation.

Changing Properties of Steam

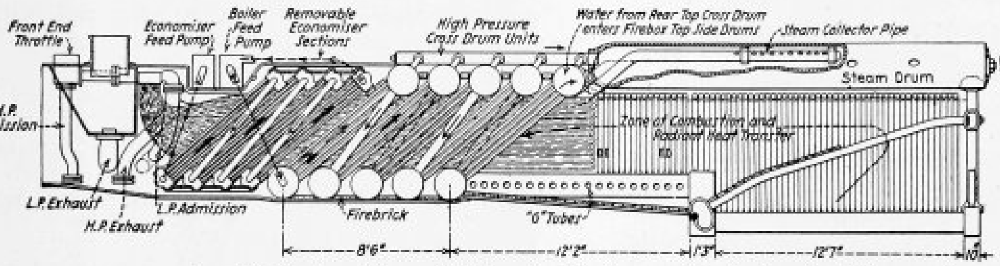
In this connection it is well to call attention to the changing properties of steam with increasing pressures, which create changing conditions in the design. While the total heat required per pound of steam changes little, more heat is required to get the water to the boiling point for higher pressures, but when once reached, less heat is required for evaporation. This is shown as follows:

Boiler pressure, lb.	Heat in boiling water	Heat of vaporization
800	506 B.t.u.	687 B.t.u.
200	361 B.t.u.	838 B.t.u.

The result is that the feed-water heating function of the boiler becomes more important with rising pressures and the evaporative function relatively less so.

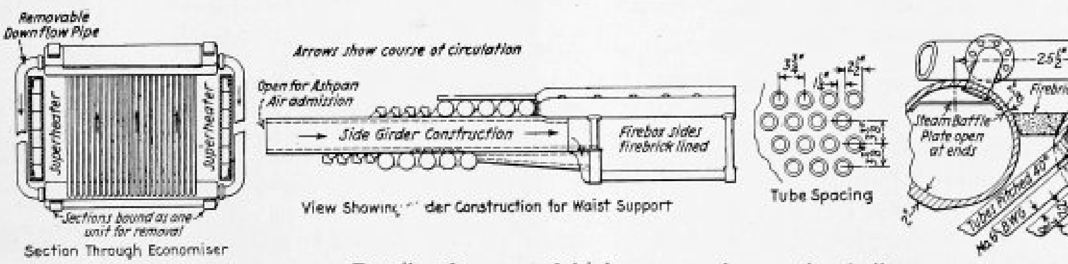
After heating the feed water from 200 degrees to 350 degrees F. in the economizer, naturally the hot feed water entering the cross-drum units of the evaporative system must first be heated to 520 degrees (the temperature of saturated steam at 800 pounds pressure) before steam will form so that probably the first two or three cross-drum units will be needed to perform this function, leaving the active evaporation to the two or three rear cross-drum units, the combustion chamber and the firebox, which are located in the hot zone.

Thus the work of heating the feed water is an essential element in the proper design of a high-pressure boiler, and if this can be done in the manner stated by progressive circulation, from the smokebox rearward, there should be a gradual increase in water temperatures starting with 200 degrees F. feed water that



General Data	
Heating Surface	
Firebox	774 sq. ft.
Comb. Chbr.	270 sq. ft.
Waist	1,300 sq. ft.
Total Evaporative	2,344 sq. ft.
Economiser	1,340 sq. ft.
Superheater	2,160 sq. ft.
Total Heating Surface	5,844 sq. ft.
Volume Combustion Chamber and Firebox = 735 cu. ft.	

Longitudinal section of full watertube locomotive boiler for 800 pounds pressure



Details of proposed high-pressure locomotive boiler

should prove of immense benefit in keeping the smokebox temperatures low and the boiler efficiency at its maximum. The introduction of feed water on the forward sides of a firetube boiler offers no analogy to this, since owing to the lack of proper circulation it is probable that the water next to the front tube sheet is for the most part close to the normal 388 degrees F. water temperature at which steam evaporates in a 200 pounds per square inch pressure boiler, so that higher smokebox temperatures would prevail despite the lower pressures in a firetube boiler. In the proposed boiler every drop of water must traverse successively through the four economizer units and the five high-pressure, cross-drum units before it can arrive at the combustion chamber and firebox zone in the rear. There is no return. Once in the firebox it circulates from one side to the other, until it is evaporated.

The following results should be obtained from progressive circulation:

(a) A steady progressive lessening of the scale contents of the water, which deposits its burden of mineral salts in traversing all the tube units in the barrel before arriving at the firebox zone in a purified condition. Much of this scale is left in the economizer and never gets into the evaporative section, so that the economizer acts as a feed-water purifier as well as a feed-water heater.

(b) The steady counter-current circulation of water to the rear and the furnace gases to the front, with progressively colder water as the gases go toward the smokebox, not only maintains a high temperature head between the furnace gases and hot water as explained above, promoting boiler efficiency, but equalizes the temperatures throughout the boiler and thus prevents leaks due to unequal expansion and contraction.

Design Features of the Economizer and Cross Drums

In order that the inclined tube units may be easy to clean, the economizer sections, which are not part of the evaporative system, are made removable as a whole for cleaning. The cross drums of the high-pressure system are made of a sufficient size for man entry, thus doing away with the necessity of individual handholes for the inclined water tubes. While handholes are still employed for each tube in the combustion chamber and firebox, the circulating water is largely purified when it reaches the firebox section of the locomotive.

The manner in which such a cross-drum construction may be utilized in a boiler assembly rigid enough to withstand the shocks of railway service is indicated in one of the illustrations, which shows a hollow, air-cooled plate girder rigidly fastened to the boiler back end on each side. This design serves several purposes:

(1) As a supporting foundation for the cross-drum units, economizer and smokebox.

(2) As a covering shell for the sides.

(3) As an air preheater.

(4) As a preventive to radiation.

The last two functions listed are closely connected. The speed of the locomotive forces air down through the hollow girders. This air is preheated on its way and is finally conducted to the ashpan. The air keeps the girders cool and at the same time lessens radiation to the outside air. The cooling effect is hastened by the employment of light cross-horizontal plates inside the girders, widely spaced near the smokebox to hinder the air velocity as little as possible, but more closely spaced as the combustion chamber is approached. The cross plates draw the heat away from the inner walls of the girders and thus prevent their overheating, although the girders are shielded from excessive heat in the combustion chamber by the *E* and *D* side-wall tubes.

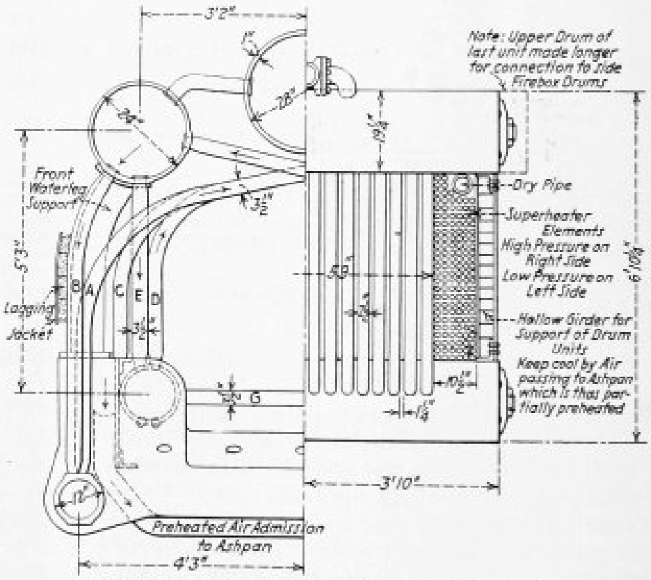
This preheated air is hardly sufficient in quantity for general firing purposes, but a shutter control on the ashpan can be used for such additional air as is required. The heat absorbed by the air, save as it prevents radiation, for the most part is neither a thermal gain or loss, since it is taken from the active furnace gases on their way through the barrel and led back again to the firebox. It is a thermal gain, however, in its beneficial effects in promoting combustion efficiency. In keeping the girders cool it also saves the weight of firebrick that might otherwise be required for their protection.

Compound Superheating

Compound superheating is provided for much as in the former design. The high-pressure steam is superheated in the units shown on the right side of the barrel, while the superheating of the exhaust steam from the high-pressure cylinder is done on the left side.

The superheater header can be designed with a separator in the middle to handle the steam in the same way.

The employment of such a superheater need not unduly complicate the structure. Superheater units of normal or heavy type can be used, but the density of the steam would aid the heat transfer and keep the equipment compact. The lower pressure portion would



Transverse section through watertube boiler

act also as a storage receiver for the steam between stages. This compound superheating is such an important factor in the practical utilization of the theoretical gains possible from the use of high pressures, that it seems strange that it has not been stressed heretofore.

The employment of straight inclined tubes rising to the rear is also retained. This provides a counter-current circulation of water and gases, swift water circulation and permits greater tube lengths and hence fewer tube joints than are possible without employing a system of complicated bends that are not only hard to clean, but expensive to replace. While the evaporative surface is limited to gain added combustion efficiency, the superior circulation should increase its effectiveness 50 percent by contrast with normal firetube heating surface.

The watertube boiler thus suggested is equipped to more nearly realize the theoretical gains possible with high pressures than has heretofore been possible, since to recapitulate:

(a) It provides through compound superheating an adequate means to compare with the superheat attained in lower pressure boilers.

(b) Through the principle of progressive circulation and the gradual heating of the water on its way to the rear, it maintains a high-temperature head through the length of the boiler promoting boiler efficiency at the same time that safety is promoted and scale kept out of the firebox zone.

(c) Aside from the progressive circulation of water through so many passes, the swiftness of circulation possible all through the boiler is something totally unlike anything obtainable in a firetube locomotive boiler, which should prevent excessive scaling and promote the unit evaporation.

(d) It provides a superior combustion efficiency because of the long flameway (made possible by a design permitting a combustion chamber of any length desired), by the use of preheated air, and an inclined tube arrangement which deflects sparks to the hot-brick floor of the combustion chamber for ignition and consumption.

Such a boiler would be rather heavy, but because of the lighter weight of water carried, will only run about 10 percent heavier than a 200-pound per square inch pressure, firetube boiler of similar overall dimensions with its load of water. Because of the 35 percent greater power in the high-pressure steam, however, the proposed boiler should weigh considerably less per horsepower delivered. Its water storage capacity would be from 50 to 60 percent that of the firetube boiler, while its steam-storage capacity, owing to the density and greater power of the high-pressure steam would be much greater than its firetube predecessor. From the standpoint of safety from explosion it would stand alone.

British Railroad Improves the Boiler Shop Layout

By G. P. Blackall

A VERY interesting alteration in the layout and methods of repairing boilers has recently taken place at the Great Western Railway Company's locomotive works at Swindon, England. The improvements aim at reducing costs and decreasing the time occupied in executing repairs.

The principles behind the alterations have been the superseding of pneumatic power previously employed for drilling out staybolts, reaming and tapping staybolts, and expanding tubes by up-to-date electrical machines of special designs, and the provision of structures to enable easy and quick application of the machines and also a concentration of several machines on each boiler. The machines are of types designed and made by the French concern, Constructions Electriques Wageor, and adapted at Swindon to the particular requirements met with in dealing with the various types of boilers employed on the Great Western Railway locomotives.

As previously stated, the drills use electricity as the driving agent, but are fed into the stays that are being drilled out by a piston operated by compressed air. This, a patented feature of the equipment, obviates the considerable effort previously required by the operators, and provides a very quick but extremely resilient control of the machine.

Structures, in the midst of which the boilers being repaired are placed, are provided with easily controlled supports for the feeding device, and enable a number of drills to work simultaneously on each boiler, suitable types of drilling machines being supplied for use in the various positions.

Self-Feeding Tools Used

The machines are of rugged design and manufacture, and are exceedingly rapid in operation. Each machine requires only one operator, and without effort or undue hurrying he can comfortably drill out three stays per minute. In operation, the electric current of the motor is switched on, the drill point applied to the stay to be drilled, and the compressed air admitted to the feeding piston by means of a specially designed handle which allows the air to enter the cylinder gradually, thereby avoiding all shock to the machine and releasing it instantaneously when the work is completed. The machines are in balanced suspension, so that the operator has no weight to sustain.

A further set of structures is provided for the operations of reaming and tapping holes after the stays have been removed. The structures in these cases are simpler, and in general construction the machines are similar to the drilling machines, but in some cases are less powerful for these operations and require no pneumatic feed.

As in the case of the drilling machines, these structures are in balanced suspension, and are operated by one man. In the case of tapping, an average of two holes reamed and tapped in three minutes can be attained.

Down the length of the drilling structure a runway is provided for the tube-expanding machine, which is a very interesting, and ingenious appliance. Here again, the operator is relieved of nearly all manual labor, the machine feeding in, after being once set in motion, and automatically stopping when a pre-determined expanding pressure is being exerted. The machine remains outside the firebox or smokebox, the shaft to the expander being provided with universal joints. The operator carries a switch control box with three buttons. The expander is inserted in the tube, the "forward" button pressed, which causes the expander to revolve and feed into the tube, during which time the current required to drive the machine gradually increases until the work of expanding requires a pre-determined current consumption, at which a switch automatically cuts off the current, and the pressing of the reverse button releases the expander. By this means, six 1⅝-inch tubes can be expanded per minute. The switch insures that all the tubes are expanded to the same degree, and by varying the setting of the switch, various sizes of tubes can be expanded by the same machine, up to and including 5⅛-inch superheater flues.

Light tubular structures, which can be swung open to admit easy location of the boilers, are also provided for the supports and platforms for machining, riveting and calking. By these alterations the appearance of the boiler shop has been greatly improved. The previous numerous and costly trestles and wooden platforms have been entirely eliminated, and quicker and more economical repairing of the boilers has been effected.

Locomotive Boiler Construction-VIII

Layout and fabrication of firebox, smokebox and front tube sheet rings—Longitudinal and tube sheet braces

By W. E. Joynes*

THE layout, drilling and trimming of the flange plates to the point of flanging having been presented in the preceding instalments, the layout and manufacturing operations of such boiler details as firebox ring, smokebox ring, tube sheet ring and the boiler braces will now be given, in order that these details will be ready for the fitting up work and assembly as soon as the flange work has been completed.

Firebox Ring

Firebox rings are made in one-piece solid cast steel or with cast steel ends and forged sides. A ring that is made in one-piece cast steel usually has to be heated, straightened and leveled in the smith shop before the layout of the ring can be started.

When a firebox ring is made with cast-steel ends and forged sides, the ends and side pieces are forge-welded together in the smith shop and put into shape for the layout work. Before the welding is done the side pieces are machined on the inside and outside edges to the finished dimension as given on the drawing. The end pieces are also machined along the ends, on the inside and outside edges, close to the corner radii. The cutting is done on a horizontal milling machine.

The side pieces are spaced to the required parallel distance apart and rigidly clamped with heavy bars. The cast-steel ends are then set up and also clamped in place. The tie clamps for holding the ends have heavy turnbuckles for retaining the correct length of the ring during the welding operations.

The corners and scarf are scribed to a template and then milled to shape on a vertical milling machine. The layerout should check the size of the ring at this time and tram diagonally across the corners to see if the ring is square.

Fig. 36 is the detail drawing of a one-piece cast-steel firebox ring of typical design. This same drawing would also represent the ring with cast steel ends and forged sides if the scarfed welding connection was shown as in Fig. 39.

The inside and outside edges of the ring are laid out on the top surface of the ring. The surface is painted with a thin white mixture into which the lines are scribed.

The inside length of the casting is measured to find how much excess stock has been machined off. If the measured length is ½ inch or ¾ inch shorter than the finish dimension, scribe a line equal to one-half of the surplus stock dimension from the inside edge, at one end of the ring, across the end as shown in Fig. 37.

The ring is squared from this line as follows: The center of the width of the ring is found on this line by holding a straight edge against the inside edges of the rough casting and then projecting a point onto the base line that has just been scribed along the end of the ring. Half the distance between these points is, of course, the center of the width of the rough casting. Half of the finished width dimension, $76 \div 2 = 38$ inches is measured with a steel tape on either side of the center point. From these points intersecting arcs are trammed at the other end of the ring as shown. Half of the inside width of the ring is now measured on either side of the trammed intersecting-arc point.

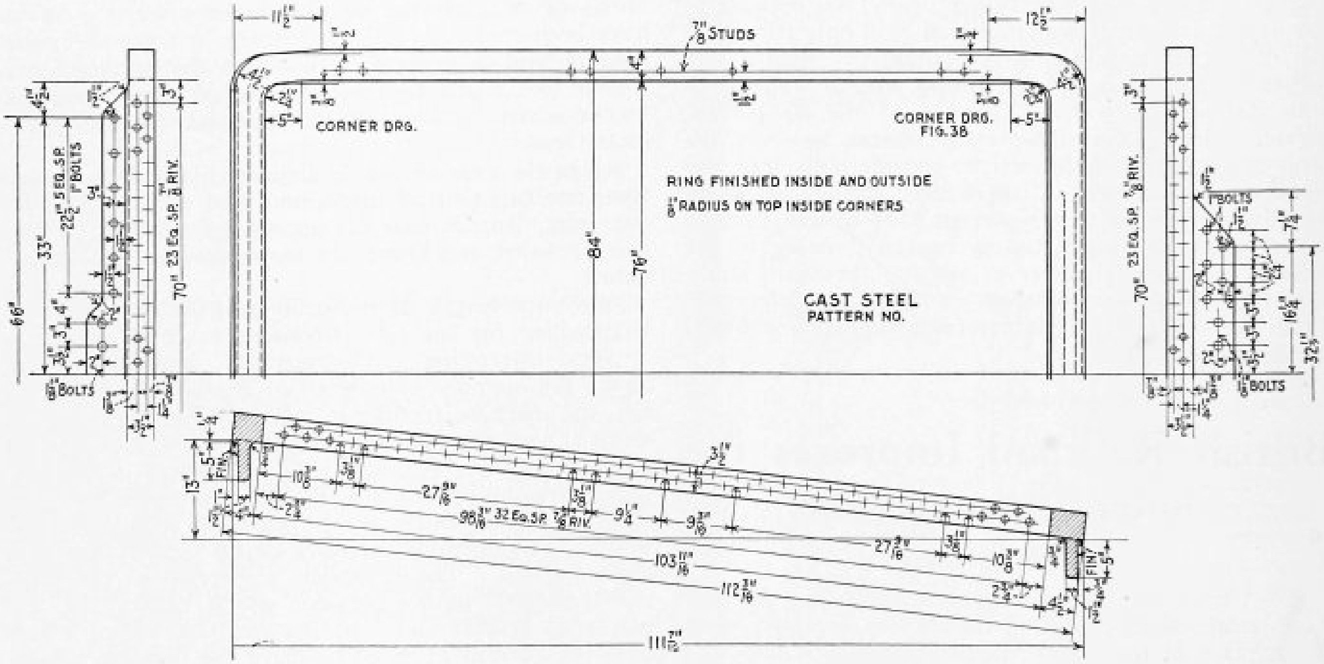


Fig. 36.—Firebox ring

* Boiler designing department, American Locomotive Company, Schenectady, N. Y.

Part of the side lines at the trammed end of the ring is scribed in with the use of a straight edge. The inside length of the ring is measured at either side of the same to intersect the short side lines.

Trammels are set diagonally across the corner points. This tram set is transferred to the opposite side and an

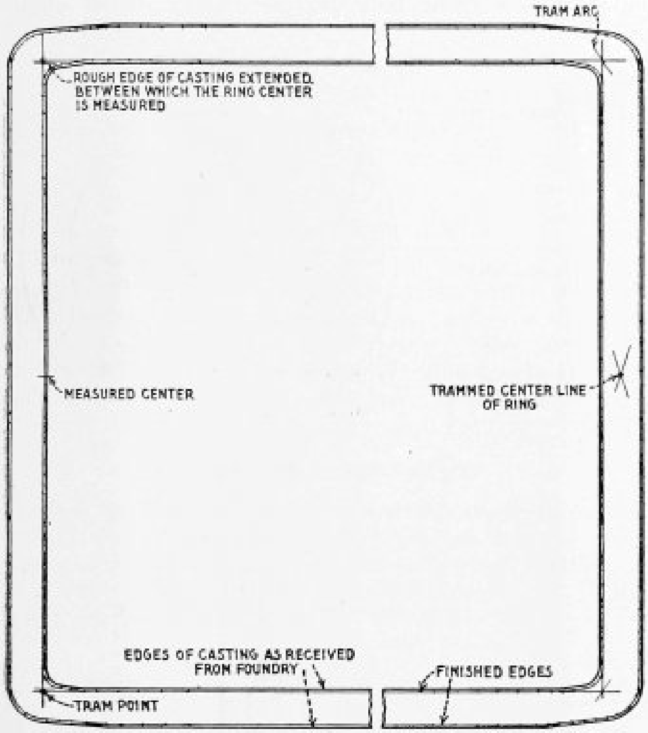


Fig. 37.—Firebox ring laid out for milling and planing inside and outside edges

arc is scribed at the opposite diagonal corner to check the squaring of the ring layout. The inside side lines and the other end line can now be scribed in. The width of the sides and the front and back waterlegs are measured and these lines scribed in.

Thin metal templates are carefully cut to the shape of the corners. The templates are lined up with the side and end lines and the corner shape scribed on the ring. The lines are lightly center punched around the corners and a short distance along the straight lines as shown. A vertical milling machine is used for machining the corners and ends to the scribed shape. The sides are planed to the scribed lines on a double head, horizontal planing machine. Four rough cuts are made at one time. Only two finish cuts are practical to prevent springing the sides.

Due to the long length of firebox rings, milling the sides is not possible except on rings where the total length can be reached by setting the ring up twice. The cost of the second setting would prohibit this method of finishing the side edges. The top and bottom surfaces of the ring are not machine finished, except in cases where the total engine weight must be reduced; the top surface of the ring is then finished to the drawing dimension.

The ring is now returned to the layout stands for drawing in the rivet lines and marking off the rivet holes from the metal templates that have been previously made for locating these holes in the side sheets and in the flange sheets. Wooden straight-edges are used for leveling and drawing all long lines in connection with firebox ring work.

The ring is placed on the stands, bottom face up. After this the rivet lap is measured 1⅜ inches from the bottom surface, at each end of the ring sides.

Long straight-edges extending beyond each end of the ring, are clamped to the sides with the top edge of the same in line with the measured rivet lap marks. A straight-edge is now laid on top of the side straight-edges, across each end of the ring.

A spirit level is placed on the end straight-edges to check the level of the ring. Should the ring be found out of level the side straight-edges may be moved down slightly toward the top of the ring in order to bring the rivet lines on the four edges in a horizontal plane.

The stock for the rivet lap at the bottom and top of the ring must not be less than the dimension on the drawing. The thickness stock of the ring usually exceeds the finished dimension enough to permit lowering the side straight-edges.

The ring should be returned to the fire for straightening if found too much out of level.

When the straight-edges are level, a soapstone line is drawn along the top edge of the side straight-edges and along the bottom edge of the end straight-edges.

The end rivet holes are now located on these lines. A straight-edge is held on the inside edges of the ring and lines are projected across the top surface of the ring for measuring the hole locations. The patch bolt riveting is spaced off for the corners, short radial lines are drawn and center punched on the bottom surface of the ring for the location of these screw rivets or

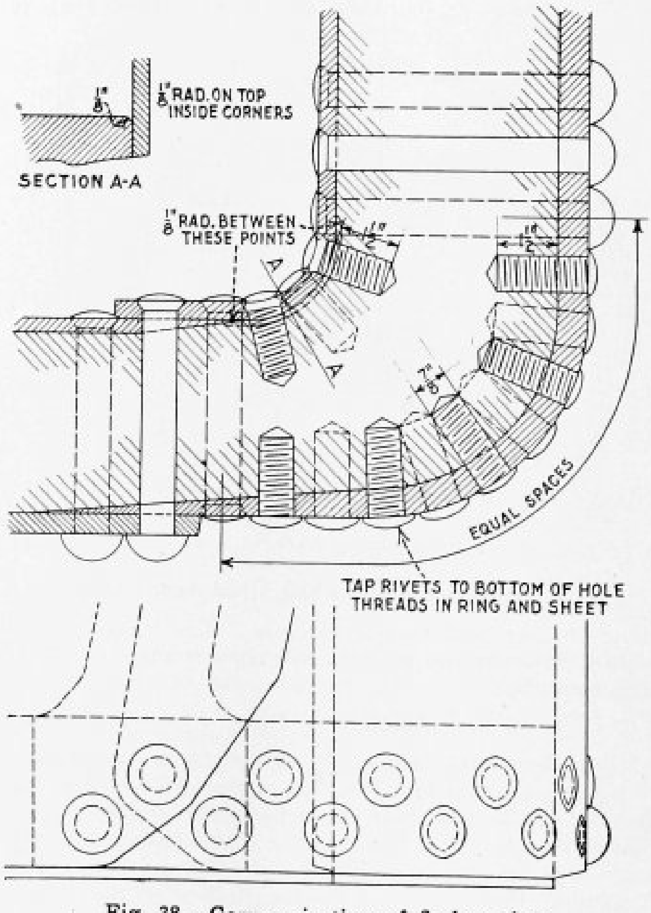


Fig. 38.—Corner riveting of firebox ring

lines across the full surface for corner through rivets. A corner riveting arrangement is shown in Fig. 38.

The rivet holes space templates are next clamped to the ring, lined up with the end holes location, and the holes marker punched on the ring. The template should include both rows of rivet holes. The top rivet line may also be drawn on the ring to assure the marker punch holes being centered on the line when center punching the marker punch holes a larger size.

The bolt holes in the lugs and the ashpan or grate frame support studs shown in the bottom surface of the ring should be laid out at this time as dimensioned on the drawing.

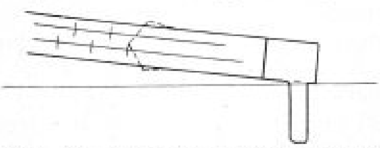


Fig. 39.—Method of forge welding cast-steel firebox ring ends to wrought-iron side pieces.

When the bottom edges of the lugs are required to be finished, the finish line should be laid out and center punched by the layerout.

Drilling Firebox Rings

A multiple drilling machine with twelve or more drill spindles is used for drilling the rivet holes in firebox rings. A deep pit is located at the front of the machine for lowering the ring to the support arms on the drilling table. All drills operate simultaneously when required.

The lug-bolt holes and the stud holes in the bottom of the ring are also drilled on this drilling machine.

The holes for the corner riveting are not drilled until after the ring has been assembled in the boiler and the flange sheets laid up to the ring.

The ring is ready for assembling when the machine work on the lugs has been completed. This work is

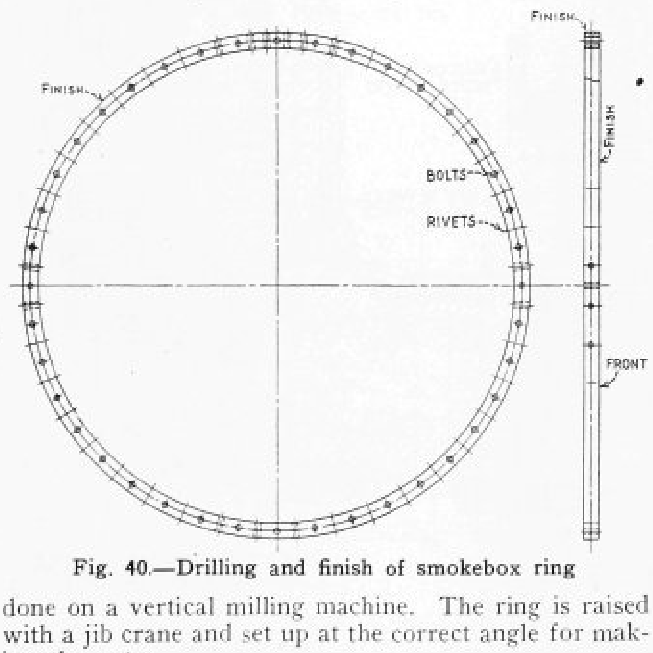


Fig. 40.—Drilling and finish of smokebox ring

done on a vertical milling machine. The ring is raised with a jib crane and set up at the correct angle for making the cuts.

Smokebox Ring

Smokebox rings are made of square or rectangular bar iron or soft steel. The first operation to change the straight bar to a circular one is to break (slightly bend) one end of the cold bar under a steam hammer. This facilitates the rolling of the bar to shape in the bending rolls. The required diameter of the ring is checked during the rolling operation with a metal template, shaped to the correct bending radius. The ends of the ring are butted square and forge-welded together. The ring is turned down to the correct diameter on a boring mill. The front face is also turned off on this machine. The diameter is checked with a steel square-bar scale, hooked at one end for one-man use. The operator of this machine also cuts a light line in the front face of the ring for the bolt circle and a rivet line on the outside surface.

Laying Out the Rivet and Bolt Holes

Fig. 40 shows the surfaces that are machine finished, the smokebox front bolt arrangement and the shell

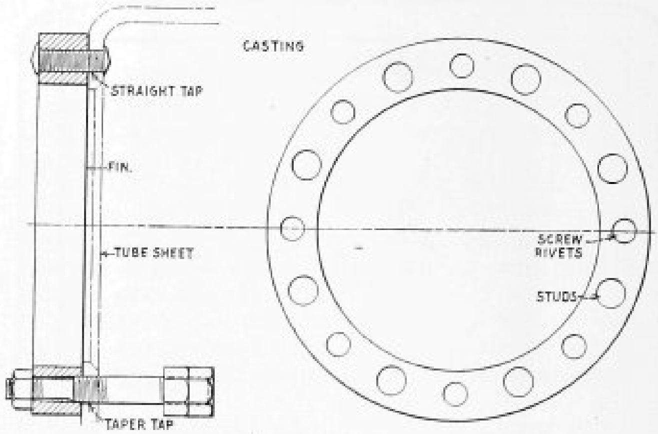


Fig. 41.—Tube sheet ring

riveting arrangement for a typical ring drilling design.

The outside circumference of the ring is calculated. A point for the top of the ring is established, and one-half of the circumference is wheeled from this point for locating a bottom center. The other half of the ring

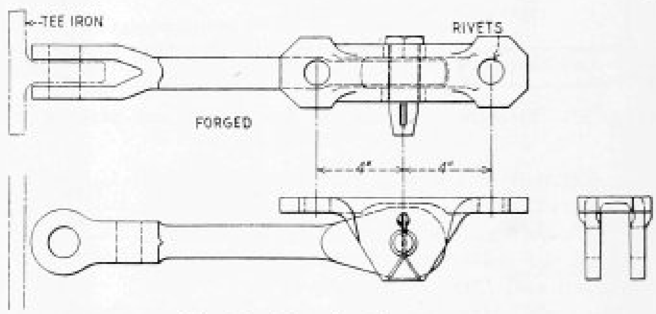


Fig. 42.—Longitudinal brace

should also be wheeled from the top point, which will check the circumference of the ring.

The circumference is now quartered by wheeling. These four points are squared to the front face. Center lines are drawn with the use of a straight-edge that will reach across the ring.

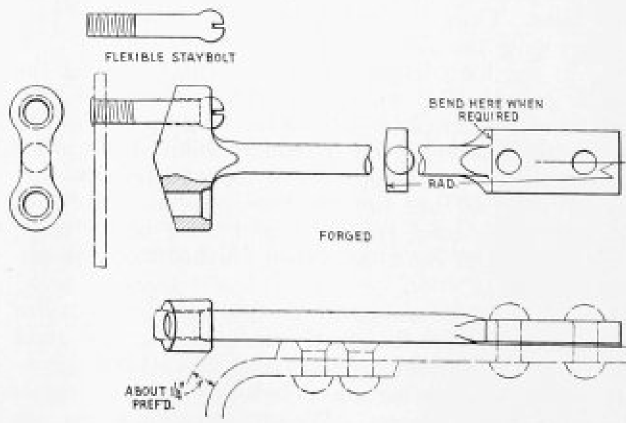


Fig. 43.—Firebox tube sheet brace

The bolt and rivet centers are spaced off with a divider for the first and all duplicate rings. This layout

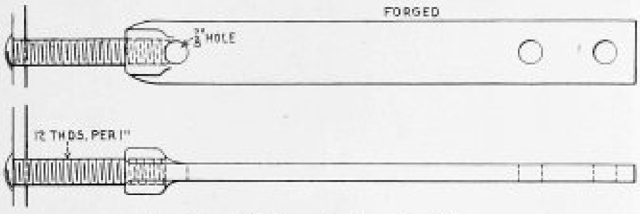


Fig. 44.—Firebox tube sheet brace

method assures all rivet holes being equally spaced for each ring, should the circumference of the duplicate rings vary slightly.

Drilling Smokebox Rings

A two-spindle drilling machine is used for drilling smokebox rings. Deep pits at the front of the machine allow two rings to be supported on arms, with rollers, which project from the drill table. The rings are turned on the rollers for each rivet hole location in the outside face. The bolt holes are also drilled on this machine—both drills operating simultaneously.

Front Tube Sheet Ring

Tube sheet rings are made of cast steel or cast iron. The contact surface to the tube sheet is the only edge of the ring that is finished. This surface is turned off on a lathe. The screw rivet and stud holes are drilled directly from the holes in the tube sheet. More information concerning the drilling and tapping of these

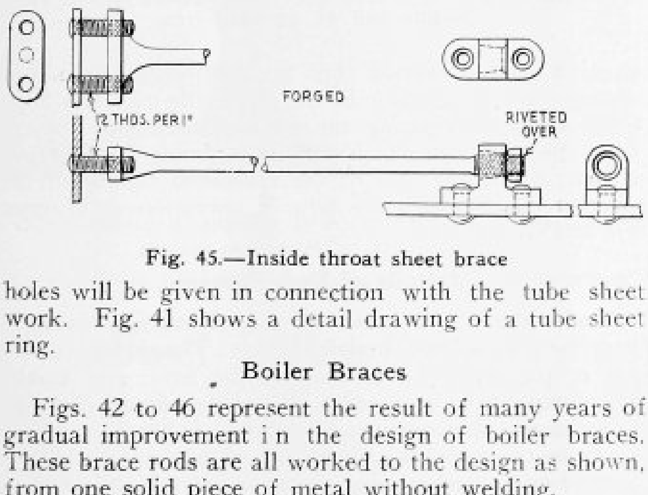


Fig. 45.—Inside throat sheet brace

holes will be given in connection with the tube sheet work. Fig. 41 shows a detail drawing of a tube sheet ring.

Boiler Braces

Figs. 42 to 46 represent the result of many years of gradual improvement in the design of boiler braces. These brace rods are all worked to the design as shown, from one solid piece of metal without welding.

The jaw shown on the rod in Fig. 42 is made by upsetting the rod and then opening the same with a drop die to the jaw shape. The other end of the rod is first

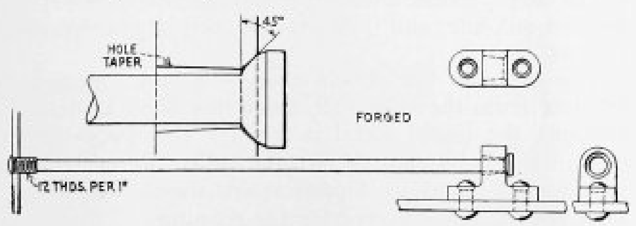


Fig. 46.—Inside throat sheet brace

upset and then flattened, as shown, with an upset machine die. The foot is punched out of a plate to the required bending shape. The plate is heated and bent to shape with dies in a hydraulic machine. This is done in one operation.

The brace shown in Fig. 43 is worked out of a rectangular bar. The first operation is to break down the center into the required rod shape. The end is flattened with a channel shape former under a power hammer. The other end is upset to shape with one operation in an upset die machine.

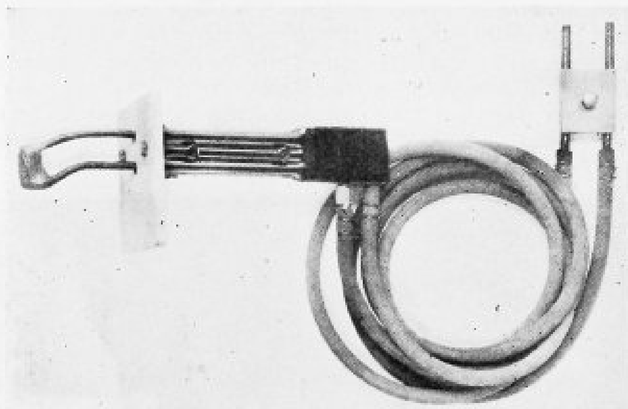
Figs. 44, 45 and 46 show braces which are upset from bars and rods in upset die machines. The brace foot shown in Figs 45 and 46 can be made with an upset or drop die. All rivet or stay holes are drilled in the braces or feet ready for application to the boiler.

(To be continued)

New Type Water-Cooled Carbon Electrode Holder

An entirely new type water-cooled, carbon-electrode holder for heavy-duty manual welding by the carbon arc process has recently been developed by The Lincoln Electric Company, Cleveland, O. Designed primarily to insure greater comfort and less fatigue for the welder operator, it has been found after extensive tests in the manufacturer's plant that the new holder effects a marked economy in the use of carbon electrodes.

Due to the design of the electrode holder, it is possible to weld with the arc tip of the carbon electrode projecting less than 3 inches from the carbon holder. Consequently there is less carbon area heated, thereby greatly reducing the vaporization of the carbon. Thus it is possible to use smaller size carbons with higher current density, which effects a decided saving in electrode costs.



Type W, Lincoln water-cooled carbon electrode holder

One of the features, contributing to the light weight of the holder, is the use of the hose which carries the water to also carry the cable to the holder. Each of the two water tubes contains a small light cable from the connector to the holder. The water flowing through the holder also acts as a cooling agent for the cables. By the use of this cooling agent the size cable to the holder is reduced to a fraction of the size necessary if it were not used.

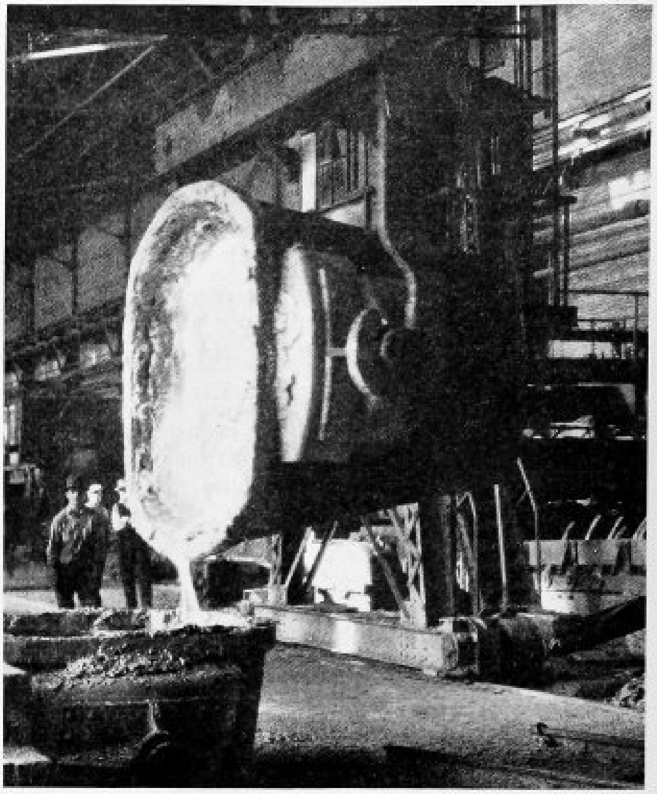
The carbon holder consists of coiled copper tubing through which water constantly circulates, the carbon electrode being inserted through the coil. The carbon holders are manufactured in sizes for use with ¼-inch, 5/16-inch, ⅜-inch and ½-inch carbons. A hand shield of compressed magnesium protects the operator's hand from the arc rays. The water cooling system is also incorporated in the hand grip of the holder to keep it cool.

Byers New Process for Manufacturing Wrought Iron

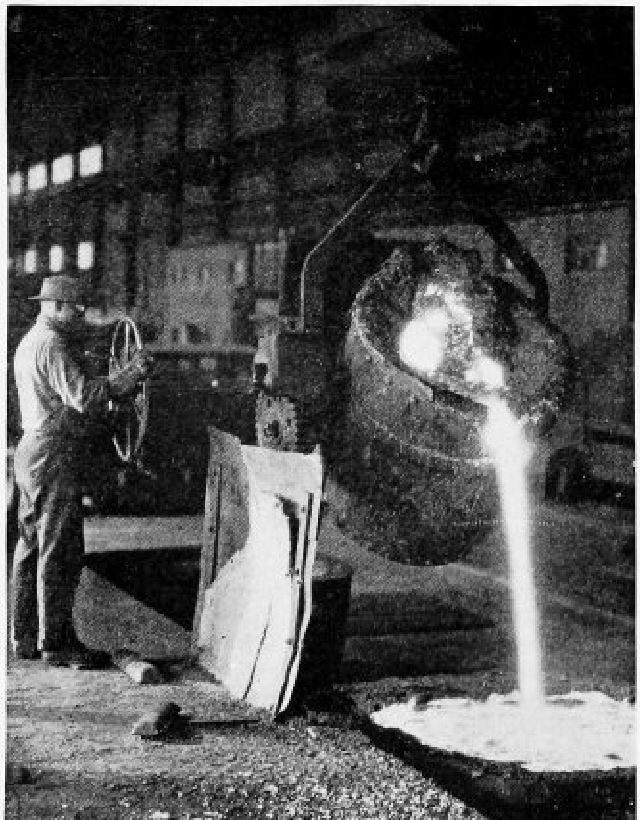
FROM 1784, when Henry Cort made the first real step toward scientifically manufacturing wrought iron, until about ten years ago, no major changes were made in the processes for the manufacture of this material. At that time Dr. James Aston, consulting metallurgist for the A. M. Byers Company, Pittsburgh, Pa., commenced the development of a new process for producing genuine wrought iron in quantities which might ultimately approximate steel production. His work culminated in what is known as the Byers New Process which was applied on a commercial scale to the manufacture of wrought iron in the spring of 1928 at a plant which the company leased at Warren, Ohio.

The Byers process is considered to be one of the greatest developments in the ferrous industry since the Bessemer converter, and the A. M. Byers Company is now spending nearly ten million dollars for the largest and most modern wrought iron plant in America. It is expected that this new unit, which is the first of an extensive expansion program, will be completed within a year.

The new unit will be erected at Ambridge, Pa., on a site consisting of more than 100 acres, with complete rail and water terminal facilities. In addition to the new process and skelp mills, the building program will eventually include coke ovens, blast furnaces and every modern facility for manufacturing pig metal from which wrought iron is made. In addition to the expansion being carried on at Ambridge, numerous changes are being made in the pipe mills at South Side, Pittsburgh, anticipating the greatly increased tonnage from the new unit, which will approximate 200,000 tons a year, or double that of the combined output of the present plants which are now in operation at Warren, O., and Girard, O.



Liquid slag being poured from ladle, leaving sponge or puddle ball of wrought iron



Shotting results in a characteristic puddle ball of large size, consisting of pea-sized globules of pure iron coated with silicate slag

Details of New Process

Under the old process of manufacturing wrought iron there were three essential steps: The melting of the ore or pig iron; the refining of the iron; and finally impregnating the iron with a slag of the correct chemical proportions, all done in one furnace. In the Byers New Process, the metal is refined in a converter and is then poured into a bath of slag, an operation which is known as "shotting." The melting of the pig iron is done in a cupola having a capacity of roughly 20 tons an hour.

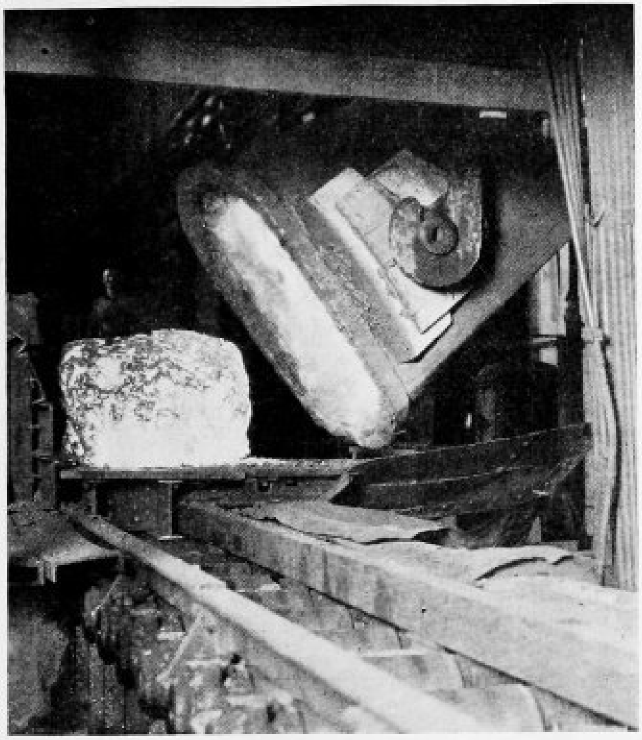
The pig iron is known as Bessemer, having an analysis of 1½ percent silicon; 1 percent manganese; 0.05 percent sulphur, and 0.08 percent to 0.10 percent phosphorus.

The metal in the cupola absorbs a small amount of sulphur from the coke and, since this is an undesirable element, the liquid metal is treated to reduce the sulphur, while being poured into the ladle. Roughly, about two tons of metal are tapped at one time. The metal is then poured into a converter for refining.

The next step or shotting process is to pour the liquid iron into a bath of slag.

When the stream of iron comes into contact with the slag, the liberated gas causes millions of tiny explosions, which break the metal up into tiny pea-sized globules, exactly as in a puddling furnace when the metal is "coming to nature." The identical reactions take place as in hand-puddling, only at a much faster rate of speed and with greater uniformity.

The thimble is now raised and tipped until the excess slag is poured off. In the bottom of the thimble remains the sponge from which a spongy ball is formed weighing approximately 2200 pounds, and having a length of 5 feet, with a cross section of 12 inches by 14 inches. The composition of this ball is exactly the same as the ball obtained from a puddling furnace, the latter weighing only about 200 pounds, being limited by the strength of the operator to handle it.



This puddle ball resulting from the shotting in the Byers process weighs about 2000 pounds

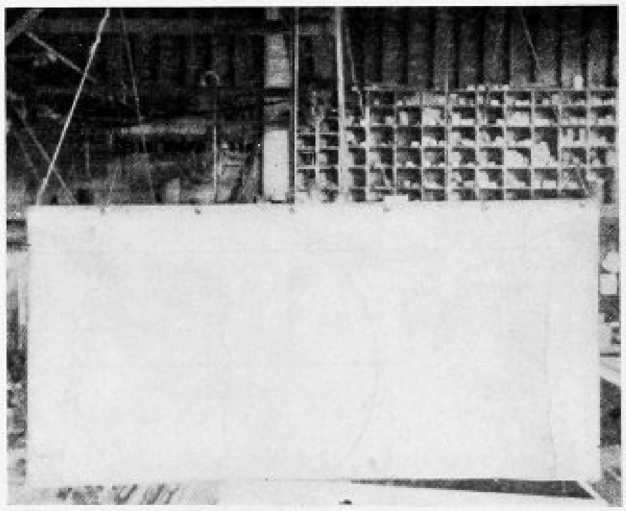
The ingot is passed through the blooming mill until it reaches the shears in the form of a bar approximately 200 feet long by 4 inches to 8 inches wide and ¾-inch thick.

As much fine wrought iron can be produced by the Byers New Process in twenty minutes as can be turned out by two puddlers working a ten-hour day.

Anticipating some of the reductions which would be made possible by this new process, the A. M. Byers Company on January 2 announced the first price reduction on wrought iron pipe since 1923. The price reduction ranged all the way from $2 to $18 per ton on the different sizes. The real significance of this price reduction lies not in its size, which is relatively small, but in its foreshadowing further reductions with the completion of the new plant, when wrought iron will be produced on a vastly greater scale and at a correspondingly lower cost.

A Convenient Welding Booth

THERE is never too much room in the shop and the ordinary welding booth is always more or less in the way when not in use. It is difficult to place heavy material in the booth, unless it is of the folding type, and then it is troublesome to remove and put back in place.



A canvas welding booth which can be lifted up out of the way

Steel Boiler Orders

NEW orders for 1075 steel boilers were placed in January, as reported to the Department of Commerce by 81 manufacturers, comprising most of the leading firms in the industry, as compared with 1343 boilers in December and 1244 in January, 1928. The following table presents the number and square footage of each kind of boiler ordered for the past thirteen months, including comparisons with the corresponding period last year.

	Total year, 1928		September, 1928		October, 1928		November, 1928		December, 1928		January, 1929		January, 1928	
	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.
GRAND TOTAL	19,672	17,684,811	1,749	1,453,199	1,803	1,500,114	1,660	1,459,440	1,343	1,308,125	1,075	1,243,479	1,244	992,785
STATIONARY														
Total	19,441	17,144,880	1,731	1,417,608	1,793	1,482,096	1,650	1,453,601	1,321	1,229,847	1,067	1,238,724	1,229	974,288
Watertube	1,315	6,909,982	104	435,969	86	513,925	95	592,747	72	*609,446	97	695,809	84	347,057
Horizontal return tubular	1,513	1,884,401	135	153,965	160	192,577	108	130,810	71	87,259	63	73,604	89	141,219
Vertical firetube	1,726	495,674	100	29,421	143	40,976	148	38,640	161	39,162	136	41,665	145	35,981
Locomotive (not railway)	392	263,201	26	22,030	36	23,265	29	28,715	25	14,480	18	9,670	20	9,407
Steel heating [1]	12,685	6,152,393	1,151	591,049	1,195	566,781	1,055	496,657	883	391,571	618	310,628	769	359,401
Oil country	956	900,317	122	122,760	111	104,042	111	109,449	63	53,807	71	64,399	41	32,992
Self contained portable [2]	680	462,627	76	54,023	56	37,936	61	45,736	38	30,187	53	32,516	62	36,566
Miscellaneous	174	76,285	17	8,391	6	2,594	43	10,847	8	3,935	11	10,433	19	11,665
MARINE														
Total	231	539,931	18	35,591	10	18,018	10	5,839	22	78,278	8	4,755	15	18,497
Watertube	99	467,084	12	34,416	4	14,579	1	400	15	72,850	....	....	6	10,532
Pipe	3	3,623	....	....	1	894	....	....	1	848	....	....	....	....
Scotch	112	59,619	6	1,175	5	2,545	9	5,439	4	3,350	8	4,755	9	7,965
2 and 3 flue	13	5,577	....	....	....	....	....	....	2	1,230	....	....	....	....
Miscellaneous	4	3,998	....	....	....	....	....	....	....	....	....	....	....	....

[1] As differentiated from power. [2] Not including types listed above. * Revised.

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Stack with Rectangular Base

Q.—Will you please explain the method of laying out a stack with a rectangular base? J. F. D.

A.—The following is a method of developing a stack which is setting on a rectangular base, the diameter of the stack being greater than the width of the rectangular base, as shown in Fig. 1.

The portion of the stack above the rectangular base is a true cylinder and should be made separate. The side pieces, *x* and *y*, Fig. 1., are developed as follows:

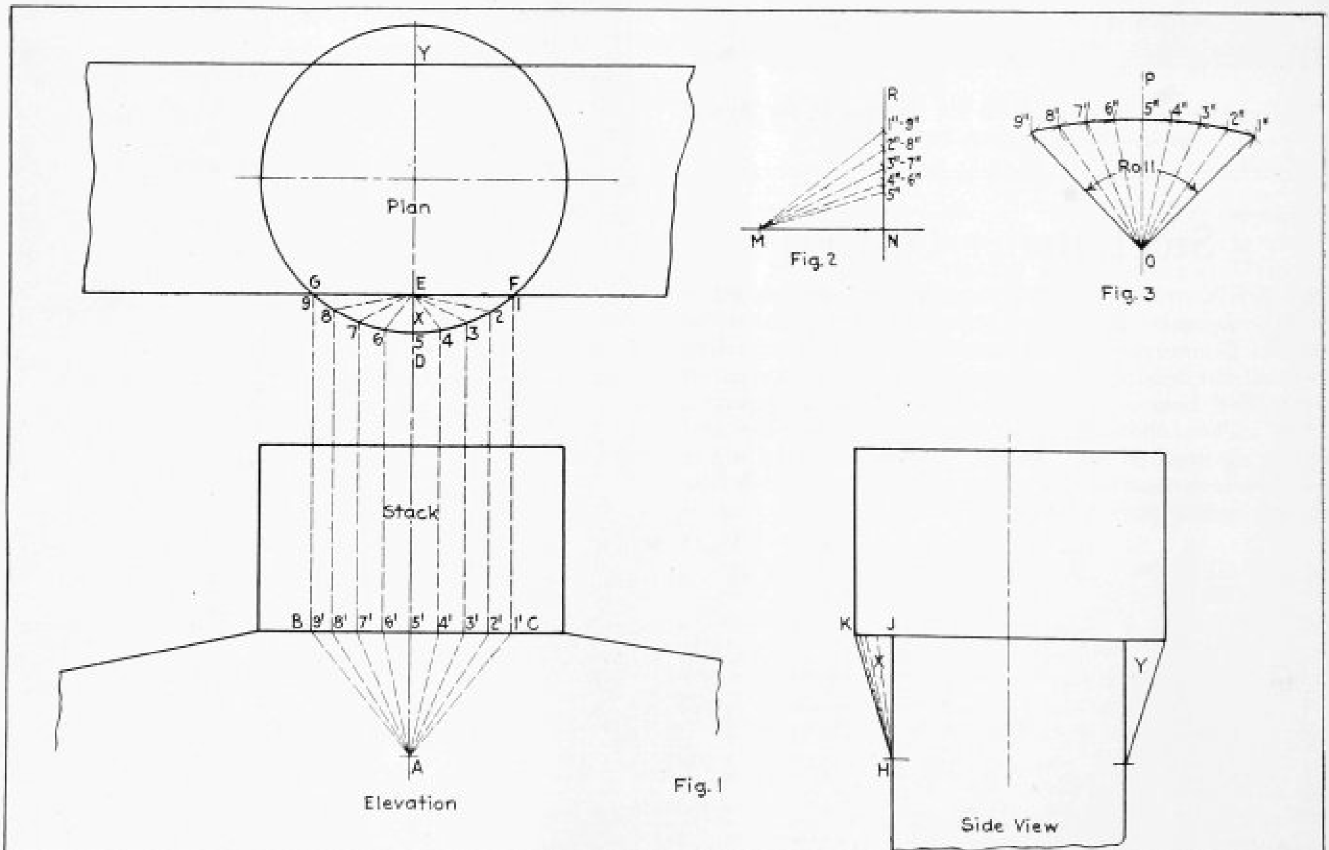
The side piece *x* and *y*, Fig. 1 are identical and the development of one can therefore be duplicated for the other.

To develop piece *x*: Divide the arc *F-D-G* in the plan into any number of equal parts, as eight in this case; the greater the number of parts taken the more accurate the final development will be. Number the intersections from *1* to *9*. Connect each of these points to *E* drawing the lines *E-1*, *E-2*, *E-3*, *E-4*, etc.

Parallel to the line *A-E* and through the points *1* to *9* draw lines cutting the line *B-C* in the elevation at the points *1'* to *9'*. Connect the points *1'*, *2'*, *3'*, *4'*, etc., to *9'*, to the point *A* drawing the lines *1'-A*, *2'-A*, *3'-A*, *4'-A*, etc.

The object has now been divided into a series of triangles having a common altitude *H-J* which is the perpendicular distance between the point *A* and the line *B-C*. To find the true lengths of the lines *A-1'*, *A-2'*, *A-3'*, *A-4'*, etc., of the elevation, draw the line *M-N* in Fig. 2 equal in length to the common altitude *N-J*. At *N* erect a perpendicular to the line *M-N* as *N-R*.

Step off on the line *N-R* with *N* as a center and using *E-5* of the plan as a radius, the distance *N-5"* and in



Development of circular stack with rectangular base

the same manner using the distances *E-4, E-6, E-3, E-7,* etc. Step off the distances *N-4", N-6", N-3", N-7",* etc. Connect the points *1", 2", 3", 4*, etc. to *9"* with the point *M*. The distances *M-1", M-2", M-3", M-4"* etc., to *M-9"* are the true lengths of the lines *A-1', A-2', A-3', A-4',* etc., to *A-9'*.

To construct the development of the plate, as shown in Fig. 3, draw any line as *O-P* and with *O* as a center and with the dividers set with a radius equal to the distance *M-5"* in Fig. 2 step off the distance *O-5"*.

Set the dividers equal to the distances *1-2, 2-3, 3-4,* etc., of the plan view and with *5"* in Fig. 3 as a center scribe an arc each side of the line *O-P*, then with the dividers set equal to the distance *M-4"* and *M-6"* and with *O* as a center scribe an arc intersecting same at the points *4"* and *6"*; using these points as centers, repeat this process using the distances *M-3", M-7", M-2", M-8"*, etc., as radii until the development is complete.

Hopper Development

Q.—Please furnish me at your earliest convenience the layout of a hopper. What puzzles me is the layout of the corners. This hopper is to be made in one piece with seams at sides. J. J. M.

A—To develop the hopper, as shown in Fig. 1, it is necessary to draw a plan and elevation.

Draw the horizontal center line *M-N* through the plan, thus dividing the object into symmetrical halves. It will now be seen that if a development is made of the lower half, as seen in the plan, a duplication of the resultant figure will be a complete development.

As the front and rear corners are developed in the same manner a development of the front corner *E-G-F* of the plan will illustrate the method used for all corners.

Divide the corner arc *G-F* into any number of equal parts; the greater the number of parts taken the more accurate the development. Six equal parts are taken in this case, and number the points from *1* to *7* as shown in the plan. Connect these points with *E* drawing the lines *1-E, 2-E, 3-E, 4-E,* etc.

Erect perpendiculars to the line *A-B* of the elevation, passing through the points *1* to *7* of the plan cutting the line *D-C*. Number the points where the perpendiculars cut the line *D-C* from *1'-7'* and where they cut the line *A-B* from *1"-7"*.

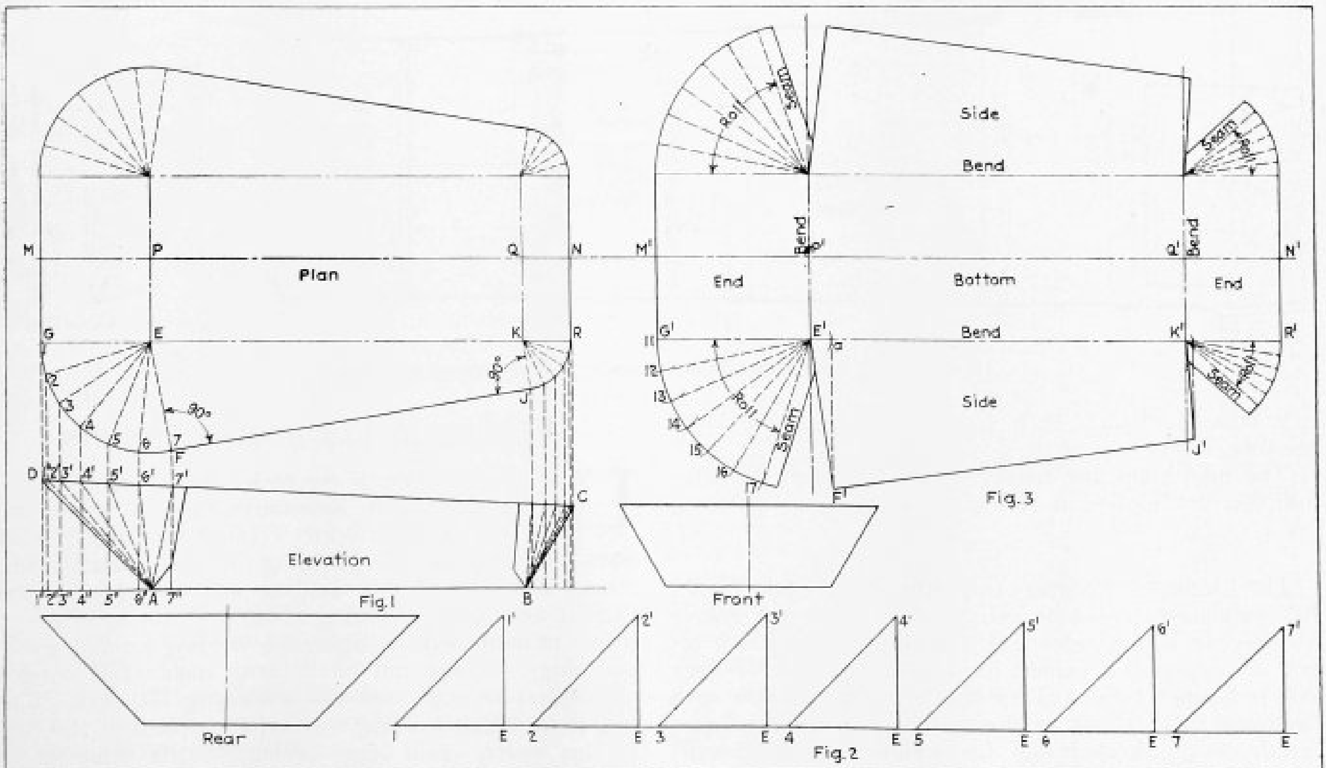
Draw the line *1'-A, 2'-A, 3'-A, 4'-A,* etc. The surface of the corner is thus divided into a number of triangles. It is now necessary to obtain the true lengths of the lines *1'-A, 2'-A, 3'-A, 4'-A,* etc. To do this it will be necessary to erect a series of right angle triangles as shown in Fig. 2.

On a horizontal line step off the distance *1-E* equal in length to the distance *1-E* of the plan, at *E* erect a perpendicular and step off the distance *E-1'* equal to the distance *1-1* in the elevation. Repeat this process as shown, using *E-2, E-3, E-4,* etc., as the bases and *2'-2", 3'-3", 4'-4"* for the corresponding altitudes, the hypotenuses of these triangles being the true lengths of the line *2'-A, 3'-A, 4'-A,* etc., of the elevation.

The next step is to construct the development as shown in Fig. 3. First construct on the line *M'-N'* the rectangular bottom *P'-E'-K'-Q'* equal to *P-E-K-Q* of the plan. *G'-E'* is equal to *A-D* and *K'-R'* is equal to *B-C*, completing the end portions *M'-G'-E'-P'* and *K'-R'-N'-Q'*.

On the line *E'-K'* with *E'* as a center, step off the distance *E'-a* equal to *A-7"* of the elevation; at *a* erect a perpendicular and with *E* as a center and with the dividers set equal to the distance *7-7'* in Fig. 2 scribe an arc cutting the perpendicular at *F'*. The point *J'* is obtained in like manner from the development of the front corner. Connect the points *E', F', J', K'* completing the side.

To complete the rear corner, set the dividers equal to the chord distance *1-2* in the plan, and with *G'* as a center scribe an arc; then with *E'* as a center and with



Plan and elevation layout of hopper, and pattern development

the dividers set equal to the distance *2-2'* in Fig. 2 scribe an arc; where these arcs intersect will locate point *12*. Then with point *12* as a center and the dividers set equal to the chord distance *2-3* of the plan, scribe an arc; with *E'* as a center and with the dividers set equal to *3-3'*, Fig. 2, scribe an arc; where these arcs intersect will locate point *13*. Repeat this process until the points *14, 15, 16* and *17* are located. Connect these points with a line, add on the seam and the development of the rear corner is complete.

The same procedure is used to obtain the development of the front corner, thus completing the lower half of the development.

Ratio of Tube Length to Sectional Area

Q.—I desire to procure information concerning the tubes in locomotive boilers, particularly those of extraordinary length that sag at the middle with their weight. Can you enlighten me as to what method is adopted in America to overcome that difficulty in the way of supporting plates midway between tube sheets or any device which is used? H. G. C.

A.—For bituminous coal-burning locomotives the preferred ratio of tube length to the sectional area of the tube outside is from 70 to 73.

Boiler Tubes Relation of Diameter to Length

Outside Diameter of Tube	Length corresponding to ratio of 70	73
2 inches	18 feet 4 inches	19 feet 1 inches
2 ¼ inches	23 feet 2 inches	4 feet 2 inches
2 ½ inches	28 feet 7 inches	29 feet 10 inches

The idea of supporting tubes between the front and back tube sheets is not used to any great extent.

A survey of some of the latest power indicates that 20-foot tube lengths for 2 ¼-inch tubes without any intermediate support to be the accepted practice.

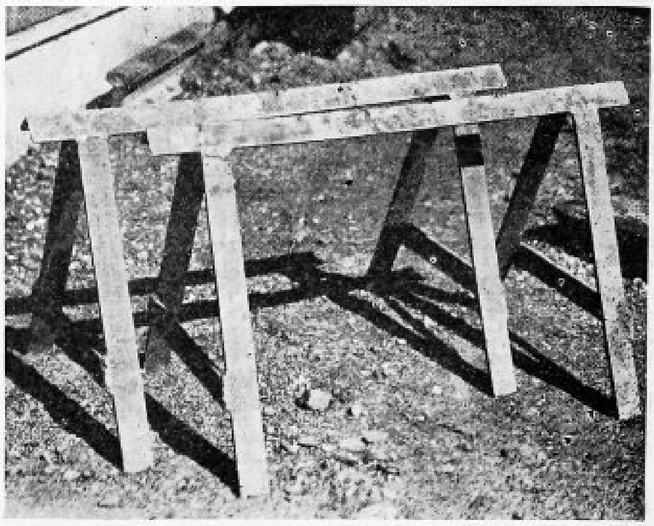
Fig. 1 shows an intermediate tube sheet as applied to a boiler with 2 ¼-inch diameter tubes, 25 feet over the tube sheets.

The tube holes are drilled out 2 11/16-inch diameter and ferrules applied as shown for supporting the tubes.

The Linde Air Products Company, New York, N. Y., has published a booklet entitled "Oxwelding Pressure Vessels" in which procedure control is stressed as a result of experience gained in the construction of over 200 pressure vessels. This article is divided into such headings as check of welder's ability, selection of material, design, preparation for welding, welding technique, inspection and test.

Welded Horses

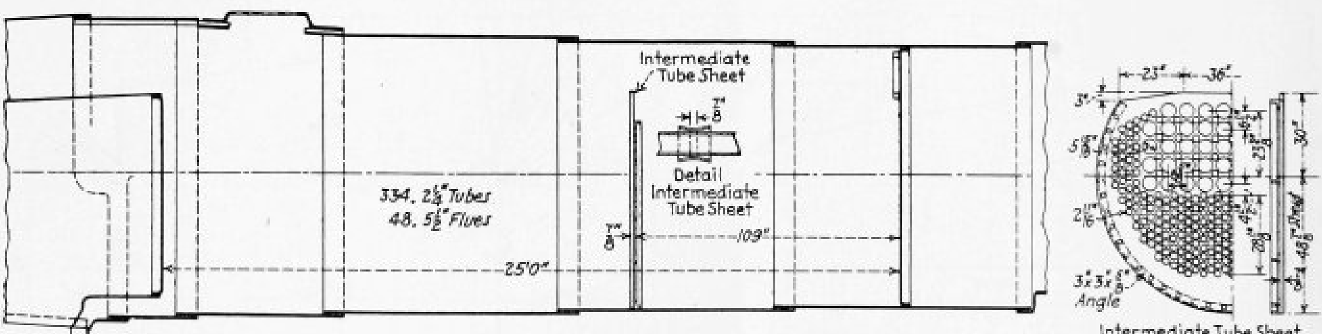
A PAIR of ruggedly-built horses, that can be made from scrap material usually found in any boiler shop, are shown in the accompanying figure. These were constructed from some scrap angle iron by a plant welder of a large eastern shop. The finished product



A pair of welded horses constructed from boiler shop scrap material

was a great improvement over the wooden ones that had been used in the past due to the additional strength and simplicity.

It was a simple task to weld these pieces of scrap together. The accompanying illustration shows clearly the construction of the horse and the location of the welds. The pieces were all welded with butt-type joints and a small amount of welding rod was added for extra strength.



Sections of locomotive boiler showing arrangement of tubes

Welding in Locomotive Boilers

IN the construction of the boiler for the new Northern Pacific Mallet locomotive, a total of nearly 1000 feet of electric arc welding was used. This does not include the welding of flues and tubes. About 230 feet of this welding was employed in the firebox assembly. Welding along the calking edges of seams to increase their tightness, welding around washout plugs, fittings and liners, both inside and outside the boiler, accounts for the remaining 770 feet. The extent to which welding was safely applied in the case of this boiler, again bears evidence to its value in the boiler field and the possibility of its still wider use.

Associations

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Chief Inspector—A. G. Pack, Washington, D. C.

Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

Steamboat Inspection Service of the Department of Commerce

Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

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Assistant International President—William Atkinson, suite 522, Brotherhood Block, Kansas City, Kansas.

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States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Memphis, Tenn.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

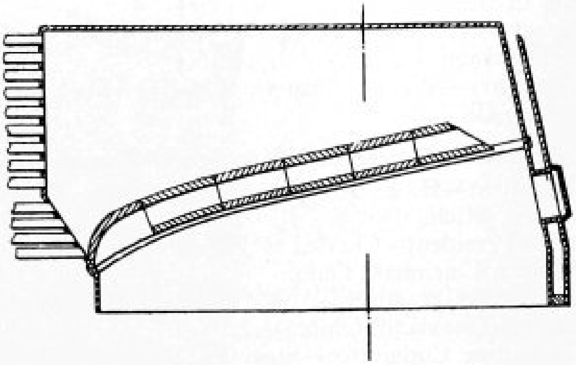
Compiled by
DWIGHT B. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

RE. 17,088. FIREBOX FOR BOILERS, ROBERT MARVIN SPENCER, OF WAYCROSS, GEORGIA.

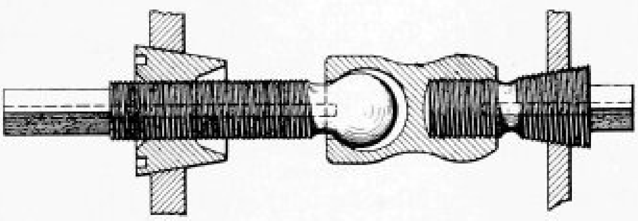
Claim.—In combination with a boiler firebox, longitudinally extending arch pipes between the fire containing portion of the fire box and the fire flues thereof, a plurality of arch sections of hollow construction mounted



on said arch pipes, each section including a plurality of hollow blocks, the intermediate blocks being open ended, and the front block having one open end adjacent the next intermediate block and an open bottom, and the other end block having open ends one of which is beveled.

1,680,229. FLEXIBLE STAYBOLT. WILLIAM POLLOCK, OF PITTSBURGH, PENNSYLVANIA.

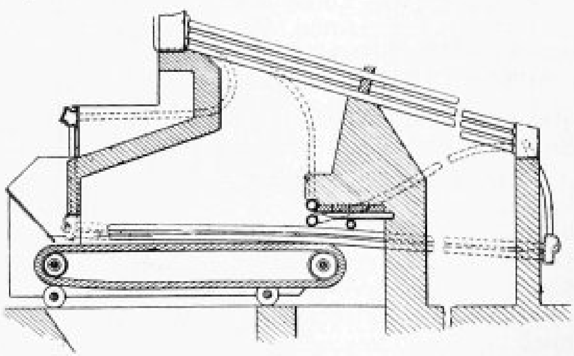
Claim.—A boiler staybolt comprising an end section having a central tapered and threaded portion, a straight threaded end portion and a wrench receiving opposite end portion; an intermediate section having a threaded socket in one end receiving the threaded end portion and having a



ball socket in the remaining end; a second end section having a straight threaded body, a ball end held in said ball socket and a remaining end portion adapted to receive a wrench; and a tapered plug screwed on the last mentioned straight threaded portion, the smaller ends of the tapered threaded portion and of the plug confronting each other. Two claims.

1,656,643. FURNACE. THOMAS A. MARSH, OF CHICAGO, ILLINOIS, ASSIGNOR TO GREEN ENGINEERING COMPANY, OF EAST CHICAGO, INDIANA, A CORPORATION OF ILLINOIS.

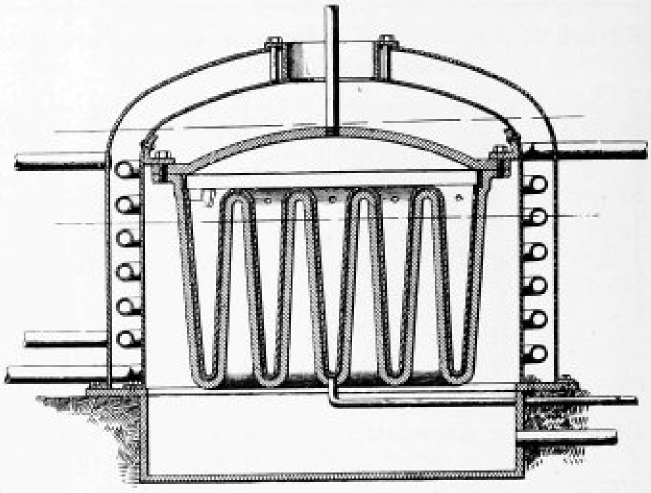
Claim.—In a furnace having side walls, the combination with a traveling grate therebetween, of fluid cooled conduits at the side of the grate and extending substantially the full length thereof with the conduits substantially uniform in diameter and continuous and unbroken from end to



end, said conduits having their forward portions continued to the front of the furnace past the ignition zone of the fuel bed on the grate at the front end of the latter and being bent outward from the grate in advance of said zone so as to have no cooling effect thereon, the remaining portions of the conduits continuing from said zone to the rear end of the grate and arranged to be in direct contact with the fuel bed for more than half the length of the grate. Two claims.

1,680,608. FLASH BOILER. ALLIE GLENN GARBUTT, OF VALDOSTA, GEORGIA.

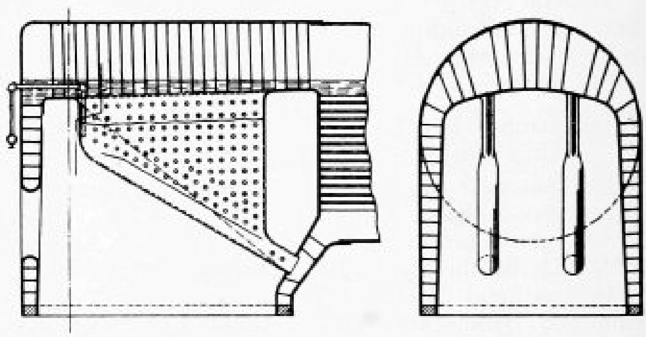
Claim.—A flash boiler of the character described having a steam producer comprising a plurality of concentric annular sections, connections between the alternate ends of adjacent sections forming a producer



zigzag in cross section, said sections and said connections being made up of closely spaced walls defining a sinuous water space through which the water travels spread out into a thin film and in the form of rising and falling sheets. Five claims.

1,679,051. THERMIC SIPHON FOR LOCOMOTIVES. JOHN L. NICHOLSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO LOCOMOTIVE FIREBOX COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

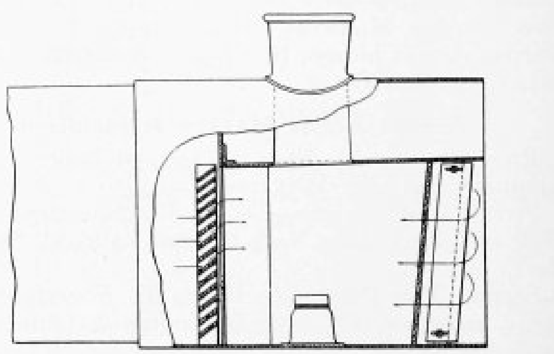
Claim.—A thermic siphon having an angularly disposed bottom portion and a substantially upright front end, the rear end of said siphon being truncated



to extend substantially parallel with said front end and merging into said angularly disposed bottom portion in a curve of a desired radius. Nine claims.

1,683,455. LOCOMOTIVE STRUCTURE. GUY T. FOSTER, OF DAYTON, OHIO, ASSIGNOR TO LEROY THOMPSON, OF NEW YORK, N. Y.

Claim.—In a locomotive boiler structure including firebox, boiler flues, and a cylindrical, horizontally extending smokebox, and smokestack and injection nozzle arranged in vertical axial alinement in the top and bottom of the smokebox, a horizontally extending partition arranged within the smokebox and extending longitudinally from the rear to the front wall of the smokebox and closing off an upper idle space within the cylindrical outer wall of the smokebox and a bifurcated vertically extending partition



arranged within the smokebox and beneath the said horizontally extending partition and extending from the rear and on opposite sides of the axis upon which smokestack and injection nozzle are alined, and affording passageways for the gases forwardly from the boiler flues in bifurcated course adjacent the side walls of the smokebox, and then rearwardly in united course at the center of the smokebox toward the vertical axis in which smokestack and injection nozzle are alined. Five claims.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX **April, 1929** **Number 4**

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

Chicago: 105 West Adams St. Cleveland: Terminal Tower
Washington: 17th and H. Sts., N. W.
San Francisco: 215 Market St.

THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Marine Boiler Rules

EVERY manufacturer of marine boilers has a direct interest in the action taken by the American Marine Standards Committee, at its meeting in New York city March 21, in adopting Standard Rules for the Design and Construction of Marine Boilers and Pressure Vessels and Standard Specifications for Marine Boiler Steel Plate. These rules were originally formulated several months ago by a special committee consisting of representatives of the shipbuilders, ship operators, classification societies, marine underwriters, Navy Department, the United States Steamboat Inspection Service, the A. S. M. E. Boiler Code Committee and others either directly or indirectly interested in the matter, and, as such, represent the consensus of opinion of the best minds in the marine industry. Before the final adoption of the rules, opportunity was given to all interested individuals or groups to submit criticisms or suggestions on the work of the committee. All such comments received were discussed at the March meeting and after careful consideration, the constructive suggestions advanced were incorporated in the rules as finally approved. As time goes on, it is the intent of the committee to review and revise the rules in conformity with later developments as they occur.

No group of individuals has a better understanding of the requirements of marine boiler practice than the American Marine Standards Committee and it may be stated that the combined efforts of the members will form the best possible basis for marine boiler construction in the future. In spite of this, and the fact that the committee is acting under the auspices of the Division of Simplified Practice of the United States Department of Commerce, the United States Steamboat Inspection Service, another division of the same department, has seen fit to proceed with the preparation of a code of marine boiler regulations that practically ignores the approved standard rules of the industry. Acting on the premise that no abstract code of rules could be inclusive enough to cover all contingencies arising in the inspection of marine boilers, the Board of Supervising Inspectors is at present combining such portions of their former rules as now apply with extracts from the A. S. M. E. Boiler Code and sections of the American Marine Standards Code, which regulations, it is presumed, will be presented for the approval of the Department of Commerce at some later date. There is grave danger of confusion in the industry if such action is taken.

The thought has been expressed by those concerned with the promotion of uniformity that the marine standards in complete form, as approved by the industry as a whole, should be made the basis of the design requirements of the steamboat inspection service. The additional regulations necessary for the administration, inspection and interpretation of the basic rules in specific cases, such as boilers installed on river and light-draft vessels, should naturally be dealt with in full by the inspection service itself. It is to be hoped that the boiler rules as already approved by the marine industry through its standards committee with the co-operation of the steamboat inspection service will be incorporated in full in the official regulations of that body.

Unquestionably it is to the best interests of those engaged in building marine boilers, both individually and as a group to support the rules adopted by the American Marine Standards Committee, and to utilize them in all future marine boiler design.

Low Water Failures

IN the seventeenth annual report of the Bureau of Locomotive Inspection, an abstract of which appeared on page 10 of the January issue of The Boiler Maker, A. G. Pack, chief inspector, took occasion, in commenting on the value of the thermic syphon in lessening the damage due to low water failures, to state:

"There seems little question that, where fireboxes are equipped with thermic syphons properly applied, such explosions as those shown by the illustrations will be avoided by hindering any great area of the crown sheet from becoming overheated due to low water prior to the failure of the sheet in front of or between the syphons, thus precluding the probability of the entire crown sheet being blown down or the firebox from being blown out."

This statement occurred in connection with an analysis of the low-water failure of a combustion chamber boiler described on page 14 and illustrated on page 15 of the January issue. The boiler in question was equipped with two thermic syphons. As a result of the failure, the crown sheet pulled away from 64 radial stays and pocketed to a maximum depth of 3¾ inches, covering an elliptical area 28 inches in width by 52 inches in length. Unquestionably the syphons prevented a much more serious failure as evidenced by Mr. Pack's remarks in this connection:

"The line of demarcation usually caused by overheating was indefinitely defined and therefore could not be determined. Since there was no damage to the crown sheet or stays other than within the pocketed area, it appears evident that the syphon supplied sufficient water to the crown sheet to prevent it from becoming overheated over any considerable area prior to the failure shown."

It is interesting to note that in low water cases where boilers having a straight flue sheet have been equipped with thermic syphons, the damage has been confined to a space extending from the end of the syphon connections and between them forward about 20 inches to the flue sheet. Failures of this character as reported by Mr. Pack in past years have resulted generally in the pulling away of not more than half a dozen radials from the crown sheet and the pocketing of a very small section of the sheet. With the addition of the combustion chamber, as in the accident described, the small unprotected area in boilers with straight flue sheets has become greatly extended.

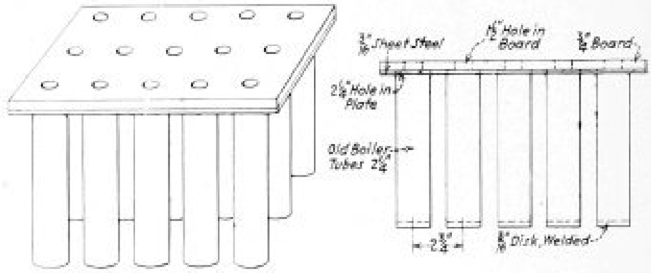
The earlier low water cases which occurred on straight flue sheet fireboxes proved the safety feature of the syphon for this class of boiler and pointed out the necessity for further protection of the combustion chamber type. As a result, the combustion chamber type syphon was developed and more than 400 have already been applied. When this syphon is used, the unprotected area of the crown sheet is again reduced to approximately the same dimensions as prevailed in the older type boiler. Undoubtedly the failure described in this year's locomotive inspection report would have been confined to a much more restricted area had combustion chamber syphons been applied.

Communications

Container for Staybolt Taps

To the Editor:

I am enclosing a sketch and description of a container I have had in use many months and have had many favorable remarks passed on its convenience. This container for staybolt taps serves equally as well on the job while tapping out a firebox as it does in



Easily made container for storing staybolt taps

keeping taps immersed in light oil in the tool room. The board on top of the container with holes ½-inch smaller than the inside diameter of flues prevents the threads coming in contact with other metal thereby protecting the sharp cutting edges of the taps.

Another feature in favor of this container is the small space required for a large number of taps; one 12-inches by 30-inches will accommodate 40 taps. A portion of an old tube sheet cut to the desired shape and size is suitable for the plate to which scrap flues are welded. The lower ends of the tubes have circular plates welded in which makes them oiltight.

Chattanooga, Tenn. C. H. Decker.

Another Flue Plug Accident

To the Editor:

On page 33 of the February issue, reference is made by Mr. Feeney to a flue plug accident that occurred in his work. This accident as it was told around the flange fire by an old-timer, is no doubt the truth, as I can verify this story by a similar experience that I had with a flue plug in a locomotive that was on the storage track for about six to eight months. This incident happened at Big Springs, Texas, on the Texas and Pacific Railroad in the year 1898, thirty years ago. We did not have the electric light to work by and were using an open light, which was known as a signal oil flue lamp. After entering the firebox I had placed my lamp about seven or eight inches from the plug which was on the left hand side, the fourth or fifth flue from the top. I hit the plug a side blow in order to loosen it and there was a terrific report followed by a blue flame several feet in length. The gas from the flue burned several seconds after being ignited from my lamp.

The plug was stopped in its travel by the rear of the firebox which made a noise equal to that of a report from a shot gun. My supposition as to gas in the flue is that, when you plug a flue, you imprison air, and the farther in you drive the plug the greater becomes your air pressure. This air, mixed with the fuel that is left in the soot when the flue is plugged, generates a gas by heat from the firebox. Such a gas will remain in the flue until it is released. This gas to my knowledge will not accumulate unless the flue is heated and kept air tight, and the hotter the flue becomes the more pressure it attains and in time will explode at its weakest point.

El Paso, Texas. P. J. Peters.

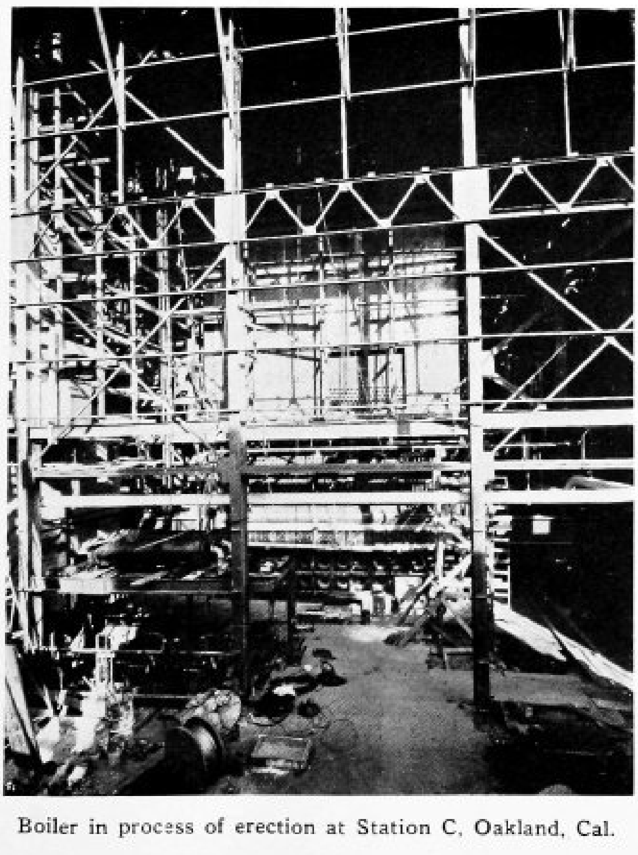
Power Boilers

To the Editor:

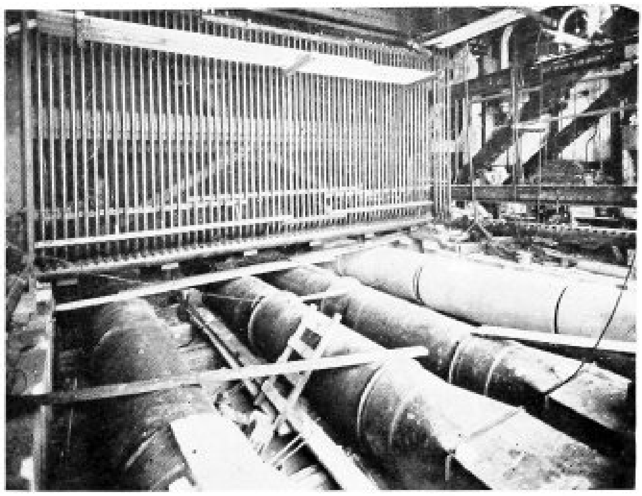
I am enclosing two views of one of the new boilers recently installed in Station C Oakland, Cal., by the Pacific Gas & Electric Company. These boilers are said to be the largest in capacity and dimensions built to operate at 450 pounds pressure, one being of sufficient capacity for supplying steam enough to run the new 50,000-horsepower turbine which was installed at the same time.

Some idea of the enormous size of the boilers may be obtained from the fact that they reach to the height of a five story building, an automatic elevator being provided to furnish transportation to the various elevations and to the auxiliaries. The boilers operate at a pressure of 450 pounds per square inch, while superheaters have been installed to heat the steam to a temperature of 730 degrees F. just before it enters the turbine.

The excessive temperature at which the furnace must operate at full load has rendered the use of solid brick furnace walls almost impossible. To provide walls which can stand temperatures as high as 2900 degrees F. which is expected to be a maximum in the furnace, and also to assist in extracting all possible heat from the flame, water-cooled walls are used. The walls consist of cast-iron blocks faced on the inside with a refractory lining which will stand the high temperatures of the furnace. The water cooling feature consists of vertical tubes 3¼ inches in diameter, spaced 6 inches apart, measured from center to center of the tubes. These



Boiler in process of erection at Station C, Oakland, Cal.



Water walls of boiler at Station C

tubes fit into the outer sides of the cast-iron blocks. Thus the heat from the furnace is carried directly to the water in the tubes and through them to the main boiler through suitable headers. Eight old boilers were torn out to make room for these new boilers.

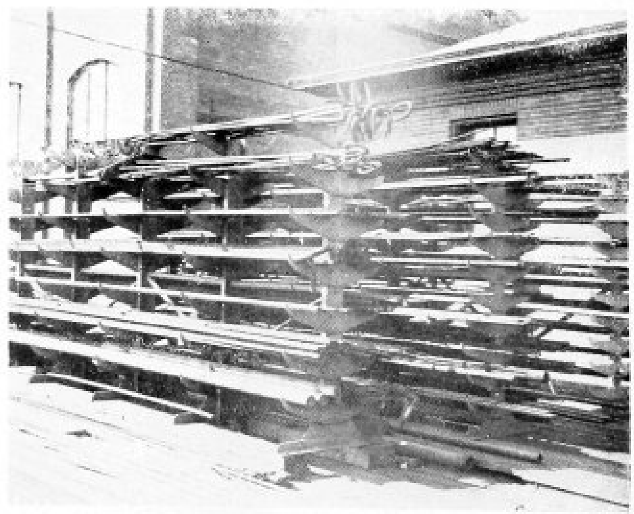
New boilers are to be installed in Station A of the same company, which will operate at 1400 pounds.

San Francisco, Cal. C. W. Geiger.

Storage Rack for Rods and Pipe

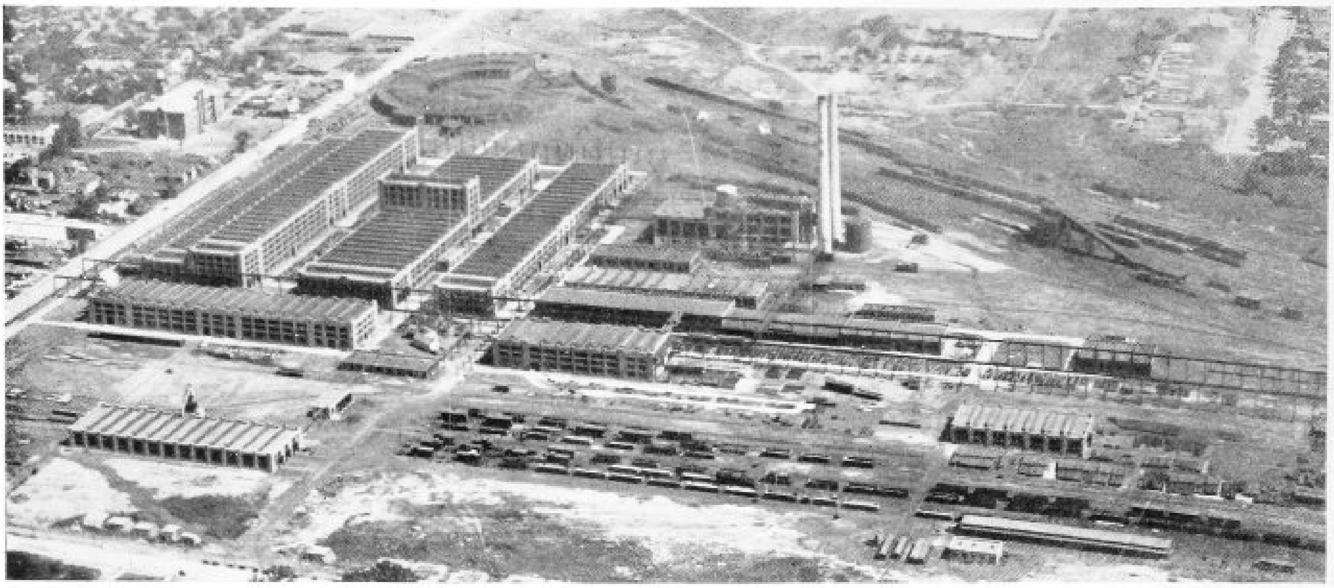
LONG pipes and steel rods are material difficult to store in an orderly manner on the storage platform. The racks shown in the illustration, which are used at the Denver shops of the Colorado & Southern, not only keep such material in order, but make it easily accessible.

Each rack is made of five upright sections of 4-inch channel iron. These are connected lengthwise by three



Long pieces of bars and pipe can be easily stored in this rack

¾-inch rods, passed through sections of 1½-inch pipe and tightened with heavy nuts at the ends. A 4-inch angle, welded to the bottom end of each upright, forms the base. Ten 30-inch sections of ½-inch steel, turned up at each end and 6-inches deep in the middle, are welded to the flat side of the upright channels. These racks are 14-feet long and 6-feet high.



Aerial view of the new Illinois Central shops

New Repair Shops of Illinois Central

A brief outline of the boiler and flue shops at Paducah, Ky.—Arrangement and types of machine equipment

On September 1, 1927, the Illinois Central placed in operation new locomotive repair shops at Paducah, Ky. An entirely new shop organization was built up and the results of the first year's operation have fully met all expectations. Practically all machine-tool equipment installed in these shops was purchased new and represented the latest design of heavy-duty machinery then available. Opening shops of the magnitude of those at Paducah, involving the introduction of new methods and practices and the development of new forces, brought out many new problems not previously encountered. However, these were quickly adjusted and the plant placed on a smooth working basis within a year of the opening date and with an increased output each month comparable with the increase in forces.

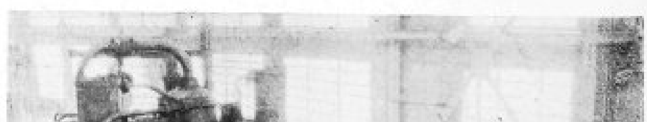
The Illinois Central, like many of the large railroad systems of the present day comprises not only the original charter lines, but a consolidation of many small roads acquired by purchase, lease or other methods. In many cases, repair shop facilities constituted part of the fixed property of these roads and they continued to be operated as such for the purpose of making heavy repairs to engines and cars.

Many Old Shops on System

Naturally, some of these shops were very old, and while they were serving their purpose to the extent of their capacity, it was only by reason of making large yearly replacements and additions of modern machine tools and mechanical labor-saving devices that the output of these shops could be kept up with the requirements.

The ages of these shops at the time the new shops at

A 7-foot radial drill in boiler shop



Hydraulic press and furnace

Paducah opened covers a range of 23 to 60 years. When it is considered that the main shops at Burnside, Ill., which were the largest on the system prior to the construction of the new facilities at Paducah, were 34 years old and that the size and weight of locomotives have continually increased, particularly in the past 10 years, it is readily apparent why the Illinois Central built new shops. It was simply a matter of necessity as the locomotives purchased in more recent years were so large they could not be placed in the then existing shop buildings.

At the time the Burnside shops were built, the largest locomotive owned was a Consolidation, 2-8-0 type, 35 feet 6¼ inches over all in length and weighing 137,300 pounds. In 1927, the larger engines were:

Type	Length	Weight
2-6-6-2	62 ft. 7 in.	438,000 lb.
2-10-2	56 ft. 8¾ in.	382,000 lb.
2-8-4	55 ft. 1½ in.	388,000 lb.
4-8-2	56 ft. ¾ in.	367,500 lb.

There has been a maximum increase of 76.3 percent in length and 219 percent in weight.

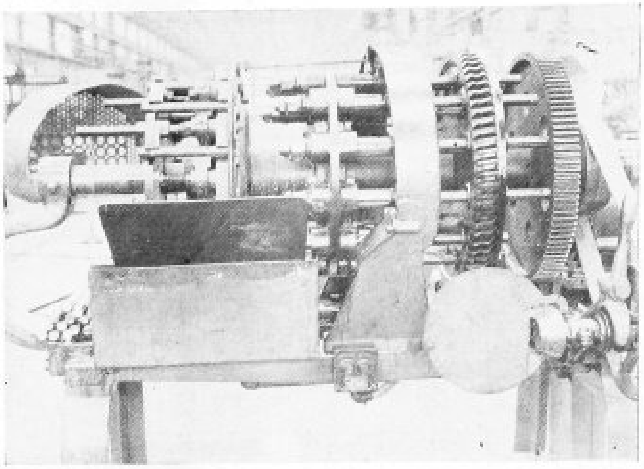
The Illinois Central System is divided generally into two grand divisions by the Ohio River. Burnside shops serve the territory north of the river except for those locomotives which are too large for the shops to accommodate. Paducah shops serve all of the territory south of the river as well as those large locomotives which cannot be handled at Burnside.

There were several advantages accruing to the railroad which influenced the selection of Paducah for the location of the new shops. It is on the main line from Louisville to New Orleans readily accessible to all points in the Southern district and also within reasonable distance of points on the Northern district. It is a city of good size presenting favorable housing and living conditions for the workmen and has a fairly even climate. The company owned considerable property which could be utilized to good advantage for shop purposes and which permitted purchasing less additional land than would have been the case if these shops had been located at some other point on the system.

Ground was first broken for the new shops March 31, 1925, and they were opened for operation in September, 1927. The locomotive group consists of four main buildings: Machine and erecting shop, boiler shop, blacksmith shop and tank and paint shop; also a lesser set of buildings consisting of a paint and carpenter-shop building, a combination pipe, tin, air brake and electrical shop, the flue shop located in one end of the iron-storage building, brass foundry and two toilet, wash-room and locker buildings. The storehouse, oil house and paint-storage building, iron-storage building and power house serve both the locomotive and car departments. The general layout provides for future extension to all shop buildings within predetermined limits.

Details of Boiler Shop

The boiler shop is 624 feet long and 166 feet wide with an erecting bay on one side and a machine bay on the other, each of equal depth. The two center bays of this building are elevated above the balance of the building, providing a riveting tower for handling boilers vertically in the 26-foot gap riveter. The traveling crane equipment in this shop consists of one 75-ton gap crane on the erecting side, two 15-ton cranes on the machine side and a 25-ton crane in the tower portion of the building. This crane is operated by remote control from the platform of the gap riveter



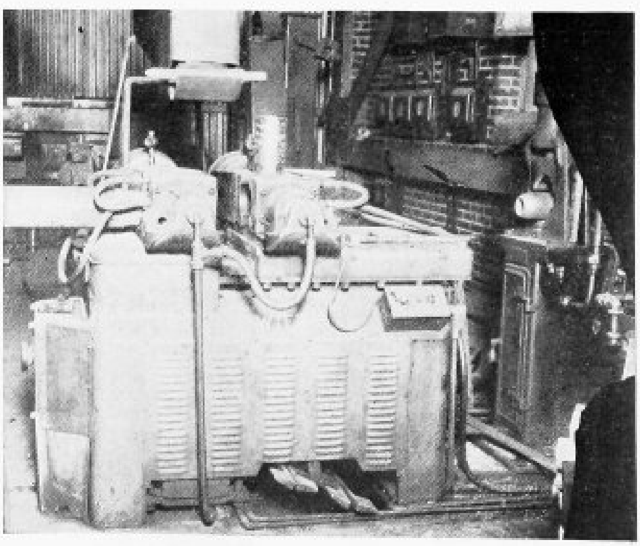
Multiple-spindle staybolt drilling machine

but also has an operator's cage on the crane with dual control. The equipment is shown in Table I, the location of machines being shown in one of the illustrations.

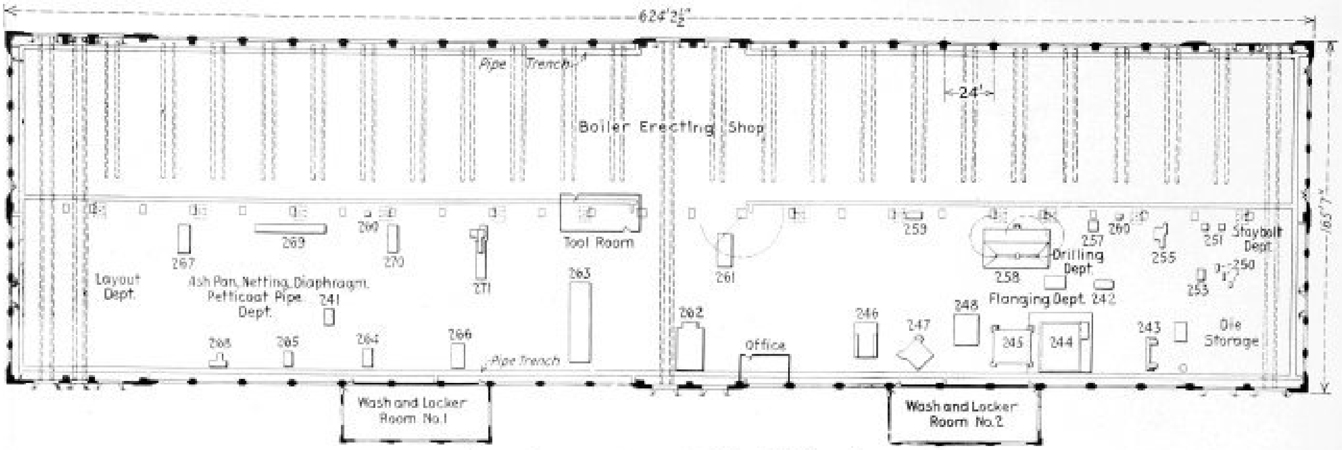
A special mounting of a 7-foot radial drill used for drilling sheets and plates for locomotive fireboxes is illustrated. The drill is mounted on a movable carriage which is operated by electric motor, permitting quick movement of the entire machine on the rails which extend the full length of the depressed pit in which the machine operates. The machine is held in place at any location by air clamps with control placed for the convenience of the operator. Such an arrangement permits handling work of this nature quickly by moving the machine along the track to reach all portions of the sheets being drilled, rather than moving the sheets to keep within the range of the machine.

Another illustration shows an unusual multiple-spindle staybolt drilling machine. The design of this machine is such that the spindles are mounted and operated on a circular fixed head in a horizontal position, while the staybolts are handled in a revolving fixture which stops opposite each spindle for the hole to be drilled to a greater depth by the succeeding twist drill.

The use of the high-speed circular cold saw for cutting off rough ends of flues greatly reduces the time and also gives a better finish than was obtained with the old rotary knives. All the welding of boiler tubes



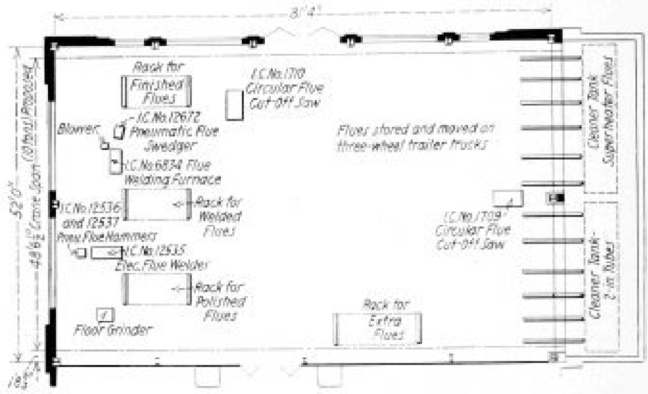
Electric flue welder in operation



General arrangement of the boiler shop

Table 1.—Boiler Shop Machines and Equipment

Item No.	Machine	Motor
241—1—	Bar cutter, general work	1—7½ hp.—a.c.
242—1—	McCabe pneumatic flanging machine	....
243—1—	Pneumatic flanging clamp, 10 ft.	....
244—1—	Hydraulic flanging press, 2,100 tons	....
245—1—	Plate heating furnace and blower, 12 ft. by 15 ft.	1— 10 hp.—a.c.
246—1—	Hydraulic flanging press—Sectional, 100 tons	....
247—1—	Plate heating furnace and blower, 7 ft. by 8 ft.	1— 10 hp.—a.c.
248—1—	Face plate, 12 ft. by 15 ft.	....
250—3—	Metal saws, 6 in. by 6 in.	3— 1 hp.—a.c.
251—1—	Staybolt machine, 6 spindles	1— 10 hp.—a.c.
253—1—	Staybolt drill, 12 spindles	1— 5 hp.—a.c.
255—1—	Horizontal punch, 20 in.	1—7½ hp.—a.c.
257—1—	2-spindle drill, 20 in.	1— 2 hp.—a.c.
258—1—	Radial drill—Boiler plate work, 7 ft.	1— 25 hp.—main drive a.c. 1— 5 hp.—power traverse a.c. 1— ¾ hp.—comp. pump a.c.
259—1—	Plain radial drill, 3 ft.	1— 10 hp.—a.c.
260—2—	Dbl. floor grinders, 18 in. by 3 in.	2— 5 hp.—a.c.
261—1—	Reach stake riveter (hydraulic), 30 tons, 18 in. gap by 84 in.	....
262—1—	Gap bull riveter (hydraulic), 200 tons, 20 ft.	....
263—1—	Bending roll, 20 ft. by 1⅛ in.	1— 60 hp.—main drive a.c. 1— 25 hp.—hoisting motor a.c.
264—1—	Vertical punch—single, 24 in.	1— 10 hp.—a.c.
265—1—	Vertical shear—single, 24 in.	1—7½ hp.—a.c.
266—1—	Vertical punch—single, 60 in.	1— 10 hp.—a.c.
267—1—	Vertical shear—single, 60 in.	1—7½ hp.—a.c.
268—1—	Rotary bevel shear, No. 3	1— 10 hp.—a.c.
269—1—	Plate planer, 20 ft. by 1½ in.	1— 20 hp.—a.c.
270—1—	Single punch, 48 in.	1— 10 hp.—a.c.
271—1—	Bending roll, 6 ft.	1— 5 hp.—a.c.
...—1—	Superheater-unit grinder—pneumatic	....



Layout of flue shop

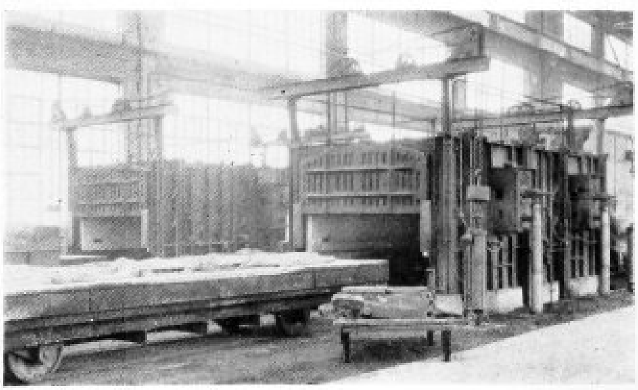
Table 2.—Equipment in the Flue Shop

No. units	Machine	Motor
1—	Electric flue welder, 6 in. capacity	1— 7½ hp.—a.c.
2—	Ryerson pit type flue cleaners	2—25 hp.—a.c.
1—	Pneumatic flue welder	....
1—	Pneumatic flue swedger, 2 in.	....
1—	Pneumatic flue swedger, 6 in.	....
1—	Special flue welding furnace and blower	1— 3 hp.—a.c.
1—	Circular flue cut-off saw	1—10 hp.—a.c.
1—	Safe end flue lathe	1— 1 hp.—a.c.

The brass foundry is 67 ft. by 98 ft. in size. In the building there is a foundry floor 67 ft. by 66 ft., a pattern shop 25 ft. by 32 ft., and a pattern storage room 42 ft. by 32 ft.

at Paducah shops is performed on the electric welder illustrated. This method of welding has been found more rapid and the costs compare very favorably with the methods formerly employed.

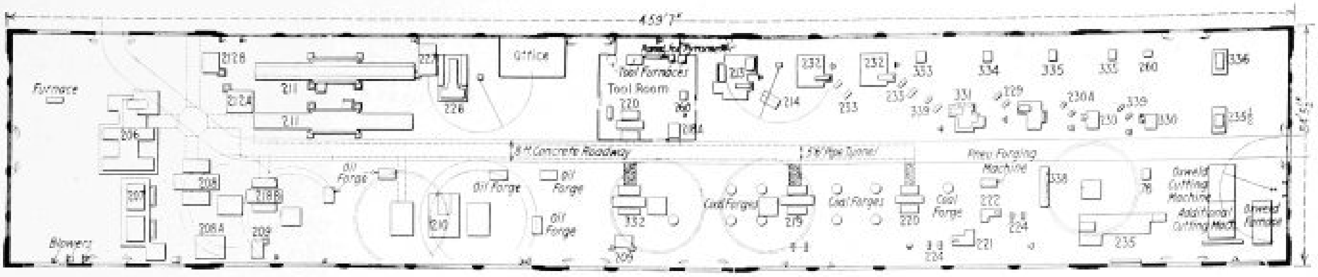
There is also a separate building, 84 feet by 193 feet, for the storage of iron and steel. The flue shop, occupying a space 84 feet by 54 feet, is located in one end of this building. The arrangement of the shop is shown above, and the equipment is listed in Table 2.


Annealing furnaces in smith shop

Two water-type flue cleaners are located just outside of the building at one end of the flue shop and under the main yard craneway. An opening in this end of the building permits the flues, when cleaned, to be rolled directly to racks inside of the shop, from which they are handled through the machines.

Blacksmith Shop Has Modern Equipment

The blacksmith shop is 84 feet wide by 46 feet long and is provided with a 10-ton overhead traveling crane. All steam lines and hydraulic pressure lines are carried in a concrete tunnel through the center of the shop, with laterals to the various machines and tools. Pillar cranes electrically operated and ranging from 2 to 10 tons in capacity serve the steam hammers. A battery of twelve 10,000-gallon oil tanks is located underground on the west side of the building and the hydraulic system of handling oil to the furnaces and forges is used. The layout of the shop is shown on page 97, and the machines are listed in Table 3.



Location of machine equipment in the blacksmith shop

Table 3.—Equipment in the Blacksmith Shop

Item No.	No. units	Machine	Motor
78	1	Heavy duty drill, 24 in.	1— 7½ hp.—a.c.
206	1	Steam-hydraulic forging press, 1,000 tons	
207	1	Dbl. forging furnace and blower, 7 ft. by 10 ft.	1—15 hp.—a.c.
208	1	Steam hammer, 5,000 lb.	
208a	1	Forging furnace and blower, 5 ft. by 8 ft.	1— 5 hp.—a.c.
209	2	Forging furnaces and blowers, 3 ft. by 4 ft.	2— 5 hp.—a.c.
210	1	Steam hammer—frame work, 3,600 lb.	
211	2	Annealing furnaces and blowers, 6 ft. by 16 ft.	2—15 hp.—a.c.
212a	1	Carbonizing furnace and blower, 4 ft. by 6 ft.	1— 5 hp.—a.c.
212b	1	Carbonizing furnace and blower, 2 ft. 6 in. by 4 ft.	1— 5 hp.—a.c.
213	1	Forging machine, 5 in.	1—30 hp.—a.c.
214	1	Forging furnace and blower, 2 ft. by 6 in.	1— 5 hp.—a.c.
218a	1	Steam hammer for tool-dressing work, 300 lb.	
218b	1	Steam hammer, 2,500 lb.	
219	1	Steam hammer, 1,500 lb.	
220	2	Steam hammers, 1,100 lb.	
221	1	Power hammer, 300 lb.	1—10 hp.—a.c.
222	1	Power hammer, 150 lb.	1— 7½ hp.—a.c.
223,224	2	Heating furnaces with blower, 3 ft. by 5 ft.	2— 3 hp.—a.c.
226	1	Hydraulic flanging press (sectional), 100 tons	
227	1	Heating furnace with blower, 5 ft. by 8 ft.	1—10 hp.—a.c.
228	1	Bolt heading machine, 2 in.	1—15 hp.—a.c.
229	1	Forging furnace and blower, No. 5 F.	1— 3 hp.—a.c.
230	1	Bolt heading machine, 1½ in.	1—10 hp.—a.c.
230a	1	Heating furnace and blower, No. 4 F.	1— 3 hp.—a.c.
232	2	Forging machines, 3 in.	2—20 hp.—a.c.
233	2	Forging furnaces and blowers, 18 in. by 16 in.	2— 5 hp.—a.c.
235	1	Buffalo bar cutter, heavy duty	1—40 hp.—main drive, a.c. 1—10 hp.—table drive, a.c.
235½	1	Light duty bar shear	1— 3 hp.—a.c.
260	2	Dbl. floor grinders, 18 in. by 3 in.	2— 5 hp.—a.c.
330	1	High duty bolt header, 2 in.	1— 7½ hp.—a.c.
331	1	High duty bolt header, 2 in.	1—15 hp.—a.c.
332	1	Steam hammer, 2,000 lb.	
333	1	Dbl. head bolt cutter, 2 in.	1— 5 hp.—a.c.
334	1	Dbl. head bolt cutter, 1½ in.	1— 3 hp.—a.c.
335	2	Dbl. head bolt cutters, 1 in.	2— 3 hp.—a.c.
336	1	Bar shear, 2½ in. capacity	1— 5 hp.—a.c.
338	1	Punch, dbl., 20 in.	1—15 hp.—a.c.
339	2	Forging furnaces and blowers	2— 3 hp.—a.c.

An auxiliary welding department is maintained in this shop where also are located two oxygraph cutting machines for cutting shaped parts from solid stock by oxy-acetylene gas.

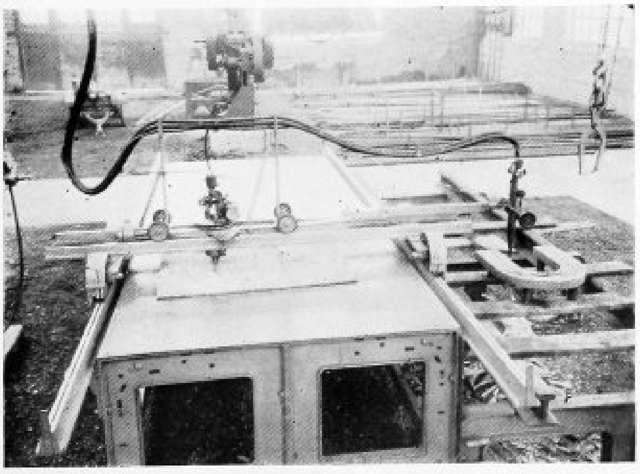
The 1000-ton steam-hydraulic press, shown in one of the illustrations, represents the latest practice in blacksmith-shop equipment for making large forgings, and handles with ease the quantity of work which it would otherwise require several large steam hammers to do. The pressing or squeezing action eliminates the noise and vibration which accompanies steam-hammer operations and produces a highly satisfactory quality of work.

The oxygraph machine, of which there are two installed in the blacksmith shop, is a good example of the many labor-saving devices with which the shops are equipped. These machines, in connection with a heat-treating furnace, permit a large amount of irregular shapes to be cut out which formerly it was necessary to form by forging. This practice has been developed to the point that many articles can be cut to size and used without machine finishing, and when finish is necessary the amount of stock to be removed is very small.

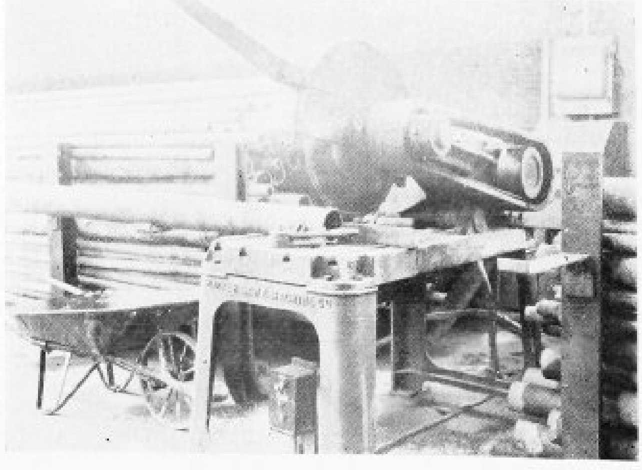
The tank and paint-shop building is 100 feet wide by 624 feet long. All work on tender trucks, cisterns and frames, as well as on steel cabs, is performed in this shop. The equipment is listed in Table 4.

Table 4.—Tools in the Tender Shop

No. units	Machine	Motor
1	Upright drill, 42 in.	1— 2 hp.—a.c.
1	Bending roll, 12 ft.	1—22 hp.—a.c.
1	Combination punch, shear and bar cutter	1— 5 hp.—a.c.
1	Punching and spacing table, 10 ft. by 33 ft. by ½ in.	1— 5 hp.—a.c.
1	Quick work rotary shear	1—15 hp.—a.c.
1	Radial drill plane, 5 ft.	1—10 hp.—a.c.
1	Upright drill, 24 in.	1— 2 hp.—a.c.
1	Dbl. floor grinder, 18 in. by 30 in.	1— 5 hp.—a.c.
2	Face plates, 8 ft. by 19 ft.	....



Oxygraph mechanical cutting torch



High-speed cold saw for tubes and flues

Spring Dolly Bar

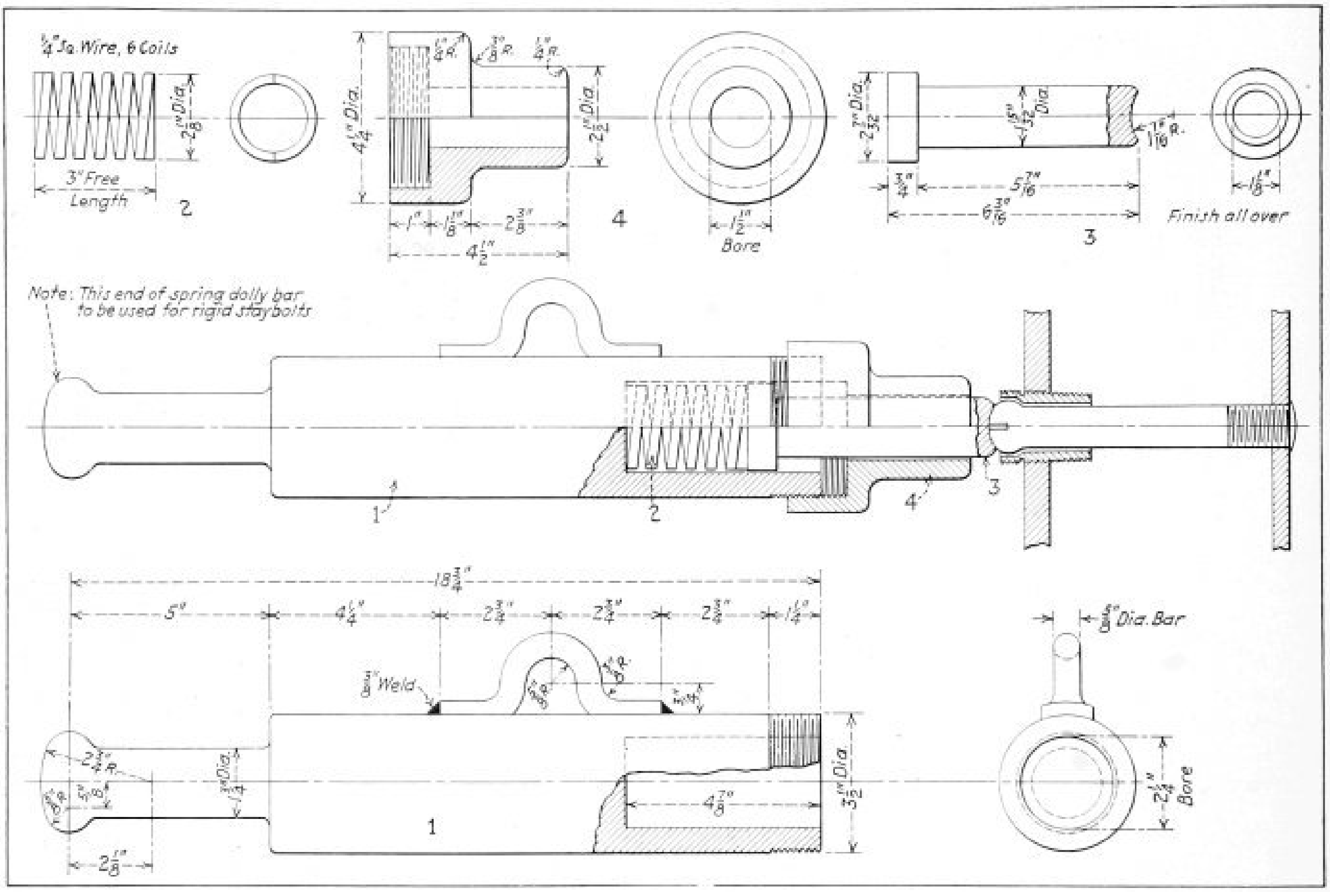
By C. E. Lester

THE spring dolly bar illustrated is a valuable adjunct to the equipment of any boiler shop where flexible staybolts are applied. With the lifting loop as shown, it is used in connection with various kinds of supports. It is, however, not too heavy to be used by hand alone.

Various types of spring dollys have been used by the writer for several years, the one illustrated being the latest design and of the greatest utility and economy by reason of its dual capacity as a holder-on for both flexible and rigid bolts. When driving up an installation of flexible and rigid bolts it eliminates the necessity of a change in bars with the consequent delay. In addition to this it has the advantage over other spring, pneumatic or common plug dollys in that it may be used at any angle. It requires no back stop and one man may operate it when driving flexible bolts. Other devices may have one or more of the advantages listed but none of them possess them all. The usual method of using several holding-on threaded sleeves for guiding the reduced body dolly with the necessity for an extra man to keep these changed for the holder-on is quickened considerably. One man is dispensed with and the manual effort lessened.

The preferable method of application with flexible staybolts is to first properly adjust the bolts and fasten them in position by nicking or centering the thread and sheet on the firebox side to prevent the driving vibration from forcing the bolts out of adjustment. This method allows the driver to proceed just as rapidly with flexible staybolts as with rigid bolts. Due to the very slight recoil the manual effort required is at a minimum and naturally the tool is a prime favorite with the workmen. While some prefer to reverse the bar and use the solid end for greater rigidity when driving rigid bolts, the spring end works as well on rigid bolts as on flexible bolts. It may be necessary, however, to change the die for one of a flatter surface if the holding end of the bolt has been driven. This is quickly done as the die sleeve is a comparatively loose fit.

Material for the construction of this tool, with the possible exception of the square spring steel, will be found in the stock or scrap of most any shop. Other sizes or shapes of spring steel may be substituted—the ¼-inch square having been found to be the most suitable after several tests. This tool has reduced the cost of driving bolts 15 percent more than any other method I have tried.



Assembly and details of a dolly bar for fitting both flexible and rigid staybolts

Improved Welding Gloves

THE Oxweld Acetylene Company, New York, N. Y., has added to its line of accessories for oxyacetylene welding and cutting, gauntlet gloves of a soft and pliable suede leather, specially treated to prevent heat from affecting it, to supersede the Oxweld horsehide gloves formerly supplied. A leather strip on the thumb seam and a semi-circular reinforcement on the inside seam adjoining the palm reinforce the glove. The left glove has a leather reinforcement, covering the entire back between the fingers and gauntlet, for protecting the back of the left hand during cutting operations. A close fitting gauntlet protects the arms.

The Old Days of Boiler Making

Being the first of several articles describing tools and methods of fifty years ago

By J. A. Anderson

J. A. Anderson

THERE is something pathetic about the term "old-timer" to one who has been through the mill for fifty years or more in any walk of life and who is now retired to the waiting list for the long, long sleep. Especially is this true to the old-time boiler maker who has filled all the positions from apprentice to superintendent in that noisy, hard trade.

The world has moved along with amazing rapidity during the last fifty-six years, and the boiler maker who has been actively engaged during all that time can recall many interesting experiences of the old days and the old ways of boiler making as compared with the present new and ever-increasing call for greater pressure.

After reading the March issue of THE BOILER MAKER the writer found himself in a reminiscent mood and so, thinking that your readers might be interested in the experiences of one who has put in fifty-six years at boiler making, I decided to describe those experiences from time to time. Following is the story of the first job entrusted to the care of the writer, when he was still in his teens and had hardly got beyond the rivet-heating stage of the trade.

In those bygone days hand hammers counted when deftly handled for cutting out, scarfing down, laying up and riveting, calking and tube setting. Well does the writer remember his first job! On this particular day in that Canadian shop there were not enough boiler makers to cover all the jobs. There was one job considered a simple one, it being a patch on an old-fashioned salt pan; just an open-top pan about 10 feet wide and 20 feet long, so that there was no pressure to contend with. However, all the operations of cutting out the cracked part, scarfing laps, fitting patch, screw-punching holes, riveting, calking, etc., had to be done, and so to this young would-be boiler maker it was a wonderful job.

Another thing which made this job interesting to this young man was the fact that it was an outside job, several miles away from the shop. However, there was something to think about in getting help, for the customer was to furnish such help as was needed, and it was in the country and no iron workers there. So on the way to the job there were many anxious moments spent by this beginner-on-the-job.

Of course in those days there were no air hammers, and yet we were proud of the tools we had. Each boiler maker usually made his own tools. No chart for shapes in those days, each man used his own judgment based on experience, and so the best judgment produced the best tools. There was quite a variety too; for instance, for the job referred to in this article, when the tools were laid carefully side by side on a bench or board, and the count made, we found we had: First, the diamond point and chipping hammer, these were to be used in our first operation of cutting out the old material; then we had the screw punch, in those days we did not do any drilling where a punch could be used, so this screw punch was used for punching the holes both in the pan and in the patch; then came the flat chisels for chipping and scarfing; and for this one-man job several hammers were used in driving the rivets, such as the plugging hammer, the bevel-faced hammer for finishing the far side of the rivet; the old English hammer for finishing the near side of the rivet, and then the Frenchman for calking down the rivet edge. There were also the calking tools, both heavy and light. Quite an array of tools, and yet for years they played a prominent part in boiler making. The boiler maker who possessed a full kit of tools was proud of them and always kept them in good condition.

The tools, then, are all in place and we are ready to proceed with the work. Arm-strong power was all we had and the conditions under which the work had to be done did not add to the worker's comfort. Kneeling on the hard metal and driving the diamond point along with a hand hammer was no easy job. Arms became tired and the sweat sometimes blinded the eyes; but it was all in the day's work.

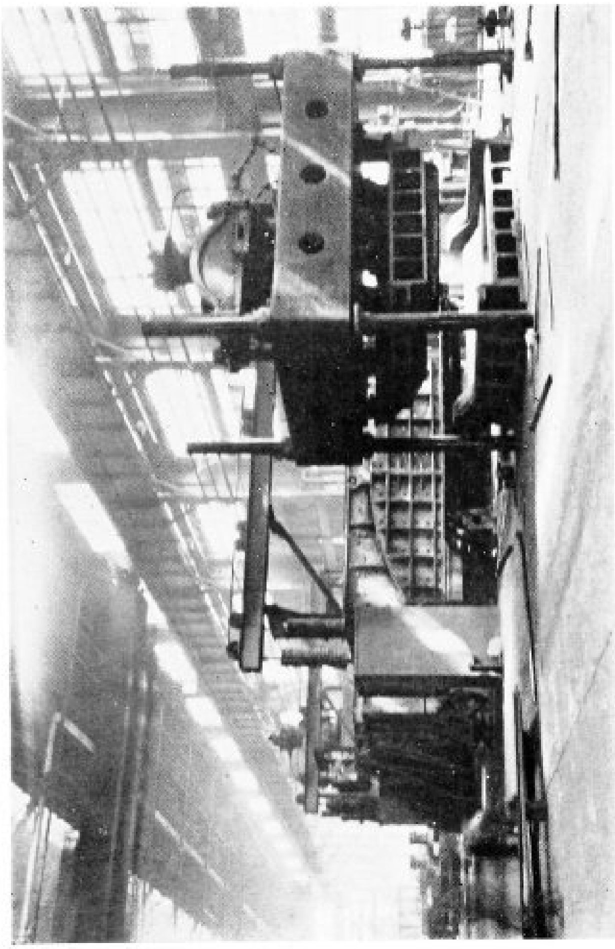
In time, the old plate was cut away, the laps scarfed, the holes laid out and screw-punched, the piece of iron plate is now carefully bent (there was no steel boiler plate in those days) and fitted in place; the rivet holes marked off and then the holes screw-punched in the patch. The patch was then bolted on, closed up, riveted and calked.

From the experience we had in working with the older boiler makers, we knew that if we wanted to escape trouble when the water was turned in, every operation from first to last must be done right.

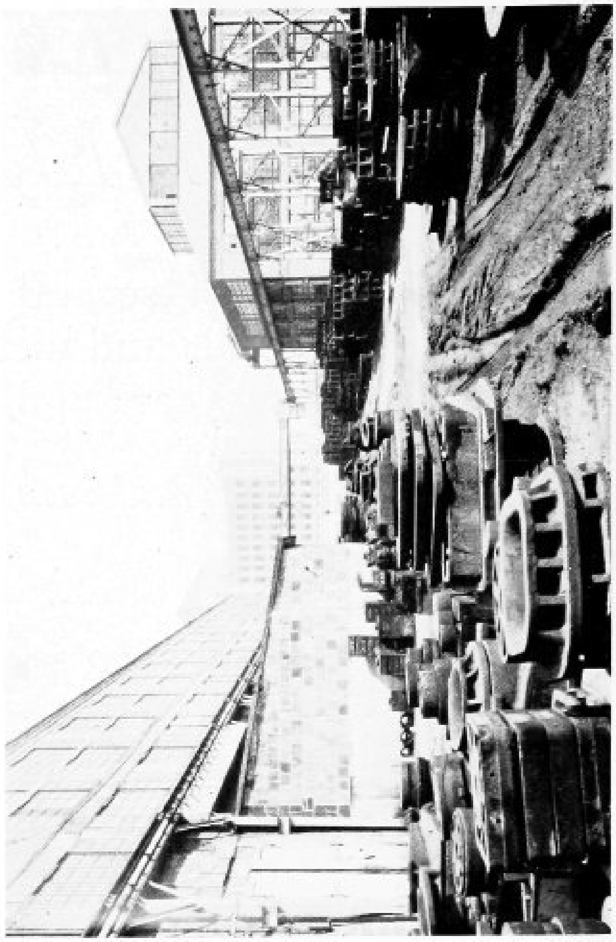
After all this work had been done, the water was turned in, and how proud we were when the work was accepted and a good word given to the doer.

The counting and doing up of the tools, and preparations for our return to the shop, was a time ever to be remembered. No general returning from battle in triumph could be more proud than this young boiler maker returning from his first outside job with success.

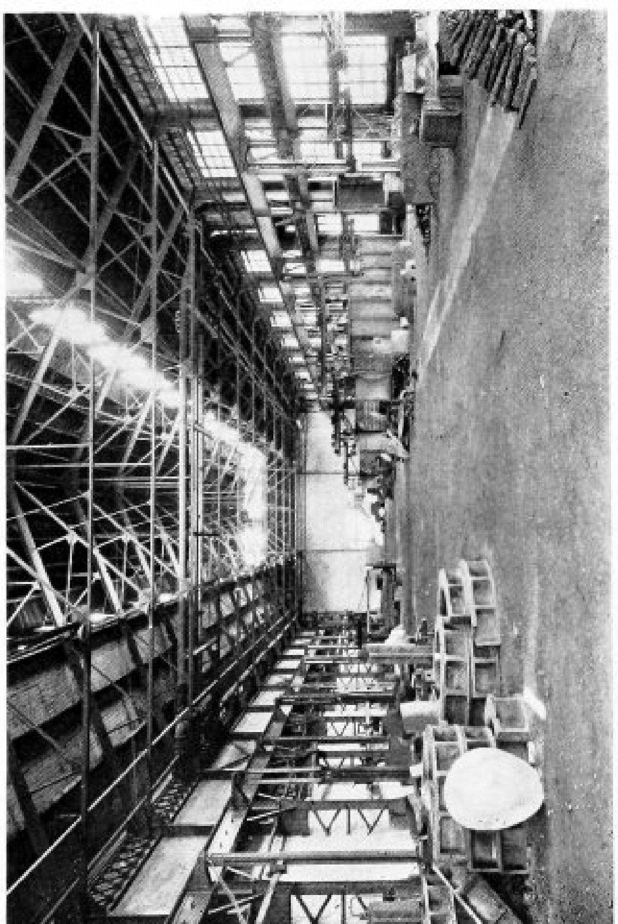
(*To be continued*)



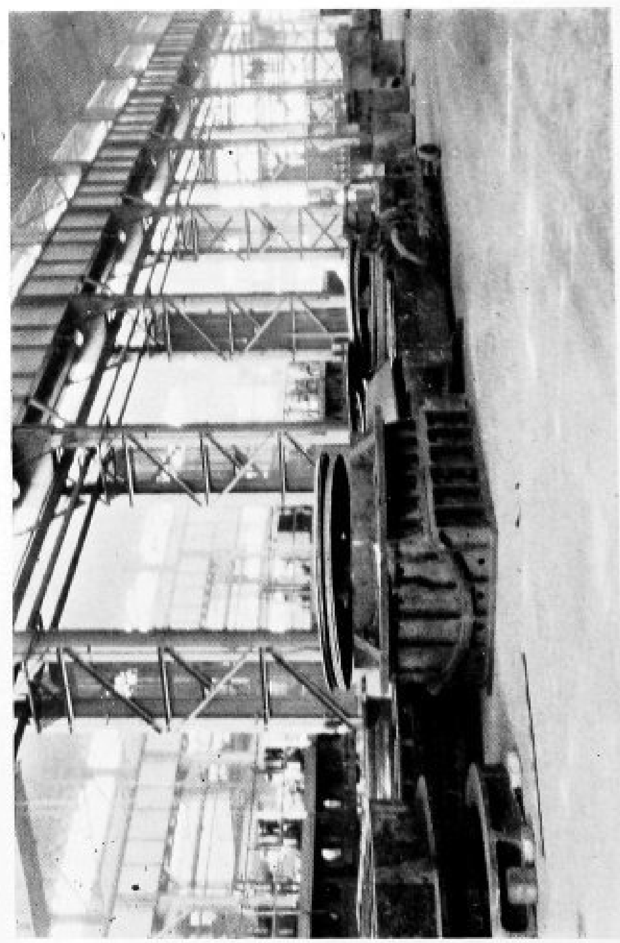
General view of the upper bay showing an R. D. Wood flanging press and its furnace



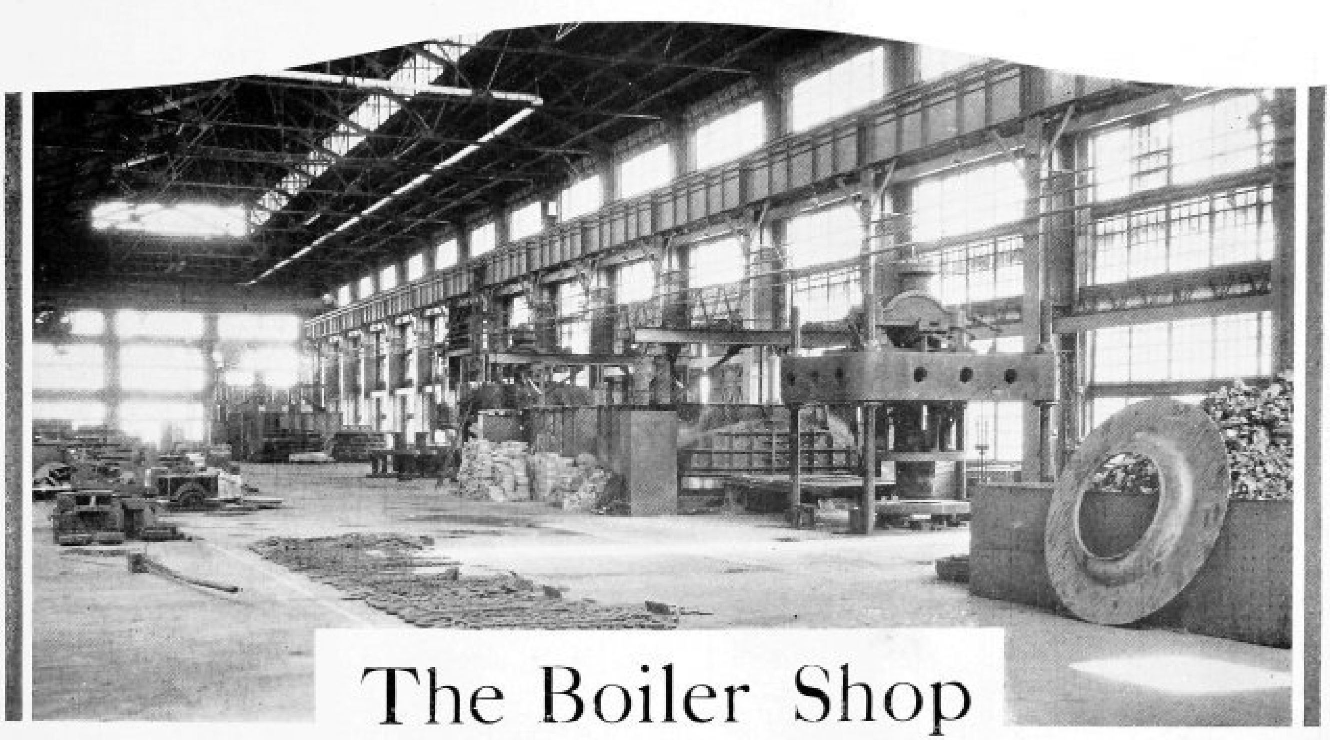
Die storage at the east side of the main boiler shop



General view of lower shop looking north



Die storage at the side of upper bay No. 13



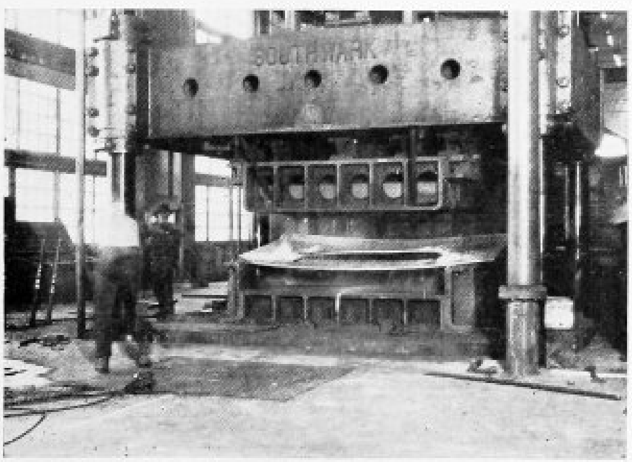
The Boiler Shop at The Baldwin Locomotive Works

Methods employed in the flanging department of the Eddystone plant

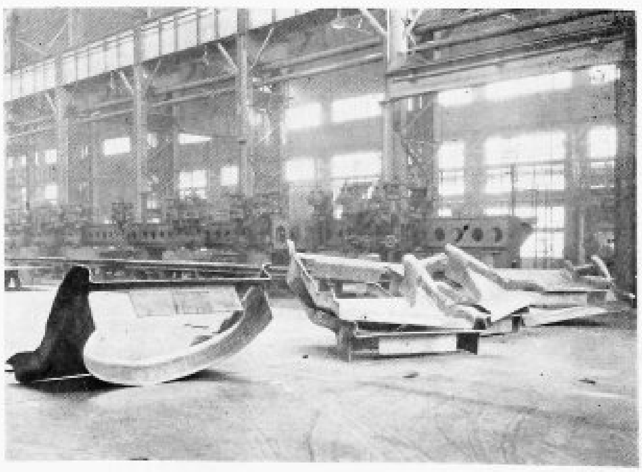
IN the process of constructing locomotive boilers at The Baldwin Locomotive Works, Eddystone, Pa., one of the departments that contributes in a large degree to the success of economical and efficient boiler production is the flange shop. Located in the extreme easterly portion of the main boiler shop, the flanging department occupies what is known as bay No. 13 which comprises a space between two lines of columns 80 feet apart and extending the width of the shop, a distance of 816 feet. Columns, are spaced every 24 feet in the width of the shop and because of this the bay is divided into 34 panels or sections.

The area is divided into two sections, an upper and lower bay. The upper bay, extending between panels 1 and 17, is served by two electric overhead traveling cranes, a 100-ton Sellers crane and a 25-ton Milwaukee-Sellers crane. The lower bay, which extends between panels 17 and 24 and which is enclosed by a cinder-block wall, is served by one 20-ton Shepard electric overhead traveling crane. The upper bay is also served by one 3-ton hand jib crane located adjacent to an R. D. Wood sectional flanger in panels 7 and 8, while the lower shop is amply supplied with jib cranes of 3-ton capacity and under. This equipment includes fourteen 3-ton hydraulic jib cranes, one 3-ton hand jib crane, two 2-ton hand jib cranes and three 1-ton hand jib cranes.

Outside the main building and extending a distance



Throat sheet in the 1160-ton Southwark press

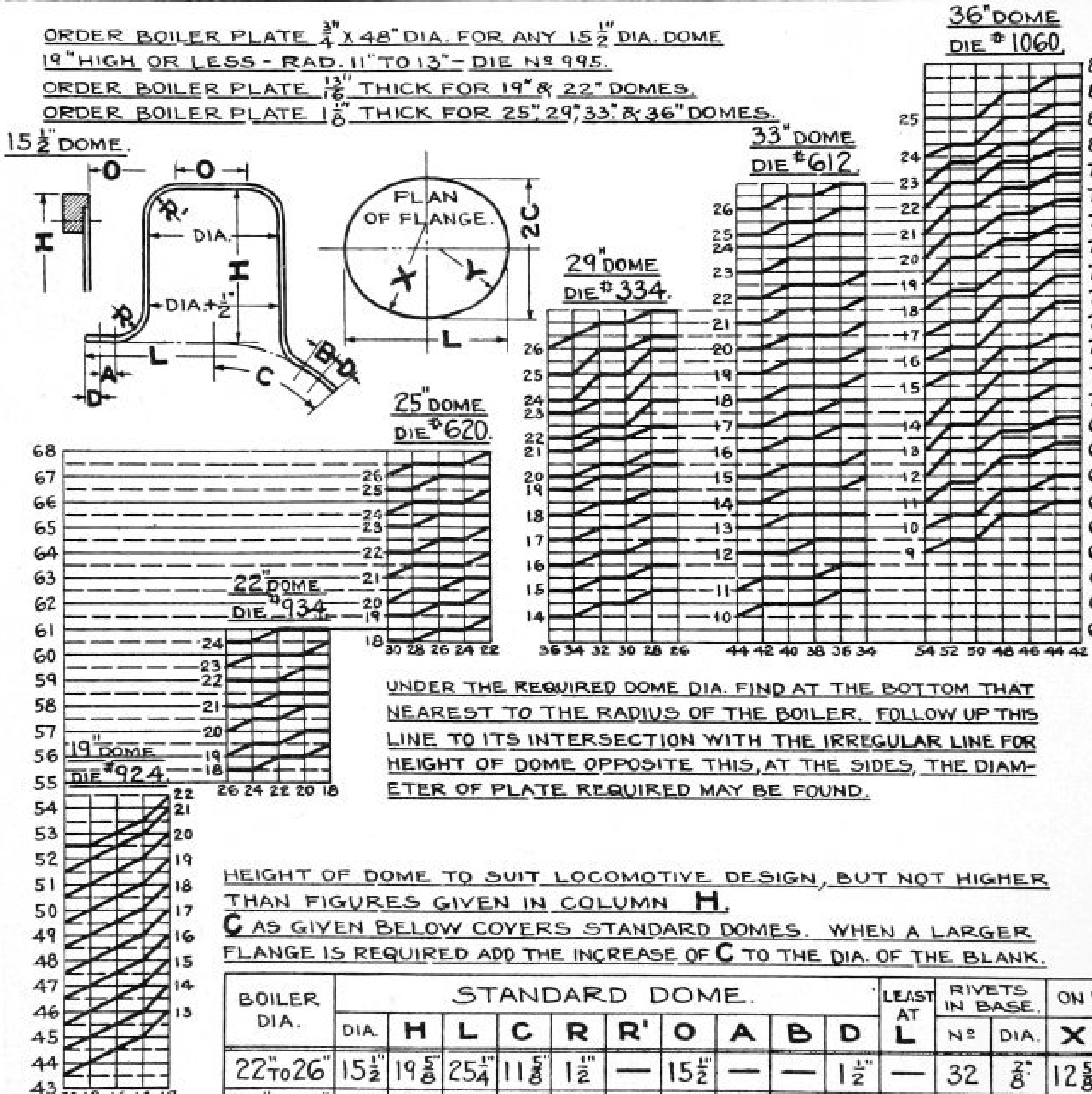


Throat sheets returned to layout department after flanging

THE BALDWIN LOCOMOTIVE WORKS
ENGINEERING DEPARTMENT
PHILADELPHIA, PA.

STANDARD DOMES

ORDER BOILER PLATE ¾" X 48" DIA. FOR ANY 15½" DIA. DOME 19" HIGH OR LESS - RAD. 11" TO 13" - DIE Nº 995.
ORDER BOILER PLATE 13/16" THICK FOR 19" & 22" DOMES.
ORDER BOILER PLATE 1⅛" THICK FOR 25", 29", 33" & 36" DOMES.

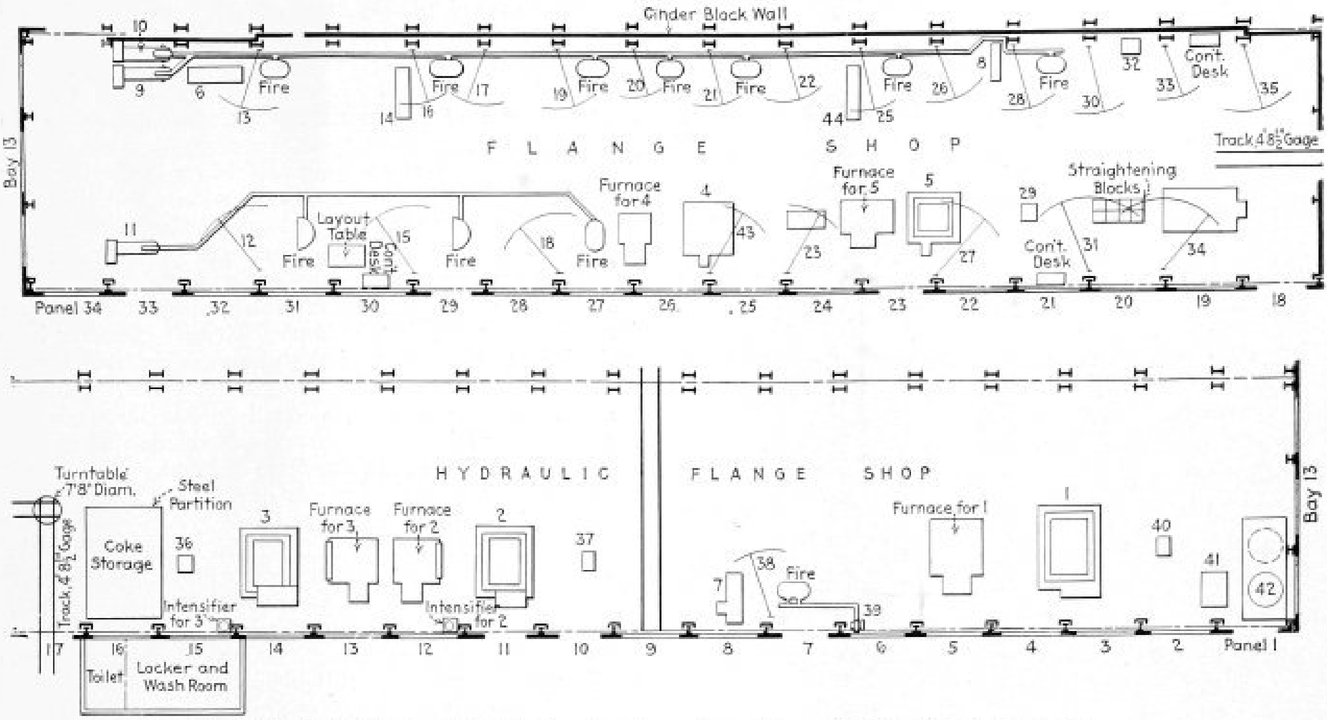


UNDER THE REQUIRED DOME DIA. FIND AT THE BOTTOM THAT NEAREST TO THE RADIUS OF THE BOILER. FOLLOW UP THIS LINE TO ITS INTERSECTION WITH THE IRREGULAR LINE FOR HEIGHT OF DOME OPPOSITE THIS, AT THE SIDES, THE DIAMETER OF PLATE REQUIRED MAY BE FOUND.

HEIGHT OF DOME TO SUIT LOCOMOTIVE DESIGN, BUT NOT HIGHER THAN FIGURES GIVEN IN COLUMN **H**.
C AS GIVEN BELOW COVERS STANDARD DOMES. WHEN A LARGER FLANGE IS REQUIRED ADD THE INCREASE OF **C** TO THE DIA. OF THE BLANK.

BOILER DIA.	STANDARD DOME.										LEAST AT	RIVETS IN BASE.		ON FLAT.	
	DIA.	H	L	C	R	R'	O	A	B	D	L	Nº	DIA.	X	Y
22" TO 26"	15½	19⅝	25¼"	11⅝"	1½"	—	15½"	—	—	1½"	—	32	⅞"	12⅝	11⅝"
28" TO 36"	19"	22"	29¼"	14⅜	2"	1"	15"	—	—	1½"	—	36	⅞"	15"	13⅝"
38" TO 44"	22"	24"	36¾"	17⅞	2"	2"	15"	1⅞"	1⅞"	1½"	36"	72	⅞"	18⅜"	16⅞"
46" TO 54"	25"	26"	41¾"	20⅛"	2"	3⅝"	15"	2½"	2½"	1½"	40½"	88	⅞"	21⅜"	19⅝"
56" TO 68"	29"	26"	49¼"	22½"	2"	3⅝"	19½"	2¼"	2¼"	1⅝"	46"	96	1"	26"	21"
70" TO 84"	33"	26"	52½"	24¼"	2"	4½"	21½"	3"	2½"	1⅝"	50"	96	1"	28"	23½"
86" & OVER	36"	26"	55"	25¾"	2"	4½"	24"	3"	2½"	1 11/16"	52½"	96	1⅛"	28¾"	24 9/16"

Chart for determining plate diameters for the fabrication of standard domes



Layout of the flange shop showing location of machines described in tables below

Table 1—Four-Post Hydraulic Flanging Presses

Machine Number	1	2	3	4	5
Machine location (panel)	3–4	11	14	25–26	22–23
Name of maker	Southwark	Southwark	R.D.Wood	R.D.Wood	Fielding, Platt&Co.
Width between front posts	15' 0"	12' 0"	12' 0"	8' 4"	7' 0"
Width between side posts	10'10"	8' 0"	8' 0"	4' 0"	2' 7"
Length of table	18' 0"	15' 0"	15' 0"	9' 0"	7' 6"
Breadth of table	11' 7"	10' 2"	10' 0"	8'10"	7' 6"
Maximum height between plattens	6' 0"	4' 0"	4' 0"	4' 0"	3' 4"
Main table pressure (tons)	1160	603	503	370	236
Center ram pressure (tons)	260	186	224	115	...
Top ram pressure (tons)	460	{214 {305	426	...	...
Four jacks pressure (tons)	280	191	151	169	85
Main table stroke	72"	48"	48"	44"	21"
Center ram stroke	36"	48"	48"	44"	...
Top ram stroke	42"	36"	29"	...	...
Four jacks stroke	36"	26"	24"	24"	21"
Furnace width	16' 4"	12' 9"	12' 9"	8' 3"	8' 3"
Furnace depth	15' 0"	13' 5"	13' 5"	10'10"	15' 6½"
Furnace front height	4' 0"	3' 4"	3' 4"	3' 0"	2' 6"
Furnace center height	3' 6"	3' 9"	3' 9"	3' 6"	3' 0"
Distance from press to furnace	21' 4"	14' 4"	14' 0"	10' 6"	8' 6"
Furnace location (panel)	5	12	13	26–27	23–24

Table 2.—Hydraulic Sectional Flanging Presses

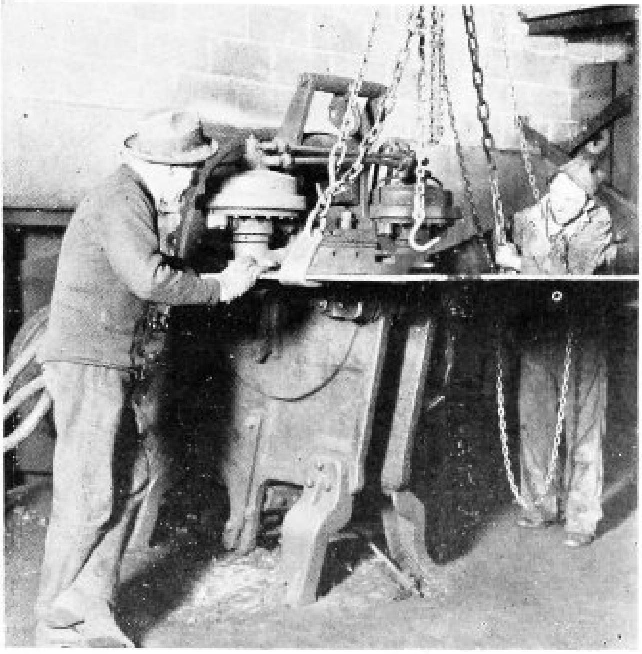
Machine Number	6	7	8
Name of maker	Southwark	R. D. Wood	Morgan Engineering Co.
Height between table and rams	45"	46"	48"
Distance between inner ram and frame	52"	62"	40"
Distance between inner and outer rams	19"	19"	16½"
Width of press	10' 0"	9' 6"	7' 0"
Width of table	5' 0"	4' 6"	3' 6"
Pressure of inner ram (tons)	106	92	48
Pressure of outer ram (tons)	106	92	48
Pressure of horizontal ram (tons)	59	48	..
Location (panel)	32	8	22

Table 3.—Machines Located in Bay 13

Machine No.	Machine	Location Panel
9	No. 7 Sturtevant blower	33
10	No. 7 Sturtevant blower	33
11	No. 8 Sturtevant blower	33
12	3-ton Baldwin hydraulic crane, 21' 10" reach	31–32
13	3-ton Baldwin hand jib crane, 20' 0" reach	31–32
14	150" Baldwin hydraulic plate clamp	30
15	3-ton Baldwin hydraulic crane, 21' 8" reach	29–30
16	3-ton Baldwin hydraulic crane, 18' 3" reach	29–30
17	1-ton Baldwin hand jib crane, 17' 4" reach	28–29
18	3-ton Baldwin hydraulic crane, 19' 1" reach	27–28
19	3-ton Baldwin hydraulic crane, 18' 7½" reach	27–28
20	2-ton Baldwin hand jib crane, 15' 8" reach	26–27
21	3-ton Baldwin hydraulic crane, 17' 9" reach	25–26
22	2-ton Baldwin hand jib crane, 16' 6" reach	24–25
23	3-ton Baldwin hydraulic crane, 22' 0" reach	24–25
24	150" Baldwin hydraulic plate clamp	24
25	3-ton Baldwin hydraulic crane, 19' 11" reach	23–24
26	3-ton Baldwin hydraulic crane, 17' 10" reach	22–23
27	3-ton R. D. Wood hydraulic crane, 23' 2" reach	22–23
28	1-ton Baldwin hand jib crane, 20' 8" reach	21–22
29	5-horsepower Baldwin electric winch	21
30	3-ton Baldwin hydraulic crane, 21' 9½" reach	20–21
31	3-ton R. D. Wood hydraulic crane, 23' 9" reach	20–21
32	McCabe ¾" plate air operated cold flanging press	20
33	1-ton Baldwin hand jib crane, 17' 2" reach	19–20
34	3-ton R. D. Wood hydraulic crane, 22' 3" reach	19–20
35	3-ton Baldwin hydraulic crane, 21' 6" reach	18–19
36	5-horsepower Baldwin electric winch	15
37	5-horsepower Baldwin electric winch	10
38	3-ton Baldwin hand jib crane, 21' 0" reach	7–8
39	No. 5 Sturtevant blower	6
40	5-horsepower Baldwin electric winch	2
41	16-inch American Engineering Co. electric capstan	2
42	Birdsboro hydraulic accumulator	1
43	3-ton Baldwin hydraulic crane, 22' 6" reach	25–26

corresponding to panels 1 to 21 is located the die storage yard. This yard is served by a 15-ton Niles-Shepard overhead traveling crane and a railroad track which enters the main shop in panel 17. With this arrangement, dies stored in any part of the die storage yard may be picked up by the outside traveling crane and carried to panel 17 where they are loaded on a small flat car and transported inside the shop. Once inside the shop, they may be picked up by either of the two cranes in the upper bay and carried to any desired location. For the purpose of transporting dies to the lower bay, a turn-table is located in panel 17 by which the flat car may be shunted on a short track extending into panels 18 and 19. There, the die may be picked up and spotted at any location in the lower bay.

With this orderly system of material handling, operating in conjunction with the most up-to-date flanging equipment, a description of which is given in the ac-



Firebox sheet being flanged on a McCabe pneumatic flanging machine

companying tables, it is not difficult to see that waste motion and time are greatly reduced as compared with hand-flanging methods. Hydraulic flanging is employed as far as possible in the construction of boilers and for this purpose a great number of dies are on hand for use on the hydraulic flange presses.

Only a limited number of dies in current use are stored inside the shop. These are located in bay No. 13 adjacent to bay No. 12 in the upper bay, but a space is always kept clear to allow the passage of tractors in their work of handling plates in and out of the shop. Thus with the use of dies, flanging operations are reduced to a minimum, most of the work being done with one heat only. However, domes and a number of other parts, such as sand box tops, cylinder heads, steam chest casings, valve head covers, and the like, which require a drawing-out process, often employ more than one heat to prevent excessive thinning of material.

All plates that require flanging on entering the boiler shop are stamped with the number of the boiler and the serial number prior to being sent to the flange shop. The class of plate, mentioned in the previous paragraph that does not require trimming prior to flanging is sent directly to the flange shop after being stamped. Other plates, such as throat sheets, firebox sheets, backheads, back tube sheets, etc., are laid out to size in the layout department and are trimmed before being flanged.

Dome Fabrication

Domes may be fabricated on either of the three flanging presses in the upper bay and the number of dies employed in the flanging process depends upon the height and diameter of the dome. Usually from one to five heats are necessary.

The drawing process of dome fabrication causes the reduction of plate thickness to a slight degree. For this reason it is necessary to order material with enough excess thickness to allow for this reduction. For convenience in ordering, the required thickness together with the diameter of the plate necessary for the efficient fabrication of a dome of definite size, is worked out by the drafting room and is presented in the form of the curves shown in one of the illustrations. From these curves, the required diameter and thickness of flat plate may be determined for the construction of a dome of given diameter and height. These curves have been worked out as a result of years of experience in dome construction and represent the greatest economies in plate size for any given type of dome.

The dies for dome flanging are set up in the flanging press with the ball or plunger portion of the die attached to the center ram of the press. The upper ring is rigidly hung from the upper or fixed platten and the lower ring is mounted on the four jacks.

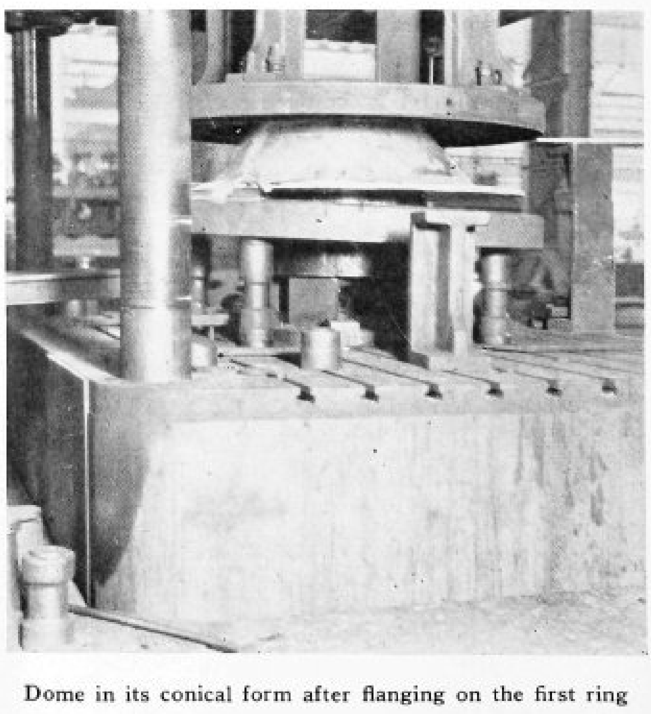
Before the flat plate from which the dome is to be formed enters the flange shop, a ¾-inch diameter hole is drilled in the center of the plate. This hole serves as a guide in centering the plate in the press, as during the first drawing process, a small bolt is screwed into the top center of the ball portion of the die. It is over this bolt that the hole in the plate is fitted. This bolt is only used for centering plates during the first process as, after the first drawing, the dome is self-centering.

The flat plate is heated in the furnace adjacent to the flanging press and the temperature of the plate is checked by means of an optical pyrometer. The large flanging furnaces are fitted with Leeds & Northrup recording electrical pyrometers, which are used for controlling the temperature to which the plates are heated.

The furnace is equipped with Best burners through which the oil is piped under pressure and atomized by means of compressed air. This burner is located in a combustion chamber at the side of the furnace.

When the plate is heated, the furnace door is opened by means of a lever located at the press-control station and a grab dog attached to a winch cable is fastened to the hot plate. By means of the winch the plate is hauled from the furnace across a bridge of rails to the press. This bridge is pivoted at the furnace end and is simply blocked up to the proper height at the die end.

When the plate has been centered in the press, the lower ring is first raised to meet the upper ring, then the plunger or ball is brought into action which draws the plate out to a conical shape. During this process the two rings are held in such a position that a certain amount of plate slippage may be obtained. By this



Dome in its conical form after flanging on the first ring means the plate is drawn to shape and not forced. This serves to retain the plate thickness and not reduce it beyond the allowable limit.

High domes are put through a series of rings, each ring being reduced in diameter until the required dome diameter is reached.

The dies are machined as carefully as possible during the process of manufacture to prevent the formation of ripples in the sheet. However, a limited number of ripples are bound to occur. These are removed during the flanging operation by the process of paddling which consists of using a metal paddle or shim placed wherever a ripple is seen and bringing the rings together. This process localizes the entire pressure of the machine on the point where the paddle is applied. After flanging, however, the heavier sheets are taken to the sectional flanger located in the upper bay where such ripples that could not be removed by the paddling process are taken out.

When the required height and diameter of dome is reached, the dies are changed and a saddle die is set up. The plunger is fastened to the top ram of the press and the saddle dies are arranged with one portion attached to the jacks and the other to top platten.

The partially-finished dome is heated and dropped into place on the lower saddle die and the plunger is inserted to insure the correct height of the dome. The dies are then brought together and the dome is fitted with a curvature corresponding to the diameter of the boiler.

After the process is completed, the dome is allowed to cool slowly. This act of annealing reduces the coarse crystalline structure of the plate and restores the plate to practically its original form.

In following the progress of material through the process of boiler manufacture at The Baldwin Locomotive Works, a further description of the machinery and methods employed in the flanging department will appear in the May issue of THE BOILER MAKER.

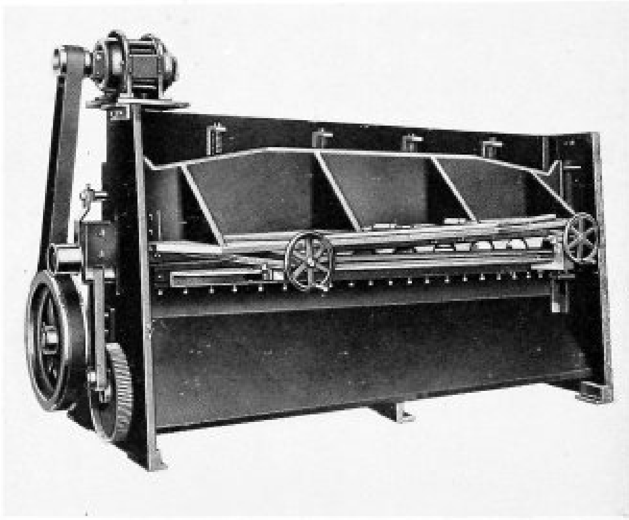
Steel Boiler Orders

NEW orders for 1025 steel boilers were placed in February, as reported to the United States Department of Commerce by 81 manufacturers, comprising most of the leading firms in the industry, as compared with 1075 boilers in January and 1171 in February, 1928. The following table presents the number and square footage of each kind of boiler ordered for the past fourteen months, including comparisons with the corresponding period last year.

All-Steel Squaring Shears

AS an addition to its present line of steel bending equipment the Dreis & Krump Manufacturing Co., Chicago, Ill., is now manufacturing all-steel squaring shears.

These shears are a radical departure from the old cast-iron type, being entirely of steel-plate construction, electric welded throughout. They are unbreakable and non-deflecting. Timken roller bearings on the flywheel shaft insure ease of operation and saving of power. Super uniform pressure hold-down assures a uniform amount of pressure on the metal before the cutting operation is started and the same pressure is held until the completion of the stroke.



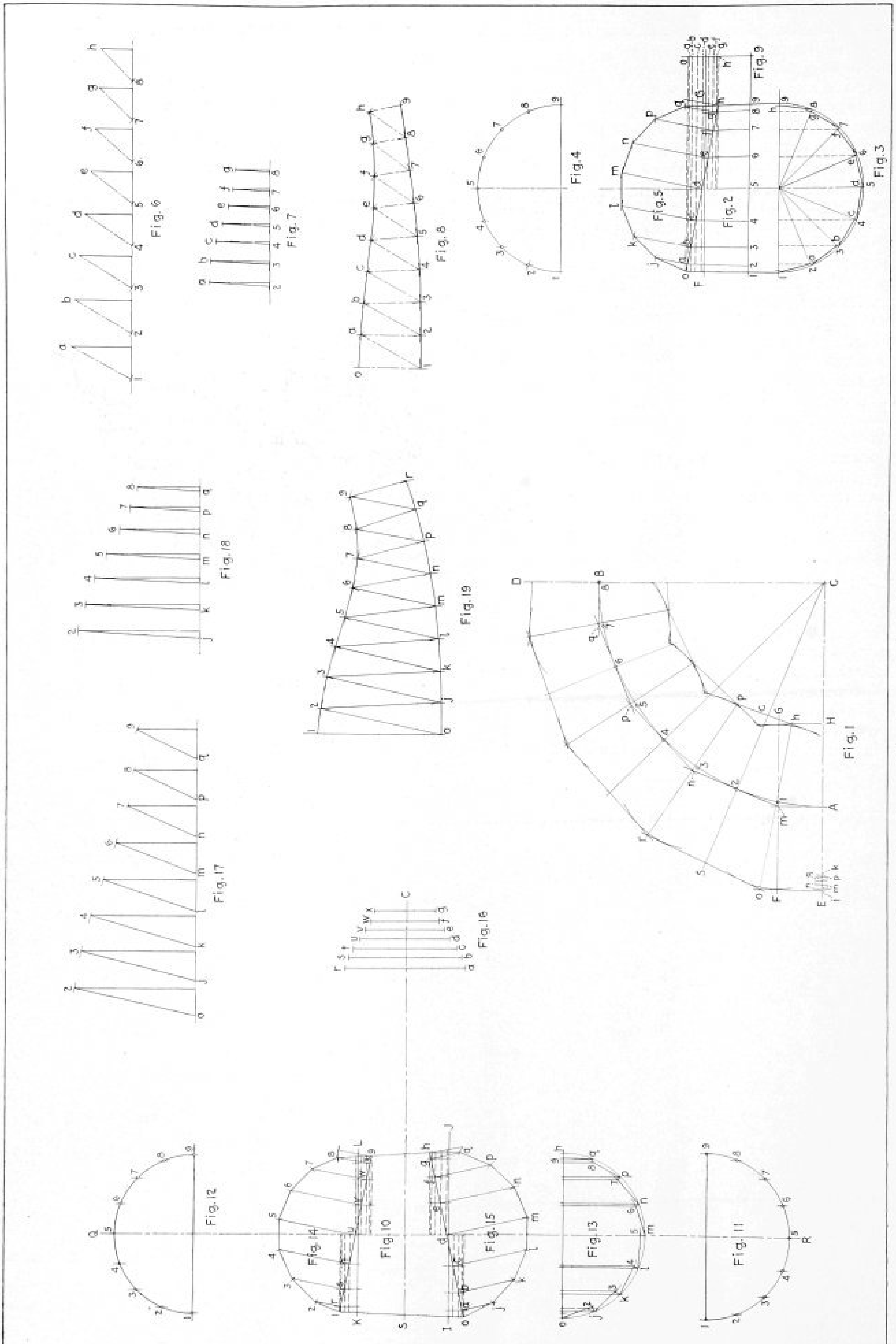
Rear view belt motor driven type squaring shears

Standard equipment includes a centralized system of lubrication, operated with a hand plunger which oils the slides and bearings with the exception of the Timken roller bearings, which require greasing, and the clutch which is either equipped with oil or grease cups.

Another new feature is that the shear is completely guarded on both ends, front, and rear with heavy sheet steel guards. The illustration shows the under-drive type shear. This illustration, rear view, shows the belted motor-drive type of motor arrangement, crank gear drive, construction of the upper knife bar, screw adjusting back gage, equipped with steel scale and pointer, and rear guard.

	Total year, 1928		November, 1928		December, 1928		January, 1928		February, 1928		January, 1929		February, 1929	
	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.
GRAND TOTAL	19,672	17,684,811	1,660	1,459,440	1,343	1,308,125	1,244	992,785	1,171	1,285,211	1,075	1,253,015	1,025	1,129,064
STATIONARY														
Total	19,441	17,144,880	1,650	1,453,601	1,321	1,229,847	1,229	974,288	1,137	1,084,341	1,067	1,248,260	996	1,067,414
Watertube	1,315	6,909,982	95	592,747	72	609,446	84	347,057	98	525,138	*99	*705,279	87	494,757
Horizontal return tubular	1,513	1,884,401	108	130,810	71	87,259	89	141,219	87	123,146	*65	*74,204	107	142,931
Vertical firetube	1,726	495,674	148	38,640	161	39,162	145	35,981	148	48,174	*132	*40,531	138	38,906
Locomotive (not railway)	392	263,201	29	28,715	25	14,480	20	9,407	30	19,452	18	9,670	17	11,141
Steel heating [1]	12,685	6,152,393	1,055	496,657	883	391,571	769	359,401	682	320,078	618	310,628	489	248,292
Oil country	956	900,317	111	109,449	63	53,807	41	32,992	34	28,020	71	64,399	98	89,501
Self contained portable [2]	680	462,627	61	45,736	38	30,187	62	36,566	54	19,052	53	32,516	52	38,964
Miscellaneous	174	76,285	43	10,847	8	3,935	19	11,665	4	1,281	11	10,433	8	2,922
MARINE														
Total	231	539,931	10	5,839	22	78,278	15	18,497	34	200,870	8	4,755	29	61,650
Watertube	99	467,084	1	400	15	72,850	6	10,532	18	194,112	...	....	21	50,112
Pipe	3	3,623	...	....	1	848	..	....	...	....	...	....	1	706
Scotch	112	59,649	9	5,439	4	3,350	9	7,965	16	6,758	8	4,755	6	10,399
2 and 3 flue	13	5,577	...	....	2	1,230	..	....	...	....	...	....	...	....
Miscellaneous	4	3,998	...	....	...	....	..	....	...	....	...	....	1	433

[1] As differentiated from power. [2] Not including types listed above. * Revised.



Details of 90-degree elbow layout, and development of patterns

Laying Out a Taper Elbow

Triangulation methods employed to develop a 90° elbow—Details of patterns

By George M. Davies

IN response to a request from one of our readers as to the best way to lay out a taper elbow, the following explanation is given:

The development of a 90-degree tapering elbow can be made by either triangulation or the method of conic sections. For an elbow 30 inches in diameter, at the large end and 24 inches in diameter at the small end, the development by triangulation would be the most preferable, as the layout can be done to a scale. When taking off the different lengths to lay down the pattern, these lengths may be multiplied by the scale.

The number of sections taken is dependent upon the radius of the elbow, the larger the radius, the greater the number of sections taken. The elbow as shown in Fig. 1 was laid out to scale of 1½ inches = 12 inches. The radius of the elbow used was 40 inches.

Fig. 1 is a side elevation and is constructed as a pattern. Lay off a right angle *E-C-D*, and from the point *C* as a center, strike a quarter of a circle *A-B*, with a radius required for the center of the elbow. Determine the number of sections wanted in the elbow and multiply by two. This elbow is made in four sections, three whole and two half, and is known as a four-section elbow. There should always be a half section at each end, otherwise it would be necessary to miter the end of the connecting pipe to the end section.

As stated above, this is a four-section elbow and 4 × 2 = 8; then divide the quarter circle into eight equal parts, as *1, 2, 3, 4, etc.* After having done this, draw lines from *C* through the points *2, 4, 6.* On these points, at right angles to the radial lines and tangent to the circle, draw straight lines of an indefinite length, intersecting each other at *M-N-P-Q*. Then on the line *C-E*, set off the half diameter of the large end on each side of the center *A*, and on the line *C-D*, set off the half diameter of the small end on each side of the center *B*.

In order to get a regular taper it is necessary to have the diameters of the ends of the different sections at the miter or joint lines. To determine these, set off on the line *A-E*, from *A*, the half diameter of the small end, which leaves the distance *J-K* as the difference of half the diameters of the two ends. This difference must be divided into four equal parts, consisting of three whole and two half parts, just as the elbow is divided into three whole and two half sections, and the half parts should be at the end as shown. Then the distance *A-q'* is the half diameter on the joint line *7;* the distance *A-p'* is the half diameter on the joint line *5;* the distance *A-n'* is the half diameter on joint line *3*, and *A-m'* is the half diameter on the joint line *1*.

Take these half diameters as radii, and from the intersections *q, p, n, m,* as centers, strike arcs of circles at the back and in the throat. By drawing straight lines tangent to these arcs, the back and throat are produced. Then by connecting the joints of the intersection of these lines at the back and in the throat with lines, the different sections of the elbow are defined. The side elevation is complete and the final shape and correct dimensions are determined.

Next prepare for the development of the pattern of the large end, but in order not to get too many lines piled on top of one another, make a separate drawing of this end section, as shown in Fig. 2. Within the points *1, 0, h, 9,* continue the center line far enough above and below the figure so as to be able to lay Figs. 3 and 4 on it. Then below Fig. 2, draw a horizontal line *1-9,* Fig. 3, and from its intersection with the vertical center line as a center and a radius *A-E,* Fig. 1, strike a half circle, *1-5-9* and divide it into eight equal parts and project the points *2, 3, 4, 5, 6, 7, 8* upward onto the horizontal line *1-9,* Fig. 2, locating the points *2, 8,* Fig. 2.

Above Fig. 2 erect Fig. 4, by drawing horizontal line *1-9,* and with a radius *A-m',* Fig. 1, strike a half circle and divide it into eight equal parts; then through Fig. 2, draw the horizontal line *F-G* the same height from the base line *1-9,* as the point *m,* Fig. 1, is above *A.* Then project the points 1, 2, 3, etc., Fig. 4, down to the line *F-G,* Fig. 2. From the points *2, 3, 4,* etc., on line *1-9,* Fig. 2, draw lines through the points on the line *F-G,* cutting the miter line *O-h* and establishing the points *a, b, c, d,* etc. Then project these points down to Fig. 3, making the vertical dotted lines; also from these points draw lines at right angles, as in Fig. 5; then through these points draw the horizontal dotted lines to the surface lines, having extended the line *9-h* up far enough so that the line drawn from *d* will intersect it. Then with the compasses take the distance from the center line to the surface line *1-0,* which cuts through the point *a* and use it as a radius. From the center of Fig. 3, cut the vertical dotted line in *a.* Again, take the distance from center to surface on dotted line, which cuts through the point *b,* and as before, using the center of Fig. 3, cut the vertical dotted line in *b.* Continue this until reaching the point *d,* Fig. 2. Then work from the other side, that is, from the center line out to the line *9-h,* and continue cutting the vertical dotted lines successively until all the points to be used on Fig. 3 are established.

Then connect these points with the points on the base circle *1-5-9,* Fig. 3, as *1a, a2, 2b, b3, 3c, c4,* etc., until all are connected. Take the distance from the line *1-9* to *a,* Fig. 3, and set it off on the line *a,* Fig. 5, establishing the point *j;* then take the distance from the line *1-9* to *b,* Fig. 3, and set it off on the line *b,* Fig. 5, establishing the point *k.* Continue until all the distances are set off. Then on the continuation of the line *1-9,* Fig. 2, erect a perpendicular, Fig. 9. Onto this perpendicular project the points *a, b, c, d, e, f, g* from Fig. 2. These points mark the vertical heights from the base line *1-9,* at the different points on the miter line *0-h.*

Next erect the triangles. Draw two horizontal lines as in Figs. 6 and 7. On these draw vertical lines and on these verticals set off these different heights in succession as shown, marking each set with the corresponding letter at the top. Then, from Fig. 3, take the distance *2-a,* and set it off on the horizontal line, Fig. 7, from the vertical *a,* establishing the point *2;* connect the *points 2-a.* This forms a triangle, of which *2-a* is the hypotenuse. Then from Fig. 3, take the distance *3-b* and set it off on the horizontal line, Fig. 7; from the line *b*, connect the points *3-b* and form another triangle, of which *3-b* is the hypotenuse. Continue this until all the distances from Fig. 3 have been taken and form triangles.

Then take the distance *a-1*, Fig. 3, and set it off on the horizontal line, Fig. 6, from vertical *a*, establishing the point *1;* connect *1-a* and another triangle is formed. Continue this process until all these distances are taken from Fig. 3 and the triangles in Fig. 6 are formed. The object of this operation, and, in fact, all the operations gone through with in Figs. 2, 3, 4, 5, 6, and 7, is for the purpose of obtaining true distances. Since all the distances shown in Fig. 2, except *1-0* and *9-h*, and the distances, *1, 2, 3, 4, 5, 6, 7, 8, 9*, in Fig. 3, are in perspective it is apparent that the surface of the section Fig. 2, is cut up into triangles, and that the distances or lines necessary to construct these triangles of their true size must be obtained and put together in their proper places to form the pattern as shown in Fig. 8.

Draw a vertical line as *1-0*, Fig. 8; then take the distance *1-0*, Fig. 2, and set it off on the vertical line, Fig. 8. Next take *1, 2*, Fig. 3, and with *1*, Fig. 8, as a center, describe the arc *2*. Take the distance *0*, Fig. 5, and from *0*, Fig. 8, as a center describe the arc *a*. Then take the hypotenuse of the triangle *1-a*, Fig. 6, and from the point *1*, Fig. 8, as a center, strike an arc cutting the arc *a*. Take the hypotenuse *2-a*, Fig. 7, and from the point *a*, Fig. 8, as a center, strike an arc cutting the arc *2*. Connect all these points with lines and form two triangles laid down in correct relation to each other, forming the section of the envelope shown in Fig. 2 enclosed within the points *1, 0, a, 2*.

To continue, take the distance *2-3*, Fig. 3, and from the point *2*, Fig. 8, strike an arc *3;* then take the distance *j-k*, Fig. 5, and from the point *a* strike an arc *b;* then take the hypotenuse *2-b*, Fig. 6, and from the point *2*, Fig. 8, as a center, strike an arc cutting the arc *b;* then take the hypotenuse *b-3*, Fig. 7, and from *b* as a center, strike an arc cutting the arc *3*. Continue this process and fix the point *h*, Fig. 8; then with distance *9-h*, Fig. 2, and with *h* as a center, strike an arc cutting arc *9*, thus completing half of the pattern of the first section or large end. To this add the necessary laps.

To lay out the next section, draw a vertical line *Q-R*, running through Figs. 10, 11, 12, 13, 14 and 15. Across this draw a horizontal line, as *C-S*, Fig. 10, which represents the line *C-S*, Fig. 1. On the line *Q-R*, from the line *C-S*, step off the distances *m-2* and *2-n*, Fig. 1, and through these points draw the horizontal lines *I-J* and *K-L*. Then on the vertical line *Q-R*, as in Fig. 11, describe a half circle, which is the same diameter as the circle struck from the center *m*, Fig. 1. Again, as in Fig. 12, describe another half circle the same diameter as that struck from center *n*, Fig. 1. Divide both these circles into eight equal parts, as you did in Fig. 3.

Project the points *1* to *9* on Fig. 11, upward onto the line *I-J;* and the points *1* to *9* on Fig. 12 down to the line *K-L*. Then draw the lines *0-1* and *h-9* by connecting the outside points on the lines *I-J* and *K-L*, and on these slanting lines set off the following distances: From the lines *C-S*, Fig. 1, take the distance *S-O*, Fig. 1, and set downward from the line *C-S*, Fig. 10. Then take the distance *S-1'*, Fig. 1, and set it upward from the line *C-S*, Fig. 10. Take the distance *c-h*, Fig. 1, and set it downward from *C-S*, Fig. 10. Then take the distance *c-P*, Fig. 1, and set it upward from *C-S*, Fig. 10. Connect the points *O, h* and *1, 9* with slanting lines, thus producing the miter or joint lines.

Next project the points from the lines *I-J* and *K-L* downward and upward by connecting the lines onto the lines *1-9* and *O-h*, establishing the points *a, b, c, d, e, f, g*, on *O-h*, and *r, s, t, u, v, w, x*, on the line *1-9*. From these points draw lines at right angles to the lines *1-9* and *O-h*, on which to construct Figs. 14 and 15. Then as in Fig. 13, draw a horizontal line *1-9*, project the points *a, b, c, d, e, f, g, h* and at the same time draw the vertical lines from these points as shown. Again, on Fig. 10, draw the horizontal dotted lines through the points *a, b, c, d, e, f, g*, and *r, s, t, u, v, w, x*, to the surface lines *O-1* and *h-g*. Then with compasses take the length of the dotted line which runs through the point *a*, and with the intersection of the lines *Q-R* and *1-9* as a center, cut the line *a* in *j*. Again, take the length of the dotted line which runs through the point *b*, and from the same center cut the line *b* in *k;* continue this procedure to *g*.

Then take the length of the dotted line which runs through the point *r*, and from the same center, cut the line *v* in *2*. Then take the length of the dotted line which runs through point *s* and from the same center cut the line *s* in *3*. Continue this procedure to *x*. Then connect these points with lines as follows: *O-2, 2-j, 3-j, 3-k, k-4, 4-t, t-5, 5-m, m-6, 6-n, n-7, 7-p, p-8, 8-q, q-9*. These distances are the bases of the triangles in Figs. 17 and 18. Then transfer the lengths of the vertical lines on Fig. 13 to their corresponding lines on Figs. 14 and 15, as *r-2, s-3, t-4*, on Fig. 14, and *a-j, b-k, c-j*, etc., on Fig 15. Connect the points *1, 2, 3, 4, 5, 6, 7, 8, 9*, also *a, b, c, d, e, f, g, h*, with lines, and you will have the profile of each end of the section. Next take the vertical heights between the points O-1, ar, bs, ct, du, ev, fw, gx, Fig. 10, by erecting on the line *C-S* a perpendicular for each pair of points as shown in Fig. 16, and to these project the points from the drawing Fig. 10.

To form the triangles, Fig. 17 and 18, draw two horizontal lines, and on these lines erect perpendiculars as shown. On these set off the vertical heights taken from Fig. 16. Then take the distance *0-2*, Fig. 13, and from the line *2*, Fig. 17, set it off on the horizontal line. Take the distance *j-3*, Fig. 13, and from the line *3*, Fig. 17, set it off on the horizontal line. Do this with all the large bases on Fig. 13, and connect the points *0-2, j-3, k-4*, and so on, thus forming all the large triangles. Then on the horizontal line, Fig. 18, set off the lengths of the short bases, *2-j, 3-k, 4-b, etc.* Connect the points with the lines, thus forming the other set of triangles, Fig. 18.

In Fig. 19, draw a vertical, *0-1*. On this set off the distance *0-1*, taken from Fig. 10. Then take the distance *0-j*, Fig. 15, and from *0*, Fig. 19, strike an arc *j*. Take the distance *1-2*, Fig. 14, and from *1*, Fig. 19, as a center, strike the arc *2*. Then take the hypotenuse *0-2*, Fig. 17, and from *0*, Fig. 19, as a center, cut the arc *2;* then the hypotenuse and from *2*, Fig. 19, as a center, cut the arc *j*, and connect the points so established with lines. Next take the distance *2-3*, Fig. 14, and from the point *2*, Fig. 19, strike the arc *3;* then take the distance *j-k*, Fig. 15, and from the point *j*, Fig. 19, strike the arc *k*. Take the hypotenuse *j-3*, Fig. 17, and from *j*, Fig. 19, cut the arc *3*. Then take the hypotenuse *k-3*, Fig. 16, and from the point *3*, Fig. 19, cut the arc *k*. Connect these points with lines as before. Continue this process until the point *9*, Fig. 19, is established and the arc *h* described. Then take the distance *h-9*, Fig. 10, and from the point *9*, cut the arc *h*. Connect *h-9*, with a line, and half of the pattern of the section is completed, with the exception of the laps.

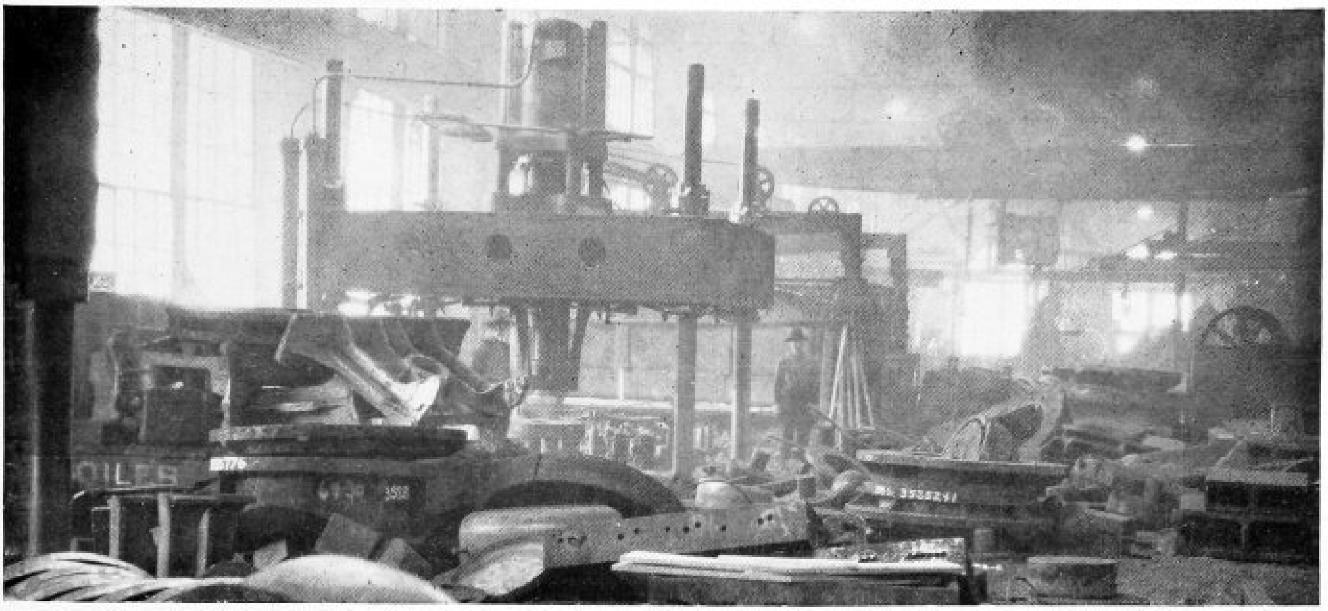


Fig. 47.—Looking down the flanging department at the Schenectady plant of the Alco Works

Locomotive Boiler Construction—IX

Flanging front tube sheets, firebox tube sheets, backheads and throat sheets on the hydraulic press

By W. E. Joynes*

ONLY in such cases where one or two flange plates are wanted and no machine flanging die is available to suit the shape of the desired flanged plate, is the old hand former method of flanging plates resorted to. Plates have been flanged for many years now by hydraulic power, applied to a flanging press. Most of the boiler flanged plates are pressed to shape in one heat with the flanging press.

Description and Operation of Hydraulic Plate-Flanging Press

The flanging press is constructed with a heavy top and bottom table, guided by four round heavy uprights. The top table is adjustable on the post with heavy screw fixtures or nuts. The lower table is raised with water pressure of about 500 tons and descends when the pressure is released.

Forming part of the tables there is a power ram in the center of each table. The upper table ram should have a pressure of 250 tons or more and be operated by power in both the up and down direction. The lower ram also operates independent of the table and a pressure of 100 tons should be available.

Four auxiliary rams of about 20 tons pressure each are also a part of the lower table equipment. These rams are used for shifting and elevating the dies to the clamping positions and also for supporting large holding dies, etc.

Fig. 47 shows a section of the flanging department, in which a flanging press can be seen in the foreground and the oil furnace in the background.

Flanging press dies are usually made of heavy cast iron, one-piece construction, consisting of an inside and outside die—termed the male and female dies. A holding or clamp die is also necessary for the flanging of some plates.

Flanging Front Tube Sheet

One or more plates, depending on the size and cut of the plates, are put into a large oil-heated furnace to bring them to a white bending heat. This is done while the dies are being set up on the press.

The furnace is far enough from the press to permit the handling of plates between the press and the furnace. The door of the furnace is made in sections and operated vertically with air power. An iron platform for supporting the plates is at the front of the furnace. Plates are brought to the furnace with an overhead traveling crane and pushed into the furnace, by man power and the crane, on pipe or round bar rollers.

A front tube sheet die consists of three pieces, viz., inside and outside die and a holding or clamping die. The inside die is bolted to legs of the upper table of the press, the holding die is set on the lower ram and the outside die bolted to leg supports clamped to the lower table.

Both the upper and lower table of the press are constructed with tie-shaped slots. Tee head bolts in these slots hold heavy strap clamps which in turn hold a series of heavy cast legs to which the dies are bolted. Fig. 48, drawing "D", shows an arrangement of the dies for flanging a front tube sheet.

The hot flat plate is drawn from the furnace across the platform, on rollers, with long rod hooks onto the holding die.

Pipes flattened at one end make the best pinch bars

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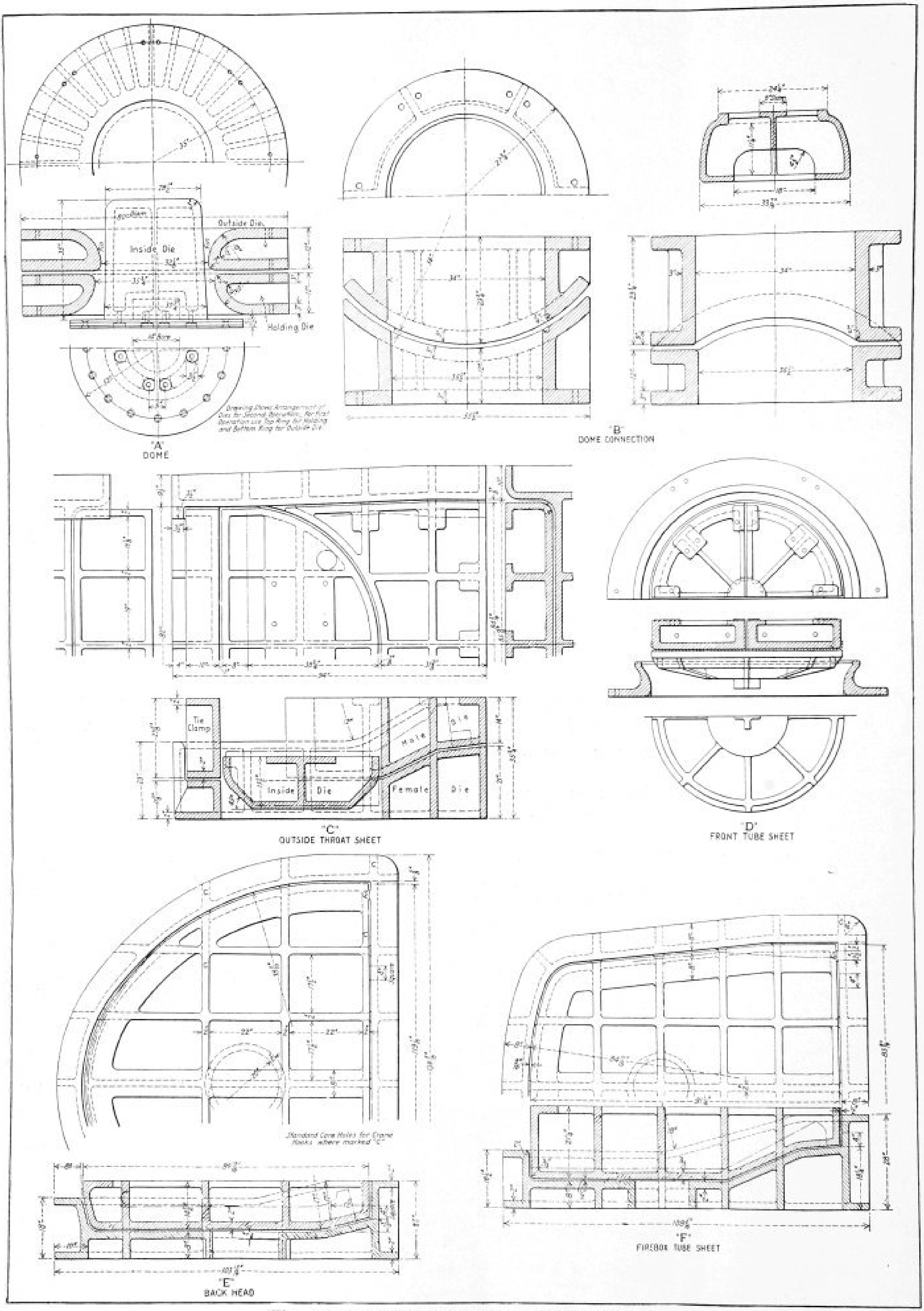


Fig. 48.—Dies used in various flanging operations

for placing the plate on the die and also for shifting and arranging the dies when setting them up on the press. They are lighter and stronger.

The lower ram is raised to clamp the plate between the dies—this straightens the plate. The flanger quickly measures the location of the plate to ascertain whether the plate is equally placed around the inside die. Releasing the lower ram slightly, allows the plate to be shifted when necessary. The lower table is now raised to bring the outside die up over the extended plate edge and center dies, which turns the plate up forming the flange.

The table and ram are now lowered and the plate is removed with the traveling crane. Bars held under the outside die and on top of the flange of the plate pull the plate from the inside die when the bottom table is lowered.

The flanged sheet is next sent to a radial drilling machine for drilling the tube lead holes, when a drilling jig is to be used for this purpose, after which it is delivered to the straightening gang. Here, the plate is wheeled for size and then put in the opposite end of the furnace to heat for the necessary straightening and sizing operations.

Dies are made to allow for contraction of the plate after it has cooled. Even though the plate should cool to the correct size it will warp out of shape, which makes the straightening and sizing of all large flanged plates necessary.

The gradual slow cooling of the plate during the straightening operation also anneals the material; in other words, the crystalline structure of the metal is practically restored to its original condition when allowed to cool slowly.

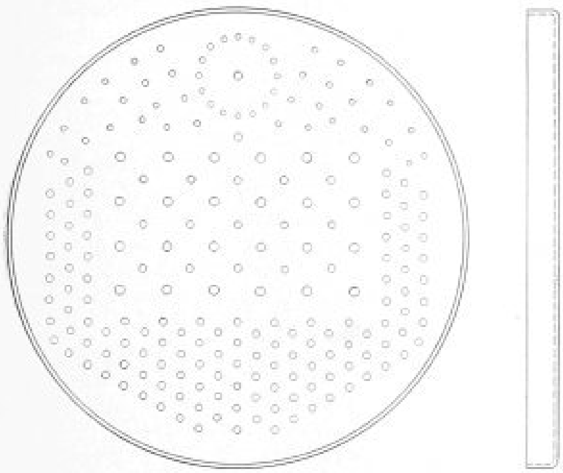


Fig. 49.—Flanged front tube sheet. Lead holes for drilling and reaming the tube holes and dry-pipe opening are shown

Method and Tools for Straightening and Sizing

The white hot flanged sheet is drawn from the furnace and skidded down inclined pipe supports to the metal straightening block. A heavy cast weight is lowered on the flat surface of the tube sheet, with the crane, to hold the same firm on the block, until the flange has been set. The weight is then removed and the flat surface is made straight with a flattening tool, sledge hammers, mauls, steel square or straight-edge. The flange is now further straightened where found necessary. Metal templates held to the inside of the flange conforming to the required contour are necessary for the crown and corner radii of the firebox flanged sheets.

The reason for drilling the tube lead holes before the flanged sheets is straightened, is to assure the proper tube clearance from the inside of the flange.

Fig. 49 is a mechanical drawing of a front tube sheet, showing the tube lead holes drilled and the sheet properly straightened.

Firebox Tube Sheet for Combustion Chamber Boilers

Fig. 50 shows this type of flanged sheet. The dies and flanging operations are similar to those for a front tube sheet.

Firebox Tube Sheet for Non-Combustion Chamber Boilers

Fig. 48, drawing "F" shows a set of dies for flanging this type of tube sheet.

The bottom or female die is clamp bolted direct to the bottom table. The male die is bolted to removable lengthening legs of the top table.

The cold plate should first be laid on the female die so the flanger can determine the exact location for placing the hot plate on this die, to give the correct depth of top flange and to equalize the depth of the side flanges.

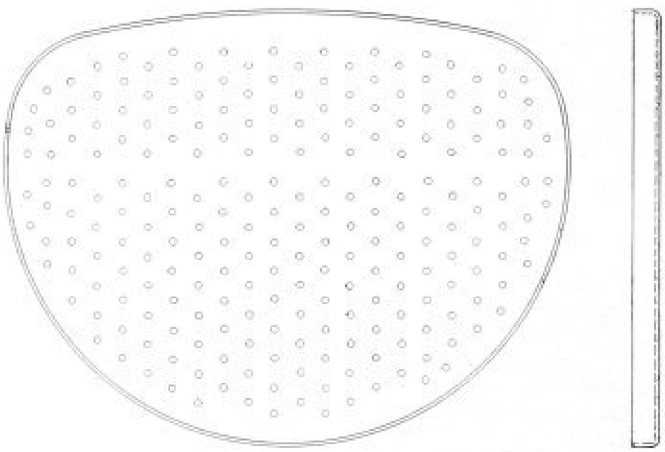


Fig. 50.—Firebox tube sheet for a combustion chamber boiler. Tube lead holes are shown

The developed flanged plate, as in Fig. 30 (page 47 February issue) is drawn from the furnace, placed on the female die and lined up with the soapstone guide marks previously made on the die. The lower table is now raised to bring the dies together on the plate, which forms the complete flange, and bends the water leg offset at the lower part of the plate for a sloped throat boiler.

The tube lead holes are next drilled, if a drilling jig is to be used for this purpose, after which the sheet is delivered to the straightening gang for the usual sizing and straightening operations.

Backhead and Firebox Back or Door Sheet

A backhead or a firebox back sheet is flanged with a two-piece die. Each die is constructed of a one-piece casting. Fig. 48 "E" shows the construction of a backhead die of this type.

The dies are set up on the press similarly as explained for non-combustion boiler firebox tube sheets, i.e. female die to lower table and male die to legs of top table. Figs. 52 and 53 show a backhead and a firebox door sheet, after being flanged and straightened. The backhead is clamped to the firebox ring for laying up the bottom corners to the ring.

Fig. 51.—Throat sheet after coming from press with tie piece still in place

In removing flanged sheets from the female die, a large hole is cored in the backhead and firebox back sheet female die and also in the firebox tube sheet female die for non-combustion chamber boilers. The hole allows the lower ram to be raised against the sheet, thereby releasing or pushing the sheets up from the die.

Flanging the Door Hole

The door hole flange in the backhead and back sheet is made with a separate set of dies and a second heat.

The dies consist of an outside die, bolted on the leg supports of the lower table, a holding die bolted to legs of the upper table and a plunger die keyed to the top ram.

The outside die and the holding die are brought together on the sheet, following this the ram pushes the plungers through the door hole cut out as shown in backhead sheet, Fig. 29 (page 46, February issue) forming the flange.

Reason for Making a Second Heat Operation of the Door Hole Flange

The door hole location is likely to be changed on the boiler for a future engine order that the dies could be used on.

The door hole not being in the center of the plate length, (rams are in the center of the tables) the bearing pressure in flanging the plate complete with door hole, would not be equally distributed over the dies. This condition might cause a broken die or an uneven turned flange.

Flanging Throat Sheets

Throat sheets being of thicker material (except dome material) than other flanged sheets of the boiler, and having a back and front flange to turn; together, with the outset forming the sloped throat design for inside fireboxes, makes it desirable for the severe flanging of this sheet to be done with care; to produce a sheet without rupture, with good flanges and as near perfect shape before the hand straightening operations as possible.

A 4-piece die, consisting of a male die, a female die, a plunger and a tie clamp is employed to produce these sheets in a satisfactory manner as written above. This type of die flanges throat sheets in a single heat, with two operations.

The female die is bolted to removable leg supports on the lower table; the heavy plunger die is bolted to a support from the top ram, while the male die and the tie clamp is bolted to removable legs of the top table.

The cold developed plate, as in Fig. 33 (page 48 February issue) is laid on the die to determine the correct flanging location.

Due to throat plates having the center portion cut out, which will permit a better circulation of heat about the plate, two or three of these plates may be put in the furnace at one time, providing the size of the plates does not make the load too great to draw from the furnace. However, as the top outer part of the wings is not flanged, this portion has to be kept from getting too hot so as the wings will not bend out of shape when the throat flange is turned. This part of the plate is kept from getting too hot by placing a piece of plate over these portions.

The hot plate is placed on the female die and lined up with the soapstone guide marks previously made on the die. The back or side flanges are now formed by raising the lower table to bring the female die, plate, male die and tie clamp die together. The dies are held intact. The top ram is now lowered with the plunger die, turning the throat or front flange. The lip on the tie piece, which acts as a guide for the plunger, is also turned with this operation.

The tie piece serves to keep the wings or top of the throat sheet from drawing down out of shape, which fact was also mentioned in the layout instruction for the throat sheet (page 48 of the February issue).

The dies are now separated for a few minutes to allow examination of the flange and also to permit the plate to contract by cooling a little.

Fig. 52.—Backhead connected to mudring

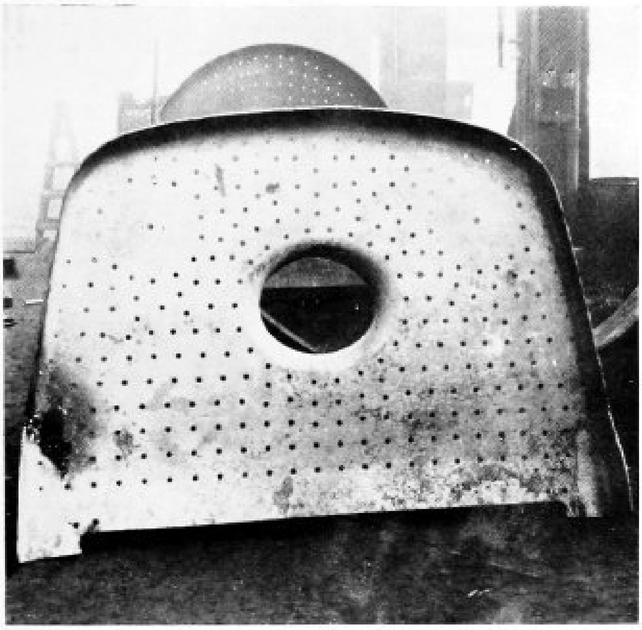


Fig. 53.—Firebox door sheet

In removing the flanged sheet from the die, the table is again raised and the plunger die lowered below the bottom surface of the plate. Bars are held on top of the plunger to strike the edge of the wings of the sheet when the plunger is raised and the table lowered simultaneously. The power thus supplied, of course, draws the sheet out of the female die.

Straightening Operations

The flanged sheet is first wheeled and otherwise gaged and measured for size, after which it is placed on an open blast coke and bituminous coal fire.

The side flanges are first made correct. Retaining the tie piece serves to facilitate this operation, after which the plate is allowed to cool and the tie piece removed with a burning torch.

The throat flange and the lower offset leg of the throat is next corrected. Flat bar templates, shaped to the inside of the sheet, are made for the center and the side shape of the offset. The radius of the throat flange is also checked with a thin metal template. The straightening work is done by pounding the flanges with mauls, flattening tools and sledge hammers on a surface block.

The sheet is next delivered to the fitting up section for laying up the corners of the same to the firebox ring.

Construction of Other Type Dies

Previous to the one-piece constructed flanging dies as described above, the sectional die was used. Sectional dies were, of course, made up of sectional parts. The male die parts when assembled formed a solid piece die; the female die was built up of sections into a frame around the male die, therefore, a separate holding die was necessary for supporting the plate when being flanged.

The idea of making dies into sections was no doubt a good one, in many respects, as the size of the die could be slightly changed by adding or removing liner plates from the contact connections, without perceptibly changing the true diameter of a plate or the fairness of an outline.

Sectional dies are being gradually replaced by the one-piece construction die for various reasons such as the saving of time to assemble the die for a different outline and the difficulty of retaining the outline, or keeping the holding bolts tight, during the flanging operations.

Hand Former Dies

Hand former dies are used as the name applies, i.e. the die is made for bending the sheet over the die by hand tools—mostly mauls. These dies are made of cast iron, and usually in one-piece.

(To be continued)

Beware of Dead Air When Entering Boiler

An inspector of many years' experience recently had a narrow escape from death by suffocation when he was overcome by foul air in the drum of a boiler that had not been in use for three years. Although he took the customary precautions to secure a circulation of fresh air, the inspector made the mistake of entering the drum too soon. He had not gone far when a sensation of dizziness told him he was losing consciousness. Fortunately, he managed to crawl to the manhole and thrust his head outside before he collapsed. There he lay until the fresh air revived him.

When boilers are idle for a long time the oxygen of the air inside seems to be used up by formation of rust or absorbed by chemical reaction with some foreign substance left inside when the boiler was emptied. The result is stagnant or "dead" air.

A boiler should never be entered until it has been ventilated thoroughly. In a coal-fired unit the condition of the air can be determined by thrusting a candle through the man-hole. If the air is bad, the flame will burn feebly or go out. This test should not be applied where oil or gas is used as fuel, for the process of ventilating the boiler by drawing air through it may carry in explosive vapor, especially if there is a leak in the fuel line. The safe way in all cases is first to make sure the method of ventilation is such that it actually does cause circulation of air through the drum, and then allow ventilation to continue until there is no doubt that the stale air has been replaced by fresh.

Closed tanks and vats of all kinds should likewise be ventilated before they are entered. In some cases they represent a greater danger than does a boiler, for they may contain, in addition to stagnant air, dangerous chemical fumes from materials previously stored there.

Important Precautions

Following are several other important precautions that should be observed by anyone who has occasion to enter a boiler:

Make sure the blow-off valve is closed when the boiler under inspection discharges into a blow-off line or tank to which other boilers are connected.

Notify the boiler room attendants that you are about to make an inspection and warn them not to open a valve or do anything else to affect the boiler under inspection. If possible, have an engineer or other responsible man stand within speaking distance.

Beware of stepping into deep soot or ashes in the back connection. Even though they have been wetted down, they may be red hot just below the surface.

Avoid the use of worn-out or partly broken ladders when climbing up onto boilers and their settings. Be careful, also, not to trust your weight on small fittings or pipe connections.—*The Locomotive.*

Revisions and Addenda to A.S.M.E. Boiler Construction Code

IT IS the policy of the American Society of Mechanical Engineers Boiler Code Committee to receive and consider as promptly as possible any desired revision of the rules and its codes. Any suggestions for revisions or modifications that are approved by the committee will be recommended for addenda to the code, to be included later on in the proper place in the code.

During the past two years the Boiler Code Committee has received and acted upon a number of suggested revisions which have been approved for publication as addenda to the code. These are published below, with the corresponding paragraph numbers to identify their locations in the various sections of the code, and are submitted for criticisms and comment thereon from any one interested therein. Discussions should be mailed to the secretary of the Boiler Code Committee, 29 West 39th St., New York, N. Y., in order that they may be presented to the committee for consideration.

New Standard for Pipe Flanges

In accordance with an announcement in January, which stated that the Boiler Code Committee had under consideration the adoption of the New American Standard for Pipe Flanges and Flanged Fittings, comments and criticisms thereon have been received and very carefully considered by the committee. As a result, the committee has decided to revise Tables A-5 and A-6 as they have appeared in former editions of the code and to make additions thereto which will correspond with the New Tentative American Standard for Steel Pipe Flanges and Flanged Fittings. On account of the limited space available in the boiler code for inclusion of these standards, it has been found necessary to limit the matter to be incorporated therefrom in the boiler code to facing dimensions and other general dimensional data pertaining to the flanges only. Accordingly, there is reproduced herewith the table of facing dimensions for five different pressure limits for flanges and two tables covering general dimensions of steel and cast-iron fittings for different pressure limits. Attention is called by the Boiler Code Committee to the fact that while in the New Tentative American Standard, the 4½- and 7-inch pipe sizes have been omitted, they are included in the following tables as special sizes. This is in response to the requests that have been received for an inclusion of information pertaining to these particular sizes which are in extensive use in connection with boiler construction and erection.

For the convenience of the reader in studying the revisions, all added matter appears in small capitals and all deleted matter in smaller type.

PAR. P-277 REVISED:

P-277. The safety valve or valves shall be connected to the boiler independent of any other steam connection, and attached as close as possible to the boiler, without any unnecessary intervening pipe or fitting. Such inter-

Steel Flanged Fittings

TABLE A-5a. FACING DIMENSIONS FOR THE AMERICAN 250, 400, 600, 900, AND 1350 LB. STEEL FLANGES

The following table is taken from publication (B16e-1927) of standards developed by the Sectional Committee on Pipe Flanges and Fittings which has received the approval of the M.S.S.A.F.I., H.P.C.N.A., A.S.M.E. and the American Standards Association.

	Outside Diameter [3]				Outside Diameter [3]			
Nominal Pipe Size In.	Raised Face, VanStone Large Male, and Large Tongue [3] In. R	Small Male [4,5] In. S	Small Tongue [5] In. T	I. D. of Large and Small Tongue [3,5] In. U	Large Female and Large Groove [5] In. W	Small Female [4,5] In. X	Small Groove [5] In. Y	I. D. of Large and Small Groove [3,5] In. Z
1/2	1 3/8	23/32	1 3/8	1	1 7/16	25/32	1 7/16	15/16
3/4	1 11/16	15/16	1 11/16	1 5/16	1 3/4	1	1 3/4	1 1/4
1	2	1 3/16	1 7/8	1 1/2	2 1/16	1 1/4	1 15/16	1 7/16
1 1/4	2 1/2	1 1/2	2 1/4	1 7/8	2 9/16	1 9/16	2 5/16	1 13/16
1 1/2	2 7/8	1 3/4	2 1/2	2 1/8	2 15/16	1 13/16	2 9/16	2 1/16
2	3 5/8	2 1/4	3 1/4	2 7/8	3 11/16	2 5/16	3 5/16	2 13/16
2 1/2	4 1/8	2 11/16	3 3/4	3 3/8	4 3/16	2 3/4	3 13/16	3 5/16
3	5	3 5/16	4 5/8	4 1/4	5 1/16	3 3/8	4 11/16	4 3/16
3 1/2	5 1/2	3 13/16	5 1/8	4 3/4	5 9/16	3 7/8	5 3/16	4 11/16
4	6 3/16	4 5/16	5 11/16	5 3/16	6 1/4	4 3/8	5 3/4	5 1/8
5	7 5/16	5 3/8	6 13/16	6 5/16	7 3/8	5 7/16	6 7/8	6 1/4
6	8 1/2	6 3/8	8	7 1/2	8 9/16	6 7/16	8 1/16	7 7/16
8	10 5/8	8 3/8	10	9 3/8	10 11/16	8 7/16	10 1/16	9 5/16
10	12 3/4	10 1/2	12	11 1/4	12 13/16	10 9/16	12 1/16	11 3/16
12	15	12 1/2	14 1/4	13 1/2	15 1/16	12 9/16	14 5/16	13 7/16
14 O.D.	16 1/4	13 3/4	15 1/2	14 3/4	16 5/16	13 13/16	15 9/16	14 11/16
16 O.D.	18 1/2	15 3/4	17 5/8	16 3/4	18 9/16	15 13/16	17 11/16	16 11/16
18 O.D.	21	17 3/4	20 1/8	19 1/4	21 1/16	17 13/16	20 3/16	19 3/16
20 O.D.	23	19 3/4	22	21	23 1/16	19 13/16	22 1/16	20 15/16
24 O.D.	27 1/4	23 3/4	26 1/4	25 1/4	27 5/16	23 13/16	26 5/16	25 3/16
SPECIAL SIZES (USE NOT RECOMMENDED)								
4 1/2	6 3/4	4 13/16	6 1/4	5 3/4	6 13/16	4 7/8	6 5/16	5 11/16
7	9 5/8	7 3/8	9	8 3/8	9 11/16	7 7/16	9 1/16	8 5/16

Height, Raised Face, 250 Lb. Std.[1] .... 1/16 in.

Height, Raised Face, Large and Small Male and Tongue, 400, 600, 900, and 1350 Lb. Stds.[2] .... 1/4 in.

Depth of Groove or Female Companion Flanges .... 3/16 in.

[1] NOTE—Regular facing for 250 lb. flange standard is a 1/16 in. raised face included in the minimum flange thickness dimensions given in Table A-5b. A 1/4 in. raised face is also permitted on the 400, 600, 900 and 1350 lb. flange standards, but it must be added to the minimum flange thicknesses given in Table A-5b.

[2] NOTE—Regular facing for 400, 600, 900, and 1350 lb. flange standards is a 1/4 in. raised face, not included in minimum flange thickness dimensions given in Table A-5b.

[3] NOTE—A tolerance of plus or minus 0.016 in. (1/64 in.) is allowed on the inside and outside diameters of all facings.

[4] NOTE—Care should be taken in the use of joints of these dimensions, as they apply particularly on lines where the joint is made on the end of pipe, to insure that pipe used is thick enough to permit sufficient bearing surface to prevent crushing the gasket.

[5] NOTE—Gaskets for male-female and tongue-groove joints shall cover the bottom of the recess with minimum clearances taking into account the tolerances prescribed in Note 3.

Steel Flanged Fittings

Table A-5*b*. Dimensions of Flanges for Maximum Working Steam Pressure at a Temperature of 750 Deg. Fahr.
The following table is taken from publication (B 16e—1927) of standards developed by the Sectional Committee on Pipe Flanges and Fittings which has received the approval of the M.S.S.A.F.I., H.P.C.N.A., A.S.M.E. and the American Standards Association.

	250 lb.					400 lb.					600 lb.					
Nominal Pipe Size In.	Outside Diameter of Flange In.	Thickness of Flange Minimum [1] In.	Diameter of Bolt Circle In.	Number of Bolts In.	Diameter of Bolts In.	Outside Diameter of Flange In.	Thickness of Flange Minimum [2] In.	Diameter of Bolt Circle In.	Number of Bolts In.	Diameter of Bolts In.	Nominal Pipe Size In.	Outside Diameter of Flange In.	Thickness of Flange Minimum [2] In.	Diameter of Bolt Circle In.	Number of Bolts In.	Diameter of Bolts In.
½	3¾	9/16	2⅝	4	½	3¾	9/16	2⅝	4	½	½	3¾	9/16	2⅝	4	½
¾	4⅝	⅝	3¼	4	⅝	4⅝	⅝	3¼	4	⅝	¾	4⅝	⅝	3¼	4	⅝
1	4⅞	11/16	3½	4	⅝	4⅞	11/16	3½	4	⅝	1	4⅞	11/16	3½	4	⅝
1¼	5¼	13/16	3⅞	4	⅝	5¼	13/16	3⅞	4	⅝	1¼	5¼	13/16	3⅞	4	⅝
1½	6⅛	⅞	4½	4	¾	6⅛	⅞	4½	4	¾	1½	6⅛	⅞	4½	4	¾
2	6½	⅞	5	8	⅝	6½	1	5	8	⅝	2	6½	1	5	8	⅝
2½	7½	1	5⅞	8	¾	7½	1⅛	5⅞	8	¾	2½	7½	1⅛	5⅞	8	¾
3	8¼	1⅛	6⅝	8	¾	8¼	1¼	6⅝	8	¾	3	8¼	1¼	6⅝	8	¾
3½	9	1 3/16	7¼	8	¾	9	1⅜	7¼	8	⅞	3½	9	1⅜	7¼	8	⅞
4	10	1¼	7⅞	8	¾	10	1⅜	7⅞	8	⅞	4	10¾	1½	8½	8	⅞
5	11	1⅜	9¼	8	¾	11	1½	9¼	8	⅞	5	13	1¾	10½	8	1
6	12½	1 7/16	10⅝	12	¾	12½	1⅝	10⅝	12	⅞	6	14	1⅞	11½	12	1
8	15	1⅝	13	12	⅞	15	1⅞	13	12	1	8	16½	2 3/16	13¾	12	1⅛
10	17½	1⅞	15¼	16	1	17½	2⅛	15¼	16	1⅛	10	20	2½	17	16	1¼
12	20½	2	17¾	16	1⅛	20½	2¼	17¾	16	1¼	12	22	2⅝	19¼	20	1¼
14 O.D.	23	2⅛	20¼	20	1⅛	23	2⅜	20¼	20	1¼	14 O.D.	23¾	2¾	20¾	20	1⅜
16 O.D.	25½	2¼	22½	20	1¼	25½	2½	22½	20	1⅜	16 O.D.	27	3	23¾	20	1½
18 O.D.	28	2⅜	24¾	24	1¼	28	2⅝	24¾	24	1⅜	18 O.D.	29¼	3¼	25¾	20	1⅝
20 O.D.	30½	2½	27	24	1¼	30½	2¾	27	24	1½	20 O.D.	32	3½	28½	24	1⅝
24 O.D.	36	2¾	32	24	1½	36	3	32	24	1¾	24 O.D.	37	4	33	24	1⅞
Special Sizes (Use Not Recommended)																
4½	10½	1 5/16	8½	8	¾	10½	1 7/16	8½	8	⅞	4½	11½	1⅝	9½	8	1
7	14	1½	11⅞	12	⅞	14	1⅝	11⅞	12	1	7	15	2 1/16	12½	12	1⅛

[1] Note—A raised face of 1/16 in. is included in minimum thickness of flanges.
[2] Note—A raised face of ¼ in. is not included in the minimum thickness of flanges.

900 lb.					1350 lb.				
Outside Diameter of Flange In.	Thickness of Flange Minimum [2] In.	Diameter of Bolt Circle In.	Number of Bolts In.	Diameter of Bolts In.	Outside Diameter of Flange In.	Thickness of Flange Minimum [2] In.	Diameter of Bolt Circle In.	Number of Bolts In.	Diameter of Bolts In.
....	...	....	..	...	....	...	....	..	...
....	...	....	..	...	....	...	....	..	...
5⅞	1⅛	4	4	⅞	5⅞	1⅛	4	4	⅞
6¼	1⅛	4⅜	4	⅞	6¼	1⅛	4⅜	4	⅞
7	1¼	4⅞	4	1	7	1¼	4⅞	4	1
8½	1½	6½	8	⅞	8½	1½	6½	8	⅞
9⅝	1⅜	7½	8	1	9⅝	1⅝	7½	8	1
9½	1½	7½	8	⅞	10½	1⅞	8	8	1⅛
10¾	1⅝	8½	8	1	11	2	8½	8	1⅛
11½	1¾	9¼	8	1⅛	12¼	2⅛	9½	8	1¼
13¾	2	11	8	1¼	14¾	2⅜	11½	8	1½
15	2 3/16	12½	12	1⅛	15½	2⅝	12½	12	1⅜
18½	2½	15½	12	1⅜	19	3	15½	12	1⅝
21½	2¾	18½	16	1⅜	23	3½	19	12	1⅞
24	3⅛	21	20	1⅜	25½	4⅛	21½	16	1⅞
25¼	3⅜	22	20	1½	....	...	....	..	...
27¾	3½	24¼	20	1⅝	....	...	....	..	...
31	4	27	20	1⅞	....	...	....	..	...
33¾	4¼	29½	20	2	....	...	....	..	...
41	5½	35½	20	2½	....	...	....	..	...
Special Sizes (Use Not Recommended)									
13	1⅞	10½	8	1⅛	13½	2¼	10½	8	1⅜
16½	2⅜	13¾	12	1⅜	17	2¾	13¾	12	1½

[2] Note—A raised face of ¼ in. is not included in the minimum thickness of flanges.

vening pipe or fitting, if used, shall not be longer than the face-to-face dimension [A-A] of the [American Extra Heavy iron flanged tee fitting of corresponding size shown in Table A-6 and Fig. A-9] CORRESPONDING FITTING OF THE SAME DIAMETER AND PRESSURE UNDER THE NEW TENTATIVE AMERICAN STANDARDS. Every safety valve shall be connected so as to stand in an upright position, with spindle vertical, when possible.

Par. P-286 Revised:

P-286. A safety valve over 3 in. in size, used for pressures greater than 15 lb. per sq. in. gage, shall have a flanged inlet connection. The dimensions of flanges subjected to boiler pressure [not exceeding 250 lb. per sq. in.] shall conform to the NEW TENTATIVE American [Extra Heavy] Standards given in Tables A-5*a*, AND A-5*b*, OR TABLE A-6*b* [A-6] of the Appendix, except that the face of the safety valve flange and the nozzle to which it is attached may be flat and without the raised face.

Par. P-299 Revised:

P-299. *Fittings.* THE flanges [d] OF [cast iron] pipe fittings shall conform to the NEW TENTATIVE American Standards given in the Appendix. If the fittings are below the water line they shall be extra heavy.

[For pressures exceeding 250 lb. per sq. in., the flange thickness, and the thickness of the bodies shall be increased to give at least the same factor of safety as the fittings specified in the Table, when used for the maximum pressures permitted in the Code.]

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 not exceeding 250 lb. but shall have the raised face for higher pressures.

The number of bolts in a flange may be increased, provided they are located on the standard bolt circle. Tables A-5*a*, A-5*b* [A-5] and A-6*a*, A-6*b* [A-6] do not apply to flanges on the boiler side of steam nozzles, or to fittings designed as part of the boiler. The terminating flanges, however, shall be in accordance with Tables A-5*a*, A-5*b* [A-5] and A-6*a*, A-6*b* [A-6].

Par. P-302 Revised:

P-302. The main stop valves of boilers shall be at least extra heavy when the maximum allowable working pressure exceeds 125 lb. per sq. in. The fittings be-

Cast Iron Flanged Fittings

Table A-6a. Dimensions of 125 Lb. Cast-Iron Flanges

The following table is taken from publication (B16a-1928) of standards developed by the Sectional Committee on Pipe Flanges and Fittings which has received the approval of the M.S.S.A.F.I., H.P.C.N.A., A.S.M.E. and the American Standards Association.

Nominal Pipe Size In.	Outside Diameter of Flange In.	Thickness of Flange Minimum [2] In.	Diameter of Bolt Circle In.	Number of Bolts [1] In.	Diameter of Bolts In.	Diameter of Drilled Bolt Holes [1] In.	Total Effective Area Bolt Metal In.	Stress Lb. per Sq. In. Bolt Metal [3] In.
1	4¼	7/16	3⅛	4	½	⅝	0.504	1340
1¼	4⅝	½	3½	4	½	⅝	0.504	1755
1½	5	9/16	3⅞	4	½	⅝	0.504	2215
2	6	⅝	4¾	4	⅝	¾	0.808	2065
2½	7	11/16	5½	4	⅝	¾	0.808	2885
3	7½	¾	6	4	⅝	¾	0.808	3510
3½	8½	13/16	7	8	⅝	¾	1.616	2410
4	9	15/16	7½	8	⅝	¾	1.616	2870
5	10	15/16	8½	8	¾	⅞	2.416	2440
6	11	1	9½	8	¾	⅞	2.416	3110
8	13½	1⅛	11¾	8	¾	⅞	2.416	4915
10	16	1 3/16	14¼	12	⅞	1	5.04	3485
12	19	1¼	17	12	⅞	1	5.04	5065
14 O.D.	21	1⅜	18¾	12	1	1⅛	6.60	4685
16 O.D.	23½	1 7/16	21¼	16	1	1⅛	8.80	4575
18 O.D.	25	1 9/16	22¾	16	1⅛	1¼	11.10	4145
20 O.D.	27½	1 11/16	25	20	1⅛	1¼	13.88	4030
24 O.D.	32	1⅞	29½	20	1¼	1⅜	17.86	4385
30 O.C.	38¾	2⅛	36	28	1¼	1⅜	25.00	4700
36 O.D.	46	2⅜	42¾	32	1½	1⅝	41.41	4035
42 O.D.	53	2⅝	49½	36	1½	1⅝	46.57	4810
48 O.D.	59½	2¾	56	44	1½	1⅝	56.93	5200
54 O.D.	66¼	3	62¾	44	1¾	2	76.82	4755
60 O.D.	73	3⅛	69¼	52	1¾	2	90.79	4925
72 O.D.	86½	3½	82½	60	1¾	2	104.70	6150
84 O.D.	99¾	3⅞	95½	64	2	2¼	147.33	5825
96 O.D.	113¼	4¼	108½	68	2¼	2½	205.56	5415
SPECIAL SIZES (Use Not Recommended)								
4½	9¼	15/16	7¾	8	¾	....	.....	....
7	12½	1 1/16	10¾	8	¾	....	.....	....

[1] Note—Drilling templates are in multiples of 4, so that fittings may be made to face in any quarter, and bolt holes straddle the center line. For bolts smaller than 1¾ in. the bolt holes shall be drilled ⅛ in. larger in diameter than the nominal diameter of the bolt. Holes for bolts 1¾ in. and larger shall be drilled ¼ in. larger than nominal diameter of bolts.

[2] Note—All 125 lb. cast-iron standard flanges have a plain face.

[3] Note—The stress shown is that of internal pressure only, assumed to act on a circular area equal in diameter to the outside diameter of a ring gasket covering the flange to the inside of bolts.

tween the boiler and such valve or valves shall be at least extra heavy, as specified in Tables A-5a, A-5b, and A-6b [A-6] of the Appendix.

British Railway to Test Schmidt Boilers

A number of special hollow-forged boilers for the new series of express locomotives, which are to be built by the London, Midland & Scottish Railway, are at present under construction at the Atlas Works, Sheffield. Hitherto the ordinary type of boiler in use on British railways has been constructed by the ordinary riveting process, but these new boilers are designed on the Schmidt high-pressure system, with which experiments have been made on the German Railways, modified to suit British conditions. The North British Locomotive Company of Glasgow, is to build a locomotive of the Royal Scot type which will be fitted with the new type of boiler. It will be of the three-cylinder compound class, and will have a tractive power of approximately 33,200 pounds. It will probably be ready for trial in July.

The new boilers are to be of larger dimensions, and the method of manufacture will permit the use of steam at much higher pressures than has hitherto been possible on British lines.

The Lincoln Electric Company, Cleveland, O., manufacturer of welding equipment announces the appointment of C. M. Taylor as sales manager. Mr. Taylor graduated from Western Reserve University in 1916 and immediately entered the employ of The Lincoln Electric Company, and shortly thereafter was made foreman of the assembly and test departments. After serving in the war he returned to the Lincoln company as time study demonstrator and observer. In 1923 he was promoted to factory manager and in 1925 was elected as vice-president of the company. Mr. Taylor remained as factory manager until his present appointment as sales manager.

Cast Iron Flanged Fittings

Table A-6b. Dimensions of 250 Lb. Cast-Iron Flanges

The following table is taken from publication (B16b-1928) of standards developed by the Sectional Committee on Pipe Flanges and Fittings which has received the approval of the M.S.S.A.F.I., H.P.C.N.A., A.S.M.E. and the American Standards Association.

Nominal Pipe Size In.	Outside Diameter of Flange In.	Thickness of Flange Minimum [2,4] In.	Diameter of Raised Face In.	Diameter of Bolt Circle In.	Number of Bolts [1] In.	Diameter of Bolts In.	Diameter of Drilled Bolt Holes [1] In.	Total Effective Area Bolt Metal In.	Stress, Lb. per Sq. In. Bolt Metal [3] In.
1	4⅞	11/16	2 11/16	3½	4	⅝	¾	0.808	970
1¼	5¼	¾	3 1/16	3⅞	4	⅝	¾	0.808	1520
1½	6⅛	13/16	3 9/16	4½	4	¾	⅞	1.208	1345
2	6½	⅞	4 3/16	5	8	⅝	¾	1.616	1595
2½	7½	1	4 15/16	5⅞	8	¾	⅞	2.416	2090
3	8¼	1⅛	5 11/16	6⅝	8	¾	⅞	2.416	2030
3½	9	1 3/16	6 5/16	7¼	8	¾	⅞	2.416	2460
4	10	1¼	6 15/16	7⅞	8	¾	⅞	2.416	3120
5	11	1⅜	8 5/16	9¼	8	¾	⅞	2.416	4385
6	12½	1 7/16	9 11/16	10⅝	12	¾	⅞	3.624	3915
8	15	1⅝	11 15/16	13	12	⅞	1	5.04	4400
10	17½	1⅞	14 1/16	15¼	16	1	1⅛	8.80	3625
12	20½	2	16 7/16	17¾	16	1⅛	1¼	11.10	3975
14 O.D.	23	2⅛	18 15/16	20¼	20	1⅛	1¼	13.88	3735
16 O.D.	25½	2¼	21 1/16	22½	20	1¼	1⅜	17.86	2255
18 O.D.	28	2⅜	23 5/16	24¾	24	1¼	1⅜	21.43	4505
20 O.D.	30½	2½	25 9/16	27	24	1¼	1⅜	21.43	4845
24 O.D.	36	2¾	30 5/16	32	24	1½	1⅝	31.06	4500
30 O.D.	43	3	37 3/16	39¼	28	1¾	2	48.89	5590
36 O.D.	50	3⅜	43 11/16	46	32	2	2¼	73.70	5355
42 O.D.	57	3 11/16	50 5/16	52¾	36	2	2¼	82.90	5945
48 O.D.	65	4	58 7/16	60¾	40	2	2¼	92.08	7315
SPECIAL SIZES (Use Not Recommended)									
4½	10½	15/16	....	8½	8	¾	...	....	....
7	14	1½	....	11⅝	12	⅞	...	....	....

[1] Note—Drilling templates are in multiples of 4, so that fittings may be made to face in any quarter, and bolt holes straddle the center line. For bolts smaller than 1¾ in., the bolt holes shall be drilled ⅛ in. larger in diameter than the nominal size of the bolts. Holes for bolts 1¾ in. and larger shall be drilled ¼ in. larger than nominal diameter of bolts.

[2] Note—All 250 lb. cast-iron standard flanges have a 1/16 in. raised face. This raised face is included in the face to face center to face and the minimum thickness of flange dimensions.

[3] Note—The stress shown is that of internal pressure only assumed to act on a circular area equal in diameter to the outside diameter of the raised face.

[4] Note—For tongue-groove and male-female facings the dimensions given in Table A-5a are recommended.

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

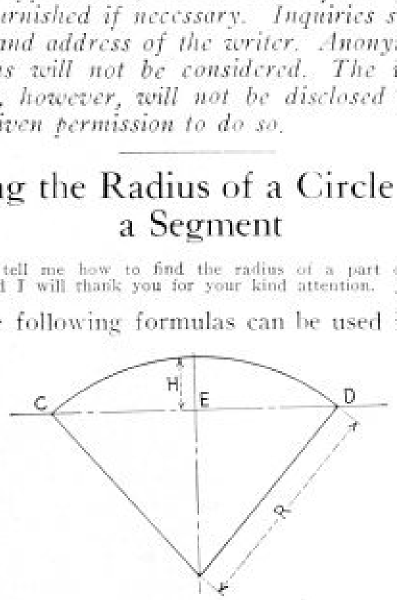
Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Finding the Radius of a Circle Given a Segment

Q.—Please tell me how to find the radius of a part of a circle, as illustrated, and I will thank you for your kind attention. J. J. R.

A.—The following formulas can be used in comput-



Finding the radius of a circle when segment is given

ing the dimensions of a segment of a circle, when any two of the dimensions are known:

Chord of arc $= CD = 2\sqrt{R^2 - (R - H)^2}$

Radius $= R = \dfrac{ED^2 + H^2}{2H}$

Height of segment $= H = R - \sqrt{R^2 - ED^2}$

Applying the formula $R = \dfrac{ED^2 + H^2}{2H}$ to the problem we have:

$$R = \frac{(2.75)^2 + (2.125)^2}{2 \times 2.125}$$

$$R = \frac{7.5625 + 4.515625}{4.25}$$

$R = 2.841$ inches.

Efficiency of Welded Joints

Q.—Would you kindly explain how to figure the efficiency, also the shearing strength, of a fusion welded longitudinal double-V butt joint? W. C. D.

A.—The efficiency of a joint is the ratio which the strength of the joint bears to the strength of the solid plate. The efficiency of a welded joint depends largely upon the quality of the weld and the ability of the welder.

The efficiency of a welded joint cannot be computed as in the case of a riveted joint. Therefore it must be based on actual tests in which efficiencies as high as 100 percent have been obtained.

The A. S. M. E. Code for Power Boilers does not permit welded seams, where the strength of the structure is dependent on the strength of the weld.

Section IV of the A. S. M. E. Code for Low-Pressure Heating Boilers, Par. H-70, is as follows:

H-70: Steel-plant boilers constructed by autogenous welding under the rules prescribed for steel-plate heating boilers may be used for steam heating at pressures not exceeding 15 pounds per square inch, for hot water heating at pressures not exceeding 160 pounds per square inch, or for temperatures not exceeding 250 degree F. For pressures in excess of 30 pounds per square inch for hot water boilers, the factor of safety for autogenously welded steel-plate boilers shall be not less than 5, assuming the strength of the welded seam at 28,000 pounds per square inch of net section of plate.

Assuming 55,000 pounds as the minimum tensile strength of a sheet, as provided in Par. H-8, the efficiency of the seam would be

$$\frac{28{,}000}{55{,}000} = 50.9 \text{ percent}$$

Section VIII of the A. S. M. E. Code for Unfired Pressure Vessels, Par. U-68, is as follows:

U-68: When properly welded by the fusion process, the strength of the joint may be calculated on a maximum unit working stress of 5600 pounds per square inch.

This is equivalent to a strength of 28,000 pounds per square inch of net section of plate with a factor of safety of 5 or an efficiency of 50.9 percent of a solid plate having a tensile strength of 55,000 pounds.

Repairing Flue Sheet Fracture

Q.—I would like you to suggest the best method to repair a fracture in the top of back flue sheet of a locomotive boiler. The fracture extends for 30 inches in the heel of the flange between the flues and the rivets. Do you advise welding this with the arc and reinforcing on the water side? Is there any law or code prohibiting this method? P. R. A.

A.—Par. 186 as found in the Addenda to the A. S. M. E. Boiler Construction Code with regards to welding is as follows:

Par. 186: *Welded joints.* The ultimate strength of a joint which has been properly welded by the forging process, shall be taken as 35,000 pounds per square inch, with steel plates having a range in tensile strength of 45,000 to 55,000 pounds per square inch.

Autogenous welding may be used in boilers in cases where the stress of load is carried by other construction which conforms to the requirements of the code and where the safety of the structure is not dependent upon the strength of the weld.

Joints between the door flanges of furnace and exterior sheets may be butt or lap-welded by the fusion process, provided these sheets are stayed or otherwise supported around the door-hole opening and provided the distance from the flange to the surrounding row of stays or other supports does not exceed the permissible staybolt pitch, as per Par. 199. If such joints are lap-welded the exterior sheet flange should preferably be placed on the outside or next to the door opening and the firebox sheet flange on the interior next to the water.

Autogenous-welded construction may be used in lieu of riveted joints in the fireboxes of internally-fired boilers, provided the welds are between two rows of staybolts, or in the case of flat surfaces, the weld is not less than one-half of a staybolt pitch from the corner.

In accordance with the last paragraph of the above, I do not believe it would be permissible to weld a fracture in the top of the back flue sheet, as outlined in the question.

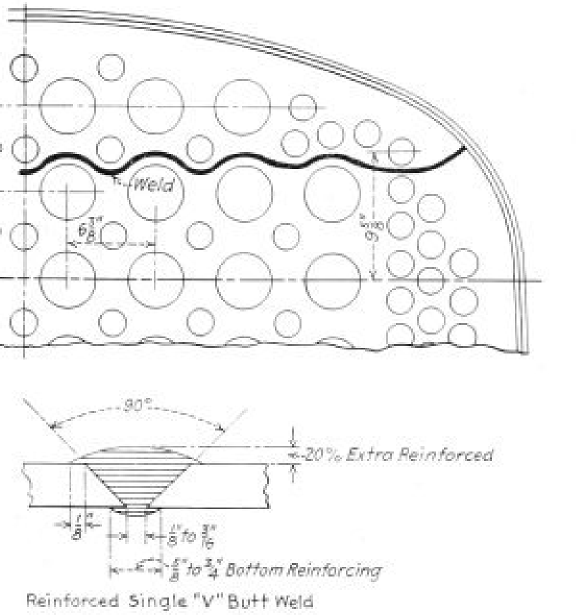


Fig. 1.—Detail of welding for tube sheet repair

I would suggest that the top of the flue sheet be renewed in a manner as illustrated in Fig. 1.

The following rules have been recommended governing the application of patches to firebox flue sheets:

Welds made on one side only: In all welds, as in the application of patches to internally-fired boilers, in places where the weld can be made on one side of the sheet, the single-V butt weld should be employed to the exclusion of the weld or other forms of joints.

Patches should be so applied that the resulting weld will be supported on both sides by rows of staybolts or other staying media.

Patches should be so located as not to cut through any of the holes employed for holding the staybolts or other staying media.

Business Notes

The Vulcan Soot Cleaner Company, Du Bois, Pa., has announced the opening of a New York office under the direction of Fred W. Linaker, vice-president, assisted by C. H. Baker. The new office is located at 120 Liberty street, New York, N. Y. This office will also handle the Beco flexible boiler baffle, produced by the Boiler Engineering Company, New York, N. Y.

An announcement has been made, as effective March 30, that the name of the American Spiral Pipe Works, Chicago, Ill., has been changed to Taylor Forge & Pipe Works. The company which has been serving the engineering trades since 1900 under the old name remains unchanged in ownership and capital structure.

Robert M. Gates, manager of the Industrial department of The Superheater Company, New York, N. Y., has been elected vice-president of that company. Mr. Gates is a native of Iowa.

The Wrought Iron Company of America, with factories at Lebanon and Scranton, Pa., has recently opened branch offices at 393 Seventh Avenue, New York, N. Y. This company produces wrought iron rivets, staybolt iron, refined bar iron, engine bolt iron, angles, channels, special shapes and many other similar products.

The Reading Iron Company, Reading, Pa., manufacturer of genuine puddled wrought iron pipe announces the establishment of a new district sales office at New Orleans, La. This office will be under the direction of George E. Tyson, and will be located at 1216 Hibernia Bank Building. Mr. Tyson was formerly of the Reading district.

The National Flue Cleaner Company, Inc., Groveville, N. J., has appointed four western agents to handle National soot blower for firetube boilers. These are McGee Sales Agency, San Francisco, Cal., Meyers & Rudolph, Los Angeles, Cal., Manufacturers Sales-Service, Salt Lake City, Utah, and W. A. Ramsey, Ltd., of Honolulu, T. H.

J. C. Lincoln, formerly president of The Lincoln Electric Company, Cleveland, O., has been elevated to the position of chairman of the board of directors. J. F. Lincoln, formerly vice-president, has been promoted to the presidency. Since 1912, when he became general manager of the company of which he now is president, J. F. Lincoln has been an outstanding figure in the electrical industry. Mr. Lincoln's new duties will afford him additional time to devote to electrical research and experimental development work which have been his major interest for the past several years.

Trade Publications

Mechanical Gas Welding.—Under the title "Developments and Progress of Mechanical Gas Welding," the Air Reduction Sales Company, New York city, has issued the reprint of a paper by J. L. Anderson, International Welding Association, held November, 1928, at Chicago.

Arc Welders.—Two folders have been received from the General Electric Company, Schenectady, N. Y., describing the WD-200A and the WD-400A arc welders. The WD-200A arc welder is rated at 200 amperes, 1 hour with a current range from 60 to 300 amperes. The WD-400A arc welder is rated at 400 amperes, 1 hour with a current range from 100 to 500 amperes.

Yoke Riveters.—Under this title the Hanna Engineering Works, Chicago, Ill., has issued a new bulletin which is designed to show how Hanna riveters have overcome the faults of earlier type machines. An analysis is made in the early pages of the action of the Hanna motion in which toggles, levers, and guide links are combined in simple form to give the ideal die movement. Advantage of Hanna riveters are outlined, and illustrated descriptions are given of the various type machines built and their application.

Associations

Bureau of Locomotive Inspection of the Interstate Commerce Commission

Chief Inspector—A. G. Pack, Washington, D. C.

Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

Steamboat Inspection Service of the Department of Commerce

Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—Fred R. Low.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 W. 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—C. D. Thomas, Salem, Oregon.

Secretary-Treasurer—C. O. Myers, Commercial National Bank Building, Columbus, Ohio.

Vice-Chairman—William H. Furman, Albany, N. Y.

Statistician—L. C. Peal, Nashville, Tenn.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

International President—J. A. Franklin, suite 522, Brotherhood Block, Kansas City, Kansas.

Assistant International President—William Atkinson, suite 522, Brotherhood Block, Kansas City, Kansas.

International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.

Editor-Manager of Journal—John J. Barry, suite 524, Brotherhood Block, Kansas City, Kansas.

International Vice-Presidents—John J. Dowd, 142 Pearsall Ave., Jersey City, N. J.; M. A. Maher, 2001 20th St., Portsmouth, O.; R. C. McCutchan, 226 Lipton St., Winnipeg, Man., Canada; H. J. Norton, Alcazar Hotel, San Francisco, Cal.; C. A. McDonald, Box B93, Route 2, Independence, Mo.; J. N. Davis, 1211 Gallatin St., N. W., Washington, D. C.; M. F. Glenn, 1434 E. 93rd St., Cleveland, O.; W. J. Coyle, 424 Third Ave., Verdun, Montreal, Canada; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; J. F. Schmitt, 25 Crestview Rd., Columbus, O.

Master Boiler Makers' Association

President—L. M. Stewart, general boiler inspector Atlantic Coast Line, Waycross, Ga.

First Vice-President—George B. Usherwood, supervisor of boilers, New York Central Railroad, Syracuse, N. Y.

Second Vice-President—Kearn E. Fogerty, general boiler inspector, Chicago, Burlington & Quincy Railroad, Aurora, Ill.

Third Vice-President—Franklin T. Litz, general boiler foreman, Chicago, Milwaukee, St. Paul & Pacific Railroad, Milwaukee, Wis.

Fourth Vice-President—O. H. Kurlfinke, boiler engineer, Southern Pacific Company, San Francisco, Cal.

Fifth Vice-President—Ira J. Pool, district boiler inspector, Baltimore & Ohio Railroad, Baltimore, Md.

Secretary—Harry D. Vought, 26 Cortlandt Street, New York.

Treasurer—W. H. Laughridge, general foreman boiler maker, Hocking Valley Railroad, Columbus, Ohio.

Executive Board—A. F. Stiglmeier, New York Central Railroad, Albany, N. Y., chairman.

Boiler Makers Supply Men's Association

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Vice-President—Harry Loeb, Lukens Steel Company, Coatesville, Pa.

Treasurer—George R. Boyce, A. M. Castle & Company, Chicago, Ill.

Secretary—W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

American Boiler Manufacturers' Association

President—H. E. Aldrich, Wickes Boiler Company, Saginaw, Mich.

Vice-President—Charles E. Tudor, Tudor Boiler Company, Cincinnati, Ohio.

Secretary-Treasurer—A. C. Baker, 801 Rockefeller Building, Cleveland, Ohio.

Executive Committee—Starr H. Barnum, the Bigelow Company, New Haven, Conn.; George W. Bach, Union Iron Works, Erie, Pa.; C. W. Edgerton, Coatesville Boiler Works, Coatesville, Pa.; Ousley Brown, Springfield Boiler Company, Springfield, Ill.; J. R. Collette, Pacific Steel Boiler Corporation, Waukegan, Ill.; E. R. Fish, Heine Boiler Company, St. Louis, Mo.; Sidney G. Bradford, Edge Moor Iron Company, Edge Moor, Del.; A. G. Pratt, Babcock & Wilcox Company, New York City; A. C. Weigel, Walsh & Weidner Company, Chattanooga, Tenn.

States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash.	Parkersburg, W. Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

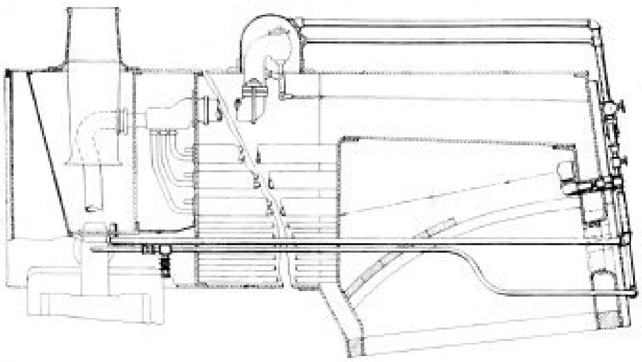
Compiled by
DWIGHT B. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

1,678,764. SMOKE CONSUMER AND SOOT BLOWER. WILLIAM D. BOYCE, OF NEW YORK, N. Y.

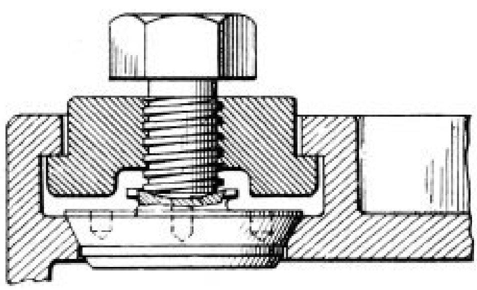
Claim.—In combination with a locomotive boiler and firebox, the latter being bounded on the top by a crown sheet, on the rear by a water leg and on the front by a flue sheet, suitable openings in the water leg for admitting atmospheric air to the firebox, a jet nozzle disposed in said firebox



above the arch and in close proximity to the crown sheet, said nozzle being arranged to direct a jet of steam toward the flue sheet, means for adjusting said nozzles to any position in three planes to vary the line of steam projection and suitable connections between said nozzle and locomotive steam pipe for supplying steam to the nozzle. Four claims.

1,683,726. BOILER PLUG. ELWOOD K. PIERCE, OF SPRINGFIELD, OHIO, ASSIGNOR TO THE CAST STEEL DEVICES COMPANY, OF LIMA, OHIO, A CORPORATION OF OHIO.

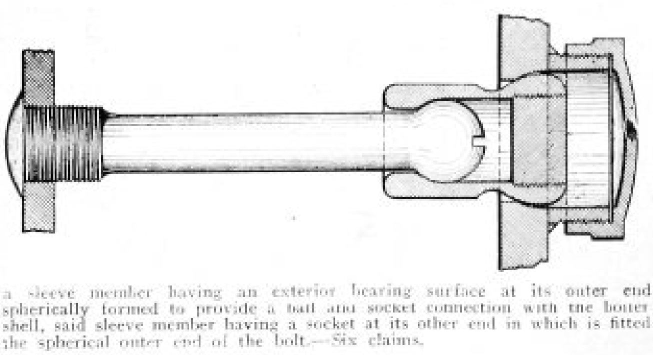
Claim.—In a device of the character set forth an annular casing provided with a pair of oppositely disposed locking flanges and intermediate slot openings all of substantially equal circumferential length, a closure member, a locking piece, a screw threaded through said locking member



for engaging said closure member, said locking piece having a pair of oppositely disposed lugs adapted to be inserted in said slot openings and rotatable into interlocking position beneath said locking flanges, and a stop formed integrally with said casing at one side of one of said slot openings limiting rotation of said locking member at substantially a quarter turn from its unlocked position, one of said locking lugs being cut away at a lower corner thereof to accommodate said stop. Two claims.

1,679,161. FLEXIBLE STAY BOLT. JULIUS KINDERVATER, OF RICHMOND, VIRGINIA.

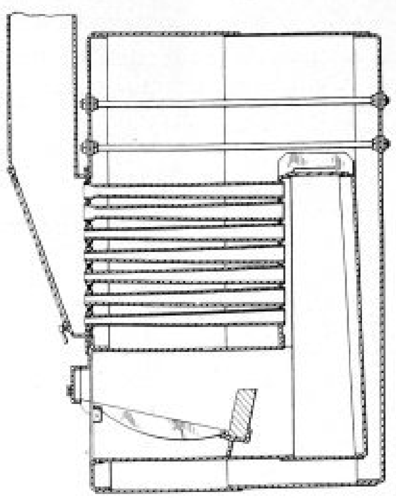
Claim.—In a boiler staybolt structure, a bolt adapted to be attached at its inner end to the firebox wall and having a spherical outer end, and



a sleeve member having an exterior bearing surface at its outer end spherically formed to provide a ball and socket connection with the boiler shell, said sleeve member having a socket at its other end in which is fitted the spherical outer end of the bolt.—Six claims.

1,684,976. STEAM GENERATOR AND THE LIKE. JOHN TAIT, OF PORT CHALMERS, NEW ZEALAND.

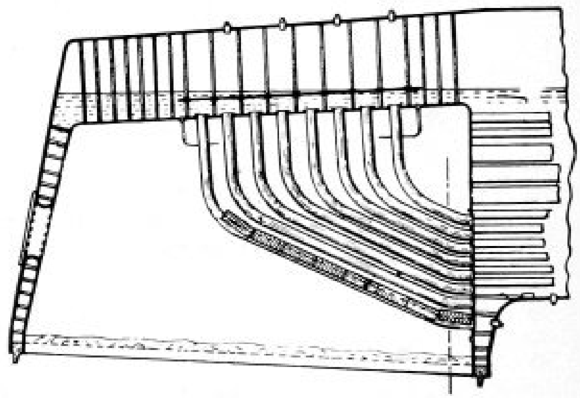
Claim.—In a multi-tubular fire-tube boiler the combination of tapered firetubes which at their smaller ends are provided with enlargements the



diameter of which is greater than that of the larger ends of the firetubes and a tubesheet into which the said enlargements are fitted. Four claims.

1,682,964. LOCOMOTIVE-BOILER FIRE BOX. CHARLES GILBERT HAWLEY, OF CHICAGO, ILLINOIS, ASSIGNOR TO LOCOMOTIVE FIREBOX COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

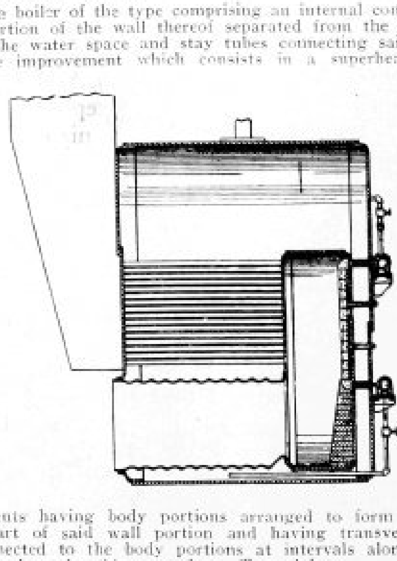
Claim.—A steam boiler having an internal firebox including a flue sheet at one end and a crown sheet at the top and a group of water-tubes all arranged in the same longitudinal vertical plane in the firebox and opening



at one end through the crown sheet and opening at the other end through the flue sheet with some of said tubes communicating with the front water leg of the boiler above said water leg, the tube ends in the crown sheet being spaced a greater distance apart than the tube ends in the flue sheet. Three claims.

1,685,930. SUPERHEATER FOR SCOTCH BOILERS. JOSEPH JOHN NELIS, OF BROOKLYN, N. Y., ASSIGNOR TO FOSTER WHEELER CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

Claim.—In a boiler of the type comprising an internal combustion chamber with a portion of the wall thereof separated from the boiler shell by a portion of the water space and stay tubes connecting said wall portion and shell, the improvement which consists in a superheater formed of



tubular elements having body portions arranged to form a lining for a substantial part of said wall portion and having transversely extending supports connected to the body portions at intervals along their lengths and extending through said stay tubes. Two claims.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX **May, 1929** **Number 5**

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Master Boiler Makers' Convention

FOR the first time in the history of the organization, the Master Boiler Makers' Association out of courtesy to its president has selected a southern city, Atlanta, Ga., as the scene of its twentieth annual convention. From all indications, members of the association and of the Boilers Makers Supply Men's Association will welcome the novelty offered by the change from northern cities. In tthe entertainment features planned for members and guests full advantage will be taken of the opportunity to make this visit to Atlanta a memorable one in the annals of the association.

As will be noted elsewhere in this issue, the exhibition facilities of the Hotel Biltmore, where the convention will be held, are excellent and from this standpoint the success of the supply men's display of tools and equipment is assured. The program of the convention also promises to bring out information that will help correct many of the ills to which the steam locomotive is subject.

Nearly 500 members and supply men have already made reservations to attend the convention, which will open Tuesday, May 21 and continue until Friday, May 24. There yet remains time for those who have been unable to plan very far in advance to also be in attendance. The policy of mechanical officials in general during recent years has been very much in favor of the work of organizations of the type of the Master Boiler Makers' Association. With few exceptions, requests of the boiler shop supervisory staff to be represented at the conventions always meet with approval. Therefore, if there are any members who have so far failed to obtain the necessary authority to be in attendance, they should bring the matter to the attention of the proper official at once.

Another point all members fortunate enough to be at Atlanta should bear in mind is that, above all, they are obliged to take an active part in the proceedings, in order to justify the consideration of their employers in sending them. No single individual or group is able to present a complete view of problems relating to the trade. Discussions of the subjects prepared by special committees should therefore be entered into by representatives of as many different railroads from all parts of the country as time will permit.

Much time can be saved in presenting the discussions if members will study the various papers carefully before the business sessions and prepare clear and concise statements, which they can read from the floor of the convention. Then, if an opportunity is not presented for all of these discussions during the meeting, such statements can be handed to the secretary who will be able to include them in the proceedings.

The convention is so ordered that it forms a pleasant vacation for everyone in attendance, but the fact must be kept in mind that unless it pays dividends in better and more economical locomotive boiler maintenance to its members and their railroads, the full value of the association can not be realized.

Boiler Manufacturers' Meeting

THIS year will mark the forty-first annual convention of the American Boiler Manufacturers' Association, which will be held June 3, 4 and 5 at Skytop Lodge, Cresco, Pa. At the time of going to press the program for the meeting had not been completed, so that the exact order and scope of the proceedings could not be published.

As has been customary at recent conventions of this association, the first session will be a general one, which will be followed by special group meetings. Standing committee reports covering problems pertaining to the industry as a whole will be dealt with at the general session, while matters individually of interest to the various subdivisions of the association will occupy most of the time of the group meetings.

Safety in the Shop

WITH conventions of the three major associations of the steam boiler industry—manufacturing, repairing and inspection—being held within the next few weeks, the subject of shop safety might appropriately be considered at this time.

The protection of the public from accidents due to boiler explosions and failures is only one phase of the situation. Safety of the individual worker in shops engaged in building boilers is equally important, and, improvements can undoubtedly be made in this direction.

As a case in point, the safety problem has been met at the Collinwood, Ohio, shops of the New York Central Railroad and surrounding territory, according to W. R. Lye, district superintendent of motive power, by making the supervisors in this district directly responsible for accidents to men coming under their jurisdiction. This measure was adopted after provisions had been made for adequate equipment, storage space, scaffolding, rearrangement of machines to allow ample working areas, the posting of safety bulletins and other steps to promote safety in general. At a recent meeting of the Safety Section of the American Railway Association, Mr. Lye stated that, since the supervisors were made responsible for this matter, in June, 1928 accidents in the district have practically ceased.

No organization is in a better position than the Master Boiler Makers' Association to survey railroad boiler shop conditions throughout the country from the viewpoint of safety and, on the basis of the findings, to establish a constructive code that will tend to lessen the hazards of boiler work. A report and discussion of this subject at some future convention of this body would be of great benefit to the industry as a whole.

Boiler Inspectors' Meeting

AN advance notice has been sent out by the secretary of the National Board of Boiler and Pressure Vessel Inspectors to all members advising them of the annual meeting of this body which will be held June 18 to 20 at Detroit, Mich. The program of proceedings has not yet been made available for publication but will appear in the next issue of THE BOILER MAKER.

Communication

High-Pressure Boilers

TO THE EDITOR:

Two high-pressure watertube boilers installed by Yarrow & Company at the works of the Castner-Kellner Alkali Company at Runcorn, England, have a working pressure of 600 pounds per square inch with a steam temperature of 780 degrees F. They are of the latest Yarrow single-flow type, large nests of tubes at the front being traversed by the hot gases, while the rear bank of tubes acts as a screen absorbing only radiant heat. The generating heating surface in each boiler amounts to 10,500 square feet. Of this the superheater heating surface is 3250 square feet, the economizer heating surface is 5500 square feet, and the air-heater heating surface is 12,000 square feet. The grate area is 324 square feet. With coal having a calorific value of 10,000 B.t.u. the normal evaporation is 61,500 pounds per hour, with an overload capacity of 75,000 pounds. The feed temperature is 225 degrees F., and the overall efficiency 86 percent. The stokers, which have a width of 17 feet 6 inches and a length of 18 feet 6 inches are of the latest underfeed L class type.

In Germany boiler drums with welded seams are now common practice, and nearly 5000 have been installed during the past six years, working at pressures ranging from 200 pounds up to 860 pounds. The drums are now made from a single plate with a single seam up to a length of 31 feet and a diameter of 4 feet 6 inches and are welded up to a thickness of 3½ inches. They are tested by hydraulic pressure up to three or four times the working pressure, and afterwards the whole drum is annealed, leaving it in the best condition for ageing.

New Shell-Bending Press

A new shell-bending press which has just been installed at the Renfrew, England, works of the Babcock & Wilcox Company, will take plates up to 40 feet in length and 2¼ inches in thickness, and will bend a three-quarter circle from 3 feet up to 4 feet 6 inches. Diameters above 4 feet 6 inches may be bent with a maximum finished width of plate of 10 feet 7¼ inches.

The press is built up of six independent units bolted together, each having its own drawback. The bottom die-holder is in two pieces joined at the center of the press. Plate pinching pins are fitted to both top and bottom die-holders. The actual bending is done by a continuous roller, which also gives the necessary cross-feed to the plate for the successive bending stages. The roller is rotated by gearing driven by an electric motor. The depth of bending is controlled by stopper nuts on the columns. These are actuated simultaneously by motor-driven gearing, the small movement being indicated on a dial with a multiplying gear.

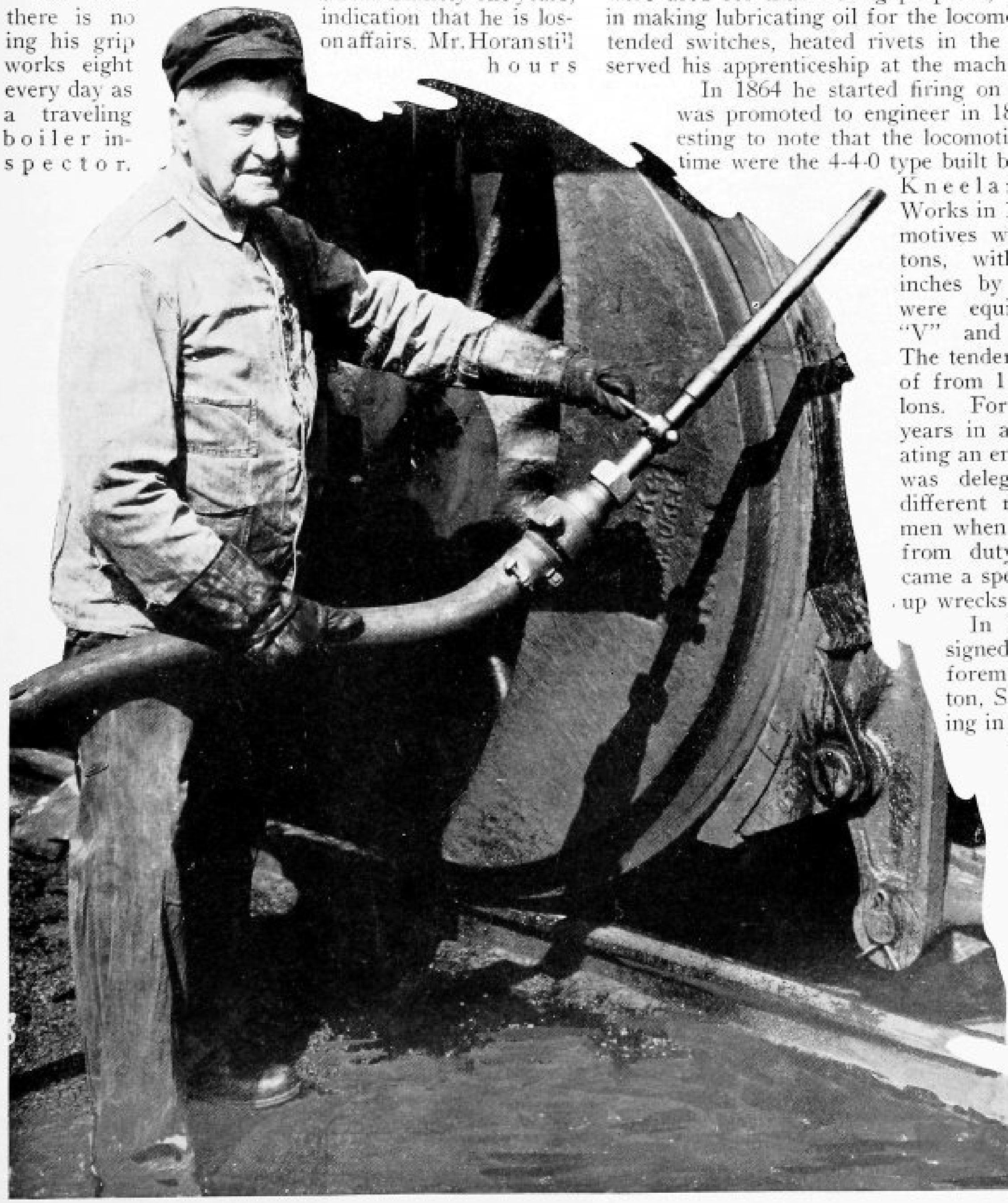
The maximum pressure exerted is 8000 tons, with a water pressure of 2½ tons per square inch. A reducing valve is incorporated to give four pressures—3200, 5000, 6500, and 8000 tons—and an intensifier is employed to give 2½ tons per square inch with a pressure of one ton per square inch. A water-saving gear is fitted, and the main cylinders work on a closed water circuit in which oil is used to provide lubrication to the rams.

London, Eng. G. P. BLACKALL.

"Soda Ash Johnny"

WHAT is believed to be a world's record in years of consecutive service with one company has been achieved by John M. Horan, who in his ninety-first year recently celebrated his seventy-third year of employment with the Chicago, Milwaukee, St. Paul & Pacific Railroad. Throughout the years of association with the Milwaukee road he has watched it grow from a single-track line to the present huge system. He is the only man, so far as is known, who was personally acquainted with every president of the lines that now constitute the Chicago, Milwaukee, St. Paul and Pacific system from their inception.

But with all of his ninety-one years, there is no indication that he is losing his grip on affairs. Mr. Horan still works eight hours every day as a traveling boiler inspector. There is still a sparkle in his eyes, he wears no spectacles and he walks with the springy step of a man many years his junior.



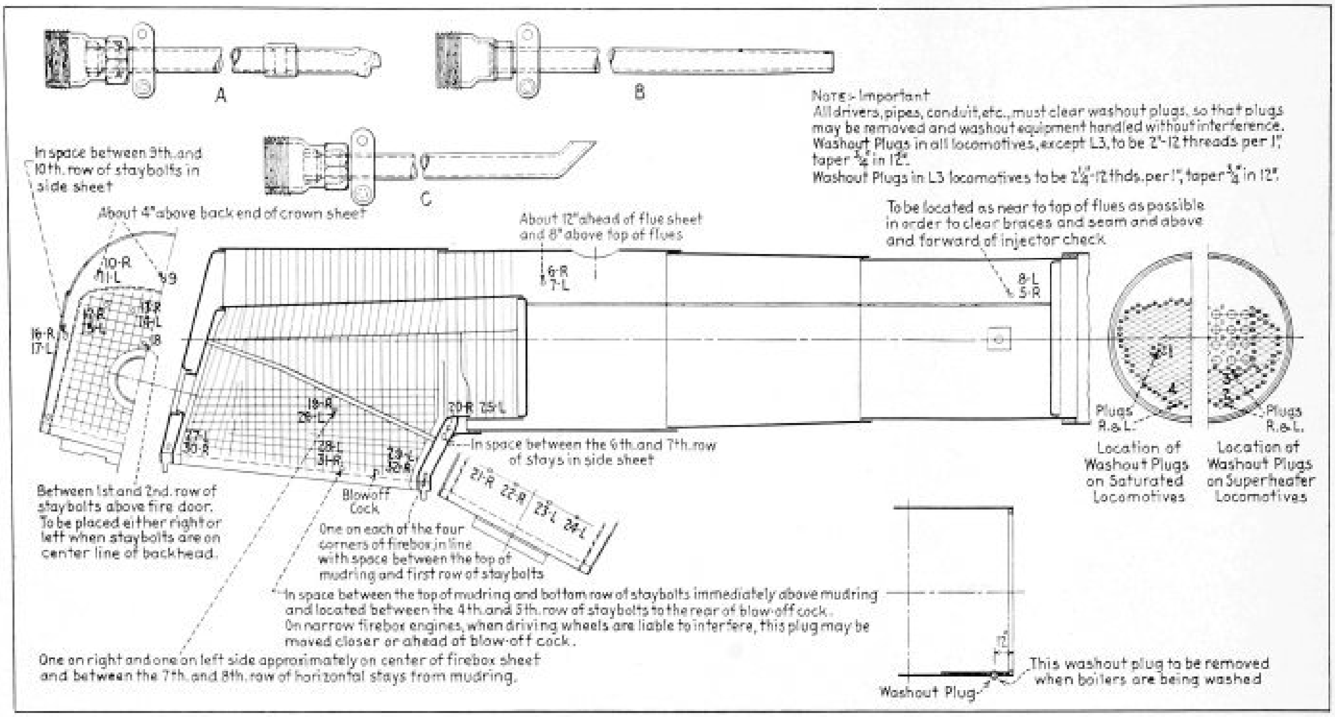
Born at Burlington, Vt., on January 23, 1838, Mr. Horan moved West with his parents in the early forties and settled in Milwaukee, Wis. He received his early education in the Milwaukee city schools and started work with the Milwaukee and Mississippi Railroad in 1855. This road then ran from Milwaukee to Whitewater, a distance of less than 100 miles. His work was that of piling wood for the wood-burning locomotives.

He followed this by melting tallow into candles which were used for illuminating purposes, and also for use in making lubricating oil for the locomotives. He later tended switches, heated rivets in the boiler shop and served his apprenticeship at the machinist trade.

In 1864 he started firing on locomotives and was promoted to engineer in 1868. It is interesting to note that the locomotives used at that time were the 4-4-0 type built by the Briese and Kneeland Locomotive Works in 1856. These locomotives weighed about 27 tons, with cylinders 15 inches by 22 inches, and were equipped with the "V" and Hook motion. The tenders had a capacity of from 1100 to 1500 gallons. For the next dozen years in addition to operating an engine, Mr. Horan was delegated to relieve different mechanical foremen when they were away from duty. He also became a specialist in picking up wrecks.

In 1882 he was assigned as general shop foreman of the Yankton, S. D., shops, serving in that capacity until 1889. The water at that time was a problem, and he gave much time to the study of a means for keeping boilers free from scale. He developed the system of location of washout plugs and the method of washing boilers, that

"Soda Ash Johnny" still on the job at ninety-one years of age



Standard locations for boiler washout plugs

is at present so successfully used on the Milwaukee road. He became so enthusiastic in the use of soda ash that he soon earned the sobriquet of "Soda Ash Johnny" which has followed him through life.

In 1890 he returned to Milwaukee where he was assigned to develop and standardize the equipment used for wrecking outfits.

His successful use of soda ash and the method of washing boilers as developed at Yankton led to his being appointed as supervisor of boiler washing for the system in 1892.

Mr. Horan celebrated his seventy-third consecutive year with the company in September, 1928, and on December 24, 1928, he was presented in behalf of the management with a seventy-five year button (the first ever bestowed) of the Veteran Employees Association.

He represents the spirit of the "Milwaukee Family," his father having started with the Milwaukee road in 1851. Mr. Horan, his sons and grandchildren are at present employed by that road.

The road's present instructions covering boiler washing, which he did so much to develop are given in the following paragraphs:

Washing Locomotive Boilers

All boiler washing is to be performed according to the following rules. No deviation will be allowed:

The requirements of the Interstate Commerce Commission are: "All boilers shall be thoroughly washed as often as the water conditions require, but not less frequently than once each month. All boilers shall be considered as having been in continuous service between washouts unless the dates of the days that the boiler was out of service are properly certified on washout reports and the report of inspection."

All water changes are not considered as washouts, and no objection is made to the removal of the plugs in the water legs to facilitate the emptying of the boiler; however, where all plugs in water legs and back head plugs, or plugs in the barrel of the boiler are removed and hose used, it is considered a washout, and it is insisted that all plugs be removed and the boiler properly washed.

The removal of all plugs and a thorough washing of the boiler is also insisted on as often as water conditions require. It is not a compliance with this rule to remove all plugs once each month, where water conditions require a more frequent washing. All plugs must be removed each time the boiler is washed. Experience has demonstrated that it is just as important to get all the soluble matter which causes foaming out of the boiler as it is to get out the incrusting solids.

When boilers are washed all washout, arch-tube and water-bar-tube plugs must be removed. Special attention must be given the arch and water-bar tubes to see that they are free from scale and sediment. It has been claimed that washout plugs are inspection plugs; but all inspection plugs should be considered as washout plugs, as they were put in the boiler for the purpose of washing the boiler and inspecting the boiler during the washing of same.

Office Record

An accurate record of all locomotive boiler washouts shall be kept in the office of the railroad company. The following information must be entered on the day that the boiler is washed:

(a) Number of locomotive
(b) Date of washout
(c) Signature of boiler washer and foreman in charge of of boiler work
(d) Statement that spindles of gage cocks and water glass cocks were removed and cocks cleaned
(e) Signature of the boiler inspector or the employee who removed the spindles and cleaned the cocks

Washout book Form 5020 has been provided for keeping the records of all washouts. In order to comply with the federal rules, this form must be kept clean and up-to-date, and should contain all the information as described above. Ditto marks or "OK" will not be accepted.

FORM 5020

CHICAGO, MILWAUKEE, ST. PAUL & PACIFIC RAILWAY COMPANY

LOCOMOTIVE BOILER WASHOUT RECORD

Eng. No.	Date of Washout	Signature of Boiler Washer or Inspector	Were Spindles of Gage Cocks and Water Glass Cocks Removed and Cleaned?	Signature of Boiler Inspector or Employee who removed spindles and cleaned cocks
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....

Boilers are washed for two general reasons:

First: To remove the accumulation of mud or scale and prevent the overheating of firebox plates and flues.

Second: To remove the slime and sludge or other matters which, if allowed to remain, will cause foaming, and also to wash from all parts any injurious concentrates that may have a tendency to cause corrosion.

Owing to the great difference in conditions under which locomotives are operated the frequency of washouts largely depends upon the conditions under which the locomotives are being operated. Good performance of the boiler during operation indicates that the washout requirements are being met, while a poor performance indicates the opposite.

Cooling Boilers

Boilers should be thoroughly cooled before being washed, except at points where hot water is used. When boilers are cooled in the natural way without use of water, the steam should be blown off, but the water should be retained above the top of the crown sheet and the boiler allowed to stand until the temperature of the steel in firebox is reduced to about 90 degrees F., or so that it feels cool to the hand; then the water is drawn off and the boiler washed. When the locomotive cannot be spared from service sufficiently long for it to be cooled in this manner before washing, proceed as follows:

When there is sufficient steam pressure, start the injector and fill the boiler with water until the steam pressure will no longer work the injector. Then connect the water pressure hose to the feed pipe between the engine and tender and fill the boiler, allowing the remaining steam pressure to blow through syphon cock or some other outlet at the top of the boiler. Open the blow-off cock and allow water to escape, but not faster than it is forced in through the check. This is necessary to keep the boiler completely filled until the temperature of the steel in the firebox is reduced to about 90 degrees. Remove all plugs and allow the boiler to empty itself.

Washing Flue Sheets

First wash the flue sheet using nozzle *C* and start at hole No. 5 just over the flues and back of the front flue sheet (see illustration). Manipulate this nozzle so as to wash all parts that can be reached through the hole. The same operation should be followed in holes 6, 7 and 8 in rotation. Then with nozzle *B* start at hole No. 8 and wash through holes 7, 6 and ending at 5 in the same manner as used with nozzle *C*.

Washing Flues

Insert nozzle *A* through hole No. 1 in the front flue sheet and push it back to rear flue sheet before turning on the water, so that sludge will not be forced ahead of the nozzle and onto the flue sheet where it is liable to adhere or bake on, making removal difficult. Then work the nozzle by means of a swivel with a rotary motion to the front flue sheet, and with the same motion work it to the back flue sheet. After reaching the back flue sheet hold the nozzle against same for a short period, at the same time revolving nozzle. Then withdraw the nozzle using a rotary motion in the same manner as used in entering. The nozzle should be worked backward and forward three times, and the same procedure should be followed in top hole No. 3. Then wash lower holes No. 4 and 2 in a similar manner except start washing from front flue sheet with water turned on.

Washing Crown Sheet

Wash crown sheet from boiler head using nozzle *A* and starting at the center hole No. 9 above the crown sheet; the nozzle should be inserted so as to direct the steam parallel to the crown sheet and turned toward the right so that scale will be washed into the water legs and not onto the flues, working forward the entire length of the crown sheet. The nozzle should then be withdrawn and directed toward the left or in the opposite direction to that used in working forward. The same procedure should be followed in the case of holes 10 and 11. Work nozzle forward and backward through each hole once, and turn nozzle upward occasionally so as to wash the top of the boiler and all radial stays or bolts as well as the crown sheet, and make a final run through the center opening to insure that no scale is left on the crown sheet.

Washing Arch Tubes

Arch tubes must be washed and cleaned with pneumatic cleaners each time the boiler is washed. With arch-tube cleaners, start as close to the back end of the arch tube as possible through hole 12, operating same with short forward and backward motions until the end of the tube is reached. Work cleaner back in same manner. Follow the same method through holes 13, 14 and 15. If scale is allowed to form in arch tubes, the tube becomes overheated and bulges are formed, and if allowed to remain, the tube warps out of line with the holes, strains are set up, cracks develop, and the tube is liable to pull out or explode. Therefore a locomotive should not be allowed to leave a terminal with dirty arch tubes, and all concerned are instructed to comply strictly with the rule. The condition of an arch tube as to scale on the water side can be determined readily by the presence of clinker adhering to the fire side. If an arch tube is clean on the water side it will be clean and smooth on the fire side. The condition of firebox sheets can usually be determined by similar evidence. It may be laid down as a general rule that clean fireboxes on the water side are clean and smooth on the fire side. Any clinkers adhering or sand paper roughness on the fire-side indicates scale formation opposite.

After arch tubes are cleaned, take nozzle *B* and wash through arch tube holes 12, 13, 14 and 15, manipulating the nozzle in such a way as to wash all parts that can be reached through the hole. Wash through holes 16 and 17 on the corners of the back head in the same manner.

With nozzle *C* wash through hole No. 18 just above the fire door on the back head; manipulate the nozzle in such a way as to wash all parts that can be reached through this hole.

Washing Side Sheet Water Spaces

With nozzle *C* wash through holes in the firebox, manipulating the nozzle in such a way as to wash all parts that can be reached through the hole. Start with hole 19 on the right side of the firebox; then to hole 20, on right front throat; then to holes 21, 22, 23 and 24 arch tubes on throat; then to hole 25, left front throat; then to hole 26 on left side of firebox, then to holes 27, 28 and 29 on left side above mud ring and holes 30, 31 and 32 on right side, these last six holes all being just above the mud ring, one on each side of the firebox and one at each of the four corners.

Inspection after Washing

It must not be assumed that because clear water runs from the holes that the boiler is cleaned, but all spaces must be examined carefully, inserting a torch made by wrapping waste saturated in oil on a long wire, and if necessary, use pick or scraper to remove accumulated scale. Threads of washout plugs and threads in plug holes should be examined to see that they are in proper condition to insure tight plugs before being screwed in.

In replacing plugs use a graphite mixture on same. The date when boilers are washed and initials designating place of washing must be stamped on a tin tag and secured to the pilot beam.

To secure best results in washing boilers a pressure of 100 to 120 pounds on the washout line is desirable.

The illustration on page 124 shows the location of washout plugs and the types of nozzles used. It is important to see that as locomotives are held in shops for repairs, washout plugs are applied in the locations shown on this drawing. Some locomotives may be found with more plugs than shown on the firebox sides, also on the barrel of boiler above the front end of the crown sheet or both sides, in which case they may be allowed to remain. However, all washout plugs must be removed at the time the boiler is washed. Washout holes in the belly of a boiler should be closed.

A suitable schedule covering time allowed between washouts consistent with water conditions should be adopted in each locality and strictly adhered to, and all washout plugs must be removed at the time the boiler is washed.

Editors Note.—The outline of Mr. Horan's career and the description of the boiler washing practice of the Chicago, Milwaukee, St. Paul & Pacific Railroad were supplied by the Master Boiler Makers' Association, through whose courtesy the material has been published.

Device for Testing Air Motors

THE tool room of the Canadian National shops at Winnipeg, Manitoba, besides handling local air-motor repairs, is also responsible for the maintenance of motors that are sent in from many smaller points on the system. Consequently, a large number of motors of various types are overhauled and repaired annually. Believing that some form of testing device would be valuable as a positive means of detecting doubtful work and would at the same time furnish some interesting information, the repair department, under the direction of B. S. Duncan, constructed a testing device.

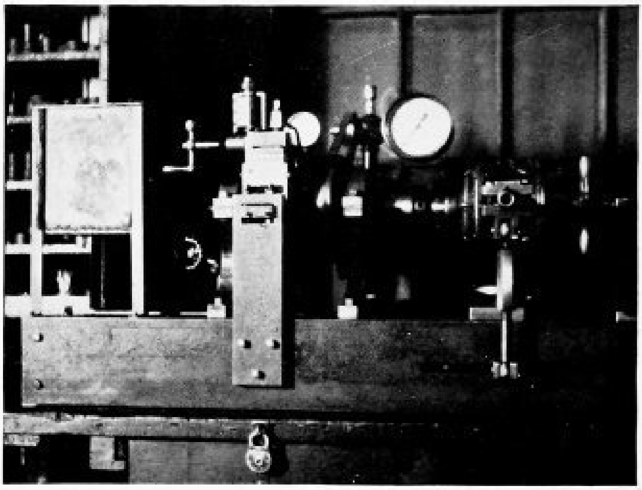
The principle of the device is that the motor drives a spindle on which is mounted a brake drum. Resistance to the rotation of the brake drum is developed by two brake shoes which are mounted in such a manner that their resistance may be gradually increased or decreased, thereby building up or reducing the load on the motor.

The motor to be tested is mounted and held securely by clamps. It is coupled to the brake spindle by a suitable driver or dog. The brake spindle is mounted on ball bearings which reduce friction to a minimum. A brake drum is mounted on the spindle, and partly surrounding the drum are two bronze-lined brake shoes. One end of the lower shoe can be seen projecting through the mounting slot in the vertical steel plate. Grease cups were fitted to the brake shoes at first, but were later replaced by graphite cups, as the latter proved to be a superior lubricant for this purpose. To apply a load on the motor, the handle in the center foreground is given several turns which forces oil into a small cylinder. A ram in this cylinder is displaced by the oil and exerts pressure on the brake drum through the medium of the brake shoes. A pipe leading from the small cylinder is coupled to the pressure gage which indicates from zero to a maximum pressure of 2000 pounds. This range covers all types of motors.

Conditions During Test

During a test, considerable heat is developed at the braking surfaces. In order to meet this condition, the left end of the brake spindle was bored out and the brake drum also made hollow to allow water to enter from the welded tank shown at the left. A simple stuffing box prevents leakage where the spindle enters the tank. The cooling water is assisted in its circulation by a stationary vane which is fastened inside the tank and which extends into the hollow part of the spindle.

The consumption of air in cubic feet per minute is obtained by reading the air-flow meter shown at the left



Device for testing air motors quickly and accurately

of the pressure gage. To the right of the air gage is a large tachometer gage, which is driven by a belt that passes over a pulley mounted on the brake spindle and registers the revolutions per minute of the motor at varying loads. A special countershaft is provided underneath the tachometer mounting and is used when compound motors are being tested, as these run at slower speeds.

Tests were made with a motor of each type used that was known to be in perfect running order. From the data obtained, it was possible to make charts that showed a standard for each type of motor, as to the air consumption and the revolutions per minute at high medium at low speeds under certain loads. If a motor, placed on test after being repaired, performs within a reasonable limit of the standard requirements, it is placed in service. If it fails to pass the test, it must be checked over until the trouble is located and the difficulty is remedied.

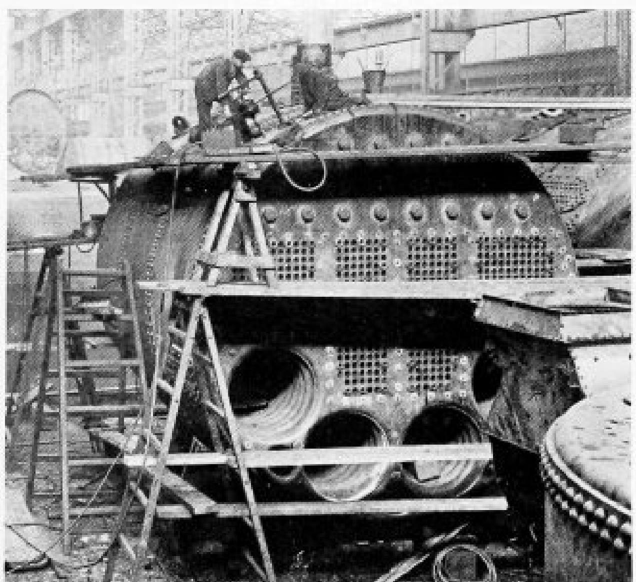
General view of the boiler shop at Birkenhead

Boiler Shop at Cammell-Laird's

By F. G. Bailey

THE machinery throughout the boiler shop of Messrs. Cammell, Laird & Company, Birkenhead, England, is of modern type, and the whole plant presents a most excellent example of present-day boiler-making equipment.

The building illustrated is divided into three bays, the main one being 500 feet long by 80 feet wide, and having a height to the crane track of 80 feet. The west bay is 422 feet long by 80 feet wide, with a height of 35 feet, while the east bay is 50 feet wide and 30 feet high. The total width of the building is therefore 210 feet and the area 94,860 square feet. The west bay is mainly given over to flanging work. The main bay is fitted with 70-ton overhead electric traveling cranes, the west bay with one 30-ton and two 10-ton overhead traveling cranes, and the east bay with one of 10 tons capacity. Raw material enters the boiler shop from the north end and leaves by the south, either for the fitting-out berths or for shipment away. At the present time, in addition to boilers for ships being built at Birkenhead, a large amount of boiler work for other firms both at home and abroad is being carried out and the boiler shop is one of the busiest in the whole establishment. The work is at the present time mostly on Scotch marine type boilers.



Finishing work on a Scotch marine boiler

In England steam generation by means of the Scotch boiler for marine service has been greatly in demand, with the result that the construction of this type as exemplified at Cammell-Laird's has reached a high state of development.

Not only, however, is the shop engaged in strictly boiler work, but a great amount of miscellaneous plate work is carried out as well, such as uptakes and light plate assemblies.

Flanging, planing and rolling methods at the Eddystone plant

The scarfing gang in action

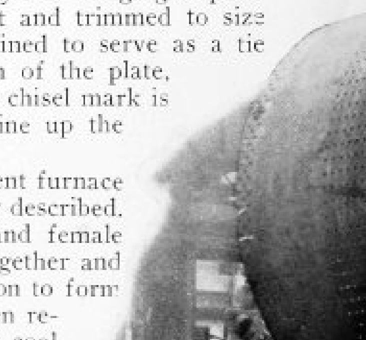
IN addition to the flanging methods described in the April issue of THE BOILER MAKER the fabrication of throat sheets and miscellaneous locomotive flanged plate is carried out in the flanging department of The Baldwin Locomotive Works, Eddystone, Pa. While all of this work is accomplished in bay No. 13, light miscellaneous material is usually flanged on the R. D. Wood four post flanging press located in panel 14 of the upper bay.

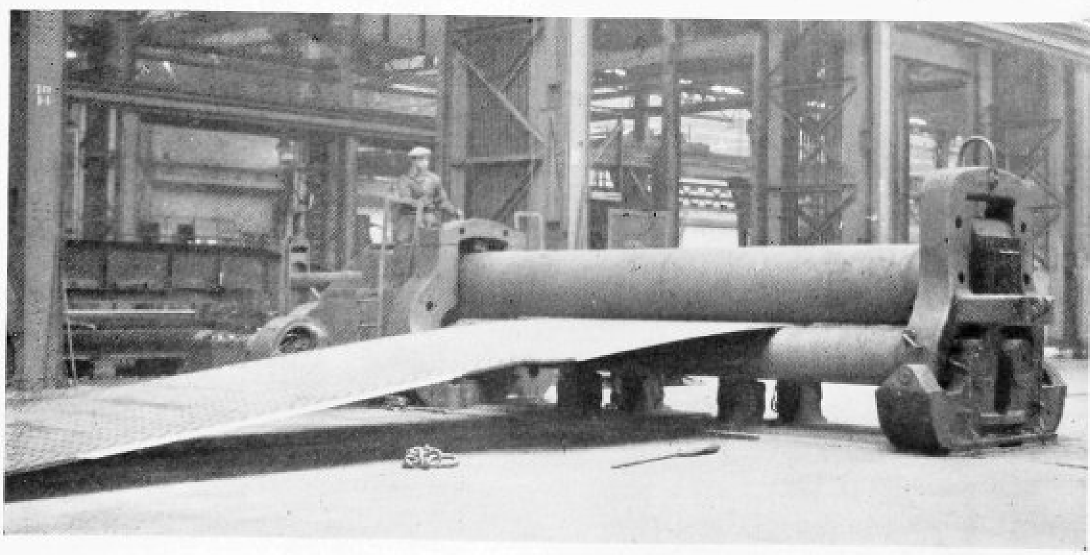
Flanging Throat Sheets

The process of flanging throat sheets is carried out in a single heat, a three-piece die being employed. This die consists of a male piece, a female piece and a plunger or ball. These are set up for operation with the ball portion of the die first hung from the top ram. The male and female portion are set in the press together and lined up with the ball after which the female die is fastened to the table and the male portion fixed to the top platten.

Prior to receipt of the plate by the flanging department, the throat sheet is laid out and trimmed to size with enough excess material retained to serve as a tie piece in flanging. At the bottom of the plate, in line with the center line, a cold chisel mark is made to enable the flangers to line up the heated plate in the die.

The plate is heated in the adjacent furnace and hauled to the die as previously described. After being lined up, the male and female portions of the die are brought together and then the plunger brought into action to form the front flange. The sheet is then removed from the press, allowed to cool slowly and transported to the surface block for lining up.



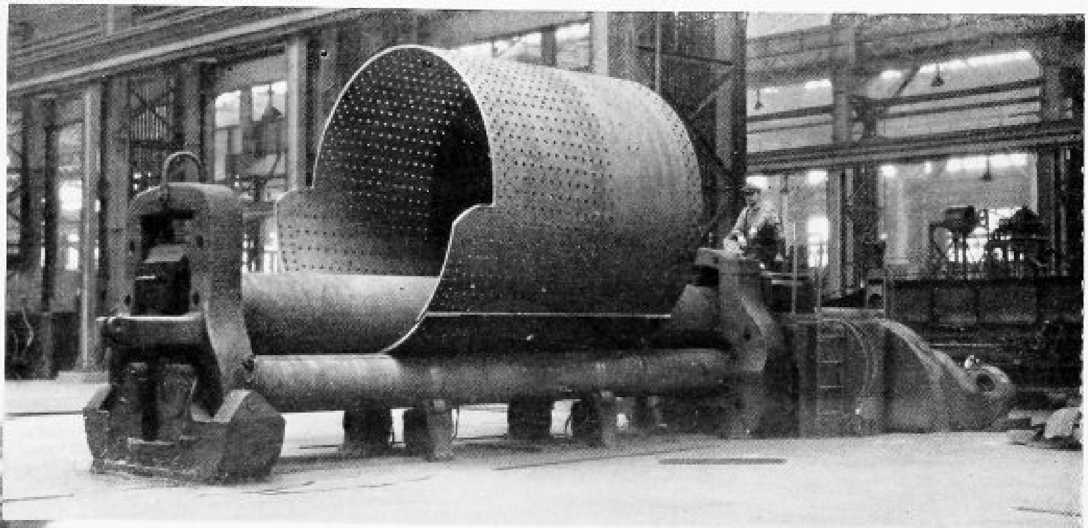


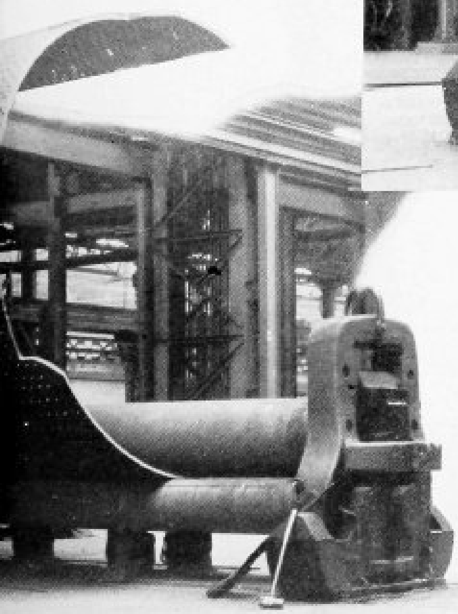
(Above) Partially rolled boiler course

(Left) Sheet entering plate roll

Boiler Work
at the
Baldwin Locomotive Shops

(Right) Final rolling operation on a cylindrical boiler course





When the throat sheet is completely flanged, the tie piece is removed by the oxy-acetylene burning process.

The complete fabrication of flange plates is controlled by one man located at a station at the side of the press where all the control levers are placed. The furnace door lever, winch control, table lever, top ram lever, jack lever and center ram lever are within easy reach of this man and facilitate in the rapid completion of flanging, while the plate is in its most favorable working state.

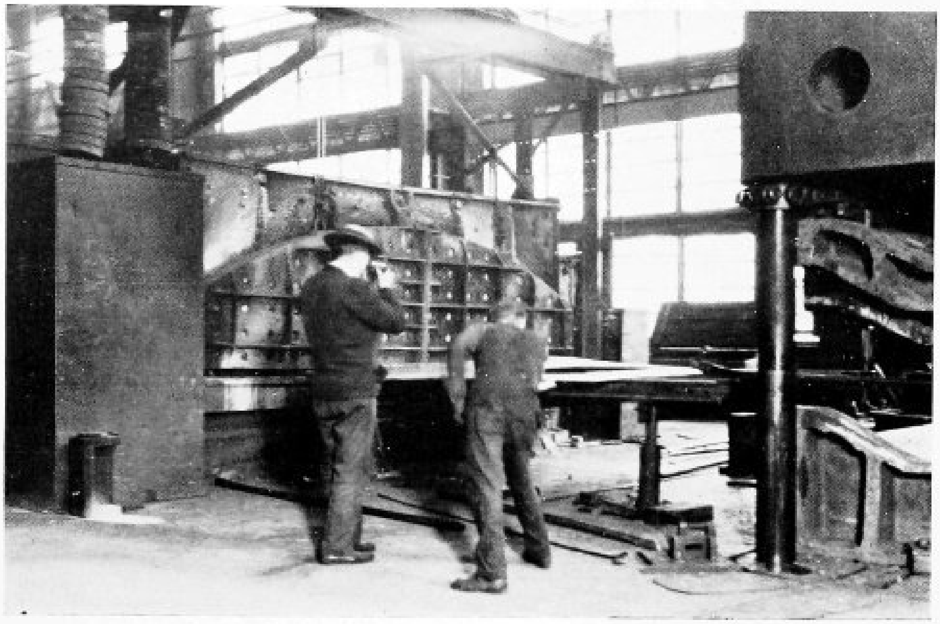
The hydraulic pressure system for the flange shop is entirely separate from the pressure system used in the bull riveters located in another part of the shop. The system employed in bay No. 13 is maintained at a pressure of 1500 pounds per square inch and an accumulator located at the north end of bay No. 13 acts as a balancer to the hydraulic pressure line. This is a storage of water designed to maintain an even pressure over the entire system.

Hand flanging is resorted to only where no dies are available to fabricate the material on a hydraulic flanger. This is often the case in small orders where the expense of making new dies is not warranted. In the course of time, however, so many dies have been constructed for hydraulic flanging that it is often possible to find a die somewhat similar to the required size. In such case, the sheets are flanged on the approximate die and the alterations are made by hand. In the case of throat sheets, where the exact die is not available, the belt is generally flanged with a die and the wings partially flanged on the sectional flanger. Firebox sheets, where there is no die, are generally flanged by hand, although the McCabe cold flanger or a combination cold flanging and hand flanging is often used. The corners are flanged by hand in the hand fires. These sheets are all annealed and straightened after flanging.

Located in the lower bay for service of the hand flangers and sectional flanging machines, are ten hand fires. These fires consist of an oval ring lined with clay and firebrick in the bottom of which is a perforated plate which allows the passage of blower air.

Three Sturtevant blowers supply blower air to the fires through an underground conduit. The fires burn coke and are banked around the edges with soft coal, while cord wood is used to cover the sheet and thereby reduce the draft of cold air on the plate.

The door holes in firebox backheads are flanged prior to the main hydraulic flanging work. This is generally done on a Morgan Engineering Company flanger located in the lower bay. Because of the small size of the door opening and the relatively long flange, several heats are required to complete the process. Where the flange is



A heated throat sheet on the bridge of rails after leaving the furnace

very short, the door hole may be flanged in one heat.

Hand flanging at The Baldwin Locomotive Works is reduced to a minimum and while it is resorted to in many cases, flanging by means of dies is the generally accepted practice.

Time, the important factor in boiler production has been saved by the employment of the most modern of flanging methods. By these methods the class of workmanship entering into boiler flanging has resulted in the interchangeability of similar boiler parts and the more rapid production of duplicate locomotive boilers.

Planing Department

In following the predetermined flow of material through the boiler shop, plates for the barrel of the boiler, shell plates, butt straps and liners pass from the drilling department in bay No. 12 to the planing department located in the upper part of bay No. 11. This department occupies a space between panels 9 and 17 and is served by two 25-ton Niles-Sellers electric overhead cranes.

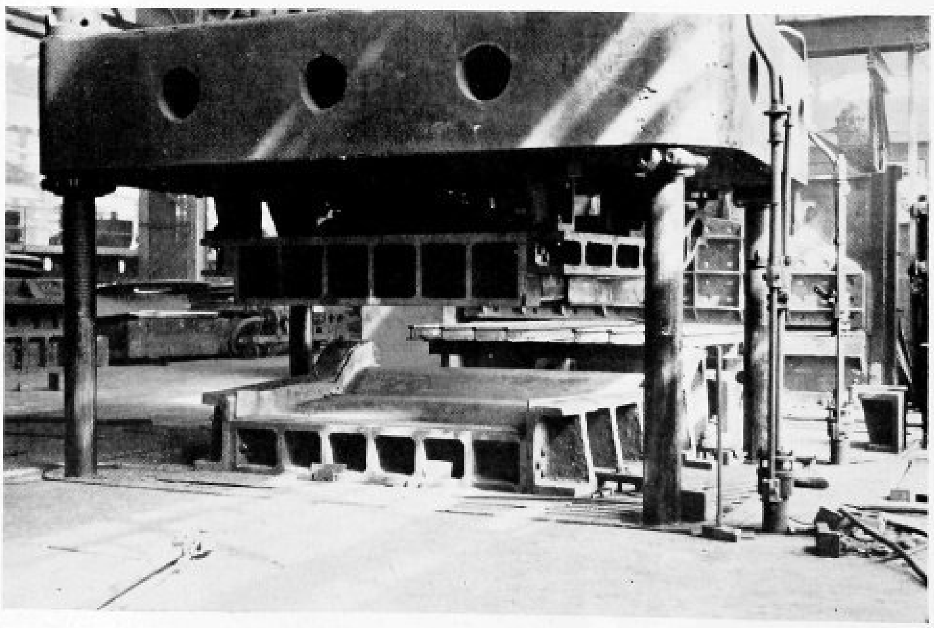
Seven planing machines are located in this department, four being placed adjacent to bay No. 10 and three at the side toward bay No. 12. Their capacities range from plates 20 feet in length in the smallest machines to plates of unlimited length. This is possible by extending the plate over other machines. In panels 10 and 11 on the side of the bay adjacent to bay No. 12 is located a Hilles & Jones planing machine having a length between housings of 26 feet 8 inches, and having a cutting surface of 21 feet 2 inches at a speed of 16 feet 9 inches per minute. A plate 61 feet 9 inches may be worked. A 10-horsepower motor, mounted on a separate stand drives the planer through a connecting belt.

In panels 11 and 12 is located another Hilles & Jones planer having approximately the same dimensions. The maximum plate, however, is limited to 27 feet and the motor which is rated at 15 horsepower is mounted on a bracket on the building column and operates the planer through a belt drive at a speed of 16¼ feet per minute.

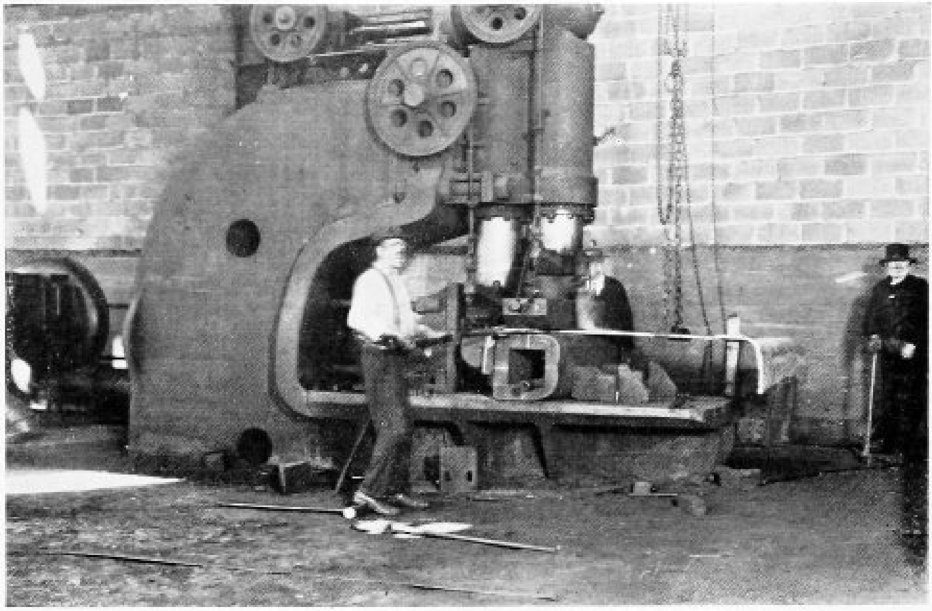
A Southwark planer having a distance between the housings of 22 feet 6 inches and capable of taking a 20-foot plate is located in panels 13 and 14. This will make a cut of 15 feet at a speed of 19 feet 10 inches per minute when driven through a belt by a 25-horsepower motor mounted on the base of the planing machine.

On the side of the bay adjacent to bay No. 10 and extending between panels 10 and 11 is located a Southwark planer having a distance between the housings of 34 feet 6 inches and capable of taking a 36-foot 3-inch plate. This machine is operated by a 20-horsepower motor mounted on the machine and driving the planer through gears at a speed of 18 feet per minute. The longest cut is 28 feet 8 inches. Between panels 12 and 13 is located a 31-foot 6-inch Southwark planer of unlimited capacity. A cut of 24 feet 11 inches may be made at 20 feet per minute by means of a 27-horsepower motor direct connected through gears to the planer.

A 27-foot Bement planer located in panel 13 is capable of taking a 28-foot 6-inch plate in cuts of 20 feet 11 inches each. This machine has a cutting speed of 20 feet per minute and is driven by an 18-horsepower motor mounted on a column bracket and connected to the machine by a belt.



Throat sheet dies set up in an R. D. Wood 4-post hydraulic flanger



Shaping a boiler sheet on a Southwark sectional flanger

In panels 15 and 16 is located a 26-foot Bement planer of unlimited capacity and having a cutting length of 20 feet 3½ inches and a speed of 22 feet 2 inches per minute. An 18-horsepower motor mounted on a separate stand drives the machine through a belt.

In all machines with the exception of the last mentioned, the clamp which holds the plate in position for cutting is actuated by two hydraulic rams located at each end of the clamp. Wooden blocks are placed under the clamp to localize the pressure and keep the plate from slipping. On the Bement planer in panels 15 and 16, nine hydraulic rams take the place of the clamps in the other machines. While other machines have a movable clamp, this machine has a fixed girder with nine individual rams.

On all machines, table rollers are mounted in brackets at a level with the planer table to facilitate the handling of plates during the planing operations.

Planing Operations

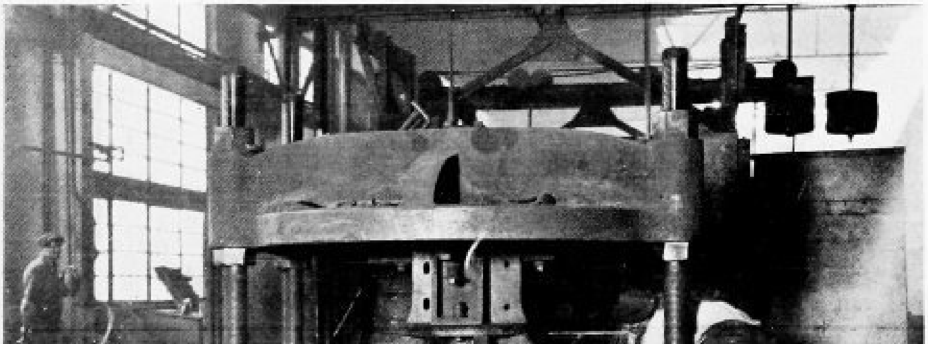
When the drilling operations on the plates have been completed, the sheets are lined up to the proper lap which is laid out exact from the center of the outside rivet hole. The plate is then sheared or burned and transported to bay No. 11 by truck on the track in panel 9. In bay No. 11 the plate is picked up by the overhead crane and spotted at the desired machine.

The planer operator places bolts at the ends of the plate in the outside rivet hole in order to facilitate the lining up of the plate in the planer carriage. When set, the sheet is clamped in the machine where it is held fast by hydraulic rams having a pressure of 1200 pounds per square inch.

Straight plates may be planed in one cut. Conical courses must be shifted in the machine and short cuts are used. Bevels or surfaces are made in a number of cuts with a finish cut considerably lighter than the rough cuts. When the plate edge is to be calked, a standard bevel of 78 degrees is used, other bevels to suit special conditions may be made as desired.

All the planing machines, with the exception of the 26-foot Bement planer, have two tool holders on the carriage for right and left hand feed. This allows the machine to cut in both directions. The 26-foot Bement planer has the left-hand cutter removed to allow the machine to cut closer to the end of the plate or to plane special shapes.

The planing department personnel consists of eight men for each shift. One man operates each of the seven machines and one man acts as a helper, serving all machines. These men come under the direct charge of a contractor for planing and plate rolling operations.

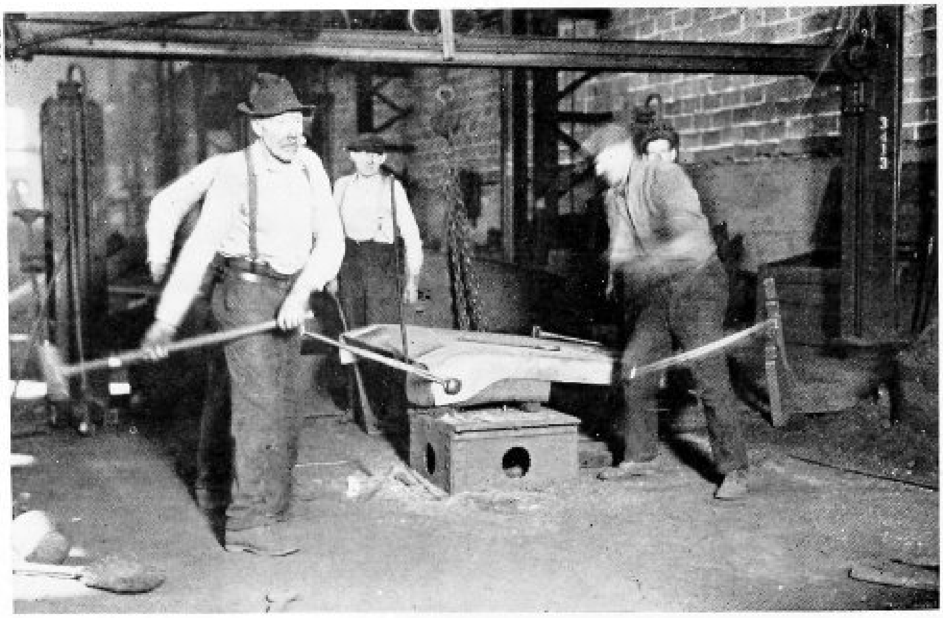


Fabricating valve head covers in the Fielding, Platt & Co. flanging press

Rolling Department

The contractor in charge of planing is also responsible for the plate rolling operations in boiler shop. This department is located in the upper portion of bay No. 10 between panels 1 and 17 and is served by two 25-ton Niles-Sellers cranes. Its equipment includes six plate rolls. One roll has a length of 11 feet; one, 12 feet; three, 16 feet and one 18 feet. All machines are of the three-roller type, the diameters of the top roll varying between 11¼ inches for the smallest machine to 26 inches for the largest machine. The bottom rolls vary between 8¼ inches in diameter to 17⅞ inches. Nominally, the smallest diameter of cylinder that may be rolled is 14 inches. Plates up to 1½ inches in thickness may be rolled.

The method of rolling one piece crown and side sheets for a combustion chamber boiler employed at The Baldwin Locomotive Works was developed at that plant many years ago. This process requires the crown and side portions to remain flat until the barrel section is rolled.



A backhead in the process of being flanged by hand

The legs of the plate which are joined to the cylindrical portion of the boiler are rolled independently of the rest of the sheet. A rod with a thickness of ⅛ inch and a width of 1 inch is placed between the combustion chamber and the top rolls. A block of wood of required thickness to produce the desired bend is placed under the sheet on one of the lower rolls. The upper roll is then lowered and the plate receives a curvature which is checked by means of a template. This process is continued at various intervals along the chamber leg until the entire leg has been given the proper curvature. The opposite leg is then rolled in the same manner.

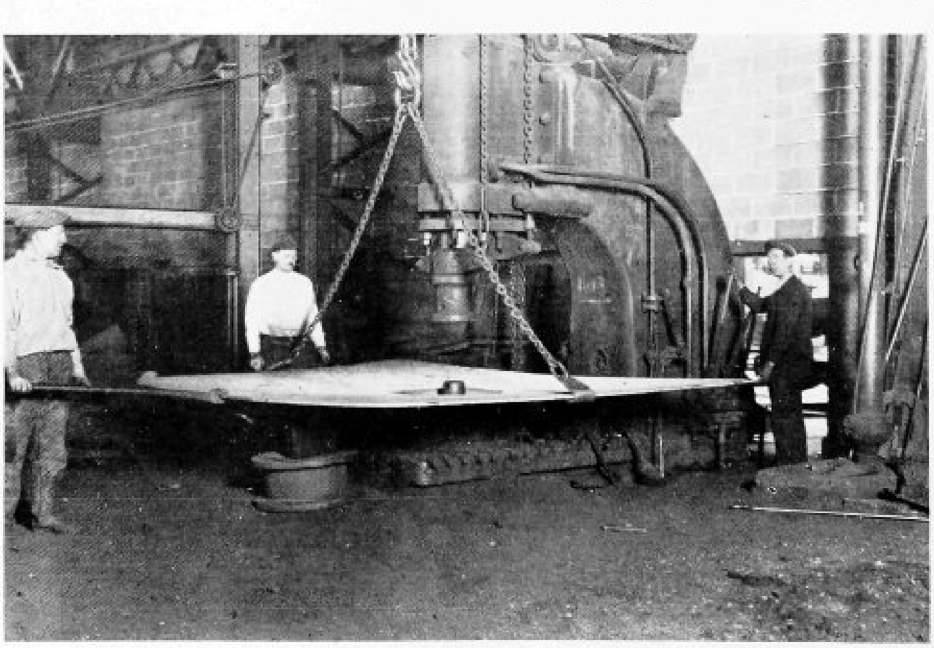
The crown of the combustion chamber sheet is rolled with a wide curve without the use of a rod. Only in the case where holes are large or far apart is a rod used to increase the curvature and eliminate humps at these points. This portion of the sheet as well as the corners or junctions between the crown and sides are rolled until the template fits the curvature. The corners are rolled over a rod.

Tapered courses are shaped to curvature with a number of settings of the rolls and are checked by means of templates. When the sheet is in the flat condition, it is laid out in the following manner to determine the location and limits of each rolling operation: Bisect the large and small arcs of the sheet and again bisect half of the small arc. The small arc is then quartered. Take the distance of one quarter the small arc and set it off on the large arc from the center of the arc and the ends. Considering the entire large arc, this will give four points. Now measure one quarter of the large arc and bisect the distance between this point and that point caused by setting off one quarter the small arc from the edge of the plate. Draw a line between this new point on the large arc and the point marking one quarter of the small arc. Set the rolls on this line and roll the course to the end.

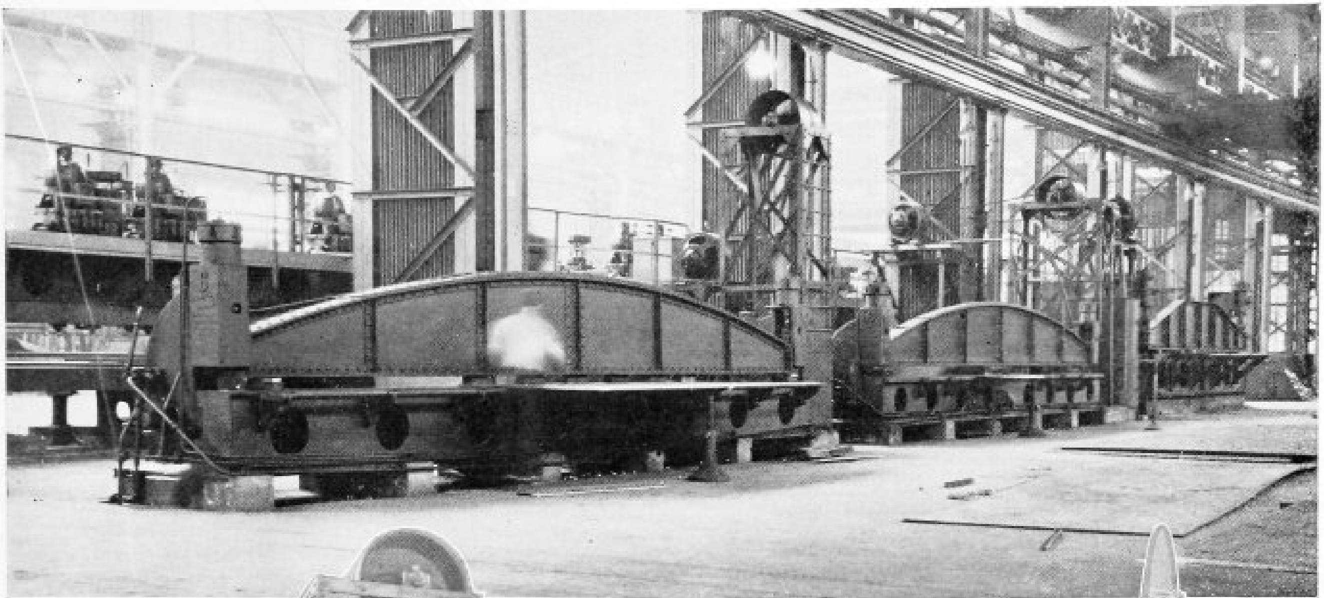
Now set the rolls on a line between one quarter the distance of the large arc and one quarter the distance of the small arc and roll the course to the center of the plate determined at the small arc.

Now reverse the process and roll the other side of the plate in the same manner. The flat portions are rolled over to obtain the required curvature.

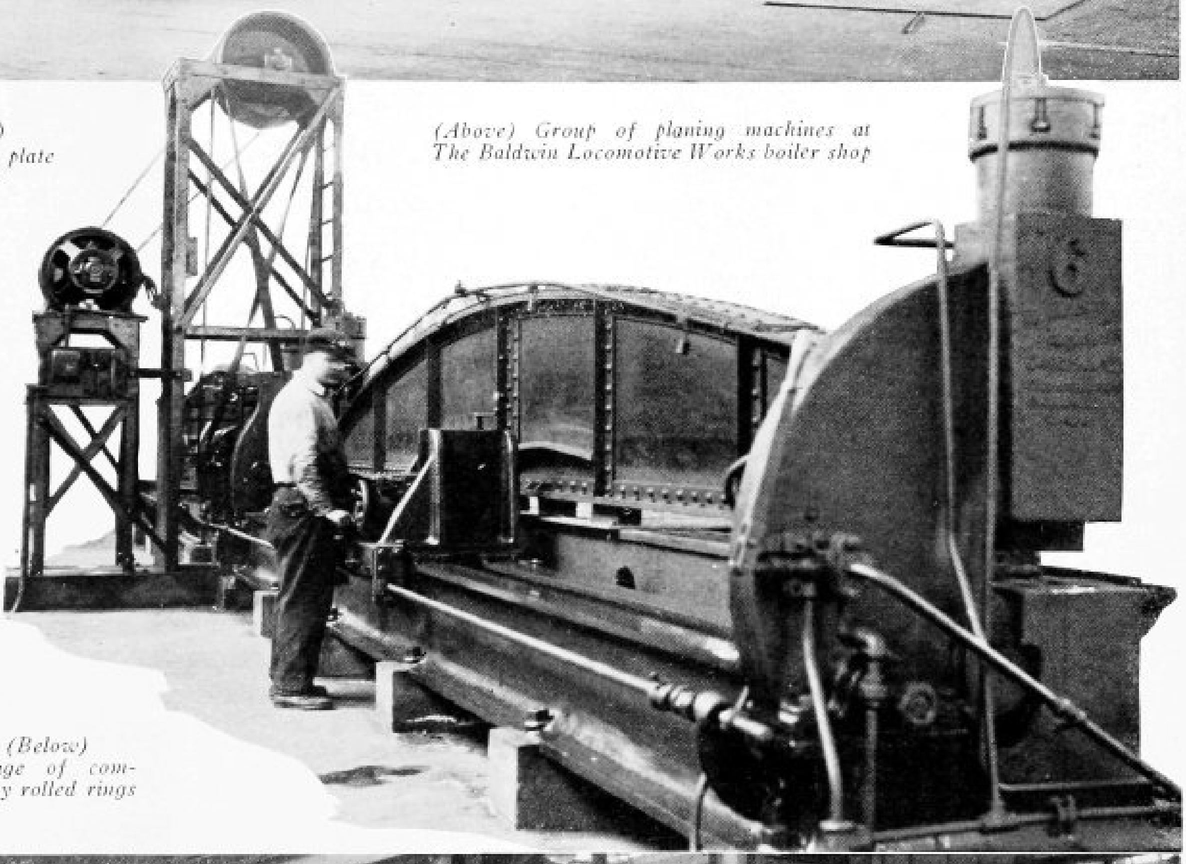
For the purpose of rolling the edges of any plate to the proper radius, a small bar of steel depending on the thickness of plate to be rolled, is placed beneath the plate on the top of one of the bottom rolls. Beneath the upper roll and on the plate is placed a rod one inch square, which when the rolls are brought together gives the plate the proper curvature. This process is re-



Flanging the door hole of a firebox back sheet on a Southwark sectional flanger

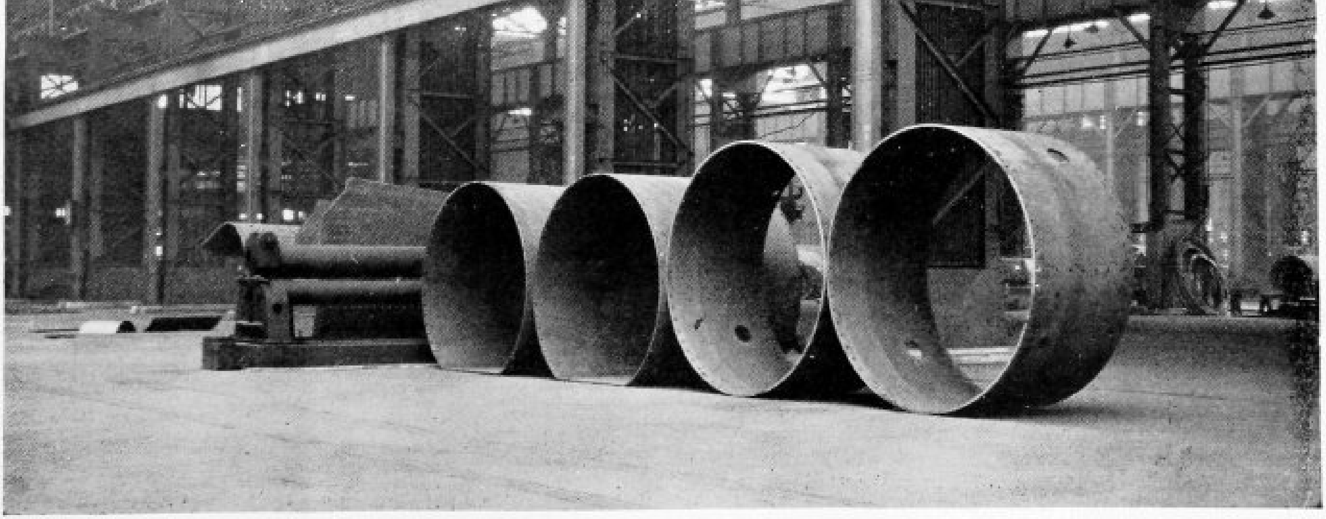


(Above) Group of planing machines at The Baldwin Locomotive Works boiler shop



(Right) Machining plate bevel

(Below) Storage of completely rolled rings



quired for the edges of all plates. After this is done the rolls alone are required to complete the curvature.

In ordinary cylindrical rolling, the upper roller is lowered after each passage of the plate through the rolls. This is continued until the proper radius is reached.

Completed cylindrically-rolled plates are taken from the machines by removing the housing at one end of the rolls. By this means the plate may be pulled from the machine and transferred to storage at the end of the bay.

In rolling plate to a radius as low as 2 inches, a T-bar is used. This is placed below the upper roll with the flange downward and a wooden block is placed between the T-bar and the roll. This is the smallest radius to which a plate may be bent in the rolling department. Smaller curves must be accomplished by flanging.

Plate Scarfing

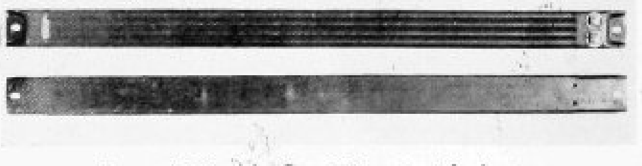
The scarfing of boiler courses and crown and sides sheet is done in the rolling department. A small air and oil-fired scarfing furnace, manufactured by The Baldwin Locomotive Works, is located in panel 7 of bay No. 10 and is served by a 6-ton hand jib crane having a 20-foot reach. In this furnace is inserted the corner of the plate to be scarfed and a hand-operated door of the balanced type is lowered on the plate which is heated to a red heat. The plate is then taken from the furnace by means of the hand crane and placed on the scarfing block located near the furnace. Here one man holds the plate on the block while three men work in the scarf by the use of hand sledges.

Four scarfs are generally required on crown and side sheets at the water space corners. Top and side sheets in one piece require no scarfing. Where they are in three pieces, the top sheet is scarfed at the corners where it is to join the side sheets. Other scarfing operations, with the possible exception of the lap on waist sheets, are done in other departments.

The June issue of THE BOILER MAKER will include descriptions of the equipment and methods employed in the water space frame or mud-ring fabrication department of the boiler shop of The Baldwin Locomotive Works.

Electric Strip Heater

A NEW electric strip heater developed by the General Electric Company, Schenectady, N Y., may be applied either as an air heater or as a "clamp-on" device. It is designed for general purposes where electric heat is required, and is suggested for use in



General Electric Co. 500-watt strip heater

cabs, valve houses, pump houses, process machines, drying ovens, compound tanks, warming tables, oil lines, etc.

The device is 24 inches long, 1½ inches wide and ⅜-inch thick. It is rated 500 watts at 110 or 220 volts. Slots are provided in each end allowing the heater to be supported in air or clamped to a metal surface.

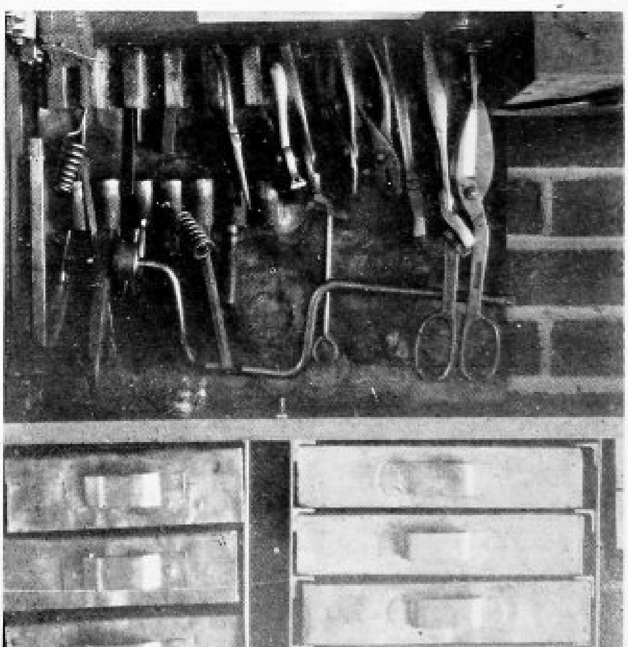
Both terminals are at one end of the unit and project from the same side. They are nickle-plated brass studs insulated from the sheath by mica washers and provided with screws and fittings for binding the connecting lead wires.

The current-carrying resistance wire inside the sheath is the usual nickle-chromium resistor wound in a helix in much the same manner as in standard G. E. sheath wire construction. The coil is supported at each end by a porcelain insulator and is stretched down the length of the unit four times, providing even distribution of heat over the entire surface of the unit.

The resistor is insulated from the sheath by magnesium oxide powder. After the heater is assembled and filled with magnesium oxide, the powder is compressed into a compact mass by a 250-ton press. At the same time four ridges are produced in the top side of the unit and these, together with depressions between, place each of the four heater windings in what is essentially individual half-tubes, adding strength and rigidity to the unit.

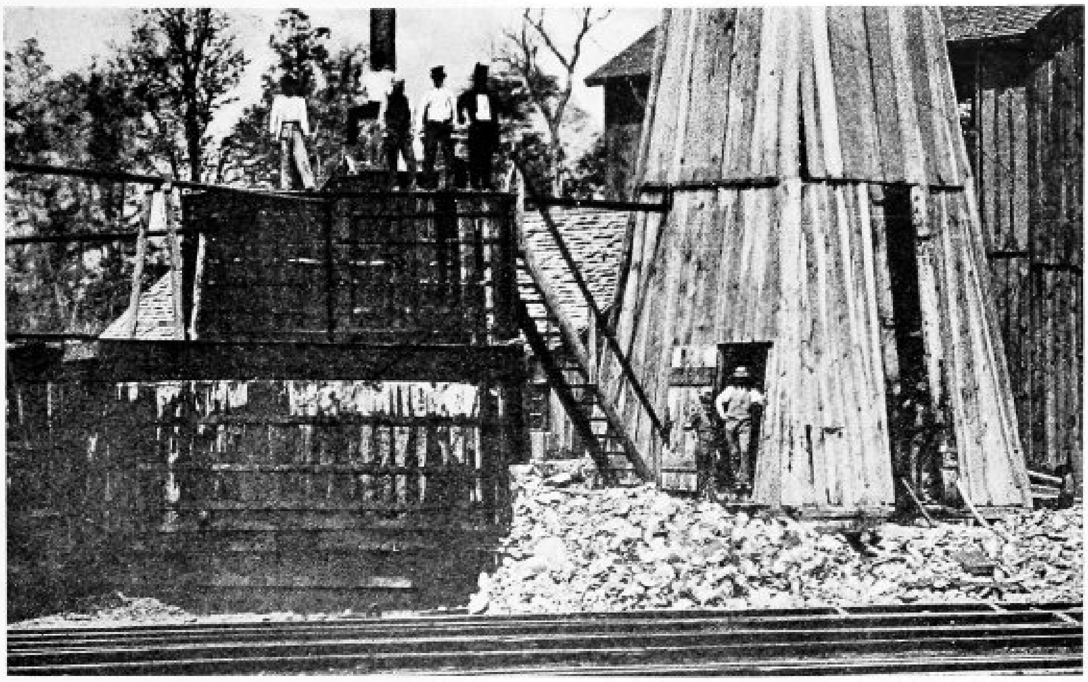
A Convenient Shop Cabinet

GREASY wooden tool boxes in the shop are always more or less of a fire hazard. For storing small tools and other materials, a cabinet, like the one illustrated, is easily made from light sheet metal and small angle sections. Scrap material may be used and then painted. The drawers are cut out and welded



A cabinet in which tools can be kept in an orderly and systematic fashion

at the corners and small handles are welded on the front end. Partitions may be made in the drawers for various stock small parts by cutting sheet metal in strips of the proper length and then welding them in crosswise. One-inch angles are used for the framework, supported by sections of strap iron, to which they are welded or bolted with small flat headed bolts.



In the oil fields fifty years ago

Maintaining Boilers Fifty Years Ago

Replacing tubes in locomotive type oil field boilers—Applying soft patches

By J. A. Anderson

THE maintenance of boilers in a bad water district fifty years ago offered considerable difficulty. The boilers were of the locomotive type, such as were used in oil well drilling and pumping. The bad-water district was the oil territory which contained much salt water.

The maintenance of these boilers, which were in service twenty-four hours a day, in the days before the tubes were lengthened by welding on safe ends, and when not much attention was given to the kind of water used in the boiler, was a problem which kept a number of boiler makers busy.

Then, as now, tube trouble was the predominating one, although corrosion and mud burns were frequent. As the scale accumulated on the tubes, and lodged on the tube sheets, the tubes leaked, then the boiler maker would be called to expand and bead them, the only expander used was the prosser or sectional one. This type of expander would not only tighten the tubes, but would also loosen the scale on the water side, so that for a time the boiler would give good service. Nevertheless the same trouble would occur again and again until finally the boiler became so dirty that the tubes would have to be removed.

Then the following system was employed: The tubes had to be removed and used again, and it was necessary to cut off at least 2 inches. During the life of the boiler and tubes this had to be done several times.

It was done in this way, if the tube sheets were in good condition, the tubes were removed, and the rivets cut out of the front head and the head driven into the barrel 2 inches and new rivet holes cut and the head re-riveted, care being taken in removing the tubes, so the ends were not damaged.

When the tube sheet in the firebox had to be renewed, it was done as follows: The sheet was cut across just under the lower tube holes. The old tube sheet had a 2-inch flange, but the new tube sheet would be given a 4-inch flange and offset 2 inches at the junction with the lower half of the old sheet. Thus the sheet was projected 2 inches into the barrel, and so allowed that amount to be cut from the ends of the tubes.

Fifty years ago and more there were not many specialists in the boiler trade, a boiler maker was expected to be what the name implies, and so they worked and studied to that end. There was no lack of opportunity for them to gain experience. The maintenance work here outlined was nearly all done in the field with tools which would now be called crude, nevertheless the workmanship was good.

The material used fifty or sixty years ago was iron, which made the cutting somewhat easier than if it had been steel. Especially was this true in cutting the tubes to length, the usual practice being to heat the ends in the rivet forge and saw them off with a buck saw.

The scale was removed from the tubes by knocking the rough off with a hammer and then removing the balance with half round files ground sharp on the edges. It was one man's job to go from boiler to boiler undergoing such repairs, and clean the tubes. In order to anneal the tube ends, they were heated to a cherry red and then covered with ashes where they were allowed to remains until cold. Copper ferrules were unknown in these days. When the tubes were loose in the holes they were shimmed up with Russian iron.

Another job which called for careful work was the application of what was called soft patches in the firebox. We did not have what is now called the standard patch bolt, the bolts we used being home made of the ordinary square-head type.

A brief description of how the patch and bolts were prepared and applied will be interesting. This was a special job and required some practice before it could be done successfully. Having cut out the damaged part of the sheet, the patch was made. The bolt holes in the patch were punched somewhat smaller than the bolt, then the patch was used as a template and some tack holes marked, drilled and tapped in the firebox sheet. Then the patch was bolted on using the tack bolts. After this the balance of the holes were drilled through the firebox sheet, the patch was then removed, the edge of it chipped bevel and the bolt holes reamed a trifle larger than the patch bolt.

Having tapped all the holes in the firebox, we proceeded to apply the patch. First we mixed some red lead with oil until it formed a paste. Then we wound some strands of hemp under the bolt head in such a way that it would not unwind when the bolt was screwed in, care being taken in winding so that the proper amount was used. We applied some of the red lead on the hemp, having all the bolts prepared. Taking the patch, we spread a thin coat of red lead about 2 inches wide around the edge. Then having prepared two fine strands of hemp we laid one around the patch just inside of the bolt holes and the other one outside of the holes.

Then we carefully placed the patch, putting in a few bolts and setting them up tight enough to hold the patch in position. After applying all the bolts, setting them up evenly by hammering the patch lightly around the bolt line until the patch was drawn up tight to the under sheet, we calked it lightly and the job was done.

Further tales of the old days will appear in early issues.

Work of the A. S. M. E. Boiler Code Committee

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the boiler code. Any one desiring information as to the application of the code is requested to communicate with the secretary of the committee, 29 West 39th St., New York, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the secretary of the committee to all of the members of the committee. The interpretation, in the form of a reply, is then prepared by the committee and passed upon at a regular meeting of the committee. This interpretation is later submitted to the council of the society for approval, after which it is issued to the inquirer.

Below are given records of the interpretations of the committee in Cases Nos. 587 (Reopened), 609 (Annulled), 616-618 as formulated at the meeting on January 10, 1929, all having been approved by the Council. In accordance with established practice, names of inquirers have been omitted.

Case No. 587 (Reopened). *Inquiry:* Will it not be permissible in the markings of cast-iron low-pressure heating boilers to place the marking either on the jacket or the firing door of the new types of sheet-metal-jacketed boilers? In the new line of sheet-metal-jacketed boilers that are now on the market, it is difficult to so place the marking as to comply with the requirement in Par. H-120 of the code that it shall be left uncovered or made readily accessible.

Reply: Par. H-120 specifically requires the marking to be stamped, cast or otherwise irremovably attached to the front and rear cored sections of vertical sectional cast-iron boilers and on the dome section of horizontal sectional cast-iron boilers. A revision of Par. H-120 is now under consideration which may, where casings are used, provide for additional markings on the casing, and under such conditions remove the requirement that the stamping required to be placed on the boiler be made accessible.

Case No. 616. *Inquiry:* Is it the intent of Par. P-296 of the code that gage connections shall be of brass, copper, or bronze composition when they are normally filled with water but may be exposed to high-pressure steam when blown for clearing the pipe of sediment and deposit?

Reply: It was the intent of this provision in Par. P-296 for brass, copper, or bronze composition that it should apply only to such connections as are never subjected to a temperature greater than that of saturated steam at a pressure of 250 pounds and not to exceed 406 degrees F.

Case No. 617. *Inquiry:* In the revised form of Par. P-200 of the code, should the sentence that contains the requirement for the drilling of staybolts used in the waterlegs of watertube boilers, have added thereto a provision that these telltale holes should extend ½ inch beyond the inside of the plate, or in the case of upset ends, extend ½ inch beyond the point of reduction in section?

Reply: It is the intent of the requirement in Par. P-200 for the drilling of the ends of staybolts used in the waterlegs of watertube boilers, that the same provisions for the depth of drilling and relation of drilling to reduction of section, shall apply as in the case of staybolts in firetube boiler waterlegs.

Case No. 618. *Inquiry:* Is it necessary, under the requirement in Par. P-254 of the code, to remove the heads from the ends of a drum after the rivet holes have been finished, in order to remove the burrs? It is pointed out that where hammer-welded drums are used the heads are fitted to them with a small tolerance, so that it is difficult to remove the head for such a purpose.

Reply: Par. P-254 refers only to longitudinal joints in which the separation of the butt straps for cleaning out the burrs is mandatory.

HIGH TEST WELDING ROD.—This publication, issued by the Oxweld Acetylene Company, New York, N. Y., is divided into two major sections, the first being reasons for specifying high test rod and the second, how to use this rod to the best advantage. The first division covers: Present demand for superior welded joints; brief historical development of high test rod; strength of joints; where to specify it; economy of its use. The second division covers briefly the principles of joint design and welding technique.

Locomotive Boiler Construction—X

Flanging operations employed on one and three-piece domes carried out in from two to seven heats

By W. E. Joynes*

CHANGING a round flat white hot plate into a dome shape, ranging in height from 6 inches to 31 inches, is successfully carried out with a set of dies constructed as shown in Fig. 48—*A* and *B*, (April issue). The *A* dies raise the dome to within a few inches of the required height dome wanted; leaving the base of the same in a flat condition. The *B* dies shape the base to fit the boiler shell and during this last operation the plunger die draws the top of the dome to the correct height.

Domes from 6 inches to 12 inches high can be made in two heats of the material. The small outside die or ring as shown in Fig. 48 *A* is used in connection with the plunger die as shown to bring the dome to within two or three inches of the 12-inch high or lower dome.

For the second operation dies similar to the dome collar flanging dies, as shown in Fig. 48 *B*, are used in connection with the same size plunger. The outside or bottom die, as shown in *B*, is blocked up if necessary on the bottom table to give the required height of dome. The holding die is bolted to legs of the upper table.

The same size plunger die without base plate is keyed to the top ram. The bottom table is raised with the base of the hot dome suspended on the inside die. The dies are brought together until the sweep of the base is more than half formed, when the plunger is brought into action. The plunger and the base dies are now operated intermittently, until the base is formed and the height reached.

The first operation on the dome plate is practically a drawing down process, in that the plate is not held with the two ring dies, but is allowed to draw freely between these dies as the plunger pushes the material up. Space blocks, about ½-inch thicker than dome plate, between the dies gives the plate free action. When the height is reached the blocks are removed and the dies pinched together, to remove the buckles in the base that will naturally form in a loose draw plate. Fig. 55 shows a flanged dome with the flat base as made in the first operation.

Domes higher than 12 inches and up to about 19 inches high, require three heats. The first operation requires a larger outside die ring and a large plunger.

A smaller ring and a smaller plunger raises the dome to the required height for the shell sweep dies. Beyond the 19-inch height, domes are successfully flanged up to 31 inches high in five to seven heats, using larger diameter rings for each heat and the same two size plungers. The smaller plunger being used only in the last two heats, including the finished heat operation.

It will readily be seen that the reason for using the large ring dies and plunger for flanging domes above 12 inches in height, is to draw more material up into the dome height. This allows more material to draw and stretch with the small plunger so as not to unduly thin the dome body and top thickness. Domes are flanged from plates 1⅛-inches and 1¼-inches thick, depending on the height of dome required. The diameter of the plate before flanging is considerably greater than the length of the neutral axis of the cross section of the finished flanged dome. A small hole in the center of the plate locates the same on a pin in the center of the plunger in the first heat. The hole also facilitates drawing the flat plate and the dome-shaped plate from the furnace as well as being used for a hook for crane handling.

Summing up the flanging of boiler plates, as they are now flanged, we find that, with the exception of the door hole flange in the backhead and firebox back sheets, these sheets are flanged in one heat with a male and female die, each die being constructed in one piece.

The firebox tube sheet for a non-combustion chamber boiler, we have learned, is flanged complete in one heat with a male and female die, made in one piece.

The front tube sheet and the back tube sheet for a combustion chamber boiler, we find requires a male and female die and

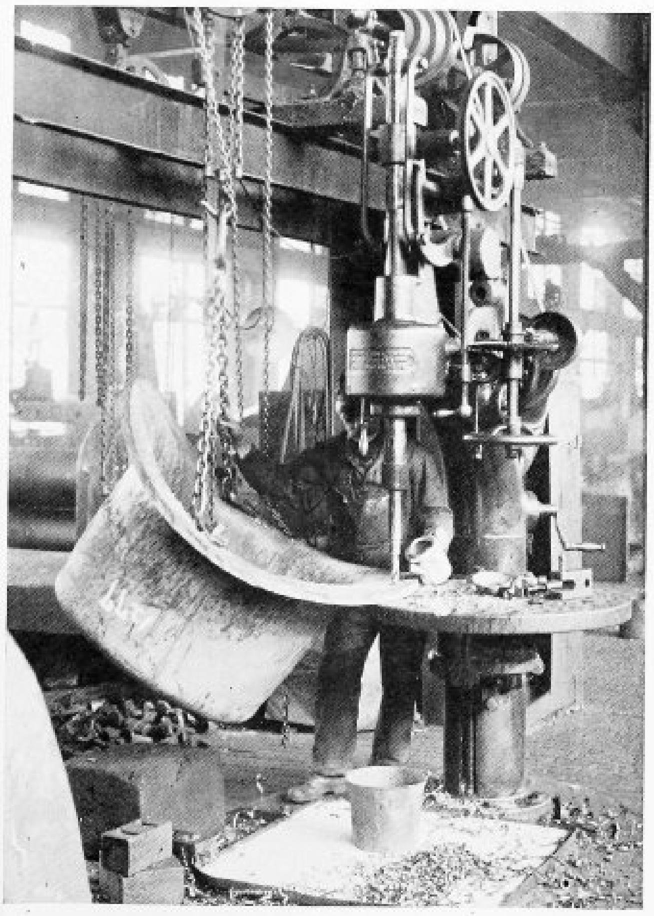


Fig. 54.—Drilling rivet holes in a dome after flanging

* Boiler designing department, American Locomotive Company, Schenectady, N. Y.

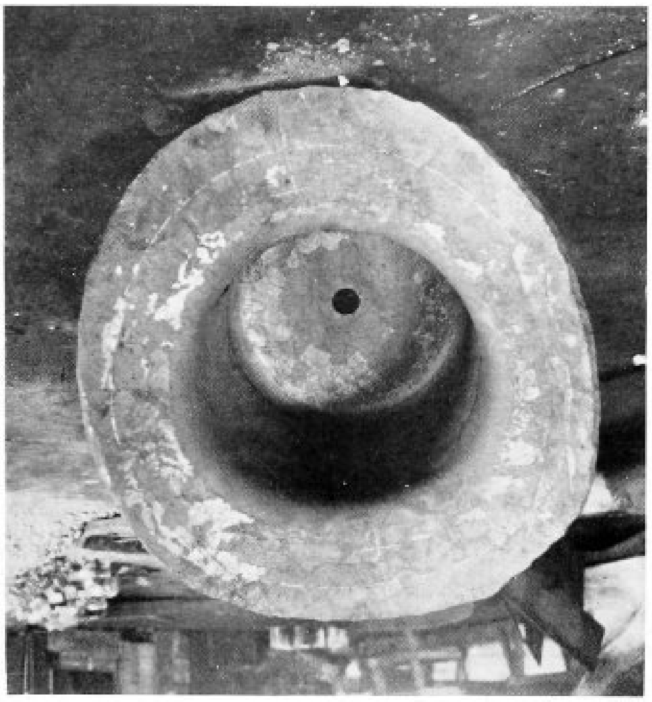


Fig. 55.—Looking into a dome flanged in one piece

also a holding or clamp die. These dies should be of the one-piece construction.

We have found that the severe flanging of a heavy throat sheet is also successfully performed with one heat of the plate and a double operation.

Turning again to the flanging of a one-piece flanged dome we find that two heats of the material will successfully carry these hat-shaped steam containers to a height of 12 inches and with three heats the height can be raised to about 19 inches. Beyond this height the number of heats will vary from 5 to 7 up to a height of 31 inches, which has been done.

Three-Piece Dome Flanging

Dome collar is flanged with an inside and outside die and a plunger die. Dome ring is flanged with an inside and outside die and a holding die.

Dome cap requires a male and female die only for the flanging operation.

A mixture of graphite and oil facilitates the removal of all plates from the dies.

Dies should be made with sufficient clearance between the male and female dies so as not to bind or unduly stress the plate. Dies with not enough clearance are often broken when the flanging pressure is applied.

Crane dogs made of flat plate with a slot in the bottom edge and a crane hook hole in one end are used for handling the flanged plates.

A gang of 5 to 7 able and experienced men, including the leader, is necessary for setting up dies and handling of the plates. The smaller sheets, such as front and combustion chamber tube sheets, dome base, dome ring and dome cap and other locomotive parts such as cylinder head casings, dome and sand box casings, etc., are flanged on a lighter flanging press. These, of course, require the smaller number of men.

The leader of the gang operates the press during the flanging operations. He must be a man of certain technique and skill and experienced in the art of flanging to flange the plates with success.

(To be continued)

Combination Crushing and Shearing Machine

THE Southwark Foundry & Machine Company, Philadelphia, Pa., has recently brought out a hydraulic scrap crushing and shearing machine, which should prove of great value to boiler shops, scrap yards, steel mills and other industries, where a large amount of scrap metal, especially of a cylindrical shape, must be flattened and cut for shipping or for re-melting.

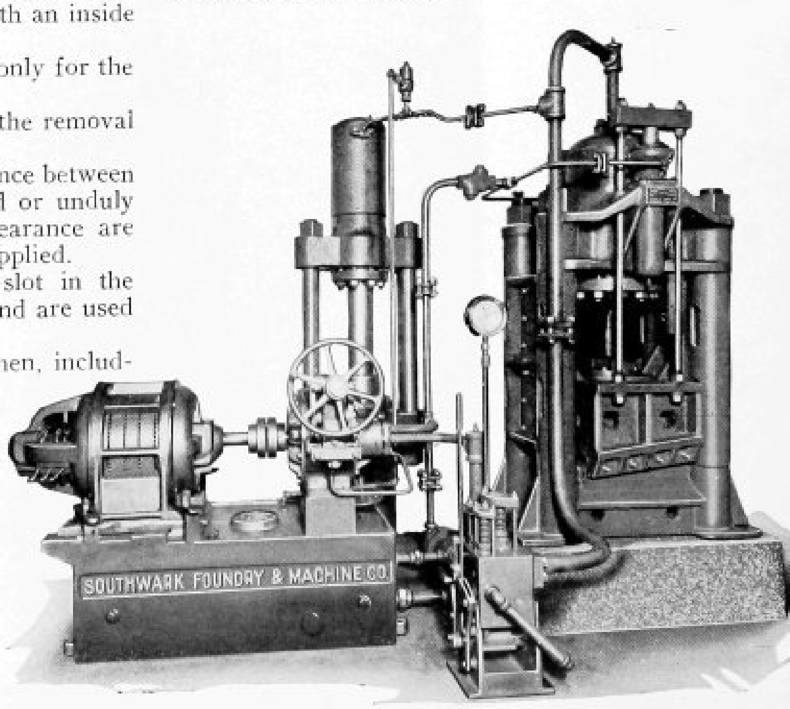
The machine is of the four-column type, the columns being surrounded by heavy cast-iron sides, which form guides for the heavy crosshead, which is attached to the hydraulic ram. The crushing surface on the lower table and on the crosshead is provided with hard steel plates to take care of the wear. These plates can be easily renewed should they become excessively worn. At the far edge of the crosshead a pair of shear knives is attached.

Handling Irregular Shapes

Irregular shapes such as pipe, flues or rolled sections are first put under the press and crushed or flattened. At the second stroke the crushed material is pushed forward and the crushed section will be sheared off at the same time that the remaining section is being crushed. Thus the crushing and shearing take place at the same time.

The machine is operated by an electrically-driven rotary pump which furnishes low pressure to an hydraulic intensifier. This intensifier has sufficient capacity to furnish high pressure to give the maximum capacity of the machine.

As oil is used in the hydraulic system instead of water, the shear can be installed in open spaces without any danger of freezing.



Hydro-electric crushing and shearing machine

Cause and Prevention of Internal Corrosion of Boilers*

By William D. Halsey†

A study of the fundamental forms of corrosion which commonly occur in both power and locomotive type boilers

THE subject of corrosion has, for years, been one of careful study by many investigators. Numerous theories have been advanced as to the cause, and all of them have seemed to fit some particular condition under investigation. However, until the electro-chemical theory was brought forward, there was no theory which adequately explained all cases. The electro-chemical theory was first advanced in 1903 and is now quite generally accepted as the real explanation of corrosion.

Most of us have observed, at one time or another, that a piece of iron in a solution of copper sulphate soon becomes coated with copper. This is because the iron goes into solution—dissolves, as a matter of fact—and in so doing makes room for itself by forcing the copper out of solution.

Iron has exactly this same action with hydrogen in solution. In other words, when free hydrogen exists in water, the iron in contact with such water goes into solution and forces the hydrogen to plate out, just as copper is plated out of the copper sulphate bath. However, as hydrogen accumulates on the iron the rate at which iron dissolves slows up. When the point is reached where the whole surface of the iron is coated with hydrogen the action stops altogether. It is in this connection that the presence of free oxygen or carbon dioxide gas in the water plays an important part in corrosion, for these gases have a notable liking for hydrogen and will combine with it at every opportunity. Thus when there is free oxygen or carbon dioxide in boiler water they quickly strip the protective layer of gaseous hydrogen from the surface of the iron and encourage further interchange of iron and hydrogen. This action will continue until all free oxygen is used up.

Fig. 1

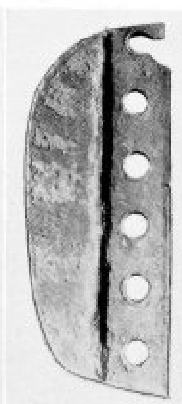


Fig. 2

As an understanding of this phenomenon requires that the reader know, at least in a general way, just what is meant by atoms, molecules, and ions, a short explanation at this point may not be amiss.

The various fundamental substances with which we deal in the realm of physics and chemistry are known as elements. Included among them are the metals and the various gases such as oxygen, hydrogen, nitrogen and many others. The smallest division of one of these elements is called an atom and it is a bit of matter so tiny that it cannot be seen even under the most powerful microscope. In fact, it has been said that if a drop of water were magnified to the size of the earth the atoms would appear to be about the size of oranges.

When two elements combine, such as in the union of hydrogen and oxygen to form water, atoms of the two elements form themselves into what is known as a molecule of the new substance. An ion, the third of this trio of infinitesimal portions, is nothing more than an atom or a group of atoms carrying a charge of electricity. This electricity may be either positive or negative.

Hydrogen ions—electrically charged atoms of hydrogen—may exist in water without being combined with the water. They always carry a positive charge of electricity. When iron goes into solution it does so as ions of iron, which also carry a positive charge. Just why iron is able to force hydrogen out of solution is explained by the fact that some elements seem to be stronger than others in maintaining themselves in solution. Listed in the order of their ability to replace others in solution, some of the more prominent elements are: cadmium, zinc, iron, nickel, lead, tin, hydrogen, copper, silver, gold. Any of these elements will replace, or have a tendency to replace the elements which stand lower on the list, if one of those elements is in solution. It will be noted that iron stands higher in the list than hydrogen.

As the hydrogen ions plate out on the iron they set up what may be looked upon as a back pressure resisting the effort of any more hydrogen to plate out. Since it is necessary for a hydrogen ion to come out of solution in order that an iron ion go in, this action eventually results in no more iron dissolving. Unfortunately, when free oxygen is present in the water this protective coating does not last long, for the oxygen promptly combines with the hydrogen to form water, thus allowing the action to recommence. From this fact it is

* Published through the courtesy of *The Locomotive*.
† Mechanical engineer, Hartford Steam Boiler Inspection and Insurance Company, Hartford, Conn.

apparent that although the inherent tendency of iron to go into solution is the cause of corrosion, the presence of free oxygen in the water is a controlling factor.

Carbon dioxide acts in a somewhat different manner but, nevertheless, has the ability to remove the hydrogen, thereby permitting more iron to dissolve.

The action of iron going into solution and hydrogen coming out may be very well demonstrated by what is known as the ferroxyl test. This consists of a solution of ferro-cyanide of potassium and phenolpthalein. Ferrocyanide of potassium in the presence of iron will show a blue color and phenolphthalein in the presence of hydrogen will show a pink color. If a piece of iron, such as a common wire nail, be placed in some gelatin containing the proper proportions of these chemicals or "indicators," as they are called, it will be found that certain parts of the nail will be surrounded by a blue color and other parts by a pink color. Where the blue appears the iron is being dissolved; the hydrogen it replaces is located in the pink area.

The total corrosion which takes place is dependent on the amount of oxygen or carbon dioxide that can reach the total area covered by hydrogen. If the iron actually exposed to the water is large in area we will have general corrosion. Fig. 1 is an example. However, if a small area of iron is exposed the total weight of iron which will go into solution will be the same as for a larger area of iron, but the loss will necessarily appear great and will show as a deep pit. This condition, wherein a small area is exposed to the water, may be brought about by mill scale adhering to the metal and thus protecting it against the solution, or by adherent scale from the water through which there is a crack. Under such a crack corrosion may occur in the form of deep pitting. Furthermore, as the iron oxide forms around the mouth of the pit local electrolytic action between the iron itself and the oxide takes place, and this further accelerates the pitting. Other conditions such as segregation of the foreign elements in steel plates or gas inclusion may also give rise to local corrosion. Where there are dissimilar metals in contact as, for instance, brass fusible plugs or other brass fittings actually in contact with the boiler shell, opportunity is given for electrolytic action between the two metals.

It is also true that where iron is highly stressed and is in direct contact with other iron which is not so highly stressed there is a greater tendency on the part of the iron under the higher stress to go into solution. The experiment of the iron nail in gelatin with the two indicators, to which reference has already been made, will very frequently show a blue color at the head and point with the pink color along the body of the nail. This is an excellent illustration of the greater tendency of the higher stressed metal (for the forming of the head and point caused high stresses in those parts) to go into solution. Furthermore, this action accounts for the grooving frequently encountered in the turn of the flange of a boiler head or along a long riveted seam. Fig. 2 shows a case of this kind.

There are many factors in the corrosion of iron which space will not permit taking up in an article as brief as this one. However, the action described herein covers in a general way the fundamental principle and allows us to turn now to a discussion of the steps which can be taken to prevent corrosion.

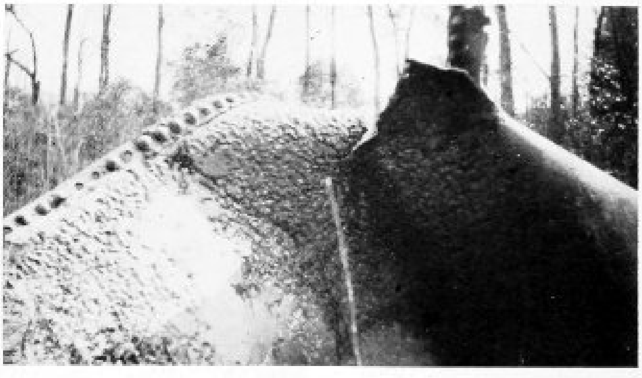
Since the presence of oxygen or carbon dioxide in the water is the factor which determines the amount of corrosion, it follows that the best preventive step is the removal of these gases. In the smaller plants an open heater, well vented, is successful in reducing their amount to what is usually considered a harmless quantity. In larger installations deaerators or deactivators are used in an endeavor to further reduce the oxygen content and the water is treated to remove the carbon dioxide. A deaerator is a vessel or system of vessels which drives the air out by the application of heat and vacuum. A deactivator is a vessel in which the water is permitted to act on iron, thus expending its oxygen.

Whenever a persistent case of corrosion is encountered the services of a competent feed water specialist should be obtained before proceeding with the installation of equipment to overcome the trouble. In some cases involved treatment may be necessary; in others the remedy may be quite simple.

Corroded Boiler Explodes

NOT long ago news was received of a disastrous boiler explosion which very evidently was caused by excessive internal corrosion of the shell. Six persons were killed and five others, including a little girl who was playing in the yard of her home some distance away, were badly injured.

Built about 1890, the horizontal tubular boiler which exploded had been in service at two other locations before it was set up at a saw-mill in a southern state. Although it was designed for a working pressure of but 90 pounds, it was used at 105 pounds with the safety valve set to blow ten pounds above that. On the day before the explosion leakage developed through the solid plate in the middle of the rear course and it was found that corrosion had eaten entirely through the shell in five different spots.



Ruptured boiler sheet

A local mechanic was employed to check the leakage, which he did by drilling through the plate at the holes and inserting ⅜-inch machine bolts with lead washers inside and nuts outside the boiler shell.

The boiler was fired up next morning, and a moment after the safety valve popped the boiler ruptured from end to end through the bottom of all three courses. At the same time the courses were separated at the girth seams, the solid plate tearing circumferentially parallel to the seams rather than through the rivet holes. A part of the boiler was blown a distance of 225 yards, landing within a few feet of the owner's residence. Another large piece, consisting of most of the front head, was hurled over the mill and a railroad siding, coming to rest 190 yards from the point where it started. Four persons were killed outright; two others died in the hospital. Property damage alone was approximately $10,000.

The owner carried no boiler insurance, so it is not probable that the boiler was examined by a competent inspector when it was brought to the sawmill and set up. An inspector would surely have noted the dangerous extent to which the shell had deteriorated, for even in the illustration it can readily be seen that corrosion and pitting had eaten down the metal alarmingly.—*The Locomotive.*

Program of Twentieth Master Boiler Makers' Convention

BELOW is published the official program of the twentieth annual convention of the Master Boiler Makers' Association which will be held at the Hotel Biltmore, Atlanta, Ga., May 21 to 24.

First Day

Tuesday, May 21, 1929

REGISTRATION OF MEMBERS AND GUESTS

8 A. M.

In order to participate in entertainments badges will be required. None will be issued unless your dues are paid and you are properly registered. No deviations from this rule.

BUSINESS SESSION

Convention called to order .... 10.00 A.M.
Singing America
Invocation:
Rev. W. E. Davis, Pastor, Central Presbyterian Church, Atlanta, Ga.
Addresses:
Hon. L. G. Hardman, Governor of Georgia.
Hon. I. N. Ragsdale, Mayor, Atlanta, Ga.
Responses:
To the Governor and the Mayor
MR. L. M. STEWART, President,
Introducing Mr. Fred Houser, Executive Secretary, Atlanta Convention and Tourist Bureau, Atlanta, Ga.
Introducing Mr. William C. Royer, Vice-President and Associate Manager, Atlanta Biltmore Hotel, Atlanta Ga.
Address:
Mr. A. E. Clift, President, Central of Georgia Railroad.
Response:
MR. GEORGE B. USHERWOOD, First Vice-President
Annual Address:
L. M. Stewart, President of the Association
Song:
Southern Melody.
Routine Business:
Annual Report of the Secretary, Harry D. Vought.
Annual Report of the Treasurer, W. H. Laughridge.
Miscellaneous Business:
New Business.
Appointment of special committees to serve during Convention.
Resolutions.
Memorials.

AFTERNOON SESSION

Convention called to order .... 2.30 P.M.
COMMITTEE REPORTS ON TOPICAL SUBJECTS:
No. 1. "RECOMMENDED PRACTICE AND STANDARDS: FUSION WELDING AS APPLIED TO STEAM PRESSURE BOILERS." Committee: J. A. Doarnberger, Chairman; H. H. Service, L. M. Stewart, J. F. Raps, J. J. Mansfield .... 2.30 to 3.00 P.M.
No. 2. "BOILER CORROSION AND PITTING AND WHAT CAN BE DONE IN THE BOILER DEPARTMENT TO RELIEVE THE CONDITION." Committee: Franklin T. Litz, Chairman; C. E. Stephenson, B. C. King. (NO REPORT SUBMITTED BY COMMITTEE).

AFTERNOON SESSION CONTINUED

SPECIAL REPORT PREPARED ON THIS SUBJECT BY MR. Albert F. Stiglmeier, Chairman Executive Board .... 3.00 to 4.00 P.M.
Invitations to discuss this subject have been extended to representative Water Service Engineers, those accepting being as follows:
Dr. C. H. Koyl, C. M. & St. P. R. R.
Mr. R. C. Bardwell, C. & O. R. R.
Mr. R. E. Coughlan, C. & N. W. R. R.
Mr. Frank N. Speller, National Tube Company
Mr. W. B. Pierce, Southern Ry. System
Mr. J. C. Ramage, (Engineer Tests) Southern Ry. System
Mr. W. B. McCaleb, Pennsylvania R. R.
Mr. W. L. Curtiss, New York Central Lines
Mr. O. W. Carrick, Wabash R. R.

EVENING

President's Night ....8.00 P.M.
Entertainment and Dance.

Second Day

Wednesday, May 22, 1929

Convention called to order .... 9.00 A.M.
Address:
F. S. Robbins, S. M. P. and Machinery, Florida East Coast Ry., St. Augustine, Florida.
Unfinished Business:
COMMITTEE REPORTS ON TOPICAL SUBJECTS:
No. 3. "WHAT ARE THE BEST METHODS FOR APPLICATION, MAINTENANCE AND GENERAL REPAIRS OF FIREBOX SYPHONS ON LOCOMOTIVE BOILERS?" Committee: C. F. Petzinger, Chairman: W. C. Becker, J. P. Powers. . 10.00 to 10.45 A.M.
No. 4. "WHAT IS THE BEST KNOWN PRACTICE FOR FINDING WATER LEVELS ON LOCOMOTIVES, WHEN APPLYING BOILERS TO FRAME OR WHEN NEW BACK HEADS ARE APPLIED?" Committee: Leonard C. Ruber, Chairman: P. J. Conrath, L. E. Hart .... 10.45 to 11.15 A.M.
No. 5. "WHAT CAN BE DONE TO STANDARDIZE THE DESIGN OF BEADING TOOLS, FLUE ROLLERS, EXPANDERS, TAPS, REAMERS, SIZES OF PNEUMATIC HAMMERS AND MOTORS FOR THE DIFFERENT CLASSES OF WORK, SPRING BARS, VISA, SOLID BARS AND WEIGHTS FOR HOLDING STAYBOLTS, ETC., USED IN BOILER CONSTRUCTION AND REPAIRS AND WOULD THE RESULTS OF SUCH STANDARDIZATION BE BENEFICIAL?" Committee: William N. Moore, Chairman; James A. Graulty, Ira J. Pool .... 11.15 to 12.00 M.
Announcements.
Recess.

AFTERNOON

Southern Barbecue and Outing.

EVENING

Informal Dance .... 9.00 to 12.00 P.M.

Third Day

Thursday, May 23, 1929

Convention called to order .... 9.00 A.M.
Address:
O. A. Garber, Chief Mechanical Officer, M. P. R. R., St. Louis, Mo.

Response:

Franklin T. Litz, Third Vice-President.

Committee Reports on Topical Subjects:

No. 6. "Does High Pressure, Long Runs and Stoker Firing Increase or Decrease the Life of the Firebox or Boiler and How Does It Affect Operating Costs of Locomotive?" Committee: Kearn E. Fogerty, Chairman; George Austin, T. W. Usherwood .... 10.00 to 10.30 A.M.

No. 7. "How Much, if any, Benefit is Derived From the Use of Steel Staybolts Instead of Iron and Hollow Staybolts Instead of Solid; Both Flexible and Rigid in Locomotive Boilers?" Committee: Walter R. Hedeman, Chairman; R. A. Pearson, Lewis Nicholas. .... 10.30 to 11.30 A.M.

No. 8. "Have Cold Drawn Flues and Cold Flanged Firebox Plates an Advantage in Service as Compared To Hot Drawn Flues and Hot Flanged Plates? What Benefit, If Any, is Derived From Annealing or Heat Treating Firebox Sheets Prior to Application?" Committee: O. H. Kurlfinke, Chairman; H. V. Stevens, George L. Young .... 11.30 to 12.00 M.

Special Afternoon Session

Guests

Officers and members of The Southern and Southwestern Railway Club.

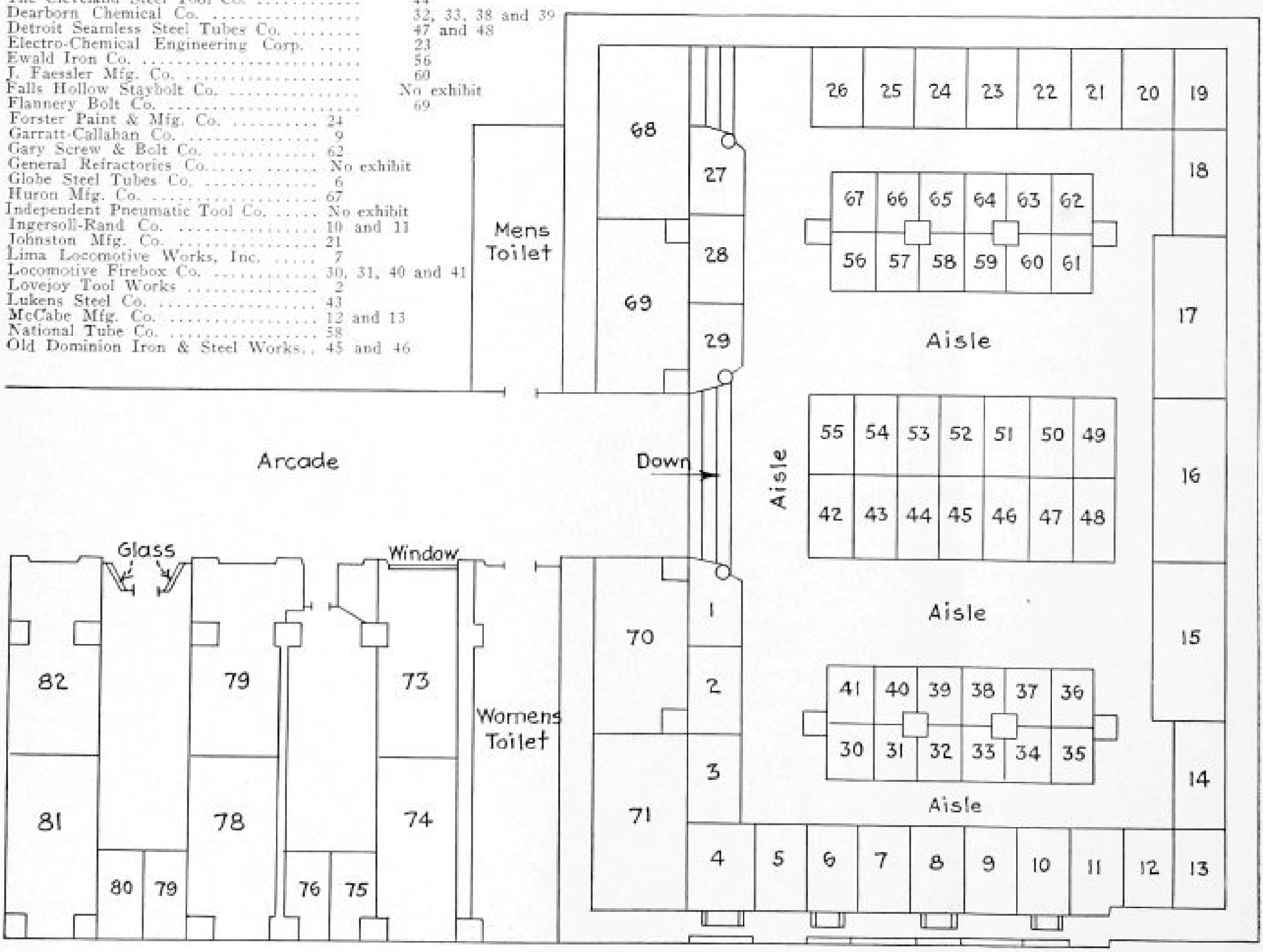
President Stewart welcomes guests.

Introducing President of Club: Mr. F. P. Howell, S. M. P., Atlantic Coast Line, Waycross, Ga.

Introducing A. J. Law, Past President of the Club, M. M., Nashville, Chattanooga & St. Louis Ry., Chattanooga, Tenn.

Exhibitors at Master Boiler Makers' Convention

Name	Booth No.
Air Reduction Sales Co.	16 and 17
American Arch Co., Inc.	25
American Locomotive Co.	28 and 29
Arrow Tools, Inc.	22
Bethlehem Steel Co.	61
The Bird-Archer Co.	15
The Boiler Maker	53
The Bourne-Fuller Co.	20
W. L. Brubaker & Bros. Co.	51 and 52
The Burden Iron Co.	5
A. M. Castle & Co.	42
Central Alloy Steel Co.	71
The Champion Rivet Co.	54
Chicago Eye Shield Co.	55
Chicago Pneumatic Tool Co.	57
The Cleveland Pneumatic Tool Co.	8
The Cleveland Steel Tool Co.	44
Dearborn Chemical Co.	32, 33, 38 and 39
Detroit Seamless Steel Tubes Co.	47 and 48
Electro-Chemical Engineering Corp.	23
Ewald Iron Co.	56
J. Faessler Mfg. Co.	60
Falls Hollow Staybolt Co.	No exhibit
Flannery Bolt Co.	69
Forster Paint & Mfg. Co.	24
Garratt-Callahan Co.	9
Gary Screw & Bolt Co.	62
General Refractories Co.	No exhibit
Globe Steel Tubes Co.	6
Huron Mfg. Co.	67
Independent Pneumatic Tool Co.	No exhibit
Ingersoll-Rand Co.	10 and 11
Johnston Mfg. Co.	21
Lima Locomotive Works, Inc.	7
Locomotive Firebox Co.	30, 31, 40 and 41
Lovejoy Tool Works	2
Lukens Steel Co.	43
McCabe Mfg. Co.	12 and 13
National Tube Co.	58
Old Dominion Iron & Steel Works	45 and 46
The Otis Steel Co.	59
The Oxweld Railroad Service Co.	68
The Paulson Tools, Inc.	37
Penn Iron & Steel Co.	35
Pittsburgh Steel Products Co.	4
Pratt & Whitney Co.	14
The Prime Mfg. Co.	36
The Railroad Herald	50
Reading Iron Co.	27
John A. Roebling's Sons Co.	18 and 19
Rome Iron Mills, Inc.	No exhibit
Joseph T. Ryerson & Son, Inc.	34
The Superheater Co.	No exhibit
Torchweld Equipment Co.	49
Ulster Iron Works	26



Response:
HARRY D. VOUGHT, Secretary of the Association
Address:
L. R. Powell, Jr., President, Seaboard Air Line, Norfolk, Va.
Response:
MR. KEARN E. FOGERTY, Second Vice-President
Address:
Mr. Alonzo, G. Pack, Chief Inspector Locomotive Boilers, Interstate Commerce Commission, Washington, D. C.
Response:
MR. ALBERT F. STIGLMEIR, Chairman Executive Board.
Film Picture and Lecture:
"FAILURE OF STEEL BOILER PLATES, ITS CAUSES AND SUGGESTED REMEDIES," Presented by Mr. H. L. Miller, Metallurgist, Central Alloy Steel Corporation, Massillon, O.
Response:
MR. IRA J. POOL, Fifth Vice-President.
Announcements.
Recess.

EVENING

Banquet Hotel Terrace .... 7.30 P.M.
Dancing .... 9.30 to 12.30 P.M.

Fourth Day

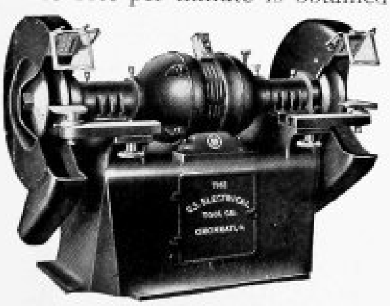
Friday, May 24, 1929

Convention called to order .... 9.00 A.M.
Address:
To Come
Response:
MR. W. H. LAUGHRIDGE, Treasurer.
COMMITTEE REPORTS ON TOPICAL SUBJECTS:
No. 9. LAW: Committee: W. J. Murphy, Chairman, E. W. Young, T. F. Powers ....10.00 to 10.15 A.M.
No. 10. TOPICS 1930 CONVENTION: Committee, C. P. Patrick, Chairman, Charles J. Longacre, R. W. Clark ....10.15 to 10.45 A.M.
Good of the Association ....10.45 to 11.00 A.M.
Unfinished Business:
Report of Executive Committee....11.00 to 11.15 A.M.
Report of Committees on Resolutions East and West ....11.15 to 11.30 A.M.
Memorials ....11.30 to 11.40 A.M.
President's Address ....11.40 to 11.50 A.M.
Election of Officers ....11.50 A.M.
Adjournment.

High-Speed Grinding Machine

A NEW machine especially designed and built for high-speed grinding and snagging has been developed by the United States Electric Tool Company, Cincinnati, O.

A speed of 9500 surface feet per minute is obtained on this machine with wheels 30 inches in diameter, having a 2½ or 3-inch face, an 18-inch hole, and operating on 40 or 60-cycle electric current. This machine is furnished for 220, 440, 550 volts 2 or 3-phase alternating current, and 220 volts direct current. The motor is rated at 15 horsepower and is designed for heavy duty grinding service. It is rated for continuous service at full horsepower with a temperature rise of 40 degrees, and with a momentary overload capacity of more than 100 percent.



High-speed grinding and snagging machine manufactured by the United States Electrical Tool Company

This U. S. Hispeed grinder is built to the American Engineering Standard code of safety. Structural-steel safety hoods over the wheels are built for wheel speeds of 10,000 surface feet per minute, and the doors on the safety hoods are also fastened on by cap screws.

Electrode Holder for Metallic Arc Welding

AN improved type of electrode holder for metallic arc welding, designed for greater operator convenience, has been announced by The Lincoln Electric Company, Cleveland, O. The holder consists essentially of a powerful clamp to hold the welding electrode firmly while welding and with an easy release feature which permits changing electrodes quickly.

The handle grip is designed for easy holding and it is claimed that the holder operates exceptionally cool,


Type T, Lincoln metal electrode holder

because the welding current is carried from the point of cable entry to the copper jaws by copper strips of low resistance. In the older types of holders, the high amperage welding current was carried through the steel frame of the holder itself and uncomfortable heating frequently resulted under continuous service.

The copper tips on the jaws reduce the sticking of the electrode to the jaws resulting in faster and easier change of electrodes and longer life for the holder. The shape of the holding clamps has been altered to give greater compactness to permit work in close corners. All metallic parts of this holder are coated with non-tarnishing cadmium plating. The holder is known as the improved type T electrode holder.

Insurance Against Gas Explosions in Boiler Furnaces

IN response to an imperative demand for insurance against gas explosions in the furnaces of steam and hot water boilers, the Hartford Steam Boiler Inspection & Insurance Company, Hartford, Conn., is now prepared to write insurance covering direct damage, other than resulting fire loss, caused by an explosion in the furnace of a boiler, or in the tubes, flues, or the passages used for conducting gases from the furnace to the chimney. The present policy issued does not provide this coverage.

This company feels that it is consistent with its policy of being pioneers and specialists in the steam boiler insurance field in writing this new insurance, and that in so doing, it is filling a long felt need. The details of the new provisions are included in a folder being sent out by the company.

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Method of Laying Out and Developing a Gas Inlet

Q.—I am sending the drawing of a gas inlet. Please explain the method of layout and the development of each section. R. O. W.

A.—To develop the gas inlet, as shown in Fig. 1, complete the plan and project the end view in a manner as indicated. One-half of the plan is symmetrical about the line *P-Q* and the projected end view is symmetrical about line *M-N*. A development of one-half of the plan as shown would therefore represent one-half of the completed pattern.

To complete this development by triangulation, divide the semi circle *M-R-N* of the end view into any number of equal parts, as twelve in this case, and number the same from *1* to *13* as shown. The greater the number of parts taken, the more accurate the development of the pattern. Project the points *1* to *13* of the end view to the elevation, cutting the line *C-B*; number these points along the line *C-B*, *1* to *13*.

Divide the line *S-T* of the end view into six equal parts, or one-half as many parts as the semi circle *M-R-N* was divided. The line *T-W* should be divided into the same number of equal parts as the line *S-T*. The total number of equal parts taken on the lines *T-S* and *T-W* should equal the total number of parts taken on *M-R-N*. Number the equal parts taken on the line *S-T* from *1'* to *7'* and the parts taken on the line *T-N* from *7'* to *13'*. Then project the points *1'* to *13'* of the end view to the elevation cutting the line *D-F-A*, numbering these points along the line *D-F-A* *1'* to *13'*.

In the next step, preparatory to obtaining the lines of the pattern, it will be necessary to construct a series of right angle triangles in order to obtain the true lengths of the surface lines of the object.

To construct the right angle triangles as shown in Fig. 3, draw a line *G-H* and at *G* erect a perpendicular. Then take dividers and using *G* as a center and the vertical distance between the line *C-B* and the point *1'* in the elevation as a radius, scribe an arc cutting the perpendicular at *J*. Then taking the distance *1-1'* in the end view as a radius and the point *G* as a center, scribe an arc cutting the line *G-H* at *K*. Connect *J* and *K* and this distance will be the true length of the line *1-1'*.

Next erect another perpendicular to the line *G-H* at the point *2'* and set the dividers equal to the vertical distance between the line *C-B* and the point *2'*. With this distance as a radius and with the point *2'* as a center scribe an arc cutting this perpendicular at the point *2"*. This distance *2'-2"* is then the common altitude of the triangles constructed to obtain the surface line *1-2'* and *2-2'* of the end view. With the dividers set equal to the distance *1-2'* of the end view and with *2'* as a center, scribe an arc cutting the horizontal line *G-H* at *1*. Connect *1-2"* and this line equals the true length of the line *1-2'* in the end view. With the dividers set equal to the distance *2-2'* of the end view and with *2'* as a center, scribe an arc cutting the horizontal line *G-H* at *2*. The distance *2-2"* equals the true length of the line *2-2'* in the end view.

Complete the series of triangles using the vertical distance from the line *C-B* to the points *3'*, *4'*, *5'*, *6'*, *7'*, *8'*, *9'*, *10'*, *11'*, *12'* and *13'* as the altitudes and the corresponding distances *2-3'*, *3'-3*, *3-4'*, *4'-4*, etc. of the end view as bases; complete the series of right angle triangles in Fig. 3 and Fig. 4. The hypotenuse obtained in Fig. 3 will be the true lengths of the surface lines from the line *1-1'* to the line *7-7'* of the end view, and the hypotenuses obtained in Fig. 4 will be the true lengths of the surface lines from the line *7-7'* to the line *13-13'* of the end view.

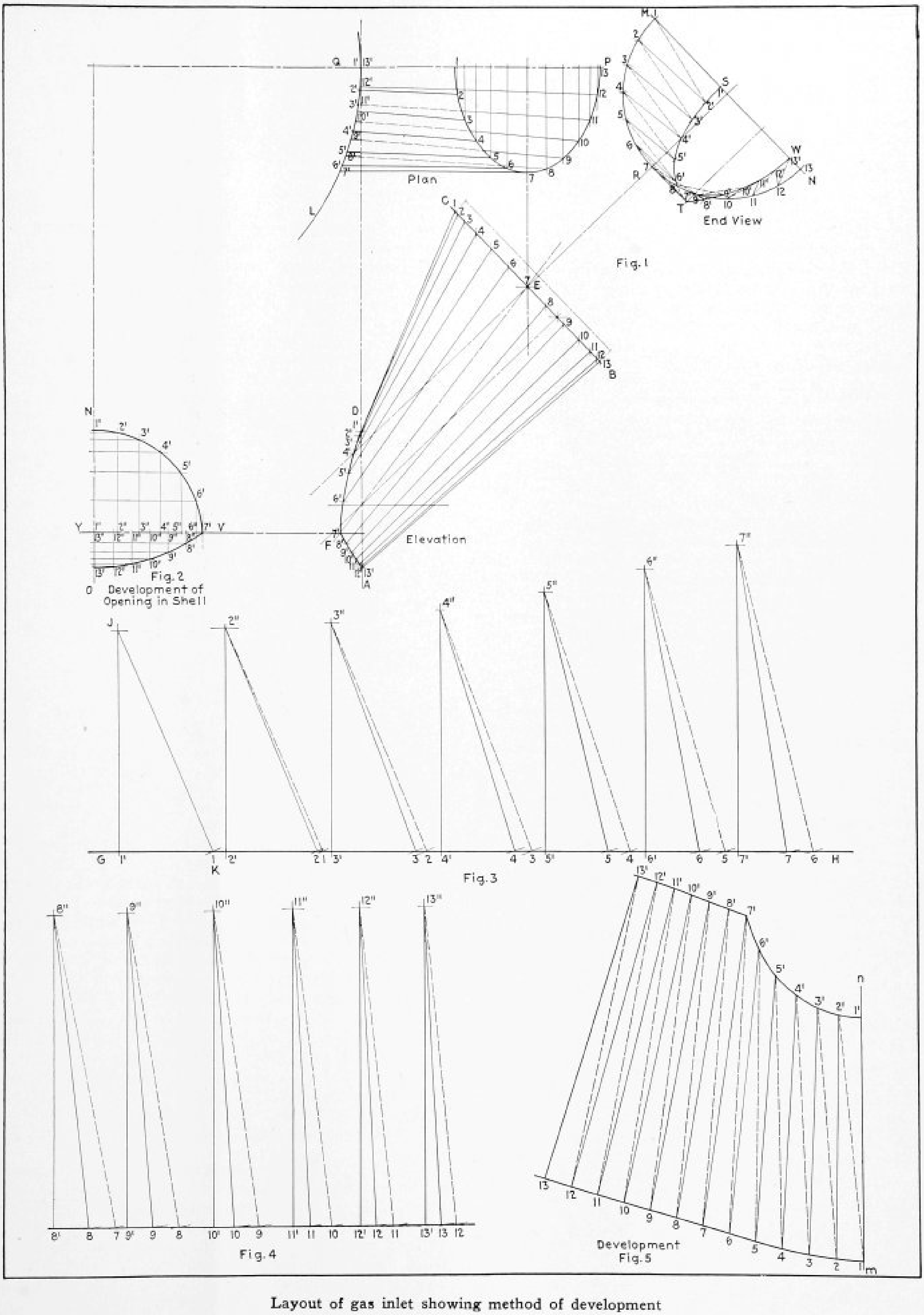
The next step before making the development is to obtain the true lengths of the lines *S-T* and *T-W* by making the development of the opening in the shell, Fig. 2. Erect *F-Y*, a perpendicular to the line *A-Q* through the point *F*. Parallel to the line *F-Y* draw lines through the points *1'* to *13'* of the elevation, extending same through the line *O-Z*, Fig. 2. On the line *V-Y*, Fig. 2, step off the distances *1"-2"*, *2"-3"*, *3"-4"*, *to 12"-13"* as shown equal to the *1'-2'*, *2'-3'*, *3'-4'*, to *12'-13'* of the plan, same to be measured along the arc *Q-L*. At the points *1"*, *2"*, *3"*, *4"* *5"* and *6"* erect perpendiculars to line *V-Y*, cutting the parallel lines locating the points *1'*, *2'*, *3'*, *4'*, etc. At the points *8"*, *9"*, *10"* *11"*, *12"* and *13"* erect perpendiculars to the line *V-Y* cutting the parallel lines locating the points *8'*, *9'*, *10'*, *11'*, *12'*, and *13'*. Draw a line through these points completing the development.

Constructing the Pattern

To construct the pattern, first set a pair of dividers equal to the spaces *1-2*, *2-3*, and *3-4* taken on the line *M-R-N* of the end view.

Begin by drawing the line *m-n*, Fig. 5, and with the trams set equal to *J-K*, Fig. 3, and with *1* as a center, scribe an arc cutting the line *m-n* setting off the distance *1-1'*. Then with the dividers set equal to the distance *1'-2'*, Fig. 2, and with *1'* as a center scribe an arc. Then with the trams set equal to the distance *1-2"*, Fig. 3, and with *1* as a center scribe an arc cutting the arc first made locating the point *2'*.

With the dividers that already have been set equal to the equal spaces on the line *M-R-N* of the end view



Layout of gas inlet showing method of development and with *1'* as a center, scribe an arc, and with the trams set equal to the distance *2-2'*, Fig. 3, and with the point *2'* as a center, scribe an arc cutting the arc first made locating the point *2*. Continue in this manner until the line *7-7'* is completed, using all the hypotenuses of Fig. 3. Then proceed by taking the hypotenuses from Fig. 4, keeping in mind that in all cases the small arcs *2'-3' 3'-4'*, *4'-5'*, etc. are equal to their corresponding spaces in Fig. 2, and that the arcs *2-3*, *3-4*, *4-5*, etc. are equal to the equal spaces on *M-R-N* of the end view, thus completing the development.

The gas inlet submitted was made in four pieces. By taking the development and cutting same along the line *7-7'* we would then have two parts as *1-1'* to *7'-7* and *7-7'* to *13'-13*. By adding to each edge the amount required for the seams, and along the edge *1-7* and *7'-13*, adding the straight lap and making two of each piece, the gas inlet would be completed.

Welding in Locomotive Boilers

Q.—The December, 1928, number of THE BOILER MAKER had a description of the boiler on engine 5000 of the Northern Pacific Railroad. The syphons were welded to the crown sheet; the flue and door-sheet flanges were welded between the first and second row of staybolts and crown stays and the calking edges of riveted seams on the barrel of the boiler were welded. All of these should be a violation of I. C. C. rules. Have the rules on welding on crown sheets been changed, or the barrel of the boiler? N. T.

A.—The Rules of the Interstate Commerce Commission Bureau of Locomotive Inspection as Amended March 4, 1915 and June 7, 1924, insofar as I can find do not include any rules with reference to the welding of locomotive boilers.

The Bureau of Locomotive Inspection has from time to time issued recommendations for welding practices for the railroads to follow. These recommendations are being strictly adhered to by many of the railroads, while other railroads have taken a more liberal interpretation of them.

In the particular case as outlined in the question, the welding in the firebox in all cases is located between two rows of staybolts and the longitudinal seam is located more than 15 inches below the highest point of the crown. The strength of the structure is therefore not dependent upon the strength of the weld to the slightest extent.

The welding of the outside butt straps of the longitudinal seams for a distance of 12 inches to 18 inches, which is no doubt for tightness, does not necessarily violate any of the recommendations, although I do not believe it is good practice to subject the shell courses to welding.

Sec. 2 of the Locomotive Inspection Law is as follows:

"That it shall be unlawful for any carrier to use or permit to be used on its line any locomotive unless said locomotive, its boiler, tender, and all parts and appurtenances thereof are in proper condition and safe to operate in the service to which the same are put, that the same may be employed in the active service of such carrier without unnecessary peril to life or limb, and unless said locomotive, its boiler, tender and all parts and appurtenances thereof have been inspected from time to time in accordance with the provisions of this Act and are able to withstand such test or tests as may be prescribed in the rules and regulations hereinafter provided for."

This section places the responsibility for the failure of any boiler due to unsafe welding or any other unsafe practice directly to the railroad operating same.

But until such time as a definite rule for welding is incorporated into the I. C. C. Rules and Regulations, there will be to some extent a variation in the welding practices of the various railroads.

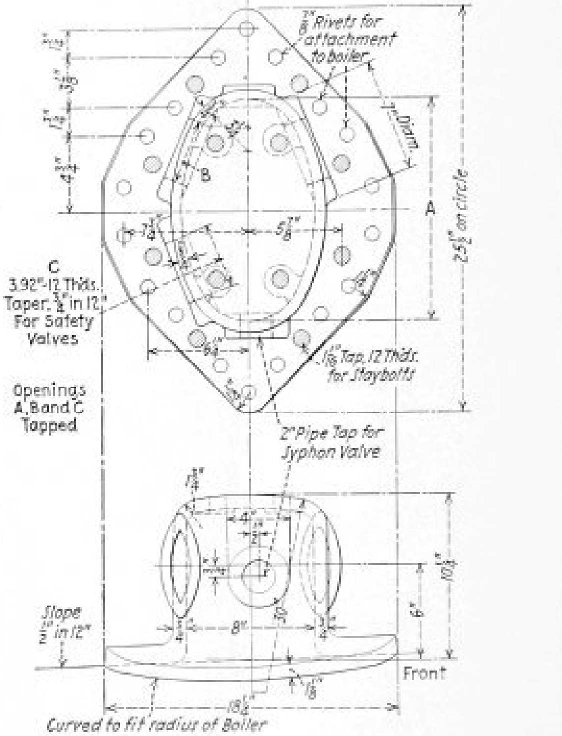
Locomotive Turret Construction

Q.—Please explain the construction and use of the turret shown.
For what purpose are the 18 holes for ⅞-inch rivets?
What is the purpose of the 12 holes marked $1\frac{1}{16}$-inch—12 thread?
Why are three safety valves used?
What is used for connection between the safety valve and the turret?
What is the "syphon" valve—marked 2-inch pipe tap? R. C. A.

A.—The design of safety valve turret as shown in the illustration is generally used on locomotive boilers, where it is necessary, because of vertical clearance, to set the safety valves in a horizontal position instead of the customary vertical position.

The 18 holes for ⅞-inch rivets are used for fitting rivets to secure the turret to the boiler. The number used is governed by the following:

The strength of the rivets in shear on each side of a frame or ring reinforcing manholes or other openings



Turret for locomotive boiler having horizontal safety valves

such as those cut for steel nozzles and boiler flanges over 3-inch pipe size, shall be at least equal to the tensile strength of the maximum amount of shell plate removed by the opening and rivet holes for the reinforcement on any line parallel to the longitudinal axis of the shell, through the manhole or other opening.

The 12 holes marked $1\frac{1}{16}$ inches—12 threads are for the staybolts supporting the crown sheet as this turret is evidently located on the top of the firebox. By applying the staybolts in this manner they are not covered by the turret and are more accessible for inspection and renewing.

It is customary to use a brass bushing or extension for connecting the safety valves to the turret of the boiler.

The "syphon valve" is generally a globe valve secured to the turret with a short nipple. It has various uses, some of the most common being: A connection for an extra steam gage when setting or testing the safety valves; a means of releasing the air from the boiler when filling same for a hydrostatic test. This valve is also used for blowing down and filling the boiler in case of minor repairs at the round house.

Associations

Bureau of Locomotive Inspection of the Interstate Commerce Commission

Chief Inspector—A. G. Pack, Washington, D. C.

Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

Steamboat Inspection Service of the Department of Commerce

Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—Fred R. Low.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 W. 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—C. D. Thomas, Salem, Oregon.

Secretary-Treasurer—C. O. Myers, Commercial National Bank Building, Columbus, Ohio.

Vice-Chairman—William H. Furman, Albany, N. Y.

Statistician—L. C. Peal, Nashville, Tenn.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

International President—J. A. Franklin, suite 522, Brotherhood Block, Kansas City, Kansas.

Assistant International President—William Atkinson, suite 522, Brotherhood Block, Kansas City, Kansas.

International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.

Editor-Manager of Journal—John J. Barry, suite 524, Brotherhood Block, Kansas City, Kansas.

International Vice-Presidents—John J. Dowd, 142 Pearsall Ave., Jersey City, N. J.; M. A. Maher, 2001 20th St., Portsmouth, O.; R. C. McCutchan, 226 Lipton St., Winnipeg, Man., Canada; H. J. Norton, Alcazar Hotel, San Francisco, Cal.; C. A. McDonald, Box B93, Route 2, Independence, Mo.; J. N. Davis, 1211 Gallatin St., N. W., Washington, D. C.; M. F. Glenn, 1434 E. 93rd St., Cleveland, O.; W. J. Coyle, 424 Third Ave., Verdun, Montreal, Canada; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; J. F. Schmitt, 25 Crestview Rd., Columbus, O.

Master Boiler Makers' Association

President—L. M. Stewart, general boiler inspector Atlantic Coast Line, Waycross, Ga.

First Vice-President—George B. Usherwood, supervisor of boilers, New York Central Railroad, Syracuse, N. Y.

Second Vice-President—Kearn E. Fogerty, general boiler inspector, Chicago, Burlington & Quincy Railroad, Aurora, Ill.

Third Vice-President—Franklin T. Litz, general boiler foreman, Chicago, Milwaukee, St. Paul & Pacific Railroad, Milwaukee, Wis.

Fourth Vice-President—O. H. Kurlfinke, boiler engineer, Southern Pacific Company, San Francisco, Cal.

Fifth Vice-President—Ira J. Pool, district boiler inspector, Baltimore & Ohio Railroad, Baltimore, Md.

Secretary—Harry D. Vought, 26 Cortlandt Street, New York.

Treasurer—W. H. Laughridge, general foreman boiler maker, Hocking Valley Railroad, Columbus, Ohio.

Executive Board—A. F. Stiglmeier, New York Central Railroad, Albany, N. Y., chairman.

Boiler Makers Supply Men's Association

President—John C. Kuhns, Burden Iron Company, Chicago, Ill.

Vice-President—Harry Loeb, Lukens Steel Company, Coatesville, Pa.

Treasurer—George R. Boyce, A. M. Castle & Company, Chicago, Ill.

Secretary—W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

American Boiler Manufacturers' Association

President—H. E. Aldrich, Wickes Boiler Company, Saginaw, Mich.

Vice-President—Charles E. Tudor, Tudor Boiler Company, Cincinnati, Ohio.

Secretary-Treasurer—A. C. Baker, 801 Rockefeller Building, Cleveland, Ohio.

Executive Committee—Starr H. Barnum, the Bigelow Company, New Haven, Conn.; George W. Bach, Union Iron Works, Erie, Pa.; C. W. Edgerton, Coatesville Boiler Works, Coatesville, Pa.; Ousley Brown, Springfield Boiler Company, Springfield, Ill.; J. R. Collette, Pacific Steel Boiler Corporation, Waukegan, Ill.; E. R. Fish, Heine Boiler Company, St. Louis, Mo.; Sidney G. Bradford, Edge Moor Iron Company, Edge Moor, Del.; A. G. Pratt, Babcock & Wilcox Company, New York City; A. C. Weigel, Walsh & Weidner Company, Chattanooga, Tenn.

States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash.	Parkersburg, W. Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

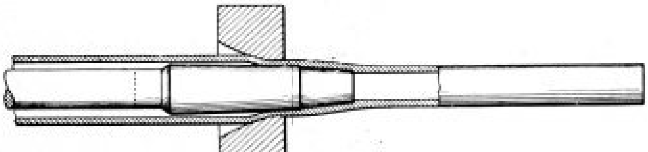
Compiled by
DWIGHT B. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

1,685,636. TUBE-DRAWING PLUG. JOSEPH KEMP, OF BALTIMORE, MARYLAND.

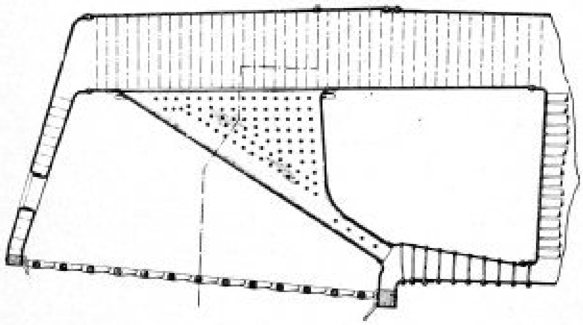
Claim.—A tube drawing plug formed of metallic material and including a tapered body portion and a gripping nose extended from the forward



end of said body portion, said gripping nose having its forward end possessing a malleable characteristic, the remaining portion of said nose and said body portion being hard. Five claims.

1,688,594. LOCOMOTIVE BOILER. JOHN L. NICHOLSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO LOCOMOTIVE FIREBOX COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

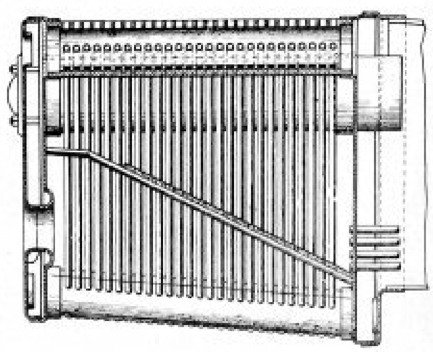
Claim.—A locomotive firebox, in combination with one or more hollow substantially vertical and triangular water-circulating elements therein, the top of each element opening through the crown sheet into the space



above the same, each element having an intake throat at its lower end through which communication is established with the bottom of the boiler, said element including a front wall which is inclined upwardly and rearwardly from the connection of said wall with the intake throat. Four claims.

1,687,197. WATER-TUBE FIRE BOX FOR LOCOMOTIVE BOILERS. GEORGE H. EMERSON AND OLIVER C. CROMWELL, OF BALTIMORE, MARYLAND.

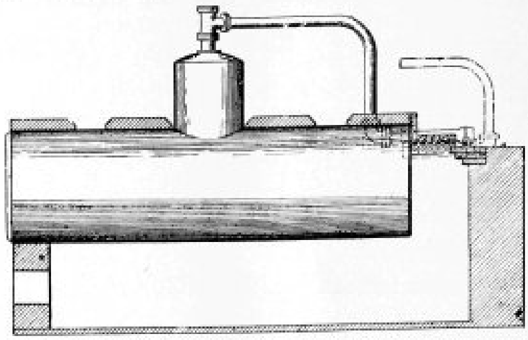
Claim.—In a boiler a pair of drums arranged one above the other, inner and outer rows of water tubes extending vertically between said drums, the tubes of said inner and outer rows respectively having their upper ends fitted in holes in a side and in the bottom of the upper drum, and the



tubes of both rows having their lower ends fitted in holes in the top of the lower drum at the inner side of its vertical center line, said upper drum being provided in its top with an opening lying in its central vertical plane and said lower drum being provided in its bottom with an opening on the outer side of its vertical center, said openings permitting access to the tube ends fitted in the drums, and a detachable closure for the opening in each drum. Nine claims.

1,681,952. RETURN TUBULAR SUPERHEATER BOILER. JOHN PRIMROSE, OF RICHMOND, NEW YORK, ASSIGNOR TO FOSTER WHEELER CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

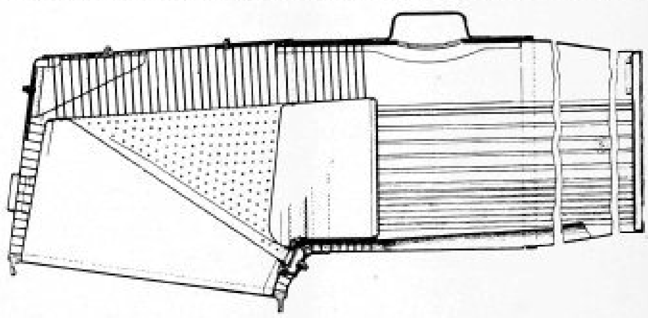
Claim.—In a return tubular boiler furnace having masonry housing walls at the sides and rear end of the furnace chamber portion at the rear of the boiler, the improvement which consists in a superheater form-



ing a roof for said chamber portion and comprising headers mounted on the housing walls at the sides of said chamber portion, and superheater elements connecting said headers and each comprising a body portion extending across said chamber portion and a transverse end portion connecting the body portion to one of said headers. Four claims.

1,681,405. LOCOMOTIVE BOILER. CHARLES GILBERT HAWLEY, OF CHICAGO, ILLINOIS, ASSIGNOR TO LOCOMOTIVE FIREBOX COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

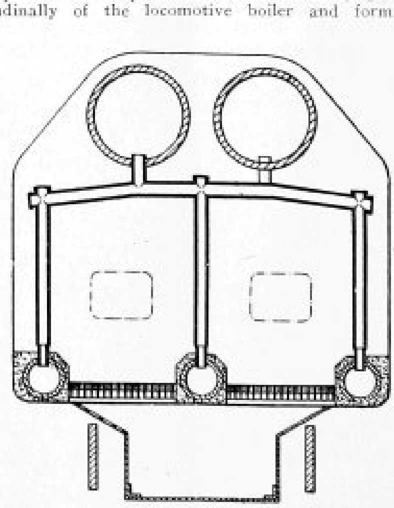
Claim.—The herein described locomotive boiler having a firebox formed with side water legs and a throat, a water-steaming and circulating element arranged in the firebox and having an inlet end connected to the



throat, in combination with parts that divide a portion of the firebox throat from those portions of the throat through which the side water legs communicate with the body of the boiler, said parts being spaced from but in communication with the inlet end of said water steaming and circulating element. Fourteen claims.

1,686,893. HIGH-PRESSURE STEAM BOILER FOR LOCOMOTIVES. JACOB BUCHLI, OF WINTERTHUR, SWITZERLAND.

Claim.—A locomotive boiler, comprising in combination, a pair of upper drums, lower drums, and a firebox comprising a front wall, a rear wall, and a plurality of fork shaped water tube elements arranged close together longitudinally of the locomotive boiler and forming the lateral



walls and the roof of the firebox to protect the upper drums and an intermediate wall inside the latter, said fork shaped tube elements consisting of three vertical tubes beaded into the lower drums and of a horizontal tube connecting said vertical tubes together, the horizontal tube of each tube element being provided with a single vertical branch and said branches being alternately beaded into said upper drums. Four claims.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX **June, 1929** **Number 6**

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

Chicago: 105 West Adams St. Cleveland: Terminal Tower
Washington: 17th and H. Sts., N. W.
San Francisco: 215 Market St.

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THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

Request for change of address should reach us on or before the first day of the month preceding the issue with which it is to go into effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice. In sending us change of address, please be sure to send us your old address as well as the new one.

Contents

Boiler Inspection Departments

ACTION was recently taken by the governor of a midwestern state, removing from office the chief of the boiler inspection department for political reasons and replacing him with an individual of his own party affiliations, who is neither fitted by training nor experience to fill this important position. The appointee has been in fact associated with the plumbing industry for a number of years.

That such a policy is allowed to exist not only in this but in many other states indicates a weakness in the political structure and should be corrected. The position of chief of any labor or safety department of a state government should rightfully be independent of political parties and, when the proper qualified individual is found to fill this post, he should be independent of changing administrations so long as he conducts the affairs of his department satisfactorily.

In this particular instance, the present inspector, who was originally appointed as the most competent civil service candidate, has been connected with the boiler industry for many years and has not only filled his office with distinction, but his efforts have been reflected in the boiler inspection departments of every state operating under the A. S. M. E. Boiler Construction Code. It was mainly through his efforts and untiring zeal that the National Board of Boiler and Pressure Vessel Inspectors came into being eight years ago and has reached its present position of influence throughout the country.

Immediate action should be taken by the citizens of this state and by concerns manufacturing and selling boilers in the state to bring pressure to bear with the governor looking towards his early reinstatement.

Support Your Railroad

ACCORDING to A. E. Clift, president of the Central of Georgia Railway and L. R. Powell, Jr., president of the Seaboard Air Line, in addresses before the twentieth annual convention of the Master Boiler Makers' Association, the railroads of the country are facing a new era in the scheme of transportation. The expanding use of the bus and aeroplane make necessary increased efficiency in all departments, and both officials stressed the part which the mechanical personnel must play in maintaining equipment on a high standard. Convenience, comfort, safety and in the case of freight, reliable service, insure the future of rail transportation in competition with all other types of carriers. Each has its logical use, but the bulk of all freight and the vast majority of all passenger traffic will continue to be carried by rail.

Each of these officials also dealt with the financial problems of the railroads, valuation, taxation, distribution of railroad investment securities, and operating expense. The latter item from slightly different angles was particularly emphasized by each speaker. This is a phase of the financial problem for which the mechanical staff is directly responsible and which the master boiler maker, as an important figure in the scheme of organization, can help control.

First, by the conservation of time, labor and materials in his department will he be able to help. The elimination of waste of all kinds is also part of his function. The maintenance of all parts of the boiler in the best possible condition at all times will not only promote safety but increase ton-mileage of the road's motive power, and thus increase revenue.

All of these problems are as much the master boiler maker's, as they are the president's, and the Atlanta convention marks the point in the association's history when railroad presidents have made public recognition of the value of its work. A new period has opened, in which the master boiler makers of the country must think in broader terms of the policies for which their roads stand and enter actively into other phases of their problems besides the running of their shops.

And to those who unfortunately were unable to attend the Atlanta convention, it may be said that they missed one of the most valuable and instructive conventions ever held by the association. It is possible by the payment of dues, however, to keep in good standing and obtain the proceedings.

If any of our readers among the master boiler makers of the country are among the delinquents of the association, we would urge that they rectify this condition by renewing membership at once through the assistant secretary, A. F. Stiglmeier.

Boiler Manufacturers' Meeting

ONE of the most successful meetings in the history of the American Boiler Manufacturers' Association was recently conducted at Skytop Lodge, Cresco, Pa. The new system of organization, under which certain sessions are devoted to a discussion of matters pertinent to the respective groups, has worked out advantageously during the past year, and a great deal of progress has been made in solving many of the technical and trade problems of the divisions.

A policy of expansion of association activities has been formulated that will increase the prestige and promote a better understanding of the work of the industry. Within the association itself, efforts will be made to combat unfair and uneconomic practices along lines adopted by many trade associations.

The broader scope of these activities and the ever-increasing interest in reaching a common solution to trade problems will tend in the future to establish the boiler manufacturing industry in a firmer position than ever in the power field of this country.

Locomotive Boiler Construction

DUE to space required in this issue to include a comprehensive outline of the proceedings of the Master Boiler Makers' Association Convention and that of the American Boiler Manufacturers' Association, it was necessary to omit the eleventh installment of the article, "Locomotive Boiler Construction," by W. C. Joynes. This installment will therefore be published in the July issue of THE BOILER MAKER.

Seventh Meeting of National Board

THE seventh annual meeting of the National Board of Boiler and Pressure Vessels Inspectors will be held at the Hotel Fort Shelby, Detroit, Mich., June 18, 19 and 20. An interesting program has been prepared for this meeting in which problems affecting conformity in the construction, installation and inspection of steam boilers will be discussed. A complete report of the proceedings of the meeting will appear in a later issue of THE BOILER MAKER. The details of the program are given below.

Tuesday, June 18th, 1929

Address—John F. Bischof, Commissioner of Buildings and Safety Engr., City of Detroit.

Address—Hon. Wm. T. Blake, Director of Industrial Relations, State of Ohio.

Address—C. D. Thomas, chairman, chief boiler inspector, State of Oregon.

Report—C. O. Myers, secretary-treasurer, chief boiler inspector, State of Ohio.

Report—L. C. Peal, statistician, city boiler inspector, Nashville, Tenn.

General discussion and appointment of committees.

Afternoon Session

Address—Chas. J. McCabe, city smoke inspector, Detroit, "What are the Essentials in a Boiler Furnace in Relation to Safe Operation of a Boiler."

Report—C. W. Obert, honorary secretary A. S. M. E. Boiler Code Committee "Interpretations and Revisions of the A. S. M. E. Code During Past Year."

Address—P. R. Hawthorne, welding engr., The Petroleum Iron Works Co. "Welded Pressure Vessels."

Evening Session

Informal Dinner, Hotel Fort Shelby.

H. H. Mills, chief Bureau of Safety Engineering, Detroit, Mich. Subject—"The Importance of the Hydrostatic Test in Boiler Inspection."

Thos. P. Hetu, chief inspector Hartford Steam Boiler Inspection & Insurance Company, Detroit, Mich. Subject—"The Essentials in Shop Inspection."

Allan A. Grant, chief inspector the Travelers' Insurance Company, Detroit, Mich. Subject—"What Shall We Do With Bulged Shells on Steam Boilers."

Thos. H. Quiery, engineer, London Guarantee & Accident Co., Detroit, Mich. Subject—"Second Hand Boilers."

Wesley McLean, chief inspector Ocean Accident & Guarantee Corporation, Detroit, Mich. Subject—"Pressure Vessels."

Otis L. Schooley, chief inspector Maryland Casualty Company, Detroit, Mich. Subject—"Desirability of Organizing Commissioned Boiler Inspectors."

Wednesday, June 19th, 1929

Address—L. B. Betz, chemical engineer, "Boiler Water Correction Through Application of Colloidal Gels."

Address—Geo. C. Reinhard, chief chemist, feedwaters, Inc., "Conditioning of Boiler Feed Water, Introducing the Colloidal Aspect."

Address—F. G. Straub, research chemical engineer, University of Illinois, "Embrittlement in Steam Boilers."

Thursday, June 20th, 1929

Executive Session of the National Board of Boiler and Pressure Vessel Inspectors. Committee Reports.

Truing the Boiler Shop Grinding Wheel

By James F. Hobart

"I SAY, Bob, what makes that tremendous racket in your boiler shop? Are you running all the machines with old Ford automobiles, or have you lately put in a rumbler for used boiler tubes?"

"Nothing of that kind, Bill. The noise you hear is probably made by the shop grinding wheel which somebody must have started up. That machine must have gotten out of balance somehow, for it does rattle some while it is running!"

Did *you* ever try to do a job of grinding on a wheel in similar condition? You might as well trundle the grinding wheel down a hill and try to work on the wheel while it is rolling down! But, when you meet up with such a grinding wheel, and must use it, what is to be done? The proper thing is: Never let a grinding wheel get into such condition. True the surface of the wheel slightly, as needed, and the wheel will never get into the condition of the wheel in Bob's shop. Provide a good wheel-dressing tool, either a black diamond or a wheel tool. The latter works on much the same principle as does the wheel glass cutter. Give the tool to some good man and make him responsible for the condition of the grinding wheel. Never let several people true the grinding wheel. That is a one-man job and one man should always do it. Then he knows how he left any wheel and also knows what will be needed the next time the wheel becomes slightly out of round. Besides being impossible for good or quick grinding, a wobbly grinding wheel is absolutely dangerous, as the stress to which the wheel is exposed while running in an unbalanced condition is often greater than realized.

When a rattling, wobbling grinding wheel must be used, give it "first aid" before attempting to do any grinding with the wheel. "First aid" calls for the application of the diamond or other truing-up tool. Should the wheel prove to be very badly out of round, tool down a narrow space on either edge of the wheel, then with a small cold chisel, or a miniature mason's "pount" and a small hammer, chip off all material between the two above-mentioned tool cuts. Then smooth the face of the wheel with the truing tool.

In case no regular wheel-truing appliance is available, proceed to rig up a makeshift tool at once. Procure a piece of flat steel about 2 feet long and anywhere between 1/8 and 1/5-inch thick by 1 to 1½ inches wide. Bend the bar flatwise into a U shape and drill a hole through both legs, close to the ends. Make the hole a sliding fit for a bolt upon which three or four small washers will slide easily. The washers may be for ¼ to ½-inch bolts. The bolt should be screwed home upon the U-shaped bar until the washers are held close but loosely between the legs of the U. Lubricate the washers and bolt, then apply the device as if it were a regular wheel-truing tool and the rolling washers will cut into the face of the grinding wheel in great shape. More pressure is needed when using this tool than when the diamond tool is applied, so see that there is a good, solid rest or "fence" for the tool to bear against when being applied to a grinding wheel. With such a makeshift tool, the edges of a wheel may be cut down until the wheel is round, but it may not be found possible to cut down squarely. A sort of bevel may have to be made, as the washer tool cannot cut into a corner as readily as can be done with a diamond tool.

When a grinding wheel is belted downward, little or no attention need be given to the looseness of the journal bearings, but when a wheel is belted upwards, it will be necessary to "take-up" the bearings until the journals fit without looseness or lost motion. Possibly the journal bearings must be scraped to a better fit. Or, new bearings may have to be poured from some good alloy for journal bearings.

Usually a grinder will run smoothly and without rattling or "jumping" as soon as the wheel has been made round and true. But sometimes other things have to be taken care of as will be shown later; for sometimes the metal bushing around the hole in a grinding wheel is in such bad condition that it is nearly impossible to mount the grinding wheel properly on its mandrel.

Pure soft lead may be used for grinding wheel bushings, although some people prefer babbitt, as it is harder and resists wear better than lead. It will pay for you to have a simple tool for pouring new wheel bushings when necessary.

It is very easy to cast a new bushing with the apparatus. Simply place the proper sized mandrel in a hole in the middle of the circle-marked horizontal plate upon which the grinding wheel is laid during the casting process. Center the wheel to one of the concentric circles marked upon the plate, then pour in barely melted soft metal around the mandrel, which should be removed immediately before the soft metal becomes thoroughly cold. The mandrel comes out easily while the bushing is hot.

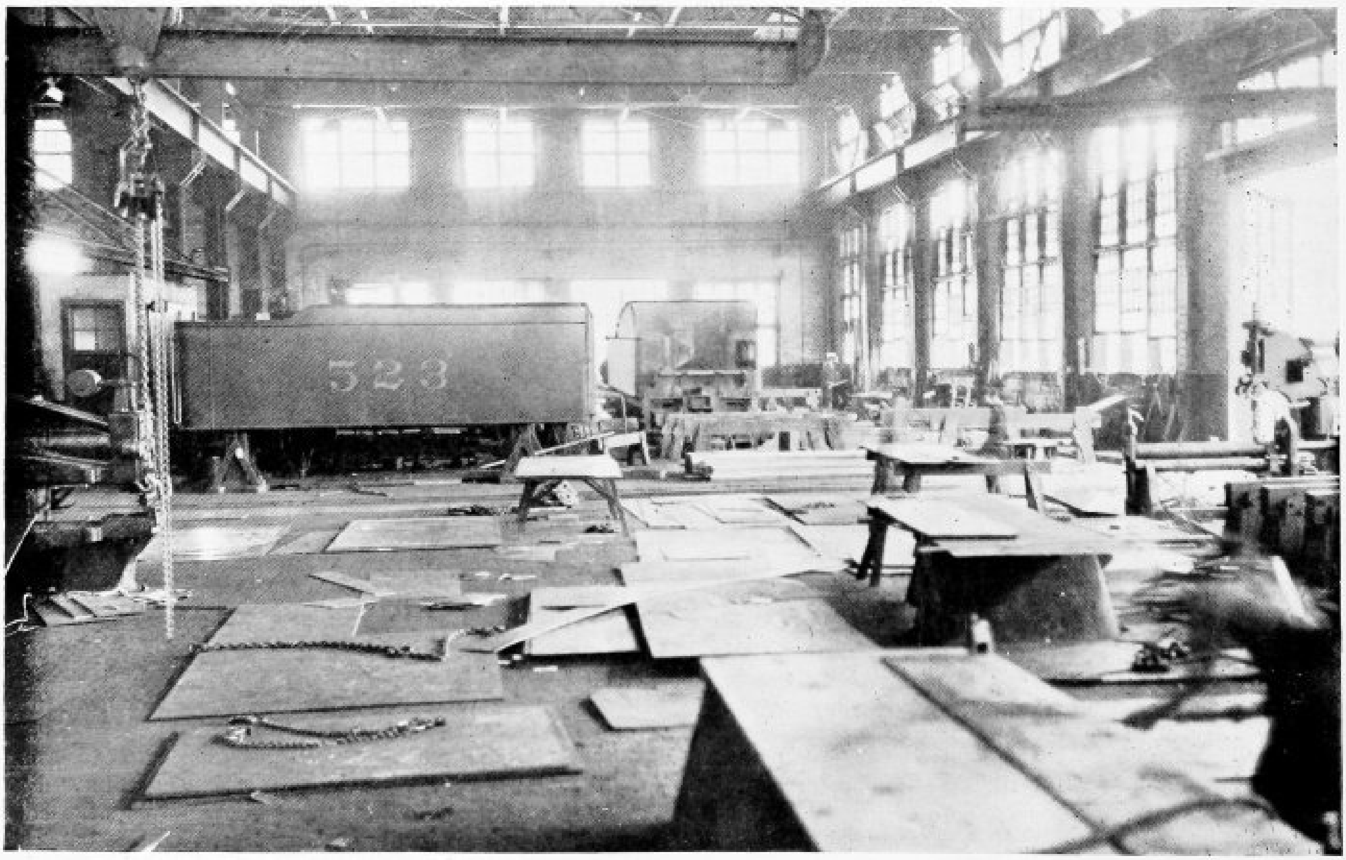
While grinding wheels with good bushings may usually be placed upon the grinder mandrel in any old way, it is best to fit each wheel in the same manner. Make a mark upon the face of the fixed flange and always bring this mark uppermost when setting a wheel. Make a mark with paint, or otherwise, upon one side of the grinding wheel which will be covered by the fixed collar when the wheel is in place. When placing a grinding wheel upon its mandrel, bring the collar mark upwards to the top and then place the mark on the wheel against the mark on the collar. Screw the nut home with the wheel in that position. This causes the wheel to be set in place in the same position.

In some boiler shops, grinding wheels, when not in place upon the mandrel or the grinding machine, are often found covered with dust on a bench or in a box, or hung upon rods driven at an angle into a post or wall, the angle being evidently for keeping the wheels from sliding off the rod. Both these methods are bad. Wheels thrown flat on the bench, floor, or in a box, are liable to be damaged by something falling upon them. Wheels strung upon metal rods are nearly always found with damaged bushings, which have been injured by contact, with the rods upon which the wheels are hung.

Place the wheels one edge in a small U-shaped trough, the sides of which are formed of stout wooden slats, with openings between the slats for the escape of such dust and dirt as may chance to fall upon the grinding wheels while in the little trough. Wheels thus stored may be tilted or slid back and forth to find and take out the required wheel, and the bushings will be protected from accidental injury.

In extreme cases, truing a wheel will not cause it to run smoothly and then the mandrel should be removed from its bearings and rested for running balance upon some straight, level and smooth metal edges, accurately leveled. Possibly some metal may have to be drilled from the flanges in order to obtain a perfect balance. Once in a great while, a grinding wheel will be found

Layout and flanging department



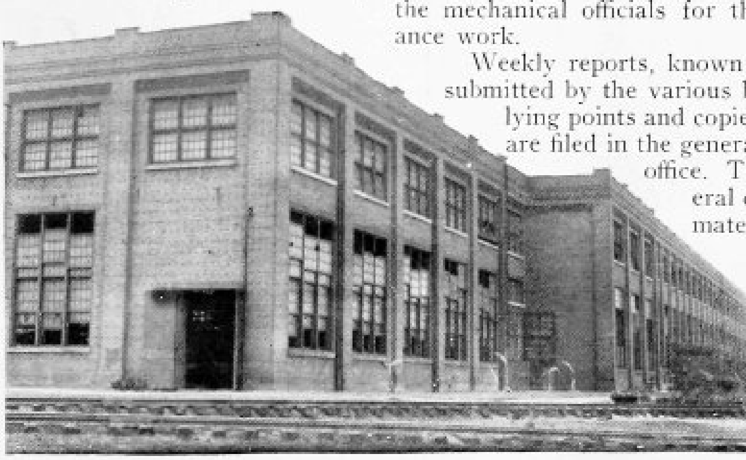
Tank department occupies one end of boiler shop

Centralizing Boiler Repair Work

Macon Shops of Central of Georgia handle heavy repairs for entire system

A REMARKABLE record of efficiency based on the centralization idea of conducting locomotive repair work has been accomplished by the Central of Georgia Railway Company shops at Macon, Ga. Not only are all heavy locomotive maintenance operations conducted at this point but all major car work and tank work as well.

Boiler maintenance and replacement are special features of the repair concentration at Macon for here all classified repairs for the entire system are handled and, in addition, fabrication is carried out on parts to be used for lighter repairs at the boiler shops in Savannah, Columbus and Cedartown. The boiler shop has an average output of between 12 and 15 classified repairs a month with the same number of rebuilt tanks. Besides this, a considerable number of complete back ends are constructed principally on shop orders and syphon work is carried out on work orders. Fabrication of all steel car work for the system is handled in this shop. The extent to which methods have been developed may be better understood when it is realized that this production is accomplished with a total boiler shop staff of about 50 men.



Boiler shop is of brick and steel-frame construction

Although the entire Central of Georgia plant at Macon is twenty years old, the buildings as originally designed were of a type construction and so arranged that they compare favorably with the most modern locomotive repair shops. The efficient adaptation of a twenty-year-old shop layout to the handling of large power is due in large measure to the intelligent application of crane service and other forms of material-handling equipment, which will be described later.

All of the shops are of brick and steel-frame construction. The main building, containing the machine and erecting shops, is 510 feet long by 181 feet wide. The wing which houses the tank, flue and boiler departments, is 260 feet long by 130 feet wide. In addition to the back shop buildings, the plant includes a 32-stall engine house, a modern storehouse, oil house and wood shop. Because of the fact that the erecting shop is so closely connected with the boiler shop, a brief outline of its facilities may be of interest. This shop is 510 feet long by 60 feet wide and has 22 pits. It is served by 10-ton and 30-ton traveling cranes for handling of locomotive parts and miscellaneous material and by a 150-ton crane for handling locomotives. The 30-ton crane can be operated the full length of both the erecting and boiler shops and is used for transporting boilers, flues and other parts between these two shops.

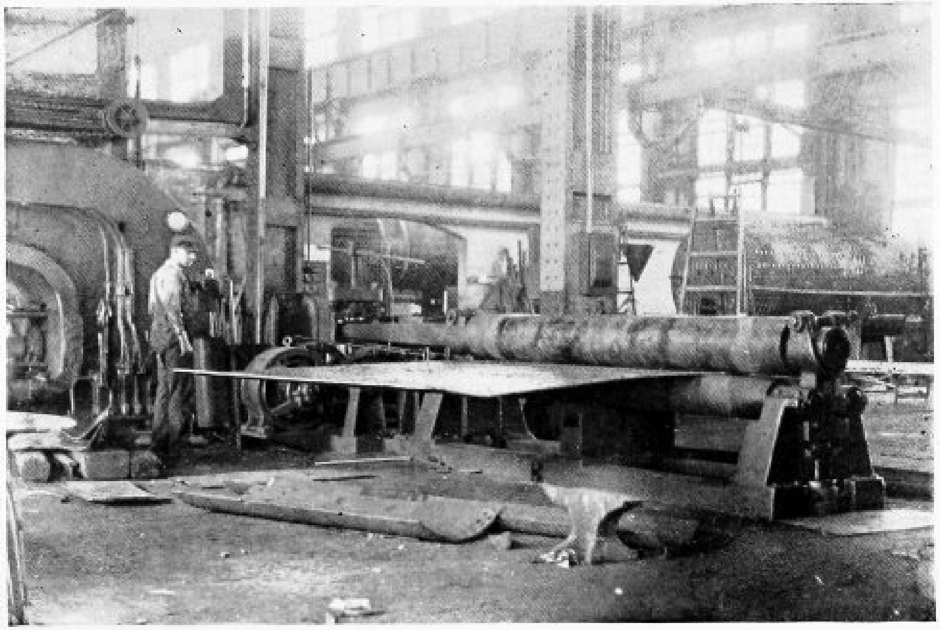
A compact and closely knit boiler department organization has been built up for all shops on the system under the leadership of C. F. Petzinger, general foreman boiler maker. Under him there are three foremen at Macon, one in the back shop, one in the round house and the third in the boiler shop. Foremen located at the three other principal shops of the company also report to the general foreman boiler maker as does the chief boiler inspector for the road. By this arrangement the condition and replacement of all locomotive boilers throughout the entire system are kept in constant check by the general foreman, who is directly responsible to the mechanical officials for this part of the maintenance work.

Weekly reports, known as situation reports, are submitted by the various boiler foremen at all outlying points and copies of all inspection reports are filed in the general foreman boiler maker's office. These reports cover general conditions at these points, material needed and progress being made on any heavy repair jobs. All current boiler work is scheduled according to these reports.

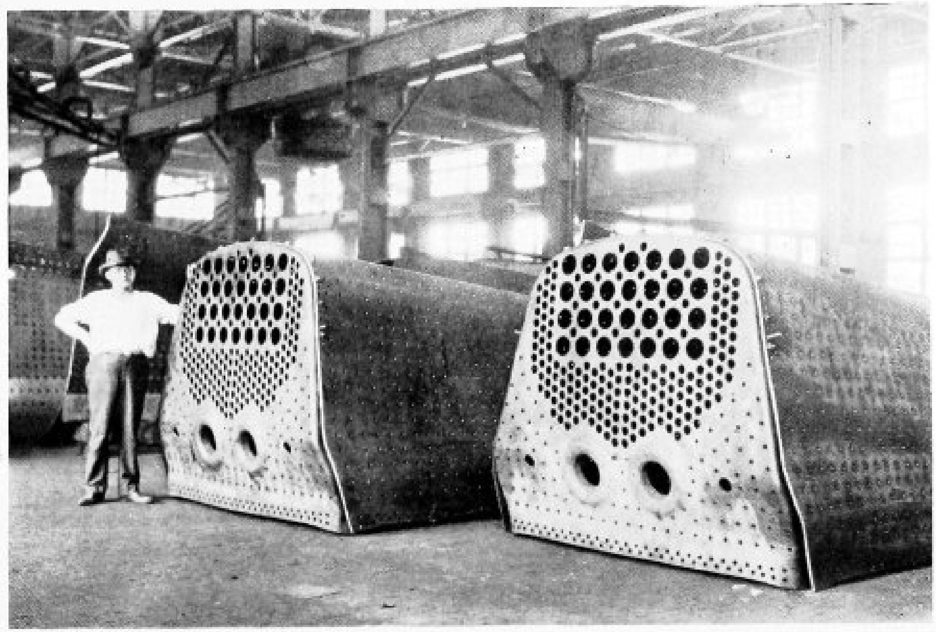
A policy of early replacement of all equipment before deterioration develops and modernization of certain classes of engines is the basis on which this railroad conducts its affairs. This being the case, the superintendent of motive power calls in the general boiler foreman at the end of each year, who, from his assistants' reports and his own check on conditions throughout the system is able to estimate approximately how many fireboxes, flue replacements and heavy classified repairs will be necessary during the coming year. The engine numbers to be given major repairs are recorded and schedules are sent to the master mechanics who arrange to shop the engines accordingly. At Columbus and Savannah the heaviest boiler work carried out consists of the renewal of half side sheets and flue renewals. Running and light boiler repairs constitute the bulk of the jobs at these points. At Cedartown application of flues and running repairs are handled.

With a staff at the Macon boiler shop consisting of 19 boiler makers, 19 specialists, including crane men, tool room men, punch and shear operators, tank men, ashpan men, and the like, 3 welders, 2 inspectors, 4 regular apprentices, 2 co-operative apprentices from Georgia Tech and one messenger, besides the supervisory force of three men, it is quite remarkable that the shop is able to handle such a great diversity of work. This is possible only because of the excellent training of the men and efficient equipment.

The policy of the company is to provide modern machinery best adapted to speed up production. This, combined with a shop layout that avoids lost motion,

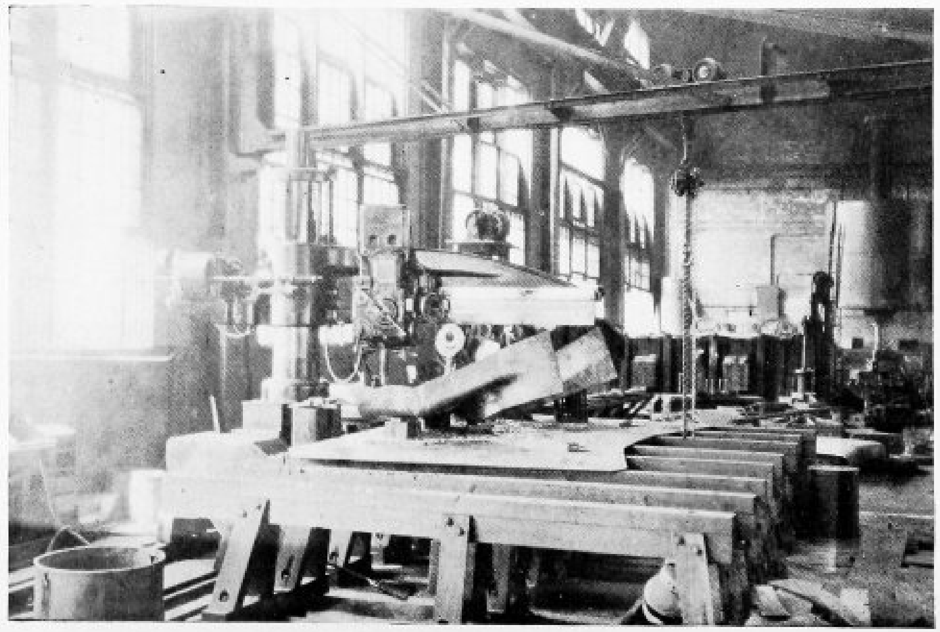


Rolling a firebox sheet



Firebox sheets bolted up for assembly

Material is handled by truck and tractor



Special tools are used to speed operations

Ashpan shop and tool room

is a considerable factor in solving the output problem.

Until recent years, ample space was available in the shop for handling the largest size power used on the road and, at the same time, carry out tank and cab work without congestion or interference. Today, however, larger boilers and tanks coming in for repairs require more space so that within a short time it is planned to extend the width of the boiler shop to the full 181-foot width of the erecting and machine shop building. By moving the tank department to this extension, ample room will be allowed for boiler assembly and fitting up work.

In the July issue of THE BOILER MAKER the shop layout, machine tool equipment and method of conducting repairs at the Macon shops of the Central of Georgia Railway will be fully described and illustrated.

Lebanon Boiler Works Offered for Sale

THE Lebanon Boiler Works, Inc., Lebanon, Pa., one of the oldest and best known boiler shops in the country has recently been offered for sale in its entirety, including charter, property, buildings, equipment and raw materials. This plant, on the main line of the Reading Railway, has an area of 164,092 square feet of ground and 47,925 square feet of shop.

The equipment includes bending rolls, punches and shears, pneumatic and hydraulic bull riveters, air compressor plant, plain and wall radial drills, acetylene oxweld outfits, acetylene generators, Lincoln electric welders, cranes, chain hoists, lathes, shaper, drills, grinders, forges, anvils and a steam hammer.

Motors, small tools such as drills, reamers, taps, jacks, punches, dies, pneumatic hammers, etc., render the shop ready to operate at the throw of a switch.

The reputation of Lebanon Boiler Works products is a great asset and an excellent opportunity is offered to one who would step into this plant and operate it in an efficient manner.

Welding Code for Building Construction

DUE to the increase in the use of welding and gas cutting in general construction, the American Welding Society has codified these practices in the application of fusion welding and gas cutting in building construction which have reached the stage where they may be properly standardized. Recommended practices have been published in a bulletin entitled Part A "American Welding Society Code for Fusion Welding and Gas Cutting of Structural Steel" and may be obtained from the American Welding Society, 33 W. 39th street, New York, N. Y., at a nominal charge of 25 cents a copy.

Smoke Prevention Meeting

THE Smoke Prevention Association held its twenty-third annual convention at Kansas City, Mo., on May 14 to 17. During the last three days of the meeting several railroad men addressed the convention. These included J. E. Bjorkholm, assistant superintendent of motive power of the Chicago, Milwaukee, St. Paul & Pacific, whose subject was "Black Smoke and its Prevention"; D. C. Buell of the Railway Educational Bureau at Omaha, Neb., whose subject was "Why Toss Your Money Out of the Smoke Stack"; Charles Longman, road foreman of engines of the Chicago & North Western, whose subject was "Diesel Locomotive Practice."

Boiler Makers Hold

Five hundred members and guests of Master and mechanical officials discuss present-day

Officers of Master Boiler Makers' Association

Standing, W. H. Laughridge, treasurer; I. J. Pool, fifth vice-president; O. H. Kurlfinke, fourth vice-president; F. T. Litz, third vice-president; K. E. Fogerty, second vice-president; G. B. Usherwood, first vice-president; A. F. Stiglmeier, chairman executive board; L. M. Stewart, president.

THE twentieth annual convention of the Master Boiler Makers' Association, held at the Atlanta Biltmore Hotel, Atlanta, Ga., May 21 to 24 was featured by addresses of two railroad presidents—A. E. Clift, president of the Central of Georgia Railway and L. R. Powell, Jr., president of the Seaboard Air Line. This was the first meeting of the association ever held in the South and was presided over by the first southern president, L. M. Stewart, general boiler inspector, Atlantic Coast Line, Waycross, Ga. The attendance in point of numbers was less than usual, about 200 master boiler makers, 125 members of the Boiler Makers' Supply Men's Association, 60 guests and 125 ladies being registered. In addition, at a special session Thursday afternoon more than 100 members of the Southern and Southwestern Railway Club were also in attendance as guests of the association. In connection with the meeting, a matter of particular note was the fact that twelve past presidents of the association were present, including George Wagstaff of the American Arch Company, New York; J. A. Doarnberger, master boiler maker, Norfolk & Western Railroad, Roanoke, Va.; P. J. Conrath, boiler tube expert, National Tube Company, Chicago, Ill.; T. W. Lowe, formerly general boiler inspector, Canadian Pacific Railway, Winnipeg, Manitoba, Canada; W. H. Laughridge, general foreman boiler maker, Hocking Valley Railroad, Columbus, O.; D. A. Lucas, works manager, Prime Manufacturing Company, Milwaukee, Wis.; A. N. Lucas, district manager, Oxweld Railroad Service Company, Wauwatosa, Wis.; Frank Gray, tank foreman, Chicago & Alton Railroad, Bloomington, Ill.; Thomas Lewis, formerly general boiler inspector, Lehigh Valley Railroad, Sayre, Pa.; E. W. Young, formerly mechanical assistant to general superintendent of motive power, Chicago, Milwaukee, St. Paul & Pacific Railroad, Dubuque, Iowa; T. F. Powers, assistant superintendent of motive power, Chicago & Northwestern Railway, Oak Park, Ill.; J. F. Raps, general locomotive inspector, Illinois Central Railroad, Chicago, Ill.

After the customary formalities of opening the convention and addresses of welcome by state and city officials, President Stewart introduced A. E. Clift, president of the Central of Georgia Railway, an abstract of whose speech follows:

Railroad Operating Problems

By A. E. Clift

The whole theory of operation of the steam railroad is centered around the boiler, for without adequate boilers it is impossible to have a steam railroad.

In looking over the latest report of the Interstate Commerce Commission covering boiler inspections for 1928, I was interested in noting the steady decreases reported in locomotive failures. I was especially impressed with the decrease in casualties from steam locomotive accidents. I noticed that in 1928 the number of deaths (thirty) from such accidents was less than 50 percent of the total deaths from this cause in 1924,

Southern Convention

Boiler Makers' Association hear executive railroad financial and operating problems

while the 1928 injuries were only 40 percent of the 1924 total. I attach so much importance to the subject of safety and prevention of personal injuries that this is to me by far the most satisfactory feature of the report, as it must be to you who are so largely responsible for the better showing our locomotives are making. It is only fair to pay tribute to the work of the Interstate Commerce Commission inspectors, as their efforts have proven very helpful to the railroads in keeping maintenance up to a high standard.

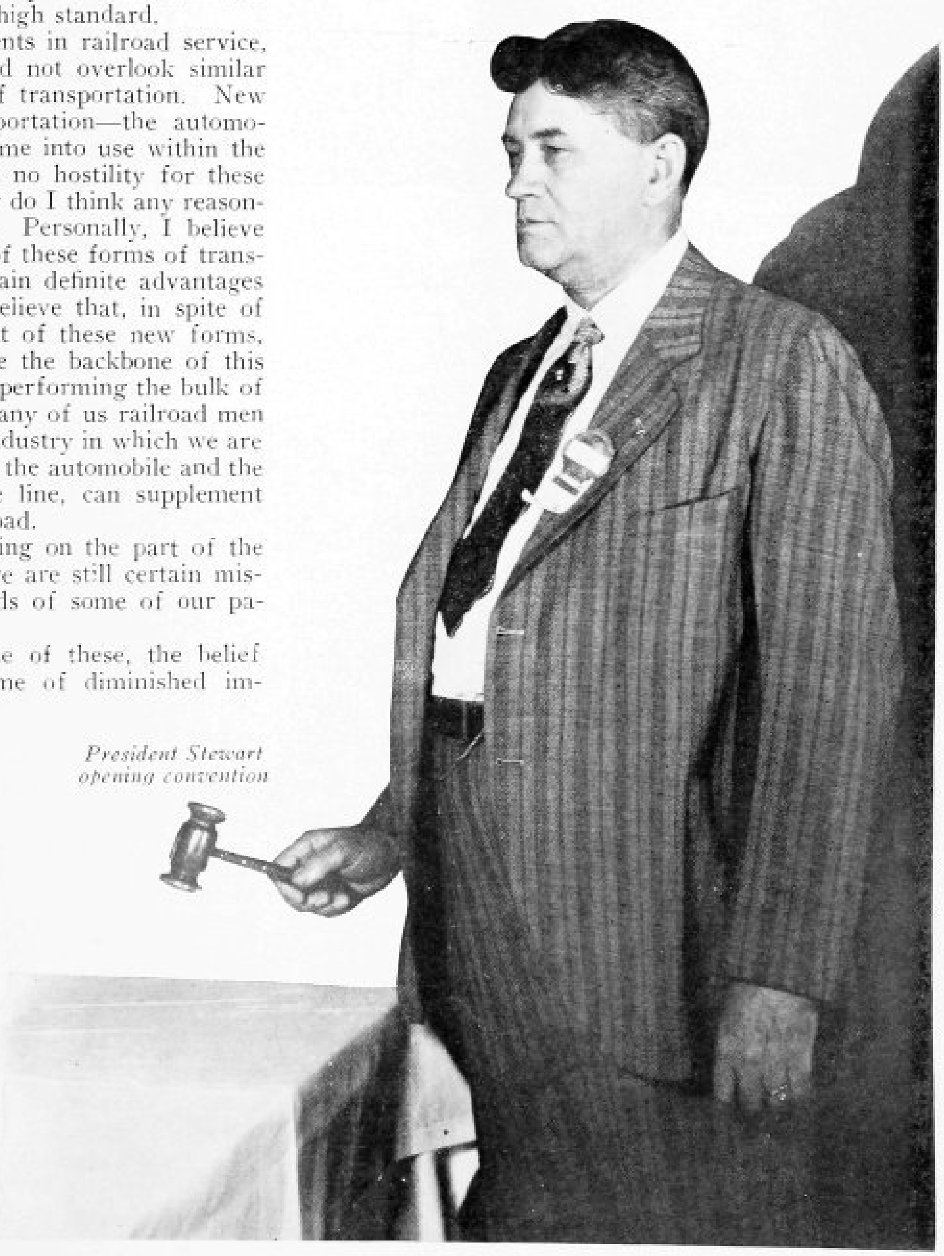
In considering the improvements in railroad service, we of the railroad world should not overlook similar improvements in other forms of transportation. New and important agents of transportation—the automobile and the aeroplane—have come into use within the memories of all of us. I have no hostility for these new forms of transportation, nor do I think any reasonable railroad man should have. Personally, I believe that there is room for all three of these forms of transportation, because each has certain definite advantages to recommend it. But I also believe that, in spite of the past and future development of these new forms, the railroads will continue to be the backbone of this country's transportation system, performing the bulk of the work. I do not believe that any of us railroad men need fear for the future of the industry in which we are employed, as in my opinion while the automobile and the aeroplane, as well as the barge line, can supplement they can never replace the railroad.

In spite of the improved feeling on the part of the public toward the railroads, there are still certain misconceptions existing in the minds of some of our patrons that should be corrected.

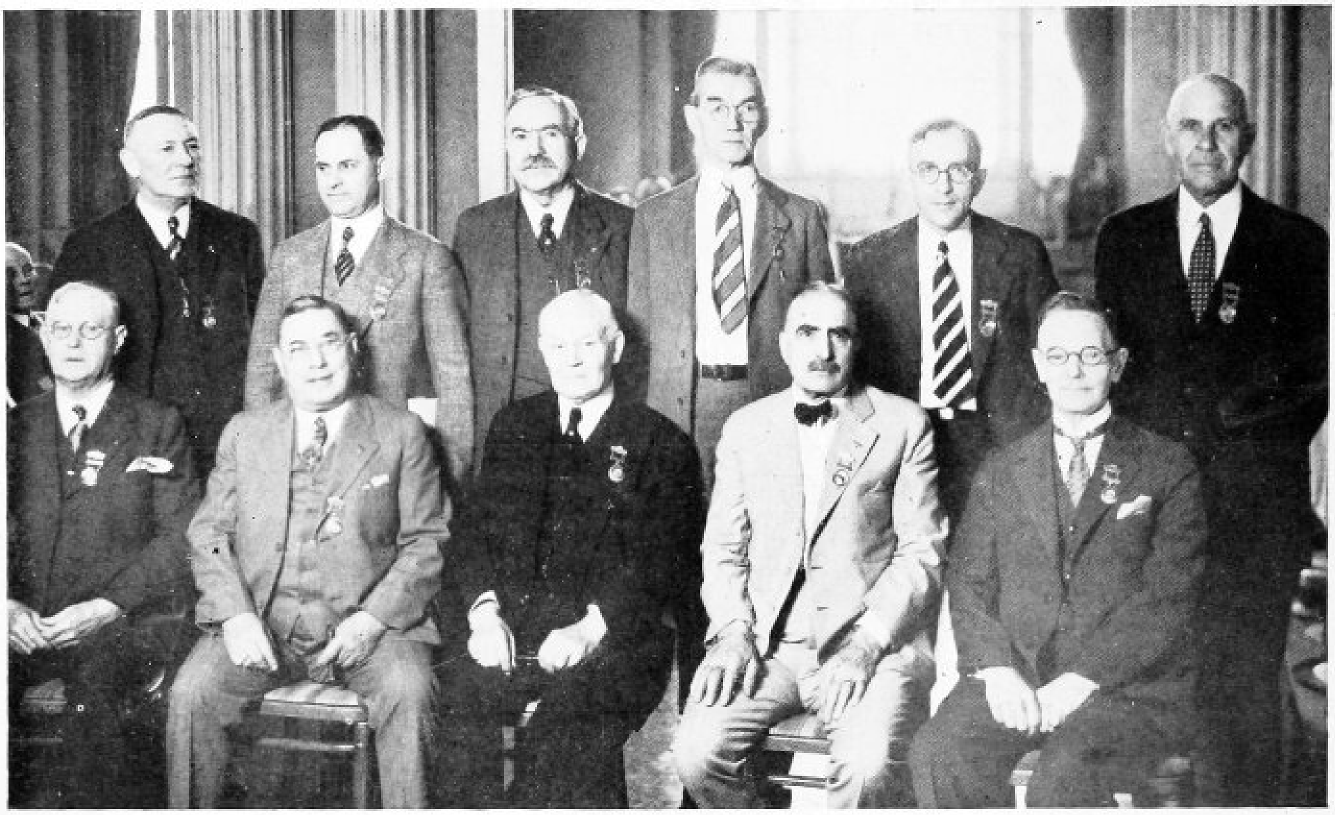
I have already alluded to one of these, the belief that the railroads are to become of diminished importance in this country's transportation system. Even among some railroad workers such an impression exists. I have no desire to minimize the importance of the bus and truck lines, but the increasing freight traffic of the railroads indicates that they are not imperiling our existence.

Nor will the automobile, buses or aeroplanes ever eliminate the railroads from the business of transporting passengers. In the main, I believe that passenger traffic will eventually be divided among the automobiles, the aeroplanes and the railroads. Automobiles and buses will handle those moving relatively short distances, the air line handling those demanding speed above all else, while the railroad will continue to handle the great majority who value the comfort, convenience, safety and protection which the railroad affords.

Another misconception on the part of the public is in regard to the so-called "government guarantee". We all know that the government not only does not guaran-



President Stewart opening convention



Past presidents at convention of Master Boiler Makers' Association

Back row (left to right), J. A. Doarnberger, J. F. Raps, Frank Gray, W. H. Laughridge, T. F. Powers, E. W. Young. Front row (left to right), Thomas Lewis, A. N. Lucas, George Wagstaff, P. J. Conrath, T. W. Lowe. (D. A. Lucas was also in attendance.)

tee any fixed return to the railroads, but that it actually limits the amount that each may earn. And yet, a surprisingly large number of persons who are otherwise well informed will tell you that the government does actually guarantee a certain return to the railroads. The truth is that the Interstate Commerce Commission fixes the value of the railroads and says that they *may* earn 5¾ percent upon that valuation. The law makes no provision whereby they shall earn that much. It is merely a permission to earn it if we can. The railroads as a whole have never earned that rate of return. The Central of Georgia has always fallen short of it. But while the law only permits us to earn that modest return if we can, it is very strict about its provision on the maximum side and says if we earn more than 6 percent, half of all earnings above that figure must be paid to the government under the "recapture" clause, while the other half must be placed in a reserve fund. Your support should be given the railroads to overcome these impressions.

After the conclusion of Mr. Clift's talk, President Stewart delivered his annual address to the association, which was in part as follows:

President's Annual Address

We have members present today from the north, south, east and west. They have come not only to learn about what the other fellow is doing, but to tell the other fellow what they are doing to maintain the steam boilers on their railroads to full efficiency. In other words we pool our ideas and methods of building and repairing steam boilers with special reference to the high pressure and long run locomotives of the present day.

You will all agree that the methods and the duties imposed upon the members and those in supervisory capacities have become more intricate with the introduction of the super-locomotive, several types of which are in service at the present time and indicate the trend of the future locomotive. The fabrication of heavier and higher tensile strength plates and staybolts makes the work extremely difficult, and requires ability, efficiency and precision in carrying out the details of each operation. The difficulties to be overcome will act as an incentive to the members of this association and will achieve for them greater prestige and recognition in the mechanical world.

The topics selected are such, that if discussed properly they will be of great benefit to all the members. It is only by our attendance at each and every session that discussions will be of benefit to us, so that we can go back to our employers and demonstrate that it paid them to send us here, I know that this will be the case, for we have the reputation of being a hard working organization, one whose members are always in the meeting room during sessions, and anxious to take part in the discussions. After all, this is only our duty for when we are sent here under pay and with our expenses paid, we are obliged to attend each and every meeting and take part in the discussions, just as we are expected to be on the job in our shops at home. So let us make this a business proposition to our employers, by each one of us taking home something in the way of knowledge that will make them more anxious to send us here in the future.

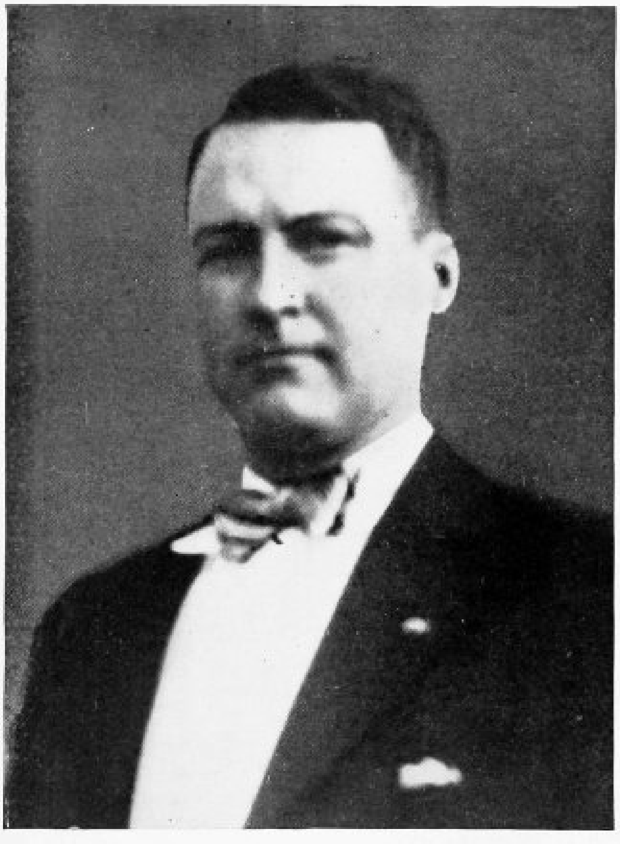
The remainder of the opening session was devoted to the annual reports of Harry D. Vought, secretary and W. H. Laughridge, treasurer, the reading of memorials for deceased members, appointment of committees and other routine business.

Tuesday Afternoon Session

The session Tuesday afternoon was devoted to the reading and discussion of two reports of topical committees. The paper on "Recommended Practice and Standards for Fusion Welding as Applied to Steam Pressure Boilers" appears below together with the subsequent discussion.

Fusion Welding as Applied to Steam Pressure Boilers

The report of your committee on this subject must of necessity be somewhat brief this year, due to the fact that the report last year was unusually complete and comprehensive in that it touched upon all developments in the art up to that time; also the intervening period has not produced sufficient material to permit of an extensive report covering phases of the art not already covered by reports of previous years. We have, however, kept in close touch with such developments as have transpired and are gratified to find that the results obtained from the gradually extended use of welding serve to confirm the conclusions arrived at and expressed by this association.



L. E. Hart, fifth vice-president

Each year the decrease of radical innovations in the welding art, we believe, may be correctly interpreted as indicating a sane, normal progress and a healthy condition of stability that insures the art a more and more important position in industry as time passes. This does not mean, of course, that no further development is to be expected; on the contrary, now that the primary experimental stage is definitely a thing of the past, and as the application of the art has become more general, and as more minds consequently are focused upon the subject, we should expect a uniform and gradual progress—a progress that will differ from that of the past, in that instead of being marked with startling innovations, it will consist of a cumulative series of gradual refinement of practices and extension of applications.

On all sides we find evidence that this phase of the development of the welding art is already well under way. As an illustration, we will consider an example of boiler construction that in its field is probably the outstanding accomplishment of the past year, and with which a number of you are already familiar. The case referred to is that of the 2-8-8-4 type simple articulated locomotive, built for the Northern Pacific Railway Company by the American Locomotive Company.

The estimated weight of this boiler is 165,000 pounds. It is 63 feet 8¾ inches long; and the third and largest barrel ring, which is made of 1 3/16-inch thick steel plate, is 110¼ inches outside diameter. It has a grate area of 182 square feet, a total heating surface of 7673 square feet; a total superheating surface of 3319 square feet, and carries a working pressure of 250 pounds per square inch.

Inasmuch as the unusual size of this boiler placed the design and construction somewhat in the experimental class, only the strongest and most trustworthy methods were used throughout. For this reason, it is especially significant that the firebox is entirely of welded construction, except that rivets are used in attaching the back flue sheet to the combustion chamber and the mud ring to the inside and outside sheets.

The firebox and combustion chamber combined are 343⅛ inches long; the firebox is 114¼ inches wide, and the combustion chamber is 72½ inches long. The firebox consists of seven sheets—two side sheets, door sheet, throat sheet, back flue sheet, crown sheet and combustion chamber sheet.

The door sheet is welded to the crown and side sheets The side sheets are welded to the crown sheets. The side sheets are welded to the side, crown and combustion chamber sheets. The bottom seam of the combustion chamber is welded. The combustion chamber crown and the firebox crown are joined by a welded seam, running transversely through the crown, 84 inches in length. In addition to this, there are five Nicholson thermic syphons welded in place; three of them in the firebox and two in the combustion chamber. At their upper ends, they are welded to the crown sheet. The lower end of the combustion chamber syphons are welded to a diaphragm which is set in and welded to the bottom of the combustion chamber. The lower ends of the firebox syphons are welded into corrugated openings in the throat sheet.

The fire door opening and the cleaning openings on the sides have the sleeves welded in place.

The mud ring is welded to both firebox sheets and outside sheets at the bottom for a distance of about 10 inches each side of the corner.

In the construction of the front end, welding is again

Members and guests of Master Boiler Make

employed extensively, which is also significant when we notice the following comment: "In building this part of the boiler, accuracy had to be maintained so that when the (feed water) heater was dropped into place it fitted perfectly and with ⅛-inch clearance to allow for expansion of gases."

There is a total of 229 feet of welded seams in the firebox, and in addition, a total of 575 feet is used externally; and 169 feet internally in the barrel section of the boiler as a sealing feature at seam edges, making a total of 973 feet of welding employed in the construction of this boiler.

In the 1928 report, your committee mentioned several examples of welding as applied to ships—among them a completely welded tanker and a battleship with a welded hull. These cases were then considered more or less of an experimental nature and were cited as instances of the extension of the welding art. It now seems that results have proven welding to be equally as valuable in this class of work as it is in locomotive work.

It is quite gratifying to your committee that the development of welding is now apparently being carried along conservatively. Fewer hit or miss methods are being employed, but our past experience has been sufficiently broad to enable us to study the question scientifically and we may expect from now on definite and steady progress; and it is essential that no stumbling block be put in the path of this development.

Welding should, of course, be regulated and efficiently supervised to minimize the possibility of poor workmanship. But this is true of all shop work, and such regulation and supervision should be given by the railroads themselves, based upon practical economy and common sense.

As it is considered that a low water case would constitute the supreme test of any seam, let us consider the effect of low water cases. There have been cases where every conceivable combination of seams has been involved—some with riveted seams only; some with welded seams only; others with both riveted and welded seams, and still others where no seams were involved. We see no reason to expect anything different in the future, and we will continue from time to time to encounter cases involving all these combinations, with perhaps an increase in the proportion of welded seams as welding becomes more generally favored in place of riveting. In other words, the presence or absence of welding is neither going to increase nor decrease the number of low water cases, nor is it going to affect in any way the intensity of any explosion that may occur. The intensity would, in our opinion, be just about the same. It matters not whether the seams are welded or riveted, or whether there are no seams at all involved.

This opinion is not the result of hasty conclusions on the part of your committee, but has been arrived at after a close study of a vast number of low water cases, and we believe that it will be found that the records of most railroads will substantiate this conclusion.

The pioneers who are responsible for the development and practical application of gas and electric welding have given to industry a valuable asset, which will increase in value as the art is further developed and experience in its use is broadened.

In addition to its value as a tool of industry, this process of joining metals together has immeasurably decreased the personal hazard of shop work, particularly in locomotive boiler and kindred work, by decreasing the noise and eliminating the possibility of flying chips—two factors chiefly responsible for defective hearing and loss of sight among our shop men. As the art of welding becomes more and more general, we shall see fewer deaf, and one-eyed boiler makers employed in our shops—a pitiful sight familiar in the old days of riveting, patch-bolting, chipping and calking.

Those who are inclined to oppose gas and electric welding should give this safety feature of the new process very careful consideration before arbitrarily attempting to place restrictions on it which might eventually stop its use or impede further progress—their opposition showing that they are, though unconsciously, increasing the hazard that workmen face daily.

The most carefully laid plans do not always materialize as expected. However, the welding process has now been in use a sufficient length of time to allay the fears of the most timid and skeptical; and due to the extreme importance of this very valuable asset, it is the recommendation of your committee that this subject be thoroughly discussed from the floor of the convention in order that all may derive the benefit of any recent or projected improvements in practice or application of the welding art that may not be known to all

Association at twentieth annual convention

members present, in the interest not only of efficiency and progress, but of safety as well.

This report was prepared by a committee composed of J. A. Doarnberger, chairman, L. M. Stewart, H. H. Service, J. F. Raps and J. J. Mansfield.

Discussion

W. H. LAUGHRIDGE, (Hocking Valley Railroad): In times past the practice of fusion welding has been criticized and there have been examples of fusion welding shown that deserved criticism. The members of this committee and the members of this organization do not approve of any such plastering of welds, as has sometimes occurred. I am satisfied that there is no question in regard to the practicability of fusion welding in locomotive fireboxes and I am saying this from personal experience which has covered the time since welding was first introduced. I am perfectly satisfied that it is safe where it is used in a practical way.

E. P. FAIRCHILD, (Atlantic Coast Line): I am very much interested in the welding game. I have been in it since 1922 and have been following it closely since that time and I shall try to give you a few points from what I have observed in the past few years in regard to welding as it may be of benefit to you and I hope that someone else here will express himself so that I can have something to take back with me this time. I had occasion some time ago to inspect and examine very closely a locomotive that was built for the Great Northern Railroad and everything on that locomotive was welded. All the brackets attached to the frame were welded except the guides. The foot plates were completely welded as were the deck plates. The tank frame was of structural steel and completely welded. I might say that in February of 1926 we inspected that tank and found all plates, etc., to be in as good condition as the day they were welded. The tank sides had not warped nor gotten out of shape; there were no loose bolts or rivets and all welding was in first class condition. This was after practically 18 months' service. In order to get our welding up to standard and keep it up to standard, we conduct tests of our welders every six months. In January we held such a test, and out of 18, there were only three of them that fell below 100 percent efficiency. On electric welding, we had a test made and only two fell below 100 percent. By this method we keep our welding up to standard. We are now substituting steel welded plates in our shops for castings. We find these give much better service and are much more economical than the castings.

L. E. HART, (Atlantic Coast Line): I can remember a few years ago of putting my head in a firebox with leaks all around me. We did not know whether it was safe, but we took a chance. On our railroad we have a number of welded fireboxes, in fact, about all of them are welded, and we find very few leaks. Certainly we have repairs to make, but we have been able to make repairs far superior to those in the past by the process of welding. We do not believe in putting just any kind of a welding operator on the job. In the first place we must have superior supervision for welding. Welding is an art—every man cannot do it. Every man placed in the shop to operate a welding outfit, regardless of which process he uses, should be a trained man when it comes to boiler work. Inefficient supervision is largely responsible for poor work. On our railroad, we insist on the very best weld that can be made, and to this end we must have proper supervision. We do not, however, stand for careless operators.

GEORGE AUSTIN, (Santa Fe Railroad): I recently had one of my staff go over our files of every locomotive firebox that is in service. I had him note the number of patches that had been applied by the fusion welding process. This did not include welds that were used in connection with syphons. It related to half side sheets, application of door sheets or crown sheets patches, fire-door hole patches or any part of the firebox practically, except patches in the crown sheet which we do not apply. We found that we had in service 5400 and some odd of such sheets and patches. During the year 1928, the Santa Fe locomotives actually accumulated an engine mileage of 63,300,000 and during that mileage we had two failures on account of fireboxes. It seems very clear that fusion welding has been absolutely successful and while it is now only applicable to the lower part of the firebox, in my judgment I feel it to be applicable and a safe process in any part of the firebox.

MR. WILSON, (Bureau of Locomotive Inspection): The report of the Master Boiler Makers' Association Committee on Welding, contains the following:

"There is a total of 229 feet of welded seams in the firebox, and in addition, a total of 575 feet is used externally; and 169 feet internally in the barrel section of the boiler as a sealing feature at seam edges, making a total of 973 feet of welding employed in the construction of this boiler."

In connection with the item "a total of 229 feet of welded seams in the firebox," official information shows that all welded seams in the firebox are of conventional type and location, there being nothing unusual with respect thereto.

In connection with the item "a total of 575 feet is used externally," which apparently applies to the external firebox, this would seem to include sealing at the mudring corners and the outside throat sheet—wrapper sheet seams, and some of the welding around staybolt sleeves and washout plug sleeves and blow-off cock nipples. There would appear to be no new features in connection with the application of welding to the external firebox, although welding around washout plug sleeves and blow-off cock nipples is of negative value as it is sometimes applied to conceal improper fitting of the parts and it serves no useful purpose if the parts are properly fitted.

In connection with the item of "169 feet internally in the barrel section of the boiler as a sealing feature at seam edges," the only welding shown on the barrel, with the exception of welded staybolt sleeves on the combustion chamber course, is the sealing between the edges of the barrel sheets at the ends of the butt straps, a total of 9 feet; and welding around washout plug sleeves, which is not considered good practice, this consists of 16 feet on the first two courses and 9 feet on the third or combustion chamber course. Probably the 169 feet stated to be used as a "sealing feature" refers to the sealing of riveted seams and other welding on the smoke box which consists of approximately 115 linear feet.

In reading the above, some people might consider that these seams on these barrel courses were welded but they are mostly butt-strapped and welded and the welding done around the edge. I want you to understand that I am not against fusion welding. I think it is one of the greatest inventions that has come into the mechanical world the last few years, but it is still in its infancy and the only thing I say is, do not go too far with it until you know what you are doing. We have some good welders in this country. Some of the work that I see is mighty bad, and yet the officials will say that they have good welders. You may have good welders and you may do good work, but there is a lot that is being done far from well and it is not the fault of the process—it is the fault of the man and the supervisor looking after that work. You cannot get too good supervisors, neither can you get too good welders and if you get good welders, appreciate them.

MR. CAMPBELL, (M. K. & G. Railroad): I was glad for one feature of the paper that was read, that was the safety feature, where it said that if we established more welding, we would not have quite so many deaf and sightless men around our plants. We are conservative in the welding proposition. In putting in new fireboxes we place the crown sheet in first, then we place the flue sheet in and the back sheet or door sheet. The back sheet of the firebox is riveted around the top and around the corner to about 12 or 15 inches from the highest point at either end. Also the flue sheet is riveted, then down the leg of the firebox is lap welded.

Boiler Corrosion and Pitting

Due to the failure of a regularly appointed committee to submit a report, the writer was asked to submit a paper covering this subject. If more time had been given me, it would have been my endeavor to obtain facts from sources, which through their scientific research work, have the information available in reliable form. However, this brief report may serve to stimulate discussion that will be interesting and instructive to the convention.

This topic may be divided logically under two headings, as follows:

1. *Boiler corrosion and pitting.* This section pertains to the underlying causes. The writer is frank to admit that it would be a waste of your valuable time for him to attempt to explain the theories in this connection, when we have with us here today men who are not only capable but willing to give us the benefit of their research work along these lines. It is undoubtedly the desire of the convention that these men be given the privilege of the floor, whether they are members of the association or not.

2. *What can be done in the boiler department to relieve the condition?* This should be divided into two headings: A.—Boiler in Service, and B.—Boiler in Storage.

A. The care of the boiler in service is directly up to the foreman boiler maker. In districts where pitting and grooving occur, there is usually some form of water treatment in vogue. The foreman boiler maker should see that the instructions for treating the water are rigidly followed; also that the boilers are thoroughly washed out at prescribed intervals, particular attention being given to the belly of the boiler and bottom of flues and, of course, the water legs. If this work is conscientiously done, the foreman boiler maker has done all he can do to relieve the situation.

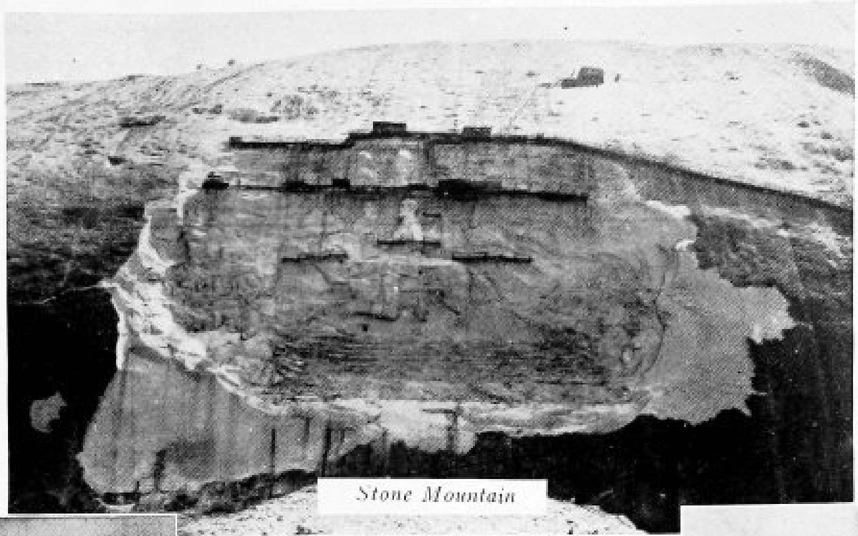
B. Experience has taught us that the pitting is greatly aggravated where boilers are stored. The question arises what can the foreman boiler maker do to relieve this situation?

When the boiler is to be stored during summer months or in districts where freezing need not be considered, the boiler should be thoroughly washed, cocks or valves having openings into the boiler should be removed and openings plugged air tight. The boiler should then be filled completely, leaving no air space.

When the boiler is to be stored during winter months in districts where freezing conditions exist, it should be thoroughly washed, then filled with water to the usual water level. Next, the boiler should be fired up, getting the full steam pressure carried. Blow off the steam as rapidly as possible. When steam is blown off remove all bottom washout plugs and lift the dome cap, the object being to remove all water and steam as rapidly as possible. The boiler should then be sealed up tight to exclude all air, removing all cocks and valves where necessary. It is true there is considerable trouble and labor connected with this practice, but it is the experience of the writer that it is time and money well spent. This report was prepared by A. F. Stiglmeier, chairman of the executive board.

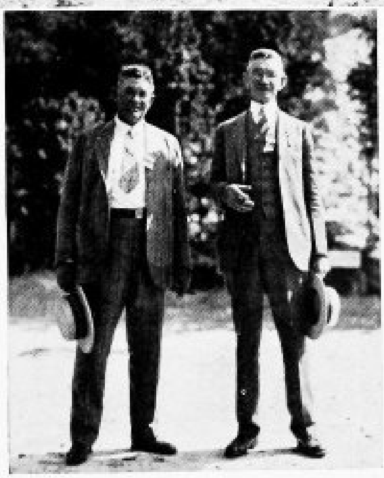
Discussion

B. C. KING, (Northern Pacific Railroad): The only thing we can do to help the condition along is careful boiler washing. Watch the washing of the boilers when they come in. We find that most of the pitting



Stone Mountain

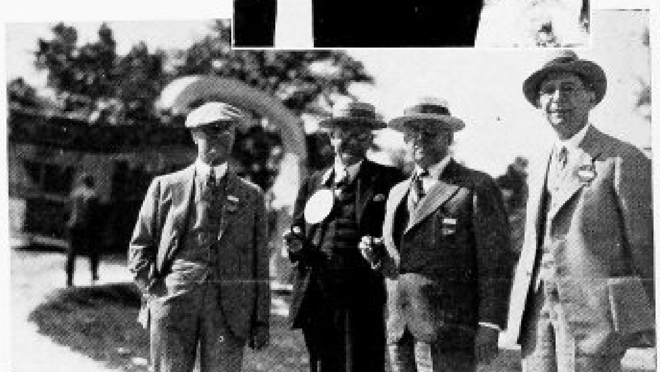
(Below) — Harry Loeb, president Supply Association



President Stewart and the genial treasurer, W. H. Laughridge

(Below) — G. B. Usherwood, the new president

(Above) — Buses arriving at Stone Mountain



Supply men who helped make barbecue a success, George Boyce, Uncle Fred Houser, J. C. Kuhns, and the hard-working secretary, W. H. Dangel

(Right) — Prominent members and ladies after enjoying the barbecue

is under the scale except where we have an acid condition. In our very best water division, where we have no treated water, we have the worst pitting and, for a long time, we were unable to do anything without the aid of some treatment, either mechanical or treating plant, which we are now installing.

T. P. MADDEN, (Missouri Pacific Railroad): We watch our boiler washing and that is about all the boiler foreman can do—see that he has had plenty of boiler pressure and that the proper time is taken to remove all scale.

O. H. KURLFINKE, (Southern Pacific Railroad): I have here a report made by our chief chemist on the use of its exchange silicate (zeolite) water softening in railroad practice. This paper was presented before the Division of Water, Sewage and Sanitation at the 75th meeting of the American Chemical Society, St. Louis, Mo., April 16 to 19, 1928. There are a lot of facts in this report that, I think, you gentlemen here are vitally interested in. (This paper will be presented in full in a later issue).

On page 55 of the official proceedings of the nineteenth annual convention held in Cleveland last year, I made some remarks concerning the use of air separators in the injector lines. Supplementing these remarks would now advise that the set of preheater tubes which to that time had made 24,803 miles, and which were applied October, 1926, were removed in August, 1928, and during 15 months actual service, made 32,074 miles. This tube mileage does not equal the most favorable performance we have experienced from similar locomotives not equipped with these separators and we therefore have arranged to continue the test with another set of new tubes and which to date have made but 18,557 miles. The average tube mileage for this type of power without separators is 27,250 miles and the mileage of 32,074 indicates an improvement. Next year I will endeavor to present the service given by the tubes now under test.

Combating Boiler Corrosion

By C. H. Koyl

THE progress of any science is made in stages, first of observation and collection of data, second of forming from these data a theory and third checking this theory by more observation to learn whether the theory is consistent with all observed facts. In the matter of corrosion in locomotive boilers and means of prevention, this has been a year of observation for purposes of checking the discoveries on this subject made in former years.

You will remember the statements of our former meetings, (1) that corrosion of steel and other metals takes place only under water, or at least in the presence of moisture, (2) that corrosion, such as pitting and grooving, proceeds only by the solution of atoms of iron in the water, (3) that iron can dissolve in water only when an equivalent number of hydrogen ions can be released from the water at some other point on the metal, and (4) that therefore we can prevent corrosion in our boilers, if we can prevent the escape of hydrogen ions from the water in the boilers.

You will recall also the statement at our last meeting that our three proven methods of reducing and practically eliminating pitting are all in the last analysis simply different methods of preventing the escape of hydrogen ions from the water.

The first and oldest of these methods consists of the use of caustic soda in the boiler water, because the presence of caustic soda so reduces the number of hydrogen ions that the tendency to escape is practically nil. But this method is limited to soft waters because there would be excessive foaming with hard waters.

The second method, the Gunderson method, consists in keeping the iron coated with metallic arsenic which prevents the access of hydrogen ions to their only door of escape, the cathodic iron surface. This method can be used, it is believed, equally well on soft and hard waters. During the past year there has been quite an extension of the use of the Gunderson process on other roads than the Chicago & Alton where its value was first demonstrated, and considerable first-hand-information is probably now available.

The third method is that of the exclusion of oxygen from the feed water because this process allows the hydrogen ions to prevent their own escape by jamming the door of egress. This process has been proven for locomotive use by four years continuous service on the C. M. St. P. & P. R. R., and I am now able to give you the completion of the story.

This boiler was fitted with an open feed-water heater and placed in service on the worst-pitting division of the C. M. St. P. & P. R. R. in January 1925. For comparison, another locomotive with new flues, a mate in all respects except that it had no heater, was placed in companion service. During the four years a couple of tubes were removed every two months from the heater engine for examination. At first these tubes were replaced by new tubes, but after a couple of years replacements were made by second-hand tubes from other boilers of which many had been spot-welded and had small pit marks surrounding the spot-welds.

At the end of 2½ years not a mark had been discovered on any tube of the heater engine, but at that time it was necessary to move the engine for a month to a district where only some of the waters were treated and the mixture of soft and hard waters caused so much foaming that the new and inexperienced crew used the injector most of the time. When the engine was returned to the roundhouse two tubes were found pitted on the front end. These tubes were replaced by others and the engine put back on treated water service.

At the end of four years' service, in January 1929, the boiler was dismantled and every tube and flue and the boiler shell examined by six of our best boiler men. All the original tubes were in practically the original condition, the new tubes used in replacement were in the same condition, the spot-welded tubes looked as when they were inserted in this boiler, the small pits clean and with no sign of deepening. All the tubes and flues, with the exception of the second-hand replacements, were retipped and put back in the boiler for another four years' service.

During these four years the companion engine, without a heater, has been reflued four times, and each time we have been able to retip only about 40 percent of the flues.

During the past year, on each of four other divisions, we have tested three mated engines, one with an open feed-water heater, one with a closed feed-water heater, and one without a heater. Two of these divisions had treated water, one had waters about 30 grains-per-gallon hard to which we added soda-ash in the engine tank, and the other division had water about 15 grains-per-gallon hard but carrying also a few grains of natural sodium carbonate. All of these boilers we have examined at the end of one year's work, and in each case we have found the open-heater-boiler in the best condition, the closed-heater boiler next, and the boiler without a heater last. None of these boilers were badly pitted, there being only small pits on the worst of them and rust spots showing through a thin scale on the others.

Three conclusions appear to me evident from the examinations of these boilers; (1) that the presence of caustic soda in the treated waters has nearly annihilated corrosion of all kinds; (2) that the use of soda-ash on our hard-water division between Perry, Ia., and Council Bluffs, Ia., has nearly done away with pitting, and (3) that the open feed-water heaters on these other divisions have not received the loving care bestowed by the original crew on the first open heater placed four years ago on the Sioux City Division.

I am firmly convinced that the exclusion of oxygen from the feed-water of any locomotive on a treated-water district will prevent all pitting, and that an open feed-water heater, properly operated, will exclude enough oxygen for the purpose. But it must be remembered that the occasional use of the injector will admit enough oxygen to cause some pitting on any district where pitting is naturally bad.

And do not forget that the crew which operates an open heater for the exclusion of oxygen and the prevention of pitting is also saving about 12 percent of the coal and water, which in an engine of ordinary size is worth $2000 per year.

O. W. CARRICK: I was formerly on the Wabash payroll, but at the present time, it is my pleasure to be with the Electro-Chemical Corporation, which is promoting the Gunderson process—as a result of this, I am indirectly on the pay rolls of several railroads, so I am still railroading. Dr. Koyl mentioned the three various methods, so called, for the prevention of corrosion. In the Gunderson process, the sole purpose is to maintain a protective film on the boiler interior, this film consisting of a coating of metallic arsenic and on top of this plating of arsenic, a plating or film of hydrogen gas. If the process maintains the film of hydogen gas, it is impossible for the iron to go into solution and with the use of current taken from the generator, the water is broken up into its hydrogen and oxygen constituents. In protecting any metal under the electro-chemical theory, it is necessary to preserve a protective film. Even under atmospheric conditions, this protective film is produced. Mr. Speller recently had an article in the *Industrial Engineering Chemist*, in which he brought out the various alloys that are being used in metals to produce oxides on the surface and also he brings out the fact that these alloying metals and the films do not function in the same manner in the boiler water. He makes the statement that paints are absolutely useless to prevent corrosion under water conditions or soils. The Gunderson process is now in use in 120 locomotives. In the matter of maintenance of equipment, we have had some trouble in the insulation breaking down where the current is passed through the boiler shell, and recently we have developed electrodes with more insulating material on them to get away from this. It is necessary that the current flow into the boiler and whenever the insulation breaks down the effectiveness of the process is retarded. Instructions are given to the various electrical men or the inspectors to determine whether the current is flowing through into the boiler in the correct manner or not and it is very simple to check up the efficiency of the process.

S. E. JOHNSON, (Chesapeake & Ohio Railroad): The subject of pitting and corrosion is very complex and one which calls for lots of study and no doubt you gentlemen think we should have a solution ready for you at this time. However, when you realize that there are probably as many as seven or eight factors, important factors, which have to do with this problem and that anyone or any combination of these under favorable corrosion conditions, may result in trouble, you will find that it is certainly a difficult problem. Now, there are only three or four methods of attacking the problem and those have been outlined to you and I will not go into details further. However, it is only fair for you to know that on the C. & O., we have been using a treatment, primarily lime, soda, ash and some suitable coagulant and we have done very well with it. In 1923, when systematic treatment was started on that railroad failures resulting from leaks on that road were 186. As a result of treatment and co-operation of the boiler department, we do not hesitate to say that leaky failures, which are attributable to water conditions, have been decreased from 186 to 3 in 1928. If there is an engine comes into the shop, which is pitted, my attention or the attention of our department is called to it. We do not stop there. We trace the history of the service of that engine back to the district to which the trouble could be attributed. By that method, we have found, in most cases, where to start work first, and we prevent, or practically prevent pitting and corrosion and on metal flues, fireboxes, etc., there is a coating—a very fine coating of calcium that is no thicker than this sheet of paper and I think that is the secret of our success. If you want to protect the metal, you must put the protective coating there.

R. E. COUGHLAN, (Chicago & North Western Railroad): There are lots of ways you can co-operate with the chemist. On our railroad, about six years ago, we introduced the boiler foreman to a little test outfit by which he, himself, could make a simple test and determine the quality of water. That has been a life saver. Now, in approaching it in a technical way and in a practical way, for your information, I might say that during the past year, we have commenced to show results financially both on railroads, as well as in the case of industrial concerns.

Wednesday Morning Session

After calling the convention to order Wednesday morning, President Stewart introduced O. H. Hunt, mechanical engineer, Florida East Coast Railway, an abstract of whose remarks follows:

Co-operation with the Mechanical Department

O. H. Hunt

THE master boiler maker is in almost daily contact with the railroad mechanical engineer, directly or indirectly. The workings of the boiler inspection law practically makes the master boiler maker and the mechanical engineer jointly responsible for changes in boilers and repairs requiring an alteration report. Numerous other questions arise that have to be settled between them. This does not mean that we short-circuit or side-step the head of the department, but we work out the details and take them to him for approval.

Less frequently but nevertheless quite often the master boiler maker is in contact with designing engineers of machine and small tools such as are used in the boiler shop.

Combustion engineers in the design, construction and operation of the many types of furnaces in use.

Hydraulic engineers in the design, construction and arrangement of water systems and hydraulic tools.

Compressed air engineers in the various uses to which compressed air is applied.

Welding engineers in the use of electricity and gas in cutting and welding, and the equipment necessary to carry on the work.

Electro-chemical engineers in processes designed to reduce or eliminate pitting and corrosion in boilers, and chemical engineers in water softening and preparations for reducing foaming and softening scale that boilers may be kept clean without an undue expenditure of labor.

To this may be added the designers of the many different appurtenances necessary to complete the modern boiler.

Salesmen and service engineers following up and checking the application and operation of their various specialties and to the everlasting credit of the master boiler maker, and a very striking evidence of his general knowledge it must be said that he works in harmony with all of these and still delivers his boilers to the erecting shop on schedule, and how he does it is almost incomprehensible, but he does it.

In the many things that enter into the construction and maintenance of boilers, whether it be a question of tools, methods of construction or maintenance of appurtenances, some of which are originated by the master boiler maker, some by other members of the railroad organization and some by manufacturers or their representatives; it is by the combined knowledge of the different parties interested, and attacking the problem from different angles and that has made possible the giant boilers of today. None of these are the results of an over-night thought. It has taken years of hard work, disappointments, near success and finally achievement to increase boiler pressure from the very low pressure once carried to the high pressures now in use. No one is willing to hazard a statement as to when the practical working limit will be reached. A radical departure from standard designs, while they may appear simple problems on the drawing board, tax the boiler shop to the utmost to work out ways and means of construction. The standard tools are not suitable for the work and new tools must be designed. The first tools worked out are not perfect and the master boiler maker finds the weak spots when they are put in operation. Then the job is complete and goes on test, weaknesses develop where they were not thought of or where the construction seems to be the best possible, and the design must be changed and that part of the work must be done over again. This was our experience in applying the first oil-burning equipment to coal burners and in applying the first superheating equipment. I believe the Florida East Coast applied the first superheating equipment to a saturated engine that was applied in the southeast.

In all the changes through which the art has passed it has been the privilege and duty of the master boiler maker to choose and hold to that which was good and to discard that which was bad or useless. By so doing we now have pneumatic and hydraulic riveting instead of hand work, electric welding to help keep our flues tight and for making repairs. Pneumatic tools for drilling, tapping, reaming, etc., superheaters, feed water heaters, exhaust steam injectors, water softeners to keep the hard scale out of our boilers, washing compounds to soften such scale as does form to enable us to more thoroughly clean the boilers, thermic syphons, flexible staybolts and many other items too numerous to mention.

On our road we have consistently carried out the principles of co-operation between various interests that have a bearing on our problem for a number of years and are now reaping results. We are using fusion welding in all places where we have found it safe and profitable, hot water for washing and filling boilers, a regular schedule of washing and blowing, a softening compound for scale before washing, hollow flexible stays. We have found it necessary to increase the number of washout plugs in boilers over the conventional number.

Thermic syphons, feed-water heaters, softening water in charge of a chemist whose duty it is to see that the proper amount of softening material is used to keep the water in good condition. Careful inspection not only to conform to I. C. C. regulations, but to keep the power in best possible condition; working on the principle that a stitch in time saves a patch. By so doing we have reduced our staybolt breakage on engines with syphons, feed-water heaters and flexible staybolts in complete installations to 281 bolts per 1000 engine miles, as compared with 2631 bolts to 1000 engine miles on engines not so equipped.

The use of the electric welder, softened water, regular washing and blowing syphons for circulation, feed-water heaters for increasing the temperature of the feed water before entering the boiler, combustion chamber fireboxes that relieve the ends of the flues from the intense heat in the main part of the firebox, and the use of softening compound in boilers before washing has increased the flue miles from an average of 35,000 which was the limit before any of the foregoing appliances or material were in use, until on April 30, of this year, we had 56 locomotives that had made more than 75,000 miles; 19 with more than 100,000 miles, to two with over 200,000 miles, the maximum being 245,096 miles. Just how much credit must be given to each of these items it is impossible to say. There is no doubt that each plays an important part but, after all, if it were not for the skill and industry of the men having the maintenance and operation in charge they would be useless. To these men must be given the large credit.

The remainder of the morning session was devoted to the reading and discussion of three topical reports which included:

"The Best Methods for Applying and Maintaining Firebox Syphons on Locomotive Boilers," prepared by a committee composed of C. F. Petzinger, chairman; W. C. Becker and J. P. Powers.

"Best Practice for Finding Water Levels on Locomotives when Applying Boilers to Frame," prepared by a committee composed of L. C. Ruber, chairman; P. J. Conrath and L. E. Hart.

"Standardizing the Design of Boiler Tools," prepared by a committee composed of W. N. Moore, chairman; J. A. Graulty and I. J. Pool.

These papers and their subsequent discussion will be published in an early issue of THE BOILER MAKER.

On Wednesday afternoon members of the association, their guests and ladies were entertained at a barbecue held at Stone Mountain as guests of the Boiler Makers' Supply Men's Association.

Thursday Morning Session

The principal address delivered at the opening of the Thursday morning session was by O. A. Garber, chief mechanical officer, Missouri Pacific Railroad. An abstract of Mr. Garber's remarks follows:

Cutting Maintenance Costs

O. A. Garber

To my mind, the two most important duties of the mechanical department of a railroad are: First, to give service; and second, to maintain the equipment at the least possible cost.

The boiler, being the foundation of the power in a locomotive, should be given first consideration when the locomotive is passing through the back shop for general repairs. It is the duty of the boiler supervisors, when an engine is brought into a shop, to see that the tubes are removed at once so that he may have a thorough inspection made of the interior and exterior of the boiler without delay, in order that there will be no loss in time of scheduling the work so that the engine may be handled through the shop in the least possible number of days.

I want to lay particular stress on the fact that a supervisor should give as much of his personal attention as possible to the important work to be done on the boilers in his shop. For instance, in applying a new firebox to an old shell, special care should be taken in the laying out to see that the staybolt holes are in proper alinement and sheets properly fitted and bolted up before any riveting is started. Careful supervision should be given the tapping and running in of staybolts. No loose bolts should be allowed to remain in the boiler. Bolts applied in this manner and carefully headed over should give you considerable service before any trouble is experienced with them. This applies to both new and repair work. Whenever proper inspection has been made and it is found that shell sheets or firebox sheets are in need of repairs, I feel that we are justified in replacing the sheet rather than putting a patch on it and gambling on more trouble with it in the future. I think you will find that the application of an entire new sheet will in the long run prove to be more economical than applying patches to the sheets on the boiler.

After the locomotive boiler has been properly repaired in the back shop and the locomotive placed back in service, it is then our duty to see that the enginemen, hostlers and roundhouse men are properly instructed and educated as to proper care to be given the boiler while in their care. Enginemen should be educated to avoid putting water into a boiler when the engine is not in motion, if at all possible. They should also be educated to have their boilers full when they arrive at the cinder pit, and, needless to say, water should never be put into a locomotive boiler after the fire has been knocked, if it can possibly be avoided. After the fire has been knocked and the engine moved to enginehouse, the smoke stack should be covered. This will help to keep air from being drawn through the tubes and causing them to leak. One of the most important items in the care of a locomotive boiler in an enginehouse is the proper washing of the boiler. The boiler foreman should see that there is posted in the house, so that it can be seen by all concerned, a set of rules providing for proper cooling down and washing of boilers, and it should be the duty of the boiler foreman to see that all boilers are properly inspected after they are washed. There should also be set up in the roundhouse a code of rules setting forth the particular cares, which should be given to washing of the boilers on the particular districts, according to the conditions on the respective districts, including minimum length of time between washouts, etc.

With the proper co-operation from the other departments of the railroad, we should be able to get much better service out of our boilers than many of us are getting at the present time.

Today the tendency is to go to higher boiler pressures. This means a steel of greater strength and heavier plates, which leads up to new tools for the purpose of doing the work economically. It is your duty as supervisors to be able to sell to your management the idea that proper tools should be furnished in order that you may be able to economically and successfully build and repair these large boilers which are now confronting you. You should, of course, see that all of your small tools as well as large tools are kept in first class condition at all times.

Many railroads are making a special effort to give their apprentices a technical education along with the practical work done by them in the shops. Incidentally, this is being done by the railroad for which I am working. We believe that by so doing we will have a much more competent mechanic at the expiration of his apprenticeship, and feel that he should be kept in our service if at all possible.

The question of feed water that is furnished our locomotive boilers today is one that requires more study than probably any other that confronts us at this time. Many railroads have corrected bad feed-water conditions on their line of road by a chemical treatment of their water, while others have found waters which they have not been able as yet to properly treat to stop corrosion. This matter is being given very careful consideration by the Mechanical Division of the American Railway Association at the present time and we hope to be able to derive great benefits from the study that they are preparing to make.

It is the duty of each and every supervisor to see that there is posted in his shop a set of safety first rules to be adhered to by the men under his jurisdiction. He should know that all tools are kept in a safe and suitable condition for service, both for the benefit of the company for which you work and for the benefit of the employee and his family.

Following the conclusion of Mr. Garber's talk, the discussion of committee reports was continued. The first paper at this time covering the subject of effect of long locomotive runs on the life of fireboxes. This paper appears below.

Locomotives in Long Run Service—Effect of High Pressures and Stoker Firing

The committee has studied this subject very thoroughly from all angles. The economy and other advantages of operating a locomotive over two or more divisions have been quite well demonstrated by railroads throughout the country. By this means the mileage has been increased and the maintenance cost of the locomotive at the intermediate terminal has been considerably lessened by reducing the shop forces, as well as decreasing the maintenance cost of tools and supplies.

When locomotives are on long runs and the working pressure is maintained the greater portion of the time, less coaling and steaming of the boiler is required, which reduces the contraction and expansion of the firebox sheets to a minimum, and causes longer life for the firebox, boiler and attachments.

Again, modern design fireboxes and boilers, as well as the material which make up these parts, have a considerable bearing on prolonging the life of the firebox and the boiler.

Several of the railroads have gone to the high pressure of 275 pounds per square inch, and are getting very good results. Again, long runs and stoker firing are combined together to increase the life of fireboxes by having a more even temperature, not only by keeping the fire door closed when engine is working, but by the elimination of frequent cooling of the boiler at washouts as well.

Long runs also make for a higher standing of conditions when dispatching a locomotive out on a trip. It also encourages the management to invest in better water conditions; that is, they feel that it pays to spend money to improve bad water conditions, rather than to spend money at terminals for boiler work, boiler washing and engine handling. All of these savings have a tendency to materially reduce the operating cost.

If we could maintain the boiler from the time it was built, at an even temperature, there would be little necessity for renewals or repairs. The strains and stresses caused by unequal or varying temperatures wear out the boiler, and it goes without saying that the most extreme variations in temperatures are in roundhouse handling.

Therefore, if you can cut the roundhouse handling in two, it would greatly extend the life of the boiler and the firebox. There are other factors which enter into this problem—for example, pitting and corrosion which are caused largely by water conditions. While these have some direct bearing it is a fact that the stresses due to unequal temperatures create a condition in the metal that permits the corrosive agents to get in. Therefore the varying temperatures and corrosion are the principal deteriorating agents which boiler men have been fighting against and which in some parts of the country prevent long runs of locomotives.

Our investigation has developed the fact that locomotives throughout the country engaged in long-run service are equipped to burn oil, and it is our understanding that they are giving excellent results.

There are several modern appliances, such as feedwater heaters, arch tubes, arch brick, syphons and the welding of flues in firebox end which contribute to the longer life of the firebox on long runs, and it is the consensus of opinion that the last item mentioned has been a very large factor in the long runs of locomotives.

This report was prepared by a committee composed of K. E. Fogerty, chairman, George Austin and T. W. Usherwood.

Discussion

J. F. RAPS, (Illinois Central Railroad): The Illinois Central Railroad has employed a number of Lima A-1 locomotives, having a boiler pressure up to 250 pounds per square inch, for the last two years. Up to the present time no trouble has been experienced in long locomotive runs where these engines were used so far as the boilers are concerned, but considerable trouble has been experienced in maintaining the running gear. This is probably due to the fact that more tonnage is hauled behind these engines and they go to pieces more quickly. Two years ago the length of runs on this road was extended up to 395 miles. Savings have been accomplished by extending the length of run, because where formerly a locomotive would go 80,000 miles between shoppings the Illinois Central is now getting from 100,000 to 150,000 miles. This result is partly due to the fact that forces have been reduced and the need of power keeps the engines on the road longer. The maintenance under these conditions is perfectly acceptable, however, to the Interstate Commerce Commission, Bureau of Locomotive Inspection. It is our experience that the stoker-fired engine, where properly handled, will have a tendency to extend the life of tubes and flues. With hand firing, engine crews often keep too thin a bed of fuel which eventually cause fire cracks to form in the plates. With stoker firing, holes in the fire bed are prevented and the rapid heating and cooling of the sheets is thus eliminated. The life of firebox sheets and flues reverts back to the proper drafting of locomotives. Low water conditions, welding of flues in the rear tube sheet and long locomotive runs have, we feel, greatly improved maintenance conditions.

GEORGE AUSTIN, (Santa Fe Railroad): On the Santa Fe it was first necessary to improve water conditions before long runs could be made successfully. At the present time the longest run on this road, a matter of 660 miles, is maintained with oil-burning mountain-type locomotives. These locomotives are making the run from Los Angeles to Winston, Ariz., and return without being detached from the train. Before flues were welded to the back tube sheet it was necessary to re-calk them at Winston before going out on a run. Before water conditions were improved a set of flues would last only from 9000 to 10,000 miles in general, and it was exceptional for a set to last 20,000 miles. Staybolt breakage under present operating conditions has been reduced almost 4000 bolts a year. In 1927 we renewed 67 fireboxes and in 1928 it was necessary to renew only 24 fireboxes. The first fireboxes on mountain-type and Santa Fe-type locomotives placed in service in 1919 have yet to be renewed. The thermic syphons, we have found, have also greatly aided in satisfactorily accomplishing the long locomotive runs on the Santa Fe. Corrosion and pitting especially on freight runs have also been materially reduced. To this end, we have installed 75 auxiliary water treating plants in addition to the main plants throughout the system. It is our intention to increase pressures carried on our locomotive boilers, five of our engines now carrying 275 pounds per square inch.

T. P. MADDEN, (Missouri Pacific Railroad): For runs of 200 miles or over we find that it is necessary to improve water conditions in order to escape trouble. Formerly where staybolts on our locomotives would start to leak on new power after six weeks or two months service and we would have to renew half side sheets in three months, we have extended this time to more than a year. Water treatment has been mainly responsible in accomplishing this result.

Use of Steel Staybolts in Locomotive Boilers

A very careful investigation involving 88 percent of all the locomotives in the United States reveals that very little progress has been made in this country regarding adoption of steel staybolts instead of iron.

At the present time steel staybolts are used on but 2 percent of all the locomotives investigated as mentioned above, the total number investigated being 88 percent, and information received thereon should be representative of all the locomotives in the country, this report covering 57,900 locomotives out of a total of 65,900.

The majority of installations of steel staybolts are still reported as being on test. In a few cases where opinions are expressed they are favorable, and one southern road of considerable size has adopted the steel staybolts as standard, the number of locomotives on this road being 80 percent of the total of all those using steel staybolts.

To make this clearer, steel staybolts have been adopted as standard on one road having over 1000 locomotives, and these are 80 percent of the 2 percent of all locomotives in the United States equipped with steel staybolts.

It would appear at the present time that there are not enough conclusive results available to express a definite opinion as regards the benefits derived from the use of steel staybolts as compared with iron, in the United States.

The accompanying table shows typical specifications for steel staybolts in five different cases.

In England steel staybolts are in general use, also staybolts of iron and copper, and the results obtained with steel staybolts are reported as being satisfactory and very favorable.

In Canada steel staybolts have been used for six or seven years on one of the large roads with excellent results, and on another large trunk line both steel and iron bolts are used and it is expected that steel will be adopted as standard.

In Mexico inquiries covering 411 locomotives elicited reports that steel staybolts are not used.

Regarding the benefits derived from the use of rigid hollow bolts instead of solid: These are undoubtedly beneficial, being much easier for inspection purposes as indicating broken bolts no matter where the fracture is located and save time, in that it is not necessary to remove any grate bars or brick work to make the ordinary hammer inspection.

A great many roads are going to the use of hollow flexible staybolts instead of solid flexibles, as with these any failed bolts can readily be detected as soon as the fracture occurs.

With this type of staybolt it is also possible to make use of the electrical inspection method thereby eliminating the necessity of removing caps every two years.

This report was prepared by a committee consisting of W. R. Hedeman, chairman; R. A. Pearson, and Lewis Nicholas.

Comparison of Specifications—Steel Staybolts

Specification	Carbon Percent	Percent Manganese	Silicon Percent	Sulphur Percent	Percent Phosphorous
A	.15 Max.	—	—	—	—
B	.10 to .12	.35 to .50	.15 to .20	.05 Max.	.05 Max.
C	.12 to .18	—	—	.06 Max.	.06 Max.
D	—	—	—	—	—
E	.10% Max.	—	—	.05% Max.	.05% Max.

Nickel Percent	Chromium Percent	Tensile Strength	Elastic Limit	Elongation in 8 in.	Reduction in Area
1.50 to 2.00	.15 to .30	69360	48930	32.75%	63.70%
—	—	55000 to 65000	65% of Tensile	30 to 35%	55 to 65%
—	—	64000 to 74000	—	28 to 23 over 3"	—
—	—	52000 to 60000	—	27%	—
—	—	50000 Min.	—	30% Min.	65% Min.

Discussion

I. J. Pool, (Baltimore & Ohio Railroad): My experience with steel staybolts is confined to one full installation of flexible steel staybolts applied to a Mallet compound engine with a working pressure of 220 pounds per square inch. The firebox end of these staybolts had a tell-tale hole and instead of driving the bolts in the usual way, they were expanded tight in their holes after which the edges of bolt heads were beaded down to the sheet with a special made beading tool.

I had an opportunity to follow this installation of staybolts for about two years during which time the locomotive ran approximately 40,000 miles. During this period our inspections indicated that we experienced considerably less staybolt leakage in fire line of side sheets than on other locomotives operating under similar conditions. I attribute this improvement to the staybolts being expanded instead of driven.

Some time later we attempted to apply some iron staybolts in the same manner as the steel bolts were applied. In doing this we found the iron would split before bolt would expand tight in hole and cause a bad condition. After the engine, I referred to, had been in service for approximately one year, we began experiencing considerable trouble with the staybolts breaking. Examination of staybolts adjacent to those found broken showed no evidence of fracture such as is frequently found in iron staybolts. This condition left me with the impression that steel staybolts when found broken fail without giving warning and do not develop the same kind of progressive fractures as do iron staybolts. In connection with the use of hollow staybolts—this type bolt is becoming more popular for the reason that it simplifies inspection. The fact that a fracture can be located anywhere regardless of location is an item well worth consideration.

R. A. Pearson, (Canadian Pacific Railway): In our experience steel staybolts have less breakage than iron. Hollow flexible bolts are gradually coming into wider use on our railroad and give excellent satisfaction. We have not had steel staybolts in service long enough yet to determine exactly how they will work out.

M. V. Milton, (Canadian National Railway): Five years ago we built 100 engines equipped with steel staybolts, both solid and hollow flexible type. On one mountain-type locomotive we have had a mileage of 300,000 with only one bolt breaking. All later power is being equipped with steel staybolts. The steel has a small nickel content.

W. H. Laughridge, (Hocking Valley Railroad): We have not had enough experience as yet with steel staybolts to make any definite statement in this connection. We have, however, experienced difficulty in threading the steel bolts satisfactorily and finally solved the problem by grinding the dies carefully and threading the bolts while maintaining sufficient and proper lubrication. Seven years ago we tried out an old ogee firebox with steel bolts and ran it for two years with complete satisfaction. Recently we fitted a Mallet with a complete installation of steel bolts. We expect good results from the use of steel.

E. P. Fairchild, (Atlantic Coast Line): We have also had trouble with threading steel bolts and find that by adding sulphur to the compound we can overcome the difficulty. Steel staybolts have been made standard on our railroad. The secret of overcoming leakage is in getting a snug fit and by carefully using the bar when driving. Steel staybolts have been in service on our road for three or four years but we are unable as yet to give any definite comparisons.

L. M. STEWART, (Atlantic Coast Line): Seven years ago we first tried out the steel staybolt and finally adopted it as standard after it had indicated its value over this period of time. We used full installations of hollow steel staybolts on fireboxes. We are considering flexible bolts for later power to operate under high pressures.

A. F. STIGLMEIER, (New York Central Railroad): In our estimation the hollow flexible bolt is the staybolt of the day. All our later power is equipped with flexible bolts. We use a wrought-iron type bolt. The hollow flexible staybolt will be found of advantage in boilers carrying higher pressures.

J. F. RAPS, (Illinois Central Railroad): We have had ten engines equipped with steel staybolts in service now for four years and, at the next convention, will undoubtedly be able to give an interesting service report on them. The hollow bolt is, we think, necessary in cutting down inspection and maintenance costs because of the necessity of stripping an engine, removing lagging and removing solid flexible bolt caps in order to examine them. We save about $200 per engine by using the hollow bolt, figuring the cost of the solid bolt at 11½ cents and of the flexible bolt at 4 cents. The hollow rigid staybolt is as great a money saver as the hollow flexible staybolt.

C. W. BUFFINGTON, (Chesapeake & Ohio Railway): On our road four large Mallet locomotives were equipped with steel and iron bolts in various combinations and after a year and a half we found that the iron bolts appeared to be in slightly better condition than the steel. Our experience is that the holes on flexible bolts stop up and do not make the savings in inspection costs claimed by some of the members. If the hole extends from the top down, the difficulty is greater than when the hole is at the bottom. We have gone back to the use of solid flexible bolts.

The final paper discussed during the morning session was on the subject "Cold-Drawn Flues and Cold-Flanged Firebox Plates and Their Advantages." This paper, which will appear in an early issue of THE BOILER MAKER, was prepared by a committee composed of O. H. Kurlfinke, chairman; H. V. Stevens and George L. Young.

Thursday Afternoon Session

On Thursday afternoon the association was host to officers and members of the Southern and Southwestern Railway Club. F. P. Powell, superintendent of motive power, Atlantic Coast Line, president of the club, after a short outline of its history, introduced A. J. Law, past president, who is master mechanic of the Chattanooga & St. Louis Railway at Chattanooga, Tenn.

The afternoon was mainly devoted to addresses of general interest, the first being delivered by L. R. Powell, Jr., president of the Seaboard Air Line. His remarks will be published in a later issue.

At the conclusion of Mr. Powell's talk, John M. Hall, assistant chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission, addressed the combined associations.

The final paper of the afternoon, which was illustrated by lantern slides, was read by H. L. Miller, metallurgist, Central Alloy Steel Corporation, Massillon, O., on the subject "Failure of Steel Boiler Plates —Its Causes and Suggested Remedies." This paper, which is too lengthy for publication in this report of the proceedings of the meeting, will appear in later issues of THE BOILER MAKER.

The annual banquet tendered by the Supply Men's Association to members and guests of the Master Boiler Makers' Association, was held on the hotel terrace Thursday evening.

Friday Morning Session

The closing session of the convention on Friday was devoted to routine business and the election of officers. R. E. Simpson, general manager (Lines West) of the Southern Railway, who had been scheduled to address the meeting at this session, was unable to attend because of ill health.

Election of Officers

Near the end of the session the following officers were elected for the coming year:

President—George B. Usherwood, supervisor of boilers, New York Central Railroad, Syracuse, N. Y.

First Vice-President—Kearn E. Fogerty, general boiler inspector, Chicago, Burlington & Quincy Railroad, Aurora, Ill.

Second Vice-President—Franklin T. Litz, general boiler foreman, St. Paul Railroad, Milwaukee, Wis.

Third Vice-President—O. H. Kurlfinke, boiler engineer, Southern Pacific Railroad, San Francisco, Cal.

Fourth Vice-President—Ira J. Pool, district boiler inspector, Baltimore & Ohio Railroad, Baltimore Md.

Fifth Vice-President—L. E. Hart, boiler foreman, Atlantic Coast Line, Rocky Mount, N. C.

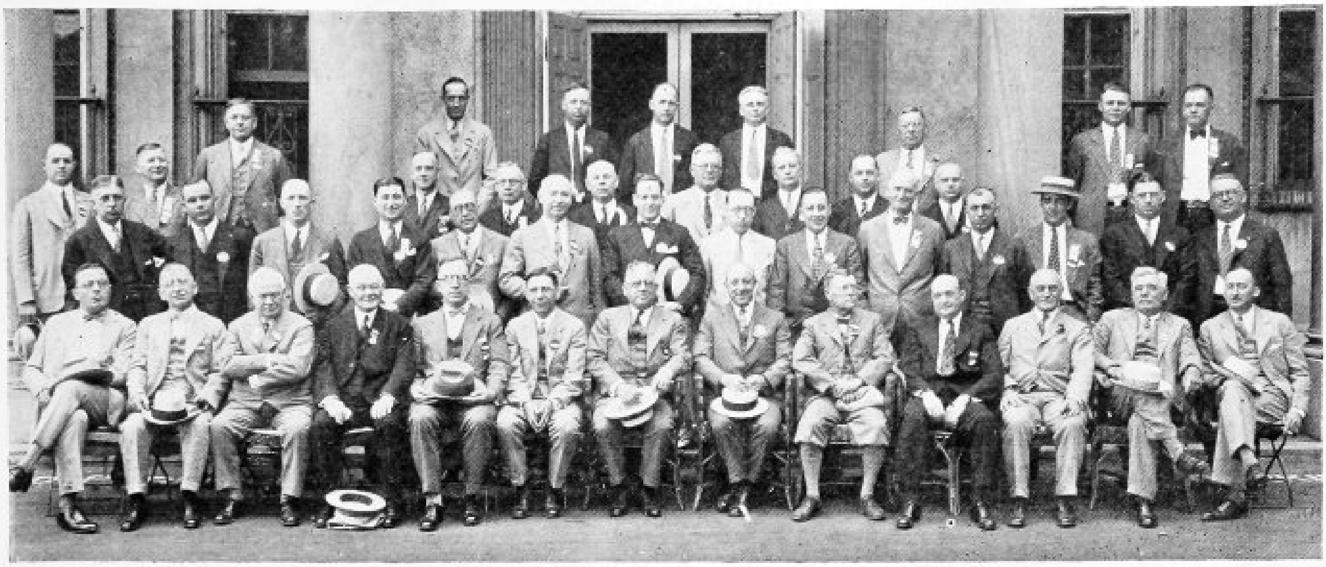
Assistant Secretary—Albert F. Stiglmeier, general foreman boiler maker, New York Central Railroad, Albany, N. Y.

Treasurer—W. H. Laughridge, general foreman boiler maker, Hocking Valley Railroad, Columbus, O.

Executive Board—A. F. Stiglmeier, New York Central Railroad, Albany, N. Y., chairman.

Executive Board (one year)—Albert F. Stiglmeier general foreman boiler maker, New York Central Railroad, Albany, N. Y.; C. H. Browning, general foreman boiler maker, Grand Trunk Railroad, Battle Creek, Mich.; George L. Young, foreman boiler maker, Reading Company, Reading, Pa. (Two years)—Charles J. Longacre, foreman boiler maker, Meadow Shops, Pennsylvania Railroad, Elizabeth, N. J.; R. A. Pearson, General boiler inspector, Canadian Railway, Winnipeg, Manitoba; William N. Moore, general boiler foreman, Pere Marquette Railroad, Grand Rapids, Mich. (Three years)—John Harthill, general foreman boiler maker, New York Central Railroad, Cleveland, O.; M. A. Foss, supervisor, boiler inspection and maintenance, New York, New Haven & Hartford Railroad, New Haven, Conn.; George G. Fisher, foreman boiler maker, Belt Railroad, Chicago, Ill.

At a meeting of the executive board, following the session, Charles J. Longacre was appointed secretary of the executive board.



Officers and members of Boiler Makers' Supply Men's Association at Convention

Annual Meeting of Boiler Maker Supply Men

AT the annual meeting of the Boiler Makers' Supply Men's Association, held at the Atlanta-Biltmore Hotel, Atlanta, Ga., May 23, in conjunction with the twentieth annual convention of the Master Boiler Makers' Association, the following officers were elected for the coming year:

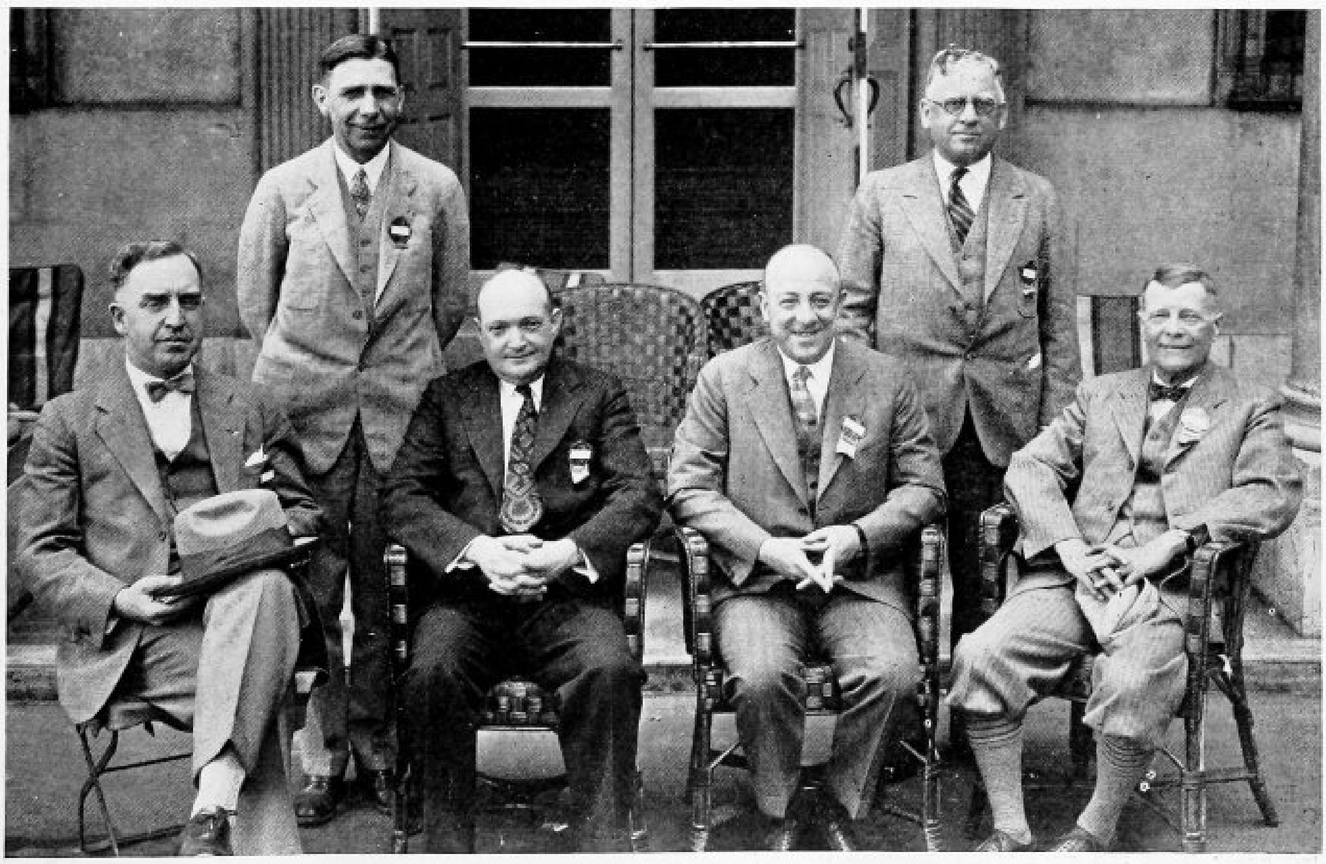
President—Harry Loeb, Lukens Steel Company.

Vice-President—Irving H. Jones, Central Alloy Steel Corporation.

Secretary—Frank C. Hasse, Oxweld Railroad Service Company.

Treasurer—George R. Boyce, A. M. Castle & Company.

Executive Committee (one year)—P. J. Conrath, National Tube Company, Chicago, Ill.; E. S. FitzSimmons, Flannery Bolt Company, Pittsburgh, Pa.; R. T. Peabody, Air Reduction Sales Company, New York, N. Y. (Two years)—M. K. Tate, Lima Locomotive Works, Lima, Ohio; B. H. Tripp, Cleveland Pneumatic Tool Company, New York, N. Y.; C. S. Wright, Oxweld Railroad Service Company, Atlanta, Ga. (Three years)—J. C. Kuhns, The Burden Iron Company, Troy, N. Y.; H. N. Reynolds, Huron Manufacturing Company, Detroit, Mich.; Leslie Pyle, Locomotive Firebox Company, Chicago, Ill.



Officers of Boiler Makers' Supply Men's Association

Left to right (standing), W. H. Dangel, secretary 1929; J. C. Kuhns, president, 1929; (seated) F. C. Hasse, secretary-elect; I. H. Jones, vice-president-elect; Harry Loeb, president-elect; G. R. Boyce, treasurer.

List of Exhibitors and Supply Men at Boiler Makers Convention

Air Reduction Sales Company, New York.—Airco oxygen, acetylene and Airco Davis-Bournonville oxy-acetylene welding and cutting apparatus and supplies. Represented by E. M. Sexton, R. T. Peabody, H. R. Walsh, G. Van Alstyne, S. W. Booth and W. R. Roberts.

American Arch Company, Inc. New York—"Scene-in-Action" pictures showing Security sectional arch. Represented by T. Mahar, W. W. Neale, T. F. Kilcoyne and George Wagstaff.

American Locomotive Company, Chicago, Ill.—Flexible and rigid staybolts, flexible staybolt parts. Represented by Ross Anderson, Ben Woody and G. P. Robinson.

Arrow Tools, Inc., Chicago, Ill.—Chisels, calking tools, beading tools, rivet sets, backing-out punches, various other small forged tools. Represented by N. W. Benedict and D. B. Parker.

Bethlehem Steel Company, Bethlehem, Pa.—Charcoal iron boiler tubes, engine bolt and staybolt iron and steel, exhibit of bolts, nuts and rivets, exhibit of boiler and locomotive firebox plate. Represented by George Raub and E. A. Jones.

Bird-Archer Company, New York.—Various chemicals, sludge removers and blow-off cocks. Represented by H. C. Harragin, J. D. Callahan and H. P. Mauer.

THE BOILER MAKER, New York.—Represented by R. E. Beauchamp, L. S. Blodgett and George Slate.

The Bourne-Fuller Company, Cleveland, Ohio.—Climax alloy steel, solid and hollow staybolts, Upson rivets, bolts, nuts and specialties. Represented by C. H. Aiken.

W. L. Brubaker & Bros. Company.—Spiral inserted blade reamer, special crown bolt tap, spiral fluted; combined flue sheet tool and other tools. Represented by W. Searls Rose and C. W. Borneman.

Burden Iron Company, Troy, N. Y.—Samples of finished products. Represented by William Downs and John C. Kuhns.

A. M. Castle & Company, Chicago, Ill.—Represented by George R. Boyce and L. J. Quetsch.

Central Alloy Steel Company, Massillon, O.—Toncan Iron boiler plate and tubes. Represented by Irving H. Jones, Howard L. Miller, G. T. Ramsey and J. B. Hammond.

Champion Rivet Company, Cleveland, O.—Various specimens of rivets, etc. Represented by D. J. Champion and T. J. Lawless.

Chicago Eye Shield Company:—Welding glass, helmets, goggles, sand blast helmets, everything to protect eyes and head. Represented by Robert Malcom and John Liautaud.

Chicago Pneumatic Tool Company, New York.—No. 34-RC staybolt tapper, No. 91 Little Giant corner drill, Boyer No. 80-X rivet buster, Boyer riveter, Boyer superior chipper, etc. Represented by J. L. Rowe, D. E. Cooke, E. K. Lynch, H. R. Deubel, L. F. Duffy and W. A. Andrews, Jr.

The Cleveland Pneumatic Tool Company, Cleveland, O.—Complete line of Cleveland air tools and Cleco fittings, such as riveters, chippers, air drills, grinders, rammers and other air tools. Represented by O. C. Stoelker and C. J. Albert.

The Cleveland Steel Tool Company, Cleveland, O.—Punches, dies, rivet sets, compression dies, coupling nuts and chisel blanks. Represented by R. J. Venning, J. B. Corby, H. I. Kahn, W. F. Delaney and H. W. Leighton.

Dearborn Chemical Company, Chicago, Ill.—Samples of Dearborn products (boiler feed water treatment, NO-OX-ID rust preventive, etc.) and literature describing same. Represented by J. W. Nutting and F. J. Boatright.

Detroit Seamless Steel Tubes Company, Detroit, Mich.—Samples of locomotive tubes, including flues, arch tubes and superheater tubes; samples of stationary boiler tubes and physical tests relating to boiler tubes. Represented by C. H. Hobbs, H. E. Ross and W. H. S. Bateman.

Electro-Chemical Engineering Corporation, Chicago, Ill.—One complete Gunderson process equipment for preventing pitting and grooving in locomotive boilers; samples of pitted boiler tubes and steel and samples of boiler material protected by the use of the Gunderson electro-chemical process. Represented by O. W. Carrick.

Ewald Iron Company, Chicago, Ill.—Represented by W. R. Walsh.

J. Faessler Manufacturing Company, Moberly, Mo.—Boiler makers tools, flue rollers, flue expanders, flue cutters, etc. Represented by G. R. Maupin and P. C. Cady.

Falls Hollow Staybolt Company, Cuyahoga Falls, O.—No exhibit.

Flannery Bolt Company, Pittsburg, Pa.—Flannery flexible staybolts, Flannery telltale staybolts, Flannery rigid solid and hollow staybolts, tools for installation. Represented by J. Rogers Flannery, E. J. Reusswig, Leo Finegan, E. S. FitzSimmons, John H. Murrin, E. G. Flannery and James A. Murrin.

Forster Paint & Manufacturing Company, Winona, Minn.—Printed matter only. Represented by O. T. Caswell.

Garratt-Callahan Company, Chicago, Ill.—Magic boiler preservative. Represented by J. G. Barclay and W. F. Casper.

Gary Screw & Bolt Company, Gary, Ind.—Bolts, nuts and rivets. Represented by G. J. Garvey.

General Refractories Company, Philadelphia, Pa.—Represented by J. T. Anthony.

Globe Steel Tubes Company, Chicago, Ill.—Boiler tubing, bushing stock and mechanical tubing both plain and formed. Represented by E. C. Carroll and T. F. Clifford.

Huron Manufacturing Company, Detroit, Mich.—Washout plugs and arch tube plugs. Represented by H. N. Reynolds, E. C. Roddie and E. H. Willard.

Independent Pneumatic Tool Company, Chicago, Ill.—No exhibit.

Ingersoll-Rand Company, New York.—Represented by H. C. Burgess, W. A. Johnson and T. B. Scott.

International Nickel Company, New York.—Represented by A. L. Roberts.

Johnson Manufacturing Company, Minneapolis, Minn.—Reverse oil burner for furnaces and forges, non-clogging oil burner for rivet forges and heating torch. Represented by Harry L. Burrhus.

Lima Locomotive Works, Inc., Lima, O.—Photograph of Lima superpower locomotives. Represented by M. K. Tate.

Locomotive Firebox Company, Chicago, Ill.—Models of locomotive boiler and Nicholson thermic syphon. Represented by L. R. Pyle, C. A. Seley, C. M. Rogers, E. Frank Smith, E. J. Reardon and Walter J. Varner.

Lovejoy Tool Works, Chicago, Ill.—Lacerda dolly-bars, flaring tools, chucks, re-cupping tools, tube expanders and other boiler makers' tools. Represented by W. H. Dangel.

Lukens Steel Company, Coatesville, Pa.—Samples and test pieces of O. H. Steel, nickel steel and toncan iron; also photographs and literature regarding products and process of manufacture. Represented by W. H. S. Bateman, Harry Loeb, Adolp Rider, Jr., and J. Frederic Wiese.

McCabe Manufacturing Company, Lawrence, Mass.—No exhibit.

National Tube Company, Pittsburgh, Pa., Superheater tubes, hot roll seamless pipe, seamless boiler tubes. Represented by Henry P. Nelson, F. Murray, H. B. Robinson, P. J. Conrath, Oscar G. Steiner and J. W. Kelley.

Old Dominion Iron & Steel Works, Inc., Belle Isle, Richmond, Va.—Samples of staybolt iron and electric staybolt steel; solid and hollow rolled and finished bolts. Represented by Thos. S. Wheelwright and Major George Brooks West.

Otis Steel Company, Cleveland, O.—Represented by George E. Sevey.

Oxweld Railroad Service Company, Chicago, Ill.—Oxyacetylene cutting and welding apparatus. Represented by F. C. Hasse, C. S. Wright, E. P. Duren, W. D. Waldron, H. C. Jefferson, R. R. Kester, A. L. Hedgepath, W. A. Hogan, O. D. Hays and A. N. Lucas.

The Paulson Tools, Inc., Wallingford, Conn.—Beading tools, chisels, rivet sets, safety chisel, flue belling tools. Represented by Charles Loucks and J. J. Brosnan.

Penn Iron & Steel Company, Creighton, Pa.—Samples of Lewis special staybolt and Lewis engine bolt iron. Represented by Charles J. Nieman.

Pittsburgh Steel Products Company, Pittsburgh, Pa. No exhibit.

Pratt & Whitney Company, Hartford, Conn.—Taps and tools for boiler work. Represented by A. J. Fox, R. E. Laffler, F. A. Armstrong and E. E. Cullison.

The Prime Manufacturing Company, Milwaukee, Wis.—Clear-vision windows, square-thread plugs, side windshields, washout and arch-tube plugs, Prime composite washout plugs, two-seated gage cocks, tank-hose strainers and air-bell ringer. Represented by D. A. Lucas, F. C. Hasse, A. N.

Lucas, William Leighton, C. S. Wright, R. R. Kester, William Champieux, O. P. Hays and J. S. Stone.

The *Railroad Herald*, Atlanta, Ga.—Represented by E. C. Laird.

Reading Iron Company, Reading, Pa.—Samples of charcoal iron boiler tubes and samples of staybolt and engine bolt iron. Represented by G. H. Woodroffe and W. H. S. Bateman.

John A. Roebling's Sons Company, Trenton, N. J.—Welding wire, gas and electric; Roebling wire rope safety slings, Roebling Alligator wrenches, New Jersey spark arrester netting. Represented by George E. Hull and C. G. Mullings.

Rome Iron Mills, Inc., New York. No exhibit.

Jos. T. Ryerson & Son, Inc., Chicago, Ill.—Represented by G. L. Shinkle, V. C. Cartus and A. W. Wilcuts.

The Superheater Company, New York.—Represented by C. H. David, W. E. Libby and A. C. McLachlan.

The Talmadge Manufacturing Company, Cleveland, O.—No exhibit.

Torchweld Equipment Company, Chicago, Ill.—Torchweld complete line of non-flash gas welding and cutting equipment. Represented by R. M. Smith.

Ulster Iron Works, Dover, N. J.—Hand-puddled wrought iron, staybolt and engine bolt iron specimens, boiler studs, wrought iron rivets. Represented by C. F. Barton, W. W. Fetner, N. S. Thulin, John Craigie and E. W. Kavanagh.

Registration of Members at Convention

Aiken, C. H., Dept. Boiler Equip., Bourne-Fuller Co., Shaker Heights, 3628 E. 163rd st., Cleveland, O.
Alexander, George L., B. F., Frisco Sys., W. Tulsa, Okla.
Atkinson, William B., F. B. M., Mo. Pacific R. R., 5016 Chippewa st., St. Louis, Mo.
Austin, George, G. B. I., A. T. & S. F. R. R., 11 Devon Apts., Topeka, Kan.

Batchman, F. A., F. B. M., N. Y. C. R. R., 1421 Krau st., Elkhart, Ind.
Becker, B. F., I. C. R. R., 8051 Ellis ave., Chicago, Ill.
Beland, Arthur J. G., F. B. M., N. Y. C. Lines, Chicago Junction Ry., 7346 Kenwood ave., Chicago, Ill.
Bell, Harry, Asst. B. F., M. K. T. R. R., 528 N. 11th st., Waco, Tex.
Bell, W. G., G. B. I., Fla. E. Coast Ry., St. Augustine, Fla.
Berry, Frank E., F. B. M., Erie R. R., Route 3, Box 42, Beria, Ohio.
Brennan, Edw. J., G. B. F., B. & M. R. R., 56 Monument st., West Medford, Mass.
Brennan, E. I., Gang F., C. & O. Ry., 21147 9th ave., Huntington, W. Va.
Browning, Charles H., G. F. B. M., G. T. Ry., 56 Manchester st., Battle Creek, Mich.
Bruce, James, B. M. F., Frisco R. R., 2014 Central ave., Kansas City, Kan.
Brush, Harry R., B. M. F., Atlantic Coast Line, Box 545, Lakeland, Fla.
Buffington, C. W., G. M. B. M., C. & O. R. R., Richmond, Va.
Burkholtz, Trav. G. B., Frisco R. R., 1019 State st., Springfield, Mo.
Burnside, G. M., B. F., Monongahela Ry., 242 Bank st., Brownsville, Pa.
Burnside, Robert, Dist. B. I., N. Y. C. R. R., 105 E. 3rd st., Oswego, N. Y.

Campbell, J. A., Asst. B. F., M. K. T. R. R., 1521 Grand st., Parsons, Kan.
Carroll, S. M., G. M. B. M., C. & O. Ry., 2961 Staunton Road, Huntington, W. Va.
Cavedo, A. L., B. F., C. & O. Ry., 2213 W. Grace st., Richmond, Va.
Chaistain, J. H., B. M. F., N. C. & St. L. R. R., 447 S. E. Blvd., Atlanta, Ga.
Christopherson, Sigurd, F., N. Y., N. H. & H. R. R., 17 Sheldon st., E. Milton, Mass.
Clark, R. W., G. F. B. M., N. C. & St. L. R. R., 1806 Division st., Nashville, Tenn.
Clas, John A., G. B. F., D. & H. R. R., 10 S. Bertha st., Albany, N. Y.
Crimmins, R. P., D. B. F., Big Four R. R., 1005 Wabash ave., Mattoon, Ill.
Comrie, H. M., Trav. B. I., Canadian Pacific R. R., 417 Simcoe st., Winnipeg, Canada.
Conrath, F. J., B. Tube Expt., Nat. Tube Co., 4712 Drexel Blvd., Chicago, Ill.
Cook, E. C., Managing Editor, *Ry. Journal*, 327 S. La Salle St., Chicago, Ill.
Cook, R. L., F. B. M., Atlantic Coast Line, 808 Francis st., Waycross, Ga.
Cooke, J. E., M. B. M., Bessemer & Lake Erie R. R., 360 S. Main st., Greenville, Pa.
Coon, W. C., Dist. B. I., N. Y. C. Ry., 135 La Salle ave., Buffalo, N. Y.
Cosgrove, P. E., G. F. B. M., Elgin, Joliet & E., 103 Glenwood ave., Joliet, Ill.
Cowan, B. B., Chief B. I., Cen. of Ga. Ry., 814 Napier ave., Macon, Ga.
Culbertson, R. A., Dist. B. I., C. & O. Ry., 307 E. 45th st., Chicago, Ill.

Davey, J. J., G. B. I., Northern Pacific Ry., St. Paul, Minn.
Dean, W. H., F. B. M., C. & O. of I. R. R., 466 W. Main st., Peru, Md.
Desmond, J. J., B. M. F., Washington Terminal Co., 2520 10th st., N.E., Washington, D. C.
Dittrich, A. C., G. B. I., Soo Line, 1409 5th st., N., Minneapolis, Minn.
Doarnberger, J. A., M. B. M., N. & W. Ry., 1502 Patterson st., S.W., Roanoke, Va.
Ducy, Frank, B. F., Wabash R. R., 421 Central ave., Decatur, Ill.
Duffy, George, B. F., B. & O.
Duffe, C. G., G. F. B. M., Kansas City Term. Ry., 4730 Fairmont ave., Kansas City, Mo.
Dunford, V. H., G. M. B., Seaboard Air Line, 603 Realty Bldg., Savannah, Ga.
Dwyer, John, B. I., Boston & Maine, Green Island, N. Y.

Evan, W. H., F. B. M., Georgia R. R., 528 Walker st., Augusta, Ga.
Evans, F. C., Asst. F. B. M., Hocking Val. R. R., 45 Richardson ave., Columbus, O.

Feisner, Adolph, B. M. F., I. C. R. R., 623 Sumner st., Waterloo, Iowa.
Fisher, George G., G. F. B. M., Belt R. R. of Chicago, 8711 Peoria st., Chicago, Ill.
FitzSimmons, Mgr. of Sales, Flannery Bolt Co., P. O. Box 25, Oakland Station, Pittsburgh, Pa.
Flohr, L. J., B. I., C. & O. Ry., 709 Franklin ave., Lexington, Ky.
Fogerty, Kearn E., G. B. I., C. B. & Q., 522 La Salle st., Chicago, Ill.
Foss, M. A., Supv. B. I., N. Y., N. H. & H. R. R, 145 Elm st., West Haven, Conn.
Fussell, J. L., F. B. M., Atlantic Coast Line, 825 S. Willow ave., Tampa, Fla.

George, William, G. F. B. M., M. C. R. R., 1310 Cooper st., Jackson, Mich.
Gilbert, G. B. F., Southern Ry., 120 Calloway st., Macon, Ga.
Gill, K. K., F. B. M., A. & W. P. R. R., 205 Yancy ave., Montgomery, Ala.
Good, Wm. B., Asst. G. Loco. B. I., I. C. R. R., 6318 Kenwood ave., Chicago, Ill.
Gossett, H. R., B. F., Yazer & Miss. Valley R. R., 705 Harris st., Vicksburg, Miss.
Gray, Frank, Tank F., C. & A. R. R., 201 W. Graham st., Bloomington, Ill.

Hagen, R. L., B. F., Southern Pacific Ry., 1115 Gargan st., Houston, Tex.
Hancken, W. C., B. M. F., Atlanta B. & Coast Ry., 115 S. Johnson st., Fitzgerald, Ga.
Handlee, Chris S., F., Atlantic Coast Line, 2318 Boulevard, Jacksonville, Fla.
Harless, R. L., B. F., M. V. & K. O. & G. Ry., Muskogee, Okla.
Harmon, R. E., B. I., C. & E. I. Ry., 309 S. Pryam ave., Salem, Ill.
Harper, Carl A., G. B. I., C. C. C. & St. L. Ry., 3006 N. Delaware st., Indianapolis, Ind.
Harryman, A. M., B. F., T. & N. O. R. R., 3608 Pershing Drive, El Paso, Tex.
Hart, L. E., B. F., Atlantic Coast Line, 621 Hammond st., Rocky Mount, N. C.
Harthill, John, G. F. B. M., N. Y. C. R. R., 14708 Coit Road, Cleveland, O.
Hasse, Frank C., Gen. Manager, Oxweld R. R. Service, 230 N. Michigan ave., Carbide Carbon Bldg., Chicago, Ill.
Hatch, William, B. I., N. Y., N. H. & H. R. R., 34 Opher st., Jamaica Plain, Mass.
Hayth, W. V., B. F., C. & O. Ry., 718 Temple st., Hinton, W. Va.
Healey, Michael J., Master Mechanic, Indianapolis Union Ry., 23-24 W. N. Y., Indianapolis, Ind.
Hedeman, W. R., M. B. M., B. & O. R. R., 3315 Echodale ave., Baltimore, Md.
Heiner, C. W., F., I. C. R. R., 212 S. 15th st., Mattoon, Ill.
Hilliger, Ernest E., B. F., N. Y. C. R. R., 148 Millicent ave., Buffalo, N. Y.
Howard, Hal, B. F., I. C. R. R., 206 W. Baltimore st., Jackson, Tenn.
Hudson, R. H., B. M. F., C. & O. R. R., 307 S. 8th St., Ironton, O.
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Work of the A. S. M. E. Boiler Code Committee

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the boiler code. Any one desiring information as to the application of the code is requested to communicate with the secretary of the committee, 29 West 39th St., New York, N. Y.

The procedure of the committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the secretary of the committee to all of the members of the committee. The interpretation, in the form of a reply, is then prepared by the committee and passed upon at a regular meeting of the committee. This interpretation is later submitted to the council of the society for approval, after which it is issued to the inquirer.

Below are given records of the interpretations of the committee in Cases Nos. 619 and 620.

CASE NO. 619. *Inquiry:* Is it permissible, under the Code for Low-Pressure Heating Boilers, to attach welded staybolts by pressing the plate into countersunk position rather than actually countersinking to within 1/16 inch of the full thickness of the plate? All other details and dimensions of the welding process would conform to the requirements of Par. H-83 of the Code.

Reply: If the surface of the plate around the edge of the staybolt hole is depressed by a pressing operation which will conform the surface thereof to the countersunk form specified in Par. H-83 without removal of any metal, it is the opinion of the committee that the requirements of this rule will be met.

CASE NO. 620. *Inquiry:* Was it the intent of Par. U-67 of the Code pertaining to welding processes, to eliminate the carbon-arc process of welding? The electric-arc process is referred to, but appears to be limited to the metallic-arc type used welding wire in connection therewith.

Reply: It is the opinion of the committee that the term "electric-arc process," as used in Par. U-67, includes any electric process wherein the electric arc is used for fusing and where the metal is melted down or additional metal is deposited in making the weld.

Personal

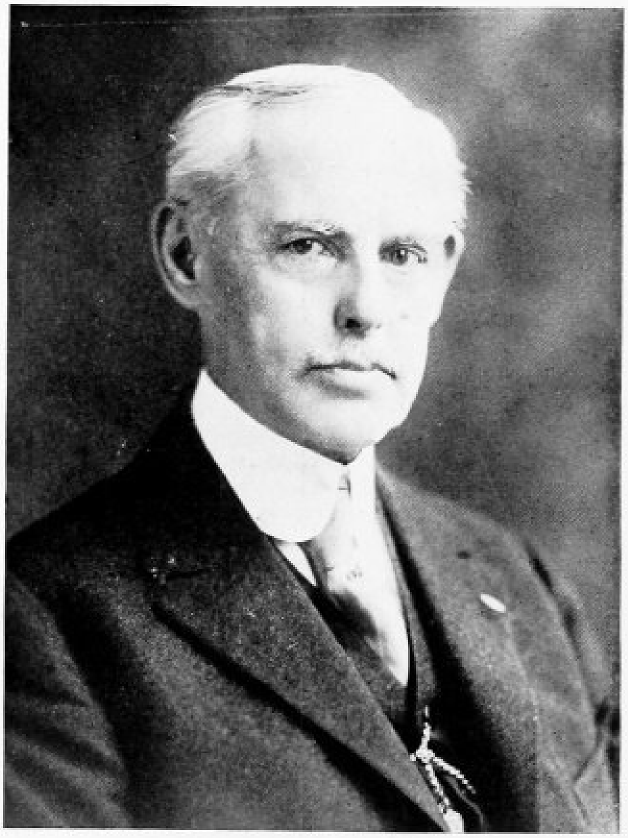
C. E. Lester, recently appointed assistant to the shop superintendent of the Broderick Company, Muncie, Ind., manufacturers of oil country boilers, has been promoted to superintendent of that company as of March 31.

B. W. Brown has been advanced to district sales representative of The Lincoln Electric Company, Cleveland, O., with headquarters at Milwaukee, Wis. G. O. Forseth, formerly a sales representative at Detroit, Mich., has been promoted to district sales representative with headquarters at Minneapolis, Minn.

Obituary

Secretary of the Master Boiler Makers' Association Dies

HARRY DYRE VOUGHT, for twenty-two years secretary of the Master Boiler Makers' Association, died at his home in Montclair, N. J., on June 3, at the age of seventy-nine. Born at Buffalo, N. Y., August 14, 1849, Mr. Vought began a newspaper career on the *Buffalo Post* on May 11, 1868, becoming city editor of that paper in 1872. In 1876 he joined the *Buffalo Courier* as reporter and served in the capacities of assistant city editor and railroad editor until 1897. For the next twenty years he was railroad editor of the *New York Commercial*, retiring from active newspaper work in 1918.



H. D. Vought

Mr. Vought was elected secretary of the Master Boiler Makers' Association in 1907 at the time of the consolidation of the International Railway Master Boiler Makers' Association and the Master Steam Boiler Makers' Association. In addition to his affiliation with the Master Boiler Makers' Association he was secretary and treasurer of the Central Railway Club of Buffalo, N. Y., for nearly 50 years and was secretary of the New York Railway Club for 26 years. He was a member of the New York Press Club and the Buffalo Press Club. Mr. Vought's funeral included Masonic services.

Boiler Manufacturers' Association Forty-First Annual Meeting

Constructive policies outlined for future expansion of activities of the association

A CONTINUATION of efforts along the lines of economic development characterized the forty-first annual meeting of the American Boiler Manufacturers' Association, which was held at Skytop Lodge, Cresco, Pa., June 3 to 5. About fifty members and associate members were present Monday when H. E. Aldrich, president of the Association called the meeting to order and presented the president's annual address. An abstract of his remarks follows:

President's Address

We convene at this, our forty-first annual meeting, to consider and take action on ways and means—for the betterment of the boiler industry. Due to our present form of group organization, with the recommendations of the chairmen to be made to the respective groups, this is only a brief general statement. Apparently our membership is well satisfied with the group or division form of organization. It seems that the activities of the past year have demonstrated the value of this plan, and it should be continued.

The trade association idea is firmly established in the business structure of this country. The following statement by Mr. Christie Benét at the recent annual meeting of the United States Chamber of Commerce is of particular interest in this connection:

"Voluntary group action is rapidly becoming the dominant force in industry.

"The whole economic administration of the country depends on the co-operative principle. Trade associations have demonstrated that they can promote a more moral, more efficient, more stable economic structure to the advantage not only of the associations but of society.

"These results are being obtained without defeating the essential features of the competitive process. Co-operation which is not in the public interest is not in the interest of the industry which promotes it."

Money wisely spent by trade associations has proven a good investment, and the individual manufacturer has benefited proportionately. In the purchase of most commodities the consumer is paying an amount for research, service, trade association activities, etc. In most instances it is well worth the extra cost to the consumer. The success, progress, and prosperity of every industry is of value in proportionate measure to public welfare.

It is most fortunate that today we have as President of the United States, the Honorable Herbert Hoover, one who has already proven his sincere interest in both industry and agriculture, and their relationship to human welfare. Under his guidance it seems assured that business will receive every legitimate assistance. Just how soon each industry will obtain full benefit of the new government attitude toward trade associations will depend on the exchange of confidence and co-operation between the individual manufacturers. The want-to-help-business attitude has been a development in which public opinion has played an important part. The fact that the public itself now hold so large an interest in stock and securities makes a general demand for business aids to help profits. Some industrial leaders are even talking "compulsory profits." The subject of the anti-trust law interpretations is one that is being widely discussed by business magazines and publications.

Charles M. Schwab, President of the American Iron & Steel Institute, recently cautioned the steel industry about over-expansion. Of more interest perhaps was his statement that the return on the capital investment of 70 percent of the industry last year was 6.35 percent, and the fact that he considers this too low. His determined and continued stand during the past year for higher prices has had the desired effect in the steel business, and has undoubtedly had a beneficial effect on other industries as well.

The boiler industry manufactures a product requiring large plants equipped with heavy tools, skilled mechanics, and a staff of competent engineers. In addition there are, as a part of every sale, responsibilities of safety and performance. Considering these facts the earnings on the investment are far too low.

Costs in every plant should be established by an efficient cost accounting system. To the cost of every product should be added the carefully determined overhead or burden, and a substantial profit. The boiler industry must have substantial profits in order to properly render a full measure of user service.

The manufacturers in this association furnish equipment for both utilities and privately owned power plants.

It seems that the following principles similar to those expressed on a recent editorial page of *Power* should be endorsed by this association. These are:

1. The buying of power when it should be bought.
2. The making of power when it should be made.

We should stand firmly either for central station power or the isolated plant, whichever is of advantage in engineering and economy. Of such endorsement there would be no just criticism. On such a basis we could co-operate with others who have like interests.

In conclusion, I mention several activities or objectives which at the present time appear desirable and deserve your continued consideration:

1. An association trade-mark. The wide usage of a trade-mark will make our association better known.
2. Trade practice conferences by the various groups under the auspices of the Federal Trade Commission.
3. Printed codes of practice including not only unfair and uneconomic trade practices, but also copies of resolutions on guarantees, warranties, and the attitude of the association on questions of common interest.

During the past year, under able leadership and active personnel, the various divisions have been organized. Much has been accomplished. It is true that some groups have been slower than others but there have been good reasons for delays. I strongly recommend frequent group meetings which will bring confidence, understanding, and unity of action.

May we continue to build a strong, active and progressive organization devoted to the business welfare and prosperity of the boiler industry.

The remainder of the Monday morning session was devoted to the presentation of standing committee reports, the first of which was by A. C. Baker, secretary-treasurer.

A. S. M. E. Boiler Code

Work of the American Society of Mechanical Engineers' Boiler Code Committee during the year was outlined by E. R. Fish, who represents the association on the Code committee. A number of radical changes have been made in the form of revisions to the code, and these have just recently been printed for final issuing. Most revisions are based on interpretations passed upon by the code committee and approved by the council of the society. They include points that were under controversy or were indefinite and required clarifying. For example radical changes have been made in the dished head formula, which will require changes in thickness.

Although these changes will not be put into legal effect until January, 1930, manufacturers can anticipate them so that no hardships need be experienced when they become mandatory.

The question of how large openings in shells may be without reinforcement is a matter being given considerable study by several companies at the present time. A great deal is being learned as to the stresses around the edges of these openings and the proper character of the reinforcement, shape of opening and the like.

Changes are also being made in safety valve conditions, especially in old boilers, where the fuel burning rate is raised. Changes also occur in the matter of steam gage piping. New standards have been adopted for flanged fittings. New alloy steel specifications for bolting material have been passed upon.

Changes in stamping have been adopted for all classes of boilers and this distinctive stamping for each class will be used hereafter.

Welding and the extent to which it can be applied in boiler work is under careful study by a joint committee made up of members of the Boiler Code Committee and the American Welding Society. The tentative code of fusion welding which has been developed will be published officially by the Society within a short time for study by all interested individuals and companies.

Cost Accounting

W. C. Connelly, chairman of the Cost Committee, in an informal report indicated that all members should maintain accurate cost finding methods in their plants. The watertube boiler division of the industry has surveyed the methods employed by its members, with excellent results to the group as a whole. Mr. Connelly suggested that similar action on the part of other groups of the industry might overcome many of the difficulties now experienced in conducting their affairs.

A. C. Weigel, chairman of the committee on auxiliary equipment, urged members to take advantage of the facilities of the committee in investigating matters relating to auxiliary equipment and materials.

C. O. Myers, secretary of the National Board of Boiler and Pressure Vessel Inspectors, next presented a progress report of the activities of this organization. An abstract of Mr. Myer's remarks follows:

National Board Work

All arrangements have been made for our annual meeting to be held in Hotel Fort Shelby, Detroit, Michigan, June 18, 19 and 20. Some important matters will be presented at this meeting, one of which is of particular interest and covers suggested amendments to the constitution. It is suggested that Article 3, Section 3, under the caption "Associate Members" be amended to provide for commissioned boiler inspectors and that the annual dues be reduced from $5.00 to $1.00. Article 4, Section 1, 2 and 3, placing the secretary-treasurer's position in the hands of the executive board and the addition of another officer to be known as Research Engineer. Article 6, Section 1, amended to provide that the retiring chairman be a member of the executive board.

The question of adopting some uniform regulations for columns and supports for horizontal return tubular and watertube boilers was called to our attention by Mr. Aldrich, president of the A. B. M. A. He suggested certain practices that were agreed upon by the horizontal return tubular section and the watertube section. I referred this matter to C. D. Thomas, chief inspector of the State of Oregon and chairman of the National Board and he appointed a committee to give it a thorough study and report back to our meeting in Detroit, Mich.

The members of the National Board are sincere in their efforts to work out any technicalities that interfere with the uniform administration of the A. S. M. E. Boiler Code and they appreciate any questions being submitted to them. All of our meetings will be open and we would appreciate having the boiler manufacturers attend and take part in our session.

A written report prepared by J. B. Romer, on the subject of feed water studies, of which committee he is chairman, was next presented by the secretary. This report is in part as follows:

Boiler Feed Water Studies Report

During the past year, the Boiler Feed Water Studies Committee has been busy in an effort to complete the financial structure that would enable it to proceed with its research program. Excellent progress has been made along this and other lines. Considerable work of the Committee has been devoted to securing technical papers which have been released through the various associations affiliated in this study. At the fall meeting of the A. S. M. E. five progress reports were presented. The papers read before this meeting were as follows:

"Formation and Heat Transfer Effects of Calcium Sulphate Boiler Scale," by Everett P. Partridge and Prof. A. E. White.
"New Methods of Analyses for Sulphates and Phosphates," by Prof. Frederick G. Straub.

A group of papers will be presented at the forthcoming Convention of the American Water Works Association as a result of the committee's activities. A list of these papers is given below:

"Recent Developments in Boiler Operation and Their Influence on Feed Water Treatment," by Mr. S. T. Powell, Baltimore, Md.
"Deaeration of Boiler Feed Water," by Mr. J. R. McDermet, Jeannette, Pa.
"The Dissociation of Water in Steel Tubes at High Temperatures and Pressures," by C. H. Fellows, Detroit Edison Co., Detroit, Mich.

"Calculation of Chemicals for Water Softening," by Dr. A. M. Buswell, State Water Survey, Urbana, Ill.
"The Prevention of Pitting in Locomotive Boilers by Exclusion of Dissolved Oxygen from the Feedwater," by C. H. Koyl, Chicago, Milwaukee & St. Paul, Pacific Railroad, Chicago, Ill.
"Railway Water Treatment Progress and Research Requirements," by R. C. Bardwell, Supt. Water Supply Chesapeake & Ohio Railway, Richmond, Va.

These papers will also be published in the journals of the affiliated associations.

There are not sufficient funds for the publication and distribution of all these papers since to do this it would be extremely costly owing to the very large membership (about 200,000) of all the technical associations co-operating in this work.

An agreement will shortly be consummated between the Boiler Feed Water Studies Committee and Prof. C. W. Foulk of the Ohio State University to carry on interesting and instructive research studies on priming and foaming of boiler waters. Professor Foulk is doing an excellent piece of research work on this important problem. Part of this work will be to actually take photographs of the phenomena of priming and foaming of concentrated boiler waters.

Contact has been made with the United States Naval Testing Station at Annapolis through the appointment of Captain Dinger, Commander of the Station, to the executive committee. Through this contact, valuable information on the corrosion of steel may shortly be released.

The larger work on corrosion is being held in abeyance until a sufficient fund is available to assure the continuity of the research studies.

Arrangements are nearing completion for a co-operative study for the determination of hydrogen-ion concentration of boiler water under high pressures and temperatures. This co-operative work will be done by A. M. Buswell at the University of Illinois in co-operation with the Research Department of the Leeds & Northrup Company.

Although the actual starting of the proposed research work has taken a longer while than was originally anticipated, it is now believed that the necessary preliminary work has been completed so that during the next few months the projects will be well under way.

Uniform Boiler Law Society

Charles E. Gorton, chairman of the executive committee of the American Uniform Boiler Law Society, presented an outline of the work of the society during the past year. Constant effort is necessary to keep difficulties ironed out that occur in connection with the applications of the A. S. M. E. Boiler Code. Several changes have been made in the roster of states and cities operating under the code and these have been indicated in a report recently sent out by Mr. Gorton. This report will appear in the July issue of THE BOILER MAKER.

The final discussion of the general session occurred in connection with the adoption of an A. B. M. A. trademark design which might be used by member companies. Several designs were presented for study and consideration and these were to be acted upon at a later session.

Monday Evening Session

At the Monday evening session through the courtesy of the Stone & Webster Engineering Corporation, Boston, Mass., a motion picture of the development of the Conowingo Hydro-electric Plant in Maryland at the outlet of the Susquehanna river was shown.

The association was next addressed by Dr. Hugh P. Baker, manager, Trade Association Department, United States Chamber of Commerce, who took as his subject "The Business Man and His Trade Association." In the course of his remarks Dr. Baker indicated the manner in which trade associations are taking advantage of the present possibilities for development. For several years past the work of these associations has been fostered by the government and every assistance has been given where it was desirable to promote their development along sound economic lines and for the betterment of industry.

Dr. Baker mentioned several practices in association work that should be avoided, and then concentrated his remarks on the four principle evils of business and the part the association should play in overcoming them. These evils are: Over-production, or under-consumption; price cutting by industry in general; exchange of business among a group of producers or manufacturers; continuance of unfair practices, making for unfair competition.

He then outlined the constructive policies adopted by other associations to overcome these difficulties. If the activities of a trade association are focused on these problems constructively, the industry will go a long way toward their solution.

Tuesday Session

On Tuesday morning, meetings for members of the various groups of the association were held:

These groups include the water tube boiler division, the horizontal return tubular boiler division, the heating boiler division, the vertical boiler division and the oil country boiler division.

The division committees are made up of company members and representatives as follows:

WATERTUBE DIVISION

W. C. Connelly, Chairman, The D. Connelly Boiler Co., Cleveland, O.
S. G. Bradford, Edge Moor Iron Works, Edge Moor, Del.
Owsley Brown, The Springfield Boiler Co., Springfield, Ill.
C. W. Middleton, Babcock & Wilcox Co., New York City.
Frank E. Brinig, Erie City Iron Works, Erie, Penn.
A. C. Weigel, Hedges-Walsh-Weidner Co., New York City.
E. G. Wein, E. Keeler Co., Williamsport, Penn.

HORIZONTAL RETURN TUBULAR DIVISION

C. E. Tudor, Chairman, Tudor Boiler Mfg. Co., Cincinnati, O.
Starr H. Barnum, The Bigelow Company, New Haven, Conn.
C. W. Edgerton, Coatesville Boiler Co., New York City.
J. G. Eury, Henry Vogt Machine Co., Louisville, Ky.
Wm. Heagerty, Oil City Boiler Works, Oil City, Penn.

HEATING DIVISION

Homer Addams, Chairman, Fitzgibbons Boiler Co., New York City.
J. R. Collette, Pacific Steel Boiler Corp., Waukegan, Ill.
R. B. Dickson, Kewanee Boiler Corp., Kewanee, Ill.
C. W. Edgerton, Coatesville Boiler Co., New York City.
W. A. Nevin, Heggie Simplex Boiler Co., Joliet, Ill.

VERTICAL DIVISION

F. B. Metcalf, Chairman, International Boiler Works, E. Stroudsburg, Penn.
Jos. Doyle, Ames Iron Works, Oswego, N. Y.
J. F. Johnston, Johnston Bros., Ferrysburg, Mich.

OIL COUNTRY

J. H. Broderick, Chairman, The Broderick Co., Muncie, Ind.
Hugh Donovan, Donovan Boiler Works, Parkersburg, W. Va.
Sjoerd Mensonides, Farrar & Trefts, Buffalo, N. Y.

The annual dinner of the association for members and guests was held Tuesday evening.

Wednesday Session

At the final session of the meeting, which was of a general nature the chairmen of the various groups, reported on the progress made on problems peculiar to their several branches of the industry.

Steel Heating Boilers

Homer Addams, speaking for the steel heating boiler division, stated that the present members of the group feel it is advisable for additional manufacturers in this field to join the ranks of the association. The advantages to be gained by the steel heating boiler companies from the activities of the association are too great to be overlooked.

One matter of a technical nature that is shortly coming up for decision by this branch of the industry is a rating code for steel heating boilers. A committee of the division will shortly confer with the American Society of Heating and Ventilating Engineers on this important matter at the forthcoming annual meeting of this body.

Watertube Boiler Division

W. C. Connelly, chairman of the watertube boiler division, reported that this group has held about six meetings during the year at all of which the chief executive of each of the member companies was in attendance. In the course of these meetings a code of practice has been proposed. No formal program of activities for the coming year has as yet been arranged, but it is felt that the progress will be even greater in the next twelve months.

Starr H. Barnum next presented a bulletin for approval under the title "Precautionary Measures to Take Against Caustic Embrittlement by Boiler Users." This bulletin outlines the work done by investigators on the subject of caustic embrittlement, and the action taken in the Care of Power Boilers Code of the A. S. M. E. to prevent this trouble in boilers, which with slight revision was adopted.

This bulletin will be issued to members, who may use it to inform their customers of the trouble, and in what quarters advice may be obtained to combat it. Articles concerning the care and prevention of caustic embrittlement have appeared in THE BOILER MAKER from time to time during the past three years.

Trade-Mark Adopted

The subject of a suitable trade-mark for the American Boiler Manufacturers' Association was next considered. A reproduction of the trade-mark as approved will be published later. This trade-mark is intended for use on letterheads of member companies and for other purposes, with the intention of spreading the name and prestige of the organization wherever boilers are used.

Horizontal Boiler Division

Charles E. Tudor, chairman of the horizontal return tubular group, stated that a lecture on the subject of this type boiler, which had been held up for some time, pending the completion of lantern slides to illustrate it, would now go forward, as a result of promised cooperation of members at this meeting. The lecture will be presented for the first time at a special group meeting to be held in September or October.

Following the suggestion that some sizes of horizontal boilers be eliminated, it was decided by the group to discontinue this type boiler for 125 pounds per square inch pressure. Further discussion on this matter will take place at the fall meeting.

A. C. Weigel suggested that since several lines of fire tube boilers were not active by groups, the name of this division should be changed to "Fire Tube Boiler Division." This division will in future include all fire tube type boilers for power purposes, with the exception of the heating boiler.

Election of Officers

The final action taken at the meeting was the election of officers for the coming year. M. H. Broderick, chairman of the nominating committee, presented the following names to the association, and these were formally elected.

President—H. E. Aldrich, The Wickes Boiler Company, Saginaw, Mich.

Vice-President—Owsley Brown, Springfield Boiler Company, Springfield, Ill.

Secretary-Treasurer—A. C. Baker, 801 Rockefeller Building, Cleveland, O.

Executive Committee—Homer Addams, Fitzgibbon Boiler Company, Inc., New York, N. Y.; G. W. Bach, Union Iron Works, Erie, Pa.; H. H. Clemment, Erie City Iron Works, Erie, Pa.; J. R. Collette, Pacific Steel Boiler Corp., Waukegan, Ill.; F. W. Chipman, International Engineering Works, Framingham, Mass.; E. R. Fish, Heine Boiler Company, St. Louis, Mo.; C. E. Tudor, Tudor Boiler Company, Cincinnati, O.; A. C. Weigel, Walsh and Weidner Company, Chattanooga, Tenn.; S. G. Bradford, Edge Moor Iron Company, Edge Moor, Del.

Registration at A. B. M. A. Meeting

The following members and associates were registered at the forty-first annual meeting of the American Boiler Manufacturers' Association:

Addams, Homer, Fitzgibbons Boiler Company, Inc., New York, N. Y.
Aldrich, H. E., Wickes Boiler Company, Saginaw, Mich.
Baker, A. C., Secretary A. B. M. A., Cleveland, Ohio.
Barnum, G. S., The Bigelow Company, New Haven, Conn.
Barnum, Starr H., The Bigelow Company, New Haven, Conn.
Bateman, W. H. S., Champion Rivet Company, Philadelphia, Pa.
Baylor, A. L., James Leffel & Company, Springfield, Ohio.
Bentley, G. H., Bethlehem Steel Corp., Ltd., Bethlehem, Pa.
Blake, A. D., *Power*, New York City.
Blodgett, L. S., THE BOILER MAKER, New York City.
Bradford, S. G., Edge Moor Iron Company, Edge Moor, Del.
Brinig, F. E., Erie City Iron Works, Erie, Pa.
Broderick, M. H., The Broderick Company, Muncie, Ind.
Brown, J. Roland, Reliance Gauge Column Company, Cleveland, O.
Cardwell, George A., Lukens Steel Company, Coatesville, Pa.
Champion, D. J., The Champion Rivet Company, Cleveland, O.
Champion, T. Pierre, The Champion Rivet Company, Cleveland, O.
Chipman, F. W., International Engineering Works, Framingham, Mass.
Collette, J. R., Pacific Steel Boiler Corporation, Waukegan, Ill.
Connelly, W. C., D. Connelly Boiler Works, Cleveland, O.
Daniels, C. M., Bethlehem Steel Corporation, Ltd., Bethlehem, Pa.
Dickson, R. B., Kewanee Boiler Corporation, Kewanee, Ill.
Eury, J. G., Henry Vogt Machine Company, Louisville, Ky.
Felker, George F., Crosby Steam Gauge Company, New York City.
Fish, E. R., Heine Boiler Company, St. Louis, Mo.
Flanagan, F. J., Pittsburgh Steel Products Company, Pittsburgh, Pa.
Goldie, A. R., Babcock-Wilcox-Goldie-McCulloch Company, Galt, Ont., Can.
Gordon, C. W., The Superheater Company, New York, N. Y.
Gorton, Charles E., American Uniform Boiler Law Society, New York City.
Hammerslough, J. S., Springfield Boiler Company, Springfield, Ill.
Heagerty, Wm., Oil City Boiler Works, Oil City, Pa.
Huyette, P. B., Paul B. Huyette Company, Philadelphia, Pa.
Huyette, S. L., Paul B. Huyette Company, Philadelphia, Pa.
Jeter, S. F., Hartford Steam Boiler Inspection and Insurance Company, Hartford, Conn.
Lally, R. R., Globe Steel Tubes Company, Detroit, Mich.
McAllenan, George, McAllenan Bros., Pittsburgh, Pa.
Metcalf, F. B., International Boiler Works, E. Stroudsburg, Pa.
Middleton, C. W., Babcock and Wilcox Company, New York City.
Myers, C. O., Chief Boiler Inspector, State of Ohio, Columbus, O.
Nevin, W. A., Heggie, Simplex Company, Joliet, Ill.
Newlin, H. S., M. W. Kellog Company.
Obert, C. W., Union Carbide and Chemical Corporation, New York City.
Pratt, A. G., Babcock and Wilcox Company, New York City.
Shively, J. H., Edge Moor Iron Company, Edge Moor, Del.
Tudor, Charles E., Tudor Boiler Company, Cincinnati, O.
Waring, B. G., Yarnall Company, Philadelphia, Pa.
Weigel, A. C., Walsh and Weidner Company, Chattanooga, Tenn.
Wickes, E. B., Wickes Boiler Company, Saginaw, Mich.

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Torque at Contact With Face of Rollers

Q.—Please publish through the Questions and Answers column in The Boiler Maker, the formula with an example for determining the torque at contact with the face of rollers as shown in the attached sketch. The sketch represents a rotary lime kiln 8 feet in diameter by 130 feet long revolving at 1½ revolutions per minute. The total weight of the kiln and material being 486,000 pounds bearing on 8 rollers, 4 at each end. G. E. L.

A.—In answering this question I am assuming the torque at contact with face of rollers to be the frictional

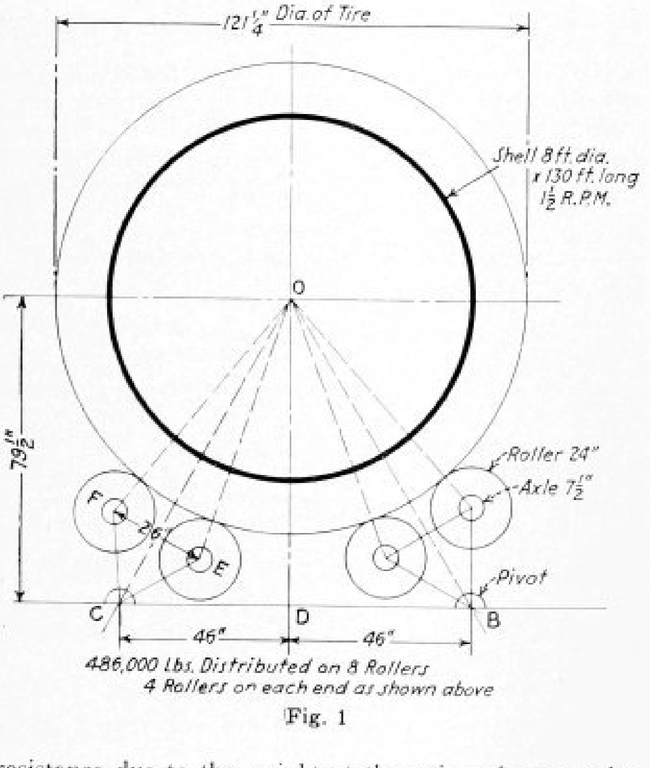


Fig. 1

resistance due to the weight at the point of contact between the two rollers.

The first step in determining the actual force at the points of contact due to the weight, is to find the force due to the weight along the lines OB and OC in Fig. 1.

This is done by applying the principle of parallelogram of forces:—When a body remains at rest while being acted on by two or more forces, it is said to be in a state of equilibrium, and so also are the forces. Thus, if the forces Pp, Qq, Rr (Fig. 2) acting on the body p, q, r, keep it at rest, they are in equilibrium, and any two of them balance the third. The lines of force if produced

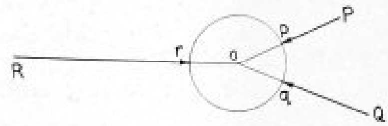


Fig. 2.—Equilibrium of forces

meet at one point O within the body and if a parallelogram be constructed having two adjacent sides proportional to and parallel to two of the forces respectively, to represent them in magnitude and direction, the

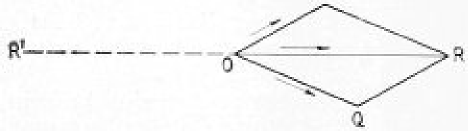


Fig. 3.—Parallelogram of forces

diagonal of the parallelogram will represent the third force in magnitude and direction.

Set the lines OP and OQ (Fig. 3,) representing the forces Pp and Qq in magnitude and direction and complete the parallelogram by drawing the parallels PR, and QR. Then draw OR. OR represents, in magnitude

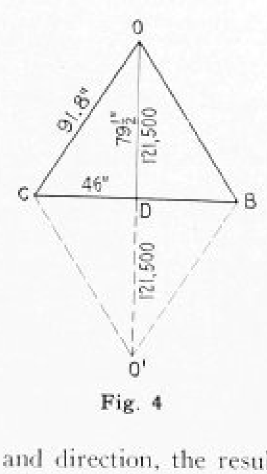


Fig. 4

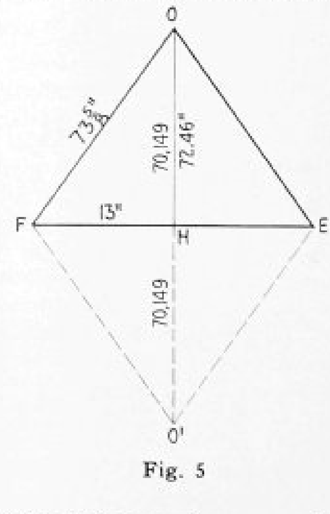


Fig. 5

and direction, the resultant of the two forces; and RO taken in the opposite direction represents the third force Rr (Fig. 2). If it be applied in this direction to the point O, *as indicated by the dotted line* OR', it would balance the other two. This construction is called the parallelogram of forces, and is applicable to any three forces in equilibrium.

Applying this principle to the problem, it is first necessary to determine the load at each end of the roller, which equals

$$486{,}000 \div 2 = 243{,}000$$

$$243{,}000 = OO' \text{ (Fig. 4)}$$

$$OD = \frac{243{,}000}{2} = 121{,}500 \text{ pounds}$$

$$OB = \sqrt{\overline{OD}^2 + \overline{CD}^2} = OC$$

$$OB = 91.8 \text{ inches} = OC$$

$$121{,}500 : 79.5 :: OB : 91.8$$

$$\text{Force } OB = \frac{121{,}500 \times 91.8}{79.5}$$

$$\text{Force } OB = 140{,}298 \text{ pounds}$$

The next step is to find the force along the lines OE and OF (Fig. 1) the same method being used as in determining the force in OB and OC.

$$140{,}298 = \text{the force } OO' \text{ (Fig. 5)}$$

$$OH = \frac{140{,}298}{2} = 70{,}149 \text{ pounds}$$

$$OE = OH = \sqrt{\overline{OF}^2 - \overline{FH}^2}$$

$$OH = 72.46$$

$$70{,}149 : 72.46 :: OF : 73.625$$

$$\text{Force } OF = 71{,}276 \text{ pounds}$$

Load at each point of contact = 71,276 pounds

Work Absorbed by Friction.

The product of the total pressure between the rubbing surfaces by the coefficient of friction, is the total frictional resistance; and the product of this resistance by the space through which it acts, is the work done, or absorbed by friction.

Let

W = the load or pressure in pounds

f = coefficient of friction between two surfaces.

d = the diameter of the journal

U = the work absorbed in foot-pounds for one turn

Frictional resistance = Wf

$U = WfY\ .26\ d$

The coefficients of friction for the various substances can be obtained from any standard handbook.

Calculating Stays for a Flat Head

Q.—Will you please give me the method of calculating the stays for a flat head 32 inches diameter, ⅝-inch thickness, 9000 pounds allowable stress per square inch for stays, 300 pounds pressure.

Also please show distance from flange before it is necessary to stay head. Also please show where stays are located and method used to locate each stay.

In staying any head would the following method for finding the circle to space the stays be correct?

Example: Sixteen stays
1 in center to support 6-inch diameter circle
5 in next row
10 in outer row
1 stay supports 6-inch diameter circle
5 stays support 5 × 6-inch diameter circles = 30 inches
30 inches × .3183 = 9.549 diameter of circle for the 5 stays
10 stays support 10 × 6-inch diameter = 60 inches × .3183 = 19.098 diameter of circle for 10 stays.

Thanking you for this information, I am, R. H. L.

A.—The first step to determine the number and diameter of stays required to support the head as shown in Fig. 1 under the conditions as outlined in the question would be to determine the actual area supported by the stays.

The following formula can be used to determine the unstayed distance from the shell:

$$d = \frac{5 \times T}{\sqrt{P}}$$

Where

d = unstayed distance from shell in inches.

T = thickness of head in sixteenths of an inch.

P = maximum allowable working pressure, pounds per square inch.

Applying this formula to the problem we have,

$$d = \frac{5 \times 10}{\sqrt{300}} = 2.886 \text{ inches}$$

32 inches — 5.77 inches = 26.23 inches diameter of area to be stayed

area 26¼ inches diameter circle = 541.19 square inches.

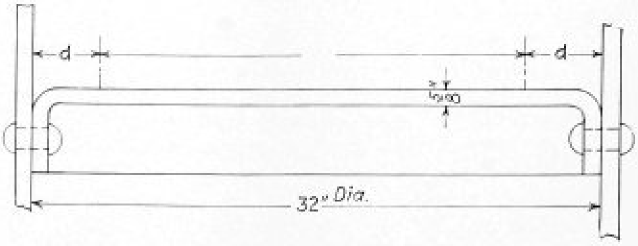


Fig. 1

$$\frac{541.19 \times 300}{9000} = 18.03 \text{ square inches required cross-sectional area of stays.}$$

The maximum allowable pitch of stays for a ⅝-inch sheet under 300 pounds pressure is 6¼ inches.

6.25 inches × 6.25 inches = 39.06 square inches

$$\frac{39.06 \times 300}{9000} = 1.302 \text{ square inches net sectional area of staybolt for } 6\tfrac{1}{4}\text{-inch pitch stays.}$$

Area 1 5/16-inch diameter stay = 1.353 square inches

18.3 ÷ 1.302 = 13.8 or 14 — 15/16-inch diameter stays required.

In actual practice, however, the diameter and spacing of the staybolts figured does not necessarily have to be used, but is a minimum. A greater number of stays of less diameter could be used if a better distribution of the stays over the area to be stayed can be obtained.

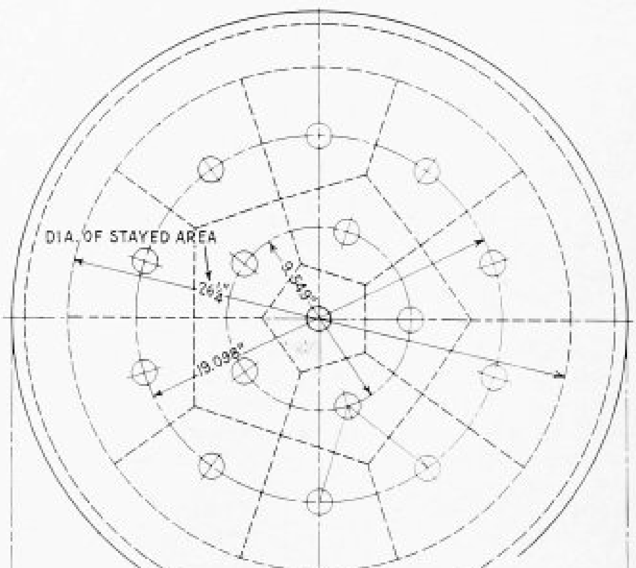


Fig. 2

Fig. 2 shows the distribution of stays as outlined in the question.

The center stay is supporting 20.41 square inches.

The five in the next row are supporting 25.84 square inches each.

The ten in the outside row are supporting 39.15 square inches each.

(Cross-sectional area of stay not deducted.)

The required diameter of stay for each condition would then be

$$\frac{20.41 \times 300}{9000} =$$ .68 square inches required net sectional area of stay at center = 15/16-inch diameter of center stay.

$$\frac{25.84 \times 300}{9000} =$$ .861 square inches required net sectional area of each of the five stays on 9.549-inch diameter circle. = 1 1/16-inch diameter stays.

$$\frac{39.15 \times 300}{9000} =$$ 1.305 square inches required net sectional area of each of the ten stays in the outer row. = 1 5/16-inch diameter stays.

From the above, it is evident that the load is not evenly distributed over the stays. This condition could be overcome by increasing the pitch circle of the two outer rows and increasing the number of stays in the outer row, thus obtaining a more even distribution of the load and keeping the same diameter for all the stays.

Heating Surface of a Dog House Boiler

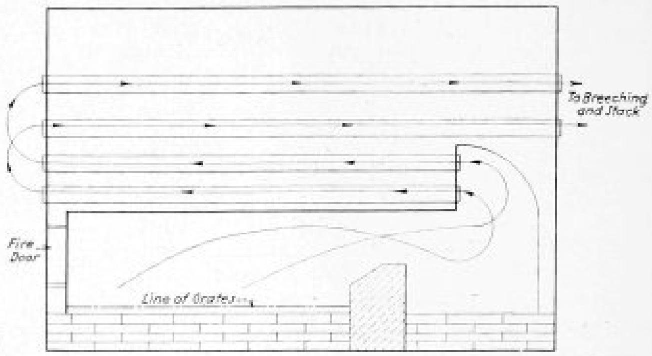
Q.—Will you kindly explain the method of determining the number and length of tubes in both the direct and return banks for best and most efficient operating conditions in the type of boiler shown below, assuming a given stack temperature of 550 to 600 degrees. This is what is commonly termed the "Dog House" type of boiler. I shall be very pleased and grateful to you for anything in regard to this you may be able to inform me of. C. E. P.

A.—The length and number of tubes required for a boiler is based on the heating surface required to give the specified boiler-horsepower.

The heating surface in the case of the boiler outlined in the question would be the total heating surface of the firebox, plus the heating surface of the tubes. The greater percent of the heat will be absorbed by the tubes in the first pass. If the tubes were continuous it would also be true that the greater percent of the heat would be absorbed at the end nearest the firebox, therefore, in computing the heating surface of the tubes they could be considered as continuous providing the same number of tubes are used in both the direct and return banks.

Short tubes have much greater evaporative value per square foot of heating surface than long tubes, but they discharge the gases into the smokebox at much higher temperatures. Therefore, while the heat absorbed per foot of length is much greater for short than long tubes it is not so economical, and the short tube boiler, other things being equal, requires more coal for a given evaporation.

Where tubes 12 to 14 feet long give smokebox temperatures of about 750 to 800 degrees, tubes 20 to 22 feet in length reduce this to 550 to 600 degrees, the only increase of energy required being the slightly greater draft in the stack to pull the gases through the long tubes. It has been shown by tests that the use of long tubes gives a better utilization of coal and because of the greater dif-



Gas flow in a dog house boiler

ference between the temperature of the furnace and that of the stacks, greater economy results.

Welding in Heating Boilers

Q.—Is welding permissible in a cast-iron sectional heating boiler carrying 15 pounds of steam pressure? Would the same rule as applied to steel boilers supported by staybolts A Par. 186 found in Addenda to A. S. M. E. Boiler Construction Code cover the above? T. H.

A.—Par. 186 found in the Addenda to the A. S. M. E. Boiler Construction Code is intended to cover power boilers.

Section IV of the Boiler Construction Code covers the rules for the construction of low-pressure heating boilers. Part II of this section, covering cast-iron heating boilers, does not provide for welding of same.

The Master Boiler Makers' Association's committee on recommended practice and standards, made the following recommendation with reference to cast-iron boilers:

Autogenous welding of cracks and fractures in cast-iron boilers should not be permitted.

Trade Practices

IN a recent bulletin of Ernst & Ernst, public accountants, New York, N. Y., it is pointed out that the Federal Trade Commission is now definitely committed to a course of encouraging trade associations in the development of rules of proper business conduct. To this end the commission accepts, it is stated, all such rules adopted by resolutions of the trade in trade practice conferences, but divides these into two groups, (1) those which are enforceable by the commission under existing law as interpreted by court decisions, and (2) those which are not so enforceable. The commission goes a step further, however, and attempts to lay down the principle that a secret violation of any of these second group rules by a member of the trade, who has agreed to them constitutes in itself an unfair trade practice, permitting the commission to take action against the violator. Thus, it is not the practice itself but the clandestine violation of an agreement on the practice which constitutes the violation. The position of the commission has not yet been tested, and there is a good deal of interest in whether it can be maintained.

The Central Iron & Steel Company, Harrisburg, Pa., has moved its New York district office from the Evening Post building to 25 Broadway, and the Pittsburgh district office from the Commonwealth building to the Oliver building.

Associations

Bureau of Locomotive Inspection of the Interstate Commerce Commission

Chief Inspector—A. G. Pack, Washington, D. C.

Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

Steamboat Inspection Service of the Department of Commerce

Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—Fred R. Low.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 W. 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—C. D. Thomas, Salem, Oregon.

Secretary-Treasurer—C. O. Myers, Commercial National Bank Building, Columbus, Ohio.

Vice-Chairman—William H. Furman, Albany, N. Y.

Statistician—L. C. Peal, Nashville, Tenn.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

International President—J. A. Franklin, suite 522, Brotherhood Block, Kansas City, Kansas.

Assistant International President—William Atkinson, suite 522, Brotherhood Block, Kansas City, Kansas.

International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.

Editor-Manager of Journal—John J. Barry, suite 524, Brotherhood Block, Kansas City, Kansas.

International Vice-Presidents—John J. Dowd, 142 Pearsall Ave., Jersey City, N. J.; M. A. Maher, 2001 20th St., Portsmouth, O.; R. C. McCutchan, 226 Lipton St., Winnipeg, Man., Canada; H. J. Norton, Alcazar Hotel, San Francisco, Cal.; C. A. McDonald, Box B93, Route 2, Independence, Mo.; J. N. Davis, 1211 Gallatin St., N. W., Washington, D. C.; M. F. Glenn, 1434 E. 93rd St., Cleveland, O.; W. J. Coyle, 424 Third Ave., Verdun, Montreal, Canada; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; J. F. Schmitt, 25 Crestview Rd., Columbus, O.

Master Boiler Makers' Association

President—George B. Usherwood, supervisor of boilers, New York Central Railroad, Syracuse, N. Y.

First Vice-President—Kearn E. Fogerty, general boiler inspector, Chicago, Burlington & Quincy Railroad, Aurora, Ill.

Second Vice-President—Franklin T. Litz, general boiler foreman, Chicago, Milwaukee, St. Paul & Pacific Railroad, Milwaukee, Wis.

Third Vice-President—O. H. Kurlfinke, boiler engineer, Southern Pacific Railroad, San Francisco, Cal.

Fourth Vice-President—Ira J. Pool, district boiler inspector, Baltimore & Ohio Railroad, Baltimore, Md.

Fifth Vice-President—L. E. Hart, boiler foreman, Atlantic Coast Line, Rocky Mount, North Carolina.

Assistant Secretary—Albert F. Stiglmeier, general foreman boiler maker, New York Central Railroad, Albany, N. Y.

Treasurer—W. H. Laughridge, general foreman boiler maker, Hocking Valley Railroad, Columbus, Ohio.

Executive Board—A. F. Stiglmeier, New York Central Railroad, Albany, N. Y., chairman.

Boiler Makers' Supply Men's Association

President—Harry Loeb, Lukens Steel Company, Coatesville, Pa.

Vice-President—Irving H. Jones, Central Alloy Steel Corporation, Massillon, Ohio.

Treasurer—George R. Boyce, A. M. Castle & Company, Chicago, Ill.

Secretary—Frank C. Hasse, Oxweld Railroad Service Company, New York, N. Y.

American Boiler Manufacturers' Association

President—H. E. Aldrich, The Wickes Boiler Company, Saginaw, Mich.

Vice-President—Owsley Brown, Springfield Boiler Company, Springfield, Ill.

Secretary-Treasurer—A. C. Baker, 801 Rockefeller Building, Cleveland, O.

Executive Committee—Homer Addams, Fitzgibbon Boiler Company, Inc., New York, N. Y.; G. W. Bach, Union Iron Works, Erie, Pa.; H. H. Clemment, Erie City Iron Works, Erie, Pa.; J. R. Collette, Pacific Steel Boiler Corp., Waukegan, Ill.; F. W. Chipman, International Engineering Works, Framingham, Mass.; E. R. Fish, Heine Boiler Company, St. Louis, Mo.; C. E. Tudor, Tudor Boiler Company, Cincinnati, O.; A. C. Weigel, Walsh and Weidner Company, Chattanooga, Tenn.; S. G. Bradford, Edge Moor Iron Company, Edge Moor, Del.

States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W.Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash.	Parkersburg, W.Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

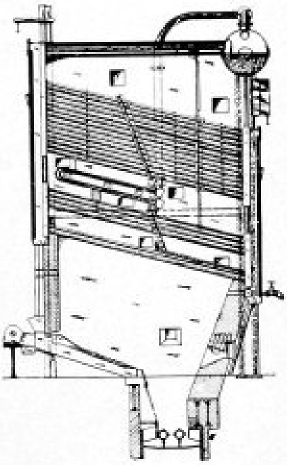
Compiled by

DWIGHT B. GALT, Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

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

1,692,171. 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.

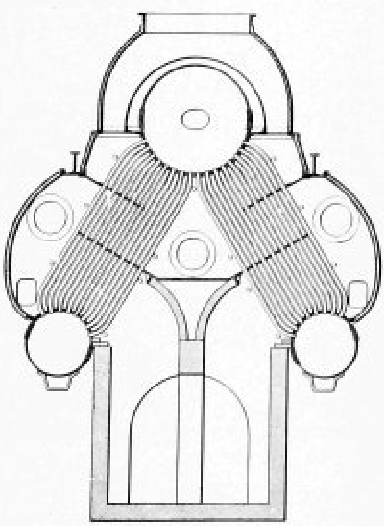
Claim.—A boiler having horizontally extending watertubes connected at their ends to uptake and downtake water chambers, said tubes being divided to form a lower, a middle and an upper bank with a space between each pair of successive banks, a roof baffle extending from the down-



take water chamber along the tubes of the lower bank, a first cross baffle extending upwardly from the inner end of said roof baffle across tubes of the middle and upper banks, a second cross baffle extending downwardly across the upper bank and entering the space between the upper and middle banks and a superheater located in the first pass between the uptake water chamber and said first cross baffle and in the space between the upper and the middle banks and with substantially all of its tube heating surface located in the first pass. Fifteen claims.

1,685,962. BOILER. WILLIAM W. SMITH, OF JERSEY CITY, NEW JERSEY.

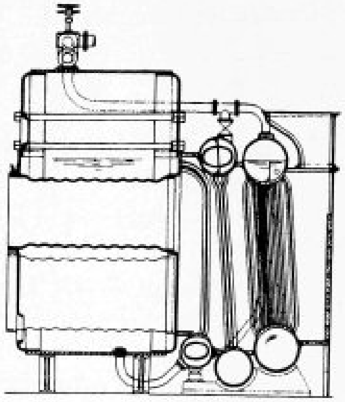
Claim.—A boiler including in combination a pair of lower drums, a central wall between the latter, a steam header above said central wall, a plurality of banks of tubes connecting said lower drums and said steam header, baffle walls extending transversely of said tubes, roofs extending



upwardly and outwardly from said central wall and terminating at said baffle walls, side walls parallel with said central wall terminating adjacent said lower drums, curved side shells forming outer walls opposite said tubes and a casing connected with said side shells enclosing part of said steam header and having a gas outlet formed therein.

1,692,660. STEAM-GENERATING PLANT. JAMES HOWDEN HUME, OF GLASGOW, SCOTLAND.

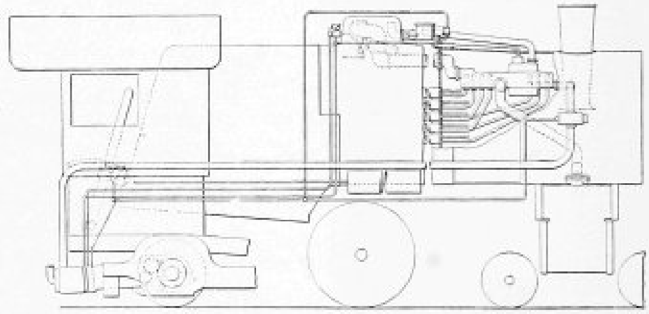
Claim.—A steam generating plant comprising a boiler of the cylindrical type, an economizer spaced from the back end of the boiler and comprising upper and lower drums and substantially vertical tubes connecting said drums, a connection between the steam space of the upper drum and the steam space of the boiler, the lower drum being unconnected



with the boiler otherwise than by way of said tubes, a water box at about the level of the bottom of the boiler, a connection between said water box and the lower side of the boiler, upcast circulating tubes led from said water box to the back of the boiler, said circulating tubes being located nearer the back end of the boiler than said first-mentioned tubes, and a downcomer connection from said upper drum to said water box. Three claims.

1,689,676. LOCOMOTIVE BOOSTER. FREDERICK W. MARTIN, OF BRONXVILLE, NEW YORK, ASSIGNOR TO FRANKLIN RAILWAY SUPPLY COMPANY, A CORPORATION OF DELAWARE.

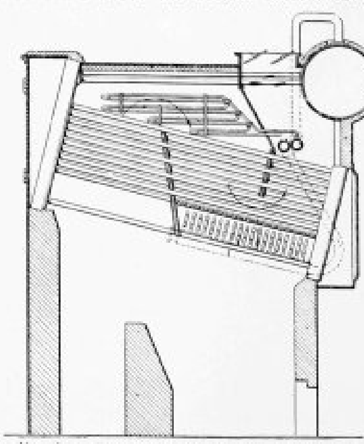
Claim.—The combination with a locomotive and a booster, of superheating means for the locomotive steam supply, and means for passing



separately therethrough the steam supply for the booster when the latter is in operation. Eleven claims.

1,679,585. SUPERHEATER FOR BOILERS. RUDOLF M. OSTERMANN, OF EVANSTON, ILLINOIS, ASSIGNOR TO THE SUPERHEATER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

Claim.—In combination with a boiler furnace and a boiler having inclined tubes set above said furnace at different levels, an upright baffle extending upwardly across said tubes, a longitudinal baffle extending from the first-mentioned baffle above the bottom thereof forwardly and down-



wardly at an inclination corresponding to that of said tubes and forming with said longitudinal baffle a closed pocket out of the path of the furnace gases but exposed to the radiant heat from said furnace, and a superheater located in the pocket below said inclined baffle and in advance of said upright baffle. Four claims.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX | July, 1929 | Number 7

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

Chicago: 105 West Adams St. Cleveland: Terminal Tower
Washington: 17th and H. Sts., N. W.
San Francisco: 215 Market St.

H. H. BROWN, Editor
L. S. BLODGETT, Managing Editor
WARNER LUMBARD, Associate Editor

THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Nickel-Alloy Boiler Steel

A SERIES of investigations on the aging and recrystallization of boiler plates have recently been carried out for the Technical Commission of the Association of Plate Manufacturers by the Kaiser Wilhelm Institute for Iron Research in Düsseldorf, Germany. Among other studies special attention was given to the tendency of boiler steel to form coarse-grain recrystallization. Investigations previously made indicate that the addition of nickel modifies the undesirable phenomena of aging, and that nickel also tends to suppress coarse crystallization.

The findings as outlined in the report of the investigations serve to endorse the decisions on this question arrived at by metallurgists in the United States. In locomotive boiler work nickel-alloy steel is coming into wider use both in this country and in Canada with excellent service results.

The German tests in question were made on fourteen kinds of boiler plate about 0.8-inch thick of varying chemical composition, with carbon from 0.06 to 0.29 percent and silicon from traces to 0.19 percent. Nickel was present only in two of the steel samples and varied from 3.18 to 4.80 percent.

Test pieces were subjected to stretching at low temperature and thereafter were left alone for periods of 3, 14, 30, 90 and 270 days at room temperature varying from 17 to 22 degrees Centigrade. Artificial aging was resorted to on some of the samples which, after stretching, were placed for two hours into an oil bath maintained at 200 degrees Centigrade (392 degrees F.) and were then tested in tension and notch shock.

Among the test results it was noted that stretching up to 5680 pounds per square inch above the elastic limit either left the tensile strength of the test pieces unaffected or affected to only a very small extent. With an increase in the duration of aging there was as a rule an increase in tensile strength, but only to a small extent. On the whole, it was found that, in the majority of cases under investigation, allowing the sample to lie for a period of nine months did not increase the tensile strength to the same effect as heat treating to 392 degrees F.

The changes in elongation and contraction produced by stretching proved to be small. With the increase of the time of aging, the elongation became as a rule smaller while the changes in contraction with an increase in the time of aging were not uniform. The most pronounced changes due to stretching and aging were produced in notch strength. Notch strength was materially lowered in some test pieces by the action of stretching alone. At 32 degrees F. most of the straight-carbon-steel plates indicated a very low notch strength after aging, while plates containing nickel showed a remarkably high strength. At 122 degrees F. however the superiority of aged nickel-alloy plates as compared with straight-carbon-steel plates disappeared practically completely, while at 392 degrees F. the mild steel plates appeared to be superior in regard to notch strength to hard steel or nickel-alloy plates. The critical stretching and heating of all unalloyed-boiler plates produced a lowering of the yield point and tensile strength of the samples tested.

On the whole the tests on recrystallization basically confirmed the conclusions obtained by previous investigations, namely, that the tendency toward coarse-grain formation and resultant lowering of the yield point and increase in sponginess are particularly prominent in low-carbon-steel plates and are more or less suppressed in high-carbon steels and alloy steels.

The investigations have been fully reported by A. Pomp in the January and March issues of *Zeitschrift des Bayerischen Revisions Vereins.*

Boiler Repair Efficiency

FROM the shop records of railroads employing some system of centralized locomotive repairs, it may be inferred that in practically every case savings in material and labor have resulted, while at the same time production in maintenance operations has been greatly increased.

One such plant where the results have proven the value of repair centralization—that of the Central of Georgia Railway Macon shops—averages 15 classified locomotive repairs a month with a minimum staff. For example, in the boiler shop the staff includes only approximately 50 men and this organization not only carries out boiler work but plate fabrication for car repairs and tank repairs for the entire system as well. Details of the shop, its organization, tools and methods are being described in two articles, the first of which appeared in the June issue and the second on page 188 of this issue.

Efficiency of both personnel and equipment are essential factors in the success of the centralization scheme, if the expected results in production are to be accomplished. Proper training and experience of the men in their various departments and competent supervision take care of the personnel factor, while the policy of the executive and mechanical departments must provide for modern machinery and equipment. At Macon these two requirements have been adequately met. The record of the boiler shop staff speaks for itself, while modernization of plant layout and equipment has long been the policy of the Central of Georgia. Although the shop itself is about twenty years old, it compares in every way with the latest plant design. Production tools are installed as new developments indicate advantages to be gained from their use. Material handling has been reduced to what is nearly a mechanical basis with crane, and truck and tractor systems. Operations have been resolved into their simplest form requiring a minimum number of men. The scheduling system is simplicity itself, involving none of the complications found where the shops of a system are scattered over a large territory. Centralization of locomotive repairs on this system has proven remarkably successful.

In connection with the announcement on page 194, that Daniel Adamson, a boiler manufacturer, had been made president of the British Institution of Mechanical Engineers, it is interesting to recall that in 1911 the American Society of Mechanical Engineers was also presided over by a boiler manufacturer. In that year the president, Col. E. D. Meier, was president and chief engineer of the Heine Safety Boiler Co., St. Louis, Mo.

Flanging and Riveting Fifty Years Ago

The oil refineries furnished a variety of work for the boiler makers

By J. A. Anderson

FIFTY years and more ago was an experimental period in the building of refinery equipment, such as stills, tanks, agitators, boilers and other plate work. It was also a transition period in the making of boilers.

In those days the two-flue boiler was in use. This was followed by boilers having six or eight smaller flues, 6 or 8 inches in diameter. Then the "multi-tube" boiler became popular for many years.

The equipment of the old-time boiler shop was limited, the only power tool available in this shop was an old-fashioned combination punch and shear of the Alligator type. The punch bolted to one timber, the shear to another, set about 6 feet apart, with the belt drive and fly wheel at the rear of the long upper members of the punch and shear. A set of plate rolls operated by man power, a crude drill press which was fastened to an overhead frame with a portable table on the floor, and a belt-driven bolt-threading machine completed the power equipment.

We were, however, well provided with hand-operated tools, such as sledges, holding on hammers, side sets and chisel bars.

As we look back to those old times and the amount of work involved in the construction of a boiler, we wonder how it was possible to do so much with so little equipment.

Flanging and riveting were our big jobs. Refinery work was extensive as compared with boiler work and called for a great deal of flanging and riveting. For instance, the stills were 10 feet in diameter and 30 feet in length. The agitators were from 15 to 20 feet in diameter and from 20 to 30 feet in height; then there were settling pans 50 feet square and 4 feet high, all made of iron plate from 1/4 to 3/8-inch thick and 4 by 8 feet in size. There was no pressure carried in the stills or other vessels in those days of oil refining so that thin material could be used.

Many of the heads were made up of several pieces flanged by hand and then riveted together by the old-time rivet gang so that the flange turner and rivet gang were considered the key men of those days, when well-trained minds and muscle counted. Many ingenious methods were used to make the labor as easy as possible.

There were no annealing furnaces in which to heat and then straighten the flanged parts, so that the flange turner not only had to flange the part but he had to know how to keep the work straight and in proper shape. A great deal of the iron used for the flanged parts was of such Old-Country brands as "Lowmoor" and "Donald." It was a pleasure to flange it. After knocking down a heat, a few blows with the hammer in the right places was sure to bring out a straight head when it was finished.

The riveting was all done by the "gang," which consisted of the right and left-hand riveter, the holder-on and the rivet heater, all trained until they became experts in their line.

The riveters stood on the scaffold and drove the rivets day after day, the rivets being heated to the right temperature to make the driving as easy as possible. The rivets were heated in an open rivet forge using blacksmith coal and fitted with a small bellows to blow the rivet fire. It was no small job to be a good rivet heater.

On the holder-on depended the condition of his side of the work. He had to see that the edge of the sheet was kept closed up and that the rivet heads were held on even. This in itself was quite a knack, as the holding-on hammer was equipped with a long hickory handle slung on a hook some distance from the hammer head so that it would have the proper rebound when the rivets were driven. To enable the holder-on to control the movements of the hammer, a pin or bolt was put through the handle about a foot from the end. In this way the hammer could be guided in its bounding on the rivet head. A good rivet gang was the pride of the foreman.

In those days a gang of riveters usually traveled together when out of a job, and one would not accept a job unless all were hired.

Good riveters were known by name wherever there was a boiler shop. While "any hand and any hammer" used to be a slogan used by some boiler makers, there were not many who tried to become an expert on either side of the rivet.

The old-time riveters were glad of every opportunity to exhibit their skill, and so in holiday parades they would be seen and heard as they stood upon a float and, in a way, drove rivets in some old cylinder as they moved along the street. This float was perhaps as interesting as any in the parade, but they did not do any riveting while the band was playing.

The next article will deal with the evolution of riveting from fifty years ago up to the present time.

Conservation of Materials and Labor by the Mechanical Department*

L. R. Powell †

RUNNING a railroad does not consist alone of going out and getting freight and passengers to move over its lines. It does not consist alone of running trains from one point to another. There is not any one person on the payrolls of a railroad from the president to the track walker who should not be vitally interested in every fact that in any way concerns his road. There is not a law passed in any state affecting transportation in any of its forms; there is not a new invention relating to any phase of transportation; there is no change in the public's attitude toward the railroads; which will not sooner or later affect your line and in turn affect you and the other employees of your line. Conversely, there is hardly an act of yours in relation to your fellow men which directly or indirectly does not have a bearing on the success of your road. Of what use would it be for our traffic departments to work day and night to secure revenues for us; of what use would it be for our purchasing departments to bend every energy to secure materials at the lowest possible prices and to see that stocks are kept at the lowest point and still always have on hand the materials needed by every department; of what use would it be for our transportation people to plan more economical methods of handling our business; of what use would it be for our accounting and treasury departments to so handle the accounts and funds of the company as to conserve every dollar possible; if you maintenance people were not ever watchful to see that all the material which is furnished you is properly applied; if you permitted work to be done carelessly by those under your supervision; or if you allowed material to be wantonly wasted. While I am confident that you are not only conscious of these facts but are bending your energies in the proper direction, I wish to stress the importance of the effect your efforts will have in the way of savings and economies for the roads which you serve.

Material purchased for use is a definite subtraction from the treasury. If it is not used it is a dead loss. If it is not properly used or does not serve the purpose for which it was purchased it is a partial or total loss. In 1928 with the gross revenues of something over six billion dollars, nearly a billion and a quarter dollars were spent for maintenance of equipment, which of course included labor as well as material. From this you will note that the money spent for maintenance of equipment was approximately 20 percent of the gross revenues of the railroads and equalled the net return earned on their capital investment, which amounted to only 4¾ percent on an investment of practically twenty-five billion dollars. You will see from this what vast opportunities there are for waste caused by careless handling of material, or by ordering more than is absolutely required for economical operations.

The railroads must look to you master boiler makers and their other mechanical experts for those improvements in the construction of their locomotives and other facilities which will enable them to show satisfactory net earnings. In your hands is placed the responsibility of seeing that the equipment is modern and economical in operation and that no new standards are adopted until they have fully proven their worth. Millions of dollars can easily be lost through the use of wrong appliances, which cannot be detected except by those of you who have the proper technical training and whose duty it is to safeguard your company's interest.

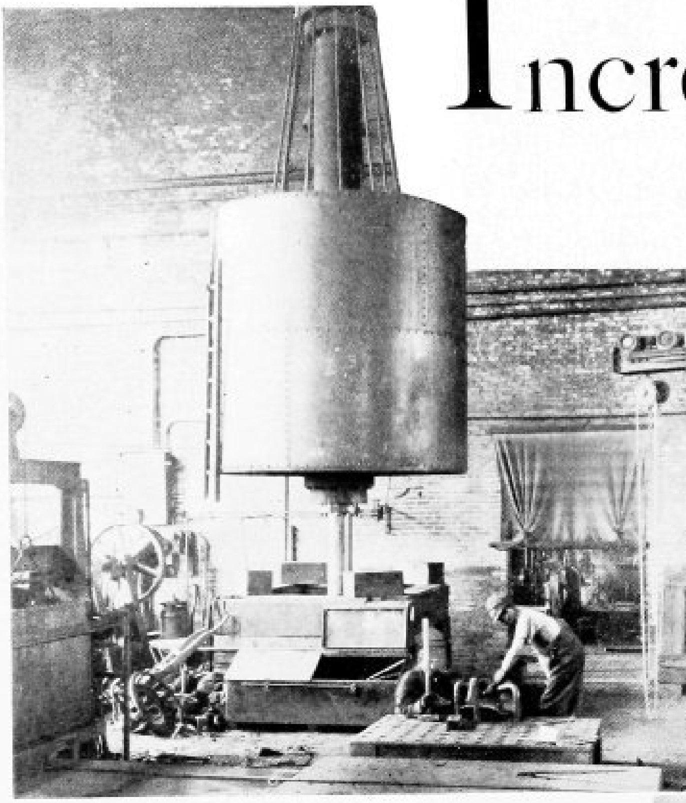
You all know as well as I the vast improvements that have been made in locomotive design during the past fifty years. They have about reached their limit in size to be used economically with our present standard of tracks and bridges, so that the principal improvements for some time to come will have to be in refinement of design. No part of the locomotive is more important than the boiler. It has been rightly called its heart. You master boiler makers will have to see that as the strain upon the boiler is increased by the additional stress put upon it through improvements in other portions of the locomotive, its strength will be increased to meet these additional burdens and it will be enabled to function in relation to the improvements in the other parts.

I have mentioned the fact that the successful operation of our lines depends upon every one of us in any way connected with them. There are, however, factors affecting the success of our railroads over which we have no direct control, and in which every railroader should be vitally interested.

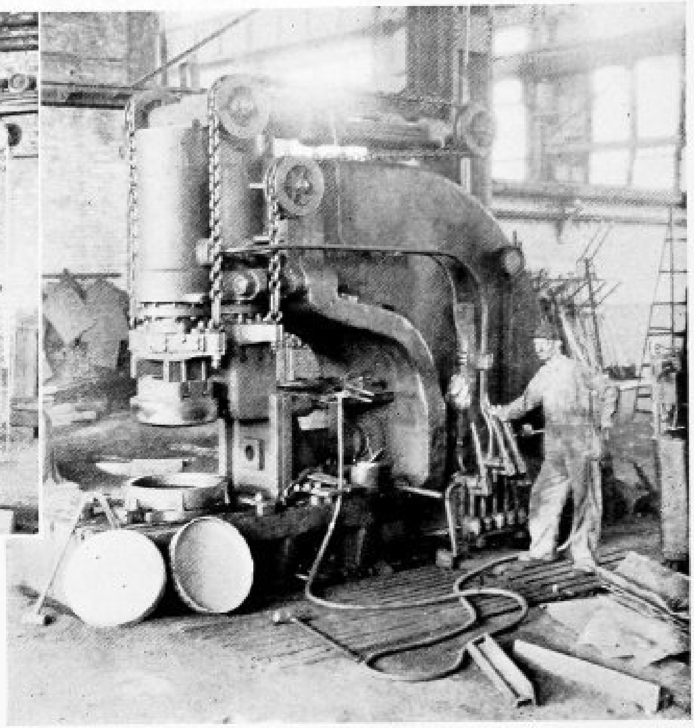
The remainder of Mr. Powell's address was devoted to a discussion of these factors, including railroad investments, taxation and others, on which he asked the support of the members to help rectify.

* Abstract of address before the twentieth annual convention of the Master Boiler Makers' Association, held at Atlanta, Ga., May 21 to 24.
† President, Seaboard Air Line, Norfolk, Va.

Centralization Plan Results in Increasing Boiler



Hydraulic accumulator for flanging press



The 200-ton flanging press in action

IN the June issue, page 153, a general description of the Central of Georgia Railway shops at Macon, Ga., was published. The feature of these shops is the fact that centralization of all classes of locomotive repairs is carried out at this point for the entire system. Details of the organization of the boiler shop were given, and, since readers of THE BOILER MAKER are mainly interested in this phase of locomotive maintenance, the arrangement of the boiler shop, equipment and a description of some of the methods employed are contained in the following paragraphs.

In order to better understand the manner in which boiler work is carried out at Macon the arrangement of the boiler shop is given on page 190 with the location of departments and the machine equipment. The shop includes a flue department, ashpan and light metal department, tank department, cab department, layout floor, fabricating and flanging department and assembly.

A complete list of the machine tool equipment in the boiler shop is as follows:

One safe end cutting machine; S. B. Patch & Sons.
One superheater tube-welding machine; Draper Mfg. Co.
One hot saw and tube expander, motor driven; Jos. T. Ryerson & Son.
One flue cutting machine, motor driven; Fox.
One vertical punch, 60-inch throat, motor driven; Hilles & Jones.
One throatless shear, motor driven; Lennox Throatless Shear Co.
One grinder, motor driven; Bridgeport Safety Emery Wheel Co.
One flue welding furnace; Railway Materials Co.
One swaging and welding machine; Draper & Co.
One rotary bevel shear, motor driven; capacity ¾-inch plate; Jos. T. Ryerson & Son.
One friction saw, motor driven; Jos. T. Ryerson & Son.
One rotary shear, motor driven; Kling.
One vertical drill, 44-inch, motor driven; Foote-Burt Co.
One bending rolls, motor driven; Hilles & Jones.
One horizontal flange drill, motor driven; Beaman & Smith Co.
One portable radial drill, 7-foot, motor driven; Carlton Machine Tool Co.
One angle shear; capacity ½-inch by 5-inch by 5-inch; motor driven; Long & Alstatter
One plate planer, 12-foot; motor driven; Cleveland Punch & Shear Works.
One bending rolls, 12-foot; motor driven; Cleveland Punch & Shear Works.
One annealing furnace; Railway Materials Co.
Two triplex pumps, motor driven; Goulds.
One portable flanging machine; McCabe Mfg. Co.
One hand clamps; home built.
One hydraulic flanging press, 200-ton; Camden Iron Works.
One horizontal punch, motor driven; capacity, 1¼-inch, 1-inch plate, 12-inch gap; Cleveland Punch & Shear Works.
One punch, motor driven; 60-inch gap; Cleveland Punch & Shear Works.
One shear, motor driven; 60-inch gap; Cleveland Punch & Shear Works.
One hydraulic accumulator, 1500 pounds pressure; capacity, 12 inches by 15 feet; Camden Iron Works.

Extending the length of the shop and adjacent to the southwest side is the material-storage yard. Plates are stored on edge in racks so that they may be handled

Repairs with Small Staff

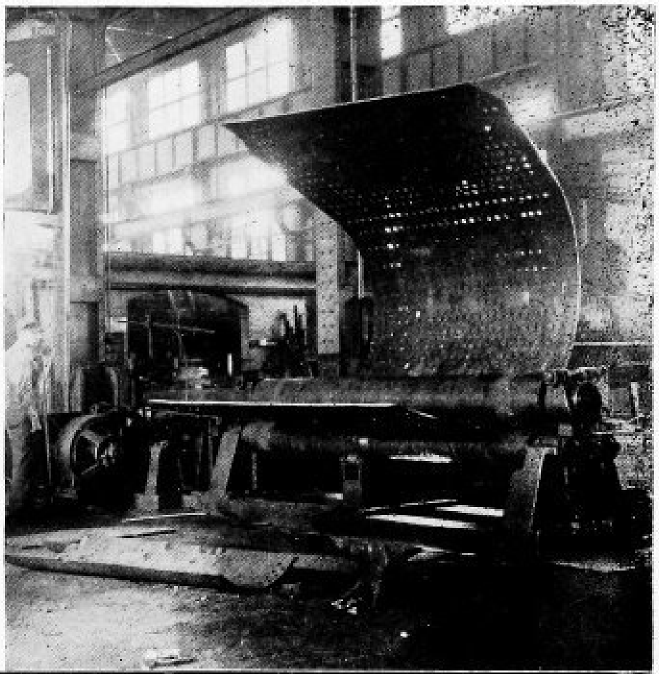
Central of Georgia methods at Macon make possible 15 classified repairs a month

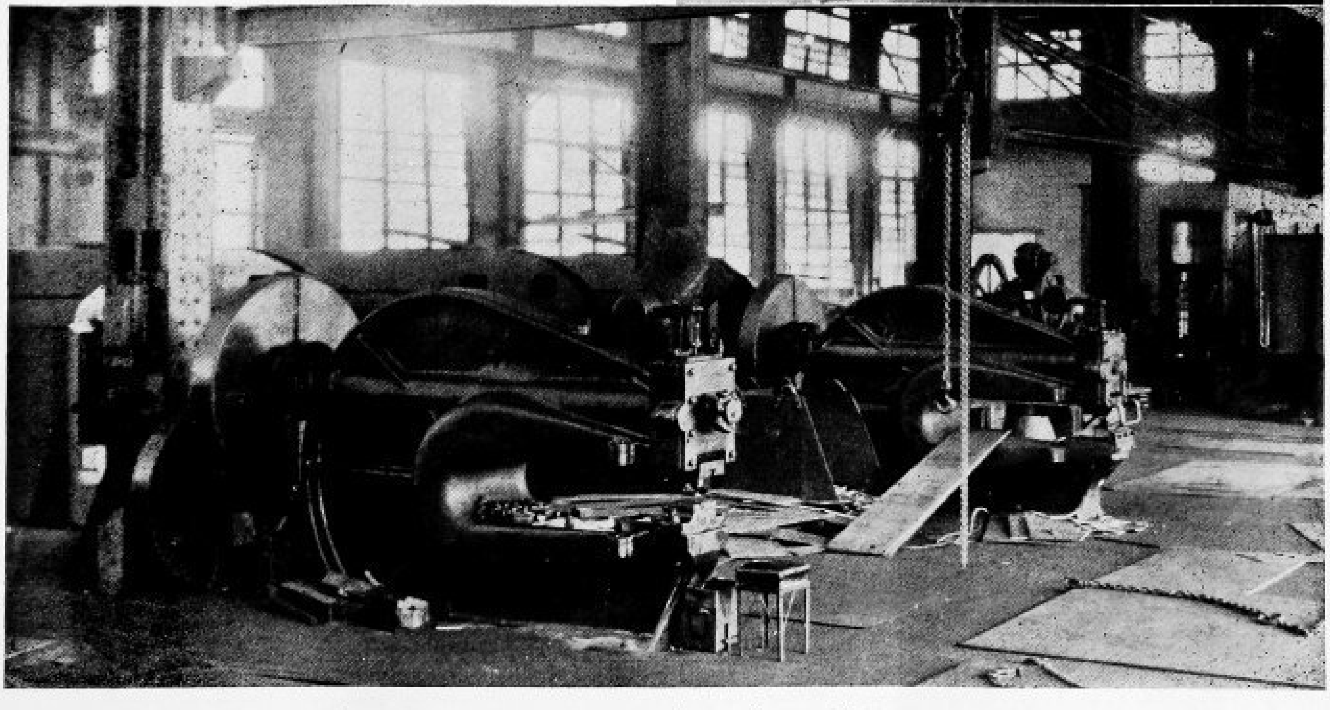
readily and with the least labor. A 10-ton full gantry traveling crane unloads material into the racks directly from the cars. In the order of weight and classes of plate, the racks are arranged as follows: Six racks for soft steel; fifteen racks for tank steel; eight racks for flanged steel and eight racks for firebox steel. In the section devoted to firebox steel several racks are of a length suitable to accommodate the largest sheets used at the shop, up to a length of 284 inches.

New racks for complete flue, angle, template, and pattern storage are soon to be built. All waste and scrap materials are stored in special bins in the yard. For handling such scrap, the yard crane is fitted with heavy magnets. One man besides the crane man can handle any sheet that comes to the yard.

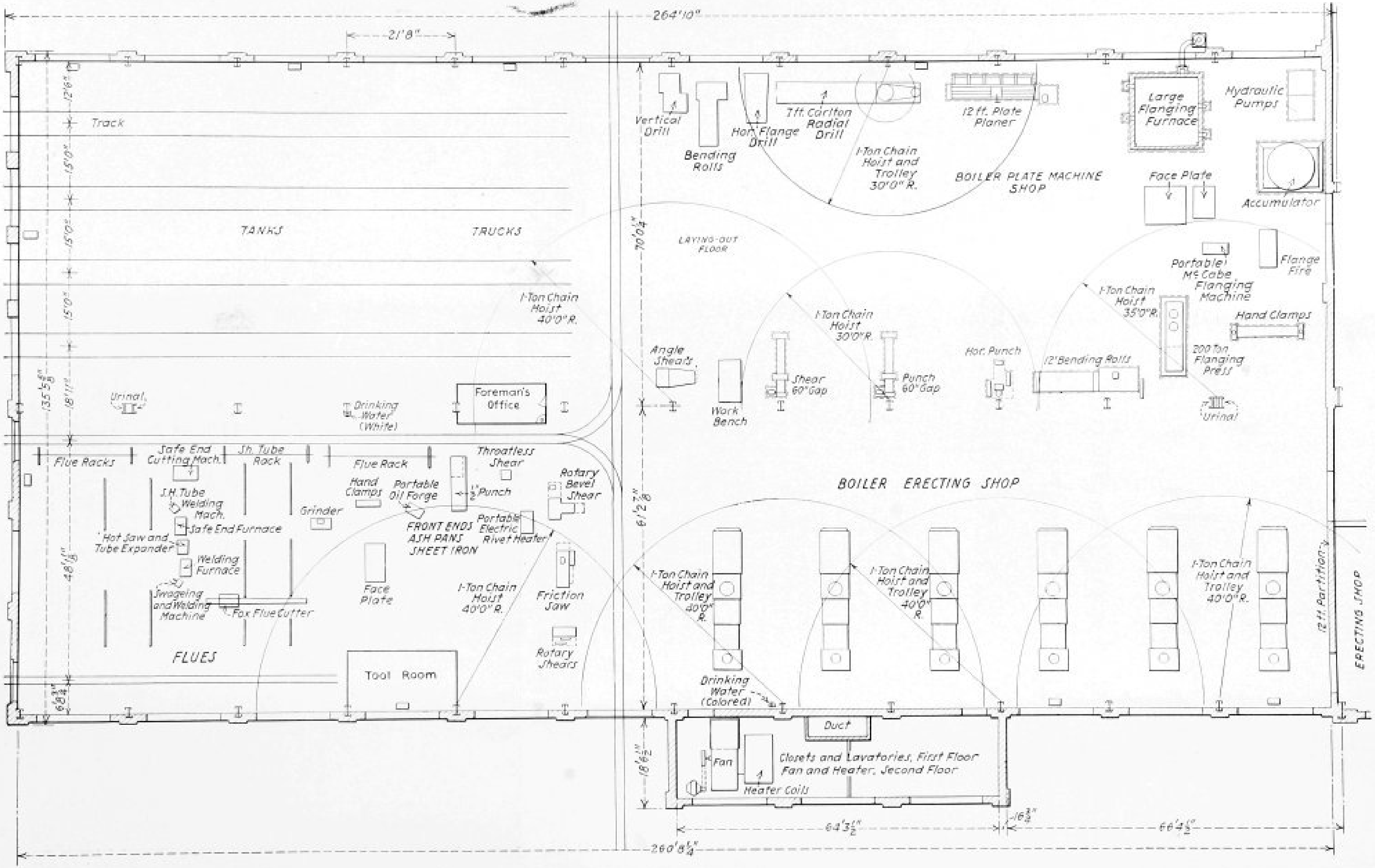
For the handling of materials and parts the shop is exceptionally well equipped. Movement of small parts or light material is accomplished by means of hand trucks operated on the shop rail system, while heavier plates and materials are moved by a truck and tractor system. Three tractors supply transportation for the entire plant.

If required in the shop immediately, plates are re-





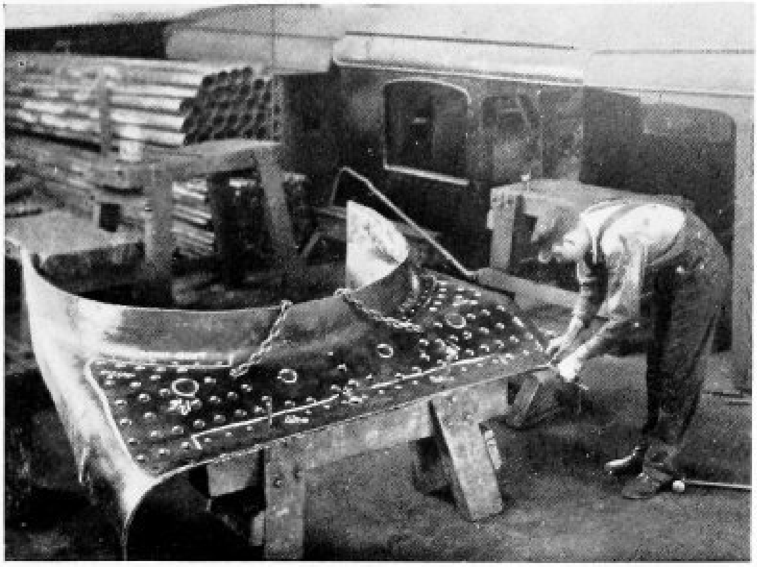
Battery of punches and shears in boiler shop. (Above) Firebox sheet being rolled



Arrangement of the Central of Georgia boiler shop at Macon moved from the cars and placed in the laying out department.

Shell work and flat plates are taken to the drill press and drilled; then to the plate planer and finally to the assembly floor. All operations on the shell are carried through without back tracking for any operation.

In the case of flange work, however, it follows through the layout operation and drilling and thence to the flanging department. Finally it retraces its course to the layout bench for hole-marking the flanges. From here the flanged sheets go to the drill press and punch and from this point to the assembly bay.



Lining up a throat sheet

These operations are all according to the best boiler shop practice and do not offer any material departures from customary methods. Several points of special note, however, occur in the standards maintained. It has been found at this shop that proper penetration and quality of welds can be maintained on plate of a thickness up to ⅜ inch with the electric arc welder; all heavier plates are welded with the torch. For electric arc welding the boiler shop equipment includes two 2-man machines in the boiler shop and one 2-man in the roundhouse. A complete equipment of oxy-acetylene welding and cutting torches is available.

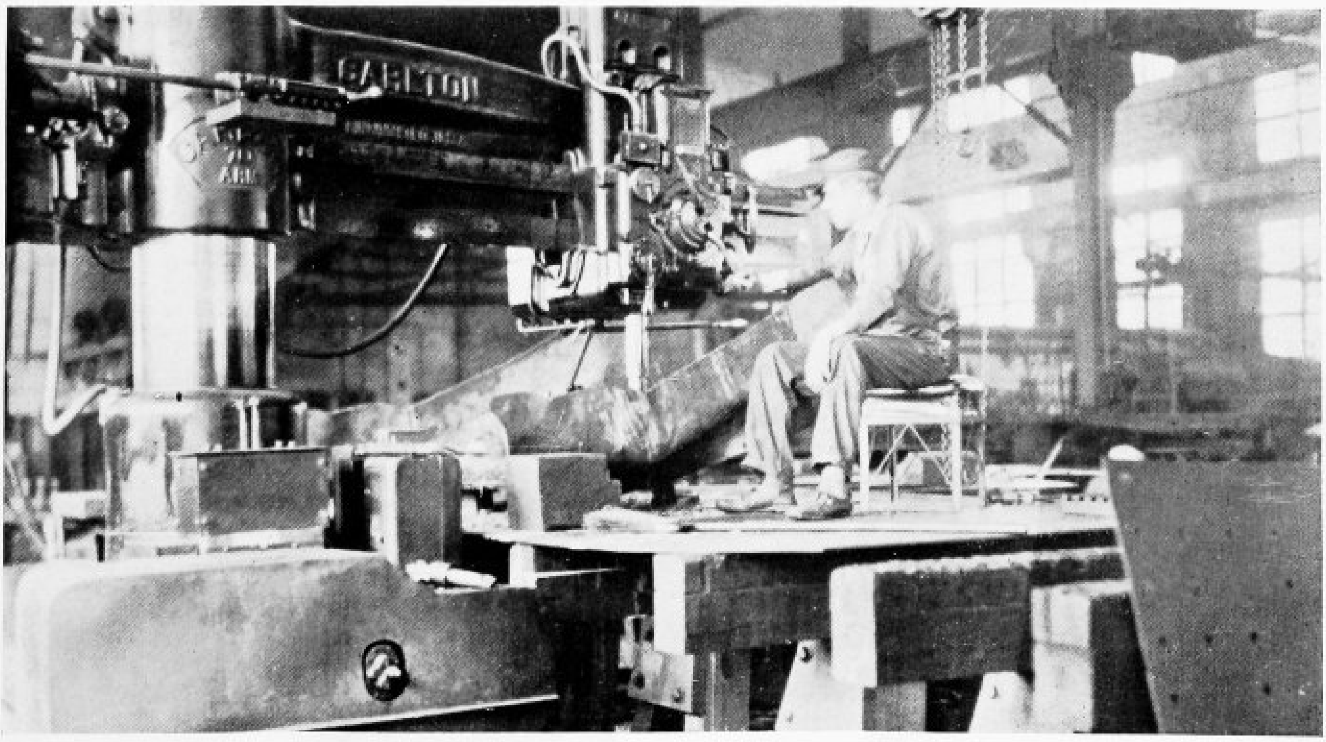
Firebox welding at this shop is handled conservatively and comes well within the limits prescribed by the Bureau of Locomotive Inspection. Butt welding is used exclusively and seams are welded inside and out. This also applies to patches. New firebox sheets are welded only up to within 15 inches of the highest point of the crown sheet.

All plates up to ½ inch are beveled on the rotary shears while all sheets above this thickness are planed both for bevels and for butt joints. No shell work is beveled on the rotary shears.

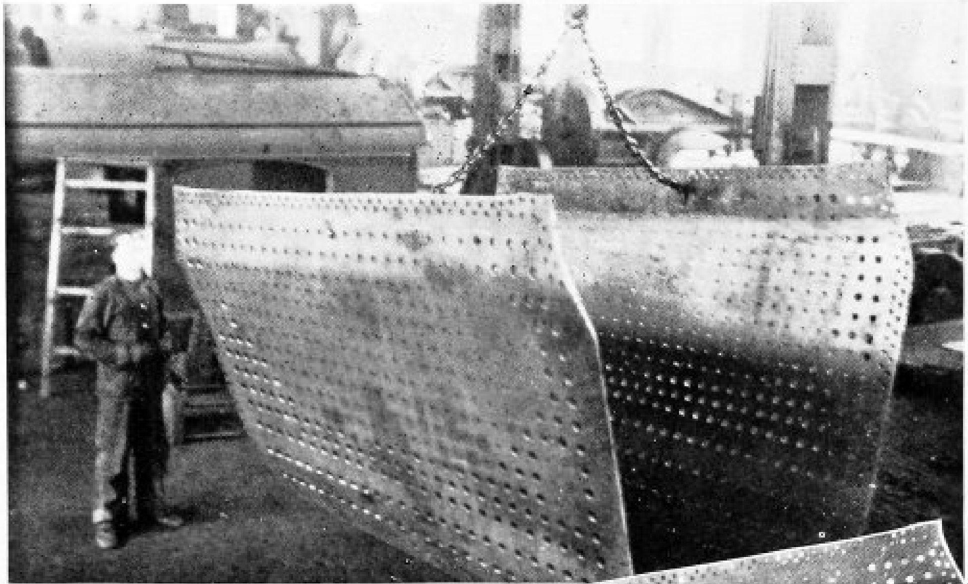
In making staybolt inspections, air pressure is applied to boilers after they have been emptied and the hammer test is used under this condition. Fire and hydrostatic tests of boilers are carried out in the back shop.

Templates for all fireboxes on heavier power are kept available. Back-end replacements for a total of nine classes of engines can thus be made at any time. All car work in this shop for the entire system is made from templates. Sheets cut for the lighter classes of engines are used for templates in all repetitive operations. New shell work is all laid out on the bench.

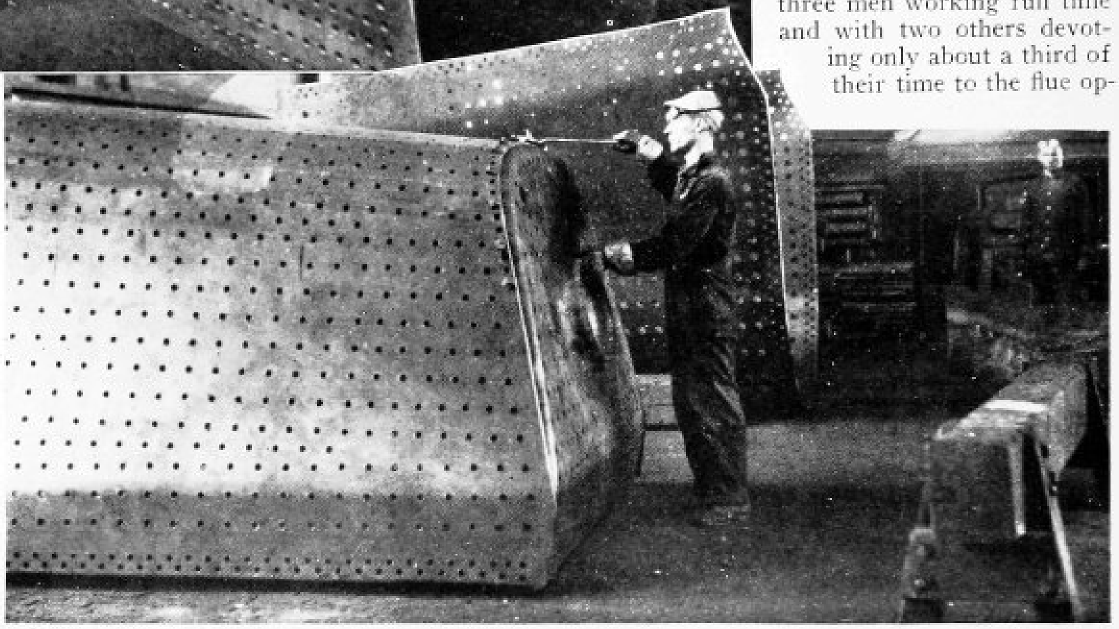
A very important adjunct in speeding up assembly work at Macon is the complete equipment of electric



A special 7-foot radial drill is used to speed up production



(Above) — Firebox sheet ready for the assembly operations



(Right) — Bolting-up operations on firebox assembly

rivet heaters. In the boiler shop alone there are a total of three large and three small Berwick heaters, supplied by the American Car & Foundry Company, divided between the heavier boiler work and tank and cab work.

A simple and direct method of scheduling material is employed which is especially adaptable to the work at this shop. When an engine comes in for classified repairs, all work and material are charged directly to that engine all the way through the various departments. New back ends, however, which may be applied to the different classes of heavy power when they come in for repairs are carried out on shop orders. Syphon work is done on work orders.

When the engine on which a new back end is to be installed comes into the shop or when syphon work is scheduled on a boiler, then the shop order for the back end or the work order for the syphon is charged directly to that engine.

For example, it was found that fifteen Pacific type locomotives, constituting one class of power and having boilers equipped with combustion chambers, were difficult to maintain in a tight condition. The general boiler foreman discovered that by making certain changes in the combustion chamber design the difficulty could be overcome. After being checked by the mechanical engineering department, authority was given to assemble a new back end incorporating the changes. This was done and the new back end tried out and approved.

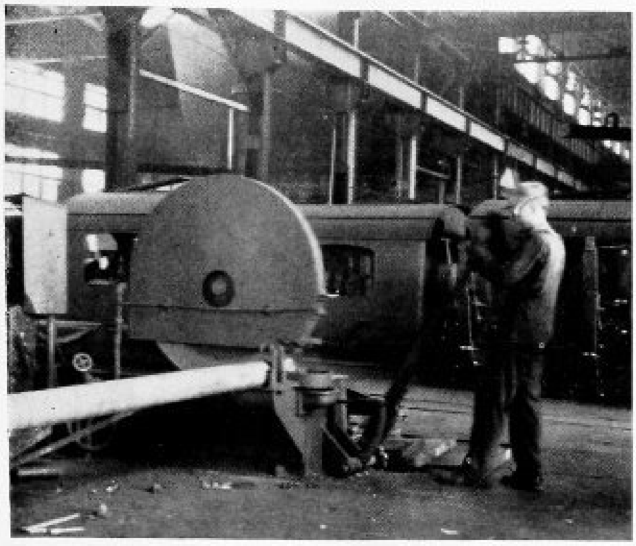
Fourteen additional back ends of this type were then made up on shop orders and installed on the locomotives of this class as they were shopped.

One of the most interesting operations carried out is the flue work, which is done here for the entire system. A production of about 250 tubes and flues a day is maintained constantly with three men working full time and with two others devoting only about a third of their time to the flue operation.

From outlying shops, flues are brought to the material yard in cars and stored until required. Tubes and flues from the back shop are brought by the shop crane to the transfer shop track, located about midway down the length of the boiler shop, and here they are loaded into cradle trucks. At this point the tractor hooks on and delivers the tube bundles to the yard crane which in turn drops them onto gravity racks feeding into a wet rattler. The present rattler, which was only recently installed to replace one which had been in operation since the shop was built, is a product of the boiler shop.

After cleaning, the tubes are again delivered to the cradle trucks and taken to the flue department, the arrangement of which is shown in the shop plan on page 190. Gravity racks are used to the best possible advantage in this flue department to eliminate handling as much as possible.

Furthermore, it is the only shop within the writer's experience in which the operations of cutting off on the hot saw, belling the tube end and inserting the safe end are combined into one operation. One man handles the tube from the heating furnace through this operation, after which the welder and a helper place it in the welding furnace, and weld and swedge it. These



Cutting off superheater flues

From this point, two operators devoting only part of their time to flue operations, gage the tubes, cut them to length and then anneal the front ends in the opposite side of the first heating furnace and cut off the firebox end. After this, the tubes roll into place on the gravity racks for bundling and returning to the back shop for application or to the cars for delivery to outlying shops.

Records of the Bureau of Locomotive Inspection *

John M. Hall †

We of the Bureau of Locomotive Inspection appreciate the helpful co-operation of the membership of this association, for we are not unmindful that without such co-operation we would not have achieved the wonderful results obtained. I think it right and proper to also acknowledge the fine spirit of co-operation the bureau is receiving not only from the mechanical officials of the railroads, but from the operating personnel as well, from presidents down, and I am quite sure that this co-operation is a reflection of our efforts to perform our duty in the enforcement of the law and rules in an intelligent and reasonable manner. I say "reasonable" but perhaps "practical" would be the more expressive word to use as it is our imperative duty to see that the mandates of the law are observed by all carriers alike.

In one of the Washington newspapers there appears a short humorous article each day headed "Who Remembers?" and then is usually pictured some event of twenty-five or thirty years ago and this has caused me to think back a few short years and ask a few questions along the line of "Who Remembers?"

For instance, who remembers when many locomotive boilers in the United States were continued in service with many flues plugged, often up to 50 percent of those in the boiler?

Who remembers when broken staybolts were allowed to remain in the firebox until the locomotive went to the back shop for heavy repairs?

Who remembers when roundhouse boiler makers had to be somewhat of a seamstress, that is, he used to sew up firebox cracks with a chain of plugs?

Who remembers when the boiler maker helper had to hold a sheet of tin over the boiler maker while he worked inside the firebox, to protect him from leaking crown stays, squirting staybolts, leaking firebox sheets, and seams, and when single riveted patches were applied to defective boiler sheets without any regard to factor of safety?

Who remembers when at boiler washout periods the four corner washout plugs and perhaps one in the backhead were removed and a hose nozzle was inserted in the hole in backhead and a lazy stream of cold water was allowed to trickle in the boiler?

Who remembers when the belly of boilers was permitted to become solid with mud and scale until the flues had to be removed in order to clean out the boiler?

Who remembers when the left injector would not work and the right one would only take up half the water?

Who remembers when the safety valves were set in the back shop and allowed to remain until the next shopping provided the engineer did not get out on the boiler and screw them down in order to get more pressure; and, when one of them lifted it did not seat until the pressure was about half exhausted from the boiler?

Who remembers when flue and other boiler failures were quite common, and, in fact, the thing to be expected on certain divisions of many railroads, and that flue failures occurred every few hundred miles, while today many roads are making a record of many thousands of miles between such failures?

Now someone may be asking "does he think that the boiler inspection law has been entirely responsible for all the improvements in locomotive boilers?" Well, I have already mentioned co-operation and I am not unmindful that many obsolete boilers have been replaced by larger and more modern boilers and also that different methods of repair have come into vogue and that all-up-to-date roundhouses are now equipped with hot water boiler washing facilities, all of which are helpful. But let me ask you a question. Had it not been for the constant pressure of the law and the knowledge that 50 (now 65) good practical government inspectors were eternally on the job, would it not most likely have required a much longer period of time to bring your locomotives up to the present generally very good condition? I think that you will agree with me that it would.

Someone may ask, "What does the record show?" Briefly it shows that during the fiscal year ending June 30, 1912, the first year of the law, that we had 856 accidents due to failure of some part or appurtenance of locomotive boilers which resulted in 91 deaths and 1005 serious personal injuries. A steady improvement was then noted and in 1915 we had 424 such accidents, 13 killed and 467 injured, and in 1928 we had 150 accidents, 26 killed and 174 injured. It will thus be seen that there has been a very substantial reduction in the number of boiler accidents with a corresponding reduction in the number of casualties.

Of the locomotives inspected by our inspectors in 1912, 65.7 percent were found defective, in 1915 this percentage dropped to 44.4 and in the last fiscal year, ending June 30, 1928, but 24 percent were found defective, and I am informed that on many railroads loco-

* Abstract of address before the twentieth annual convention of the Master Boiler Makers' Association, Atlanta, Ga., May 21 to 24.

† Assistant chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission, Washington, D. C.

motive failures from mechanical defects are now comparatively few and all of this has resulted in a smoother and if you please a more harmonious operation, also in a substantial reduction in maintenance and operating costs.

Lee Stewart's Wrist Watch

IT all started at the Atlanta convention! Evidently, feeling rather proud of the fact that their boss was president of the Master Boiler Makers' Association, the boiler foremen of the Atlantic Coast Line got together and decided that, since he was the first southern president ever elected, Lee Stewart should also have the distinction of being the first boiler maker to wear a wrist watch. To this end they proceeded to buy the best and fanciest watch possible and appointed L. E. Hart, fifth vice-president of the association, a committee of one to present it to Lee at the annual banquet.

Well, after that for the remainder of the meeting the convention was conducted as never before. That was all right too because it didn't last much longer.

However, when Lee got back to Waycross he held a reception for all his foremen and told them that, in spite of the fact that a wrist watch might be regarded as rather a dainty adornment for a boiler maker's arm, he was going to wear it any way.

As a surprise for their distinguished guest, the foremen then presented several other practical gifts to go with the wrist watch, including a set of silk underwear (baby blue in color) a pair of golf knickers with accessories, including genuine made-in-Scotland hose and a set of three-way golf clubs. Not to be outdone by the men, a number of the girls in the office also presented Lee with a handsome compact and lipstick set to be used with his golf make-up.

Accepting his gifts in the best of spirit and humor, Lee assured the foremen that he would cherish them always and that he would endeavor to wear them on some auspicious occasion—rouge and all.

"As for the wrist watch, I wouldn't wear any other kind now," he stated, at the conclusion of the ceremonies.

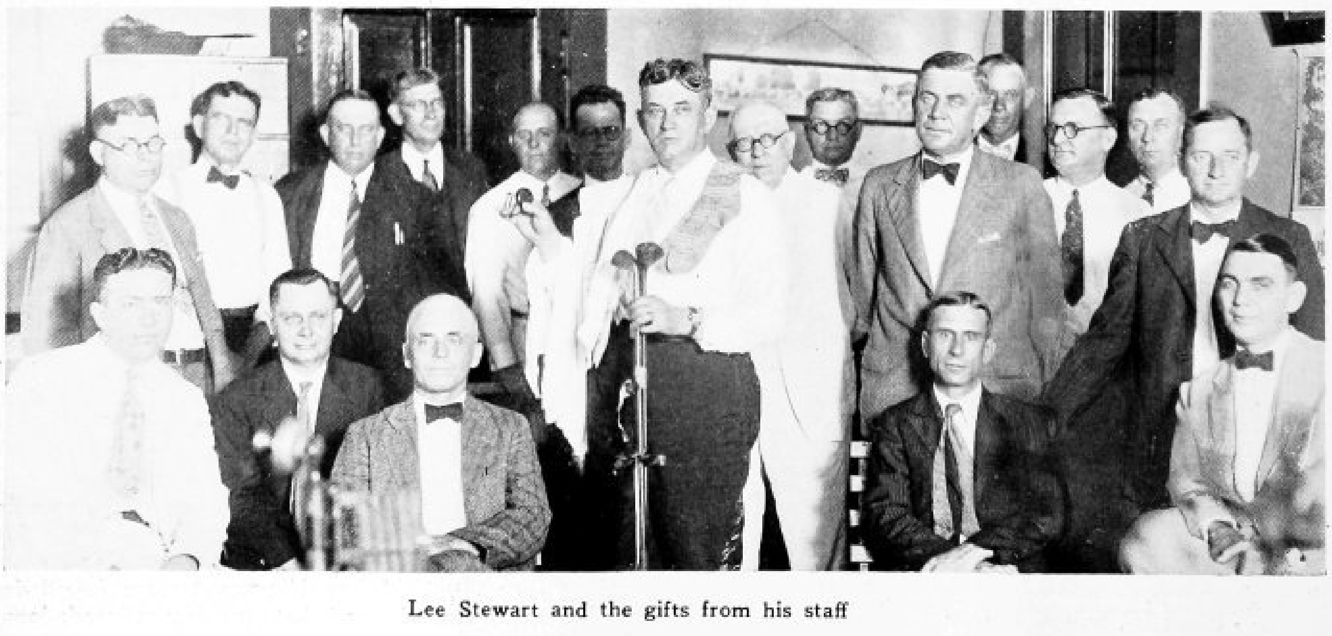
Lee may find his golf clubs of considerable use next year; for there are several other boiler maker golfers who will be waiting the chance to take him on at the Pittsburgh convention.

First Boiler Maker President of British Mechanical Engineers

THE annual summer meeting of the British Institution of Mechanical Engineers, this year held in Manchester at the end of June, had a special interest for boiler makers, as for the first time in its history the Institution had a boiler maker as its president. The Institution, which was founded by George Stevenson in 1846, is the oldest and probably the best-known of its kind in the world. Many famous engineers have accepted the presidency in the past, and it is very appropriate that this year the office should be filled by Daniel Adamson, head of the firm of Joseph Adamson & Company, boiler makers, of Hyde.

Mr. Adamson, who is an ex-president of the Manchester Association of Engineers, has a name well-known in British engineering, both by family tradition and by his own scientific work. He is a member of British, American, and French engineering institutions, and is the author of many technical papers, being awarded the Hawkesley Gold Medal of the Institution of Mechanical Engineers in 1916 for a paper on spur gearing.

Mr. Adamson's firm makes flanged boiler plates, boilers of all kinds, welded vessels, and cranes. The works at Hyde now comprise nine bays. In 1 and 2 are hydraulic presses and dies. Bay 3 contains the smithshop and the machinery for fire welding and flanging, together with oxy-acetylene welding equipment. Bay 4 is the plate shop, with bending rolls, milling spindles, and vertical drilling machines, and two large vertical boring mills. The pattern shop occupies bay 5; 6 is the boiler shop, and 7 and 8 contain the erecting and fitting shops and the testing pit. Originally the works manufactured steam boilers only; but it was enlarged in 1883 by the addition of a new shop for hydraulic press work, and in 1894 the overhead crane department was added.



Lee Stewart and the gifts from his staff

Applying Firebox Syphons*

Forty-five railroads contribute experience as to best methods of servicing thermic syphons

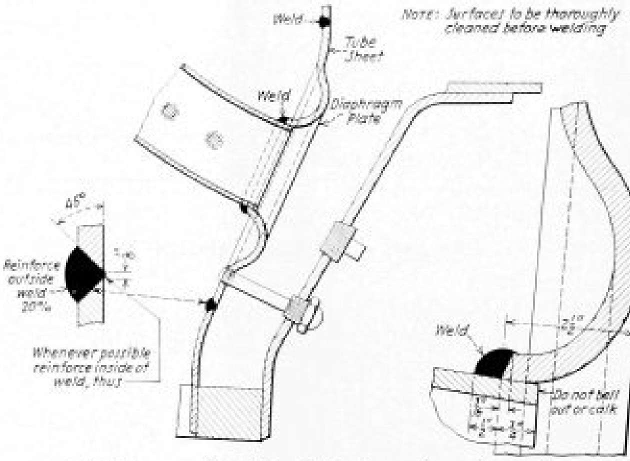
YOUR committee has gone into this subject thoroughly, and, owing to the importance of the subject, wrote to forty-nine railroads that had thermic syphons in locomotives two years or longer, and received replies from forty-five of the railroads, and the application of syphons varies very little. From these reports, we submit the following as the best method of application. This applies to locomotives with one, two or three syphons:

1. Rolling of firebox.—The first step taken is the rolling of firebox wrapper sheet. In doing this, care should be taken so that a perfect roll is developed in crown sheet. The reason for this is that when bolting in door and back tube sheets to the wrapper sheet there would be no excess strain on the crown sheet. If no perfect roll is made the wrapper sheet is bound to warp while the syphons are being welded in, which is caused by the excess strain.

2. Door and tube sheets should be riveted in before syphons are applied.—Where possible, back tube sheets should be made with the diaphragm holes for syphons in them from ¼ to ½-inch larger than the neck of each syphon, so that when welding the syphon to the crown sheet, the neck of the syphon will be permitted to move in any direction, caused by expansion and contraction taking place when welding. Opening for the syphon should then be marked off in the crown sheet and cut out with the acetylene torch. The syphon is then laid out, trimmed, and beveled to fit in place. Radial staybolt holes laid out and drilled. The syphon is then placed in position in the firebox, the firebox being turned down on its back or crown sheet down. It is then fitted and the proper clearance made for welding. This is a V-butt weld with an opening of 3/16 inch, the weld to be made from the fire side. The syphon is then marked off at the neck or tube sheet connection and either removed from the firebox or shoved through the opening and burned off the proper length, which is ⅜ inch into the diaphragm plate. The syphon is then placed in its permanent position.

3. Preparation for welding syphon.—Several small straps ½ inch by 2½ inches by 7 inches are now made which are used for holding the syphon in place when welding. These straps are put on the inside of the crown sheet, one end of each strap being bolted in a radial stay hole in the crown sheet. A strap is bolted in about every third hole. As welding progresses these straps are removed one at a time so as not to weld over them during the operation.

4. Welding.—All welding should be done from the fire side. The first operation in welding is to weld both ends of each syphon so as to prevent any side pull on the flange which perhaps would happen if this were not done. The next operation is to weld along the side of the syphon between the flange and crown sheet butt. This weld should be from 10 inches to 12 inches long. The same distance is then welded on the opposite side of the flange and the same operation is then performed on the other syphon. This operation is then repeated by coming back to the fire side weld and welding again a distance of about 10 inches or 12 inches. This is repeated until the entire length of the syphons is welded to the crown sheet. The straps which held the syphons in position should be removed as the welding progresses. The firebox is now turned up in its natural position and all surplus metal chipped off, flush with the water side of the crown sheet. Generally a small sag will be noticed in the crown sheet which cannot be prevented due to welding. To straighten this out a long bar or straight edge is applied to the top of the crown sheet and the sag is removed by tightening up on the straps that are bolted over this bar to the radial staybolt holes in the crown sheet. After the crown sheet is straightened up a light weld is applied around the outside or water side of the flange of the syphon, or the weld is reinforced.



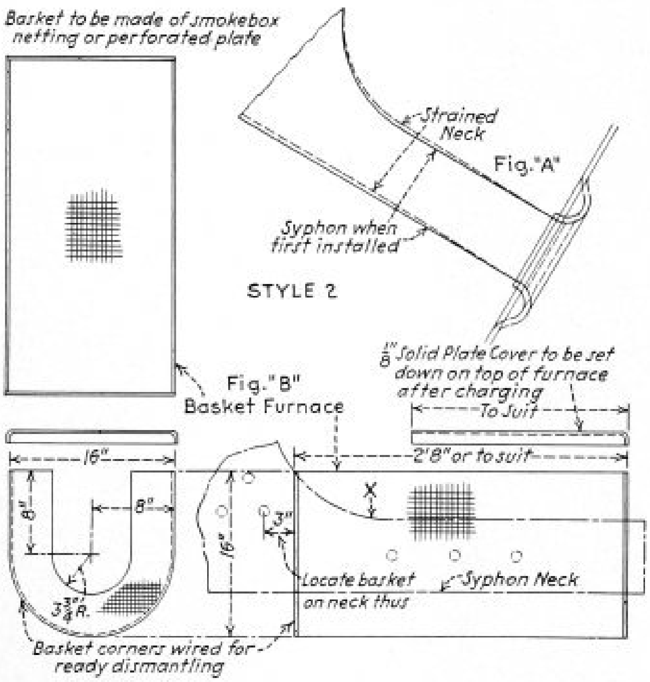
Diaphragm plate for Nicholson thermic syphon

Method of applying Nicholson thermic syphon to locomotive firebox

The next operation is to lay up the hole in the diaphragm around the syphon neck, which is done by heating with an acetylene torch and hammering, starting at the bottom. Before any welding is done, the

* Report presented at the twentieth annual convention of the Master Boiler Makers' Association, held at Atlanta, Ga., May 21 to 24.

syphon-neck bar should be removed from the crown sheet so as to prevent any strain on the syphons. The syphon should be laid up well on both the water and fire side and welded on the fire side only. After the syphons are completed, should there be a question as to an uneven stress being left on the center parts of the syphons, a mold or form can be made to fit around the syphon neck and therein build a charcoal fire and heat the syphon neck cherry or dark red and remove the mold or form after it has cooled down. After the syphons are completed, a careful inspection should be made of the interior to see that there is no forging matter left in them, for should there be, there is a possibility of the sheet at that point being burned. In order to make this close inspection it is of importance that washout plugs should be so located that one will have a clear vision of all parts of the interior of the syphons. After the fire box is placed in position, radial stays and flexible staybolts are applied in the usual manner. Flexible staybolts should be applied all around the syphon neck.



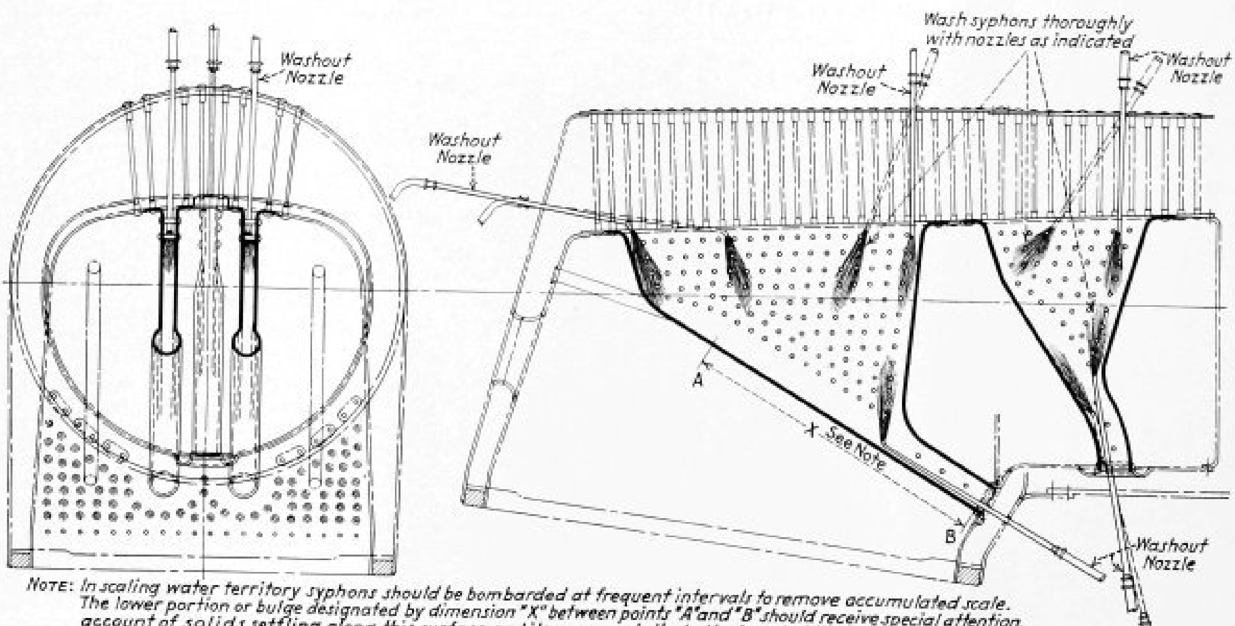
Syphon neck heating furnace

Maintenance

The main thing from a maintenance standpoint is a thorough and systematic washing of syphons, and to see that they are kept perfectly clean. Not much trouble will be experienced with the diaphragm plate if flexible staybolts are properly applied around it. Your committee finds that it is very essential that all parts of the syphon be kept clean, and believes that the district or section of the country in which locomotives operate must govern this question. We are quite sure that if the rules outlined by the manufacturers of the thermic syphon are followed, little trouble will be experienced. The rules call for interior of syphons to be washed and cleaned, the bottom of the exterior to be bumped with a special designed tool, inspection made of interior and exterior at each washout. In addition, in very bad water districts and where a sand blast machine is in use, the water side of the diaphragm plate at the roll of the flange should be sand blasted about every ninety days with an air pressure on the machine not over 40 pounds. This is to remove any scale that might accumulate at that point, for it is very essential to keep the sheet clean. The working of the sheet at this point, if not protected, will perhaps change the structure of the material, causing the sheet to crack. After the sheet has been sand blasted, air pressure should be used to clean the space between the diaphragm flange and the neck of the syphon so that at all times there will be water at this point when fire is in the firebox.

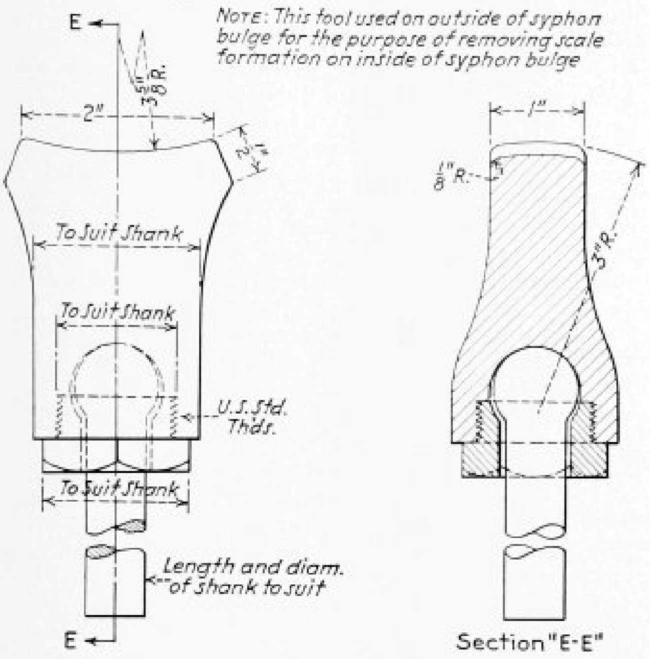
General Repairs

Repairs to thermic syphons should be taken care of in the same way as any other part of the firebox or boiler; that is, repairs are to be made in a safe and satisfactory manner. From forty-five railroads that have had thermic syphons in locomotives two years or longer, it is reported that 75 percent of syphon repairs, are at the diaphragm plate or syphon neck. Cracks develop around the diaphragm plate and on top



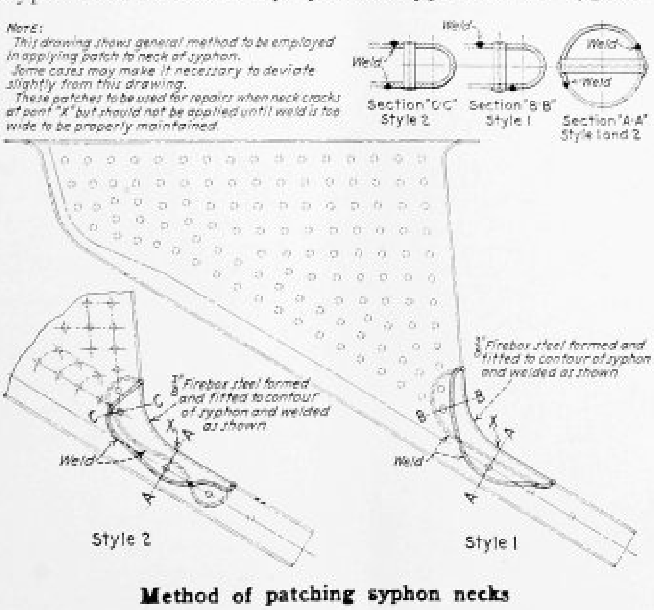
Method of cleaning syphon

of the neck. When a circumferential fracture develops in the syphon neck it should not be welded, but a patch should be applied with proper staybolt spacing in the patch, or the bottom section of the syphon should be removed and a new section applied. In applying this new section regardless of how much of the section is



Bobbing tool

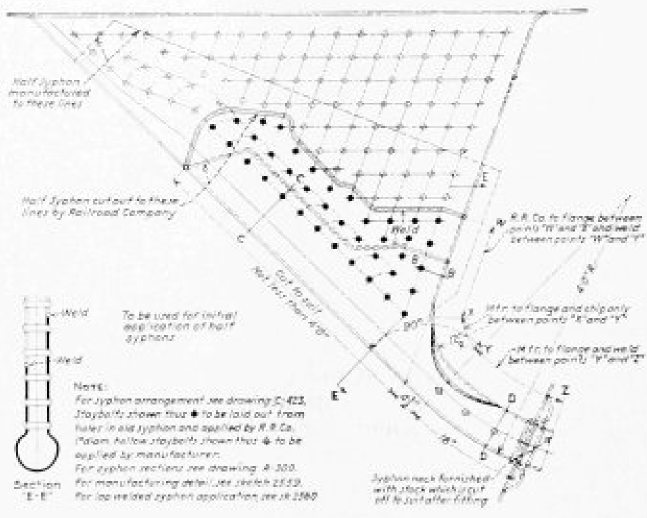
removed, the weld, where the new section joins on the old section, should not be applied opposite each other. The safest method is to have the weld on one side at least two rows of staybolts higher than the weld on the opposite side, or apply the section of the syphon in a saw tooth manner, alternating the so-called teeth in order that the staybolts will be in the new section on one side and in the old section of the syphon on the opposite side. When cracks develop in the diaphragm plate these can be repaired readily by cutting out the crack and welding, but when a crack or fracture develops which is 40 percent of the circumference of the diaphragm plate, the diaphragm should be renewed. This can be done by burning the diaphragm plate from the syphon neck without injury to the syphon or the syphon



Method of patching syphon necks

neck, and a new diaphragm plate can be applied as in the case of ordinary repairs to any other part of the firebox.

No trouble is reported from any railroad with the butt weld of the syphon to the crown sheet. The lap weld, however, does give trouble from fire cracking. This is due to the double thickness of metal at this point and the additional metal which is applied in welding the syphon to the crown sheet, as this metal is applied on both the water and fire side of the crown sheet and the syphon. These cracks should not be disturbed until leaks occur from them. Then they should be cut out with a cape chisel or diamond point and welded. This method is very satisfactory in some districts, whereas in other districts it is only temporary, and in cases where it is unsatisfactory, the syphon should be removed; this to be judged and handled the same as any other repairs to the firebox, bearing in mind that either the repair or removal of the syphon is done in a safe and satisfactory manner. We find that a locomotive with syphons applied with the corrugation of the diaphragm plate in the fire side of the firebox and welded to the syphon neck gives more trouble from cracking than a locomotive which has the corrugation dished into the water side, and welded on the fire side of the syphon neck only. Nicholson thermic syphons have been in service since June 1918, and at the present time there are about 8700



Method of applying half syphon

syphons in 4300 locomotives, and we have reports that there have been fifteen cases of low water where the water was down from 2½ inches to 12 inches below highest point of crown sheet, and the approximate damage in these cases was from $50 to $350.

These low water cases prove the syphon is a positive safety device by reason of the syphon action which pumps water out of the syphons and over the greater part of crown sheet, keeping it cool. A very small part of the crown sheet ahead, and sometimes back of the syphons usually gets hot, pulling away from crown stays, which also allows some steam to enter the firebox, giving warning of danger and relieving boiler pressure.

This report was prepared by a committee composed of C. J. Petzinger, chairman, W. C. Becker, and J. F. Powers.

Discussion

W. N. Moore; (Pere Marquette): We have had a little trouble with syphons cracking in the neck. I received a copy of a pamphlet a few weeks ago showing where a syphon was successfully patched on the bottom. We have always patched syphons in the middle, making a long-shaped patch, including two staybolts on the inside or outside, whichever the case might be. I believe that the thermic syphon is beneficial in the firebox.

L. J. JOHNSON; (FLORIDA EAST COAST): I was interested in Mr. Petzinger's remarks on taking diaphragm plates out when they cracked and were past welding. On our railroad, we have 15, 300-class engines with contour on the fire side and they gave a lot of trouble. When we removed the diaphragm, we put the contour on the water side and we have had no trouble since. Only a few have cracked and these we rewelded until we found they needed patching. Then we have two, 400-class engines, Mountain-type, that we put a half diaphragm plate in just half way the neck of the syphon and have had no trouble with the weld.

C. A. SELEY; (LOCOMOTIVE FIRE BOX COMPANY): The syphon has been the most interesting phase of all my experience in railroad work. The big thing is the circulation of the water. Previous speakers have referred to the matter of circulation, but it goes further than that. The matter of the circulation of the water in firing up and in operation takes care of the boiler. Great stresses would occur in the boiler, were it not for the fact that the water is circulated to all parts and kept at a uniform temperature. It is structural stresses that bring the locomotive in to the back shop for maintenance. The syphon stands alone in its field, and, while there has been trouble in maintenance, as evidenced by the arrangement of patches and welding as described, it is inevitable that it should lessen the chance of trouble extending into the firebox. If we can reduce the magnitude of the stresses, we are going to have the best possible performance of the principal part of the locomotive which we all know is the boiler.

W. G. BELL, (FLORIDA EAST COAST): On the Florida East Coast Railway we have, at the present time, 142 locomotives equipped with thermic syphons, consisting of passenger, freight and switch engines. Of this number, 15 were built and equipped with syphons in 1923. Our experience, therefore, is varied covering a number of years.

With reference to the application, we have made a test of both lap and butt-weld connection at junction of the syphon and crown sheet. We have found the lap weld is not as satisfactory as the butt weld, as fire cracks develop and in some cases this weld failed, while the butt weld gave very little trouble. It is, in my opinion, a superior method. At the junction of the syphon and flue sheet or inner throat sheet we have tested the diaphragm sheet with the connection to the syphon, both in the water space and on the fire side. We consider the application with the connection of the syphon and diaphragm on the fire side superior, giving more flexibility and in case of repairs the welded section is readily accessible.

Our standard instructions for application, maintenance and repairs to syphons are as follows:

Application: Junction of syphon flange and crown sheet to be butt welded. Syphon flange to be secured with one row of radial stays. Junction of diaphragm sheet and neck of syphon to be lap-welded with weld on fire side.

Repairs: Cracks in neck of syphon not exceeding 10 inches are to be welded. Cracks in syphon neck exceeding 10 inches will require patching. All patches to be butt welded and secured with staybolts properly spaced. Cracks in diaphragm can be patched. Patches are to be butt welded and so shaped as to be properly secured with staybolts. After patch is applied on neck and before putting in staybolts, syphon neck is to be annealed. After welding a crack exceeding 5 inches in length on syphon neck, syphon is to be annealed.

Maintenance: Syphon necks are to be annealed at each annual inspection and reported by making a notation on back of form 3—"Syphons Annealed."

Syphon Annealing: With boiler drained, fill the annealing furnace with charcoal, ignite and fan with enough compressed air to burn slowly. Bring the syphon neck to cherry red being careful not to cause overheating. When the neck is heated to the proper temperature, cover the burning charcoal remaining in the furnace with air slacked lime. All draft should be immediately shut off after basket is filled with lime. After neck has returned to normal temperature remove the furnace. The syphon heating furnace is constructed from front end netting or perforated plates.

The early experience with the syphons on the Florida East Coast was not very satisfactory on account of syphons cracking at the neck and also the diaphragm sheets would crack. Several kinds of patches were tried on the syphon neck, all of which were unsatisfactory, until the butt-welded patch was tried. Practically all of our syphon troubles are now eliminated. It is very seldom that we now have a new syphon defect. From time to time some of the old defects require rewelding. The elimination of our syphon troubles followed from the annealing of syphon necks, long engine runs, good and efficient boiler washing, using only hot water for washing and filling boilers and close supervision, both at the terminals and on the line of road.

Benefits: Only a few years ago, 60,000 miles was the maximum flue mileage and very often it was necessary to renew the flues after 30,000 flue miles. After 50,000 to 60,000 miles the boiler scale would average around 2000 to 2500 pounds. This was with non-syphon engines.

At the present time we have engines that have attained a flue mileage of 240,000 miles and are in excellent condition. We have not had a leaky flue or firebox in the last two years. Just recently the flues were removed from a syphon engine that had a flue mileage of 200,000. The flues would have made at least another 100,000 miles. The scale on the flues was very light. The boiler scale aggregated 400 pounds. The flues were removed on account of machinery repairs and only having a few months to the Federal limit.

During 1925 in 1000 engines receiving monthly inspection a total of 2631 staybolts and radial stays was found broken. These were non-syphon engines.

During 1928 in 1000 engines receiving monthly inspections a total of 281 staybolts and radial stays was found broken. All of these engines have a full installation of flexible staybolts and practically all are syphon engines.

It is my opinion that the large reduction of broken stays is the result of full installation of flexible staybolts, syphons and washing and filling boilers with hot water only, and, further, that the increased flue mileage is due to combustion chambers, syphons, proper application of flues and our practice of washing boilers, which is as follows:

At each monthly inspection period we spray the front part of the boiler and flues with an acid compound which dissolves the carbonate boiler scale, after which the boiler is washed and filled with hot water.

Locomotive Boiler Construction-XI

Fitting up, machining and finishing flanged sheets ready for assembling in the boiler

By W. E. Joynes *

THE first operation on the front tube sheet, after it has been flanged and straightened, is to drill and ream the flue and tube holes. These holes are first drilled to within 1/32 inch of the finished size and then reamed to the finished diameter.

The flue lead holes are ⅛ inch larger in diameter than the tube lead holes. The shank for holding the drill cutter is made with a pilot to fit the flue holes only. These are drilled first thereby avoiding the mistake of drilling a flue hole for a tube hole.

The drilling and reaming is done on a multiple drilling machine, where two or three holes may be drilled simultaneously. It is not practical, however, to ream more than one hole at the same time.

The tube and flue holes are chamfered to a very small radius on both sides of the sheet to prevent cutting the tubes and flues during the rolling and beading over operations. Chamfering or cutting the small radius is done on the above-mentioned drilling machine. The brace-tee-iron rivet holes are also countersunk, as shown in Fig. 35 (page 49, February issue), on this machine.

Turning the flange down to the correct depth, with a beveled calking edge, can be the next operation on the front tube sheet. This work is done on a boring mill with a cutting tool ground to the correct calking bevel.

The rivet holes in the flange, for the shell connection, are next laid out and drilled. The rivet line is measured from the water-side surface of the sheet. The location of the rivet line and the number of rivets are given on the boiler drawing. The spacing-off of the rivet holes is done by first dividing the circumference of the line into quarters as explained for smokebox rings, Fig. 40 (page 82, March issue). The rivet-hole centers are then spaced off with a divider for the first and all duplicate tube sheets.

Following the above operations the dry-pipe hole is cut out and then beveled out with an angle-ground tool.

The tube-sheet ring is then clamp bolted in place and two of the screw rivet holes drilled to size for tapping, after which two bolts are applied in these holes and the clamp straps removed. The remaining screw rivet holes are then drilled, the cutting and drilling work being done on a radial drilling machine.

The tube sheet is now removed to a round barrel-shaped support for applying the screw rivets. Here the ring is rigidly bolted, then a staybolt tap is run through the holes with a portable air-powered machine. The rivets, which are made of staybolt iron, are applied with an air machine and riveted over with hand hammers on the smokebox side of the sheet. A holding-on hammer, of course, is held on the opposite end of the screw rivets, while being riveted.

The heads of the rivets are not riveted over on the ring now due to the fact that the tube sheets would have to be turned over for this operation.

The tube sheet is again set up on the radial drilling machine, this time for drilling and straight tapping the stud holes in the sheet and ring. A taper tap is also run through these holes and taper-threaded studs applied, as shown in Fig. 42 (page 82, March issue) before the boiler test is made.

The dry-pipe hole bevel is also finished cut, on the drilling machine, at this time

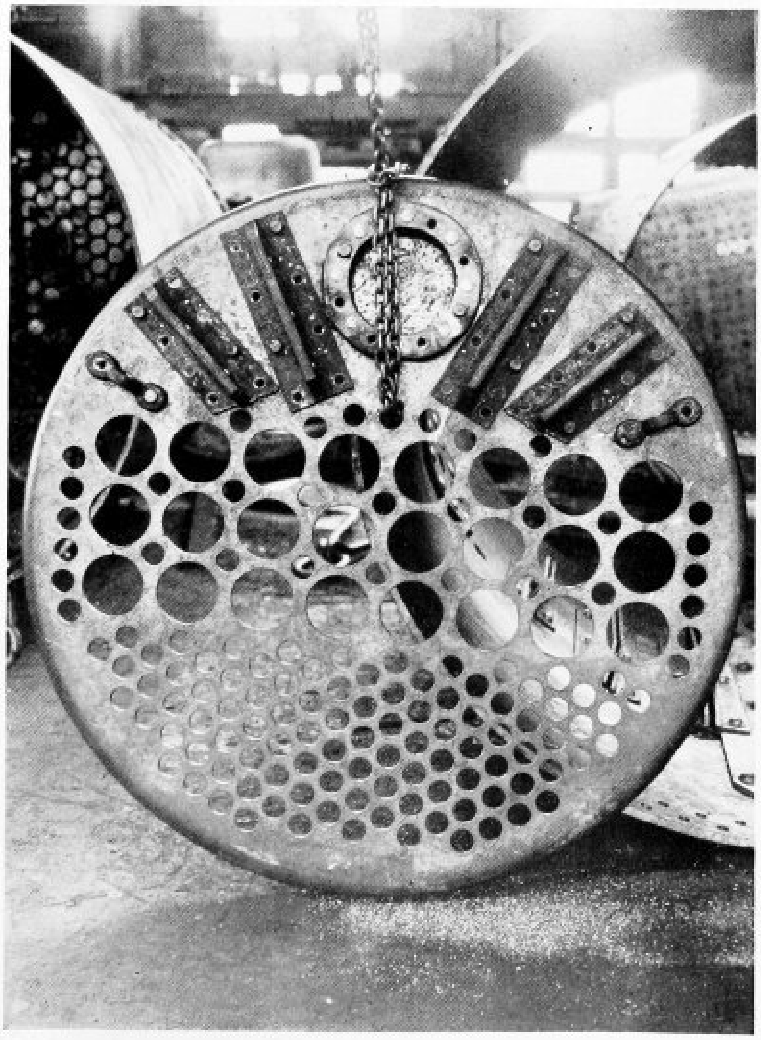


Fig. 56.—Brace iron arrangement on front tube sheet

* Boiler designing department, American Locomotive Works, Schenectady, N. Y.

for grinding the ball-joint fit. A solid, 45-degree beveled, milling cutter is used for this operation.

A light round plate is now bolted over the dry-pipe hole on the smokebox side to protect the bevel during the grinding operation.

The tube sheet is next removed to the floor of the hydraulic bull-riveting section. Here the brace-tee-irons are bolted in place and the holes reamed for riveting on one of the smaller hydraulic bulls.

The heads of the tube-sheet ring screw rivets are hammered over on the ring when the sheet is set up for bolting on the brace tees.

The tube sheet is now ready for assembling in the first ring. A description of the assemblage and riveting operations was given on page 291 of the October, 1928, issue.

An outline of the brace irons, as given on the detail outline drawings, is marked around the brace rivet holes (water side of sheet) of the flanged front tube sheet. The tees or angles with flanges that are required to be cut off on an angle are laid on the marked outline. The part or whole of the flange which is to be cut off is squared from the plate surface to the edge of the brace iron and then across the surface of the same, after which the tee irons are burned off with a torch; angle irons are sheared off.

The rivet holes in the front tube sheet are circled with soapstone on the brace irons and center punched for drilling.

The locations of the brace rod pins for tee braces, as given on the boiler drawing, are laid out on the flange after which they are drilled.

Angle-iron braces connect a gusset plate. The connection is made with bolts, with the bolt end slightly hammered against the nut to prevent the nut from coming off. The gusset plate drawing gives the location of the bolt holes.

Tee or angle brace outlines for a backhead are marked around the rivet holes in the flat backhead sheet before the same is flanged. Marking off the angle cuts from the flanged sheet is not practical in actual work.

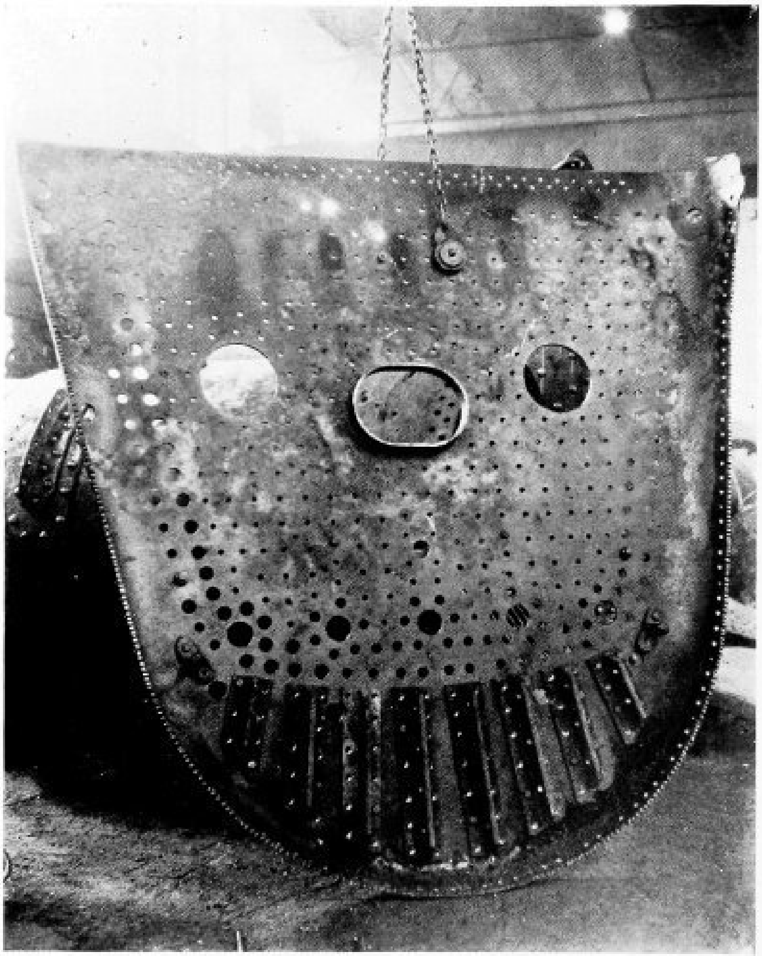


Fig. 57.—Backhead showing brace iron arrangement

Layout and Machine Work on a One-Piece Flanged Dome

The first work on a one-piece flanged dome is to lay out and drill the rivet holes in the base flange for the shell connection.

A thin metal half template of the rivet arrangement as shown in Fig. 58 is made. The template is clamped to the inside surface of the base with the template center in line with the dome center line. The rivet hole locations are then center punched directly on the base. The dome center line is identified by two small indentations made on the under side of the base flange, by the holding die, during the flanging operation.

The holes are drilled on a radial drilling machine with the bottom surface of the base facing the drill. The dome is often moved on the table so the holes will be drilled radial to the boiler shell. Fig. 54 of the May issue shows the drilling operation.

The template outline should allow stock on the dome base to be milled off. The excess material is burned off for the milling operation.

The next operation is to cut the opening in the top of the dome and counterbore the top surface around the opening for receiving the copper-wire gasket. These two operations are done on a boring mill. Two cutting tools are necessary for cutting the opening. The follower tool should have a slightly narrower cutting edge to prevent the lead tool from binding.

A drilling gage is used in connection with drilling the dome cap stud holes in the dome and the dome cap.

Milling the edge of the dome base, as shown on the drawing, Fig. 58, completes the dome for riveting to the boiler shell.

Back End of Boiler

In fitting the flanged sheets that compose the back end of the boiler, either the firebox flanged sheets or the outside shell with the throat and the back-head sheet may be assembled first for fitting up.

Fitting-Up a Combustion Chamber Firebox, in Which the Inside Throat Sheet Has Welded Connections

The back or door sheet and the inside throat sheet (shop term—yoke sheet) corners are first laid up to the firebox ring corners.

The firebox ring is placed on the floor, top face up and supported above the surface of the floor by the expansion plate lugs or blocked up higher, if necessary, to permit heavy screw clamps at the front end for holding the throat sheets.

One corner of the sheet is heated on an open blast fire. The sheet is then raised with a jib crane and fastened to the ring. Throat sheets are clamped; a back sheet and a backhead sheet are bolted to the ring. The corner is then hand hammered to fit the ring corner; half round, fuller and flatter tools are held

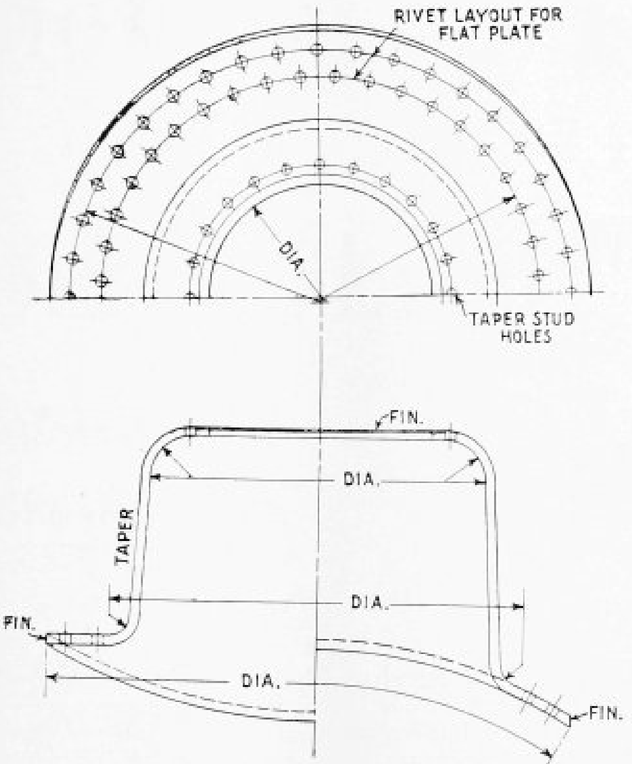


Fig. 58.—One-piece dome showing finish and drilling

against the sheet and struck with sledge hammers.

Each corner of the back sheet, backhead and throat sheets is fitted, in separate heats, in this manner.

The backhead corners should be fitted to the ring at the time.

The back sheet is removed from the ring after the corners have been fitted. The yoke sheet is retained clamped to the ring.

The crown and combustion chamber sheet, rolled to shape, is next raised with a traveling crane and lowered into place on the ring and bolted to the same through

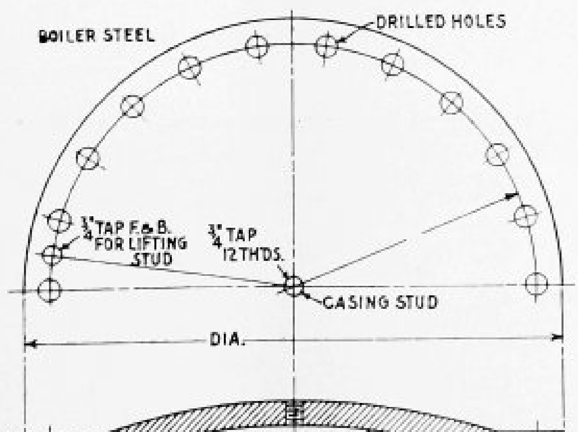


Fig. 59.—Dome cap

the tack holes. The yoke sheet is, of course, on the outside of the crown and combustion chamber sheet for the fitting and marking off work.

The location of the yoke sheet, in relation to the crown sheet sides, combustion chamber and the firebox ring, is carefully measured and then strap clamped fast for marking off the front flange of the yoke sheet, in line with the back edge of the combustion chamber.

The clamps are removed for trimming off the flange, after which the yoke sheet is raised to permit the front flange to come flush with the combustion chamber sheet.

The location of the combustion chamber and yoke sheet is now carefully checked and clamped fast. The back flanges and the wings of the yoke sheet are then marked off in line with the front edge of the crown sides sheet.

Four of the firebox ring rivet holes are also marker punched on the yoke sheet, at this time, for bolting purposes.

The center line of the flanged yoke sheet and the throat sheet is found by tramming and marked on these sheets for the fitting-up work and for laying out the staybolts.

A back sheet with riveted connections is now placed on the inside of the crown sheet for marker punching the location of the crown and sides sheet rivet holes on the flange of the back sheet. Two drift pins are driven through the tack holes in the back sheet, into the corresponding firebox ring rivet holes, and two bolts applied in the other two tack holes, which we have learned

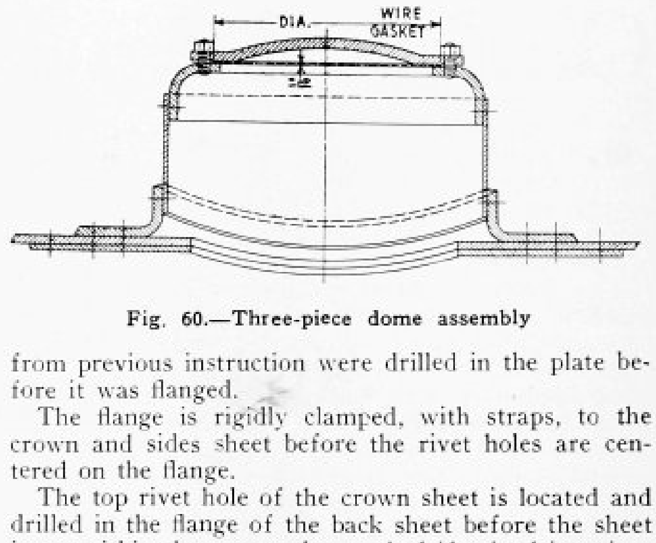


Fig. 60.—Three-piece dome assembly

from previous instruction were drilled in the plate before it was flanged.

The flange is rigidly clamped, with straps, to the crown and sides sheet before the rivet holes are centered on the flange.

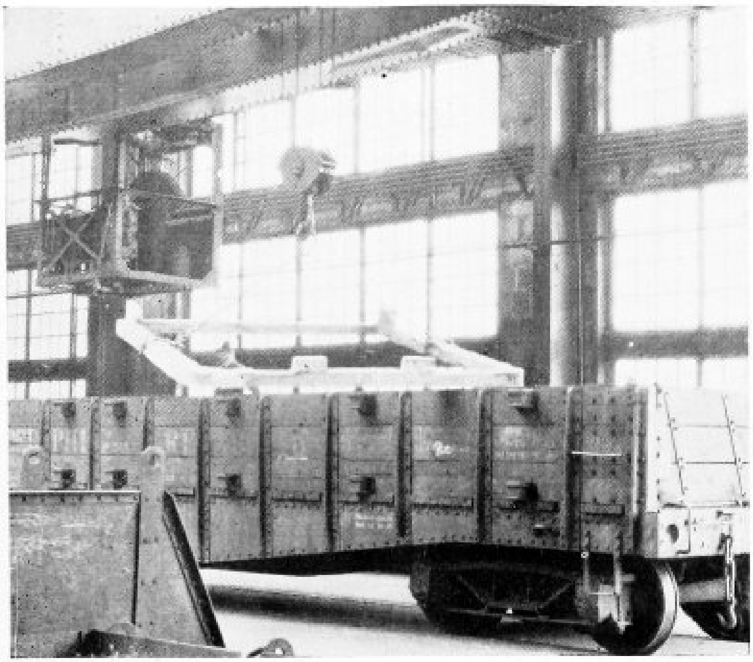
The top rivet hole of the crown sheet is located and drilled in the flange of the back sheet before the sheet is set within the crown sheet. A drift pin driven into this hole draws the flange into place at the top of the crown. The location of the back surface of the sheet, in relation to the back edge of the crown sides, should be checked.

(To be continued)

Spring Dolly Bar

IN the April issue, page 98, appeared a shop-kink description of a spring dolly bar which had been made in one of the boiler shops. Details of a similar type dolly bar are also contained in a report of the Master Boiler Makers' Association, twentieth annual convention program, under the heading "Standardizing the Design of Boiler Shop Tools," (Topic 5).

It has recently been learned that patent No. 1,521,547 for the manufacture of such a device was issued December 30, 1924, to H. A. Lacerda. This tool is now being produced by the Lovejoy Tool Company, Chicago, Ill.



Unloading mudrings in bay No. 10

Boiler *at* Baldwin Loco

The fabrication of and waist sheets at

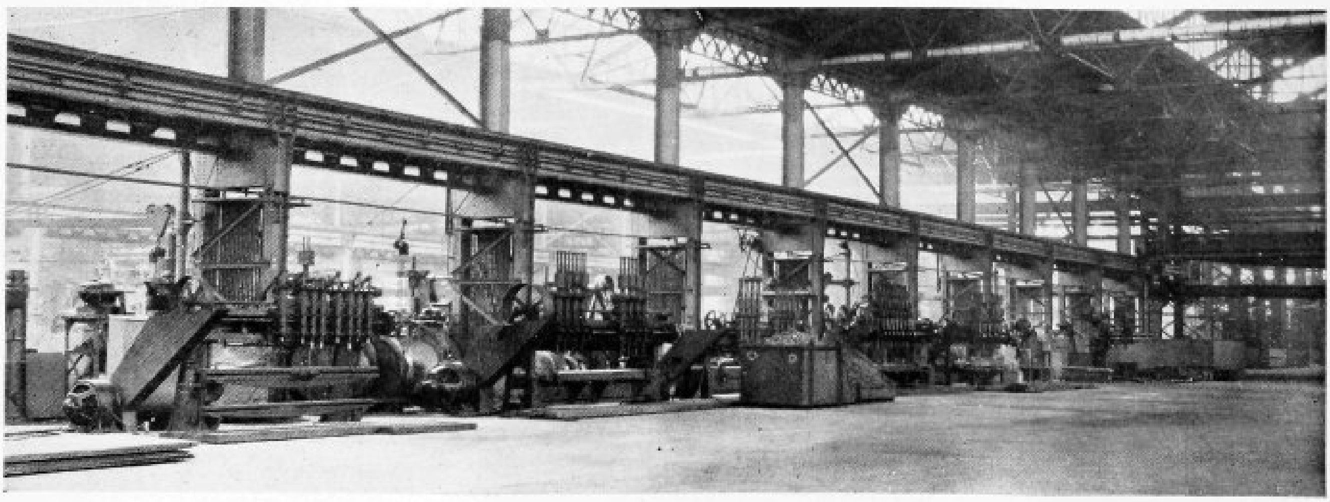
ONE of the country's outstanding water space frame departments from the standpoint of extensiveness and equipment is located in the boiler shop of The Baldwin Locomotive Works, Eddystone, Pa. It is in this department that water space frames or mud rings, waist sheets and special castings are fabricated complete for assembly. All this is accomplished in a section of the main boiler shop extending between panels 19 and 31 in bays Nos. 9 and 10, a floor space of approximately 48,000 square feet.

This department is served by two 10-ton Shepard, overhead, electric traveling cranes, one located in each bay. The machines are served by two 6-ton hand jib cranes, two 3-ton hand jib cranes and four 1¼-ton hand jib cranes. A hand transfer track located in panel 23 extends between the two bays. This track, which is 120 feet in length, is equipped with a small flat car which serves to transport material from one bay to the other in the same department.

The equipment for the fabrication of water space frames is most complete, 32 machines being employed in all. These include seven open side planers, seven 60-inch vertical milling machines, five 8-spindle multiple drills, two tapping machines, one horizontal drill press, one plate planer, two shapers, one slotter and six emery wheels or grindstones. These are described in more detail in the accompanying table on page 206.

The greater part of the water space frames constructed by The Baldwin Locomotive Works is made of steel, the castings for which are generally supplied by an outside foundry. A few frames, however, are of forged steel construction, fabricated in the company blacksmith shop. In either case, the castings or forgings are transported to the boiler shop in gondola cars which are spotted in the extreme end of bay No. 10 by means of the ladder track. An overhead crane unloads the castings which are stored at the end of the bay adjacent to the tracks.

Before the process of fabrication is started the blank casting is placed on the layout surface block in panel



Bay No. 9 showing five 8-spindle drilling machines

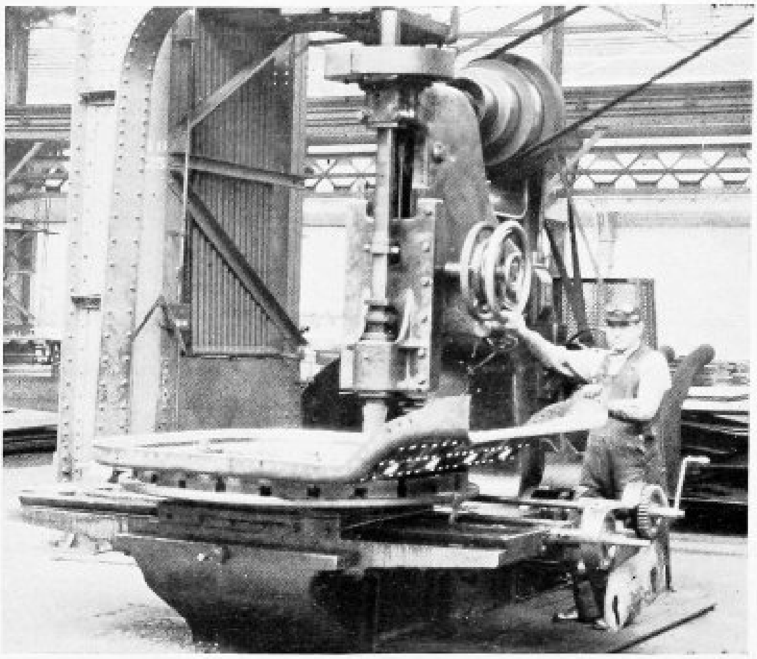
Work

the

motive Shops

water space frames

the Eddystone Plant



Machining tube sheet flanges on a vertical miller

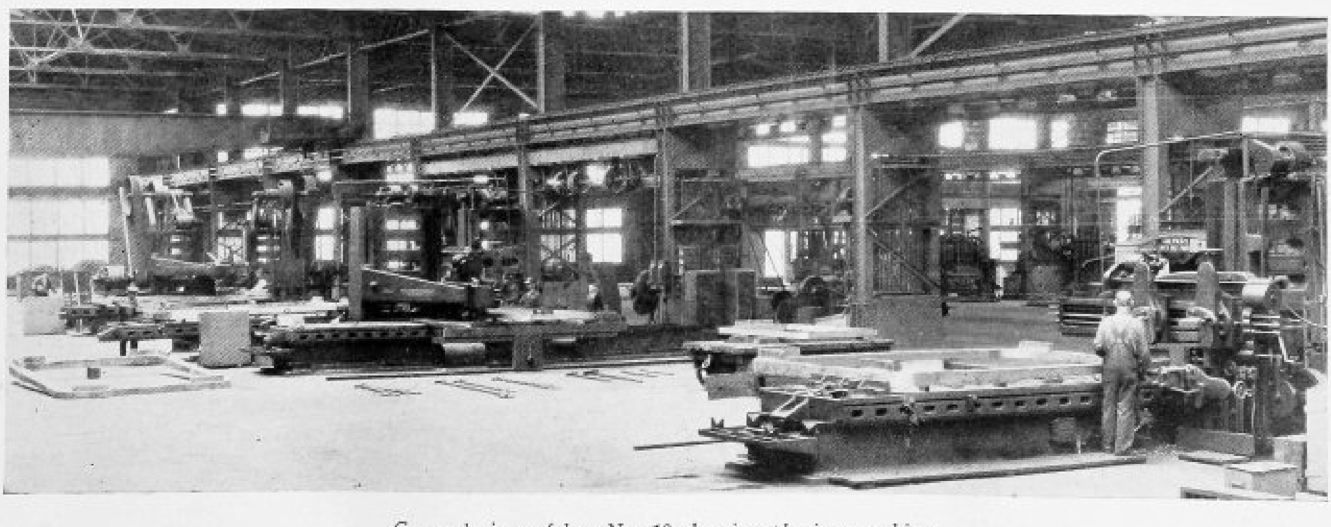
27 of bay No. 9 where it is lined up by means of surface gages to determine whether the material is square and whether sufficient material has been allowed for planing.

The limits are set for the planing operations on the outside edges and the mud ring is transported to one of five large planers located in bay No. 9. These machines are of Bethlehem Steel Company make, built at the Detrick Harvey Plant, Baltimore, Md. Each machine has four motors. A motor at the top of the machine raises and lowers the cross rail or beam carrying the two cutting arms. One located on the cross arm operates the tool, moving it to any position. A 35-horsepower motor operates the table and feed while the fourth motor operates an oil pump. All electrical equipment for these machines is of Westinghouse make. At one side of the table is a track on which runs a removable frame used as a rest for the mud ring when in the machine.

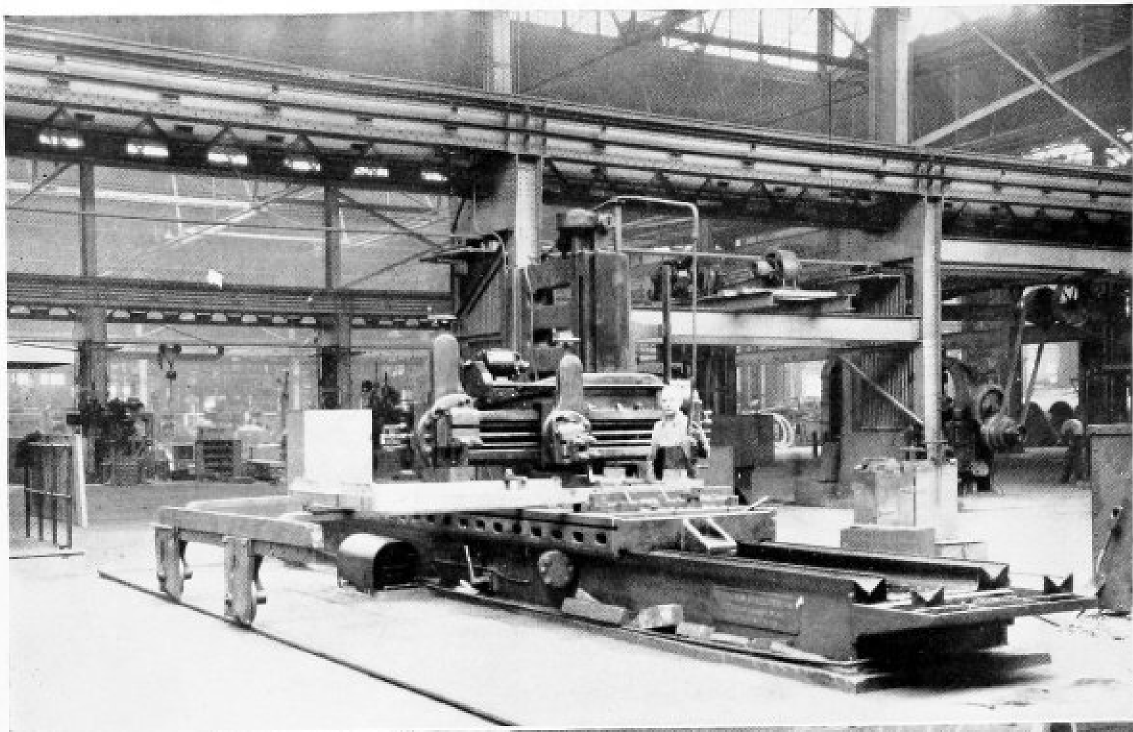
In this machine the mud ring is planed on the outside edges, right and left, front and back, the limits being previously determined.

When the outsides are planed, the ring is again set up on the surface block where it is completely laid out from templates supplied by the layout department. This process consists of laying out the corner radii for both the outer and inner edges of the four corners. The rivet holes, stud holes, lug sides and general dimensions of the card are placed upon the water space frame.

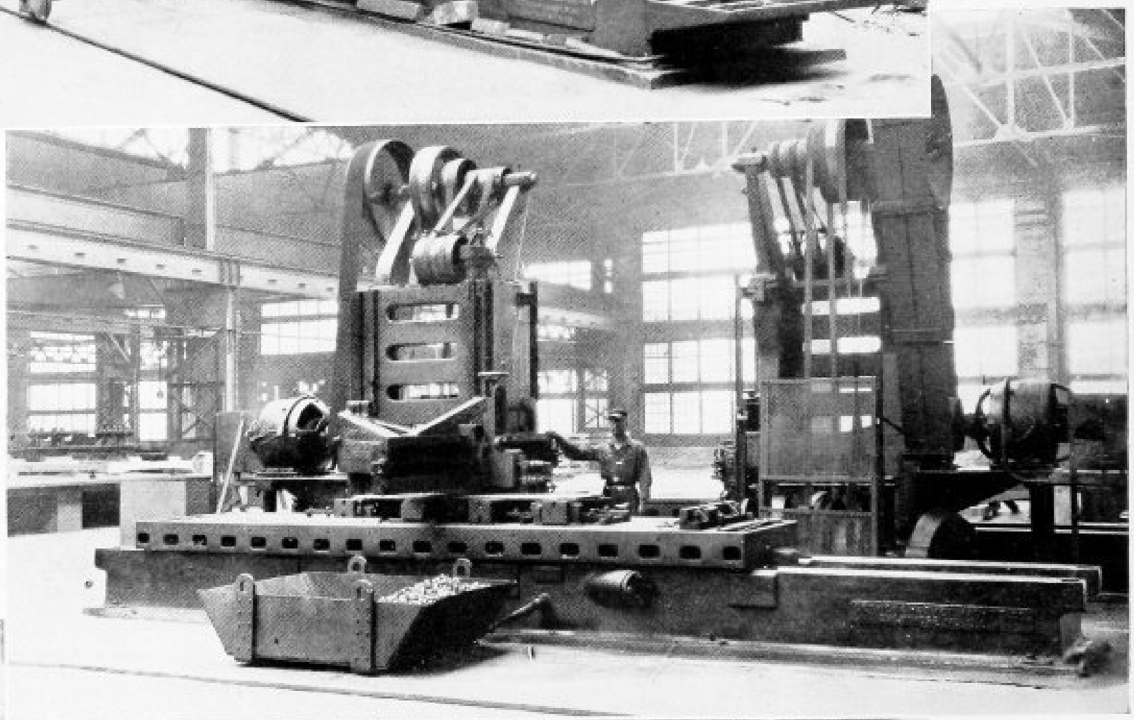
The frame is then set up on one of the seven vertical milling machines where the outer and inner corner radii are machined. After this has been completed, the frame is again set up on the planing machine where the inner sides are planed to the limits set by the milled corners and the marked dimensions. Lug sides can generally be machined in the planer, but it is often found necessary to finish this work in the shapers supplied for that purpose. The bottom of the mud ring is machined in the planer, where necessary, to permit the fitting of the ash pan. The shaper finishes the bottom where



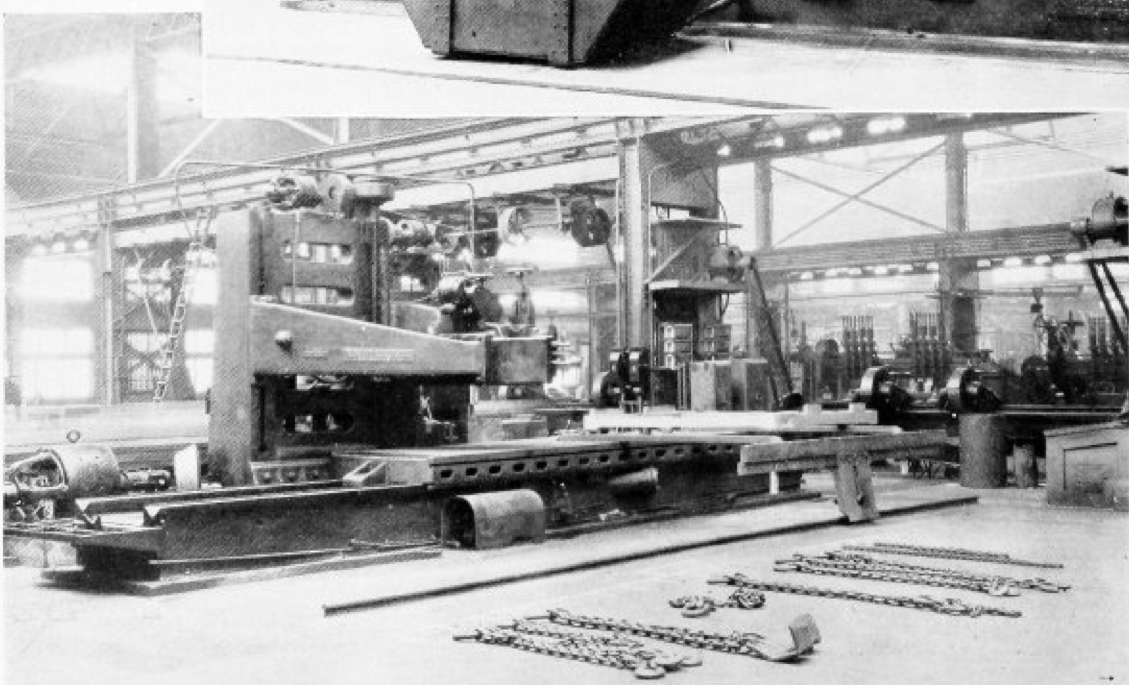
General view of bay No. 10 showing planing machines



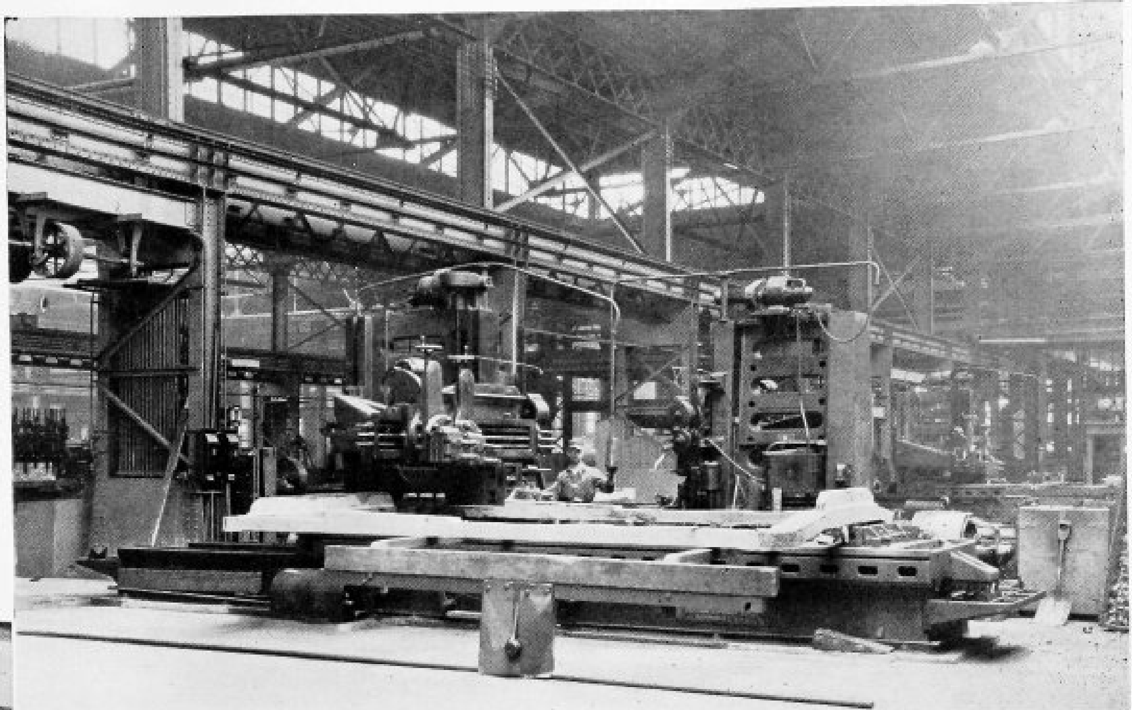
(Left)—A mud-ring set up in a planing machine for inside planing



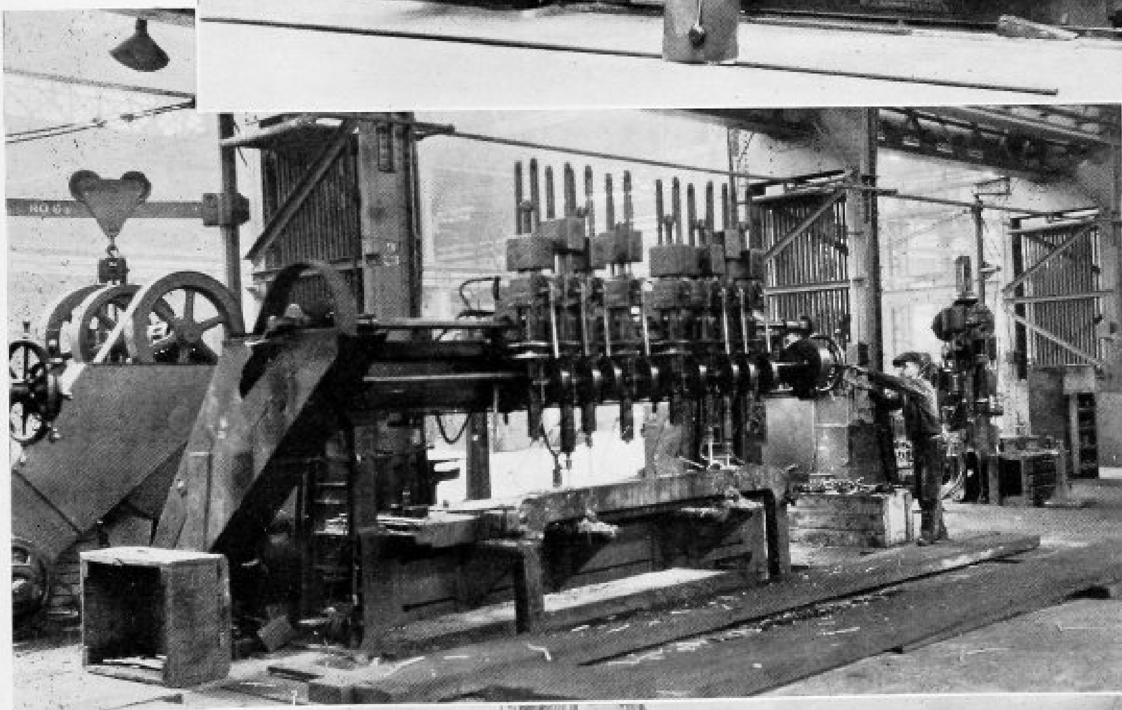
(Right) — Dietrick & Harvey 16-inch by 19-inch by 60-inch open side planer



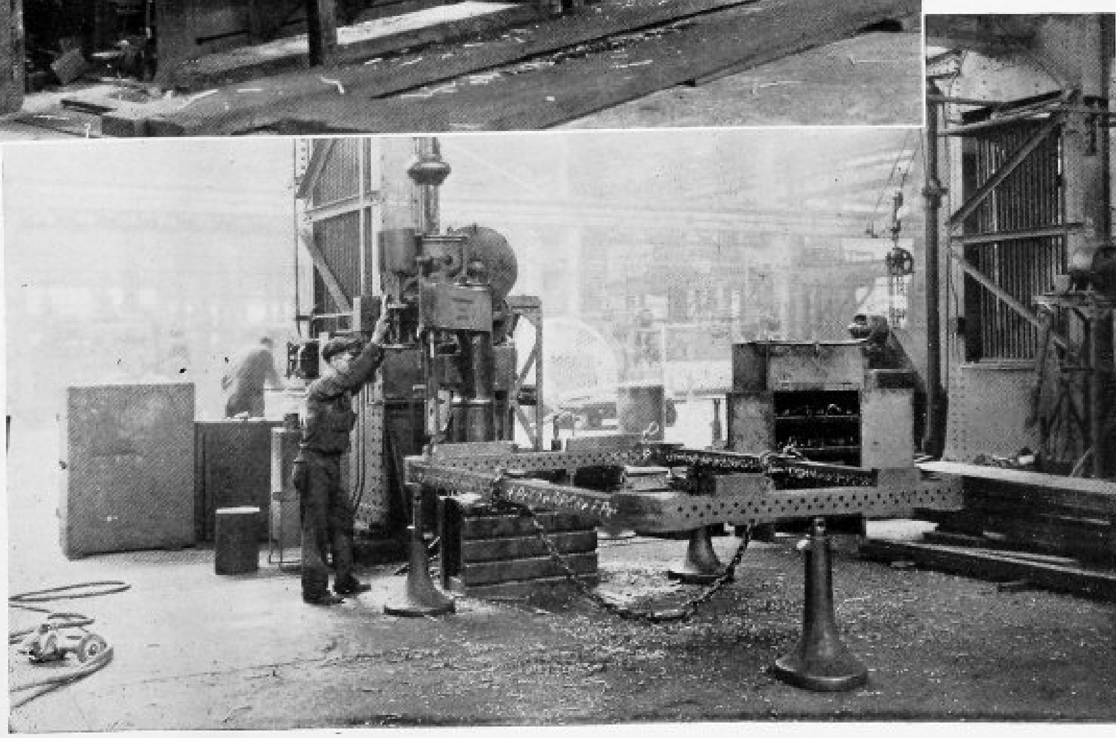
(Left) — Dietrick & Harvey 5-foot by 5-foot by 18-foot open side planer



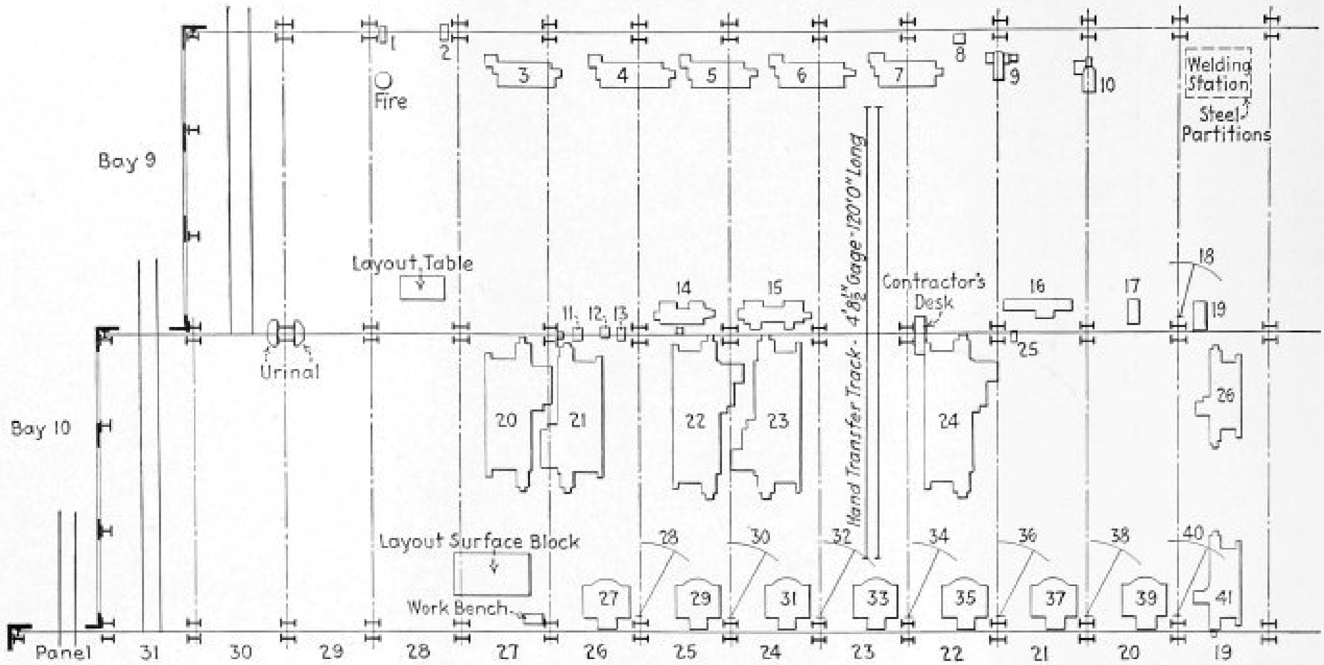
(Right)—A mudring set up in a planing machine for outside planing



(Left) — Mudring set up in an eight - spindle multiple drilling machine

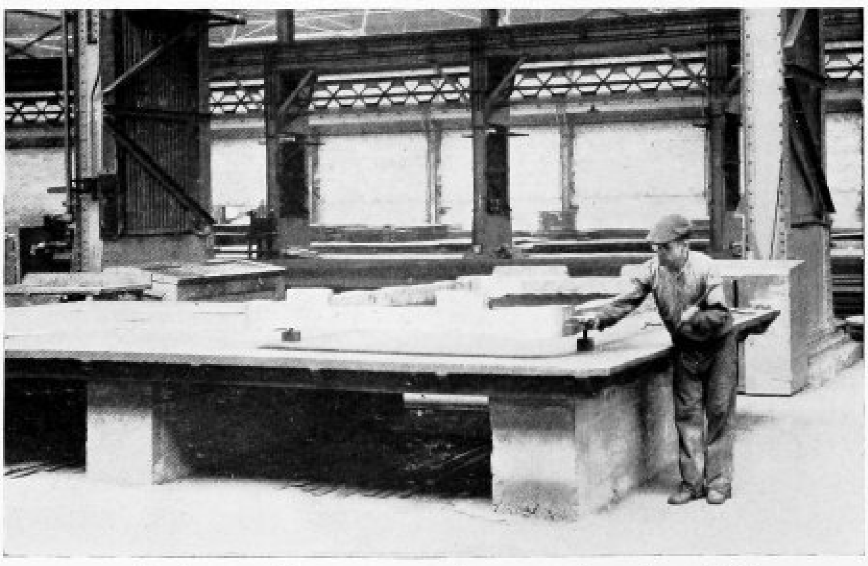


(Right) — Tapping the mudring for the attachment of the ash pan

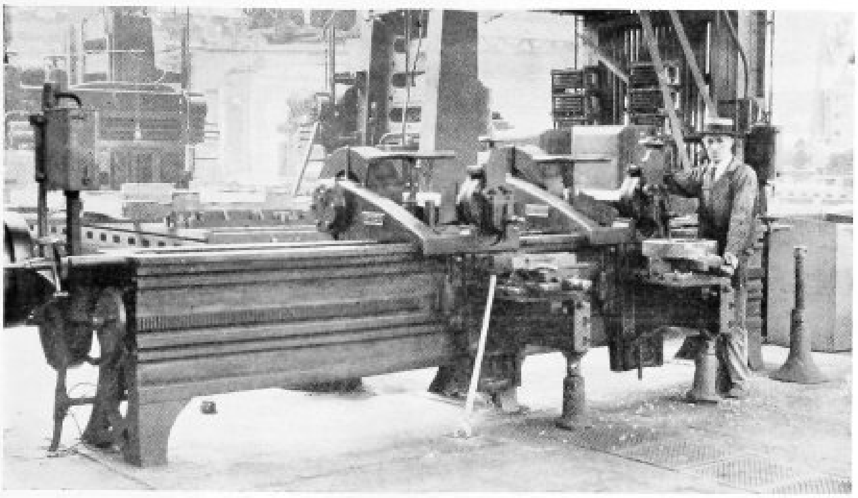


Arrangement of the water space frame department

1 No. 5 Sturtevant blower for fire.
2 Baldwin 42-inch grindstone, motor on building column bracket, belt drive.
3 Bement-Miles 8-spindle multiple drill, motor on floor.
4 Harrington 8-spindle multiple drill, motor on floor.
5 Harrington 8-spindle multiple drill, motor on floor.
6 Harrington No. 18, 8-spindle multiple drill, motor on floor.
7 Harrington No. 10A, 8-spindle multiple drill, motor on floor.
8 Hisey-Wolf 6 WFA emery wheel, motor on machine, direct drive.
9 Harrington 48-inch tapping machine, motor on machine, direct drive.
10 Fosdick & Halloway 6-inch tapping machine, motor on separate stand, belt drive.
11 Baldwin 24-inch emery wheel, machine driven by belt to line shaft.
12 Baldwin 9-inch emery wheel cutter sharpener, driven by belt to the line shaft.
13 Baldwin 42-inch grindstone with 12-inch face, driven to line shaft.
14 Bement-Miles 18-inch shaper, motor on floor, belt drive.
15 Bement-Miles 25-inch by 14-foot double shaper, motor on building column bracket, belt drive.
16 Bement plate planer, motor on steel work overhead.
17 Sellers 60-inch slotter, motor on building column, belt drive.
18 Baldwin 3-ton hand jib crane having 15½-foot reach.
19 Baldwin 1¼-inch hole horizontal drill press, motor on separate stand, belt drive.
20 Dietrick & Harvey 16-inch by 49-inch by 60-inch open side planer, motor on machine, direct drive.
21 Dietrick & Harvey 16-inch by 49-inch by 60-inch open side planer, motor on machine, direct drive.
22 Dietrick & Harvey 5-foot by 5-foot by 18-foot open side planer, motor on machine, direct drive.
23 Dietrick & Harvey 5-foot by 5-foot by 18-foot open side planer, motor on machine, direct drive.
24 Dietrick & Harvey 5-foot by 5-foot by 18-foot open side planer, motor on machine, direct drive.
25 Hisey-Wolf 14-inch single emery wheel with 2-inch face, 3-horsepower power motor mounted on machine, direct drive.
26 Dietrick & Harvey 3-foot by 3-foot by 12-foot open side planer, motor on separate stand, belt drive.
27 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, belt driven.
28 Richmond & Kemp 3-ton hand jib crane having a 20 foot reach.
29 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, direct drive.
30 Six-ton hand jib crane having a 20-foot reach.
31 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, direct drive.
32 R. D. Wood 1¼-ton hand jib crane having a 20-foot reach.
33 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, direct drive.
34 Sellers 1¼-ton hand jib crane having a 20-foot reach.
35 Bement-Miles No. 10 60-inch milling machine, motor on steel work overhead, direct drive.
36 Baldwin 1¼-ton hand jib crane having a 20-foot reach.
37 Bement-Miles No. 10, 60-inch vertical milling machine, motor on steel work overhead, direct drive.
38 Sellers 1¼-ton hand jib crane having a 20-foot reach.
39 Niles-Bement-Pond No. 10, 60-inch vertical milling machine, motor mounted on machine, direct drive.
40 Six-ton hand jib crane having a 20-foot reach.
41 Dietrick & Harvey 3-foot by 12 foot open side planer, motor on separate stand, belt drive.



Laying out the water-space frame on the surface block



Planing a firedoor ring on the 25-inch double-head shaper

the work cannot be done on the planer. The top or water space side is not finished.

On completion of the machinery process, the frame is ready for drilling. It is transported to bay No. 9 by means of the hand transfer track in panel 23. The overhead crane transports the frame to the desired machine where it is lowered into a pit with side of the frame to be drilled, resting on the machine brackets.

The pits before each of the multiple drilling machines are 18 feet deep and 4 feet wide. They extend the entire length of the machine. Water which is used for cooling the cutting tool when drilling collects in the bottom of the pit and is drained by means of a syphon system. This system consists of two pipes leading into the pit, through one of which water flows into the pit to maintain the syphon action. The other pipe draws the water from the pit to the main drainage system. A floating valve controls the water flow from the inlet pipe by stopping the pipe when the water in the pit becomes too high. To remove the collection of a large quantity of chips and turnings that fall into the pit, a large electric magnet is employed. This is lowered into the pit and effectually cleans the pit of such turnings on its removal.

After the sides of the water space frames are drilled for the riveting of the firebox and sides sheets, the frame is then taken to the tapping machine where the bottom of the frame is tapped. These tapped holes are required for the attachment of ashpan studs. After drilling and tapping, the lugs are drilled on a horizontal drill press.

Burrs on the water space frame are removed by a pneumatic hand-operated grinding machine after which process, the frame is completed and is ready for assembling in the firebox fitting floor.

The complete fabrication of waist sheets is done in this department. This type of work includes valve motion sheets, guide bearing sheets, back of furnace sheets and front of furnace sheets for connecting the boiler to the locomotive frame. Here they are laid out, burned out, milled, planed and delivered to the erecting shop.

In general, the waist sheet is made of one-half inch plate or a casting and this material is laid out on the layout table in panel 28 of bay No. 9. After being laid out, the edges of the sheet are rough-burned and machined to card size. The straight edges of the plate are planed and the concave or shaped edges of the plate are finished on the milling machine. The holes are cut out on the milling machines and the rivet holes are drilled in both the sheet and the liner, where a liner is used as is the case of large waist sheets. The rivet holes are drilled and countersunk, the rivets driven and the heads ground in this department.

In some cases holes are of such size or shape that they may not be machined on the milling machine, therefore the slotter is used for that purpose.

All edges of the waist sheet, with the exception of the center leg which attaches to the locomotive frame, are finished. This center leg is left rough in the shop and is not finished until the boiler is set in the locomotive frame in the erection shop, at which time the sheet is accurately fitted.

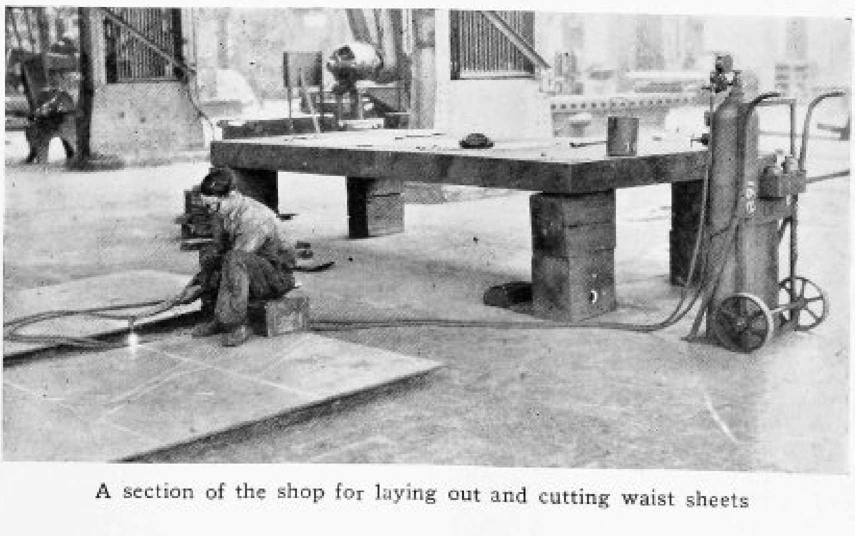
If a waist sheet is to be slightly bent, as is the case of many front and back furnace waist sheets, it is sent to the flange shop where it is given the required bend. This is done before the liners are fitted.

Angles or tee bars that attach to the barrel of the boiler for fitting waist sheets are brought to the water space frame department for milling only. The final drilling operation is done in the erecting shop.

Special work requiring milling or shaping is done in this department. Furnace tube sheets where specifications call for a taper on the inside of the flange are machined here. The tube sheet is generally set up on one of the 60-inch vertical milling machines and the inside flange is machined with a tapered milling cutter.

Fire door rings for certain types of locomotives usually for foreign railroads, are fabricated and machined in this department in a similar manner to water space frames.

Further descriptions of the equipment and methods employed in the boiler shop of The Baldwin Locomotive Works will appear in later issues of THE BOILER MAKER, the August number containing an outline of the dome machine shop and the tube sheet shop.



A section of the shop for laying out and cutting waist sheets

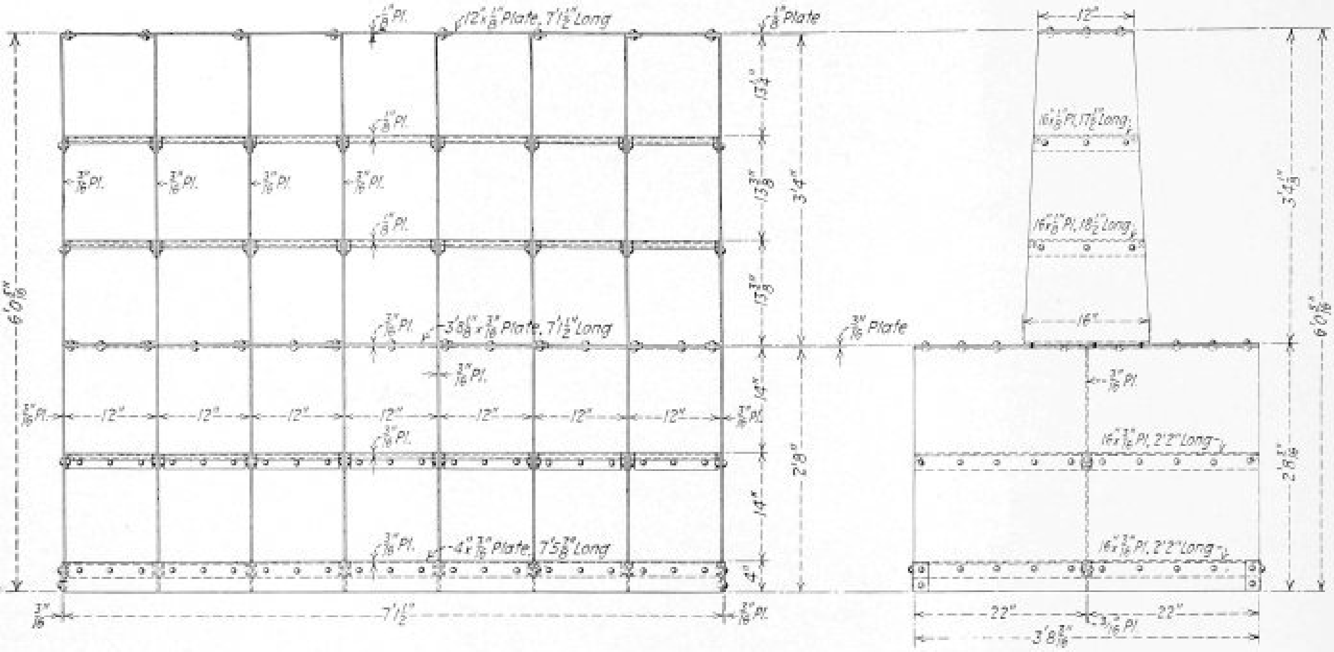
Two Designs of Staybolt Racks For the Boiler Shop

THE two designs of staybolt racks shown in the drawings are standard on an eastern railroad. The rack built with sloping shelves has an overall height of 5 feet 1¼ inch and occupies a floor space 4 feet 1¼ inches by 4 feet ⅜ inch. It is of light construction and can easily be moved to any location in the shop. The large rack is intended for a more permanent location in the shop and has considerably more storage space. It has 21 single compartments above and 14 double compartments below. The lower compartments are 22 inches deep.

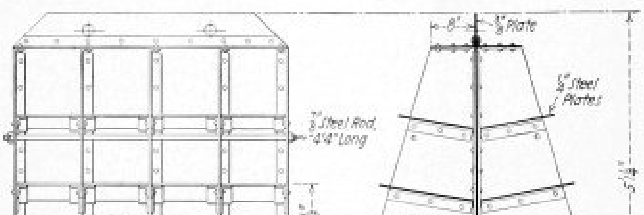
The center plate of the first rack mentioned is made of ⅜-inch steel plate and extends 5 inches above the top angle, as shown. Two 2-inch holes, located 3 inches below the top edge, are provided for crane hooks, so that the rack can be placed in a position near the locomotive, convenient for the boiler maker. The shelving is made of ¼-inch steel plate and 2-inch by 2-inch by ¼-inch angles are used throughout.

In the shop where these two racks are used the stationary rack is located where the overhead crane can set the portable rack in a position convenient for loading. The portable rack is supplied with the sizes and quantity of staybolts needed for a designated boiler and is then moved by overhead crane to a convenient position near that boiler. The slope of the shelves insures against material dropping out of the rack while it is being moved by the crane.

The stationary rack is built with straight shelves of 3/16-inch steel plate turned down at the sides for riveting to the vertical members. No angles are used in its construction.



A standard stationary staybolt rack



Staybolt rack designed to be transported by overhead crane

A New Type Revolving-Head Cutting-Off Machine

THE Oster Manufacturing Company, Cleveland, Ohio, has recently placed on the market a revolving-head blade-type cutting-off machine, the capacity of which is ⅜-inch to 2-inch solid stock and ¼-inch to 1½-inch pipe or tubing. The machine is powered with a universal motor operating from a light socket or permanent wiring installation and operates on 110 volts, single phase, of any cycles, from 25 to 60, or 110 volts direct current. This type of motor is used because its speed is governed by the load put on the machine and, therefore, the spindle speed increases inversely with the diameter of the stock being cut off. This tends to give the cutting tools a constant peripheral speed throughout the cut.

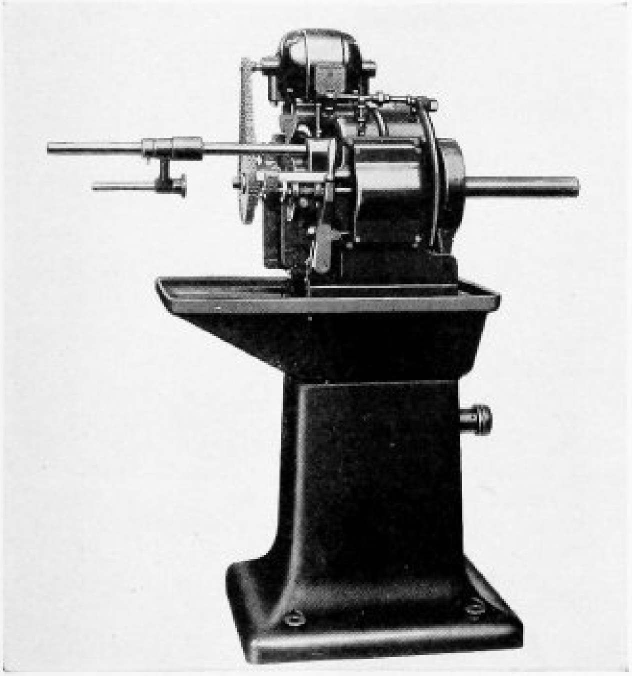
The functioning of the machine during the return of the blades for the next cut is at the highest speed of which the machine is capable. The motor is provided with a start-and-stop trigger switch, into which is built a circuit breaker, thus protecting the motor from overload.

The drive is from the motor through a silent chain to a jack shaft mounted in Timken roller bearings. The jack shaft carries the speed clutches and drives the spindle, which is also mounted, both front and rear, in Timken roller bearings of liberal size.

The cutter head is furnished with two cut-off slides mounted opposite each other in adjustable gibs in the head and protected from under wear by felt wipers. These slides are operated radially by a scroll. The cutting tools are mounted in the slides and held by the gibs. One tool is ground to U. S. S. form and the other flat. The U. S. S. tool is set one-half of its vee in advance of the flat tool, thus splitting the cut into three chips. The mounting of the tools in the slides is inclined from the radial to give the proper rake, thus requiring only end grinding of the parting tools.

Setting of the blades relative to the center of the bore is accomplished by the use of a gage locating from the rear of the slides.

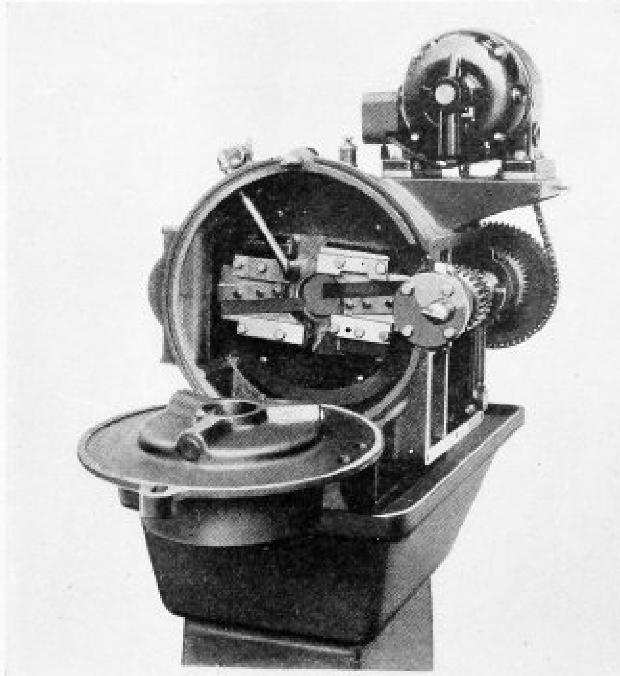
The machine is provided with a universal direct lever-operated scroll chuck of rigid design, utilizing two sets of three serrated jaws each operated by a double-side scroll. The jaws are so spaced as to give ample width of gripping surface, together with ample holding power.



Oster No. 602 cutting-off machine for bar stock and pipe—Capacity from ¼-inch to 2-inches

The direct lever-operated feature of the chuck provides for release or gripping by the movements of the chuck lever through an arc of not over 30 degrees.

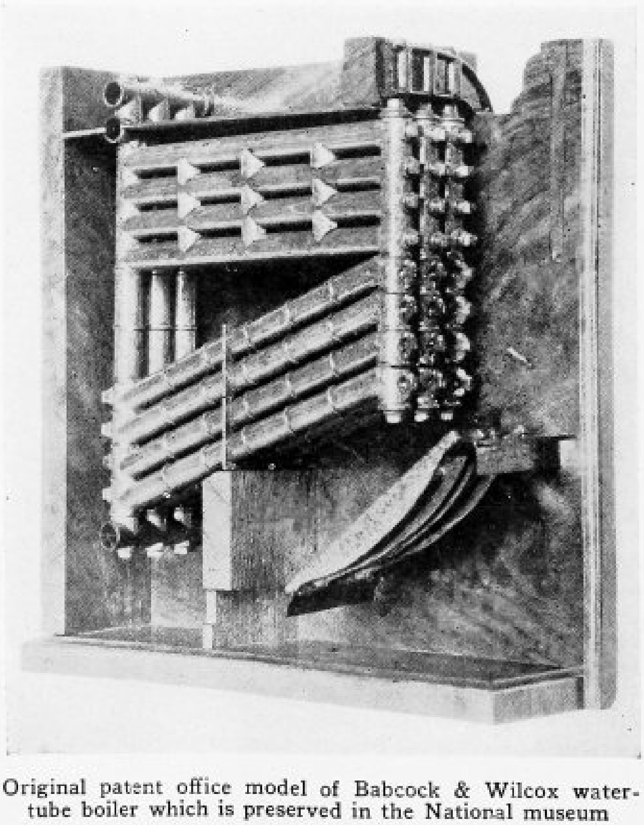
The operation of the machine is simple. Stopping of the blade at the proper limit of travel for both inside and outside diameter is accomplished by two dogs or stop collars. Having selected the size of stock to be cut off, the outside diameter collar is quickly set to a graduated scale mounted on the machine and the inside diameter collar is set to zero in the case of solid stock, or to the proper inside diameter size in the case of tubing. The stock is then inserted in the chuck, run through to the proper position, either by measurements or with the use of the stock stop with which the machine is equipped, and the chuck tightened with the chuck lever. The motor is then started and the clutch lever engaged. From this point on the operation of the machine is entirely automatic as the blade will be fed in at a rate of 0.006 inch per revolution per minute until the piece is cut off and will then be returned to the open position, ready for the next cut of the same size of stock, at five times the rate of in-feed per revolution. Further operation consists of opening the chuck, pushing the stock



Method of holding cutting tools in place

through to the proper position, tightening the chuck and engaging the clutch lever.

Except on tubing, one operator can handle two or more machines, depending on the diameter of the stock to be cut off. The machine carries all of the necessary accessories, such as cutting-compound pump and reservoir, chip strainer, guard, etc., and is delivered ready to attach to any 110-volt line. No special set-up is required.



Original patent office model of Babcock & Wilcox water-tube boiler which is preserved in the National museum

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Method of Developing Outline Sets

Q.—In THE BOILER MAKER for October, 1928, I have run against a snag. In the article "Locomotive Boiler Construction," by W. E. Joynes, on page 293, Figs. 13 and 14, I do not understand where the measurements are taken from for the outline sets front and back ends and the reason for the 12-inch ordinate on both ends? Will you be kind enough to send me a detailed explanation of the blueprint development and layout of this cone course? G. R.

A.—The method of determining the outline sets on the 12-inch ordinates, as shown on Page 293, Figs. 13 and 14 of the October issue, is as follows:

The finished gusset sheet, which is made from flat plate stock, is shown in longitudinal section in Fig. 1; Fig. 2 is an end view.

The middle portion of the finished sheet is conical and the ends are circular cylinders.

The bending line or junction angle between the larger cylinder and the cone frustum is represented by the line *A-M*, Fig. 1; similarly

$$\text{Taper} = \frac{\text{Rise of top}}{\text{Length of taper}}$$

Arrow in Fig. 1 points to the rise of top.

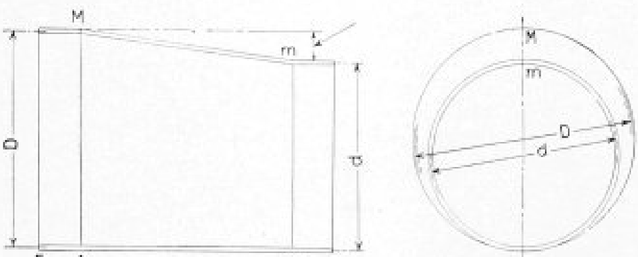


Fig. 1 Fig. 2

Sketch of a taper course

The line *a-m* represents the bending line at the smaller end of the gusset. In locomotive boiler practice the bending line is about 1 inch from the nearest edge of the adjacent seam.

At the bottom line of the gusset, as shown in Figs. 1 and 2, there is no angle at the junction of the cylindrical and conical parts; the bottom line *E-A-a-e* is a straight line and contains the apex of the cone. The bases *A-M* and *a-m*, (Fig. 1) of the cone frustum are perpendicular to the bottom line *E-A-a-e;* the diameter *D* and *d* are taken from the center of the thickness of the plate; the axes of the cylindrical portions are parallel to the line *E-A-a-e*.

In Fig. 3, the outline of the flat plate as it appears before bending and trimming is shown by the heavy full lines. The line *E-A-a-e* (Fig. 3) across the middle of the flat plate, corresponds to the bottom line, *E-A-a-e,* (Fig. 1) at the bottom of the gusset.

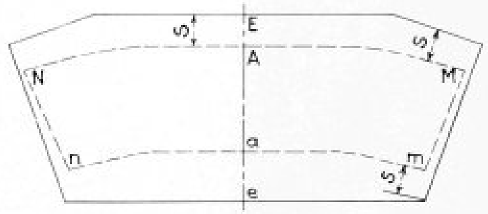


Fig. 3

The rivet holes for the seams are laid out on lines parallel to the development of the bending lines *a-m* and *A-M*, and punched in the plate while it is still flat. The plate is then bent to conical form and afterward its ends are shaped to cylindrical form.

It is necessary to allow for the distortion of plate resulting from this, in laying out the rivet holes in the flat plate. It is usual to so space the rivets that when the work is finished either a rivet or a space comes on the center of each quarter of the circumference. To secure this, locate the point of the quarter circumference on each curve which will be found at the development of the sixth tabular ordinate. At this point draw a line across each seam making it perpendicular to the curve at that point and locate the side center of the seam on this line; also draw a line joining the points of quarter circumference on each curve prolonging it across the seams on either side and on each seam; note its distance from the centers just located. Locate the top center of the seam on the large end of the gusset at twice the distance just noted from the center line *m-M* prolonged, and on the small end, taking the corresponding double distance, locate the top central point of the seam that amount outside of the *m-M*. The lower center will remain in the center of the development. Divide now each quarter into equal spaces from the center just located.

In order to lay out the rivet holes on the flat plate, the bending (junction) lines *A-M* and *a-m* of Fig. 1 are first laid out in their developed forms on the flat plate. The line *A-M* (Fig. 1) is shown developed in Fig. 3 by the broken-line curve *M-A-N;* the development of *a-m* (Fig. 1) is *m-a-n,* (Fig. 3).

The table gives co-ordinates for laying out the developed curves of the bending lines at the end of the conical portion of the gusset. The tabular values are for a diameter of 100 and for several different tapers. If the exact taper of a gusset being designed is not found in the table, the values for the nearest taper given may be used, with sufficient accuracy for general practice, by varying the distance of the bending line from the edge of the seam.

The tabular values must be multiplied by the ratio $\frac{D}{100}$ or $\frac{d}{100}$ as the case may be, to obtain the actual values to be scaled on the drawing.

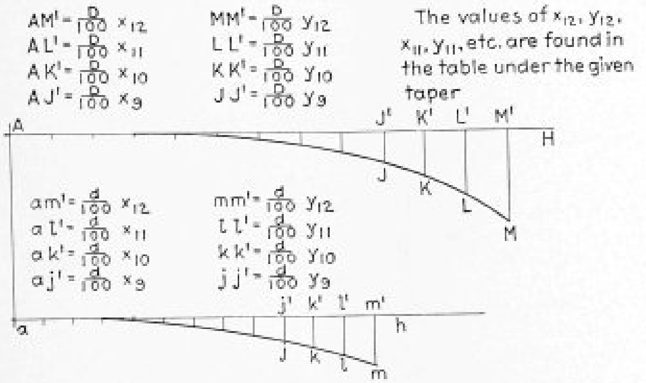


Fig. 4

Example: The gusset is to have the following dimensions:

$D = 74$	Length of taper $= 56$
$d = 60$	Rise $= 14$ (see Fig. 1)

For these values of rise and length of taper the

$$\text{Taper} = \frac{14}{56} = \tfrac{1}{4} \text{ or } 1 \text{ in } 4.$$

The curve *M-A-N*, Fig. 3, is symmetrical relative to the line *E-e*, therefore only the half curve, i.e., on one side of *E-e*, need be laid out in a drawing.

Referring to Fig. 4, draw a vertical line and measure on it the distance $A\text{-}a$ = length of taper = 56 in this example, to any convenient scale, and through the points laid off draw the two horizontal lines *A-H* and *a-h* of indefinite length.

Development of Curve *A-M*

In the table, under the heading "Taper 1 in 4" in the column headed x and in the horizontal line for point 12, is found the value 154.97, which will be designated x_{12}. Multiply this value by the ratio $\frac{D}{100} = 0.74$, which gives $\frac{D}{100} x_{12} = 0.74 \times 154.97 = 114.7$. Scale *A-M* $= 114.7$.

Under the same heading and in the same line of the table, the value in the column headed y is 17.92. Multiplying by $\frac{D}{100}$ as before gives $\frac{D}{100} y_{12} = 0.74 \times 17.92 = 13.26$.

Draw a vertical line downward from *M'* and scale 13.26 on this line, thus obtaining the point *M* which is the end point of the developed curve *M-A*.

The point *L* on the same curve is found in a similar manner. The coordinates for *L* and $AL' = 0.74\ x_{11} = 0.74 \times 142.7 = 105.6$, and $L\text{-}L' = 0.74 y_{11} = 0.74 \times 13.39 = 9.91$. For point *K* on the curve, the coordinates are $0.74 x_{10} = 0.74 \times 130.17 = 96.32$, and $0.74 y_{10} = 0.74 \times 9.64 = 4.43$; and similarly for the point *J* and the remaining points for which coordinates are given in the table. The curve is to be drawn through the points *M*, *L*, *K*, etc.

Curve *a-m*

The points on this curve are located in the same manner as for the upper curve *A-M*, but for curve *a-m* the table values must be multiplied by $\frac{d}{100} = 0.60$. The coordinates for m are $0.6 x_{12} = 0.6 \times 154.97 = 92.98$ and $0.6 y_{12} = 0.6 \times 17.92 = 10.752$.

Uniformly Spaced Ordinates

For laying out the curves *A-M* and *a-m* on the flat plate of metal it is desirable to have, for each curve, uniform spacing of its ordinates. The ordinates *M'*, *M*, *L'*, *L*, *K'*, *K*, etc. are not uniformly spaced, i.e., the distance *M'-L*, *L' K'*, *K' J'*, etc., are not equal.

In Fig. 5, referring to the longer curve *A-M*, for convenience of description, the broken-line ordinates, numbered *1*, *2*, *3-15*, *16*, are each spaced 6, 8 or 10 inches apart along the horizontal line *A-H*, except the last space which is made whatever fractional length is needed to bring the last ordinate on *M*. The length of the ordinate for point 16 on the curve should be given numerically in the drawing, and similarly for the ordinates of the other points 15,14,13, etc.

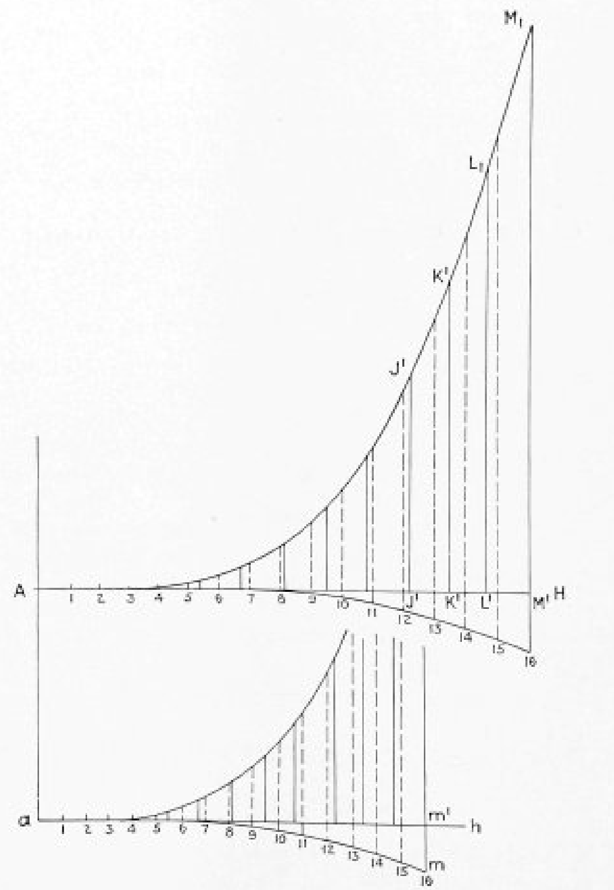


Fig. 5

The ordinates from the horizontal line *A-H* down to the points 15, 14, 13, etc., are generally too short to be measured with sufficient accuracy. Hence it is necessary to employ some means of determining their length with the required accuracy. This can be done by drawing a corresponding curve *A-M* with magnified ordinates.

Referring more particularly to Fig 5, the magnified ordinate *M-M'* is ten times as long as the actual-length ordinate *M-M'*, i.e., $M\text{-}M' = \frac{D}{10} y_{12}$. Similarly, $L\text{-}L' = \frac{D}{10} y_{11}$, $K\text{-}K' = \frac{D}{10} y_{10}$, and so on for the remaining ordinates.

After drawing the curve *M-A* through the points *M*, *L*, *K*, etc. the length of each magnified broken-line ordinate from the horizontal line *A-H* up to the curve *M-A* can be measured; one-tenth of the measurement is the length of the corresponding ordinate of the curve *M-A*.

For the low curve *m-a* the same method can be used by dividing the length *m-a* of the horizontal line into equal parts and drawing the (broken-line) ordinates through the division points.

The actual size of the flat plate required, (Fig. 3) including one-quarter inch for trimming, is obtained by laying out, outside of the bending curves, a strip whose least width is *S* = width of seam plus distance from bending point to seam plus ¼ inch.

If the horizontal seam *m-M* is a butt seam, then the edge *B-C* of the blanck should extend ¼ inch beyond the end of *M* of the curve *A-M*, and ¾ inch beyond the end *m* of the curve *a-m*. This allows for trimming after the sheet is bent to finished form; if a lap seam is used at *m-M*, then an additional allowance must be made for the seam.

GUSSET CURVE ORDINATES FOR CIRCLES 100 INCHES DIAMETER

$$\text{Taper} = \frac{\text{Length of Taper}}{\text{Rise of Top}}$$

Point	Taper 1 in 4 x	y
12	154.97	17.92
11	142.70	13.39
10	130.17	9.64
9	117.42	6.62
8	104.53	4.31
7	91.55	2.62
6	78.51	1.46
5	65.44	0.72
4	52.36	0.30
3	39.27	0.10

The above covers gusset curve ordinates for a taper of 1 inch in 4 inches, as an example. A complete set of tables covering the curve ordinates for tapers of 1 inch in 3 inches to 1 in 24.9 for each tenth of an inch can be obtained in pamphlet form, published by Lefax, Inc., Philadelphia, Pa.

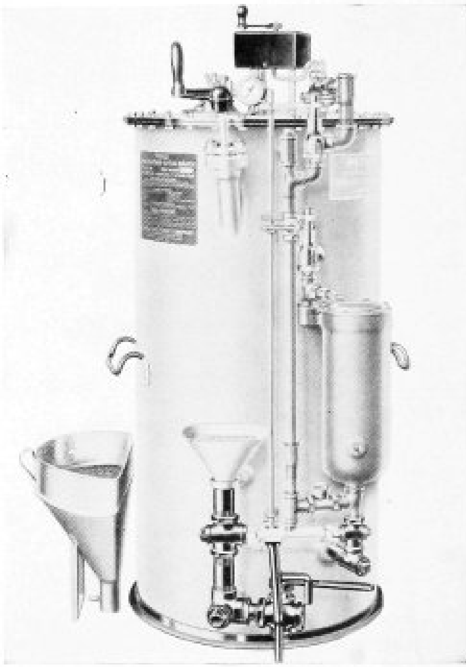
Medium-Pressure Acetylene Generator

THE Prest-O-Weld type MP-101 medium pressure acetylene generator has been developed by the Oxweld Acetylene Company, New York city, especially to meet the demand for a stationary or portable acetylene generator that can be used in connection with either medium-pressure or low-pressure welding and cutting blowpipes. This generator is adequate for any type of welding or cutting operation and can easily be carried from place to place on a truck or wagon.

Heavy gage material has been used in the construction of the generator and, where strength is required of the fittings, steel castings have been used. Bronze welding has been used for joining the generator shell and fittings. All parts are either galvanized or sherardized according to the conditions to which they are to be subjected. This generator is believed to be the strongest of its kind and size on the market and one that will require a minimum of maintenance.

The carbide valve is rotated by means of a spring clock motor which, in turn, is governed by an Oxweld diaphragm-type motor-feed control. This rotating feed valve is self-cleaning; the carbide brushes off any dust or lime deposit as it is fed. A pin in the stem above the valve prevents bridging of the carbide and consequent possible stoppage.

Pressure adjustment is easily made by means of a thumbscrew on the motor-feed control. Fluctuation during normal operation is less than 1 pound per square inch and even under severe load the carbide feed is regulated to limit after-generation to a maximum increase of 1 pound per square inch. This close regulation permits operation of the generator close to the limit of 15 pounds per square inch, without loss of gas through the relief valves when the blowpipes are turned off.



Prest-O-Weld acetylene generator having an output of 60 cubic feet of gas per hour

The motor is enclosed in a dust-tight housing. It is easily wound with a permanently attached ratchet lever. Time required for shutting down the generator, flushing and refilling with carbide and water is about 15 minutes. Relief valves are opened by raising an interference rod to vent the air-gas mixture after refilling so that it is unnecessary to vent hose or pipe lines connected to the generator.

The feed-valve cone can be raised to seal the hopper when the generator is being moved.

The carbide capacity of this generator is 30 pounds and the quarter size carbide is used. A special funnel, which is held in place on top of the generator, is provided for filling the generator with carbide. The overall dimensions of the generator are: height, 60 inches, and width, 34 inches. The weight of the generator empty is 305 pounds. With a full charge of carbide and water, the total weight of the generator is 623 pounds. The weight of the generator crated for shipment is about 455 pounds. The generator can be inclined to an angle of 30 degrees from the perpendicular without tipping.

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States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Islaand
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo	Seattle, Wash.	Parkesburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.
	Evanston, Ill.	

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash.	Parkersburg, W. Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

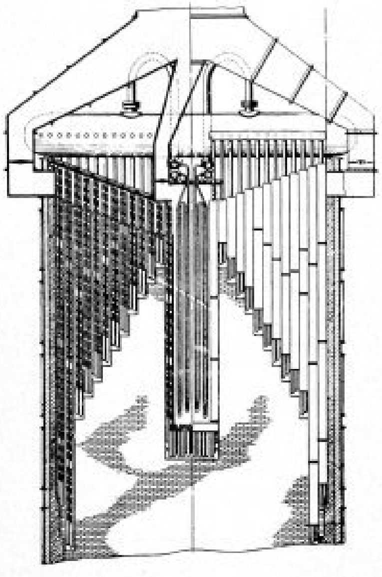
Compiled by
DWIGHT B. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

1,680,128. HIGH-PRESSURE WATER-TUBE BOILER. CARL A. W. BRANDT, OF GREAT NECK, NEW YORK, ASSIGNOR TO THE SUPERHEATER COMPANY, OF NEW YORK, N. Y.

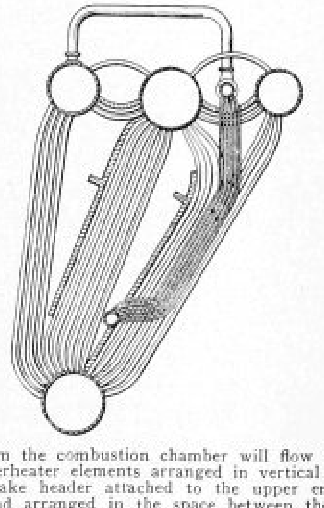
Claim.—In a boiler of the class described the combination of a setting, a furnace in the lower part of the setting, boiler tubes extending transversely across the boiler space and arranged in two substantially triangular groups with one side of the triangles against opposite walls of the boiler setting and the opposite point at the upper central part of the boiler space



whereby there is defined an inverted V-shaped combustion space above the furnace, a connection from each of the upper outer corners of the triangular spaces to the stack, two parallel spaced groups of transverse tubes extending downward from the inner upper points of the triangles into the combustion space, a group of transverse tubes extending between their lower ends, whereby a generally rectangular space is delimited from the combustion space, and a superheater extending into said rectangular space. Four claims.

1,683,669. SUPERHEATER BOILER. ROBERT L. SPENCER, OF ST. LOUIS, MISSOURI, ASSIGNOR TO HEINE BOILER COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

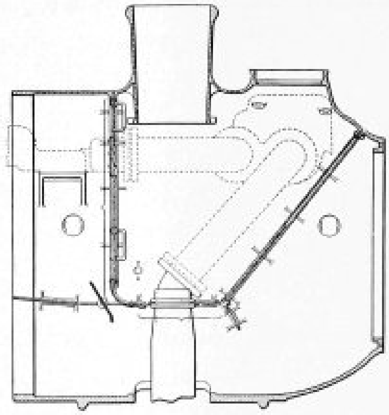
Claim.—A watertube boiler, comprising a plurality of elevated steam-and-water drums, a lower water drum, banks of upright watertubes connected at their lower ends with said water drum and at their upper ends with said steam-and-water drums, the front tube bank being arranged so



that the gases from the combustion chamber will flow upwardly over the same, upright superheater elements arranged in vertical lanes in the front tube bank, an intake header attached to the upper ends of said superheater elements and arranged in the space between the first and second steam-and-water drums, and a discharge header attached to the lower ends of said superheater elements and arranged at the rear of the front tube bank. Three claims.

1,686,788. LOCOMOTIVE SMOKEBOX STRUCTURE. WILLIAM L. BEAN, OF WEST HAVEN, CONNECTICUT.

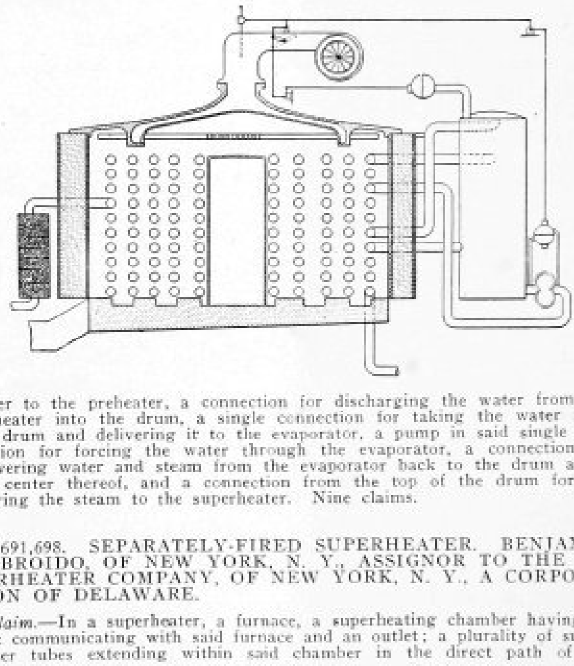
Claim.—In a smokebox structure, the combination of a smokebox, a smoke stack and a deflector to deflect the gases and smoke on their way



to said smoke stack, said deflector comprising a plate, means secured to said plate and presenting therewith a groove, and a part received in said groove. Eight claims.

1,696,892. SEMIFLASH BOILER. CHARLES A. FRENCH, OF CHICAGO, AND GUSTAF W. ENGSTROM, OF RIVERSIDE, ILLINOIS, ASSIGNORS TO INTERNATIONAL HARVESTER COMPANY, A CORPORATION OF NEW JERSEY.

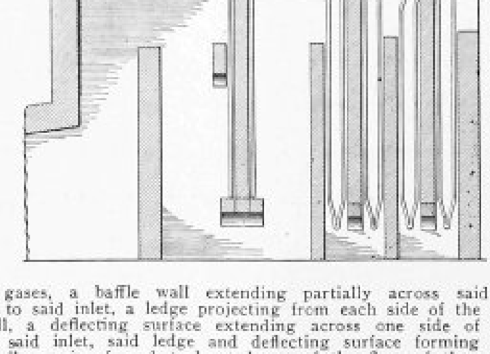
Claim.—In a steam generator, the combination of a burner, a casing, a superheater of fixed heating surface, an evaporator of fixed heating surface, a preheater of fixed heating surface, the superheater, evaporator and preheater all surrounding the burner, a storage drum, means for supplying



water to the preheater, a connection for discharging the water from the preheater into the drum, a single connection for taking the water from the drum and delivering it to the evaporator, a pump in said single connection for forcing the water through the evaporator, a connection for delivering water and steam from the evaporator back to the drum above the center thereof, and a connection from the top of the drum for delivering the steam to the superheater. Nine claims.

1,691,698. SEPARATELY-FIRED SUPERHEATER. BENJAMIN N. BROIDO, OF NEW YORK, N. Y., ASSIGNOR TO THE SUPERHEATER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

Claim.—In a superheater, a furnace, a superheating chamber having an inlet communicating with said furnace and an outlet; a plurality of superheater tubes extending within said chamber in the direct path of the



furnace gases, a baffle wall extending partially across said chamber adjacent to said inlet, a ledge projecting from each side of the bottom of said wall, a deflecting surface extending across one side of said wall opposite said inlet, said ledge and deflecting surface forming with said baffle wall a pair of pockets located out of the flow of the gases from said furnace, and a plurality of superheater units extending along each side of said baffle wall within said pockets. Eight claims.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX | August, 1929 | Number 8

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

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THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Caustic Cracking of Plates

BOILER explosions are of rare occurrence in England, but, when they do take place, the Board of Trade conducts exhaustive investigation of the causes and makes suitable recommendations for the guidance of other boiler users to prevent recurrences of the same difficulty. Therefore the recent report of an explosion at Middlesborough, England, has considerable general interest; for it involves one of the first boiler failures in that country which, in the light of American experience during the last few years, may be traceable to so-called caustic embrittlement.

In this case the Board of Trade surveyor ascribes the failure to "inter-crystalline cracking at the rivet holes." According to *The Metallurgist*, supplementing *The Engineer* for May, the Board of Trade has in this instance withheld not only recognition of the term "caustic embrittlement," but has also ignored the underlying facts and ideas that have been developed by exhaustive research to support the theory. This attitude is not justified and may prove to some extent misleading in connection with British boiler practice.

It may be that the term itself does not describe the condition actually existing in boiler plate, as evidenced by present considerations of the term being given by the American Society of Mechanical Engineers and other groups in this country. Nevertheless, Professors Parr and Straub of the University of Illinois have definitely shown that inter-crystalline cracking is produced when caustic soda solutions of sufficient concentration act upon boiler plate steel, which, at the same time, is exposed to mechanical stress. Since it has yet to be shown that cracking of this definite and unusual type can be brought about in any other way in a boiler, the evidence seems quite conclusive that these two factors working together will inevitably produce failure in the plate.

In the Middlesborough investigation by the Board of Trade, it was shown that calking had been so performed that a slight bulge occurred in one of the plates between two rows of rivets. Inside this bulge, space was provided in which, with the slight leakage taking place concentration of the boiler water might go on.

This case, and others of a like character, can only occur when, in addition to the caustic concentration, the second factor—high operating stress—is also present. Although the working stresses themselves are far below the yield point of the steel, there are at the same time stress concentrations between rivet holes set up by the original rivet pressure and subsequent thermal expansion and contraction that must be taken into account. The importance of proper riveting and the avoidance of excessive and strenuous calking can therefore be readily understood. The fact that many boilers withstand successfully the presence of a certain amount of caustic in their feed water indicates the fact that modern boiler practice avoids the imposition of fabrication stresses of undue severity. Thus the elastic stresses required to keep a seam tight need not necessarily, even when added to the stresses due to steam pressure, exceed the limit of safety when caustic concentration is present.

Certain definite precautions can be taken by boiler users to prevent caustic cracking if the feed water available contains any amount of caustic soda or chemicals liable to lead to its formation. The addition of sulphate or phosphate of soda in small amounts will inhibit the destructive action even when the concentration of caustic is high. Furthermore, severe calking as a remedy for leaking seams should be avoided.

The American Society of Mechanical Engineers has under preparation instructions for the treatment of feed waters containing any trace of caustic, and boiler operators should familiarize themselves with the condition and take steps to prevent deterioration in boilers.

Reliable boiler manufacturers are fully informed of the investigations covering the subject and have long since protected themselves against poor workmanship in their products which might become contributory to the formation of caustic cracks. There are other manufacturers in non-code territory, however, where boiler construction is possibly not as well controlled as in states governed by the A.S.M.E. Boiler Code, who might study this condition to advantage and guard against inferior workmanship. Boiler repair concerns, as well, should employ only reliable men and these should be given strict instructions against over-stressing boiler steel when tightening leaking seams or patching.

Furthermore, investigations on the subject of feed waters and their treatment should be continued until a full determination has been made of the underlying causes of caustic cracking, corrosion and pitting, and preventive treatments for all of these conditions have been developed.

Boiler Inspectors' Meeting

FURTHER evidence of the broad influence of the National Board of Boiler and Pressure Vessel Inspectors in the field of boiler construction and operation in the United States, is given in the report of the seventh annual meeting of this body. Through the courtesy of the officers of the National Board, publication of the proceedings has been authorized in THE BOILER MAKER for the benefit of all who are engaged in the industry, either in the construction, inspection or maintenance branches.

The Board is directly responsible for the safeguarding of lives and property from boiler disasters in the various communities governed by the A. S. M. E. Boiler Construction Code. Members have full control as to what boilers shall be built and operated in their respective territories. For such a group to fulfil its functions successfully complete co-operation of all its members must be a fundamental principle. Of the various associations in the boiler field, the National Board is outstanding in the unity and coherence of its organization. The industry is rapidly coming to depend more and more on its efforts, and, with its power of determining the acceptability of specific boiler and accessory designs, future developments will be greatly influenced by its work.

One of the important matters brought up for discussion during the meeting had to deal with welded pressure vessel design and inspection. This branch of the industry has reached tremendous proportions and must be provided with a suitable code and also with adequate supervision of the fabrication processes in order that it may develop safely without undergoing the tedious stages which occurred in the promulgation of the Boiler Code.

During the meeting the question of holding sessions only every two years was discussed. The expense of bringing the chief inspectors together once a year is unquestionably a burden to the organization but it is to be hoped that some means for increasing the revenue from registration of boilers or some other source may be found. Since it is impossible to accomplish the same ironing out of differences that occur by correspondence as in open meeting, it is almost essential that sessions be held at least once a year and probably oftener.

Water Flow and Tube Corrosion

By G. P. Blackall

AN instructive illustration of the influence of velocity of water flow on the rate of corrosion of steel tubes was given recently at a meeting in London of the Institution of Civil Engineers. The demonstration was made by Major J. N. D. Heenan, and the apparatus comprised an arrangement of tanks and a pump which maintained a steady flow of water through a 1/4-inch diameter nozzle on to the center of a polished steel plate. The plate was first cleaned with ether to remove all traces of grease. The water was discharged from the nozzle at about an inch above the plate, and thus flowed radially in all directions over the plate, decreasing in velocity with increase in distance from the center.

The point of transition from turbulent flow to streamline flow was clearly visible, this point being marked by a definite wave. It was soon noticed that where the water was in streamline flow on the plate outside the wave diameter small bubbles formed and remained, whereas on the surface of the plate inside the diameter of the wave where the water was in turbulent flow no bubbles adhered to the plate's surface.

After the lapse of a few hours the outer diameter of the plate started to corrode, while the inner diameter showed no trace of corrosion. The explanation of this is that where the water is in turbulent flow, the small bubbles of oxygen are swept away thus preventing corrosion; but where the water takes a streamline form, the bubbles cling to the plate surface which they corrode.

The experiment was repeated in order to determine the most suitable velocity of water flow to avoid corrosion in the steel tubes of the Foster economizer. It clearly demonstrateed that the flow of water through the tubes of an economizer should be above the critical velocity, so as to give turbulent flow and permit the scrubbing action of the water to prevent the small bubbles of oxygen from adhering to the internal surface of the tubes and damaging them.

Albert F. Stiglmeier, general foreman boiler maker, New York Central Railroad, Albany, N. Y., and formerly chairman of the executive board of the Master Boiler Makers' Association, has been appointed secretary of the association, filling the vacancy caused by the death of Harry D. Vought, former secretary.

Charles J. Longacre, foreman boiler maker, Meadow Shops, Pennsylvania Railroad, Elizabeth, N. J., has been appointed chairman of the executive board of the Master Boiler Makers' Association.

Gunderson Process for

Eliminating Boiler Corrosion

Electro-chemical and arsenic treatment in 75 locomotive boilers of Chicago & Alton

FOR several years past, during discussions of the problem of boiler corrosion at the Master Boiler Makers' Association meetings, mention has been made of the Gunderson electro-chemical arsenic process for checking this costly locomotive maintenance item. In the following paragraphs complete details of the functioning of this system are given:

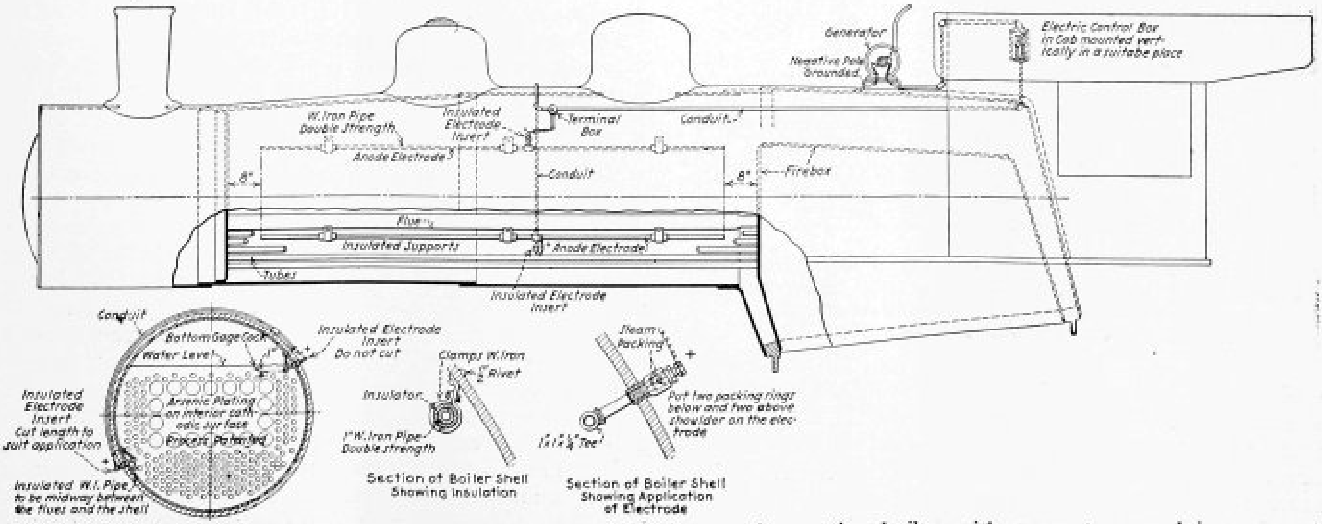
Since September, 1924, the Chicago & Alton has equipped the boilers of 75 locomotives with the Gunderson process. This method, first developed on the Alton, consists of introducing a compound of arsenic into a boiler, equipped with electrodes which permit passing electric current through the water to the interior metal surfaces of the boiler and thus create a condition inhibitive to pitting and grooving. The arsenic compound is put into the boiler in one-pound tubes through one of the washout holes. The electric current is obtained from the headlight generator or from a storage battery connected with it.

The satisfactory results of over four years' tests, most of them conducted under the direction of C. M. House, superintendent of motive power and equipment, have caused the Alton to make this equipment standard for application to all locomotives as they receive general repairs. These results are summarized by officers of the road, as follows: Practical elimination of corrosion in the boilers equipped; general increase in tube and flue life from 12 months or less to the four-year limit set by the I. C. C. requirements; firebox life proportionately increased, with substantial reduction in boiler maintenance costs and locomotive out-of-service time; and the practical elimination of engine failures due to pitted tubes and flues, with the attendant irritating and costly service delays.

Most of the raw waters available for locomotive use on the Chicago & Alton carry a high content of mineral salts, as shown in one of the tables, the total hardness in the worst case, namely, that of the Bloomington city water, being 54.3 grains per gallon. By 1924, automatic soda-ash plants had been generally installed to prevent the formation of hard scale on boiler tubes and firebox sheets. The specific treatment given the Bloomington city water was to supply 4½ pounds of soda ash per 1000 gallons, with the object of completely neutralizing the sulphate hardness and leaving a surplus of sodium carbonate. Of two other waters available for locomotive use at Bloomington, the Illinois Power & Light water was treated with 2 pounds of soda ash per 1000 gallons and the water from the Big Four well with 1¾ pounds per 1000 gallons.

By this method of treating boiler feed water, the difficulties due to scale formation were largely solved, but boiler pitting grew worse. Yard locomotives at Bloomington, Ill., for example, sometimes required almost two full sets of tubes and flues for each machinery shopping, boiler sheets and staybolts deteriorating likewise. A total of 7800 tubes was scrapped in back shops because of pitting and grooving during a period of a little more than a year, and in addition, during the same period, there were 556 instances of tube failures. Expensive delays chargeable to these failures made it imperative to check corrosion, and, in 1924, it was decided to equip test locomotives with the newly developed process.

Installations of the Gunderson process to Chicago & Alton locomotives were made as follows: 2 in 1924; 2 in 1926; 17 in 1927; 40 in 1928; and 14 in 1929 (up to March 15). It is impossible to give a definite statement of savings from the prevention of pitting and cor-



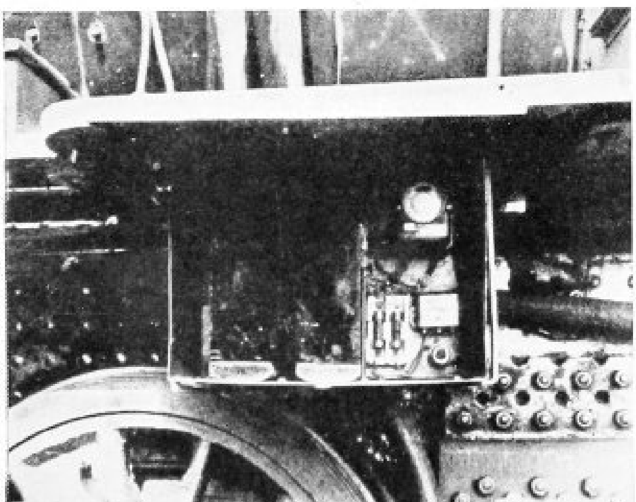
Details of the application of the Gunderson process equipment to a locomotive boiler with generator supplying current through resistances

rosion in the 75 boilers involved, because of the large number of indeterminate factors, such as the savings in boiler material, labor, locomotive out-of-service time, locomotive failures, train delays, etc. Some idea of what has been accomplished, however, may be obtained by analyzing the results in one or two specific cases.

Locomotive 49, for example, the first to be equipped, in September, 1924, is a six-wheel switcher used in the same yard service at Bloomington, Ill., as locomotive 44, non-equipped. A Pacific-type locomotive, No. 656, and a ten-wheel locomotive, No. 251, used in fast passenger service on the Northern and the Western divisions, respectively, were equipped with electrodes in October, 1924, and March, 1926, respectively, locomotives 658 and 254, non equipped, being operated in similar service.

A comparison of the service records of these locomotives will give a measure of the effectiveness of the electrode applications, since to as large an extent as possible other variables have been eliminated. There has been no change, for example, in the kind of boiler-tube material used on the Alton in recent years. While these locomotives have not all taken water from the same source, all have used water which promotes corrosive action to a greater or less extent. There has been no change in the method of blowing off or washing boilers since the installation of the process. The inbound and outbound method of blow-off is utilized on passenger power accompanied by restricted blow-off on the road. The inbound and outbound blow-off is also used with switching power, accompanied by occasional blow-offs in the yard.

Detailed boiler-shopping records of Locomotives 49 and 44 are shown in two of the tables. Within a period of three years and two months before the installation of electrodes Locomotive 49 had been through the back shop on two different occasions for re-tubing and general overhauling necessitated by pitting and grooving. Previous to the shopping in September, 1924, approximately 100 tubes had been removed in the enginehouse due to failure through pits, and while in the shop, 213 more pitted tubes were scrapped with an estimated loss in tube material alone of $595. The electrodes were installed in the boiler at this shopping period.



Battery and switches are mounted in a sheet metal box under the running board—Ampere-hour meter shown was experimental installation used to determine current consumption

The boiler was then shopped in July, 1926, principally for an inspection to determine the completeness with which corrosion had been prevented. The steel tubes were removed, found free from pits, and re-applied to another boiler and 283 new steel tubes were applied to the boiler of Locomotive 49. Other parts of the boiler were also found to be free from corrosion. At the next shopping in February, 1929, after making 50,925 miles, an interior inspection showed the boiler to be free from corrosion as far as inspection could disclose. Consequently, the tubes were not removed but were left to run the full four years allowed.

The record for Locomotive 44 shows that when it was shopped in December, 1926, practically all of the full set of 283 tubes was scrapped on account of pitting. The front tube sheet was pitted and grooved, requiring renewal, as well as the bottom half of the second course. After nine months' service, or in September, 1927, a pitted tube was replaced and from that time until March 2, 1929, or in 18 months, a total of 238 pitted tubes were replaced in this boiler at 60 different times. Replacements were made in the engine house as the tubes failed or when inspection disclosed leaks through pits.

Analysis of Raw Water Supplies (Expressed in Grains Per Gal.) at Principal Water Stations on the C. & A.

Location	Source	Total hardness	Carbonate hardness	Sulphate hardness	Alkali salts	Dissolved solids
Kansas City	City Water	17.0	10.5	6.5	6.4	23.4
Blue Springs	Pond	10.2	7.6	2.6	10.3	20.4
Odessa	Pond	9.8	5.3	4.5	4.4	14.1
Blackburn	Pond	9.6	4.7	4.9	5.5	15.1
Slater	Pond	9.2	2.9	6.3	16.2	25.3
Glasgow	Mo. River	12.2	8.2	4.0	13.4	25.6
Higbee	Pond	6.7	2.9	3.8	7.7	14.4
Larrabee	Pond	2.8	0.6	2.1	3.4	6.2
Mexico	Pond	8.2	3.5	4.5	8.4	16.8
Booth	Pond	6.9	4.1	2.8	10.0	16.9
Louisiana	Miss. River	12.0	8.4	3.6	2.0	14.0
Pearl	Ill. River	15.6	10.5	5.2	14.8	20.3
Roodhouse	Spring	19.4	16.3	3.0	1.4	20.8
Brighton Park	Chicago Water	9.0	7.0	3.0	0.1	9.1
Glenn	Canal	11.5	7.6	4.0	22.8	34.4
Braidwood	Well	21.0	18.1	2.9	15.7	37.4
Mazonia	River	19.2	12.8	6.3	7.6	26.8
Pontiac	River	22.3	15.2	6.2	11.4	32.7
Bloomington	City Water	52.2	23.6	28.6	16.8	69.0
	I. P. L. Well	42.5	28.9	13.6	6.0	48.5
	Big Four Well	37.8	28.9	8.9	9.0	46.8
Ridgely	River	10.5	7.0	3.5	9.5	19.6
Springfield	City Water	7.2	2.3	4.9	5.8	12.9
Virden	Pond	17.1	10.5	6.7	3.0	20.1
Rinaker	Pond	4.2	2.3	1.8	3.3	7.4
Godfrey	Pond	11.7	8.2	3.5	6.8	18.2
Venice	City Water	10.3	7.0	3.3	5.5	15.7

At the shopping in March, 1929, 145 pitted tubes were scrapped, even though all but 45 of the full set of tubes had been replaced since December, 1926. It will be noted that during this period of two years and three months while making 43,784 miles, 383 pitted tubes were scrapped, representing a loss in material (at 15 cents per foot) of $727, to which must be added a minimum engine house labor cost of at least $5 for each of the 60 failures, bringing the total loss due to pitted flues to $1027. It was also necessary to renew the front-tube sheet and belly sheet of the second course on account of pitting.

The effectiveness of this method of preventing corrosion has been strikingly demonstrated at the Bloomington engine house for the reason that switching Locomotives 44, 64, 65 and 412, not equipped, continue to give trouble, due to the failure of pitted tubes, thus requiring extra work in the engine house and frequently delaying switching service in the yards. Locomotive 49 has never had a flue failure since coming from the shop in 1924, and the flues are now in good condition.

Locomotive 656, in fast passenger service between Chicago and Bloomington, had several tube failures previous to the 1924 shopping due principally to grooving at the front sheet. In October, 1924, it was necessary to scrap 175 pitted steel tubes and 19 superheater flues, approximating a total loss of $898 in material. A pitted and grooved front-flue sheet was renewed, and grooves in the belly were patched. The Gunderson process, with only one electrode above the flues, was applied to the locomotive at this shopping, whereas Locomotive 49 had received two electrodes.

In July, 1926, after having made 112,000 miles, the locomotive was again shopped for general overhauling, at which time only the tubes below the superheater flues were removed for inspection. This inspection disclosed

Locomotive 49 Boiler-Shopping Record

(Electrode-equipped)

Classification, 0-6-0
Number of tubes and flues
  283 tubes, 2 in. by 12 ft. 8 in.
Class of service
  Switching service in Bloomington yards
Condition prior to 1924 shopping
  Pitted tube failures common, sometimes occurring daily
  Approximately 100 failures since previous shopping in June, 1923
  Newly applied firebox sheets and staybolts
Boiler shopped, September 24, 1924
  283 second-hand steel tubes applied
  213 old tubes scrapped on account of pitting
  210 new staybolts applied

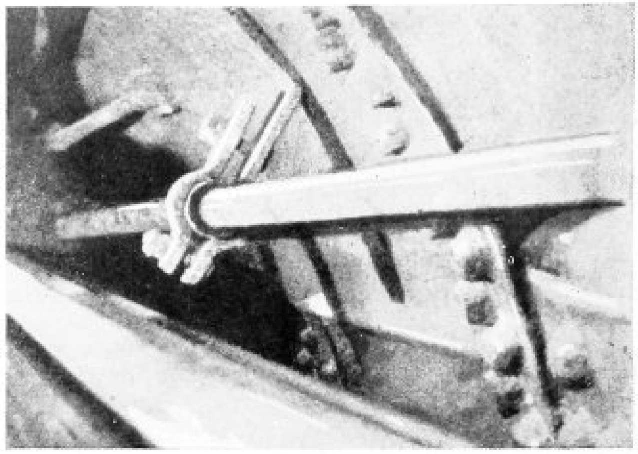
GUNDERSON PROCESS ELECTRODES INSTALLED

Date of first tube failure—None
Boiler shopped, July 21, 1926
  Tubes removed, found free of pits, safe-ended and re-applied to another boiler; 283 new 2-in. tubes applied
  New right side sheet, 7 rows high, applied
  Considerable other boiler work, done at this shopping, was not due to corrosion
  Locomotive stored empty for 3 months, but small rust spots developed on the tubes; did not have characteristics of pits
Date of first tube failure—None
  Boiler shopped, February 20, 1929—50,925 miles
  Lagging taken off to permit removal of flexible staybolt caps
  Not necessary to remove tubes
  Interior inspection showed good condition with no signs of pitting
Date of first tube failure—None
  Will get at least 4 years' service with these tubes and extension may be requested

the fact that the use of arsenic at about six months' intervals was insufficient, and that the experimental voltage of 17 volts was excessive, inasmuch as a few bottom tubes farthest from the anode were found to be slightly pitted. However, all of the tubes removed were safe-ended and re-applied to another boiler. The balance of the boiler was free from pitting or grooving. It was decided to continue the use of the single electrode, but to add arsenic semi-monthly and use between 2 and 3 volts, as tests on Locomotive 49 indicated this to be more effective. At the next shopping in November, 1928, after making 150,000 miles, all of the tubes and flues were renewed, safe-ended and re-applied, and the balance of the boiler was found free from corrosion. Of special interest was the fact that the grooving of the tubes at the front-flue sheet, so prevalent in this class of locomotive, was entirely prevented. At this shopping the latest type of double electrodes were applied.

Locomotive 658, of the same class as No. 656 and in the same service, was shopped in December, 1925, at which time 155 tubes were scrapped due to being pitted and grooved; 155 new tubes and 55 safe-ended tubes were re-applied. In July, 1927, after 19 months of service, the locomotive was in the shop for light repairs, at which time no flues were removed. On February 4, 1929, the boiler entered the shop and 30 tubes were scrapped on account of pitting; also, the first and third courses and bottom half of the second course were pitted, requiring renewal. Other locomotives of this class might be mentioned. Locomotive 621 had three flue shoppings within a period of four years and eight months with a recorded loss of $965 due to scrapped, pitted tubes. Locomotive 625, in making 110,000 miles, developed, according to the master mechanic's report, 26 different tube failures, involving 94 pitted tubes, resulting in a loss of material of over $300.

Locomotive 251, operating between St. Louis and Kansas City, with its home terminal at Slater, Mo., was equipped with electrodes at the regular shopping in March, 1926, when the majority of the 288 tubes were scrapped because of pitting. At the same time, 178 grooved staybolts were renewed, and inspection showed the side sheets to be grooved but not seriously enough



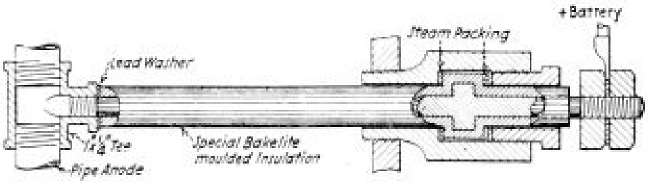
Early method used to support and insulate the upper electrode pipe

to require renewal. After three years of service, making a total of 108,744 miles without a tube failure, the boiler was again shopped in March, 1929, and found free from pitting, with one exception. The bottom electrode was discovered to be short circuited, and 30 tubes adjacent to it were pitted, 3 of them being scrapped. Locomotive 254, without the electrodes, had 225 pitted tubes renewed in the engine house previous to being shopped in September, 1927, when 93 additional pitted tubes were scrapped, making a total of 318 scrapped tubes caused by pitting during the time the locomotive was making 118,000 miles. The cost of the replacement tubes amounted to $760. Inspection showed the front-flue sheet, firebox sheets and a large number of staybolts to be seriously grooved, requiring renewal, no estimate being made of the cost of material for this work.

How the Process Works

The mechanism of boiler-metal corrosion, which the new process is designed to counteract, may be described as follows: The surface characteristics of boiler metal are never uniform, and, therefore, certain small areas have a greater electric potential or tendency to dissolve than other adjacent areas, these variations in the surface of the metal in effect acting as tiny batteries, wherein small electric currents are produced by solution of the iron as it forces hydrogen ions to be deposited on the low potential surfaces. All boiler metal is inherently subject to this destructive electrolytic action, but only under certain water conditions. The solution of iron in the boiler water is accomplished by the iron forcing out hydrogen ions and then uniting with the remaining portion of the water molecules to form iron hydrates. These hydrates react with oxygen to become oxides, some of which accentuate electrolytic action, thus explaining why pitting penetrates the boiler tubes and flues rapidly.

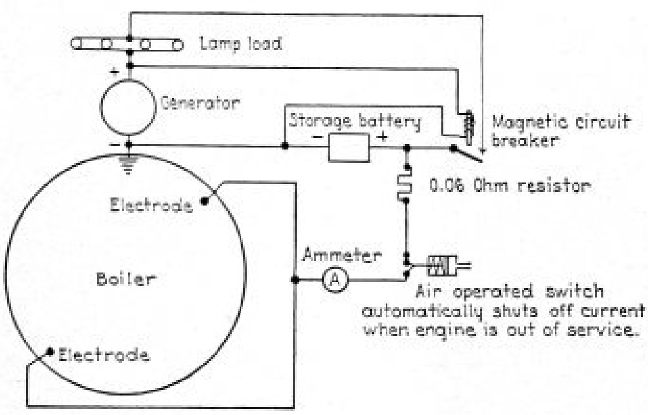
If mill scale (iron oxide), for instance, or some other substance having a like low potential, is in contact with the iron surfaces, hydrogen is deposited much more easily and the iron is corroded faster. Any strain, resulting from cold working of the metal, or vibration in road service, increases the solution pressure or electric potential of the stressed portions and causes these portions to corrode in preference to the adjacent metal on which the hydrogen is deposited. The deposit of hydrogen on the boiler metal surface as a thin invisible film, however, effectually hinders and finally entirely



Cross sectional drawing of bushing used to carry the electrical circuit through the boiler cell

prevents the deposit of additional hydrogen, and no more metal can dissolve until the hydrogen is removed by some agency. This is accomplished by dissolved oxygen in the boiler feed water which proves effective in removing the hydrogen film by combining chemically with it to form water. The real function of the Gunderson process is to maintain this film of hydrogen, producing a state of polarization like that found in batteries.

The new process sets up a protective condition on the interior surfaces of the boiler by means of an arsenic plating, on which hydrogen is deposited and tenaciously retained. Two insulated iron-pipe electrodes are installed in the boiler, and an electric current of about four or five amperes at two volts from the headlight generator (or storage battery) is passed through the boiler water from these electrodes (anodes), the boiler metal being the negative pole of the circuit. A commercial chemical compound of arsenic is dissolved in the boiler water, from which the arsenic plates out on the boiler metal. The arsenic not only has the characteristic of retaining the hydrogen film but neutralizes the inequalities of solution pressure or electric potential



Circuit diagram of electrical connections used when a storage battery is employed

which cause the localized action on the surface of the boiler metal.

The arsenic alone, without the electric current, is said not to be effective because the film on the interior boiler surfaces is soon destroyed by chemical combination with the dissolved oxygen in all boiler feed waters. The electric current, without the arsenic, will not prevent localized corrosive action which takes place just as on battery plates.

The installation is made substantially as shown in the drawing. The electrode stuffing boxes are usually located for convenience in the third course of the shell.

If the tubes and flues are in the boiler when the installation is made, both anode pipes are placed above the tubes on opposite sides of the shell. If the tubes and flues are out of the boiler when the installation is made, the anode on the left side is located above the flues and the one on the right side is located diagonally opposite the first. Each anode is spaced equi-distant between the shell and the flues. The clamp supports are assembled so as to grip snugly the insulating tubes which are placed around the 1-inch anode pipes. Metallic contact of the anode pipes with the boiler structure is avoided as this would short circuit the system. Before putting the locomotive in service, sealed cylinders, containing five pounds of the polarizing chemical (a soluble arsenic compound) are placed in the boiler through a washout hole; thereafter a one-pound cylinder is applied at least twice a month.

Locomotive 44 Boiler-Shopping Record

(Without Electrode Equipment)

Classification, 0-6-0
Number of tubes and flues
    283 tubes, 2 in. by 12 ft. 8 in.
Class of service
    Switching service in Bloomington yards
Condition of boiler
    Safe-ended tubes in good condition
    No electrode equipment
Boiler shopped, Dec. 6, 1926
    283 tubes removed, safe-ended and re-applied on account of pitting
    Front tube sheet renewed on account of pitting;
    Bottom half of second course renewed for some reason
Date of first tube failure
    September 9, 1927
    Total of 238 tube failures up to March 2, 1929
Boiler shopped, March 5, 1929—43,784 miles
    283 tubes removed, 145 being scrapped on account of pitting
    New half-belly sheet, first course, applied on account of pitting

Electric current is supplied in either of two ways from the headlight generator. One system consists of a direct circuit from the 32-volt generator through a six-ohm resistance unit and 10-ampere fuses to the boiler electrodes. The current varies from about 2½ amperes to 5 amperes, depending upon the conductivity of the boiler water. The series resistance unit possesses a regulating feature in that it serves to keep the current within desirable limits. Boiler waters which are most corrosive are those having a high hydrogen-ion content, and these require a greater current for proper control of pitting. Owing to its greater conductivity, such boiler water automatically receives a higher current than does a boiler water of lower hydrogen-ion content.

On some locomotives, the headlight generator is shut down during daylight hours primarily for the purpose of saving fuel. In such cases, a storage battery is used to supply current to the boiler electrodes. The battery is charged from the headlight generator by connecting it in series with the lighting load, the charging rate varying between 8 and 9 amperes. A single-cell battery is used and the voltage across the electrodes varies from 2 to 2½ volts, depending on whether the battery is being charged or not. In order that the storage battery may be disconnected from the generator and lighting circuit an automatic switch is employed which picks up when there is voltage on the generator and closes the lighting circuit, through the battery. The boiler electrodes are connected to the battery only when the boiler is in service. This is accomplished by an air-operated Cutler-Hammer pressure switch, set at 70 pounds which keeps the boiler-electrode circuit closed automatically during all of the time there is air pressure on the locomotive. An Exide 250-ampere hour battery is used.

Owing to the simplicity of the apparatus, there has

(*Continued on page 239*)

High Pressure Demands

Efficient Longitudinal Joints

By F. W. Dean*

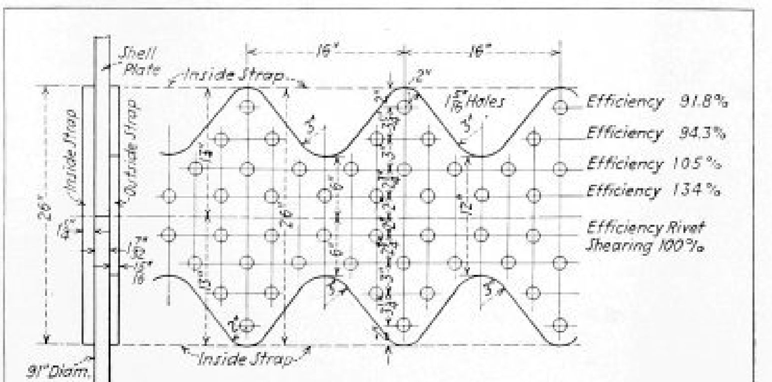
Saw-tooth design longitudinal joint for locomotive boilers shows efficiency of 92 percent

IN view of the high boiler pressures that are now being used on locomotives, and the prospect of their being higher, it would seem that the designers and manufacturers of locomotives should adopt a design of longitudinal joints for boilers different from that now generally used.

It is well known that the lap joint has been almost the sole cause of boiler explosions, excluding low water in locomotives, and this has been due chiefly to the departure from the circular form of the boiler shell in the vicinity of the joint. When the pressure increased the shell tried to become circular, and when it was reduced it tried to return to its original form. Both of these movements bent the plate at the edges of the lap and finally cracked it. Many joints began to leak, and in this way the crack became known before complete rupture occurred. Moreover the condition of having rivets overhung, especially if they do not fill the holes, as in the old days, causes the rivets to tip somewhat, and weakens the joint considerably.

The present prevailing butt joint having a narrow outside and wide inside strap is but a step removed from the lap joint, because it has a lap joint at each side. In a testing machine each side behaves like a lap joint. I have designed such joints 15 inches wide and had them tested to destruction at the Watertown Arsenal, and as tension was applied they would begin to bend. The narrow (outside) strap bends so that it is convex toward the wide strap, and each end of the wide strap bends the other way, the rupture taking place through the outer row of rivets of one wide end. Joints of this kind in service have been known to crack outside the edges of the narrow straps, so that steam blew through and the boilers were taken out of service before rupture occurred. Fortunately this is what they usually do, and are likely to do, but joints should be made so that they will not even do that. I know of a watertube boiler, the drum of which had such a joint. After being inspected hydrostatic pressure was applied and the drum split along one edge of the outside strap.

In order to have a joint that will pull straight it must be equally strong on both sides, and that is accomplished by having both straps of the same width and all rivets in double shear. The ordinary double riveted joint of this nature has an efficiency of about 75 percent, but of course this is insufficient where economy of plate is important. If there are three rows of rivets, and every second rivet is omitted in the outer rows, the efficiency can be made 84 percent without having the outer pitch too great for the strap to stand calking. If the desired efficiency is 92 percent, or even more, there must be four rows of rivets on either side of the center of the joint, and the outside pitch will be so wide that it is necessary to cut out the outside strap in the wide spaces so as to bring the calking edge near the rivets. If the joint is to be calked inside, as well as outside, the inside strap must also be cut out. Such a joint has the maximum strength and maximum efficiency of riveted joints, pulls straight, being equally strong on both sides of the plate, and is usually known as a sawtooth joint. It is the highest development of the art and is worth using.



High efficiency saw-tooth longitudinal joint

Some years ago the International Engineering Works of Framingham, Mass., made a number of saw-tooth joints and tested them to destruction and they showed no sign of bending as they were pulled.

Joints tested in a testing machine never give the computed efficiency because some rivets must be near the edges, and at such places the plate begins to fail before it does in the middle, the failure becomes progressive, and a low efficiency results. In a complete boiler the efficiency is probably greater than computed because there are so many resistances to be overcome and no rivets are near an edge.

There is another point which is overlooked and this is the small effect of extending the wide strap far be-

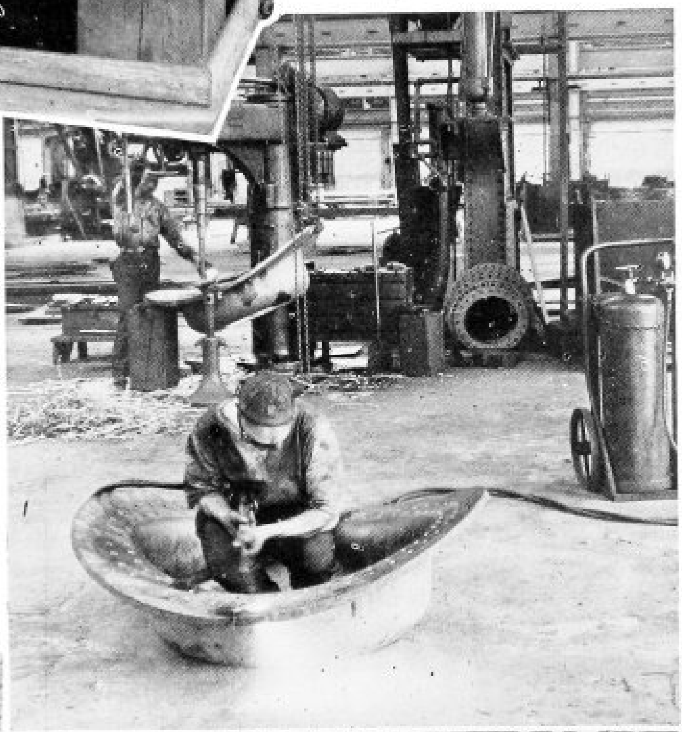
(*Continued on page 239*)

* Consulting engineer, Boston, Mass.

Locomotive Work

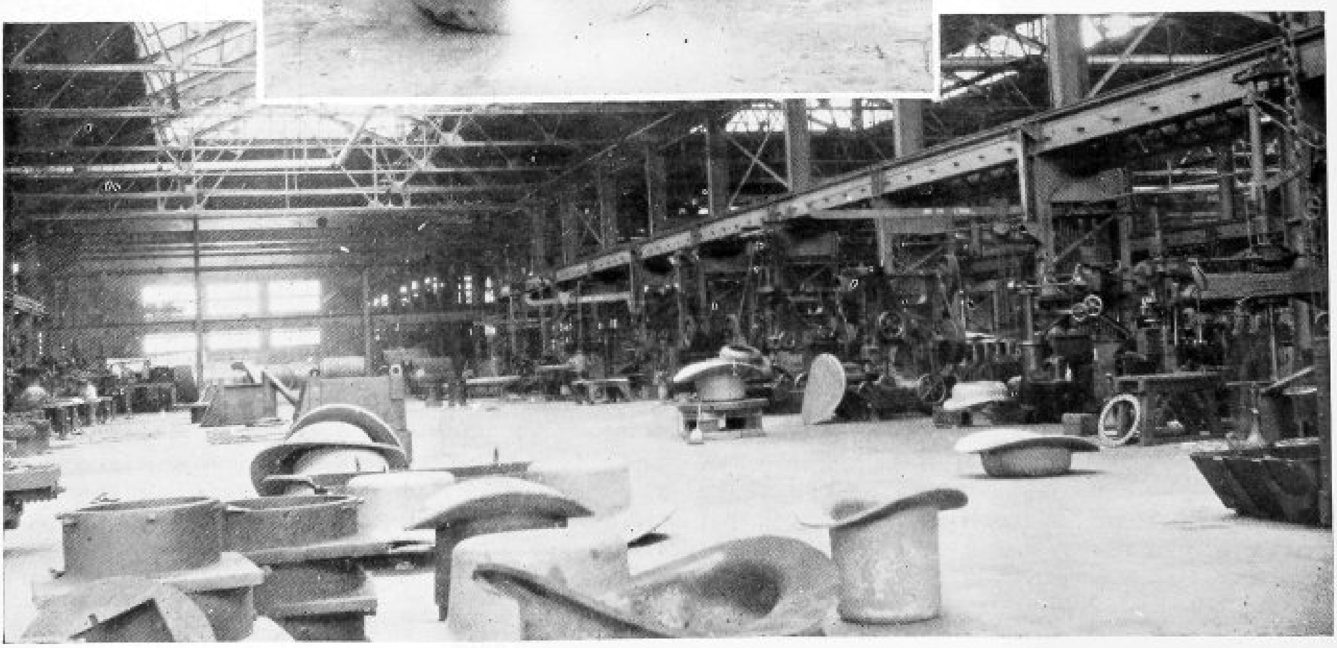
Methods of fabricating at The Baldwin

(*Above*) — *Laying out the dome flange holes and edge*



(*Right*) — *Burning the edge of the dome flange*

(*Below*) — *General view of bay No. 8 showing battery of radial drills*



IN following the logical flow of materials through the most economical channels at the boiler shop of The Baldwin Locomotive Works, Eddystone, Pa., we come to Bay No. 8 in which the front end of the boiler is assembled. It is here that domes are finished, tube sheets completed and the cylindrical and conical boiler courses fitted and riveted. In this bay the raw material begins to take a definite form and the boiler starts on its travel down the remaining bays towards completion before shipment to the erecting shop.

The dome machine shop occupies the extreme end of bay No. 8 between panels 24 and 29, inclusive. Panel 29 is occupied by a ladder track. This department together with the tube sheet shop, which extends between panels 18 and 23, inclusive, is served by a 10-ton Shepard overhead electric

Boiler at Eddystone

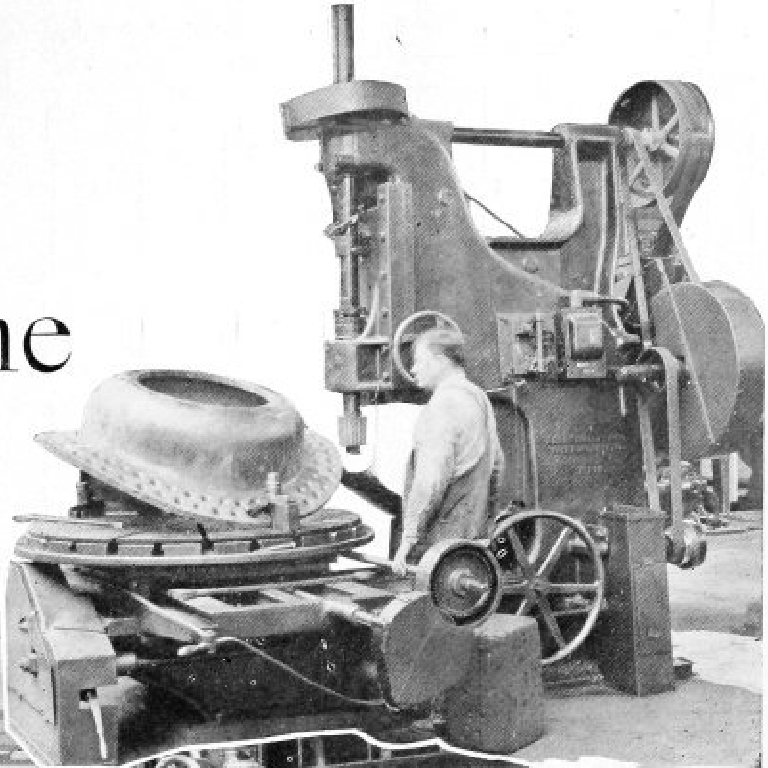
omes and tube sheets
ocomotive Works

traveling crane. Four 1-ton hand-jib cranes serve the 60-inch radial drills and the 60-inch tapping machine in the dome machine shop.

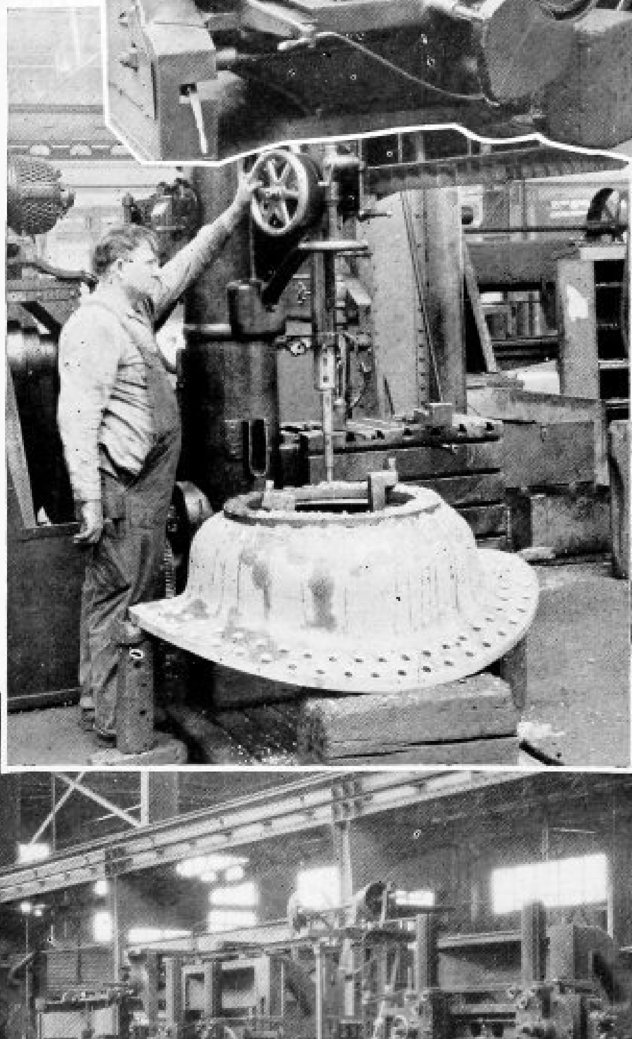
Domes are transported from the flange shop in bay No. 13 by means of a tractor and trailer and are stored in the lower end of bay No. 8 adjacent to three radius planers.

The first step toward finishing a dome is the machining of the inner flange of the dome in order to obtain a smooth surface for attachment to the boiler shell. The work is done on one of three radius planers which finished the inner dome surface to the curvature of the boiler shell.

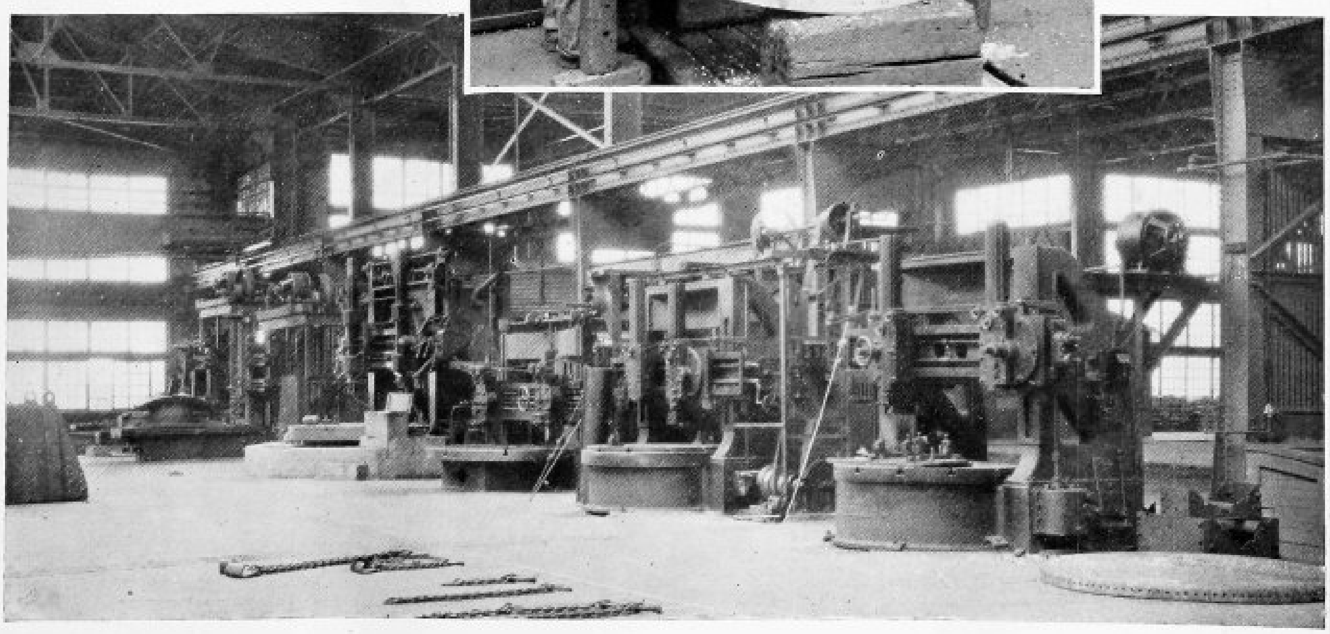
These planers have a movable table similar to that on any ordinary surface planer; the tool arm, however, differs materially. Two horizontal columns are attached to two vertical columns and may be raised and lowered by hand-operated cranks. Attached to the two horizontal columns is the tool arm which



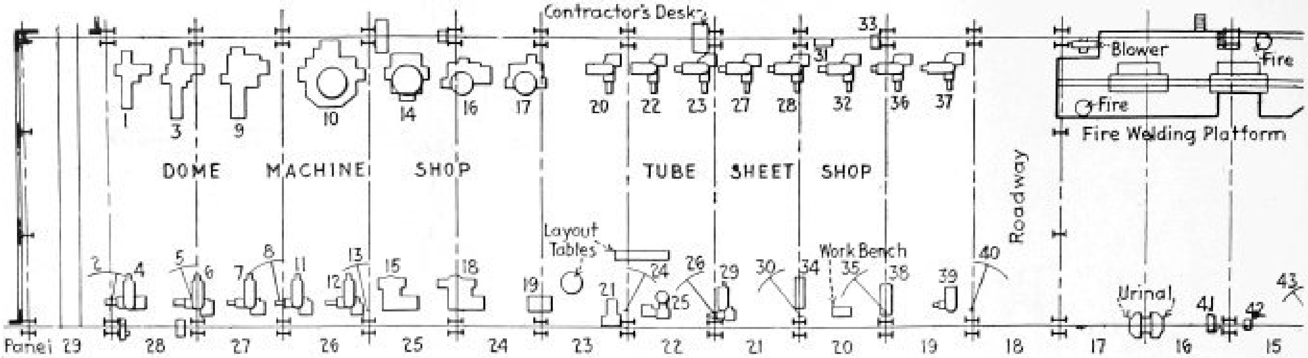
(Above)—Milling the flanges of a dome



(Left)—Dome set up with template for drilling top holes

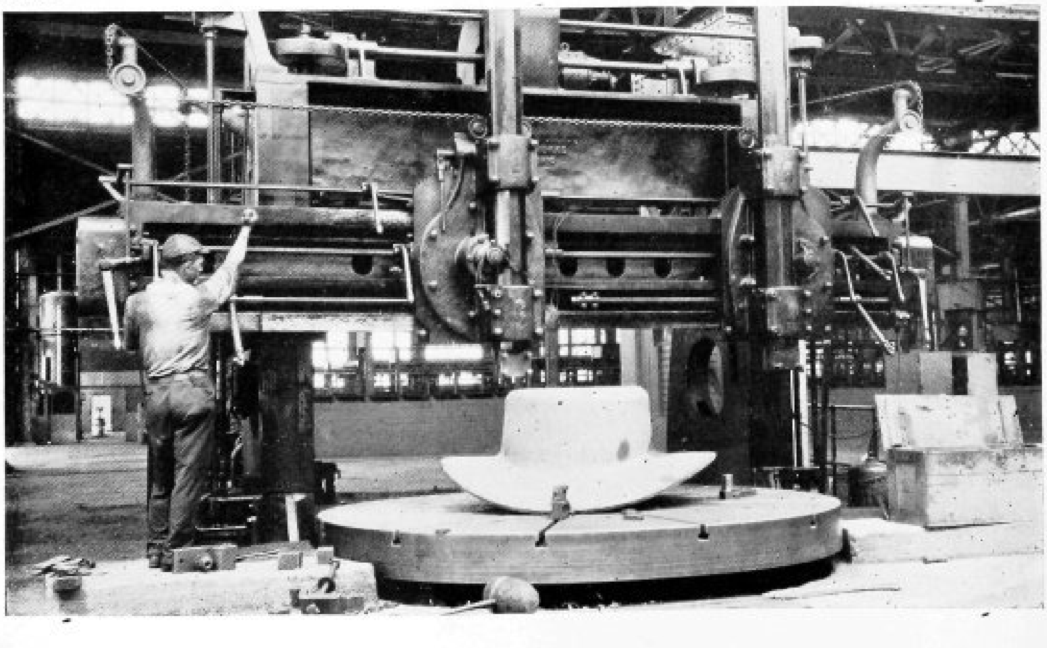


(Below)—Dome and tube sheet departments showing boring mills

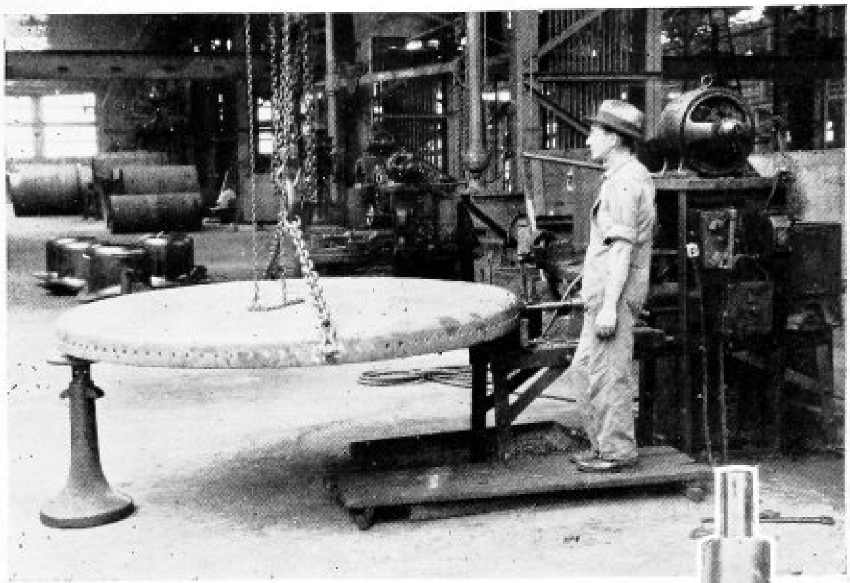


Machinery located in the dome machine shop and tube sheet shop in bay No. 8

1 Sellers 42-inch by 7-foot radius planer, motor on separate stand, belt drive.
2 Baldwin 1-ton hand jib crane having an 11-foot reach.
3 Sellers 40-inch radius planer, motor on separate stand, belt drive.
4 Harrington 60-inch radial drill, motor on machine, direct drive.
5 Baldwin 1-ton hand jib crane having a 13-foot reach.
6 Harrington 60-inch radial drill, motor on separate stand, belt drive.
7 Harrington 60-inch radial drill, motor on separate stand, belt drive.
8 Baldwin 1-ton hand jib crane having a 14-foot 6-inch reach.
9 Sellers 54-inch radius planer, motor on separate stand, belt drive.
10 Niles-Bement-Pond 120-inch boring mill, motor on machine, direct drive.
11 Harrington 60-inch radial drill, motor on separate stand, belt drive.
12 Harrington 60-inch tapping machine, motor on separate stand, belt drive.
13 Baldwin 1-ton hand jib crane having a 13-foot reach.
14 Sellers 100-inch boring mill, motor on bracket on building column, belt drive.
15 Bement-Niles No. 10, 60-inch vertical milling machine, motor on floor, belt drive.
16 J. M. Poole 76-inch boring mill, motor on machine, belt drive.
17 J. M. Poole 76-inch boring mill, motor on machine, belt drive.
18 Bement-Niles No. 10, 60-inch vertical milling machine, motor on floor, belt drive.
19 Bement 25-inch to 28-inch by 5-foot lathe, motor on bracket on building column.
20 Harrington 60-inch radial drill, motor on separate stand, belt drive.
21 James Moore shear for ⅝-inch plate, motor on floor, belt drive.
22 Harrington 60-inch radial drill, motor on machine, direct drive.
23 Harrington 60-inch radial drill, motor on machine, direct drive.
24 Baldwin 1-ton hand jib crane having a 13-foot reach.
25 Hilles & Jones 48-inch tapping machine, motor on separate stand, belt drive.
26 Baldwin 1-ton hand jib crane having a 12-foot reach.
27 Harrington 60-inch radial drill, motor on separate stand, belt drive.
28 Harrington 60-inch radial drill, motor on separate stand, belt drive.
29 Hilles & Jones 72-inch reaming machine, motor on separate stand, belt drive.
30 Baldwin 1½-ton hand jib crane having a 13-foot reach.
31 Baldwin 42-inch grindstone, motor on bracket on building column, belt drive.
32 Harrington 60-inch radial drill, motor on separate stand, belt drive.
33 Hisey-Wolf 6 WFA emery wheel, motor on machine, direct drive.
34 Baldwin 1¼-inch hole horizontal drill, motor on machine, belt drive.
35 Baldwin 1½-ton hand jib crane having a 14-foot reach
36 Harrington 60-inch radial drill, motor on separate stand, belt drive.
37 Harrington 60-inch radial drill, motor on separate stand, belt drive.
38 Baldwin 1¼-inch hole horizontal drill, motor on machine, belt drive.
39 Harrington 48-inch radial drill, motor on separate stand, belt drive.
40 Baldwin 1½-ton hand jib crane having a 14-foot reach.
41 Baldwin 42-inch grindstone, motor on bracket on building column, belt drive.
42 Baldwin 16-inch double emery wheel, motor on bracket on building column, belt drive.
43 Baldwin 1½-ton hand jib crane having an 8-foot reach.



Cutting the large dome top hole in a vertical boring mill



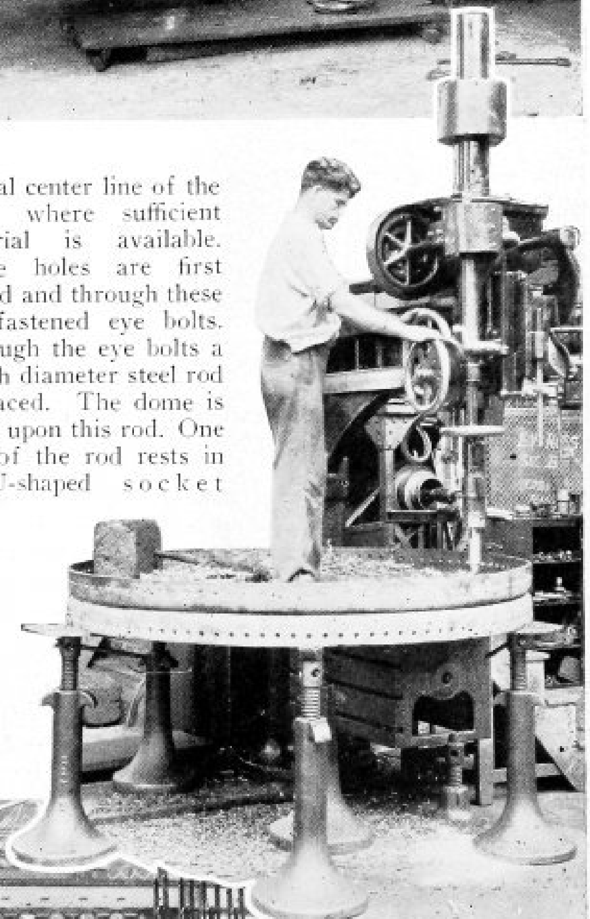
is allowed to pivot on the upper horizontal column when the distance between the tool and the pivot point conforms with the desired radius of the dome flange. The machine is fed automatically, the lower horizontal column being equipped with a machine-operated screw feed.

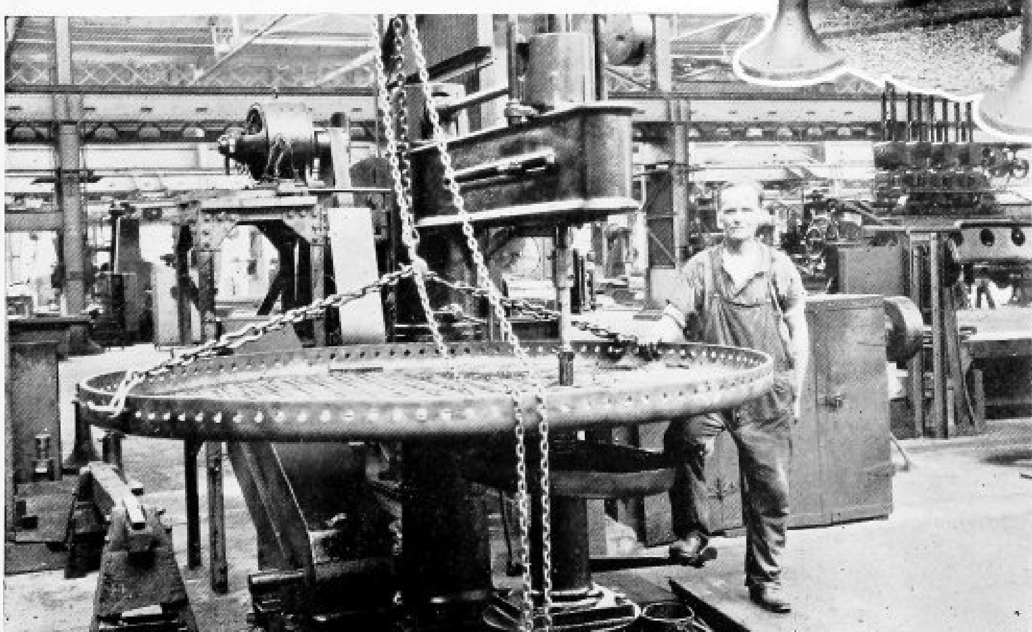
The dome is mounted in the machine by means of a collar dogged to the table and held to the dome by means of set bolts. Through the small hole in the top of the dome, left by the flanging department, a bolt is passed. To this is attached a bar of steel raised from the inner dome top by means of spacers. The device is clamped and the dome is held rigidly to the planer table. Once the machine is set up for a certain dome no attention is required due to the automatic feed. This allows one operator to run two or more machines.

Following the operation of inside planing the dome is set up in one of four boring mills for cutting the large hole in the top. In setting up the dome, the flange is fixed to the rotating table by means of dogs. The dome top is then lined up and a trial cut is taken. This is cut slightly smaller than the required diameter to allow sufficient material for a finish cut. When the rough cut is completed and the disk removed, a gasket groove, of about $\frac{1}{16}$-inch depth and of somewhat greater diameter than the hole, is cut with the same tool used for the rough cut. The finish cut on the inner edge of the hole is made with a tool with a side-cutting edge.

On completion of the hole-cutting process, the dome is handled by crane to a layout table in panel 26, where the dome is inverted with the flange uppermost. Here the dome flange is lined up and, with a template, the rivet holes are spotted, center punched, and the edge outlined with soapstone and center punched. The flange is then ready to be drilled and the edge burned off by means of an oxy-acetylene torch.

At the time of layout of the dome flange, two holes are spotted outside the cutting edge and on the longitudinal center line of the dome where sufficient material is available. These holes are first drilled and through these are fastened eye bolts. Through the eye bolts a 2-inch diameter steel rod is placed. The dome is hung upon this rod. One end of the rod rests in a U-shaped socket





(Top)— Drilling the tube sheet flange holes
(Center)—Drilling the lead holes in two tube sheets
(Left) —Reaming the flue holes in a tube sheet

Countersinking the dome flange rivet holes

fastened to the base of the radial drill at a convenient working height. The other rests on a screw jack, upon the top of which is bolted two angle clips to prevent the rod from falling off the jack. By means of wood blocks, the dome may be shifted to any angle to allow the drill to enter the flange normal to the surface.

Following the operation of drilling the flange holes the dome is reversed with the top up. In this position the flange holes are countersunk and reamed; the holes in the top of the dome are then drilled. For this purpose a steel drilling template is used, through which the drill is run, spotting the holes around the circumference. The template is then removed and the holes completely drilled. They are then tapped on a tapping machine located in panel 22.

The flange edges are burned off by means of an oxy-acetylene torch, after which the edge is machined in one of two milling machines. This process completing the fabrication of the dome, which is then transported to the upper portion of bay No. 8 where the dome is assembled to the boiler course.

Steam pipe rings are machined from castings in a lathe located in panel 24.

Tube sheets are completely fabricated in the remaining section of the lower portion of bay No. 8. These sheets, with the steam pipe ring attached, are completely drilled in this department.

When the tube sheet leaves the layout department in bay No. 12 the flange rivet holes and two tack holes on the tube sheet face are laid out. On receipt by the tube sheet department, the sheet is set up in either of two horizontal drill presses located in panel 20, and the flange rivet holes are drilled. These are drilled 1/8-inch undersize to allow for reaming during assembly. Following this procedure the tack holes in the tube sheet face are drilled on any one of eight 60-inch radial drills.

In cases where only one or two tube sheets are ordered according to one design, the tube sheet is laid out complete by the layout department. In that case, no tack holes are necessary.

But in cases where many sheets are to be drilled according to one design, a metal template made of 1/2-inch stock is employed, this being laid out by the layout department. The template is fastened to the tube sheet by means of tack bolts through the tack holes. The tube sheet with template attached is then set up in a 60-inch radial drill.

Where the right and left-hand sides of the tube sheet are similar, two sheets are bolted together for drilling at the same time. This practice speeds production.

With the template in place, a twist drill is guided by the template and run into the tube sheet only far enough to assure the hole being well centered. When this has been done for every hole in the plate the template is removed and the tube sheets rebolted together.

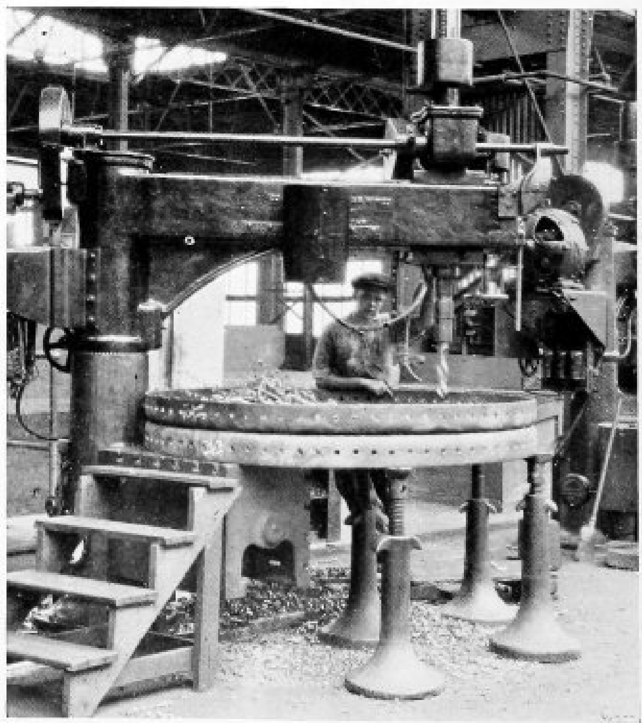
All holes 2 1/2 inches and under in diameter are drilled with a twist drill. Holes over 2 1/2 inches are machined with a cutting tool.

Rivet holes and stud holes are drilled 1/8-inch or more undersize, according to the pitch of the thread.

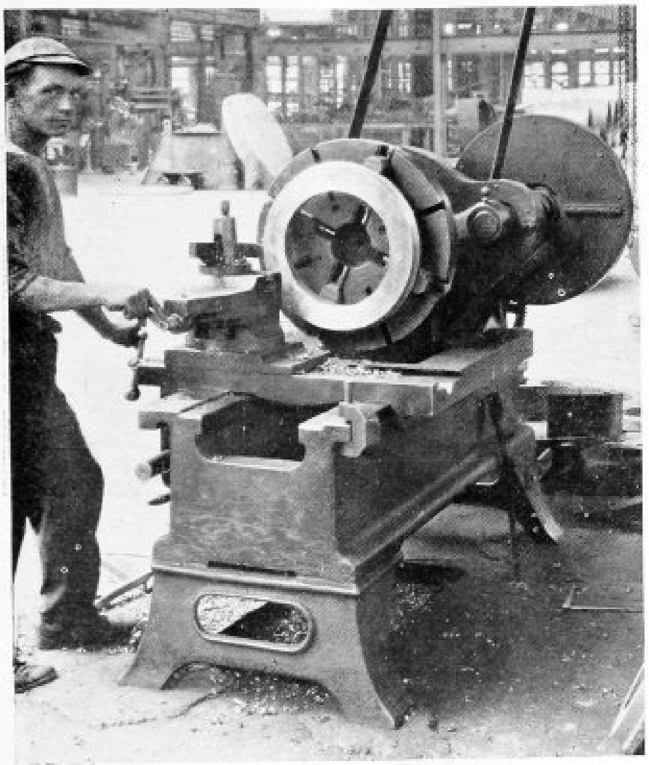
For all flue holes a 1-inch lead hole is drilled. This lead hole serves as a guide for the twist drill or the pilot of the cutter bar used in such cases. The tool used for cutting holes over 2 1/2 inches in diameter consists of a cutter bar capable of holding one or more cutters. This tool holder allows the cutting tool to be adjusted to the diameter of the hole to be cut. Superheater tube holes, steam pipe holes and large tube holes are cut in this manner. All tubes are drilled and reamed. A special counterboring tool is used to bevel the hole edges on both sides of the plate. Tapping may be done in any of the radial drills.

When the holes have been cut, either by twist drill or cutter, the tube sheet is set up in one of four boring mills where the edge of the flange is machined to size and beveled.

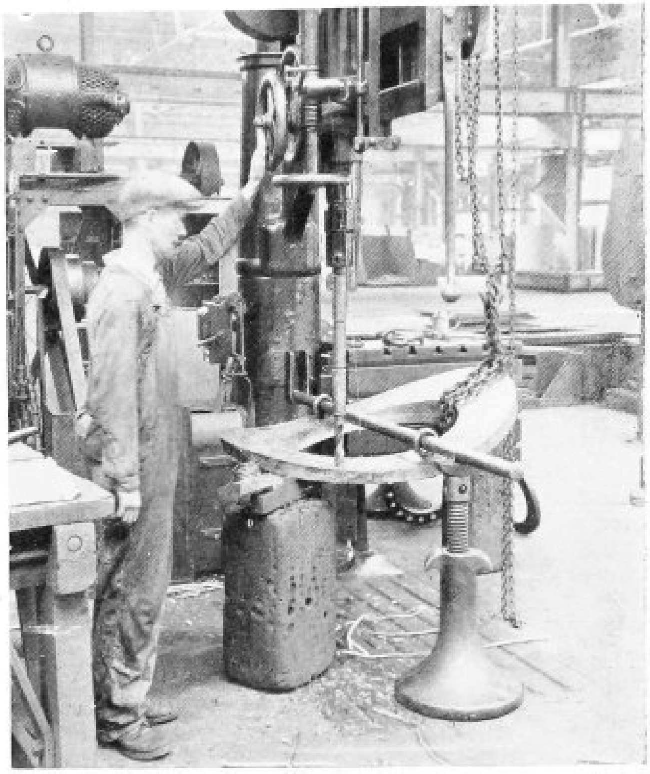
The steam pipe ring that has been machined in a lathe, is drilled in regard to rivet holes only. This ring



Flue holes being cut with a twist drill and radial drilling machine



Steam pipe ring set up in a lathe for machining

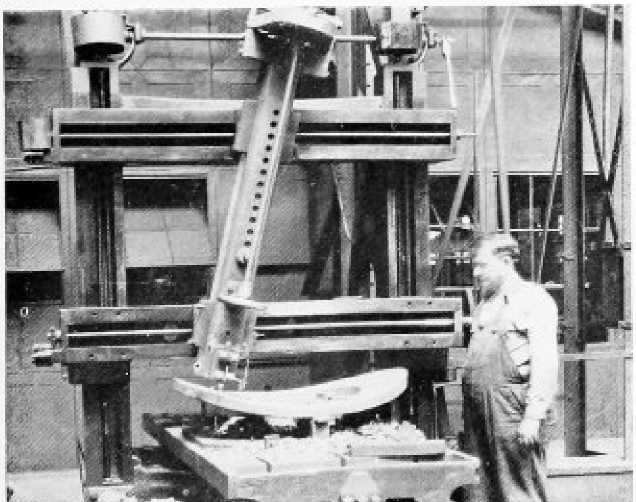


Drilling dome flange rivet holes—note holding jig

is riveted to the tube sheet already in this department.

The tap holes for the connection of the dry-steam pipe flange are laid out accurately on the tube sheet and drilled therein before the ring has been riveted to the tube sheet. The tap holes are then accurately drilled and tapped in the ring after the ring is in position.

Tee bars for the attachment of roof stays to the tube sheet are laid out and drilled in this department, fitted on and then sent to the upper bay where they are reamed and riveted to the tube sheet.



The inner surface of the dome flange being machined in a radius planer

The greatest economy of production is obtained at The Baldwin Locomotive Works by the observance of all the laws of material flow. Lost motion is eliminated by following the shortest route of procedure and through this economy a high standard of boiler construction is obtained.

New Welding Electrode

Extensive research and experimentation by the Lincoln research laboratories has made possible the offering to the trade of the "New Kathode" welding electrode by The Lincoln Electric Company, Cleveland, Ohio. The electrode is manufactured for the arc welding of mild steel and for cast-iron repair work.

It is claimed that the composition of the electrode, as well as the special treatment given in its manufacture, imparts qualities heretofore lacking in the usual electrode. Flowing easily with freedom from sputtering, the new electrode produces clean welds with minimum slag and oxidation. The high heat permissible for use with this fast-running electrode makes possible increased welding speed. The quality of the weld is not sacrificed for speed of welding, as the electrode fuses easily with deep penetration. The resulting weld on steel is soft and readily machineable.

The "New Kathode" electrode is manufactured in stock lengths of 14 inches and 24 inches. To provide best possible protection, during shipment, the rod is packed in metal containers holding 50 pounds each.

Welding Equipment.—A new catalogue, No. 29, just issued by the Torchweld Equipment Company, Chicago, Ill., covers the complete Torchweld line with cross sectional views of gas welding and cutting, lead welding, soldering, brazing and de-carbonizing equipment.

Opening session of the seventh annual meeting of the National Board of Boiler Inspectors

Inspectors Discuss Problems of Boiler Construction

Seventh annual meeting of National Board—Inspection requirements for unfired pressure vessels considered

A WIDE range of subjects pertaining to the construction and maintenance of power boilers and unfired pressure vessels were presented by authorities in their various lines before the seventh annual meeting of the National Board of Boiler and Pressure Vessel Inspectors, held June 18 to 20, at the Hotel Fort Shelby, Detroit, Mich. Practically the entire membership, consisting of chief inspectors, was in attendance, the registration, also including insurance company inspectors, prominent boiler manufacturers, and guests, totalling nearly 140.

Chairman C. D. Thomas, chief boiler inspector, State of Oregon, presided throughout the meeting. After the formal opening and addresses of welcome by city officials, the chairman introduced H. H. Mills, representing John F. Bischoff, commissioner of Buildings and Safety Engineers of the City of Detroit. Mr. Mills' remarks were in part as follows:

Boiler Inspection Procedure

The attitude of many boiler inspectors is solely the consideration of safety, but this is not justified when successful and efficient operation is considered. In order to qualify as an efficient inspector, you must be fortified with the proper tools to make the inspection, which consists of a good pair of overalls, 6-foot rule, pair of calipers, chalk pencil, note book, pocket flash light and one mason's hammer.

Inspections of boilers must be both external and internal, the external inspection to cover the outside setting, the inside of furnace, exterior of tubes, water legs and shells, while the internal refers to the examination of the interior side of the boiler heating surface.

External Inspection. When examining the exterior of the setting, note the condition of the brick work. Cracks and loose bricks should be pointed up to prevent air leaks. Inspection door, fire door and ash door should fit tightly. Buckstays should be close to the brick work, otherwise they are not properly supporting the walls, which is their only function.

On entering the furnace, examine the grates and stoker parts. Warped or burned grate bars or defective stoker parts should be renewed. Look for soot accumulation. Inspect the riveted connections, and shell joints, looking for incrustation, which may be evidence of leaks. Look for external corrosion, such as thinning of tubes and cracks near joints in the shell.

Internal Inspection. Upon entering the drum, note the thickness of the scale deposits and look for evidences of oil along the water line. Chip away the scale at every seam, note condition of the rivet heads and look for evidences of corrosion or grooving. Note condition of staybolts. Inspect the dry pipe deflection of plate and mud drum. Examine the connections to the water column and see that the pipes are clear. Examine hand-hole cap seats, noting whether any are out or grooved, or whether gaskets are sticking. Examine each tube and look for pieces of loose scale, which may cause a bag or blister. Note character and thickness of scale. So much for inspection.

I think a very good plan for the members of this organization is to see that we get uniform inspection and also a standard boiler code, which will be universal and one that is adopted throughout the country, possibly the adoption of the A. S. M. E. code. In this way every manufacturer, every inspector and every enforcement agent would know what to look for and this would satisfy everybody with the thought in mind—safety for you, for me, and the skeptical.

Chairman Thomas: Our next speaker is a man who represents one of the greatest industrial states in the nation, a man who has been associated with safety for many years, with practical experience along the lines with which we are familiar, representing a state that was probably one of the first to enact a boiler law. His experience in the administration of these laws places him in a position where he can give you an intelligent address, along the lines upon which you are all interested, and I am sure that every member here will be pleased to hear from Will T. Blake, Director of Industrial Relations of the State of Ohio.

Promotion of Safety in Ohio

By Will T. Blake

In Ohio we have a slogan that, "safety is better than compensation." We believe that it is an infinitely better business proposition to prevent accidents, prevent boiler explosions, if you please, than to compensate injured workmen or the dependents of skilled workmen, should such an explosion occur; for, as a matter of fact, industrial accidents from whatever angle they are looked at, are never profitable, in the last analysis, to either the employer, the employe, or the public.

Statisticians of national repute and safety engineers, as you well know, after years of surveys, tell us that the indirect costs of industrial accidents are four times as great as the direct costs, and you know, and I know, that the direct costs are burdensome enough in themselves, amounting annually as they do to millions of dollars in every state in the Union.

Probably it would be a matter of interest to you, in this connection, also to mention that in Ohio last year our bill for direct and indirect industrial accidents, according to figures supplied to me no later than yesterday by the superintendent of our Division of Safety and Hygiene, T. B. Kearns, reached the stupendous sum of ninety millions of dollars.

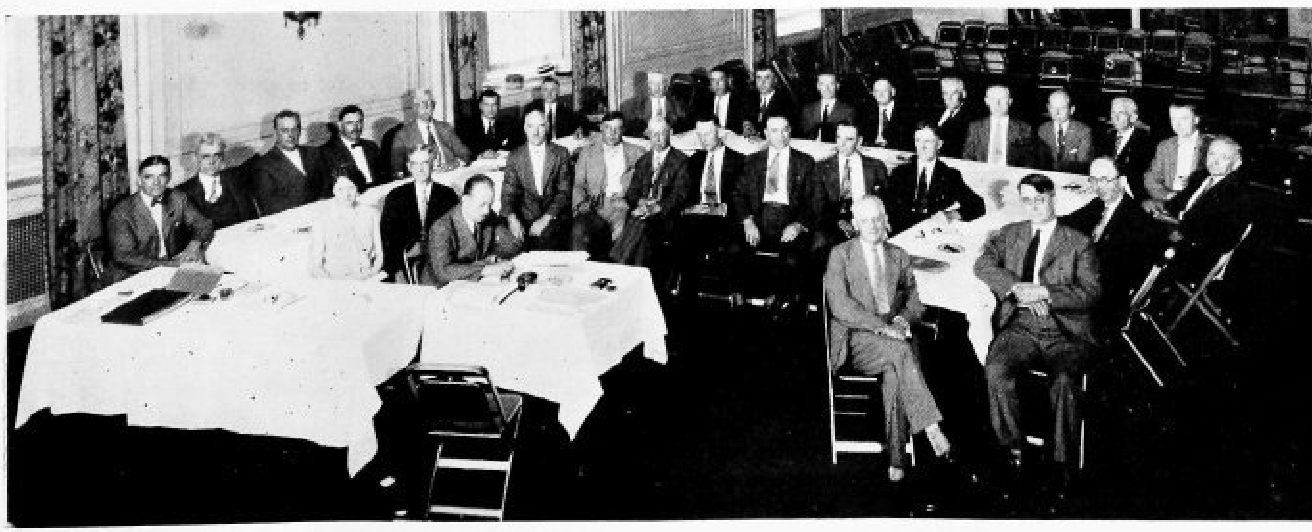
To present a little better picture of this bill, let me give you some figures, which I think tell their own grim story. In 1928, a total of 229,233 accident claims were filed with the Ohio Industrial Commission for adjudication. Of this number, 1108 were for persons killed in industry; 186 were for workmen who lost eyes in accidents in industry; 44 were for workmen who lost arms in industry; 31 were for workmen who lost legs in industry, and 76 were for workmen who lost toes in industry, and a total of 2227 were for workmen who lost fingers or parts of fingers in industry.

Now, in addition to that, a total of 53,000 workmen lost an average of 27.8 days work time, as the result of those accidents. Another group of 34,727 lost a total of 3.8 days time, while a total of 174,308 workmen received minor injuries, which required medical attention.

Now, these figures, gentlemen, are typical I should say, of the terrific toll which industry is taking annually in every state of the Union. It seems to me that none of us here would be sufficiently hardened as to say that our safety programs do not pay. But I regret to advise you that many manufacturers and many companies are still not thoroughly sold on the safety idea.

It will be interesting also, perhaps, if I just give you a little of the other side of the picture, for the Buick Motor Company and the Ford Motor Company are not companies of that type. They believe in safety. The Buick Motor Company saved $70,000 last year, gentlemen, by its safety program. The Eastman Kodak Company cut down its accident costs from $35,000 a year to $3500 a year by its safety program. The American Car and Foundry Company reports that for every dollar that it spent for safety it got back $1.70, and the United States Steel Company, which has seen the value of this safety program, reports by its own actuaries that for every $14.60 which the United States Steel Company expended the last year for safety the company got back $9.70.

Now, I might go at greater length and give you other facts and figures but I believe I have given you sufficient information to convince you of the practical character of your work as inspectors, and I want, just now in closing, to refer briefly to the object of your meeting, which I understand is to invite an exchange of ideas and experiences for the purpose of making the construction of boilers more reliable and practical, and of making the inspection of boilers more thorough, so as to further reduce the hazards to life and property; this is a very worth-while idea, because it stresses



Members of the National Board in executive session the ideal of safety education in the minds of the members.

One of our safety inspectors gave me this definition of safety yesterday, and I want to read it to you.

"Safety is a personal inspiration, all pervading and soul satisfying, destined to become one of the most potent influences in modern industry and in shaping the ever changing fabric of mankind. It is the spirit of service personified. It is the will of the master exemplified." Let us all, therefore, visualize it, grasp it, and make it one of the abiding tenets of our faith in mankind.

Chairman Thomas then presented his annual report covering the work of the Board.

Chairman Thomas' Address

While there has been considerable progress in establishing uniform practice since the organization of this body, there is yet much to be accomplished. We are, however, being brought closer and closer together at each meeting of the Board and there is no doubt that the little difference now existing in the various states and cities operating under the A. S. M. E. Code will soon disappear altogether so that future variations will be mistakes of the head only and not of the heart.

This brings another thought to my mind and that is the necessity of broadening the field of familiarity with the workings of the Code. There are several states and cities which are listed as Code states and cities and have accepted the Code as their guide but make no effort to supervise these regulations. These states and cities have had no representatives at these meetings. If we could only succeed in getting representatives of such states and cities to attend our meetings, they would become better acquainted with the Code and the workings of this Board, which in time would cause such interest in the uniform application of the Code that would result in such states and cities making laws to properly supervise the inspection of all boilers and pressure vessels.

It is well known to all that with those members who attend our meetings regularly, the Board has less trouble in enforcing the Code than with others who are less intimately acquainted with it, for they better understand the considerations which have led to the adoption of its provisions and are better able to interpret and administer it.

No society or organization is worthy of being, unless it can justify its purpose and the expense involved in the accomplishment of that purpose. Therefore, the enforcement of the Code regulations stands upon its usefulness and the applicability to the boiler manufacturers and the boiler users and we are the body who are practising and doing the application. It is, therefore, up to us to harmonize the various interests; to uniformly apply the regulations and to use discretion and good judgment in enforcing the standards.

Probably the most important men so far as carrying out the uniform application of the Code is concerned, are the shop inspector and the field inspector. Unless these men are on their toes at all times to detect deviations in the construction and installation of all pressure vessels, uniformity in practice would soon cease to exist. I do not mean by this, that the manufacturer or user would intentionally violate the regulations, but I do mean that difference though small at first, would soon become great enough to destroy the good results obtained by uniform and safe practice, and if not checked, would in time destroy the real objects of the Code itself.

It is, therefore, most important that the shop inspector report to the foreman, superintendent or manager of the shop any deviation, however slight, that comes to his notice and see that the same is rectified. Also the field inspector should report to his superior any defect that may come to his notice. The field inspector is, in a way, a check on the shop inspector. It is not, however, his duty nor is it intended that he should endeavor to put something over on the shop inspector. Should the field inspector find something that in his judgment does not comply with the Code, he should not discredit the boiler to the purchaser for the purchaser bought the boiler in good faith and if the boiler is stamped with the Code symbol, that was his guarantee that the boiler was properly constructed, and unless the boiler is defective in a way that will cause serious trouble, he should not be molested.

The duty of the field inspector is to report his findings to his chief who in turn can take the matter up with the shop inspector or the state or insurance company which he represents and also with the manufacturer of the boiler. In this way, a fair adjustment may be had.

There have been occasional complaints of the laxity of the shop inspector and from the evidence submitted it would seem that in some cases, these complaints were justified. The circular letter sent out by our secretary some time ago should have a wholesome effect, provided the chief inspector of each state and city took means to see that all inspectors under his jurisdiction received a copy. However, there should be a way to avoid such experience and we believe it could be done if the manufacturer would consult the shop inspector whenever a deviation from regular practice was contemplated. This should be done in all cases, no matter how small the deviation might be, then, if the shop inspector is not absolutely sure of his ground, he should consult his superior before making a final decision. No deviation from regular practice should be permitted unless this or some similar proceeding is followed. If the manufacturer realizes that no change in regular practice is permitted without the approval of the inspector or a higher authority the unpleasant experiences of the past can in the main be avoided.

Important questions as to the proper application of the Code and the interpretations of the Boiler Code Committee should be referred to the National Board for final decision and should not be placed before the Boiler Code Committee for the reason that the Boiler Code Committee is the legislative committee and the National Board is the executive committee.

At the time we were organized, I am of the opinion that the committee on specific designs and appliances was to be made a permanent committee or at least was to be active for the term of two years, the same as other officers, but it seems that this arrangement has not been properly carried out. We, therefore would suggest that this committee be made permanent or at least be active for the same period of time as all other officers of this organization, so that it could function at all times. On this committee rests a great responsibility, requiring a high degree of engineering skill and practical experience.

It is, therefore, evident that the appointing of such a committee should receive considerable thought. By making this committee active at all times, interested parties who wish to apply for the approval of this Board on specific designs or appliances can submit specifications and blue prints, when necessary, to the secretary-treasurer who in turn would submit copies to the committee for their consideration. The committee could then, after due consideration, pass judgment on the same and report their findings to the secretary-treasurer who could then refer the matter to the members of the Board for final action, or final action on cases where a division of opinion was found could be deferred until the next regular meeting of the National Board. In this way or by some similar method time can be allowed for thoughtful consideration of each case, and the Board would have a better understanding of all designs and appliances before final action is taken.

There is another matter that is of utmost importance which probably should be considered at this time, and that is the welded pressure vessels. From information recently obtained through the American Uniform Boiler Law Society we note that several states and some cities are now regulating the installation and operation of pressure vessels and several more are contemplating their regulation.

Some are adhering to Section 8 of the Boiler Construction Code, but most of them deviate from these rules in certain respects. The strict adherence to the Boiler Code Rules by the manufacturer practically eliminates the welding of such vessels, especially if used for air, and every state in the Union as well as all cities have thousands of these small air pressure vessels in use in service stations. We believe the time has come when certain restrictions regarding the manufacture of small welded pressure vessels should be removed. It has been demonstrated to the satisfaction of most of us that the small welded pressure vessel when manufactured by a reliable firm will stand many times the working pressure allowed on such vessels before rupture takes place. If the manufacturer of such vessels was required to register with the boiler Code Committee and file affidavits to the effect that he will manufacture such vessels in accordance with the rules for pressure vessels, and stamp his product with the Code symbol after the proper inspection has been made, there is no reason why he should not be placed on a par at least with the manufacturer of brazed vessels.

Reference is made to small pressure vessels only, for the reason that the large pressure vessels are being manufactured by such firms as have the proper equipment and under certain procedure control. We are fast drifting to a condition regarding pressure vessels that existed in the boiler manufacturing business prior to the existence of the Boiler Code.

Manufacturers of small pressure vessels today do not know what to do or how to proceed until they know where their product is going and then many times they must write for information before shipment of their product can be made.

We hope that in the very near future this condition will be clarified. That all manufacturers will be required to register with the Boiler Code Committee, have their welders pass certain tests and have their product inspected and tested by only such inspectors as hold commissions in the National Board of Boiler and Pressure Vessel Inspectors. It is also desired that they register with the National Board, for they must finally depend on the National Board Inspectors for the acceptance of their product.

We are trying to help them fight their battles; to obtain uniformity in all states and cities and we are the only organization that can enforce the regulations. We, therefore, believe that the manufacturer should, for his own protection, fully co-operate with the National Board in this matter. It is our aim to obtain such rules in the construction of all pressure vessels as will harmonize with the various interests and yet be safe. And after such rules are obtained, to have them adopted by the various states and cities having boiler laws and then enforce them. It is impossible for the manufacturer or the Boiler Code Committee to enforce these rules. We are the only body that can do so. We, therefore, appeal to the manufacturers for their full support and co-operation.

Secretary Myers' Report

At our last annual meeting the question of establishing the confidence and co-operation of the interests who are affected by the administration of boiler inspection law and regulations in the various political subdivisions of the United States was thoroughly discussed and it was unanimously ruled that an invitation be extended to the American Welding Society and the American Boiler Manufacturers' Association asking them to appoint a representative to act on the executive board of the National Board. The American Welding Society appointed S. W. Miller, who you all will recall addressed you on the subject of welding at the Nashville meeting, but unfortunately Mr. Miller passed away shortly after this appointment and we did not have an opportunity to receive any advantage of his vast experience in welding. C. W. Obert, honorory secretary of the A. S. M. E. Boiler Code Committee, and consulting engineer for the Union Carbide and Carbon Research Laboratories, was selected to succeed Mr. Miller. Mr. Obert has been giving a lot of study to the question of welding and can assist wonderfully along these lines. The American Boiler Manufacturers' Association selected E. R. Fish of the International Combustion Engineering Corporation to represent them. Mr. Fish is in close touch with Code matters and the American Uniform Boiler Law Society, in fact he has been closely associated with all movements regarding uniform boiler laws, and representatives with these experiences we can expect to be well guided in their actions in the future.

In analyzing the financial report that I submitted last year it showed that our expenses were slightly greater than our income and that we were operating at a loss. This loss was taken care of by a small surplus that was accumulated over a period of years. This matter was thoroughly discussed by the executive committee prior to the calling of this meeting for the purpose of determining whether or not our expenses should be curtailed by holding our meetings every two years instead of every year, or whether our income should be increased by increasing the registration fees. The executive board decided that, inasmuch as the boiler manufacturers were interested in the filing fees, before any action was taken the matter should be submitted to them for their consideration.

The report then continued with proposed amendments to the constitution, the statistics of boilers registered with the Board and the financial statement in detail.

After the conclusion of this report L. C. Peal, city boiler inspector, Nashville, Tenn., presented the statistical report for the year. This is in part as follows:

Boiler Statistics for Fiscal Year

In the report that was submitted for your approval at last year's meeting, we used our available figures to determine with some degree of accuracy the number of boilers in non-code territory. With the co-operation of the insurance companies we were able to give you the total number of insured boilers. The number of boilers reported by the 19 states and cities were deducted from the number given by the insurance companies and the remainder was the number of insured boilers in non-code territory.

At the present time, this seems to be the only means of getting any idea of just how many boilers there are in the various political subdivisions that have no boiler regulations. This year we had just a little better co-operation with the questionnaires sent to National Board members. We received 25 completely filled out.

These 25 chief inspectors reported a total of 251,793 boilers. Total insured boilers as reported is 276,830. This leaves the total number of insured boilers in non-code territory 25,037.

Accidents and Failures

The number of accidents reported this year is not as high as last year but the fatalities and injured are higher. There were 230 accidents reported—with a fatality list of 29—injured 45—and a property damage of $312,440.

While it is unnecessary to comment here on the A. S. M. E. Boiler Code, it is interesting to note the accident reports that come in from time to time and to segregate the reports into their classifications of code and non-code.

Boiler Failures and Accidents

Accidents and failures to code boilers	41
Accidents and failures to non-code boilers	175
Code unfired pressure vessel accidents	2
Non-code unfired pressure vessel accidents	12
Code boiler accident fatalities	1
Non-code boiler accident fatalities	9
Code boiler accident injured	0
Non-code boiler accident injured	20
Code unfired pressure vessel fatalities	0
Non-code unfired pressure vessel fatalities	19
Non-code unfired pressure vessel injured	25
Code boiler accident property damage	$23,158.00
Non-code boiler accident property damage	$289,282.00

Types of Boilers Involved

Watertube boiler accidents	26
Horizontal tubular accidents	7
Vertical tubular accidents	6
Firebox accidents	7
Cast iron sectional accidents	170
Unfired pressure vessel accidents	14

Steel Heating Boilers versus Cast Iron

Cast-iron boiler accidents were 170 with a loss of $52,105, while only three failures were reported on the steel boilers with $995 loss. The number of accidents and the loss from cast-iron boilers is considerably lower than last year. This is attributed to the fact that cast-iron boilers are being set aside in favor of the steel boiler.

While all the accident reports sent in were interesting there are a few that I think worthy of special comment.

One inspector reports accidents to two "oil stills" with eight killed and 11 injured. Cause of failure to one is given "bursted in goose neck between upper and lower connections." Cause of other is given "corrosion of plate." This was in Arkansas.

From California, we have reported six failures to unfired pressure vessels with three killed and three injured. Cause of two failures is given as "failed through weld." From Pennsylvania we have report of a loss—firebox boiler failing, killing two, injuring one badly. Cause is given as "head cracked in turn of flange. Had been welded and put back in service." From Illinois we have report of watertube boiler failure—one killed. Cause is given as "tube burst, three tubes found plugged, 39 others too full of scale to drill."

From Georgia, we have reports of an air tank failing, killing seven and injuring ten. Cause is given as "internal corrosion." A saw mill boiler in another part of Georgia failed and killed five and injured five. Cause is also given as "internal corrosion."

From Louisiana, we have one report. This was a vertical tubular boiler and it "sky-rocketed" injuring one seriously. Cause is not given.

Another report from Pennsylvania is the failure of the lower drums of two watertube boilers. The inspector states "shell cracked between tube ligaments in lower drum" and encloses drawing showing cracks. Cause is not given.

Mention of these specific accidents is made in this report in order to further emphasize the crying need of boiler regulations in territories that have none, the need of including unfired pressure vessels in all existing regulations and the importance of safety latches on fire and clean out doors.

J. C. MC CABE (Detroit): For the benefit of Mr. Peal and other members, I wish to say that a number of years ago I took occasion to look up the statistics and I found that there was about one boiler to every 225 of population. It varied between 225 and 250. This was about twelve years ago. The average horsepower was 110. Though, if a person desires to know approximately how many boilers there are in a state, divide by either one of those figures. I found in industrial states like Ohio the figure dropped to about 225. I cannot vouch for the accuracy of the figures but it will be quite approximate if you use those figures.

CHAIRMAN THOMAS: I would like to hear from the Province of Ontario in regard to the institutions and installations over there. That is not included in our report, and if Mr. Medcalf has anything to add, I think it would be interesting.

D. M. MEDCALF (Ontario): I cannot tell you much about the Province of Ontario, although we are getting some pretty good boilers. One of our latest installations is a thousand horsepower boiler; we have one installation of four and another of eight. I am down here to visit the A. O. Smith Corporation in Milwaukee. I stopped off here in America to look over a pressure tank, 10 feet in diameter, 2-inch plate, welded construction. That construction is not provided for, but the Province of Ontario has given me certain prerogatives for accepting that type of pressure vessel, under a special ruling. This is the second installation we have had. Before I accepted the first one, however, I took this up with the A. S. M. E. code committee and they did not give me any ruling, and I would like to know why they did not accept that construction.

We have less than 9,000,000 people in the Dominion of Canada against 120,000,000 over here, and our installations are small, compared to a lot of your installations here, but as I said, we are getting some real boiler installations.

A matter that is coming up now is the welding of high-pressure steam pipe lines. I just had a little battle with a concern in Detroit which wished to send their welders across to the Chrysler Company. I had to turn that job down because they were foreigners to us. So, we do not allow foreigners to come into the Province of Ontario and weld steam pipe lines.

Chairman Thomas: We should be very pleased to hear from Charles E. Gorton, Chairman of the Uniform Boiler Law Society, upon the lines of progress that have been made during the past year, or any other general information that he will be able to give us.

Charles E. Gorton (Chairman of Uniform Boiler Law Society): There is one particular question that I would like to speak about, and that is the Unfired Pressure Vessel Code. There has been a tendency throughout the country to change the Unfired Pressure Vessel Code. The Committee will admit that changes should be made in that Code. There is, however, one thing that we must bear in mind, if we are going to lean over, it must be backwards towards safety and not towards taking any chances whatsoever. There are members of the Boiler Code Committee here; if they want to take exceptions to it later on they are welcome to do it, but I feel personally that the Boiler Code Committee, through its executive committee and the executives of the American Welding Society and the American Welding Institute are nearer together today than they have ever been since the inception of the Unfired Pressure Vessel Code.

I think that everybody appreciates that it is necessary to have a set of rules which must be uniform. The Boiler Code Committee and the American Society of Mechanical Engineers have gone on record, that so far as radicalism is concerned, they will not take that position. Whatever is done will be to the best interests of all and it will be at the least expense to the manufacturer, and I think that that is what should be done.

There are one or two instances in regard to the factors of safety, which I have hopes will be cleared up and I think in time they will be. There are one or two instances in regard to the factors of safety limits of boilers. The code calls for 4½. They want it to be 5, but I think the time will come when that will be eliminated, so that no differences will appear.

We have been called upon to advise quite a number of the departments. I am very pleased myself to know that there have only been one or two changes in state and city administrations, so far as the chief inspectors are concerned, and I feel satisfied that if the chairmen of the state boards could attend one of these meetings and see the class of men administering the boiler inspection laws of their states, that in all probability there would be a different story to tell.

F. A. Page, of California, next introduced Charles Duni, chairman of the board of mechanical engineers of Los Angeles, whose remarks are in part as follows:

Inspection Personnel

By Charles Duni

My observation the past year has been that the inspectors, each and every one of them, without any reservation, have been men of character and ability, men who stand on their feet and are not afraid to say, "No, no." And you don't find them, "Yes" men. They seem to have a sense of responsibility in performing their duties that I have never found in other lines of endeavor. Once in a while you find a sheriff in the county jail suspected of something; district attorneys and other officials also, but I have failed to find yet, any criticism made of the state inspectors or the men who have charge of their department and upon the inspectors and the men who have charge of the department there are tremendous responsibilities. Who is going to check up on them? As far as they are concerned they can get by with lots of things, if one of them is looking for something, but they are not men of that caliber or character.

There is one thing that we must say they have no fear or favor. They do not care anything about whether they are going to remain in their jobs or whether they are going to be discharged, if it comes to neglecting their business. I have seen that in my position, where certain men, certain politicians wanted certain favors. In other words, wanted something put across. You cannot buy these men. If we know that a thing is wrong, we must stand on our feet and say, "No."

Now, I have observed by reason of the fact that you stand on your feet that you are very seldom removed for political reasons. We have engineers who have been on that Board for twenty-five or twenty-six years, who have gone through all sorts of different administrations. I wonder why they are there today? I know why they are there today. Because they are honest and stand on their feet, and perform their duties as they should perform them.

There seems to be a sort of inspiration with an inspector when it comes to inspecting a boiler. There seems to be a thing that comes with the trade. If he finds the least little leak in a boiler that to him is more serious than anything else. He knows that that is a forewarning and if he does not take care of it there is going to be something doing.

The public little realizes that a pressure vessel is more important than a little electrical wiring. About the worst thing you can do with the electrical wiring is to have a little fire. Nobody is going to be killed, but there is apt to be very much danger in a pressure vessel, because it is very dangerous. That is why you are so particular.

Chairman Thomas next introduced E. R. Fish, representing the American Boiler Manufacturers' Association on the executive board. An abstract of his remarks follows:

The Manufacturer and the National Board

I am not a member of the Board; I have not the qualifications to become a member of the Board, and yet I sit in the intimate deliberations of your executive committee by virtue of your recognition evidently of the fact that the boiler manufacturers are very much interested and concerned with your activities. I wonder if you realize how much they are interested; how much interest they do take in what you are doing. At all of the meetings of the American Boiler Manufacturers and the meetings of the smaller groups, for there are a number of meetings, the activities of the National Board are very often discussed. We are very much concerned and interested and want everything to go smoothly and to continue to go as smoothly as it has.

The American Boiler Manufacturer's Association has no desire to dictate to you in any way whatsoever. We are interested in having things move along smoothly and the objects of the Board carried out and attained to the fullest possible degree.

We are used to talking in percentages of efficiency with the ultimate of 100 percent. That is perfection, practically unattainable, but the nearer we get to it, the nearer we come to 100 percent prevention of accidents, the more efficient our association is.

The great State of Ohio was one of the first to recognize the necessity of a Code governing construction, installation and continual inspection of boilers.

Now, have we made progress? And the end is not yet. This matter of welding is continually coming up. It is a vital question now, one that is being discussed and one with which the Boiler Code Committee is wisely and vigorously dealing. Unfortunately there is some considerable difference of opinion as to when and how far welding should be allowed, what kind of welding, how it should be done, to what extent qualifications for proper welding should be impressed upon the mechanics who do it. They are all serious questions.

Personally, I believe that the personal factor is one of the vital ones and yet just how to arrange so that we can be assured that welding will be done only by qualified welders is a question. The Boiler Code Committee really has no business going into that. It is one of your problems, as I see it, and it is one that has to be thrashed out by you in some way. If the Boiler Code Committee does permit the use of welding, not only on pressure vessels, but possibly on boilers, we are going to have this question up very shortly in a more detailed and specific way than we have had it heretofore.

You may be interested in knowing that the American Boiler Manufacturer's Association was organized back in 1889.

Colonel E. D. Meyer, president of the Wayne Boiler Company, helped organize the Boiler Manufacturers' Association. I entered his employ two or three years later, and one of my duties was to keep track for him of the affairs of the society. I being the secretary, was charged with the minutia of the details, of course, and I recall very distinctly that one of the efforts that he tried to make very early in the game along about 1893 or '94 was to establish some rules for construction, to get at a code of some sort. He recognized that there had to be some more definite rules, more definite principles of construction than they were using.

I remember one of the early specifications of the Wayne Boiler Company. The Wayne Boiler Company did not have a shop of its own at that time, and they said that the riveting would be left to the discretion of the boiler maker, and until further standards had been adopted. In other words, the Wayne Boiler Company at that time did not have any exact specifications and there were no general ones to which they could refer.

Do not go away with the idea that that is the case now, because it was only a year or two after that that they decided, and made up their minds, to just exactly what they wanted and insisted upon their boilers being built in that way.

But that little code that the A. B. M. A tried to draw was very crude, very limited, did not go nearly far enough, but it was a start. Nobody, as a matter of fact, paid very much attention to it, I am sorry to say, but it did get the germ of the idea started.

It was not until 1911 when Colonel Meyer became president of the American Society of Mechanical Engineers that the real opportunity offered.

So, in 1911, Colonel Meyer saw that this was the opportunity, that then the opportunity existed, to start a real movement toward uniformity in boiler construction or lay down some rules and regulations regarding the major points of design, and it was he who appointed the original committee whose work has resulted in the present Code.

How that principle of accepting something that is put out by a distinterested body works, it seems to me, is amply evidenced in the way in which the Code has been received practically universally, and looked upon as being the last word.

Now, we all come together; we are all more or less inter-dependent. We cannot very well get along without each other. Without the boiler manufacturers you would not have much to do, and the boiler manufacturers without you, would be in a more or less perturbed state. So that we are all necessary to each other, not only in this, but in all walks of life, in all our interests and contacts.

CHAIRMAN THOMAS: I presume that all of the members present remember that at our meeting last year, we adopted a provision whereby a member of the American Boiler Manufacturers' Association, and of the Welding Society should be invited to represent them on the executive committee. Mr. Fish was chosen to act as a member of the executive committee, and you can readily see from the remarks that you have just heard, that he is very much interested in our prosperity.

Now, the next speaker is one who has addressed you on several previous occasions, and one with whom you are all acquainted, and I know that his work, and demonstrations in the welding business have been highly appreciated before, and I also think that the great Province of Ontario is very much interested in his work, and they, as well as ourselves, would be very glad to hear from Professor McLean Jasper, of the A. O. Smith Corporation.

Professor Jasper's remarks follow:

Need for a Uniform Pressure Vessel Code

By Prof. McLean Jasper

The most important thing that I think your chairman has spoken about is the question of your executive committee which will take care of the country and bring about a unified application of the rules and regulations for the benefit and for the protection of everybody concerned.

You have heard me two or three times, and I have tried to impress upon you this fact, that I am associated with a group of people who are anxious for protection. They are anxious for you to grow strong, so that you, in your protection of your constituents, will also protect those who are trying to build for a sound business. So, if you can do this, we know that would bring about a great reduction of accidents.

Mr. Fish has stressed a thing, with his great experience with the manufacturers, which has brought him into close contact with the situation, much closer than I have had the privilege of being, but we all should respect the work that he has done. Now, there is one thing brought up by the speaker from California that I would like to speak about. I think it is a very vital thing, and that is the periodical inspection of boilers after they are in service. If we could assure ourselves that a boiler, after it was in service would not deteriorate, then we would have no need for such inspection, but we do know that after boilers have been put into service they will deteriorate, and the more severe your inspections are made the greater protection are you going to give to the people of the several states.

Of course, we are interested in the boiler inspectors. We are interested in them because we know that they are working in a field in which it is hard to cultivate the ground. We want them to cultivate the ground so that close, sound service can come out of it.

We know that you are a body of young men and therefore I am particularly interested in what your chairman said about the executive councils or committees. The Boiler Code Committee has been more or less a legislative body, bringing up and suggesting things. Now, if we can have an active body to put these things into practice, the maker as well as the user of the vessels will be better protected, and any maker who wants to do the right thing will only welcome you in that light. I just want to emphasize this particularly now. It is the most important phase, it seems to me, of the work that you men do.

Session Wednesday and Thursday

Space does not permit reporting the Tuesday afternoon, Wednesday and Thursday sessions in this issue. The entire meeting resulted in the presentation of extremely important addresses and discussions covering all phases of boiler and pressure vessel construction and inspection, which are of too great value to the industry to dispose of in summary form. For this reason a full report of the Tuesday afternoon session will be published in the September issue and the Wednesday and Thursday sessions in October, with additional addresses by authorities in the field as independent articles.

Registration at National Board Meeting

THE following members, associates and guests were in attendance at the seventh annual meeting of the National Board of Boiler and Pressure Vessel Inspectors, held at the Hotel Fort Shelby, Detroit, Mich., June 18 to 20:

Applebaum, S. B., The Permutit Company, New York, N. Y.
Archer, Thomas A., chief boiler insp., Wilmington, Del.
Arnold, J. S., secretary Industrial Board, Department of Labor and Industry, Harrisburg, Pa.
Bach, Geo., The Union Iron Works, Erie, Pa.
Barringer, L. M., chief boiler insp., 505 County-City Bldg., Seattle, Wash.
Betz, L. D., chemical engr., 3701 N. Broad St., Philadelphia, Pa.
Blake, W. T., director of industrial relations, State of Ohio, Hartman Hotel Bldg., Columbus, Ohio.
Book, Blaine M., chief boiler insp., Department of Labor and Industry, Harrisburg, Pa.
Bowles, Verne, 3316 Pasadena Ave., Detroit, Mich.
Bragdon, G. D., General Accident Ins. Co., 414 Walnut St., Philadelphia, Pa.
Brennan, W. F., New York Indemnity Co., 4 Albany St., New York, N. Y.
Burgess, Garrett, 5050 Joy Rd., Detroit, Mich.
Butler, J. W., Hartford Steam Boiler Insp. & Ins. Co., 2401 1st Nat'l Bank Bldg., Detroit, Mich.
Campbell, A. P., Kewanee Boiler Corp., 1858 So. Western Ave., Chicago, Ill.
Cannon, E. L., New York Indemnity Co., 608 Williamson Bldg., Cleveland, Ohio.
Carroll, Lloyd E., Employers Liability Assur. Corp., 1324 Majestic Bldg., Detroit, Mich.
Carter, A. F., 1516 Gray Ave., Detroit, Mich.
Chamberlain, N. K., 1034 Book Tower, Detroit, Mich.
Cheever, Paul, 1605 Virginia Park, Detroit, Mich.
Cleary, James, 1537 Book Tower, Detroit, Mich.
Cliff, W. H., Terre Haute Boiler Works Co., Box 44, Terre Haute, Ind.
Cole, A. W., Terre Haute Boiler Works Co., 735 N. Main St., W. Lafayette, Ind.
Coleman, J. F., Hartford Steam Boiler Insp. & Ins. Co., 5140 Greenway Ave., Detroit, Mich.
Cruickshank, H. C., The Travelers Insurance Co., 2600 Union Trust Bldg., Detroit, Mich.
Daniels, A. L., city boiler insp., 307 Union Trust Bldg., Parkersburg, W. Va.
Degan, Jas. E., 622 1st St., Detroit, Mich.
Dickson, J. F., Kewanee Boiler Corp., Kewanee, Ill.
Dulmadge, Wm., 16191 Baylis Ave., Detroit, Mich.
Duni, Louis A., Rm. 26 City Hall, Los Angeles, Cal.
Eales, Wm. P., asst. supt., Travelers Indemnity Co., 700 Main St., Hartford, Conn.
Edgar, M. A., chief boiler insp., Industrial Commission, State Capitol, Madison, Wis.
Ermine, W. M., Erie City Iron Works, Erie, Pa.
Ernst, Jos., city boiler insp., 514 Gerrans Bldg., Buffalo, N. Y.
Ervin, T. C., The Lucey Mfg. Co., Chattanooga, Tenn.
Farmer, E. W., chief boiler insp., Rm. 20 State House, Providence, R. I.
Finn, Wm., 5666 Missouri Ave., Detroit, Mich.
Fish, E. R., Combustion Engineering Corp., 200 Madison Ave., New York, N. Y.
Fisher, George C., smoke insp., 1416 E. Greenwood Ave., Nashville, Tenn.
Fitt, E. W., city boiler insp., 504 City Hall, Omaha, Nebr.
Fortune, Jr., J. Robt., Vec Kar Water Softener Corp., 608 Fisher Bldg., Detroit, Mich.
Furman, Wm. H., chief boiler insp., State Capitol, Albany, N. Y.
Gearon, Gerald, chief boiler insp., 601 City Hall, Chicago, Ill.
Glossop, Ernest, Travelers Ins. Co., 511 Park Ave., Royal Oak, Mich.
Glennon, W. E., Hartford Steam Boiler Insp. & Ins. Co., 1714 1st Nat'l Bank Bldg., Cincinnati, Ohio.
Goddard, W. L., Crane Company, 836 Michigan Ave., Chicago, Ill.
Gorton, Chas. E., chairman, American Uniform Boiler Law Society, 253 Broadway, New York, N. Y.
Gould, Harry, Water Works Pumping Station, Detroit, Mich.
Granniss, Edw. R., Travelers Ins. Co., 3750 Clements St., Detroit, Mich.
Grant, A. A., The Travelers Indemnity Co., 2600 Union Trust Bldg., Detroit, Mich.
Gregg, W. S., The C. H. Dutton Company, Whites Road, Kalamazoo, Mich.
Gretzinger, John, 2972 Lothrop Ave., Detroit, Mich.
Halsey, Wm. D., Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.
Harrington, M. F., 5668 Eldred Ave., Detroit, Mich.
Hawthorne, P. R., Petroleum Iron Works Co., Sharon, Pa.
Hendra, T. J., State Board of Boiler Rules, 112 W. Main St., Kalamazoo, Mich.
Heringer, T. A., chief boiler insp., Industrial Commission, Capitol Bldg., Salt Lake City, Utah.
Hetu, Thos. P., Hartford Steam Boiler Insp. & Ins. Co., 1st National Bank Bldg., Detroit, Mich.
Hickey, E. E., General Accident Corp., 469 Ledyard St., Detroit, Mich.
Hopkins, R. R., The M. W. Kellogg Co., Danforth Ave., Jersey City, N. J.
Huddleston, S. E., Royal Indemnity Co., 3444 Gray Ave., Detroit, Mich.
Hull, Frank M., 514 N. Perry St., Titusville, Pa., The Titusville Iron Works Co.
Hunt, J. F., Hartford Steam Boiler Insp. & Ins. Co., 311 Leader Bldg., Cleveland, Ohio.
Jacques, Ed., 573 Trowbridge Ave., Detroit, Mich.
Jasper, T. McLean, director of research, A. O. Smith Corp., Milwaukee, Wis.
Joyce, Allen C., Travelers Ins. Co., 265 Union Ave., S., Grand Rapids, Mich.
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Knapp, V. W., London Guarantee & Accident Corp., 55 5th Ave., New York, N. Y.
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McCabe, Chas. J., smoke inspector, City of Detroit, Detroit, Mich.
McCabe, John C., chief boiler insp., 5450 16th St., Detroit, Mich.
McCarthy, W., London Guarantee & Accident Corp., 1044 Free Press Bldg., Detroit, Mich.
McCracken, L. H., 5372 Iroquois Ave., Detroit, Mich.
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Medcalf, D. M., chief inspector of steam boilers, Parliament Bldgs., Toronto, Ont., Canada.
Middleton, Alfred E., Travelers Indemnity Co., Grand Rapids Sav. Bank Bldg., Grand Rapids, Mich.
Mills, H. H., chief safety engr., 555 Clinton St., Detroit, Mich.
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Newton, W. L., chief boiler insp., State Department of Labor, State Capitol Bldg., Oklahoma City, Okla.
Noonan, J. D., Ocean Accident & Guarantee Corp., Ins. Exchange Bldg., Chicago, Ill.
Obert, C. W., Union Carbide & Carbon Research Laboratories, Inc., Thompson Ave. & Manley St., Long Island City, N. Y.
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Olmstead, O. B., Ontario Iron Works, Pulaski, N. Y.
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Prince, W. O., Independence Indemnity Co., 241 Euclid Ave., Cleveland, Ohio.
Quiery, John P., Pennsylvania Surety Corp., 1523 1st National Bank Bldg., Detroit, Mich.
Quiery, Thos. H., London Guarantee & Accident Corp., 1044 Free Press Bldg., Detroit, Mich.
Ranton, Wm. J., The Fidelity and Casualty Co., 106 Powers Bldg., Rochester, N. Y.
Reinhard, Geo. C., Feedwaters, Inc., 40 Rector St., New York, N. Y.
Royer, Dan L., Ocean Accident & Guarantee Corp., 1 Park Ave., New York, N. Y.
Schooley, Otis L., Maryland Casualty Co., 2311 First National Bank Bldg., Detroit, Mich.
Schrenk, J. L., 5425 W. Jefferson Ave., Detroit, Mich.
Schwab, Martin, Schwab Boiler & Machine Co., Milwaukee, Wis.
Shepard, Geo. L., Travelers Ins. Co., 1410 Webb Ave., Detroit, Mich.
Shoemaker, H. E. W., The Bartlett-Hayward Company, 4317 Groveland Ave., Baltimore, Md.
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Sleeth, T. F., 2941 Blaine Ave., Detroit, Mich.

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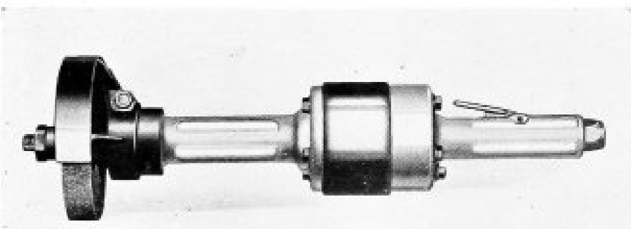
Smith, N. D., Employers Liability Assur. Corp., 175 W. Jackson Blvd., Chicago, Ill.
Soff, B. T., The Permutit Company, Detroit, Mich.
Spafford, E. A., Travelers Ins. Co., 2751 Philadelphia Ave., W., Detroit, Mich.
Speed, Jas. E., city boiler insp., City Hall, Erie, Pa.
Standart, Jay C., Travelers Ins. Co., 2751 W. Philadelphia St., Detroit, Mich.
Stewart, James D., Travelers Ins. Co., 245 Warren Ave., S. E., Grand Rapids, Mich.
Straub, Frederick G., University of Illinois, Urbana, Ill.
Thomas, C. D., chief boiler insp., State House, Salem, Oregon.
Tindall, W. P., Travelers Ins. Co., 1008 Short St., Kalamazoo, Mich.
Toohey, W. C., 146 Nevada St., Detroit, Mich., Continental Casualty Co.
Tulloch, W. B., city boiler insp., 1910 Grant St., Evanston, Ill.
Van Tassell, Geo., 9324 Woodward Ave., Detroit, Mich.
Van Voigtlander, G., Jackson, Mich.
Walker, Edward, New Jersey Board of Boiler Rules, 387 Nelson Ave., Grantwood, N. J.
Watson, C. W., General Accident Ins. Co., 1292 Marlowe Ave., Lakewood, Ohio.
Weinbeimer, C. M., Detroit Edison Co., 2000 2nd Ave., Detroit, Mich.
Werner, Alex., 3305 Tuxedo Ave., Detroit, Mich.
Wheatley, Jack, Columbia Casualty Co., 4268 Clements Ave., Detroit, Mich.
Wilcox, George, chief boiler inspector, 612 Bermer Arcade Bldg., St. Paul, Minn.
Wilson, J. F., Pennsylvania Surety Corp., Wabash Bldg., Pittsburgh, Pa.
Wilson, Thos., *Power*, 520 N. Michigan Ave., Chicago, Ill.
Wood, J. M., chief boiler insp., 404 State Capitol, Indianapolis, Ind.

Multi-Vane Grinders

A PORTABLE pneumatic grinder, known as the multi-vane grinder has been developed by the Ingersoll-Rand Company, New York, N. Y. This new type uses a multi-vane rotor that combines the lugging power of a piston machine with the smoothness of a turbine. It is claimed that these machines are the lightest in weight for their capacity that have ever been offered for portable grinding work and are also the quietest. Because of these qualities, they are less tiresome to handle, and consequently the operator can produce more work.

They are fitted with speed governors which give power where it is wanted and yet keep the grinding wheel from operating at dangerous speeds. Grinding wheels give the best results and do their fastest cutting when operated at their maximum speed; yet they cannot be operated over this maximum speed without danger of bursting.



New type I-R pneumatic grinder

By means of the governor the speed can be adjusted to any desired speed up to 6300 revolutions per minute. Grinding wheels of different diameters can therefore be driven by multi-vane grinders at their best cutting speeds. Standard machines are set at 4200 revolutions per minute, which is the best speed for 6-inch vitrified and 8-inch elastic bonded wheels.

A rotor with four power vanes is used. It is made of steel, hardened and ground to reduce wear, and is a full-floating fit on its arbor. This permits the rotor to aline itself between its two end plates so that no wearing pressure comes at the ends. The four power vanes balance the turning effort on the rotor giving a very smooth flow of power.

An exhaust deflector is used which also serves as a muffler. It baffles the exhaust air passing through it to remove the penetrating screech that is typical of many rotary grinders. The exhaust sound is a soft purr. In addition, the exhaust deflector can be turned to deflect the exhaust in any desired direction.

The wheel end bearing consists of two radial thrust ball bearings, placed to take thrust from either direction. Grinding on either side of the grinding wheel will therefore not destroy this important bearing.

In the handle of the tool is an oil chamber. From this chamber oil is automatically fed into the live air going to the machine every time the grinder is stopped and started. It keeps all wearing parts running on an oil film, thus reducing wear to a minimum.

Multi-vane grinders can be used for a wide variety of grinding, buffing, polishing, or cleaning work. When fitted with wire brushes they are also very efficient cleaning machines that can be used for removing scale, rust, paint, etc., from steel surfaces. For this work two types of wire brushes are furnished. A No. 28 cup-type wire brush is furnished for cleaning flat surfaces, and a No. 81 sectional wire brush for cleaning irregular surfaces, such as gear teeth, rivet heads, etc. Two types of handles can be furnished; a squeeze-type straight handle or an inside trigger grip handle.

New Appointments in Ryerson Company

THE increase in the number of plants and departments and the growing diversity of products and markets has made it desirable to add to the executive staff, according to Edward L. Ryerson, Jr., president of Joseph T. Ryerson & Son, Inc., Chicago, Ill.

The new elections and appointments are as follows: A. M. Mueller, who has been associated with the firm for 30 years in the accounting and sales departments, becomes assistant secretary and member of the board of directors. Mr. Mueller was manager of the St. Louis plant from 1914 to 1917 and later general manager of sales.

H. B. Ressler succeeds Mr. Mueller as general manager of sales. Mr. Ressler has a record of 25 years experience as manager of the mill order department and manager of the St. Louis plant.

Robert C. Ross is advanced from general traffic manager to assistant to the president in charge of plant operations.

Wm. H. Bryant, with 23 years of service with the Ryerson company, becomes Chicago sales manager in charge of country and city store sales. He was formerly assistant manager of sales in charge of the Chicago Country territory.

Guy H. Rumpf, formerly manager of plant operations, succeeds Mr. Ressler as manager of the St. Louis plant. He has been with the house for 17 years. Increased stocks in present lines and additional stock for new departments are being planned for this point.

Harry W. Treleaven, who has been with the firm for 20 years is elected assistant treasurer and will continue to be responsible for office management.

"These moves," says President Ryerson, "reinforce the executive personnel, keep pace with the growth and expansion of the business and make it possible to give even better service from an increasing number of plants and a fast widening range of products."

Locomotive Boiler Construction-XII

Fitting door-hole flanges—Assembling the back sheet and back tube sheet for welding and riveting

By W. E. Joynes*

When fitting the door-hole flanges with the flanges turned into the water leg, either the edge of the door-hole flange for the backhead or the edge of the back sheet is made parallel to the surface of the sheet itself.

The sheet with the parallel flange should have the flange chipped to the depth dimension, as given on the boiler drawings, before being set up for fitting the sheet with the diagonal-cut flange.

The firebox is left assembled, with door sheet and yoke sheet in place.

The backhead sheet with lifting chains clamp bolted through staybolt holes, above the center of the sheet, is raised with the jib crane and pinned through the tack holes to the firebox ring. The water space as dimensioned on the boiler drawing, at the top of the back sheet, is now measured. The excess stock on the diagonal-cut door flange is marked for chipping. The backhead sheet is removed from the ring and the flange chipped, after which it is applied again and the water space checked. One or two fittings should give the depth of the diagonal-cut flange, to make the water space dimension correct.

The water space is measured through the top backhead staybolt hole.

Disassembling the Firebox for Finishing the Flange Edges and for Drilling

The back sheet is removed first. The strap clamps holding the yoke sheet are removed. Lifting hooks held by a traveling crane, are placed under the top, front and back end of the crown and combustion chamber sheet. The tack bolts holding the crown sides to the firebox ring are removed, the wrapper sheet is then raised clear of the yoke sheet and placed on the floor nearby.

The yoke sheet is then removed with the crane and carried to the air-gun chipping section. Here the excess stock is trimmed off the back flanges and the wings, after which these edges and the front flange are bevel chipped for electric welding. The staybolt and other holes are next center punched on the yoke sheet from the thin metal template layouts as described for the throat sheet layout on page 48 of the February issue. The staybolt holes and the tack holes for drift pins and for bolting the sheet to the firebox ring are now drilled, which completes the sheet ready for the welding assemblage.

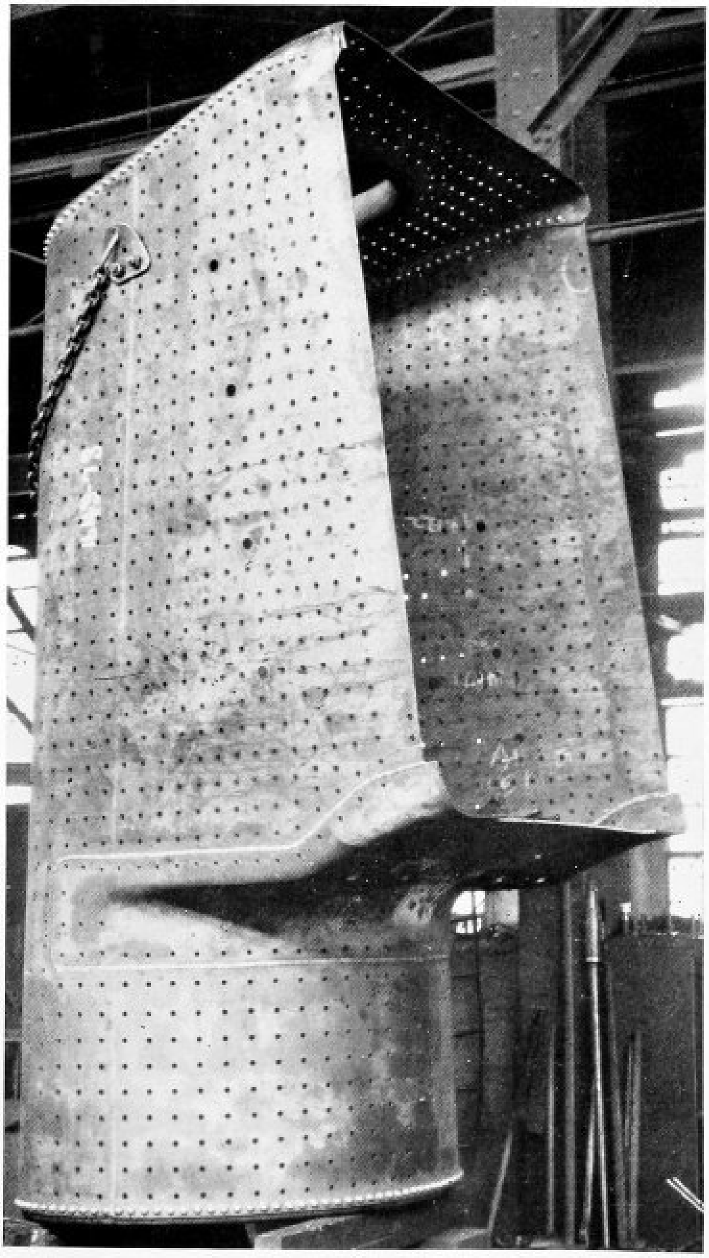


Fig. 61.—Wide firebox, with welded-in yoke sheet, completely assembled

Back Sheet

The rivet holes in the flange of the back sheet are drilled, the rivet lap is marked off, trimmed and chipped with an air gun for calking.

Back Tube Sheet

The back tube sheet is fitted in the combustion chamber before the first firebox assemblage, for marker punching the connection rivet hole centers on the flange of the sheet. The rivet holes are drilled, the rivet lap is marked off and chipped. The tube and flue holes are, of course, drilled and reamed to size before any of the above-mentioned work has been done, i.e., these holes are finished to size as soon as the sheet has been flanged

* Boiler designing department, American Locomotive Works, Schenectady, N. Y.

tube sheet flue and tube holes in the July issue.

When duplicate sheets are required a thin metal tape strip is bent around the flange and the location of the rivet-hole centers marked on the same for transferring to the duplicate tube sheets.

The firebox sheets are now ready to be assembled, for welding and riveting into a completed firebox.

Assembling the Firebox Sheets for Welding and Riveting

The back tube sheet is first put in the combustion chamber end and rigidly bolted for reaming the rivet holes.

The yoke sheet is then bolted to the firebox ring.

The crown and combustion chamber sheet, with tube sheet bolted in place, is raised with a traveling crane with lifting chains bolted at the sides of the crown and lowered into place on the ring. The yoke sheet is worked into place with pinch bars as the crown and combustion chamber sheet is lowered. The crown sides are bolted to the ring through the tack holes.

The yoke sheet is clamp bolted with straps to the combustion chamber and the crown sides.

The location of the combustion chamber and the yoke sheet in relation to the crown sides and the firebox ring is now checked, after which the yoke sheet is rigidly clamp bolted into place for electric welding. The box is retained bolted to the firebox ring for the welding operation.

The firebox, as assembled, is then delivered to the reaming section. Here, the firebox is stood on the tube sheet end. The rivet holes connecting the tube sheet are reamed to the correct riveting size; bolts are applied in the reamed holes; the first set of bolts is removed and these holes are then reamed.

The firebox back sheet is also bolted into place here, the firebox is then placed standing on the back end for reaming these rivet holes.

The staybolt holes in the yoke sheet itself are now laid out and drilled.

The firebox is next delivered to the pneumatic air riveting section for driving the tube sheet and the back sheet rivets.

Fig. 61 shows a completed wide firebox with a welded-in yoke sheet as described above—the tube sheet rivets have been driven, in the position the box is shown placed.

As practically all new designs of locomotive boilers today, are of the wide firebox type, it is fitting to state here that the articles in this series have had particular reference to this type of boiler except, of course, where the work is applicable to both the wide and the narrow type of fireboxes.

(To be continued)

Work of the A.S.M.E. Boiler Code Committee

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Any one desiring information as to the application of the Code is requested to communicate with the Secretary of the Committee, 29 West 39th St., New York, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the secretary of the committee to all of the members of the committee. The interpretation, in the form of a reply, is then prepared by the committee and passed upon at a regular meeting of the committee. This interpretation is later submitted to the council of the society for approval, after which it is issued to the inquirer.

Below are given records of the interpretations of the committee in cases Nos. 625, 626, and 627 as formulated at the meeting on May 24, 1929, all having been approved by the council. In accordance with established practice, names of inquirers have been omitted.

CASE No. 625. *Inquiry:* Is it the intent of Par. P-200 that screwed staybolts be drilled with telltale holes, where they are in effect merely an extension of the through stays below the tubes of a horizontal return tubular boiler and are used to distribute the stress, as shown in Fig. 26?

Reply: It is the opinion of the committee that there is nothing in the Code which requires the drilling of telltale holes in screwed stays used in connection with the attachments referred to, but the committee recommends that this be done. Attention is called to the fact that the complete details of the structure are not shown in the sketch in Fig. 26 and that the reply is accordingly limited to whether or not the attaching stays should be drilled with telltale holes.

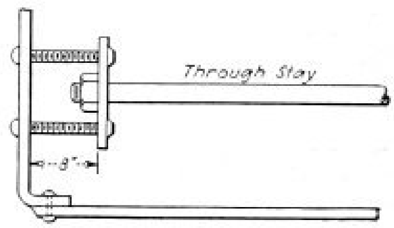


Fig. 26

CASE No. 626. *Inquiry:* Is it permissible under the rules of the Code, to attach 6-inch nozzles to the shells and heads of boiler drums designed to operate at 600 pounds per square inch, by inserting the necks through openings and flaring the ends inside, using autogenous welding inside for sealing purposes only? The necks of the nozzles are 6⅞ inches outside diameter and are machined with a shoulder that rests on the outside of the shell, the entire drum being strain-normalized after the seal welding is completed.

Reply: The practice of inserting nozzle necks to openings in boiler drums and attaching them by flaring and welding is not adequately provided for in the Code and a revision has been under consideration by the Boiler Code Committee to provide for such practice. A sub-committee of the committee has recently submitted a report on the revision of Par. P-268 with this in view, and it is the opinion of the committee that, if the proposed nozzle construction falls within the limits of this rule, it may be used with safe results. The section of the proposed revision pertaining to flared and welded connections is as follows:

b Flanged Fittings, Flared or Expanded Connections. On shells and on the spherical portions of the heads, forged steel nozzles may be inserted through an opening, flared over on the inside to an amount equal to at least the thickness of the necks of the nozzle up to an outside diameter which shall not exceed that given for unreinforced circular openings in Par. P-192. The diameter of the opening shall not be more than 1/32-inch greater than the outside diameter of the part of the nozzle which passes through the shell. Such nozzles may be sealed by fusion welding provided the carbon content of the steel does not exceed 0.30 percent and the diameter of the welded seal is at least ½ inch less than the maximum diameter allowed by the rules for unreinforced circular openings given in Par. P-193.

When the thickness of a shell or the spherical portion of a head is greater than ¾ inch, forged steel nozzles, the outside diameter of the neck of which does not exceed 4½ inches, may be attached thereto by inserting through an opening and expanding into the shell or head in accordance with the requirements for securing boiler tubes; the diameter of such an opening shall not exceed that given for unreinforced circular openings in Par. P-193.

All nozzles which are flared over on the inside of the shell or head except small nozzles where tube-seat grooves are provided, must be forged or machined with a shoulder which rests on a locally flattened surface on the outside of the shell or head to be formed by hot forging, hot flanging, or machining. When the outside of the shell or head is machined, the maximum cross-section of the metal removed in a plane passing through the opening and through the center line of the drum shall not exceed that allowed by the rules for unreinforced circular openings given in Par. P.-193.

CASE No. 627. *Inquiry:* Is it permissible, under the requirements of Pars. H-55 and H-108 of the Code, to use on steam heating boilers compound steam gages which indicate both pressure and vacuum readings so that there is no stop pin located at the zero point and the maximum travel of the pointer is less than 300 degrees?

Reply: The zero point on a compound-type steam gage has been considered to be the minimum of the range of pointer travel of the gage. It is the opinion of the committee that on a compound-type gage where used for heating purposes, the stop pins or limit stops should be set at the limits of the gage reading at both the pressure and vacuum sides. A revision of Pars. H-55 and H-108 to cover this feature is under consideration by the committee.

Efficient Longitudinal Joints

(Continued from page 221)

yond the narrow. Credit is given to this strap for standing up to its duty as well as the outside strap, and designers appear to think that it is merely necessary to extend this to add strength to the joint. Such extensions add very little to the strength because the inside strap is a bent tie and straightens out between the rivets, especially if they are far apart. This shows the importance of making joints as narrow as possible by using the smallest permissible back pitch. Moreover it is best to make the inside strap thicker than the outside in order to stiffen it.

The saw-tooth joint overcomes greatly the objections to the joint with a narrow outside and wide inside strap, and in my opinion is the only safe joint to use. The rivets in this joint bind the inside strap to the main plate more firmly than in any other joint and reduce to a minimum the straightening-out effect between rivets of the inside strap. The ineffectiveness of the extended inside strap increases the stress on the rivets that pass through both straps beyond that intended.

The Baldwin Locomotive Works showed good judgment in using this joint for their locomotive No. 60,-000, carrying 350 pounds pressure, but I have seen many new locomotives recently with bad examples of the joint which I have criticized above. In my own practice I have used the saw-tooth joint since 1910.

The sketch shows a design of saw-tooth joint of 92 percent efficiency for a boiler 91 inches inside diameter to carry 300 pounds pressure, using carbon steel.

Eliminating Boiler Corrosion

(Continued from page 220)

been practically no maintenance expense for the Gunderson process applications on C. & A. locomotives. The installations are checked by electricians at each monthly locomotive inspection to determine if the wiring, fuses and resistance units are in good operating condition and if the electrodes are thoroughly insulated. The operating expense incident to the use of the process includes the cost of electric current (about 128 watts) taken from the headlight generator, the cost of arsenic compound, and the cost of replacing the anode pipes once in four years at the limit flue-shopping period. The iron pipe anodes disintegrate or waste away, but ordinarily have a service life of at least four years.

It is estimated that the annual cost for current for a road locomotive is approximately $15.

The cost of arsenic compound, already prepared in individual tubes for application to the boiler, is 15 cents a pound. It is the practice on the Alton to apply one pound every 15 days, irrespective of water changes, so the cost of compound for each locomotive equipped amounts to 30 cents a month or $3.60 a year.

E. L. Ryerson Elected President of Joseph T. Ryerson Company

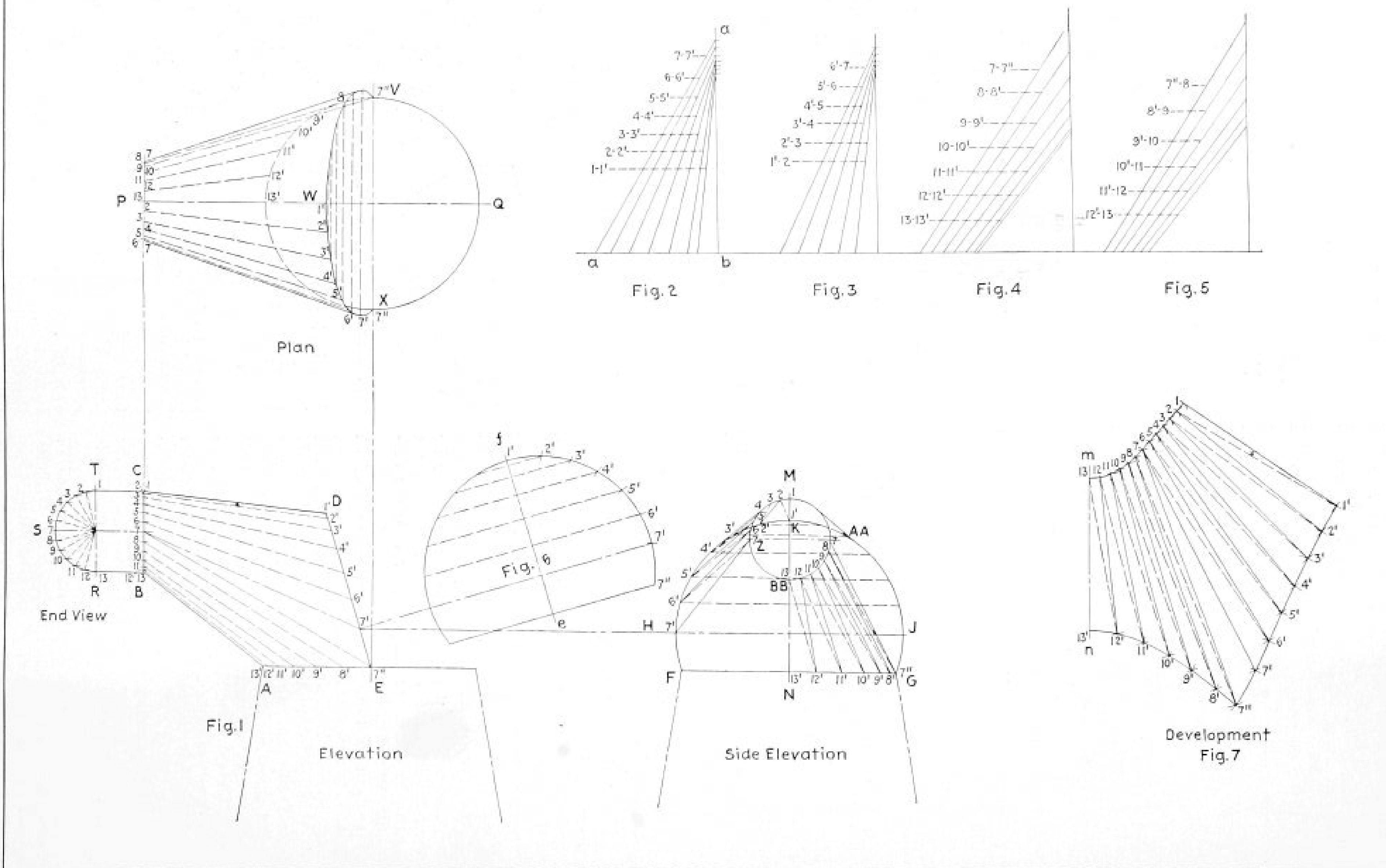
EDWARD L. Ryerson, Jr. has been elected president of Joseph T. Ryerson & Son, Inc., Chicago, Ill., succeeding Joseph T. Ryerson.

Joseph T. Ryerson will remain a member of the board and continue to hold the office of treasurer.

Edward L. Ryerson, Jr.

Edward L. Ryerson, Jr. has had twenty years experience in the operating and marketing divisions of the business and brings a wealth of practical experience to the post of president. He was graduated from Sheffield Scientific School (Yale) in 1908 and later attended the Massachusetts Institute of Technology. Coming to Ryerson company in 1909, he began in the plant operating department and held the position of works manager for several years prior to the war. Mr. Ryerson entered the service early in the war with the Aircraft Production Board in Washington and was later captain in the Air Service Division of the Signal Corps. He was elected vice-president of the firm in 1922 and vice-president and general manager in 1928.

The Ryerson company now in its 87th year is the largest independent steel warehousing organization in the world, furnishing a complete line of steel products for industrial and in fact universal consumption. Sales for the first five months of this year show an increase of over 18 percent over that of 1928. Plants are located at Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Buffalo, Boston, Cleveland, and Jersey City.



Detailed layout and development of measuring cup top

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Layout of Measuring Cup Top

Q.—Please show me how to lay out the top of a measuring cup. J. F. D.

A—To develop the top of the measuring cup as shown in Fig. 1, it is first necessary to complete the plan and project the side elevation in a manner as shown. One half of the plan is symmetrical about the line *P-Q* and the side elevation is symmetrical about the line *M-N*. A development of one-half of the plan as shown would therefore represent one-half of the completed pattern.

To make the development by triangulation, divide the semi-circle *R-S-T* of the end view into any number of equal parts, as twelve in this case, and number the same from *1* to *13* as shown. The greater the number of parts taken, the more accurate will be the development of the pattern. Project the points *1* to *13* of the end view to the elevation, cutting the line *C-B*. Number these points along the line *C-B*, *1* to *13*.

Divide the quarter circle *W-V* of the plan into six equal parts, or one-half as many parts as the semi-circle *R-S-T* was divided. The quarter circle *H-K* of the side elevation should then be divided into the same number of equal parts taken on the line *W-V*. The total number of equal parts taken on the lines *W-V* and *H-K* should equal the total number of parts taken on *R-S-T*. Number the equal parts taken on the line *W-V* from *7″* to *13′* and the parts taken on the line *H-K* from *1′* to *7′*. Then project the points *7″* to *13′* of the plan down to the elevation cutting the line *A-E* of the the points *7″* to *13′* as shown. Project the points *1′* to *7′* of the side elevation, cutting the line *D-E* of the elevation. Number the points *1′* to *7′*. Connect the points *1-1′*, *2-2′*, etc. to the points *13-13′* of the elevation as shown.

These lines are necessary in determining the altitudes of the right angle triangles necessary to construct the pattern.

The next step preparatory to obtaining the lines of the pattern is to obtain the true lengths of the bases for the right angle triangles necessary to determine the true lengths of the surface line. This is done in the plan view. The arc *M-Z* is divided into the same number of equal parts as the arc *S-T* of the end view and is numbered *1* to *7*. Connect the points *1* to *7* on the arc *M-Z* with the points *1′* to *7′* on the arc *K-H*, as *1-1′*, *2-2′*; connect these points with solid lines. Then connect the points *1′-2*, *2′-3*, *3′-4* to *6′-7* with dotted lines.

Divide arc *AA-BB* of the side elevation into the same number of equal parts as the arc *S-R* of the end view; number the points *7* to *13*. Project the points *7′* to *13′* of the plan down to the side elevation cutting the line *N-G*, number the points *7″* to *13′*. Connect the points *7-7″*, *8-8′*, etc. with full lines and *8-7″*, *9-8′*, etc. with dotted lines as shown. It will be noticed in the plan and side elevation that the top quarter and bottom quarter are taken on opposite sides of the center lines. This was done only for clearness and could have been shown on one side of the center line.

We are now ready to construct a series of right angle triangles in order to obtain the true lengths of the surface lines of the object.

To construct the right angle triangles as shown in Fig. 2, draw a line *a-b* and at *b* erect a perpendicular. Then take the dividers and using *b* as a center and the vertical distance between the line *B-C* and the point *1′* in the elevation as a radius, scribe an arc cutting the perpendicular. Then taking the distance *1-1′* in the side elevation as a radius and the point *b* as a center, scribe an arc cutting the line *a-b*. Connect these two intersections and we have the line *1-1′* of Fig. 2, which is the true length of the line *1-1′*.

Then using the vertical distances between line *B-C* and the points *1′-7′* of the elevation as altitudes and the distances *2-2′*, *3-3′* to *7-7′* of the side elevation as the bases, in the same manner, the hypotenuses *2-2′*, *3-3′* to *7-7′* obtained in Fig. 2 will be the true lengths of the surface lines *1-1′*, *2-2′* to *7-7′* of the side elevation.

Repeat this process in Figs. 3, 4 and 5 as shown until the true lengths of all the surface lines are obtained.

The next step before making the development is to obtain the true length of the line *F-K-G* of the side elevation. This can be done by making the projection as shown in Fig. 6.

Draw the line *e-f* parallel to the line *D-E* of the elevation; erect perpendiculars to the line *D-E* at the points *1′* to *7″*, same to cut the line *e-f*. On the perpendicular to the line *7″* set off each side of the center line *e-f* a distance equal to *F-N* of the side elevation. At the point *7′* set off a distance equal to the distance between the line *M-N* and the point *7′* of the side elevation. Repeat this process using the distance between the line *M-N* and the points *6′*, *5′*, *4′*, *3′* and *2′* on these corresponding lines. Connect these points completing Fig. 6.

Constructing the Pattern

To construct the pattern, first set a pair of dividers equal to the spaces, *1-2*, *2-3*, etc. on the line *R-S-T* of the end view.

Begin by drawing the line *m-n*, Fig. 7, and with the trams set equal to *13-13′*, Fig. 4, and with *13* as a center, scribe an arc cutting the line *m-n* setting off the distance *13-13'*. Then with the dividers set equal to the distance *13'-12'* of the plan and with *13'* as a center, scribe an arc. With the trams set equal to *12'-13*, Fig. 5, and with *13* as a center scribe an arc cutting the arc first made, locating the point *12'*.

With the dividers that already have been set equal to the equal spaces on the line *R-S-T* of the end view and with *13* as a center, scribe an arc; and with the trams set equal to the distance *12-12'*, Fig. 4, and with the point *12'* as a center, scribe an arc cutting the arc first made, locating the point *12*. Continue in this manner until the line *7'-7"* is reached. Then with the dividers set equal to the distance *F-7'* in the side elevation and with *7"* as a center, scribe an arc and with the compasses set equal to the distance *7-7'*, Fig. 2, and with *7* as a center scribe an arc intersecting the arc just made, locating the point *7'*. Connect *7-7'*. Proceed again as before, the arcs *7'-6'*, *6'-5'* of the development being taken equal to the distances *7'-6'*, *6'-5'*, etc. Fig. 6, until all the hypotenuses of Figs. 2, 3, 4 and 5 have been used, thus completing the development.

The development as shown in Fig. 7 is one half of the complete development of the top of the cup.

Safe Working Pressure of Old Boiler

Q.—I would like very much to see an example or an illustration of a certified boiler inspector setting the factor of safety and the allowed safe working pressure on an old boiler that is over 30 years old, in which the comparison of the deterioration of the metal along the seams and the entire structure is involved. C. M. C.

A.—I am unable to give an illustration of a certified boiler inspector's report as requested in the question, but the following information with regards to this question might be of some assistance:

The I.C.C. ruling with regards to factor of safety is as follows:

Rule 2. The lowest factor of safety for locomotive boilers, which were in service or under construction prior to January 1, 1912, shall be 3.25.

Effective October 1, 1919, the lowest factor shall be 3.5.
Effective January 1, 1921, the lowest factor shall be 3.75.
Effective January 1, 1923, the lowest factor shall be 4.

The A.S.M.E. ruling with regards to factor of safety is as follows:

SUGGESTED RULES COVERING EXISTING INSTALLATIONS *1927*-CODE

A-23. Boilers in service one year after these rules become effective shall be operated with a factor of safety of at least 4 by the formula, Par. A-22. Five years after these rules become effective, the factor of safety shall be at least 4.5. In no case shall the maximum allowable operated pressure on old boilers be increased, unless they are being operated at a lesser pressure than would be allowable for new boilers, in which case the changed pressure shall not exceed that allowable for new boilers of the same construction.

A-24. The age limit of a horizontal-return-tubular boiler having a longitudinal lap joint and carrying over 50 pounds pressure shall be 20 years, except that no lap joint boiler shall be discontinued from service solely on account of age until 5 years after these rules become effective.

A-25. Second-hand boilers, by which are meant boilers where both the ownership and location are changed, shall have a factor of safety of at least 5½, by the formula Par. A-22, one year after these rules become effective, unless constructed in accordance with the rules contained in the power boiler section, when the factor shall be at least 5.

The following example is a good illustration of determining the effect of pitting in a sheet:

If the shell is extensively pitted, for instance, when measured longitudinally through the pitted area, and is near or exceeds the measurement of the outer pitch of the longitudinal seam—determine the amount of tensile strength of the plate that has deteriorated through the net section on a line between the two extreme pits inclusive.

Assuming that all the pit holes in that line are deteriorated the worst, determine the result by the following calculations:

Determine the factor of safety of the boiler by the following example:

TS = tensile strength of the boiler shell plate
T = Thickness of shell plate
% = Percent of efficiency of longitudinal seam
R = Radius of largest shell course
FS = Factor of safety
P = Working steam pressure

$$FS = \frac{TS \times T \times \%}{R \times P} = \frac{55{,}000 \times 0.75 \times 0.86}{42 \times 200} = 4.22 +$$

Having determined the factor of safety of the boiler, determine the strengths by the following formula and example:

$A—A$ = Extreme pits in measurement
A = Thickness of plate
B = Approximate depth of pits
C = Distance between extreme pits or $A—A$ inclusive
D = Tensile strength of solid shell plate between $A—A$ inclusive
E = Sum of diameters of all pits between $A—A$ inclusive
F = Tensile strength of shell plate that has deteriorated away through the net section between $A—A$ inclusive
G = Tensile strength of remaining net section of plate between $A—A$ after deducting tensile strength of plate that has deteriorated between $A—A$ inclusive
H = Tensile strength

D $= A \times C \times H = 0.75 \times 20 \times 55{,}000 = 825{,}000$

F $= B \times E \times H = 0.1875 \times 8.5 \times 55{,}000 = 87{,}656$

$G = D—F = 737{,}344$

RFS = Required factor of safety by law = 4.
SR = Tensile strength required for RFS.

Formula:

$$SR = \left(\frac{TS}{FS}\right) RFS \times T \times C$$

Example:

$$\frac{55{,}000}{4.22} \times 4 \times 0.75 \times 20 = 781{,}980$$

From the above calculations it is seen that in this particular boiler, which is taken as an example, G does not equal or exceed SR in strength, therefore, $SR—G$ is 781,980—737,334 = 44,636 pounds. The tensile strength falls short of that required, which shows that from a trifle more than 1 9/16 square inches of deteriorated net section of plate in this example, about 13/16 square inches of the net section of shell plate between $A—A$ inclusive has deteriorated beyond the limit, requiring a tensile strength equivalent for a factor of safety of 4 by law.

J. M. Beggs, formerly of the sales department of The Van Dorn Electric Tool Company, Cleveland, O., has been appointed manager of the advertising department.

R. W. Procter, formerly associated with the Black & Decker Manufacturing Company, Towson, Md., has been appointed general sales manager of The Van Dorn Electric Tool Company, Cleveland, O., succeeding Lyman H. Bellows who recently resigned.

Associations

Bureau of Locomotive Inspection of the Interstate Commerce Commission

Chief Inspector—A. G. Pack, Washington, D. C.
Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

Steamboat Inspection Service of the Department of Commerce

Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—Fred R. Low.
Vice-Chairman—D. S. Jacobus, New York.
Secretary, C. W. Obert, 29 W. 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

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Secretary-Treasurer—C. O. Myers, Commercial National Bank Building, Columbus, Ohio.
Vice-Chairman—William H. Furman, Albany, N. Y.
Statistician—L. C. Peal, Nashville, Tenn.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

International President—J. A. Franklin, suite 522 Brotherhood Block, Kansas City, Kansas.
Assistant International President—William Atkinson, suite 522, Brotherhood Block, Kansas City, Kansas.
International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.
Editor-Manager of Journal—John J. Barry, Suite 524, Brotherhood Block, Kansas City, Kansas.
International Vice-Presidents—John J. Dowd, 142 Pearsall Ave., Jersey City, N. J.; M. A. Maher, 2001 20th St., Portsmouth, O.; R. C. McCutchan, 226 Lipton St., Winnipeg, Man., Canada; H. J. Norton, Alcazar Hotel, San Francisco, Cal.; C. A. McDonald, Box B93 Route 2 Independence, Mo.; J. N. Davis, 1211 Gallatin St., N. W. Washington, D. C.; M. F. Glenn, 1434 E. 93rd St., Cleveland, O.; W. J. Coyle, 424 Third Ave., Verdun, Montreal, Canada; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; J. F. Schmitt, 25 Crestview Rd., Columbus, O.

Master Boiler Makers' Association

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First Vice-President—Kearn E. Fogerty, general boiler inspector, Chicago, Burlington & Quincy Railroad, Aurora, Ill.
Second Vice-President—Franklin T. Litz, general boiler foreman, Chicago, Milwaukee, St. Paul & Pacific Railroad, Milwaukee, Wis.
Third Vice-President—O. H. Kurlfinke, boiler engineer, Southern Pacific Railroad San Francisco, Cal.
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Treasurer—W. H. Laughridge, general foreman boiler maker, Hocking Valley Railroad, Columbus, Ohio.
Executive Board—Charles J. Longacre, chairman, foreman boiler maker, Meadow Shops, Pennsylvania Railroad, Elizabeth, N. J.

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Vice-President—Irving H. Jones, Central Alloy Steel Corporation, Massillon, Ohio.
Treasurer—George R. Boyce, A. M. Castle & Company, Chicago, Ill.
Secretary—Frank C. Hasse, Oxweld Railroad Service Company, Chicago, Ill.

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Vice-President—Owsley Brown, Springfield Boiler Company, Springfield, Ill.
Secretary-Treasurer—A. C. Baker, 801 Rockefeller Building, Cleveland, O.
Executive Committee— Homer Addams, Fitzgibbon Boiler Company, Inc., New York, N. Y.; G. W. Bach, Union Iron Works, Erie, Pa.; H. H. Clemment, Erie City Iron Works, Erie, Pa.; J. R. Collette, Pacific Steel Boiler Corp., Waukegan, Ill.; F. W. Chipman, International Engineering Works, Framingham, Mass.; E. R. Fish, Heine Boiler Company, St. Louis, Mo.; C. E. Tudor, Tudor Boiler Company, Cincinnati, O.; A. C. Weigel, Walsh and Weidner Company, Chattanooga, Tenn.; S. G. Bradford, Edge Moor Iron Company, Edge Moor, Del.

States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Islaand
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo	Seattle, Wash.	Parkesburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.
	Evanston, Ill.	

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash.	Parkersburg, W. Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

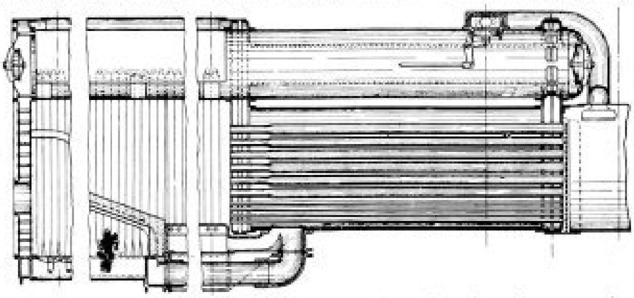
Compiled by
DWIGHT B. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

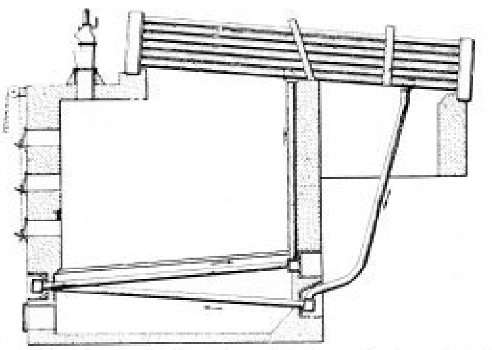
1,708,255. LOCOMOTIVE BOILER. ALFRED W. BRUCE, OF NEW YORK, N. Y.

Claim.—In a boiler of the locomotive type, the combination of a firebox, the sides of which are formed of watertubes; a barrel, extending forwardly from the forward end of the firebox; a drum, extending forwardly from the rear end of the firebox and communicating with the side watertubes thereof; means, connecting the interior of the forward end of the drum with the interior of the forward end of the barrel; and supplemental means, establishing circulation between the rear and the forward portions of the barrel. Five claims.



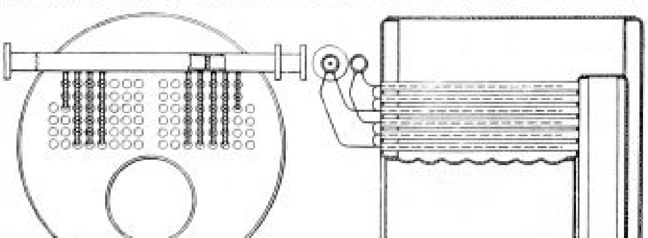
1,708,929. PULVERIZED-FUEL-BURNING FURNACE. JOHN E. BELL, OF BROOKLYN, NEW YORK, ASSIGNOR TO COMBUSTION ENGINEERING COMPANY, A CORPORATION OF NEW YORK.

Claim.—In a furnace for burning pulverized fuel, the combination of a boiler, a combustion chamber, a transverse water screen for cooling falling refuse passing out of the flame in regular continuous operation to the place of deposit beyond said screen, said screen comprising two oppositely inclined sets of tubes extending through the combustion chamber with the tubes of one set staggered with respect to the tubes of the other set, a common header for one end of said tubes, a header for each set at the other end, and means for connecting each of said last two headers into the circulation of the boiler. Two claims.



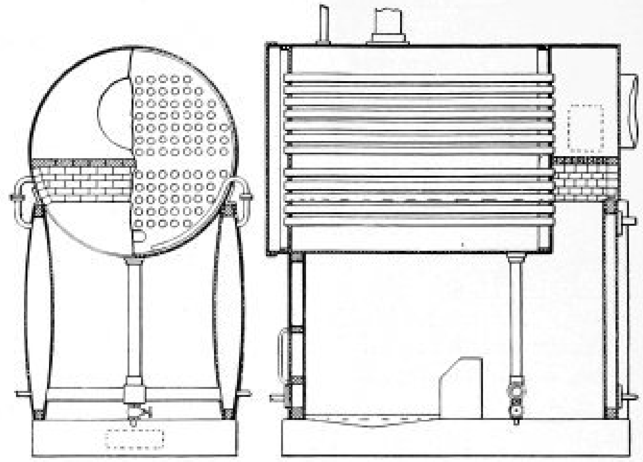
1,689,317. SUPERHEATER. JOHN A. BARNES, OF CHAPPAQUA, NEW YORK, ASSIGNOR TO THE SUPERHEATER COMPANY, OF NEW YORK, N. Y.

Claim.—In apparatus of the class described, the combination of a superheater inlet header; an outlet header; tubular superheater elements the two ends of each of which are secured to the two headers respectively; the outlet header having two outlet connections; and a partition in the outlet header between the two outlet connections and in such position that some of the elements deliver steam to one side of it and the remaining ones to the other; there being a duct adapted to carry steam from one side of the partition to the other. Two claims.



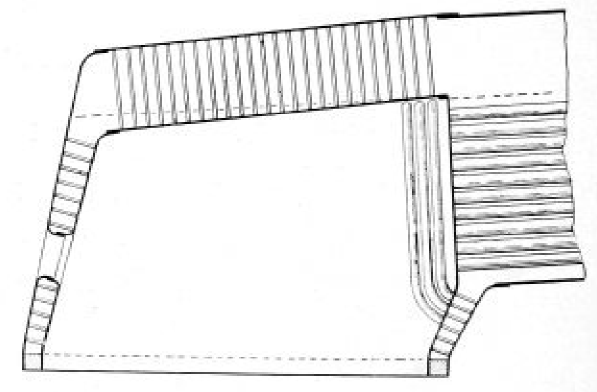
1,710,961. BOILER. FREDERIC W. BAKER, OF CLAYMONT, DELAWARE.

Claim.—In a boiler comprising a drum and a firebox, outwardly curved plates cooperatively associated to provide chambers forming the side walls of the firebox, and pipes having communication with the highest point of the chambers and the lowest point in the drum. Three claims.



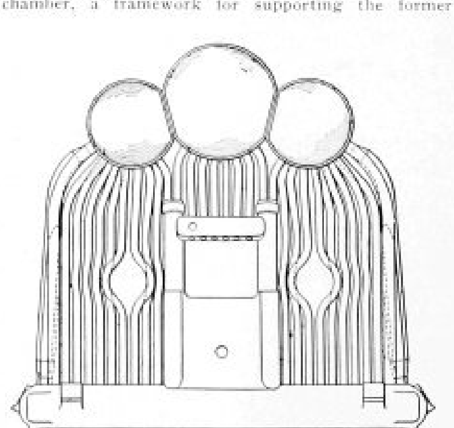
1,708,919. LOCOMOTIVE BOILER. CHARLES GILBERT HAWLEY, OF CLEVELAND, OHIO, ASSIGNOR TO LOCOMOTIVE FIREBOX COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

Claim.—A locomotive boiler embodying therein, a crown sheet having an elevated portion, means for operating at a predetermined low water level for flowing water upon the elevated portion of the crown sheet which would otherwise be exposed at said level, said means being so formed and adapted as to isolate and uncover a predetermined initial portion of limited size so as to act as a low water tell tale. Eight claims.



1,706,376. FIREBOX. WILLIAM L. BEAN, OF WEST HAVEN, AND VINCENT L. JONES, OF NEW HAVEN, CONNECTICUT, ASSIGNORS TO McCLELLON LOCOMOTIVE BOILER COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

Claim.—A locomotive firebox comprising a crown chamber and a foundation chamber, a framework for supporting the former from the latter independently of the water-containing walls of the firebox, and walls comprising tubes extending between the chambers, said framework including as a part thereof a plate extending across the rear wall of the firebox and providing for the support independently of the tubes of cab fittings as, for example, the fire door. Six claims.



The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX | **September, 1929** | **Number 9**

PUBLISHED MONTHLY BY THE
SIMMONS BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

Chicago: 105 West Adams St. Cleveland: Terminal Tower
Washington: 17th and H. Sts., N. W.
San Francisco: 215 Market St.

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THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

Request for change of address should reach us on or before the first day of the month preceding the issue with which it is to go into effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice. In sending us change of address, please be sure to send us your old address as well as the new one.

Contents

Marine Boiler Rules

COPIES of a tentative revision of Rules I and II. of all classes of the General Rules and Regulations of the United States Steamboat Inspection Service, covering the inspection of marine boilers, are being distributed to steamship companies, shipbuilders, boiler makers, steel manufacturers and others concerned for suggestions, comments and constructive criticism so that such additional revisions, alterations and amendments as may be desirable may be made before the final draft is prepared and submitted to the Board of Supervising Inspectors at its next annual meeting for action. The need for revision of these rules led last year to the adoption by the American Marine Standards Committee of a set of rules for the design and construction of marine boilers and pressure vessels. This was done in order that all American marine boilers might conform to a single standard in the interests of unified practice, safety and economy. As this standard was established in collaboration with the United States Steamboat Inspection Service, the American Bureau of Shipping, the Boiler Code Committee of the American Society of Mechanical Engineers and all other interests concerned, and was unanimously adopted, the proposed revision of the Steamboat Inspection boiler rules should be carefully examined to see that it conforms with the American Marine Standards rules. Any departure from these rules will mean the setting up of another standard which would destroy the unity achieved in establishing the American Marine Standards. As all new vessel construction undertaken with the assistance of the Shipping Board Construction Loan Fund and all repairs to Shipping Board vessels must be carried out according to the standards developed by the American Marine Standards Committee, the American Marine Standards Committee boiler rules, as approved by the marine industries, should be made the basis of the design requirements of the steamboat inspection service rules.

Safe Air Tools

HOW many men who have to handle tools or machinery, operating under high air pressure, ever stop to consider the dangerous possibilities of such equipment when mishandled? Such tools are designed to be safe under all average working conditions, and, in fact most of them are made fool-proof to guard against the careless operator. In spite of every precaution in the design and manufacture of equipment of this character, however, accidents occur every day in which air tools are involved. Most of these are due not to the failure of the tool but to the man handling it.

In this issue the National Safety Council, working in conjunction with the manufacturers of compressors and air-operated equipment, points out the most important safeguards to be employed both in the maintenance and handling of this part of the shop equipment.

One of the first requirements is to install suitable guard rails and safety devices around all moving wheels and belts on compressors.

Proper lubrication, inter-cooling and after-cooling of air will avoid the danger of explosions in air receivers. Such receivers must be properly constructed according to state and boiler code standards. They should be equipped with accurate pressure gages and pop safety valves set to blow at pressures not over six percent above the working pressure. The plant management and the operators of compressor units are responsible for observing the necessary precautions in connection with this fixed portion of the equipment. The proper pipe line installation and its maintenance also come under the jurisdiction of the mechanical department. From this point on, however, the operation of individual tools is entirely up to the men in the shop.

When goggles are required to safeguard the eyes, they should be available and worn by all those within range of flying particles. Air hose should be kept in good condition so that sudden bursting cannot occur. Retaining devices for such tools as rivet busters should be employed and spring clips on rivet sets are excellent safeguards. Gloves, torn or loose clothing, should all be avoided when operating reamers, drills or other revolving tools.

These are just a few of the most obvious points to be observed in handling air equipment. A careful study of the suggestions made by the National Safety Council will repay our readers by again calling to their attention precautions which they well know but which are sometimes forgotten in the rush for production.

Feed-Water Treatment

REPORTS of boiler inspectors and insurance companies show that more than half of the boilers examined by them are affected by burned plates, defective tubes, leakage around tubes, leakage at joints, incrustation, scale, internal grooving and internal corrosion, all of which can be traced to the feed water. An amount of scale which is harmless at low rates of steaming becomes dangerous when boilers are driven so hard that the layer of scale next to the metal is dried out, causing it to become an insulator.

In locomotive boiler tubes, scale varying in thickness up to 1/8-inch causes heat losses from small amounts up to 12 percent. Among the feed-water treatments, developed to prevent scale, in use at the present time are the hot lime-soda process, the zeolite process and the lime-barium process, each of which has its relative value. The lime-barium treatment lowers the hardness of a given water considerably but will not completely prevent the formation of hard scale in the boiler. Water treated by the zeolite process is lowest in insoluble mud-forming solids but is also highest in soluble salts. On the other hand, the insoluble solids are highest with the lime-barium treatment, while the soluble salts are lowest with this treatment. The hot lime-soda process treatment comes midway between the zeolite and the lime-barium treatment.

If failures in boilers are due to corrosion, or caustic cracking they may be prevented to a large degree by the proper treatment of feed water. Such treatment must be determined by a careful laboratory study of water conditions in a given territory and the proper preventives for that condition developed.

Communications

Duo-Decimal System

To the Editor:

Here is an interesting method of figuring areas and volumes with which I dare say many of you are not familiar. It is called the "*duo*-decimal system," because—unlike the commonly known decimal system—it deals with *12ths* of a foot instead of *10ths* of a foot.

Suppose we wish to find the area of a plate 10 feet 8 inches wide and 18 feet 7 inches long. Now, by the decimal system, it is first necessary to change both of these values to decimals of a foot, thus: 10 feet 8 inches = 10.6667 feet, and 18 feet 7 inches = 18.5833 feet. We then multiply in the usual way as follows:

```
        18.5833
        10.6667
        -------
        1300831
       1119998
      1114998
     1114998
    185833
    ----------
    198.22298611 or say 198.223 sq. ft.
```

Of course it would be considered ridiculous in practical work to carry the figures, as 18.5833 and 10.6667, to so many decimal places; 18.58 feet and 10.67 feet would give us an answer which is plenty close enough, as 198.248 or say 198.25 square feet.

Even though we do reduce the number of decimal places to lessen the labor of multiplication, the result will never come out exact in any case; and besides the many decimals to deal with, we have—at the outset—the labor of converting inches to feet before the multiplication is at all possible.

By the *duo*-decimal system, however, it is not necessary to reduce the inches to foot-decimals, but simply to put down the figures as 10.8 and 18.7, which means 10 8/12 feet and 18 7/12 feet respeectively. This method of putting down the figures should appear simple at once, since 8 inches equals 8/12 of a foot and 7 inches equals 7/12 of a foot. Now multiply in the following manner:

```
   18.7 feet
   10.8 feet
   ---------
    0.5 feet
   12.0 feet
    5.10 feet
  180.0 feet
  ----------
  198.3 feet = 198 3/12 or 198.25 square feet
```

Begin at the right, as in ordinary multiplication. Thus, 8/12 of a foot × 7/12 of a foot = 56/144 of a *square* foot, which is very closely 5/12 of a square foot, so put down the 5 as shown above. But, it is not even necessary to go through all the bother of dealing with the 56/144 of a square foot, with its consequent labor of reduction; it was done here merely to show in detail the theory involved, as well as its method of operation. Just say, instead, 8 × 7 = 56, and 56 divided by 12=4 8/12 which is so close to 5 that we may call it that without appreciable error.

Next, multiply the entire figure 18 by the figure 8, which simply means 8/12 of a foot × 18 feet, and we get 144/12 square feet, or 12 square feet, even, and put down the figure 12 in the feet column as shown in the example.

We are now through with the 8/12 of a foot, and next proceed to multiply the 18 7/12 feet by the 10 feet thus:—

10 feet × 7/12 of a foot = 70/12 square feet or 5 10/12 square feet, which is written 5.10, as shown. (Be careful of the "duo-decimal" point at all times.)

Finally, we have simply to multiply the 18 feet by the 10 feet, whence we get 180 square feet direct, and put it down in its proper place in the feet column.

Lastly, we have but to add up the figures in their respective columns, to obtain the total area desired. Remembering again that the numbers to the right of the "duo-decimal" point represent 12ths of a foot, we say: 10/12 of a foot + 5/12 of a foot = 15/12 or 1 3/12 square feet. Put down the 3 in its proper place in the column, and carry the one foot over to the feet column and we have: 180 feet + 5 feet + 12 feet + (1 foot carried over) = 198 square feet and the answer required is, 198 3/12 or 198¼ square feet. Compare this with the previous results obtained by the long and laborious decimal system, and you will see how much time and temper you can save yourself on such problems in the future. I used a lot of words to make the system clear to you, but no more nor less than I could have done had I been showing you the method personally—short of guiding your hand while you held the pencil.

Now, here is an example for you to work for yourself: What is the total area of the sides and bottom of a rectangular tank, 14 feet 5 inches long by 8 feet 3 inches wide by 7 feet 10 inches high? (The tank has no cover). And, so that you won't fret too long while waiting for a check on your accuracy, I will give you a "lift" to the answer now:

Area of bottom = 118.11 square feet
Area of each end = 64.8 square feet
Area of each side = 112.11 square feet

See how close you can come to these results, and next month I will show you how to figure volumes of solids and cubical contents of tanks by the same method.

Erie, Pa. William C. Strott

Smokestack Breeching Layout

To the Editor:

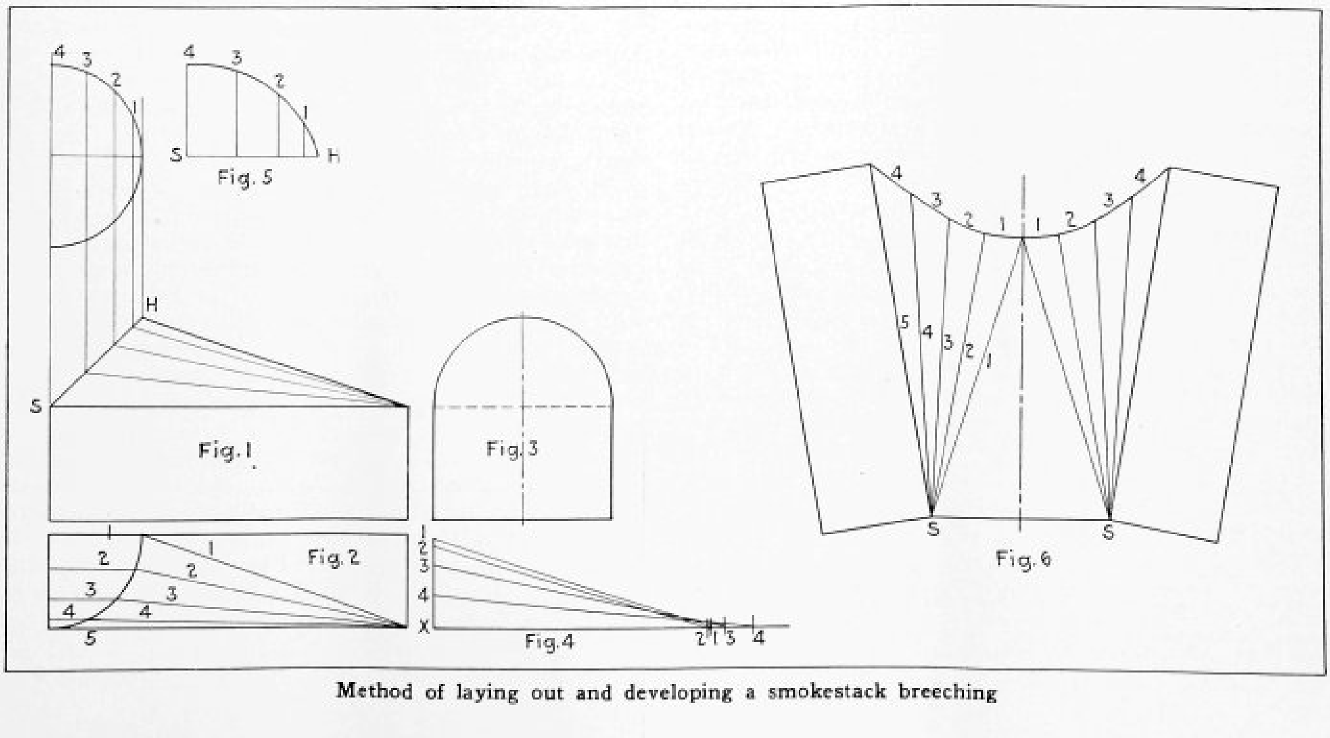
The layout of a smokestack breeching, rectangular in plan with a curved top, intersected at the center, may be of interest to the student. Fig. 1 gives the elevation of the breeching, line *S-H* showing the miter line between the stack and breeching. Fig. 2 gives the quarter plan with a quarter circle equal to the outside diameter of the stack. Divide the half circle in the elevation into equal parts and drop lines intersecting line *S-H*.

Now carry distances *4, 3, 2, 1* in the half circle over to Fig. 5, first setting off the spaces from the slope line *S-H* to straight line *S-H*, Fig. 5. Then the distances *H, 1* and *1, 2* up to *4* will give us the stretchout for the top of the breeching that goes around the stack. Divide the quarter plan, Fig. 2, as shown; erect a right angle, Fig. 4, along the vertical line; from *x* set off the lengths *1, 2, 3, 4* from the quarter circle; also set off from *x* the lines in the plan *1, 2, 3, 4* and *5*.

Set up the center line, Fig. 6, square off from bottom and make each side equal to one-half the width of the breeching, as shown in Fig. 3. Mark this distance *S, S*. Now take the dividers and set them to distance *1, 1*. Fig. 4, carry to *S* and describe arc intersecting the center line, Fig 6; take distance *H, 1*, Fig. 5 and describe circle from *1*, Fig. 6, which intersects with distance *2, 2*, taken from Fig. 4. Take up all lines in the same manner.

When line *6* has been set down, set square to points *4* and *S*, draw lines, equal in length to the height of the breeching at the square end; these lines connected up give the length of the line *5* in the plan. Laps to be allowed, also flange to circular end of breeching. Radius and bending lines are *1, 2, 3, 4* and *5*.

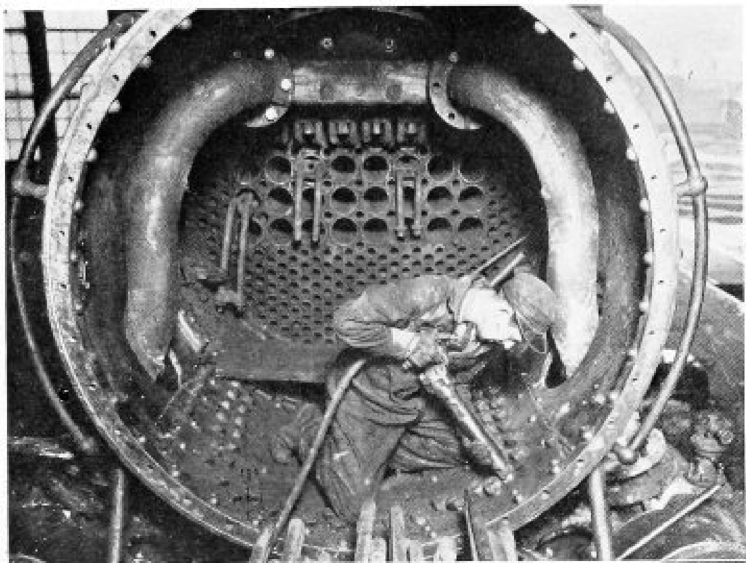
Lorain, Ohio. Joseph Smith.

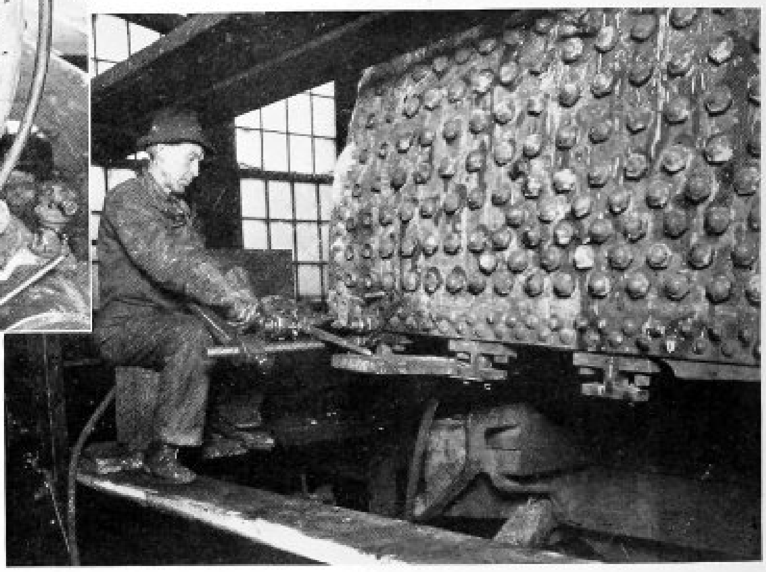


Method of laying out and developing a smokestack breeching

Promoting Safety With Compressed Air

Suggested methods for air compressors and handling tools driven





(Above) Driving saddle bolts

(Right) Drilling mud-ring corners

SAFETY is often aided by the substitution of compressed air or other mechanical power for hand labor. For example; the use of air hoists for handling materials eliminates much of the danger of pinched fingers, crushed feet, and strained backs, as well as other serious accidents.

The use of compressed air, however, introduces new hazards that can be eliminated only by proper care in installing, maintaining, and operating the compressed air equipment. Many persons have been killed or injured by explosions of air compressors and receivers, and by the introduction of compressed air into the eyes, ears and other openings in the body. These accidents have been given widespread publicity so that today considerable thought and engineering skill are being devoted to the prevention of such accidents and to the elimination of other hazards that are involved in the operation of compressed air machinery and equipment.

It is essential that compressors should be strongly built, installed on firm foundations, and securely fastened in place. Air compressors usually have extremely variable loads, for as the pressure in the air receiver fluctuates above or below normal, the compressor speed is changed or the compressor is automatically unloaded and loaded. This sudden and frequent variation of the load causes considerable vibration and imposes a severe shock upon the compressor and its foundation. The strain on the flywheel is unusually severe and special allowance should be made for it when the wheel is designed. Proper design and care of speed governors are also extremely important.

At each installation the compressor should be of such size and capacity that it is unnecessary to operate at a greater speed than that listed by the manufacturer. Excessive speed develops too much heat which increases the danger of explosion.

It is of course advisable to install guards for compressor belts, pulleys, flywheels, flywheel pits, cranks, etc. Complete enclosure is desirable, but where this is impracticable, guards should be constructed to meet the requirements.

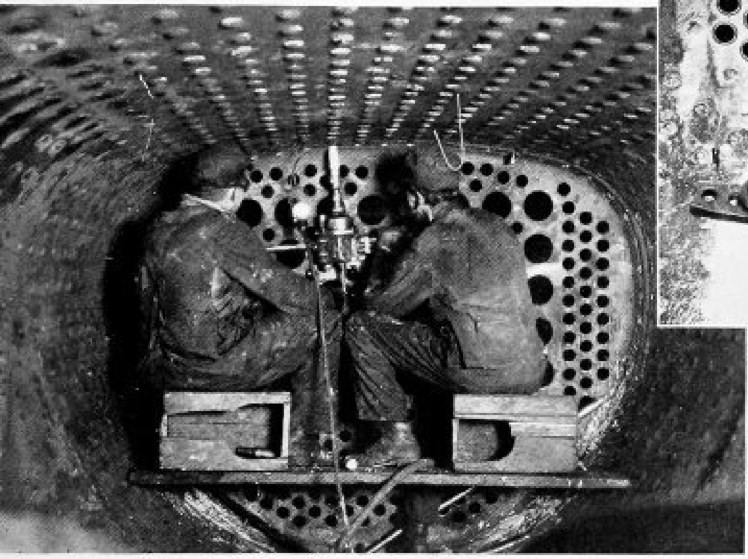
Other important points in connection with compressors are proper lubrication, cooling of air cylinder, inter and after cooling of the compressed air, and providing an intake of cool, clean air.

Air tanks or receivers should be made of boiler plate as specified in the A. S. M. E. Boiler Code, copies of which can be secured from the American Society of Mechanical Engineers, 29 West 39th Street, New York City. The Code on Unfired Pressure Vessels should be

* This article was prepared by W. Dean Keefer, director Industrial Division, National Safety Council, in collaboration with a conference committee of seventy safety engineers. Assistance in its preparation was given by the A. S. M. E. Boiler Code Committee, several of the insurance companies and by the manufacturers of compressed air machinery and equipment. Illustrations were furnished by Ingersoll-Rand Company, Cleveland Pneumatic Tool Company, The Sullivan Machinery Company and the American Car and Foundry Company.

Tools and Equipment

care and operation of
safeguards to adopt in
by high-pressure air



(Above)—Close-quarter drilling

(Left) Staybolt drilling operation

enough is known to make the best authorities recommend that special attention be given to compressor lubrication, cleanliness of the air at intake, air-cylinder temperature, and cooling the air between stages and after compression.

used in this connection instead of the boiler code. If there are state or local requirements for construction and operation, these too must be followed.

The maximum allowable working pressure of an air receiver depends upon the thickness and tensile strength of the metal, the efficiency of the joints, the dimensions of the receiver, and the factor of safety employed, as specified in the code. No air receiver should be operated at a pressure higher than the maximum allowable working pressure, except when the safety valve or valves are blowing, at which time the maximum allowable working pressure should not be exceeded by more than 6 percent.

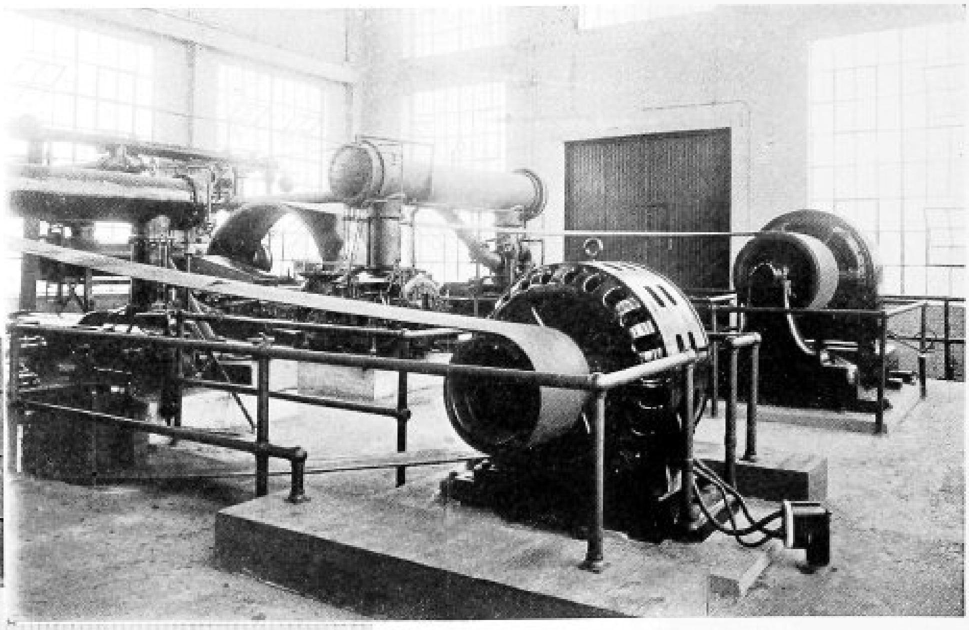
Under no circumstances should an air receiver be installed without a pressure gage and a spring pop safety valve. The size of this safety valve should be proportional to the capacity of the compressor and it should never allow the pressure in the tank to exceed the maximum allowable working pressure of the tank by more than 6 percent. The valve should be tested from time to time to see that it is in good operating condition. If the tank is located outside, the valve should have a hood over it to protect it against the weather.

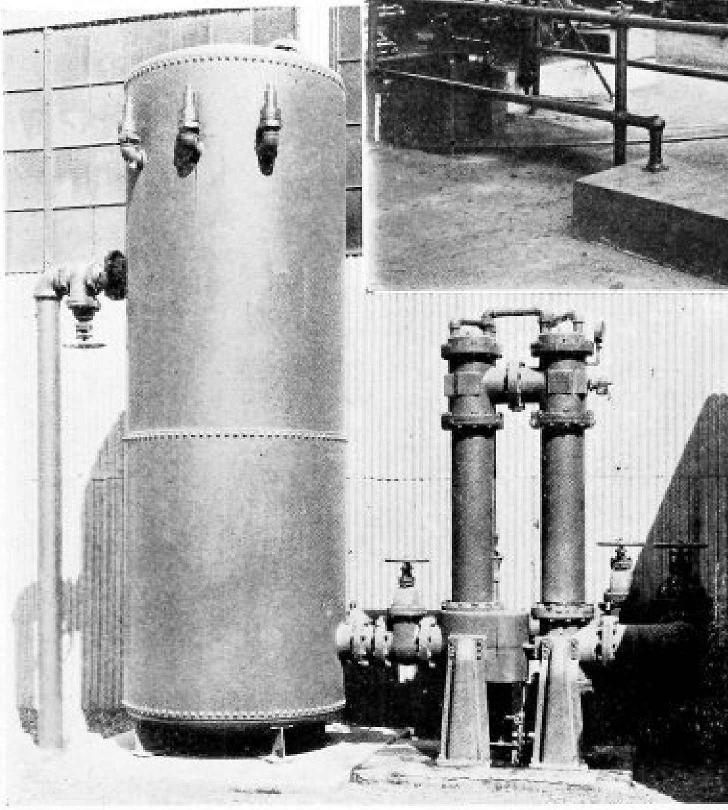
The exact causes of explosions in air compressors, receivers, and pipes are not thoroughly understood but

Some persons attribute air-compressor explosions to the volatilization of the lubricating oil and the ignition of the resulting oil vapor. Whether this is true or not, the fact remains that the temperature of the air is increased considerably in the process of compression. At a pressure of 100 pounds the temperature in an air cylinder often reaches 400 degrees F. This is sufficient to volatilize certain grades of lubricating oil whose flash points are below this temperature. (The flash point of any substance is the minimum temperature at which it gives off a flammable vapor.) When added to the compressed air, this oil vapor may form an explosive mixture which may be ignited by the temperature of the compressed air or by a glowing bit of carbon. It would therefore seem advisable in lubricating the air cylinders of air compressors to use oils that have high flash points.

It is possible that a fire or explosion may occur in the compressor or air equipment by the ignition of a flammable substance that may be mixed with air drawn in at the intake. The intake, therefore, should be located at a place where the air is pure and as clean as possible.

The air-intake pipe should be so installed that there will be no pockets for the accumulation of oil, water, or other foreign substances. These accumulations are





(Right) — Compressors with proper guard rails

(Below) — Air receiver and after-cooler for compressor plant

objectionable because they decrease the area of the intake pipe; they may also be drawn periodically into the air compressor where serious trouble may result.

Every effort should be made to reduce the temperature in the air cylinder. This will assist materially in decreasing both the volatilization and decomposition of the lubricating oil, this of course reducing the danger of fire and explosion.

In some installations fusible plugs are provided in the bonnets or other metallic parts of the air discharge valves or pipes. These plugs may act as whistle warnings or they may be arranged to relieve the air pressure automatically in case the temperature of the compressed air exceeds a certain maximum—perhaps fixed at 350 or 500 degrees F., depending upon the size and type of the compressor used.

All manufacturers in selling air compressors specify a certain maximum speed for each machine. It is advisable not to exceed this maximum speed; otherwise unnecessary and undesirable heat is developed which increases danger of fire and explosion.

In some installations, particularly if the air is to be compressed to 75 pounds pressure or more, it may be desirable to operate two-stage compressors. A two-stage unit makes it possible to operate an inter-cooler, to cool the air between the first compression which raises the pressure of the air from that of the atmosphere to approximately 30 pounds and the second compression which raises the pressure of the air from 30 pounds to 100 pounds or to pressure capacity of the machine. Compressing the air to 100 pounds pressure may raise its temperature to 480 degrees F. High temperatures are objectionable as already explained.

Many installations provide special apparatus for cooling the air after compression. This prevents further vaporization and carbonization of the particles of lubricating oil carried over from the air cylinder, it tends to condense some of the oil that has already vaporized and also condenses much of the water vapor contained in the compressed air.

Only high-grade pipes should be installed in compressed-air systems. Pipe lines should be free from sharp bends and strongly secured in place to withstand the pulsation and vibration to which they are subjected. Provision should also be made for the expansion and contraction of the piping, because in some air lines the range of temperature is as great as in steam lines. On account of the danger of workmen being burned, it may be advisable to guard or cover the discharge pipe near the compressor.

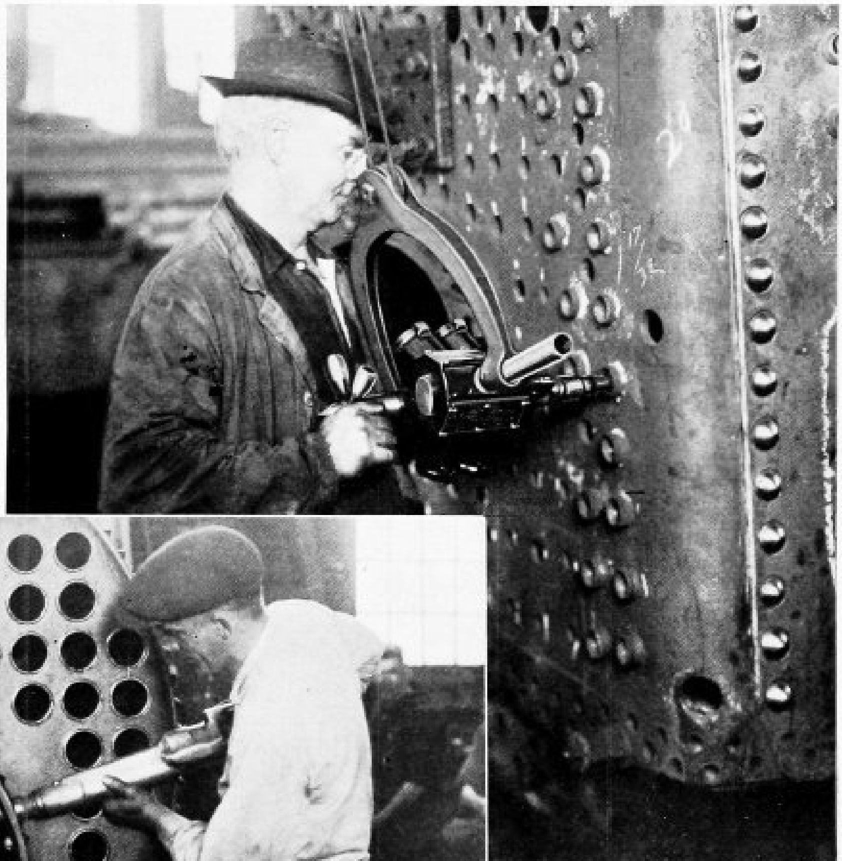
Where flexibility is desired, as in connecting portable tools to the air line, good quality hose made for this special purpose is used. Some grades of hose are protected against kinking and excessive wear by a spiral wrapping of strip metal or wire. Care must be exercised, however, to see that the hose is free from sharp projections or broken ends of this metal wrapping, particularly near the operating end; it may be advisable to wrap the hose at such spots with heavy tape or some other smooth covering. One objection to metal armored hose is that it may become dented and thus obstruct the flow of air. Every effort should be made to keep the hose out of the aisles and passageways where it may form a tripping hazard and where it may be stepped on by workmen or run over by trucks, wheelbarrows, etc. Such abuse weakens the hose considerably.

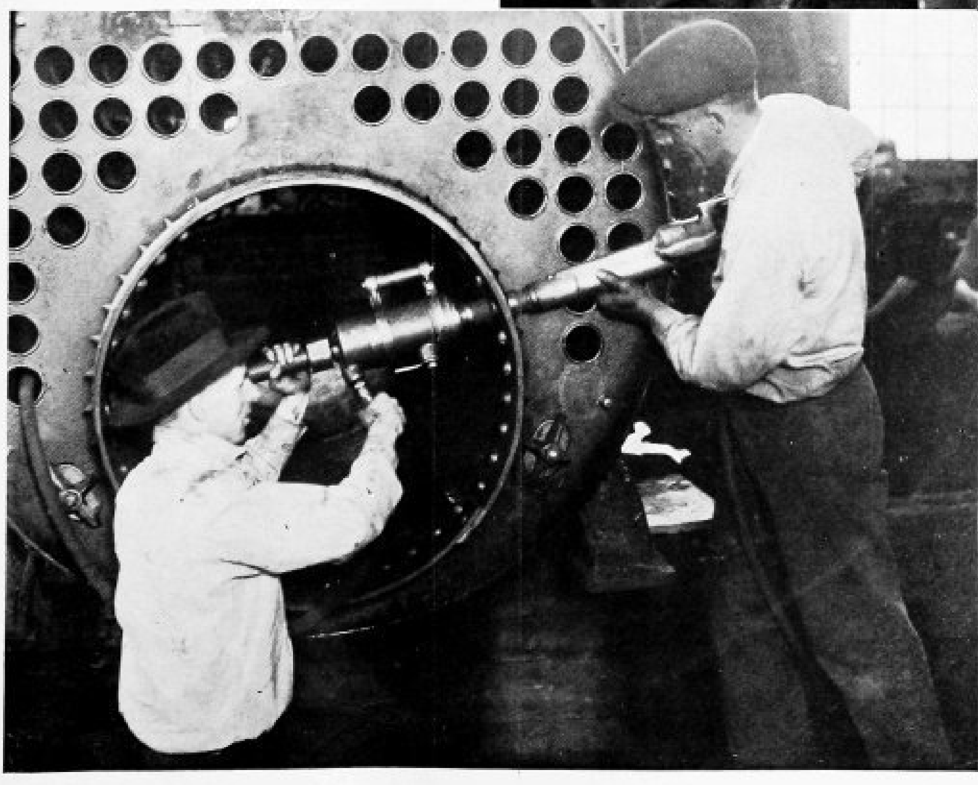
All air lines (both pipe and hose) should be inspected at regular and frequent intervals, and all defects remedied immediately. Many workmen have been seriously injured by the sudden rupture of air lines and every precaution should be taken to prevent the recurrence of such accidents. In some cases the rupture of a pipe may even cause the air receiver to burst with the resulting danger of fire or explosion. Workmen should be particularly careful when connecting a portable hose to a permanent pipe outlet. If the connection is not well made, the hose may become disconnected and "kick" around, causing injury to men nearby.

Although it is advisable to locate compressed-air lines (and receivers) in cool places, the possibility of their freezing in winter should also be taken into consideration. Freezing is objectionable because it decreases the efficiency of the pneumatic system and because the expansion of water when frozen may even burst the pipe. Thawing out a frozen air line is difficult and increases the danger of rupture, fire, and explosion. If thawing must be done, it is usually best to use hot air or the heat radiated from steam pipes. A direct fire should never be used; this may volatilize any oil that may be in the pipe, it may injure the pipe if held too long at one place, and may ignite any oil mist or spray that might be liberated from a leaky or ruptured pipe.

Under no circumstances should the operator of a portable air drill or reamer wear gloves. Many serious accidents have resulted when workers' gloves have caught on the revolving tools. Loose or torn clothing is objectionable for the same reason. Operators should keep the tools in good condition and be especially careful that the bits are ground properly with uniform flutes. If one flute is longer or deeper than another the bit may stick in the hole and cause the machine to become unmanageable. Another frequent cause of the bit sticking is feeding the machine too fast. The machine should be aimed or pointed straight at the hole, not tipped; if tipped, the bit is almost sure to stick.

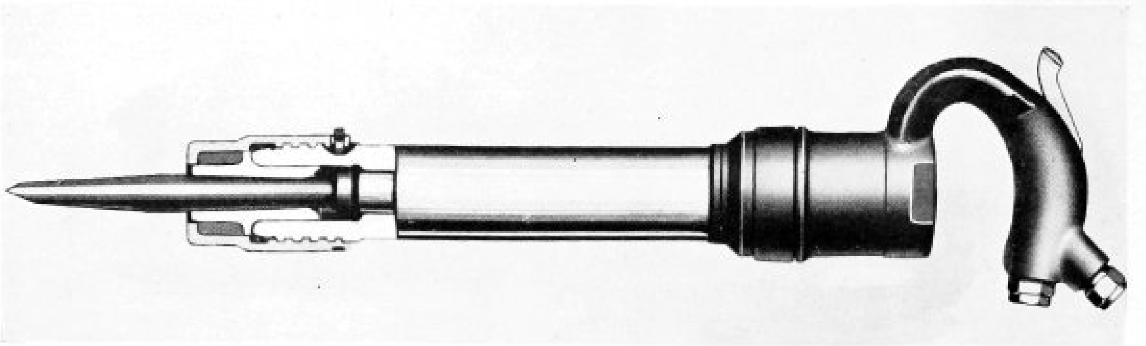
Unless he is careful and prepared for the unexpected, an operator may be seriously injured if the bit sticks in the hole. It may cause him to lose his footing and fall, the sudden jerk may break one or both arms, or the handles when torn from his grasp may revolve and strike his body one or more severe blows. It is advisable to have two men—and not one—operate the larger portable air drills and reamers. Each operator should hold a handle, being careful to stand in the clear so he will not be injured in case the machine should become unmanageable. Some workmen use a piece of pipe to slip over the control valve to keep the machine in operation. This makes it unnecessary to keep their fingers on the valve. It is dangerous, however, to do this for if the handle of the machine is torn from the operator's grasp, considerable damage might be done before he could release the pipe and stop the machine. It is best to operate the control valve by hand, then the air will





(Above)—Such supports relieve the operator

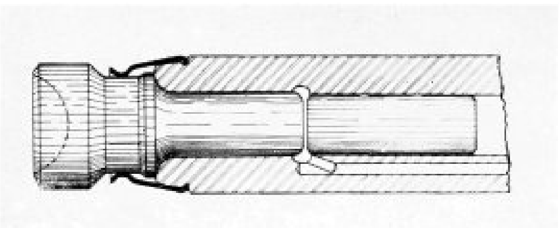
(Left) — Making hand riveting safe



Rivet buster with safety retainer

be shut off and the machine stopped automatically as soon as the handle is pulled from the operator's grasp.

Many air hammers and other pneumatic machines operating reciprocating tools, such as riveters, hammers, calkers, etc., are equipped with devices to hold the tools in the machines. Without such devices, the tools may be projected from the machines like shot from a gun and severely injure anyone whom they may hit. Workmen should not point the machines at anyone, nor should they stand in front of operators handling pneumatic hammers even though they are equipped with safety tool holders.



Riveter fitted with safety clips

With some pneumatic hammers it is possible for the piston as well as the tool to be "shot" out. This hazard however, has been eliminated by several manufacturers who have designed hammers to retain the pistons without any possibility of their coming out accidentally.

Some men complain that when using air hammers continuously, certain fingers and parts of the hands and arms temporarily become numb or "go dead." The report, however, of an investigation conducted by the United States Public Health Service indicates that in no case has trouble of this kind resulted in permanent injury. Furthermore, the trouble seems to be more marked in cold weather and in work places that are not properly heated in winter time. Some operators use rubber, asbestos, or some other substance that is a poor conductor of heat and cold, to protect their hands from the cold of the metal hammer.

It also seems that the hammers which strike the most frequent blows give more trouble in this respect than do the slower-acting hammers. Then, too, the older and more skillful men have fewer complaints than the younger and more inexperienced men who perhaps grasp the hammer and tool too tightly. The trouble can also be decreased by providing only those hammers in which the tool is held mechanically and does not require the operator to hold it by hand. Another important factor is the habit some men have of controlling the air exhaust by pressing the thumb or forefinger over the exhaust hole; this is unnecessary and undesirable.

There is also danger of the control valves of pneumatic drills, reamers, and hammers being operated accidentally. A workman may be carrying a portable air machine and accidentally close his hand on the control valve, or he may strike the valve against a nearby object. If the machine is placed carelessly on the floor, the valve may be kicked, or it may be operated by the action of some object falling against it. Particular care should be exercised in handling or laying down pneumatic machines. The danger of accidental starting is decreased if the operating trigger is inside (not on top of) the handle. Some machines have locks or devices to prevent the accidental operation of the control valves.

Accidental starting is also often caused by leaky valves. It is essential, therefore, that all valves be inspected regularly and repaired, or if necessary replaced at once. Leaks may result from corrosion due to moisture in the compressed air, so every effort should be made to remove any moisture that may be present. Some companies suspend portable pneumatic hammers in light oil or kerosene when not in use. This prevents corrosion and insures adequate lubrication.

High-Test Gas Welding Rod

THE ever widening scope of oxy-acetylene welding, especially as applied to the production of such highly stressed structures as modern, high-pressure pipe lines for the transmission of oil and natural gas; power plant headers and piping; pressure vessels; and airplane fuselages has created a definite need for a means of producing welds of uniform high strength.

This demand was recognized by the Oxweld Acetylene Company some years ago. The problem was attacked by the Union Carbide and Carbon Research Laboratories, Inc., New York, who, with the object in view of obtaining a weld metal equal or superior in physical properties to commercial grades of steel used for welding, and realizing the importance of the composition of the welding rod in securing this result, produced in 1922 the Oxweld No. 1 high-test patented steel welding rod.

The development and use of this welding rod has considerably broadened the field of oxwelding and has greatly stimulated its application to the fabrication of pressure vessels and other high-strength equipment.

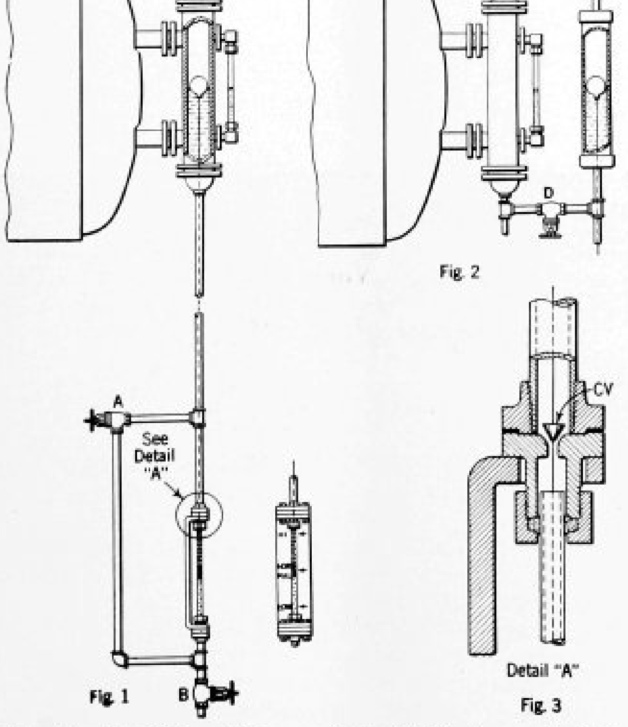
The properties of this rod may best be illustrated by a comparison with the two other grades of steel welding rod in general commercial use; low-carbon steel (or Norway iron) rod and mild-steel rod. Much more carbon is removed from the mild-steel rod than from the low-carbon steel rod during welding; therefore, the difference in composition of the weld metal obtained from these rods is slight. The carbon is removed by combination with oxygen, and the carbon monoxide or dioxide formed may result in blowholes in the weld metal. By this removal of carbon the most valuable strengthening element of the steel is lost.

The virtues of No. 1 high-test rod are imparted to it by the deoxidizing or reducing agents, manganese and silicon, particularly the silicon. When this rod is used for welding, both manganese and silicon are oxidized at the same time. Silicon is inherently more easily oxidized, but the manganese is also oxidized because it is present in greater amount. The oxides formed, together with some iron oxide, combine to form an iron-manganese silicate that readily floats to the surface in the form of a slag, which, although extremely shallow, protects the molten and cooling metal from the oxidizing action of the surrounding atmosphere, and thus keeps the amount of oxidation at a minimum. The presence in the specified proportions of manganese and silicon, which have greater affinity than carbon for oxygen (either as such or in the form of oxides) largely prevents the union of oxygen with carbon during the deposition of the weld metal. Thus sufficient carbon content of the weld metal is retained and the evolution of harmful carbon monoxide and carbon dioxide gases prevented.

Water-Level Indicator

A SIMPLE device which permits the placing of water-level indicators at any desirable location or elevation has been recently put on the market by Combustion Engineering Corporation, New York.

Fig. 1, shows how this water-level indicator operates and why it is possible to situate it at any convenient



Water-level indicator that can be installed at any desirable location on the boiler

location. The usual water column is shown connected to the boiler drum. Inside the water column is a non-corrosive float suitable for the maximum working pressure for which the boiler is designed. This float is direct connected by means of a non-corrosive wire extending downward through a small pipe to an indicator in the water glass. The circuit around this indicator is filled with cold water which has no corrosive effect on the glass.

The indicator is so adjusted that when the float in the water column on the drum is in its normal position, the indicator within the lower glass is also in the center of the glass, its normal level condition. The indicator consequently fluctuates correspondingly with the up and down movement of the water-column float at the drum.

It is possible to locate the indicator to meet any local conditions. If it is not practical to drop the indicator vertically from the water column on the drum, arrangements are easily made whereby the water column can be placed inside the drum, or, as shown in Fig. 2, horizontal extensions of any length can be made to bring the water column to any desired position.

To prevent leakage in case the water glass should be broken, an automatic shut-off valve is placed in the circuit directly above the glass. This conical valve is attached to the wire between the water column and the water level indicator in such a position, as shown in Fig. 3, that when the glass is broken, and the water released, the valve is forced into the valve seat thus closing the cold water circuit.

After a new glass has been put in place, valve A, Fig. 1, is open, valve B remaining closed thus equalizing the pressure above and below the valve. The float then returns to the position of the water level and in so doing, lifts the valve CV which allows the water to again fill the indicator gage glass.

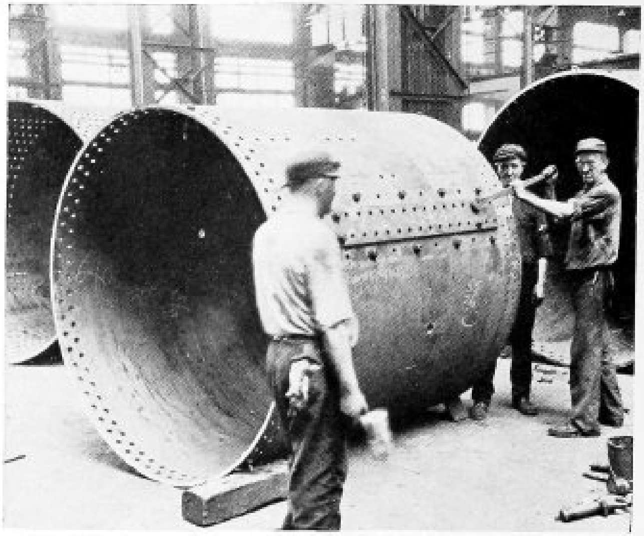
The device is especially desirable from a convenience standpoint and also, because it operates in a cold water circuit, it eliminates the continual replacing of glasses on ordinary water columns, which are eaten away and broken by the corrosive action of the hot water. By having cold water only, in contact with the glass, the usual round glass is suitable for exceedingly high pressures.

The C-E water level indicator can be installed in conjunction with, or separate from, the regular high and low-alarm signal system.

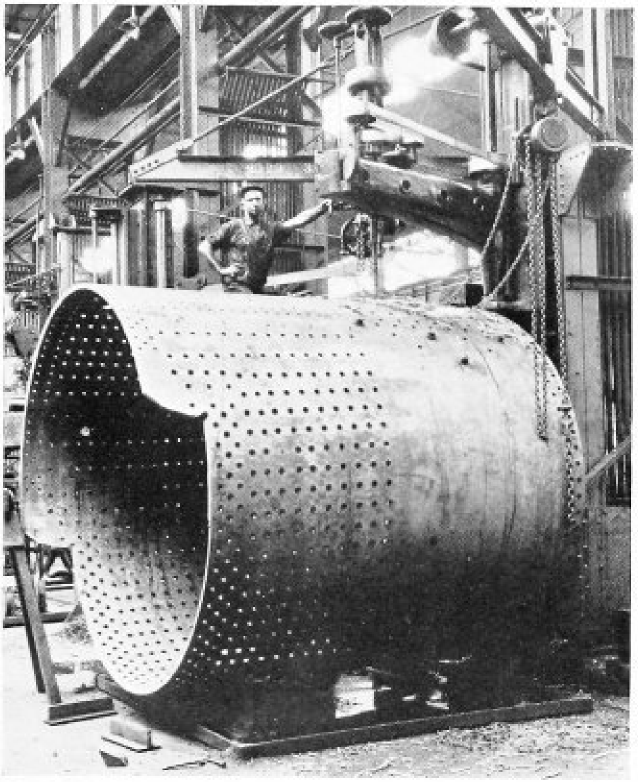
Conrad G. High, who for the past ten years has been associated with the Penn Planing Mill Company, Reading, Pa., has been appointed to the sales staff of the Reading Iron Company, Reading, Pa., district office. A. C. Knight, formerly of the Oversole Rubber Corporation, New York city, has been added to the selling staff of the New York office.

The Prest-O-Lite Company, Inc., has recently added two new acetylene-gas plants located at 540 E. 17th street, Wichita, Kansas, and at Jones street and Pennsylvania R. R., Youngstown, Ohio. These plants will supply local industry with dissolved acetylene for oxy-acetylene welding and cutting. H. Wilson is superintendent of the Wichita plant, which commenced operations on June 28, and W. Webert, whose headquarters are at the North Kansas City plant, is district superintendent. A. C. Mattison is superintendent of the Youngstown plant, which commenced operations on July 3, and C. G. Holt, whose headquarters are at the Pittsburgh plant, is district superintendent.

Bolting up the butt straps of a cylindrical course



Dome course set up in a radial column drill



Fabricating Boiler

Drilling and riveting plant of The Baldwin

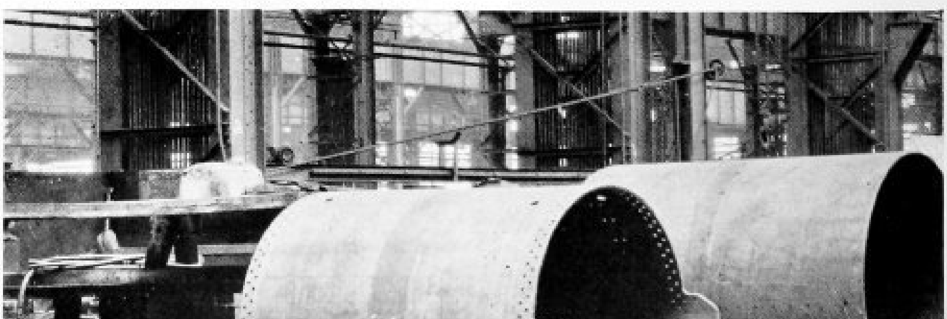
IN following the processes of boiler construction employed at the plant of The Baldwin Locomotive Works, Eddystone, Pa., the methods employed in the assembly of the boiler courses may be observed in the upper section of bay No. 8. It is in this area that the rims are drilled and welded and the butt straps shaped and fitted. The various courses are assembled from the sheets rolled in bay No. 10 and these rims, from the smokebox to the dome course, are joined, forming the barrel of the boiler.

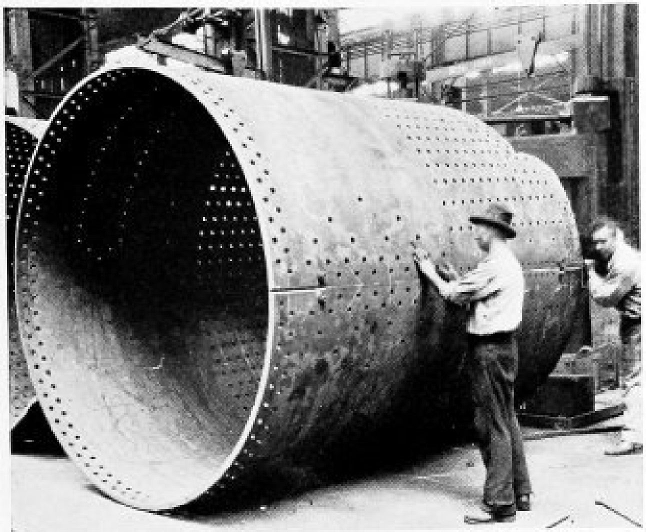
The two departments that prepare the rings for assembly occupy an area of 32,640 square feet extending between panels one and seventeen. The equipment which includes machinery of the latest type, consists of 24 machine tools, a tabulation of which is given together with the layout of the department on page 258.

At the upper end of the bay which is served by two 25-ton Niles-Sellers overhead cranes, assembly is begun by fitting the butt straps to the first course. The inside butt strap is rolled to the correct curvature of the course while the outside strap is shaped to the radius of the boiler on a 100-ton hydraulic buttstrap press located in panel 1.

Prior to fitting the butt strap, holes in the course adjacent to the joint are lined up and checked for lap and pitch. The longitudinal seam edges of the course are fastened together by a number of small steel straps held by bolts. The boiler course is then taken to a welding booth located in panel 12 where the beveled edges of the joint are arc welded to prevent leakage along the butt strap joint. These welded joints are located at each end of the course.

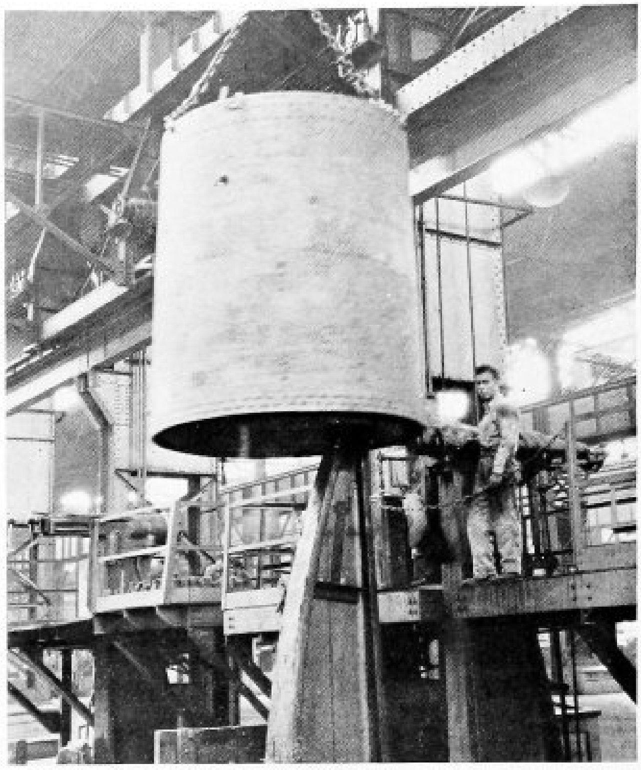
After the weld has been made, the joint is chipped and





Lining up the rivet holes at a butt joint prior to welding

Riveting the butt straps in a 68-ton hydraulic bull riveter



and Fitting Shells

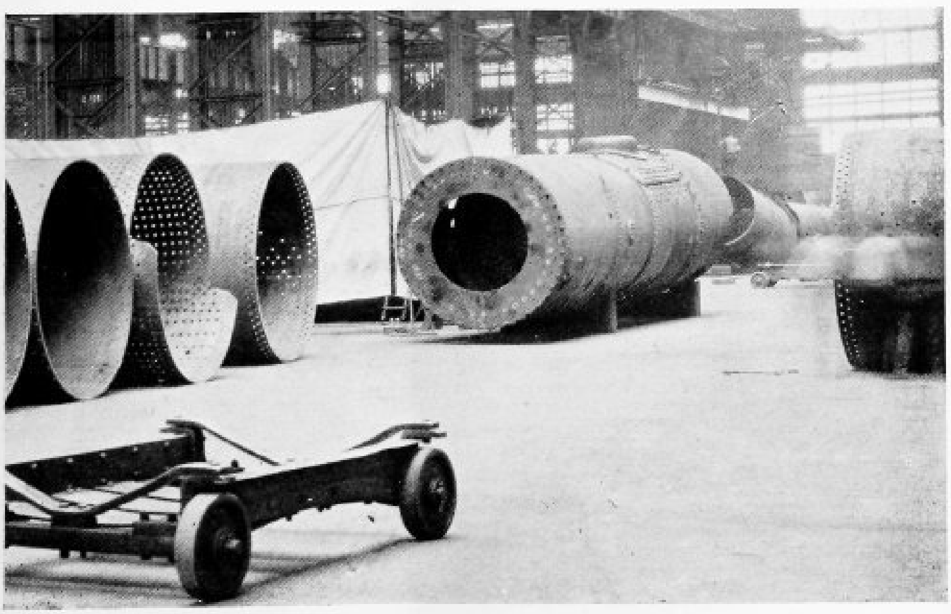
rings at the Eddystone Locomotive Works

ground to remove burrs and projections on both the joint and rivet holes. The straps are bolted in place, reamed and then riveted by means of the hydraulic bull riveters.

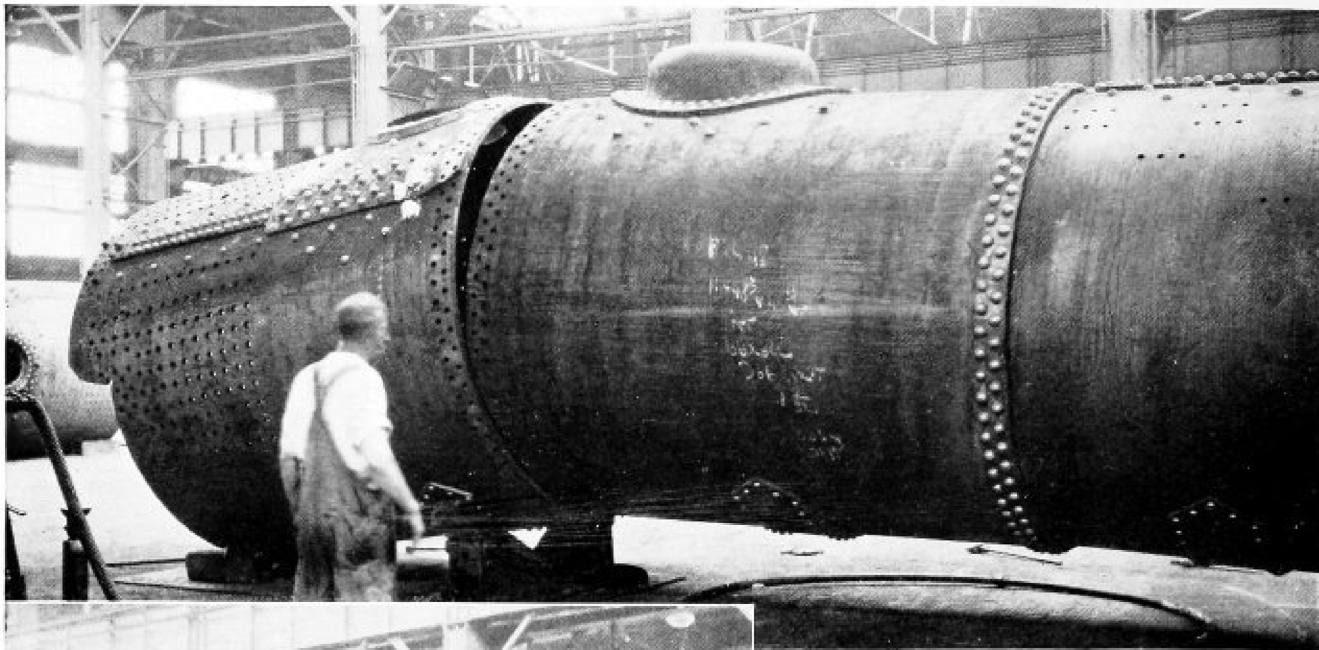
The tube sheet is next assembled to the first course. This consists of bolting up the plates, reaming and riveting. It is the custom in bolting up all parts of the boiler to bolt up every other hole so that the sheets will be knife-tight before reaming and riveting.

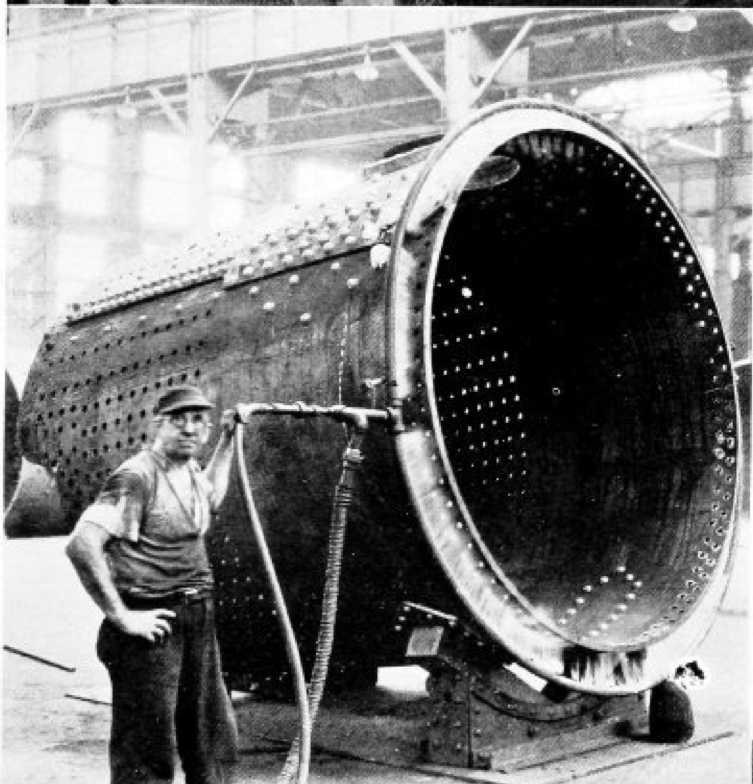
Prior to its assembly in the boiler, the smokebox is fabricated. The smokebox ring, a forging manufactured outside the boiler shop, is laid out on the assembly floor; the outside holes are drilled to size on a radial column drill and the holes on the flat portion are drilled on a regular radial drill. This ring is bolted, reamed and riveted to the smokebox sheet, after which the entire length of the longitudinal smokebox seam is arc welded. The liner in the bottom of the smokebox course is riveted, then the course is ready for assembly. The smokebox is applied after the tube sheet is in place.

For ease in assembling tube sheets in the boiler courses as well as for assembling one rim upon another, a ring heater consisting of a circular piece of 1½-inch diameter gas pipe is used. This pipe is about 6 inches larger in diameter than the boiler course and is placed around the course at the circumferential lap. Along the inner circumference of the gas-pipe ring are innumerable holes through which a mixture of gas and air are emitted. The gas is ignited and the flame is allowed to play on the plate for about 10 minutes. When



General view of the rim welding and butt strap fitting floor





the lap is in a heated state, it is slid on over the adjacent course. The rim contracts due to cooling and a tight joint results.

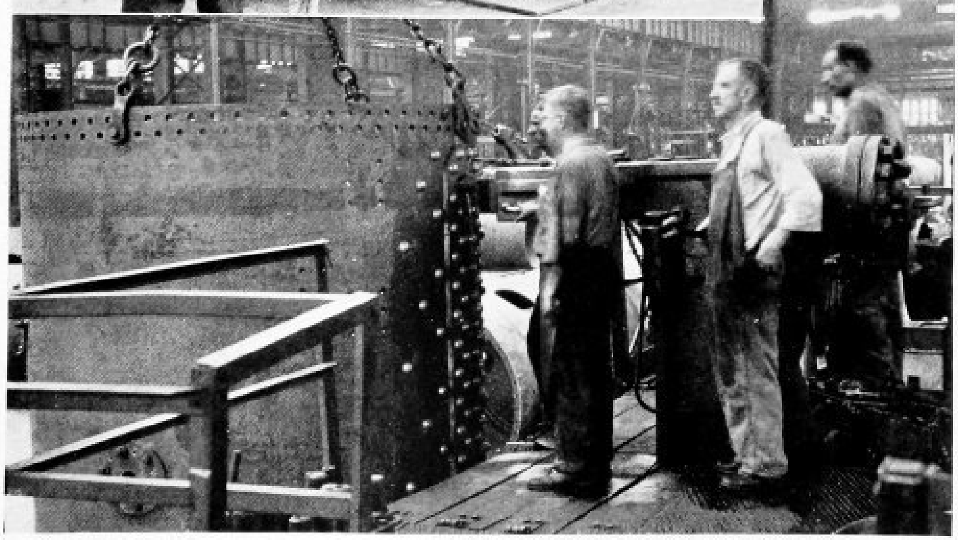
The second course is fabricated similar to the first course and is riveted to that member.

(Above) — Fitting the courses to the boiler barrel

(Left) — Preheating the lap of a course prior to fitting to the barrel

(Below) — Riveting butt straps on a 123-ton hydraulic riveter

The dome ring is fabricated similar to the first course up to the point where the dome is installed. The dome liner is clamped to the inside of the course and the course is transferred to a radial column drill where the holes in the liner and shell are drilled before the dome is put on. When this is done, the dome is set up and two holes on the front and back center line are marked off; the dome is slid back and the holes are drilled. The dome is put back in place and bolted. With the dome as a template, the remaining holes are drilled.

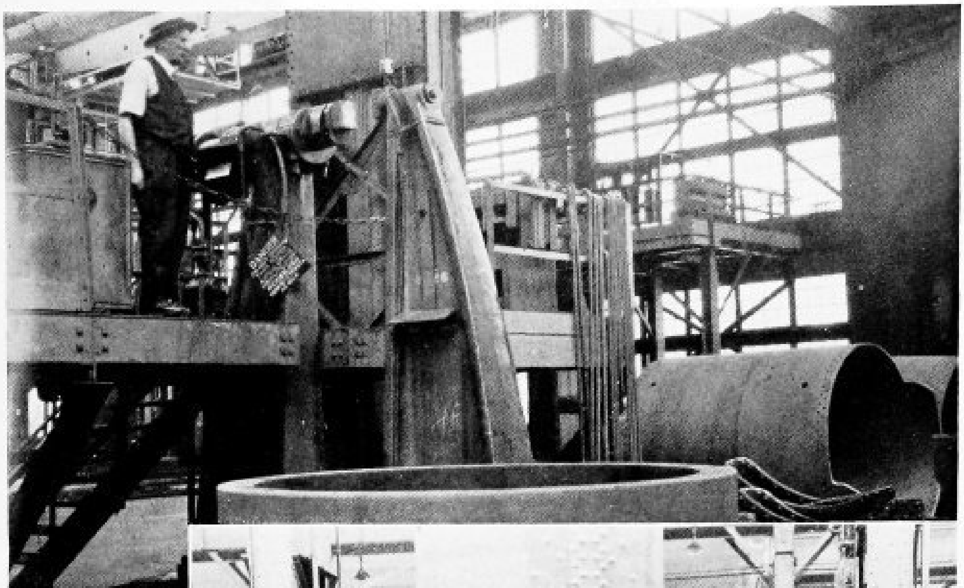


The dome and liner are next removed, dirt and burrs being eliminated by grinding. The hole is burned through the course and liner into the dome chamber. The dome, liner, and course are then reassembled and bolted up, reamed and bull riveted. When the dome is bolted up, every other hole is fastened to draw the work up tight before riveting as is done with the other sections.

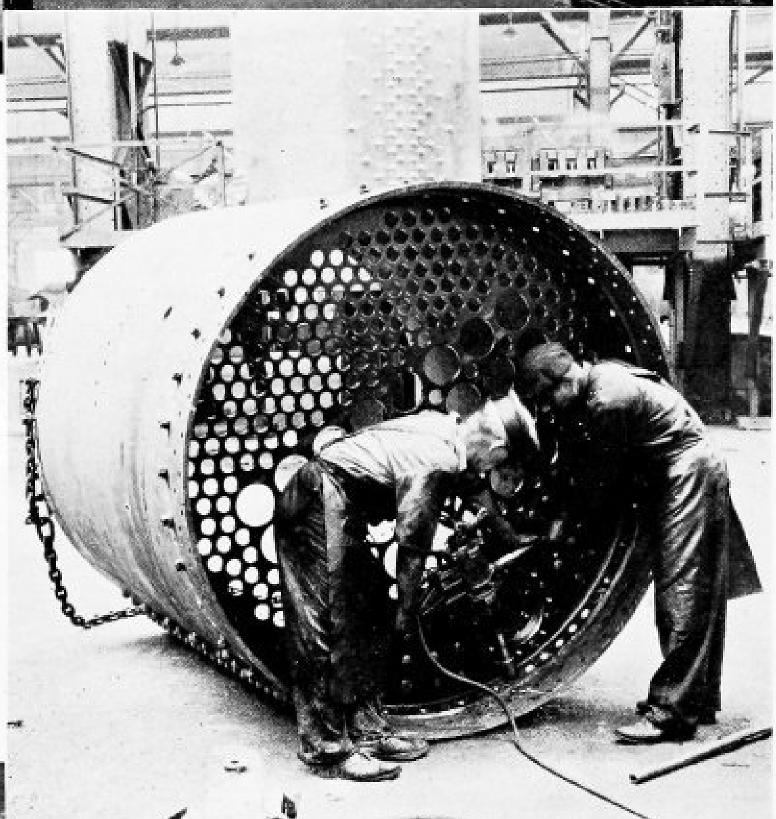
The radial column drills are each served by two hand-jib cranes. Below each drill and mounted on two tee bars are two frames each of which support two rollers, four in all. The boiler course is placed in the rollers and chain falls from each jib crane are attached to the course at either side. By the use of the falls, the course can be rotated in any position to facilitate the work. A platform at the side of the course serves as a workman's stand.

The flanges on taper courses are set by the use of tire steel rings over which the course is placed for a flange at the large end of the taper and inside of which the course is placed for a flange at the small end of the taper. The ring and course are placed in a hydraulic bull riveter with the proper die and the course is pressed against the ring. By moving the ring step by step around the circumference the flange is formed cold. Many rings of various sizes are available; each ring handling courses of six inches diameter variance. After the various rims of the boiler are finally applied and the boiler barrel is finished, it is delivered to bay No. 5 for back head application.

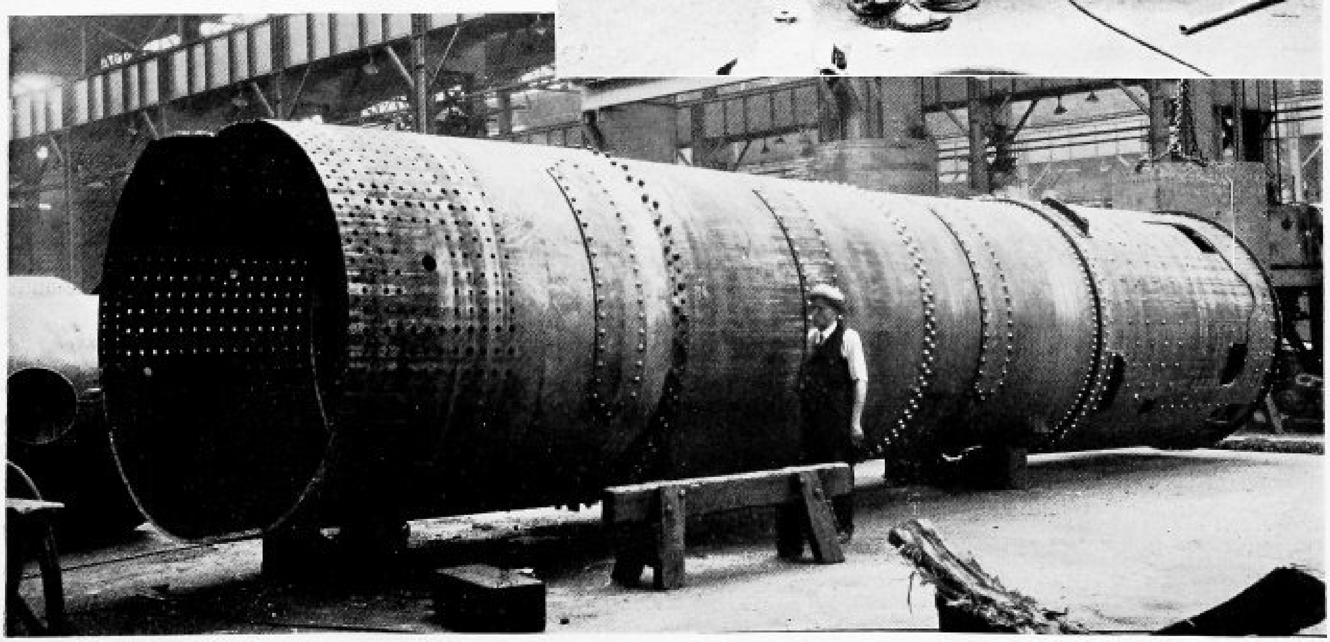
The methods employed at The Baldwin Locomotive Works represent the results of the most modern ideas in regard to flow of materials. In the case of this plant, materials move in a constant direction, eliminating unnecessary transportation.



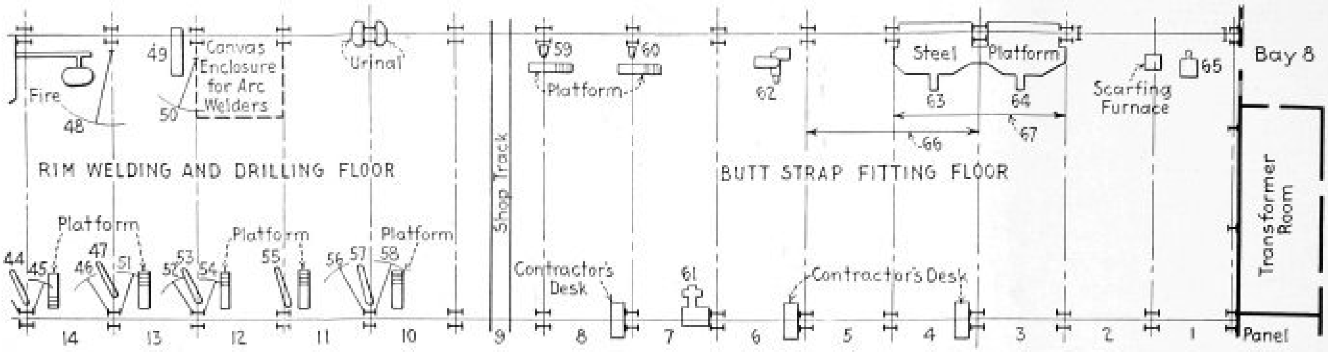
(Above)—Bull riveter set up for flanging conical courses



(Right) — Countersinking the rivet holes in a tube sheet flange



(Below)—The assembled barrel ready for transportation to bay No. 5 for fitting



Machinery located on the rim welding and drilling floor and the butt-strap fitting floor in the upper section of bay No. 8

44 Sellers 72-inch radial column drill motor on bracket on building column, belt drive.

45 Baldwin 1½-ton hand jib crane having an 8-foot reach.

46 Baldwin ½-ton hand jib crane having a 10-foot 4-inch reach.

47 Harrington 84-inch radial column drill, motor on separate stand, belt drive.

48 Baldwin 3-ton hydraulic crane having a 20-foot 6-inch reach.

49 Baldwin 70 and 100 tons hydraulic gusset flattener, 15-inch gap.

50 Baldwin 6-ton hand jib crane having a 16-foot 9-inch reach.

51 Baldwin ½-ton hand jib crane having a 10-foot 4-inch reach.

52 Baldwin 1¼-ton hand jib crane having an 8-foot reach.

53 Sellers 72-inch radial column drill, motor on bracket on building column, belt drive.

54 Baldwin 1¼-ton hand jib crane having an 8-foot reach.

55 Sellers 70-inch radial column drill, motor on bracket on building column, belt drive.

56 Baldwin 3-ton hand jib crane having a 12-foot 6-inch reach.

57 Harrington 72-inch radial column drill, motor on bracket on building column, belt drive.

58 Baldwin 3-ton hand jib crane having a 12-foot 6-inch reach.

59 Sellers 1¼-inch hole column drill, motor on bracket on building column, belt drive.

60 Sellers 1¼-inch hole column drill, motor on bracket on building column, belt drive.

61 Hilles & Jones No. 3 shears, motor on machine, direct drive.

62 Harrington 48-inch radial drill, motor on separate stand, belt drive.

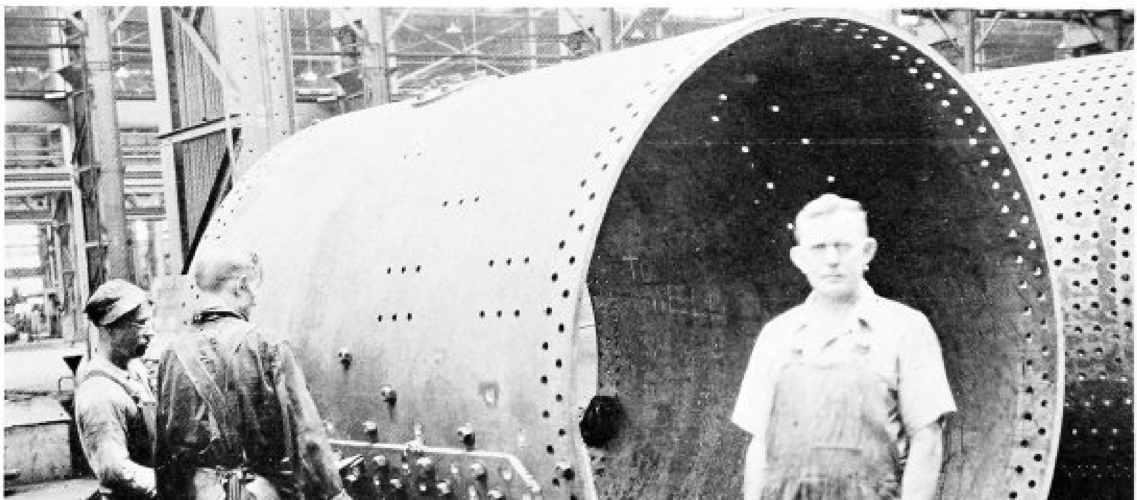
63 R. D. Wood 123 to 35-ton hydraulic bull riveter with 12-foot 3-inch stake.

64 Sellers 68-ton hydraulic bull riveter with 10-foot stake.

65 Southwark 100-ton hydraulic butt-strap press.

66 Milwaukee Type A 7½-ton wall crane with remote control, motor on machine, direct drive.

67 Milwaukee Type A 7½-ton wall crane with remote control, motor on machine, direct drive.



Reaming the butt strap rivet holes on a boiler course

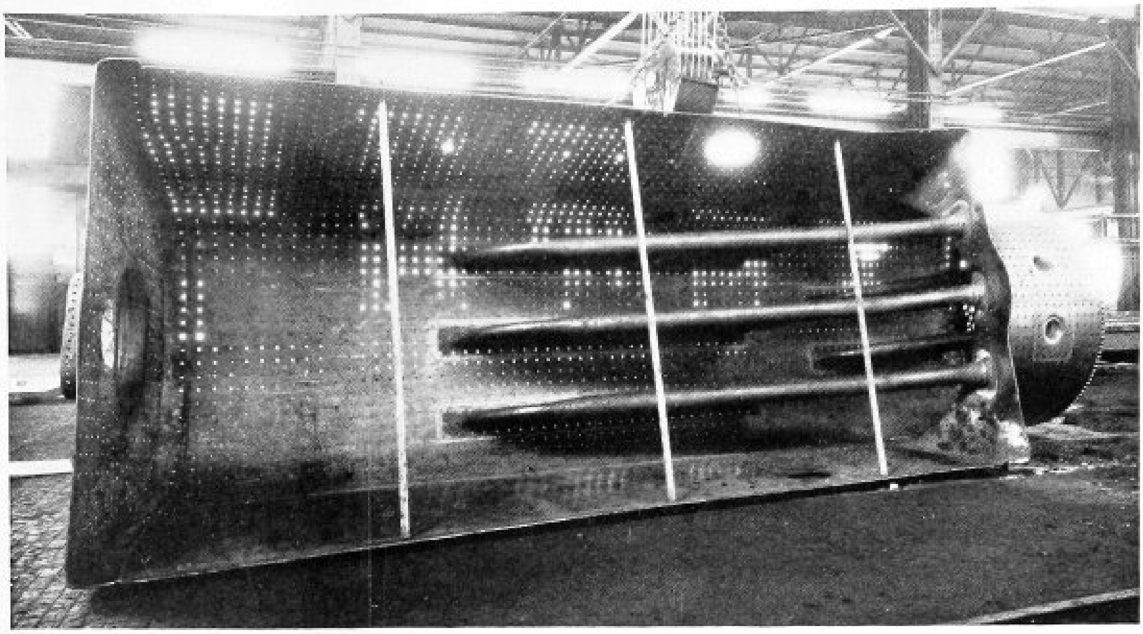


Fig. 62.—Firebox equipped with five thermic syphons

Locomotive Boiler Construction-XIII

Fitting up throat and backhead sheets—Assembling crown, sides and combustion chamber sheets—Applying thermic syphons

By W. E. Joynes*

WHEN fitting up the throat and backhead sheets, the center line of the throat sheet is located on the same by tramming before the throat sheet corners are laid up to the firebox ring.

A rivet hole is located in the seam of the back flange near the top, for bolting the casing (roof sheet) in place. This is necessary for marking off the front seam rivets of the casing on the back flanges of the throat sheet. This rivet hole is located by wheeling or measuring, with a thin metal strip, the outside diameter of the back shell course from the bottom center to the center line of the course. This measurement is then run off on the inside of the throat sheet front flange. The location of the rivet hole near the top of the back flange is then measured from the shell center.

The center firebox ring rivet hole is next located on the center of the throat sheet and drilled. The vertical location of this rivet hole on the throat sheet is marked from a bar template shaped to the inside surface of the center section of the sheet.

A drift pin through this hole locates the sheet on the firebox ring for laying up the corners, which is the next operation. The sheet is also rigidly clamped at each side of the ring in addition to being held in place at the center with the drift pin and is held clamped to the ring after the corners have been fitted. The backhead corners having been previously fitted to the ring for the purpose of fitting the firehold flange this sheet is ready to be bolted to the ring.

The backhead and throat sheet being respectively bolted and clamped to the firebox ring (wide firebox boiler), the roof sheet is raised with the overhead traveling crane (lifting hooks at the top of the

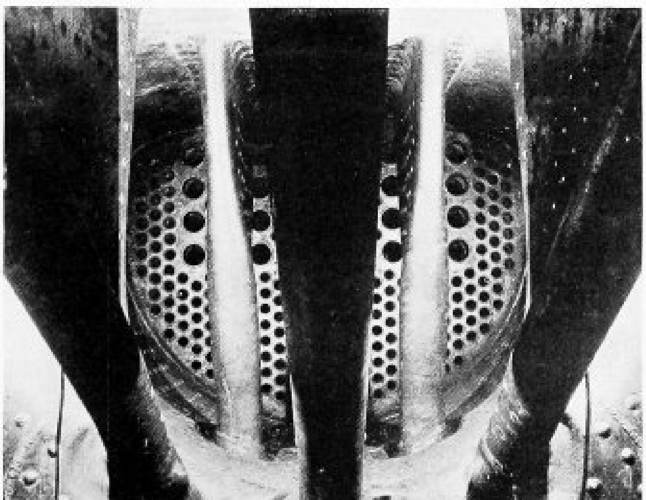


Fig. 63.—Method of connecting syphons

* Boiler designing department, American Locomotive Works, Schenectady, N. Y.

front and back end) and lowered over these sheets. The front end of the casing is lowered until the rivet holes which have been drilled near the top of the throat sheet come in line with the corresponding holes of the casing, then bolts are applied.

A drift pin in the top rivet hole at the back end of the casing and into the corresponding top rivet hole which has been previously located and drilled in the flange of the backhead, draws the backhead into place at the top of the casing. The casing is then bolted to the firebox ring.

The backhead and the throat sheet are rigidly clamp bolted into place and the seam rivets in the casing are marker punched on the flanges of these sheets.

The firebox ring rivet holes are also marker punched on the backhead and throat sheet for drilling.

The casing and flange sheets are now disassembled for marking off the staybolt holes (from a metal template) on the throat sheet, locating the washout plug holes in the corners, drilling these holes and the flange rivet holes and trimming and chipping the rivet lap of the back flanges.

The backhead corner washout plugs are located. These holes and the flange rivet holes are drilled, the rivet lap marked off, trimmed and chipped.

The tee iron braces and crow feet are next bolted in place, the rivet holes reamed for riveting and then riveted with the bull riveter.

When gusset braces are used the angle iron connections are not bolted to the backhead for riveting until after the backhead has been bolted in the casing for the gusset plates to be heat-fitted to the casing.

Assembling a Crown, Sides and Combustion Chamber Sheet Made of Four Plates, Welded Together

Six-inch by one-half inch tie straps, with the alternate staybolt holes of the rows adjoining the seam joint drilled in the straps, are necessary for bolting the crown and sides and the combustion chamber sheets together for the welding operation.

The longitudinal spacing of the holes on the straps should, of course, be an exact duplicate of the holes in the plates, and the space from the center line of the strap to the staybolt lines should check with the dimensions given on the plate development drawing when the plates are bolted together.

The layout of the holes on the strap is as follows: Draw a center line on the strap. Square the front, top staybolt hole of the side sheet to and square with the top edge of the sheet. Mark the distance of this squared point from the front end of the sheet on a metal strip, then mark the alternate staybolt holes of the top line on the strip and transfer the spacing of these holes to the staybolt line on the strap. The front staybolt hole of the crown sheet and the combustion sheets are also squared to the edge of the sheet and the spacing of the staybolt holes marked off on a metal strip for transferring to the tie straps. The tie straps should be bent to fit the outside surface of the firebox when the seam joint does not happen to come on the flat surface of the sheet.

The tie straps are bolted to the outside of the crown and top half of the combustion chamber, after which the crown sides and the bottom half of the combustion chamber are then bolted to the straps.

The side sheets are kept the correct distance apart, along the bottom, for the welding operation by pipe members with tie bolts through the same as shown in Fig. 62. The sides of the firebox should also be straightened with strong backs.

After the welding has been done on the fireside of the sheet the straps are removed for the finish weld on the water side to be done. The firebox is then fitted up as though the crown and sides and the combustion chamber sheets were made of a one-piece sheet.

Applying Nicholson Thermic Syphons in Firebox

Figs. 62 and 63 show inside views of a large firebox and combustion chamber with an installation of five Nicholson syphons.

The syphon is made of a one-piece 3/8-inch thick firebox steel plate flanged into a triangular-shaped water-leg 3 inches wide inside and welded together at the ends. It is strengthened with staybolts to resist the steam pressure. A 7-inch outside diameter neck is formed on the bottom front end of the syphon for the yoke sheet connection. The top is flanged out all around, shaped to the crown radius and electric-arc welded flush in this sheet. The neck is arc welded to a flanged hole in the yoke sheet or the back tube sheet of non-combustion chamber boilers.

The syphons serve to increase the heating surface of the firebox and to promote the water circulation of the boiler.

Fitting the Syphons to the Firebox

The firebox should be assembled complete before the syphon holes in the crown sheet are cut out and the syphons fitted, i. e., a combustion chamber firebox should have the yoke sheet welded or riveted in place and the tube sheet should be bolted in. The door or back sheet should also be in when the length of the syphon will permit the syphon being applied with the back sheet in place.

The firebox is turned on its back (crown down) and the openings are roughly cut out within the outline as laid out and center punched on the inside or fireside of the sheet by the layerout.

The firebox is next turned up in its natural position. Cover plates, which have previously been laid out and drilled with holes to match every third stay hole along the sides of the syphon opening, all holes at the ends and every third stay in the syphon flange or the holes within the opening are now bolted over the openings for fitting the syphons in the firebox.

Cover plates are not bolted over the combustion chamber openings at this time.

The flange of the syphons should be marked off from the pattern template, as described on page 17 of the January issue, drilled, trimmed and ready to be bevel-chipped for applying to the firebox.

The combustion chamber syphons are fitted with the firebox in its natural position. The syphon is set up in position and the opening marked for chipping, after which the syphon flanges are lowered flush with the crown, the cover plates applied and the syphon bolted to the same.

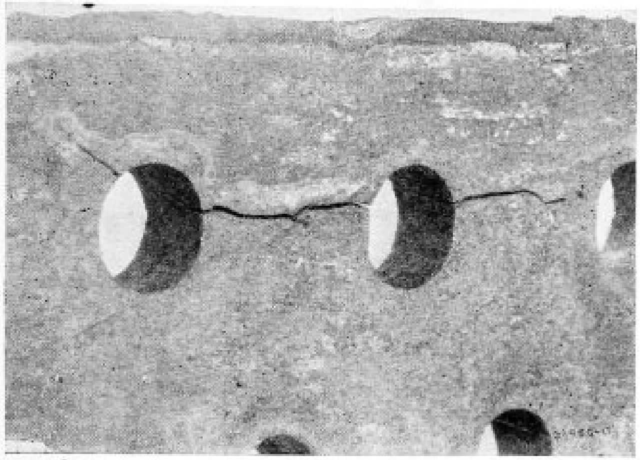
The firebox is now turned on its back for fitting the firebox syphons. The syphon flanges can now be electric-arc welded to the crown sheet as well as around the neck of the syphon to the yoke sheet on the tube sheet.

The crown sheet should be straightened with strong backs (beams) before the syphon flanges are welded to the crown sheet. The neck is cut off to the correct length and the collar of the flanged opening laid up all around the neck by heating with an acetylene torch and hammering. The neck is then welded to the collar on the inside of the firebox.

(To be continued)

Discarded Feed Pipe Furnishes Valuable Clue

BANISHED from the boiler room when its job was taken over by a newer and sounder piece of metal, a worn-out section of feed pipe would have carried a vital bit of evidence away to the junk yard had not an inspector seen it just in time. Four years ago, while examining the boilers of a large Minnesota paper mill, the inspector's interest was aroused by the peculiar appearance of a crack in the threaded end of a pipe which had been tossed onto a scrap heap



Section of boiler plate showing embrittlement cracks

behind the boiler house. Suspecting the presence of caustic embrittlement, he immediately questioned the owner on the source and treatment of feed water and cautioned him to notify headquarters if leakage developed at the seams or rivets of any boiler installed in the plant.

Constant Supervision Maintained

From that time on these boilers were kept under the closest scrutiny by the inspection force. Within a year a leaky rivet and a headless rivet were discovered, but a thorough examination revealed no further evidence of trouble. However, when an inspector visited the plant in July, 1927, he found that since his last visit a new blow-off flange had been fitted to No. 4 boiler. The old flange had been consigned to the scrap heap from which it was recovered by the inspector and sent to a metallurgist. The latter reported that the inter-crystalline cracks from rivet hole to rivet hole had been caused by caustic embrittlement.

The close watch was continued, with inspectors on the alert to detect the first sign that embrittlement was weakening vital parts of the boiler. Eventually, in August of 1928, they came upon leaky rivets behind the bridge wall in the longitudinal seam of No. 4 boiler. Removing a section of the wall, an inspector uncovered several headless rivets. He cut out other rivets in the affected area and found cracks in the shell plate and butt strap. The illustration shows the serious nature of the crack in the shell plate which resulted from the embrittlement condition.

With the owner's consent, the inspector set about removing 10 percent of all rivets below the water line. Before he had proceeded far he found serious cracks in the rear top drum. It was evident then that the boiler was affected to such an extent that it should be discarded.

A few days later the owner wired the insurance company's Chicago office: "Have had other experts examine boiler. They do not find anything which should make it necessary to reduce pressure."

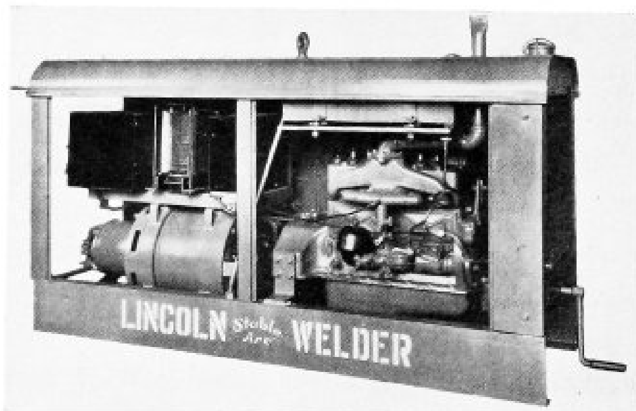
However, he consented to call in as referee Professor Frederick G. Straub, of the University of Illinois, recognized as an outstanding authority on embrittlement by reason of extensive research in that field. Professor Straub not only diagnosed the case as caustic embrittlement but confirmed the opinion of the insurance company that cracks in the head seams of the mud drum and in longitudinal seams of both mud and feed drums rendered the boiler unsafe. Needless to say, the boiler was replaced.

A great deal of credit is due the inspector who ferreted the first symptom out of the scrap heap. His discovery, made four years before embrittlement actually endangered the safety of the boiler, prompted a close watch on subsequent developments and probably prevented a serious explosion.—*The Locomotive.*

Gas-Engine Driven Welder

THE Lincoln Electric Company, Cleveland, O., has recently introduced to the trade a new model gas-engine driven welder for use where electric power is not available. The new model welder is of 200 amperes N. E. M. A. rating and is powered by a 4-cylinder Waukesha engine, operating at 1500 revolutions per minute.

The latest improvements which are featured in the new improved models of Lincoln gas-engine driven

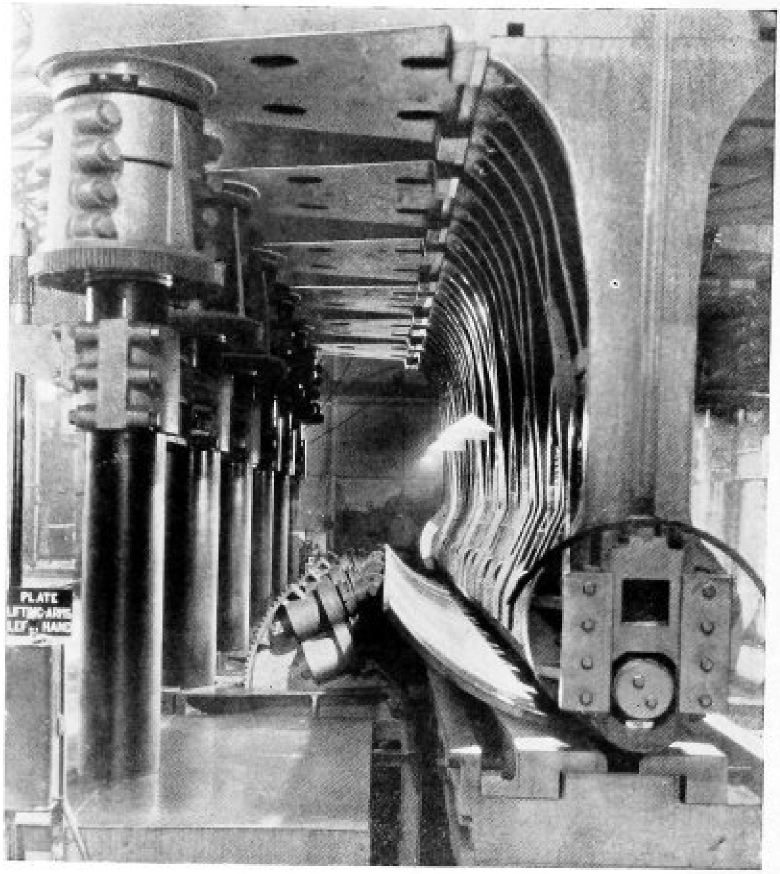


Portable-type electric welding outfit

welders are included in this new model. An automatic idling device is incorporated which reduces the speed of the gas engine when welding operations cease and automatically accelerates the engine to proper speed, as soon as welding is started. It is estimated that this device will reduce fuel consumption approximately 25 percent as well as considerably reducing wear in the welder which will permit longer life of the entire equipment.

Another feature of this new model welder is the complete protection afforded the machinery by the welded-steel canopy which totally encloses the outfit.

Unified control, a feature of all new improved Stable-Arc welders, is also incorporated in this new model. Operating controls are enclosed in a ventilated steel cabinet



Shell-bending press in operation

British Plant Equipped with Unusual Boiler Shop Machinery

By G. P. Blackall

Shell-bending press will take plates 40 feet long and 2¼ inches thick

THE boiler works of Babcock & Wilcox, Ltd., at Renfrew, Scotland, were recently thrown open to the interested members of the public for the inspection of a new high-power, shell-bending press which had just been installed. This press will take plates up to 40 feet long by 2¼ inches thick, and will bend to three-quarter circle from 3 feet up to 4 feet 6 inches diameter. Any diameter above 4 feet 6 inches may be bent with a maximum finished width of plate of 10 feet 7¼ inches.

The press is built up of six independent units bolted together, each provided with its own drawback. The bottom die-holder is in two pieces joined at the center of the press. Plate-pinching rams are fitted at both top and bottom die-holders. The actual bending is done by a continuous roller which also gives the necessary cross feed to the plate for the successive bending stages. The roller is rotated by gearing driven by an electric motor.

The depth of bending is controlled by stopper nuts on the columns which are actuated simultaneously by motor-driven gearing, the small movement required being indicated on a dial with multiplying gear.

The maximum pressure exerted by the press is 8000 tons, with a water pressure of 2½ tons per square inch. A reducing valve is employed to give four pressures, 3200, 5000, 6500, and 8000 tons. An intensifier is used to give 2½ tons per square inch with a pressure of 1 ton per square inch. Water-saving gear is fitted, and the main cylinders work on a closed water circuit in which oil is used to provide lubrication to the rams.

Other interesting machines inspected during the same visit were a hydraulic riveter, plate-edge planing machine, three-spindle drum shell circumferential hole-drilling machine, ten-spindle tube-hole drilling machine, side-planing machine, eight-spindle drum shell butt-strap rivet-hole drilling machine, and a moving head

Mammoth shell-bending press in British shop

planing machine. The first of these exerts a maximum riveting pressure of 130 tons, with a gap of 20 feet, and is fitted with reducing valve, timing valve, and water-saving gear. The post is a steel forging, and the frame a steel casting.

The plate-edge planing machine planes the edges of plates up to 40 feet in length. The saddle, carrying the tools, is rack-driven and is self-contained with the electric motor. The holding-down rams are operated by hydraulic power. The machine is automatic in action. The electric control gear is actuated by tappets on the bed.

The three-spindle drum shell circumferential hole-drilling machine drills three holes at a time, with a maximum diameter of 1 13/16 inches. Drills can be adjusted for any pitch within limits and always drill radially. The drum is held by the ends in a rotating gear which has cross and circumferential adjustment. The column carrying the drills is traversed along the bed by a power-driven gear. The maximum capacity of the machine is 5 feet diameter and 46 feet length. Push-button control is fitted to all motions.

The ten-spindle, tube-hole driller trepans, reams, and recesses tube holes up to 4 inches in diameter. Two columns are fitted, each carrying five spindles which can, if necessary, drill 3-inch diameter holes out of solid metal. The columns, which slide along the bed, are independent of each other and are self-contained with main driving and traversing motors, which are all push-button controlled from the operator's platform. The drum is held by the ends in a rotating gear which has both cross and circumferential adjustments. The maximum capacity of the machine is 5 feet diameter by 46 feet length.

The side-planing machine planes plates up to 25 feet long and 40 feet wide. The saddle is traversed by a screw which is driven by reversing pulleys at the end. The machine is automatic in action, the reversing saddle being operated by rods and gear from the saddle motion. The machine is used for planing the inside and outside of the buttstrap joint.

The eight-spindle, drum-shell, butt-strap, rivet-hole drilling machine drills eight holes at a time, the maximum diameter being 1 13/16 inches. A carriage with eight headstocks is traversed along the bed by motor-driven gearing. The drum is held by the ends in chucks fitted to the rotating gear for bringing the drum around to the correct center line for drilling. Transverse adjustment is also provided. The maximum capacity of the machine is 5 feet diameter by 46 feet length. Push-button control is fitted to all motions.

The moving-head planing machine planes the edges and butt-strap seats of drum shells, and can take up to 40 feet length by three-quarter circle 4 feet 6 inches diameter. The moving head carrying the cutting tools is self-contained with the driving motor and is actuated by a rack and pinion from either side simultaneously. The machine is arranged to cut both edges of the shell at one time, and formers are used to get the correct shape.

Milburn Acetylene Generator

A NEW portable acetylene generator for welding and cutting has recently been placed on the market by The Alexander Milburn Company, Baltimore, Md.

The generator is unique in that the body is made throughout of drawn seamless steel which makes it lighter in weight, stronger and more dependable than bodies with the usual joints. The generator is made in three sizes, 35-pound, 70-pound and 100-pound capacities.

Safety portable acetylene generator

The generator is extremely simple in design, having no clocks, nor motors and notably few moving parts. The carbide hopper-feed control and head are assembled in one unit which can be detached from the seamless steel body by the removal of a few bolts. The carbide feed is controlled by a single valve which responds to high or low pressure and automatically stops if the pressure is at zero, or if the filler plug is open or the generator is not properly closed. The control and operation of the generator is so simple that the carbide feed is uniform and a complete consumption of the entire charge of carbide is assured.

The safety feature of the generator under various conditions of usage, upsetting and tipping over is one of the notable characteristics. The Underwriters' Laboratories made tests by tipping the generator at different angles, throwing it over under different stages of operation without causing a rise in pressure of the gas or abnormal working of the machine.

The machine is equipped with well-developed blow-off valves, pressure control, safety-gas purifier and strainer. The component parts of the machine are made with over-size outlets all welded into the seamless body. The body has a protective coating inside and out. Handles of ample size, welded on to the body, provide for convenient transportation of the new generator.

The cost of generating acetylene gas in the new Milburn generator is approximately 1⅛ cents per cubic foot. In comparison with this the cost of cylinder gas ranges from 2¼ cents to 6 cents per cubic foot.

Progress Revealed by American Welding Society Fall Meeting

CONTINUED rapid expansion of welding applications, backed by extensive research activities, was revealed by the program of the Fall Meeting of the American Welding Society, 33 W. 39th St., New York, N. Y. This meeting was held in Cleveland, Ohio, September 9 to 13, with morning sessions at the Hotel Statler and afternoon sessions and extensive exhibits at the Cleveland Public Auditorium.

Because of the mass of important material available it was necessary to increase the technical sessions to six this year and to allow more time for reports of important research projects. No less than nine research papers were presented, three of them dealing with newly discovered non-destructive tests of welds. One of these tests, based on electrical conductivity, is the discovery of Elmer Sperry, well known inventor and president of the American Society of Mechanical Engineers. The second involves the use of the stethoscope and third X-ray methods.

Other research papers covered "nitrogen needles," electric welding by the carbon and metallic arcs, special metallographic studies, stress-strain characteristics of welded joints and the use of X-rays in examining welds.

The papers dealt with the welding of boiler tubes and drums, the tubes of mercury boilers, etc. Other subjects covered by technical papers included gas welding of steel buildings, automatic welding of thin sheets, welding of pipe lines, replacement of castings by welding in machine construction, and the welding of copper alloys and high-strength aluminum alloys.

In addition to the nine research papers three special sessions were devoted largely to research. A meeting of the Bureau of Welding dealt with a variety of research projects. The meeting of the Structural Steel Welding Committee recorded advances in that fast-developing field. A special conference of college professors and other research workers was held to discuss welding research and further the co-ordination of activity along this line.

Those who attended the meeting also profited by the sessions of the American Society for Steel Treating, the Iron & Steel Division of the American Institute of Mining & Metallurgical Engineers, the Institute of Metals Division of the American Society of Mechanical Engineers, which were held simultaneously in Cleveland during the week of September 9. The co-operation of these groups made possible a great exposition in the Cleveland Public Auditorium, where more than 275 manufacturers exhibited the latest equipment, supplies and methods for the manufacture, working, treating, welding and use of every kind of metal.

The officers and directors of the Independent Pneumatic Tool Company, Chicago, Ill., have announced the death of John David Hurley, president and founder of the company. Mr. Hurley pioneered in the pneumatic tool industry and was connected with the company for twenty-five years.

National Board Discusses

Boiler Construction Problems

Smoke Prevention—Welded Pressure Vessels—Work of the Boiler Code Committee

On page 228 of the August issue appeared the first section of the report of the annual meeting of the National Board of Boiler and Pressure Vessel Inspectors, held at the Hotel Fort Shelby, Detroit, Mich., June 18 to 20. Because of the length and importance of the complete transcript it has been necessary to divide it into several installments. The Tuesday afternoon session is published below:

At the opening of the afternoon session, Chairman Thomas introduced Charles J. McCabe, smoke inspector, City of Detroit, an abstract of whose remarks follows:

Eliminating Smoke Nuisance

By C. J. McCabe

A brief history, before I enter into the matter of boiler furnaces, about smoke inspection in Detroit might be of interest. The activity was started about twenty-two years ago, I believe, and a couple of barbers and hardware men were hired through their political cohorts to wipe smoke out of Detroit. That continued until about seven or eight years ago, when men who had engineering training were put into the work, and their efforts were almost swallowed up because there was one on the east side of Detroit and one on the west side.

So, as fast as they would procure abatements they would have new ones spring up, and by the time they got to the place they had started they would have the same story to contend with.

However, since then there has been a separate bureau created, with a personnel of eleven men. We hope to have that increased very soon, so that we will get the net area per inspector down to about ten miles.

Last year, if I recall the annual figures correctly, we had about forty-seven thousand re-inspections with these men, and they were instrumental in installing over 650 mechanical stokers, representing a monetary outlay of upwards of two and one-half million dollars.

Doctor Hood of the Bureau of Mines said that this work is the administration of the most difficult human problem. We cannot say, "You have to do this and that." There is some sales job attached to the work. You really have to show that man how his money is going out of his stack.

In our bureau, which is a subdivision of the Building Department, we ask for an examination of the plans for boilers, or any kind of a fuel burning device.

The essentials in a boiler furnace *with respect to the work of* the Detroit *Smoke Department* are:

1. Adequate volume, which controls the distance the heating surfaces are away from the fire, for safety of operation and to produce good combustion.
2. The proper method of firing, which may be manual or automatic.
3. Suitable furnace construction.

It happens that in our work we require the examination of plans and specifications on boilers and boiler furnaces for the purpose of checking them for setting height, chimney requirements, and the manner in which they are to be fired.

We consider the furnace volume a prime requisite because without it, it is practically impossible to obtain the proper time element that the furnace gases must have in their passage from the fuel bed to the boiler heating furnaces, and to provide for the most necessary mixing of the air for combustion with the furnace gases.

There have been installations in Detroit, some of the most excellent as well as some of the most foolish boiler settings that one could imagine.

One interesting installation was checked up by the writer in which a double-furnace Scotch marine boiler was equipped with two underfeed stokers. The furnaces were 42 inches in diameter and the distance from the top of the retorts to the top of the center line of the furnace was 20 inches.

This meant that with a 10-inch fuel bed a clearance of only 10 inches could be maintained. Of course at the side of the furnace where the curvature with respect to the fuel bed was greater, there was practically no clearance. The job was condemned and the management assured our office that the job would be operated smokelessly. The results however, soon proved the justification of our condemnation and the installation was subsequently changed and a different type of boiler installed.

Another case we had was the installation of a single retort underfeed stoker under a cast-iron boiler of the dog-house type. This was another case where practically no furnace volume was maintained and which resulted in the burning of the front sections of the boiler so badly that a new installation had to be made.

We have found, contrary to what some engineers believe, that on the small boiler using the single retort underfeed stoker the use of fire bricks along the fire line is unnecessary. However, where the fire line is in close proximity to the bottom of the water leg where a scale or mud ordinarily forms, it is desirable to have two or three courses of fire brick to protect the bottom of the water leg.

We have not found that chemical or mechanical action of the fuel bed along the fire line has caused any deterioration to the side sheet as claimed by some. This statement is made after an examination of about 200 boilers of the firebox type. Perhaps the most interesting installation the Smoke Department has examined during its three years of existence is the Sterling boiler installation at the Delray Edison Plant, Edison Blvd. This is a 2400-horsepower boiler, standard Sterling type, equipped with a screen boiler immediately below the main boiler. It is rated at about 600 horsepower. The screen boiler is unique because the furnace construction is a combination of water wall protected partly by refractory and partly by cast-iron blocks. There are three types of blocks used, namely, solid refractory blocks, hollow face cast-iron blocks, faced with carbofax material and waffle blocks. The furnace is interesting because these waffle blocks which are serrated and are placed in the rear wall, cover about 20 percent of the area of the rear wall. The intention is to gradually have these serrations filled up with molten ash and also to prevent erosion that is usually found in this part of the furnace. The front wall is composed of the refractory-faced block and the side walls have this type of block to a point well above the minimum fuel bed thickness. This would represent about 20 percent of the side wall area. The upper part of the furnace consists of the tubes of the water wall interspaced with a special refractory block. The use of this combination wall is thought to be ideal for reducing furnace maintenance by holding erosion down to a low point: to prevent spalling by the presence of the cast-iron blocks; to provide for radiant heat along the upper walls of the screen boiler for carrying-over periods of low loads.

This boiler is equipped with a 15-retort underfeed stoker. It is similar in many respects to the installation at the Boston-Weymouth Station. The stoker drive consists of 5 power boxes driven by an electric motor. There is a continuous shaft on the drive and the stoker rams are driven from a sub shaft to which shearing pins are fitted. With a 15-retort job this means that each power box will take care of three rams and with the sub-shaft arrangement it is possible to operate any other four sections of the stoker should one go out of service. Perhaps the most interesting thing about the stoker is the fact that there are six auxiliary rams on each retort. This means that there are (15 x 6) or 90 points on the stoker from which the fuel bed contour can be regulated.

The boiler that this stoker serves will operate at a pressure of 455 pounds and will develop in excess of 450 percent of rating. The stoker weighs 400,000 pounds and has a projected area of 611 square feet. It will burn normally 47,400 pounds of coal per hour. This is nearly 24 tons per hour. The boiler is an excellent piece of design from the standpoint of combustion, the screen boiler furnace having a volume of 13,400 cubic feet and the main boiler about 2500 cubic feet. This gives about 5½ cubic feet per rated horsepower for the furnace volume.

In our work we take special pains to see that boilers are set properly so that they can be safely operated and at the same time give good combustion results.

I would urge your society to set up a tabulation of minimum setting heights and if possible have them become nationally recognized. Our local requirements are as follows:

All boilers equipped with stokers shall have a minimum distance of at least 42 inches between top of retort or projected grate area and the boiler shell or bottom of front header: and in Sterling type boilers the distance from floor to center line of mud drum shall not be less than the minimum recommended by the Bureau of Smoke Inspection and Abatement. In most cases a greater distance is desirable.

All horizontal return tubular boilers not provided with mechanical stokers shall be set according to the following table:

TABLE 1.—SETTING HEIGHTS FOR BOILERS (WITHOUT STOKERS)

Boiler Diameter	Distance—Shell to grate
84 inches	72 inches
78 inches	72 inches
72 inches	60 inches
66 inches	60 inches
60 inches	54 inches
54 inches	48 inches
48 inches	48 inches
36 inches	36 inches

Stokers shall not be set less than the minimum dimensions found in the following table as compiled by the *Stoker Manufacturers' Association* in 1923:

TABLE 2—SETTING HEIGHTS FOR STOKER-EQUIPPED BOILERS

Min. = Absolute minimum. P.M. = Preferred minimum.

TYPE OF BOILER	Multiple Retort Underfeed Taylor Riley Jones A. C. Detroit		TYPE OF STOKER: Single Retort Underfeed, Type E		Single Retort Underfeed, Jones Detroit		Side Overfeed, Murphy Detroit		Front Overfeed, Roney		Chain Grates, Natural Draft		Chain Grates, Forced Draft	
	Min.	P.M.	Min.	P.M.	Min.	P.M.	Min.	P.M.	Min.	P.M.	Min.	P.M.	Min.	P.M.
Watertube:														
Horizontal	10'	12'	10'	12'	8'	10'	8'	11'	8'	10'	10'	12'	12'	14'
Inclined (Hor. M. D.)	7'	8'	6'	8'	6'	8'	5'	7'	6'	8'	6'	8'	7'	8'
Inclined (Vert. M. D.)	5'	6'	5'	6'	3'6"	5'	3'6"	5'	3'6"	5'	3'6"	5'	6'	8'
Vertical (Hor. M. D.)	3'	4'	3'	4'	3'	4'	3'	4'	3'	4'	3'	4'	3'	4'
Vertical (Vert. M. D.)														
150 h. p.	4'6"	5'	4'6"	5'	4'6"	5'	3'6"	....	3'6"	4'6"	4'1"	4'7"	5'	5'6"
250 h. p.	5'6"	6'	5'6"	6'	5'6"	6'	3'6"	....	3'6"	4'6"	4'1"	4'7"	5'	5'6"
500 h. p.	6'	6'6"	6'	6'6"	6'	6'6"	3'6"	....	3'6"	4'6"	4'1"	4'7"	6'	6'6"
Horizontal Ret. Tubular														
72 in.	8'	10'	8'	10'	7'	10'	7'	8'	6'	8'	7'	8'	8'	10'
84 in.	8'	10'	8'	10'	7'	10'	7'	8'	6'	8'	7'	8'	8'	10'

It is surprising to find how few cities have boiler setting regulations and in others where such regulations are in force how sadly inadequate they are.

The City of Pittsburgh allows the setting of an 84-inch horizontal return tubular boiler, a minimum of 38 inches from the grates and a 48-inch boiler 30 inches from the grates. The City of Cincinnati calls for 36 inches on any sized horizontal return tubular boiler from 72 inches down.

We have found in our experiences that these settings are inadequate and sometimes dangerous.

It would be a very desirable thing if your society would take up the good work of establishing minimum setting heights and make an offering indirectly towards the conservation of fuel and the prevention of boiler losses through low settings. Our office would be glad to offer your Committee, if one is appointed, any possible service.

CHAIRMAN THOMAS: I believe that all active and practical inspectors realize the importance of proper settings in order to obtain proper combustion. That has been a part of the inspector's education from the time that he has been an inspector.

The elimination of smoke has been a question that has been brought up later by interested parties who wished to keep their cities clean and that is an added thing which the inspector will have to study more or less. It may be, in time, and I am not speaking for the Board, but I know that sooner or later there will be specific rules in all cities, and there is going to be a question whether or not those rules can be made uniform the same as uniform rules for any other line that we are in. So, any information that we get upon that subject is something that we should appreciate and that we are all interested in, and that we all want to post ourselves as much as possible on, in order to get and give the proper advice to the user of fuel in order to eliminate smoke and still get the efficiency from the plant.

P. R. Hawthorne (Welding Engineer, The Petroleum Iron Works Company.)

Mr. Chairman and Gentlemen:

When we received from Mr. Meyers, an invitation to be present here before you, the officials of our company were highly delighted, first, to find that your organization would be interested in welding practice, and second, to show you what we had.

Chairman Thomas: I would like to say that you may ask questions whenever you want to.

P. R. Hawthorne, welding engineer, The Petroleum Iron Works Company, Sharon, Pa., was next introduced.

Welded Pressure Vessels

By P. R. Hawthorne

Some four years ago The Petroleum Iron Works Company, at the suggestion of one of the larger oil companies, undertook the problem of electric welding heavy-wall vessels for oil refining. Many experiments were made to produce uniformly perfect welding with a tensile strength greater than that of the plate and with more ductility than was usual in electric welds. It was through these experiments that heavy peening and welding by the back-step method were found to add both ductility and tensile strength in welds made by commercial metallic arc processes.

After considerable experimental work this company built 15 baffle towers, 6 feet in diameter by 35 feet long with 1-inch shell and 1⅛-inch heads. All were tested to 200 pounds hydrostatic pressure and the seams hammered under pressure without indication of failure in any case. These vessels are still in service and operating satisfactorily. These were welded with commercial processes and selected weld rod, much care being taken in the welding procedure. Soon after these 15 vessels were finished work was started on heavier vessels.

The company intended to build vessels of this and similar types and at the same time continue experiments to develop a process of welding which would have still better qualities as regards tensile strength and ductility, resistance to corrosion, shock and high temperatures. After some two years had elapsed a process was developed which we believed, and have since proven, has all the qualities desired. A separate plant was built, equipped with fifty-ton cranes, special electrical equipment consisting of two-unit welding generator driven by motor of 1600-horsepower capacity and special mechanical equipment for handling large vessels in process of manufacture.

The process is now developed to a point where we could, if required, use electrodes 1-inch diameter and deposit metal at the rate of 100 pounds per hour,—the deposit being practically free from blow holes and oxide and nitride inclusions, and with other properties or qualities equal to the plate and far superior to a deposit made by the usual commercial methods using metallic or carbon electrodes. Most of our work is done with electrodes ⅜-inch to ½-inch diameter, which have proven to be the most economical sizes, for the reason if we were to use larger rods the welding groove would have to be made larger. The average amperage is about 700 for ⅜-inch rod and 800 to 1000 for ½-inch rod. While the actual welding is being done, from ¼ to ½-pint of molten metal follows the weld rod and when welding plates ⅜-inch to ⅝-inch thick with automatic machines, from 18 to 24 inches of the weld seam is red hot.

As a last assurance of perfect work, particularly on vessels with thick walls, an annealing furnace is required. (This is the same furnace viewed from a different angle). The one in use with this process is charged by a car moving on a standard gage track. The door opening of the furnace is 13 by 15 feet with an inside length of 70 feet. The furnace is oil fired and equipped with automatic temperature control with variation of less than 20 degrees when operating between 1200 and 1650 degrees F. The charging car moves directly from the furnace into the welding shop for crane loading.

That welding is in its infancy is universally admitted. That remarkable progress in welding has been made during the past few years is becoming recognized, not only by manufacturers of welded product, but also by users of equipment involving factors such as high joint efficiency, resistance to high temperature, corrosion, shocks and reversal of stresses, vessels and structures made of material too thick to join by rivets and structures of such shapes and dimensions that would prohibit riveting.

That electric arc welding has made remarkable strides is evidenced by the fact that it is now used to join metals of thicknesses greater than is practical by the use of acetylene, hammer welding, gas or forge welding or any other process which is adaptable to production work.

Arc welding can be done commercially with metals up to 12 inches thick. Weld metal can be deposited at the rate of 100 pounds per hour with weld rods 1-inch diameter. The deposited metal can be and is in actual practice made entirely free from nitride inclusions and practically free from oxides and porosity. The metal can be forged or rolled as can steel plate. Can be heat treated, carburized and treated otherwise, same as rolled steel. The weld metal deposited by our process has an average tensile strength of 68,000 to 74,000 pounds per square inch and elongation 20 to 25 percent. The deposit and the junction can be inspected as the work proceeds to determine the quality of the work throughout.

Finished vessels and structures can be tested up to the elastic limit of the plate, which is far from practical with riveted vessels. Welded vessels require no maintenance expense to keep tight, no inspection of and replacing or calking loose rivets and no leaky seams. They can be made perfectly smooth inside to reduce friction and corrosion.

Welding can be, and is done to produce, in the weld deposit, physical properties equal to those of the parent metal whether this be low carbon or alloy steel. The thickness of plate which can be welded is limited only by the capacity of steel mills and the weights and dimensions of welded vessels or structures is limited only by the capacities of railroad equipment. That we can, and do produce quality welding is further evidenced by the fact that we have permanently in our shop an inspector for one of the larger insurance companies and that this and other companies will insure these vessels for any service provided the customers' design is first approved by them.

The fluid fusion process of welding owned and controlled by The Petroleum Iron Works Company is, of course, a highly specialized development. Some four years' time was used in experimental work and while we have been in production about two years we find we are just beginning to realize how little we really know, and to visualize the possibilities which may still develop. We do not hesitate to tell you the underlying principles upon which this process is based, as these are well known and recognized.

In order to produce a weld deposit which is free from oxygen and nitrogen, these elements, which are present in the atmosphere, must be prevented from coming in contact with the deposited metal while it is in liquid form and until the temperature is below 1800 degrees F. To protect the arc from open air by mechanical means would not be practical. The logical method is to liberate, by the heat of the arc, a gas which will form a sheath or envelope around the arc, which by reason of its volume and density, will actually exclude or combine the harmful gases. This is, of course most easily accomplished by using a chemical covering on the rod which will be consumed in direct proportion to the rate of melting of the rod.

Further, to produce a perfectly sound weld and one which is greater in tensile strength than the rolled rod which is melted to form the deposit, it is necessary to introduce elements which will absorb the impurities in both rod and parent metal and cause them to rise to the surface, from where they can be removed.

Further, to provide time for these reactions the metal must remain in liquid form for a considerable period. This is most easily accomplished by using high amperage and thereby depositing metal at a high rate which, however, cannot be done, to produce a sound weld with the usual commercial processes.

Further, to produce deposited weld metal in the form of a casting which will have tensile strength of from 68,000 to 74,000 pounds per square inch, with weld rods having tensile strength from 55,000 to 60,000, some alloying element must be introduced.

It would thus far appear that the rod covering is the solution of depositing metal at a high rate. This is not by any means true. It also requires exceptionally high amperage from a source of current having special electrical characteristics. The application of this process or the manner in which this welding is done, is so vastly different from ordinary welding that welders using the commercial methods cannot believe that a good deposit can be made by this process and it requires usually three to four months to develop such men into good welders.

As stated before, this process as used in our plant is a highly specialized one, developed after a long period of research work and in connection with complete physical and chemical laboratories and in co-operation with chemists and metallurgists employed for and continuously used in this work. In addition to these laboratories there is required in the shop special electric generators and resistances and exceptionally heavy and expensive bus bars and cables.

By reason of so much metal being molten at one time this process is practiced only when used with the work in a horizontal position simply because the large volume of molten metal would run off if the work were inclined. It then becomes necessary to provide special shop equipment to handle these heavy fabricated vessels which may be of almost any conceivable shape and because of the excessive weight of these parts this equipment is both heavy and expensive.

We trust our contribution to welding, in the development we have made thus far, will be an incentive for further development on the part of other manufacturers and will be of some assistance toward welding becoming generally recognized as the safest method of joining metals. (Lantern slides of various welded products of the company were shown.)

C. W. Obert, honorary secretary, A. S. M. E. Boiler Code Committee, and representative of the Committee on the National Board was then introduced.

Interpretations and Revisions of the A.S.M.E. Boiler Code

By C. W. Obert

It has been the spirit, as you know, of the Boiler Code Committee during the last few years to transfer more and more of this load that it has formerly carried over to the National Board, and it is the intent of the committee now to sit back, as it is growing old in life and age, and let you young fellows, young in organization, I mean, take the load, and the committee will serve you as a consulting body in the future, and it hopes so to relieve a lot of the grief that it has had in the years gone by.

It was, as I recall it, your intention, at the last meeting, that all of the revisions that have been coming out serially from time to time from the Boiler Code Committee, and published and issued in the pink sheet form, should, in the future, be brought to a head or culminated at the middle of the year. That has been done this year. We have gone through religiously with that program and I have here a series of fifteen sheets which I think will make up, when printed about twenty-five or thirty pages, which will be mailed immediately after July 1. They will represent all of the revisions of the year past, since your last meeting.

As far as the Boiler Code Committee is concerned, those sheets which you receive after July 1 constitute a complete record of revisions and addenda that have been worked out and approved and have passed through the society procedure up to that time.

Now, it is my understanding that it is going to be your purpose to put these into effect on January 1, 1930. I furthermore have the understanding that it will be your intent to make these permissive. That, at least, was the discussion, if I recall it correctly. I hope, if I am not right, you will correct me; that these will be permissive from the time the pink sheets come out, but that you would not make them compulsory until January 1, 1930, the thought being if any manufacturer had any changes to make in the set-up of the sheet, they will have six months within which to carry those out.

The revisions have a few interesting points in them. The dished head are perhaps the greatest of any. The revision on the dished head introduces a slightly heavier head, at least on the larger diameters.

Furthermore, it takes recognition of the ellipsoidal form of head, which was not recognized before. The ellipsoidal form of head is permitted if inserted without a manhole or other equivalent opening. That is, permitted to be of the same thickness as the cylindrical shell of the same diameter.

P-268 has been revised. Certain changes you will find in regard to nozzles and throat connections. A considerably better statement of that revision is to be found in the paragraph, but I wish to warn you that there are more changes coming. Some things that you have heard considerable discussion on do not appear in these revisions, as they were not completed at the time this group of revisions was brought to a focus and passed through the society for final action.

Quite an important revision appears in the safety-valve requirements, paragraph P-274. If I recall correctly this revision was recommended by the National Board. It covers the situation where changed conditions develop in a boiler plant and additional safety valves must be installed to cover the addition of such additional heating surface; for instance, with the addition of water walls to the boiler setting, it provides for the addition of increased safety-valve capacity on the steam main, between the boiler and points where the safety valve or valves may be attached.

Another very important thing has been worked out, and that is new flanging tables, flange and fitting standards. You will perhaps recall, those of you who have had this problem to work over, that the A. S. M. E. has worked out, through another committee than the Boiler Code Committee, a set-up of flange and fitting standards. The old standards covered cast iron. These new standards cover cast iron for 125 to 250 pounds and steel fittings for 250 pounds, 400 pounds, 600 pounds, 900 pounds and 1350 pounds.

Welding of Water Legs

The reply in Case No. 588 authorizes the welding of the turned-in flanged edge of water legs, exactly similar to the long-established practice of welding turned-in edges of sheets around fire-door openings, but stipulates that in such cases the distance from the weld to the nearest row of staybolts is not more than one-half pitch allowed by the formula in Par. P-199. It is important to note in this connection that only turned-in flanged edges on both sheets are approved for such water-leg welding, and in one instance the flanging of the furnace sheet only with a filler weld against the straight outer sheet was disapproved. The reason for disapproval of the latter is that a fillet weld does not constitute a joint of the same strength and dependability as is inherent to the butt type of joint which is approved.

Shut-off Valve Between Boiler and Superheater

Some questions have been raised in regard to the permissibility of providing a stop valve for disconnecting a superheater from its boiler so that the superheater can be shut off temporarily for repairs, packing, etc., without shutting down the boiler. The committee has ruled in Case No. 600, that Par. P-301 was not intended to prohibit the application of such a stop valve, and that a stop valve may be used if it is found desirable for some special reason, in which case the boiler must be equipped with the full required amount of relieving capacity in safety valves, and no credit allowed toward the latter for any safety valves which may be installed on the superheater.

There have been two instances in the past year or two in which reports have been received in regard to boiler manufacturers applying the Code stamp to constructions that were found by the inspectors to be contrary to Code requirements. When reported to the Boiler Code Committee such cases have always been investigated promptly, and I am pleased to be able to state that up to the present time all such cases that have been reported, have been the result of errors or misunderstandings which were of such a character as to excuse the manufacturer, who promised not to repeat the offense.

Bending of Thick Plates Cold

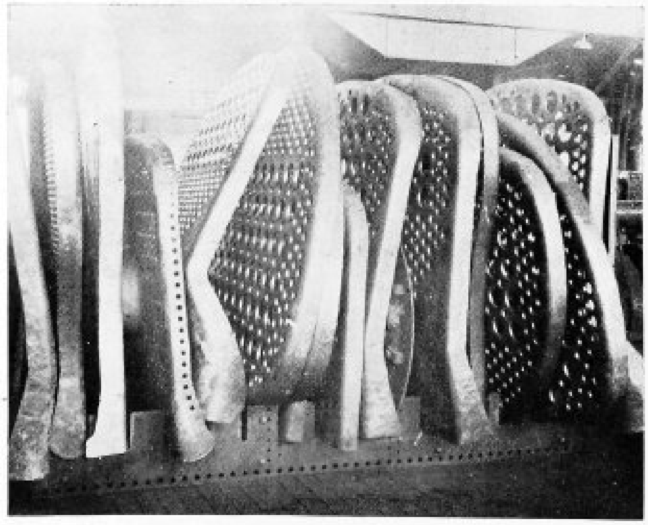
During the past year the question has been raised as to what should be the limit of thickness of plates that may be bent without heating. There have been certain instances where plates in excess of 2 inches in thickness have cracked when being rolled or being bent without heating. This is likely to become a very important question as the working pressures of boilers mount to increasingly higher figures, and the Boiler Code Committee is seeking information and advice on this question. The committee will appreciate any information concerning this practice that may be obtainable.

The committee has a sub-committee working with the steel manufacturers on that problem. It is really a very difficult question. No plates have cracked which have been less than 2 inches, but as I understand it, the limit of thickness is really causing concern on plates which are in excess of 2 inches in thickness and it goes without saying that a plate of that thickness which is sheared and cracks causes a very serious loss, and we are coming very rapidly to these thick plates, no doubt about that.

(To be continued)

Storing Boiler Heads

NUMEROUS racks and devices have been originated in railway shops to prevent littering up the floor with material. The illustration shows a rack in which the cumbersome boiler heads are placed on end. In this position the heads take up little space and



Convenient storage rack for boiler heads

are easy to get at when needed. The rack is made of two 12-foot sections of scrap plate, 14 inches wide, set edgewise about 3 feet apart and held together by several staybolts. The boiler heads are placed edgewise in slots cut in the plates.

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Welded Firebox Repairs

Q.—I am enclosing herewith a photograph of welding work done on the fireboxes of portable 45-horsepower locomotive-type oil field boilers. These boilers were originally made with mud rims which in the course of several years service became blistered and thin, making it either necessary to replace the sheets or discontinue the further use of the boilers, otherwise the boilers were in good condition and required very little if any repair work.

In order to secure further service from the boilers the mud rims were cut off at a point as close to a line of staybolts in the water leg as good practice would permit, and a half round sheet was electric welded in place to form a new bottom for the water leg as shown in the various photographs. New openings were cut for the handholes and blow-off connections which had been cut away. The picture shows a small portion of the old handholes remaining which were closed by welding in a piece of plate cut to fit.

I would appreciate an opinion as to whether you consider this work good practice or if it is dangerous. Also your opinion as to whether the

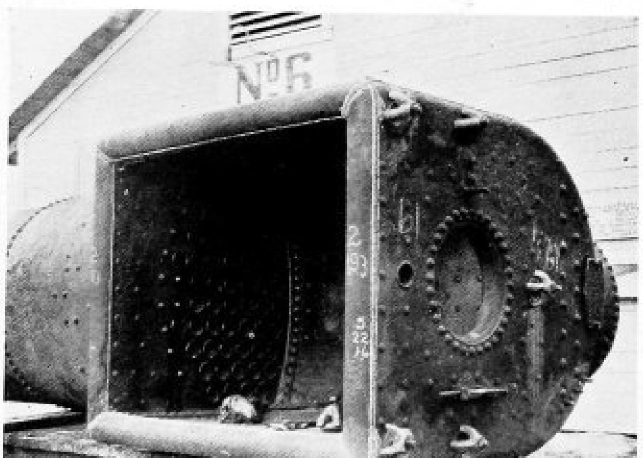


Fig. 1.—Portable boiler showing method of welding half round sheet to water leg

changes as made would have any effect on the steaming capacities of the boilers. Every precaution was taken to secure a good job and special attention was given to the welding. The edges of the plates were beveled and well fitted before welding. The outlines of all welds are shown in the photograph by chalk marks.

We have had several of the repaired boilers in service for a short time and so far the results have been very satisfactory. The boilers are used in oil field service and crude oil is used for fuel.

Thanking you in advance for your courtesy and attention. G. G.

A.—The method of repairing the firebox as outlined in the question, in my opinion, is not good boiler practice.

Par. 186 as found in the Addenda to the A. S. M. E. 1927 Boiler Code permits the welding of boilers under the following conditions:

P-186 WELDED JOINTS. The ultimate strength of a joint which has been properly welded by the forging process, shall be taken as 35,000 pounds per square inch, with steel plates having a range in tensile strength of 45,000 to 55,000 pounds per square inch. Autogenous welding may be used in boilers in cases where the stress or load is carried by other construction which conforms to the requirements of the Code and where the safety of the structure is not dependent upon the strength of the weld. Joints between the doorhole flanges of furnace and exterior sheets may be butt or lapwelded by the fusion process, provided these sheets are stayed or otherwise supported around the doorhole opening and provided the distance from the flange to the surrounding row of stays or other supports does not exceed the permissible staybolt pitch as per par. P.199. If such joints are lap welded, the exterior sheet flange should preferably be placed on the outside or next to the door opening and the fire-box sheet flange on the interior next to the water. Autogenous welded construction may be used in lieu of riveted joints in the fireboxes of internally-fired boilers, provided the welds are between two rows of staybolts, or in the case of flat surfaces the weld is not less than one-half of a staybolt pitch from the corner.

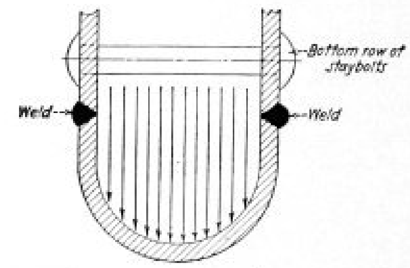


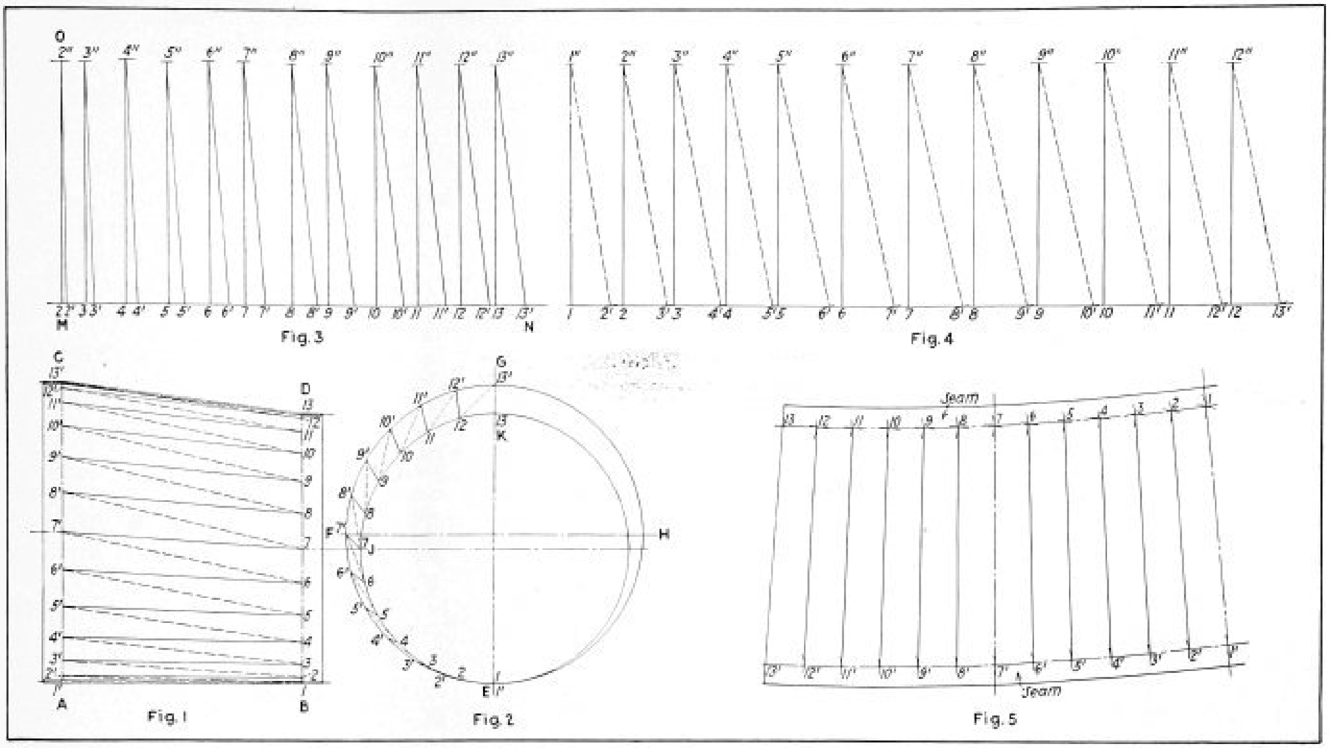
Fig. 2.—Cross-section through bottom of water leg

Fig. 2 shows a cross section through the bottom of the firebox water leg, showing the new bottom as welded in place.

The pressure on the bottom will be as indicated, placing the welds in direct tension. The welds being unsupported by any other construction whatever; the strength of the structure is therefore entirely dependent upon the strength of the weld, and for this reason is considered unsafe practice.

The steaming capacity of the boiler would be reduced in proportion to the amount that the heating surface was reduced in the firebox when making the alterations.

If it was necessary to place the firebrick higher into the firebox than on the original boiler, the reduction in the heating surface will no doubt reflect itself in the steaming qualities of the boiler, as the water evaporated is based directly upon the heating surface of the boiler. A square foot of firebox heating surface is computed to evaporate 55 pounds of water, per hour, per square foot.



Locomotive boiler course development

Development of Conical Course in a Locomotive Boiler

Q.—Will you please show the development of a conical course for a locomotive type boiler in the next issue of The Boiler Maker? I I would like to see the development of one with a horizontal bottom and sloping top, also one with sloping top and bottom. J. F. W.

A.—In the July issue, page 210, I outlined the method of developing a conical connection by means of outline sets on equally spaced ordinates. This method for drafting room practice is more accurate and the finished development more readily checked than by the method of triangulation where slight variations in developing are not easily found, especially when the developments are made to a small scale.

This method, while convenient in the drafting room for the purpose of making development plates for the layerout to follow, is not suitable for the layerout in the shop who must make his own development.

Fig. 1 shows a conical course for a locomotive type boiler, the course having a horizontal bottom and sloping top, the seam being on the top center.

In Fig. 1, *A-B-C-D* is the side elevation of the cone to be developed, the seams being omitted for the present; *A-C* is the neutral diameter at the large end and *B-D* the neutral diameter at the small end. The neutral diameter is the inside diameter plus the thickness of the sheet.

The corresponding end view is shown as *E-F-G-H*. I am only showing the development of one-half of the course, the other half being the exact duplicate of it. Divide the large half circle *E-F-G* into any number of equal parts; the number of parts taken should be divisible by two. Twelve parts were taken in this case. The larger the number of parts taken, the more accurate will be the development. Divide the small semicircle *E-J-K* into the same number of parts. Number the divisions on the large semicircle *1'-13'* and on the small semicircle, *1-13*. Join the points *2-2'*, *3-3'*, *4-4'*, etc., with full lines, also join the points *1-2'*, *2-3'*, *3-4'*, *4-5'*, etc., with dotted lines.

The triangles used in finding the true lengths of the lines *2-2'*, *3-3'*, *4-4'*, etc., and the lines *1-2'*, *2-3'*, *3-4'*, *4-5'* etc., can now be constructed. Draw the horizontal line *M-N*, Fig. 3, and at *M* erect the perpendicular *M-O*. This distance *M-O* being taken equal to the distance *A-B* in Fig. 1, which is the distance between the lines *A-C* and *B-D*, or the actual vertical height of the cone. This distance will be the altitude of all the right-angled triangles taken in Fig. 3. Then with *M* as a center step off the distance *M-2'* which is taken equal to the distance *2-2'* of the end view, Fig. 2 Connect *0-2'* which is the true length of the line *2-2'*. Repeat this process as shown, using the distance *3-3'*, *4-4'*, etc., as the bases of the right-angled triangles in Fig. 3, until the true lengths of all the solid surface lines are determined.

In Fig. 4, the triangles are constructed the same as in Fig. 3, using *M-O* as the common altitude and taking the distances *1-2'*, *2-3'*, *3-4'*, *4-5'*, etc., as the bases, until the true lengths of all the dotted surface lines are determined. The true lengths of all the solid and dotted lines are now known and the development of the sheet can be made.

In Fig. 5, lay out the horizontal line *13-13'*, equal in length to the line *13'-13"* in Fig. 3. Set a pair of dividers to the spacing *1-2*, *2-3*, *3-4*, etc., on the small semicircle and set another pair of dividers to suit the spacing of the large semicircle. The setting of these dividers should be very carefully done, as any little inaccuracy here will destroy the accuracy of the entire development. Now, with *13'* as a center, and with the dividers set to the large spacing, strike an arc. With *13* as a center, and the distance *13-12'* Fig. 4 as a radius, strike an arc cutting the previous arc at *12'*. With *12'* as a center, and the distance *12'-12"*, Fig. 3, as a radius, strike an arc. Now, with *13* as a center, and with the dividers set to the small spacing, strike an arc cutting the previous arc at *12*. Continue this operation until the points *1-1'* are reached. Join the points *1, 2, 3, 4, 5, 6*, etc., with a smooth curve, and similarly join points *1', 2', 3', 4', 5', 6'*, etc. These two lines form the development of one-half of the conical course, Fig. 1. It will be readily seen that the method is not absolutely accurate, due to the fact that a curved surface is divided into a small number of parts which are straight lines. However, with a sufficient number of subdivisions and with great care on the part of the layer out, sufficient accuracy for most practical purposes will result.

In boiler work, the complete development of the sheet should be made.

The next step is to add to the development the necessary amount top and bottom for the seams. The rivet holes for the seams are laid out on lines parallel to the development lines *1-13*, and *1'-13"*, Fig. 5, and punched in the plate while it is flat. The plate is then bent to conical form and afterwards the ends are shaped to cylindrical form.

It is necessary to allow for the distortion of the plate resulting from this. In laying out the rivet holes in the flat plate, it is usual to so space the rivets that when the work is finished either a rivet or a space comes on the center of each quarter of the circumference, which would be the lines *13-13, 7-7'* and *1-1'* in Fig. 5.

Any type of conical connection can be laid out following the same method as outlined for this particular case. Where the seam is off center, the development should be started at the seam.

Formula for Vacuum Tanks

Q.—Kindly give me formula for vacuum tanks; for example, a steel tank 36 inches diameter by 7 feet long built to carry a 29-inch vacuum. B. C. I.

A.—It is first necessary to determine the pressure on the tank due to the 29-inch vacuum in the tank.

At sea level the pressure of the atmosphere is ordinarily 14.7 pounds per square inch measured above absolute zero, that is, the zero pressure of a perfect vacuum. With a perfect vacuum at sea level the barometer would read 30 inches.

$$\frac{14.74}{30} = .4916$$ pounds pressure per inch of vacuum.

The atmospheric pressure exerted upon the tank due to a 29-inch vacuum would then be $29 \times .4916 = 14.2484$ pounds.

The absolute pressure in the tank would be the difference between 14.7 and 14.2484 or .4916 pound.

The pressure on the tank due to the 29 inch vacuum is a variable figure being influenced by the increasing elevation above sea level and weather conditions. The absolute pressure in the tank remains constant.

The following formulas can be used in determining the thickness of plate for the vacuum tank. The modification of Fairbairns rule is sometimes used for calculating the collapsing pressure of tubes.

$$P = \frac{375{,}023 \times t}{L \times D}$$

transposing

$$t = \frac{L \times D \times P}{375{,}023}$$

where

P = pressure in pounds per square inch.
t = thickness of plate in inches
L = length in feet
D = diameter in inches

Nystroms rule for calculating the collapsing pressure of tubes subject to external pressure is:

$$P = \frac{200{,}000 \times t^2}{D \times \sqrt{L}}$$

transposing

$$t^2 = \frac{D \times \sqrt{L} \times P}{200{,}000}$$

$$t = \sqrt{\frac{D \times \sqrt{L} \times P}{200{,}000}}$$

where

P = pressure in pounds per square inch
t = thickness of tube in inches
L = length of tube in feet
D = external diameter in inches

In using these formulas for thickness of plate, allowance should be made for the fact that the efficiency of riveted seams or welds have not been taken into account.

The heads can be calculated according to the method used in construction by the following formulas.

Convex heads: (Pressure on concave side.)

The thickness required in an unstayed dished head with the pressure on the concave side, when it is a segment of a sphere, shall be calculated by the formula:

$$T = \tfrac{1}{8} + \frac{(5.5 \times P \times L)}{2 \times TS}$$

T = thickness of plate in inches
P = maximum allowable working pressure, pounds per square inch
TS = tensile strength, pounds per square inch
L = radius to which head is dished in inches

Where the radius is less than 80 percent of the diameter of the shell or drum to which the head is attached, the thickness shall be at least that found by the formula by making L equal to 80 percent of the diameter of the shell or drum.

Concave heads: (Pressure on convex side.)

Dished heads with the pressure on the convex side shall have a maximum allowable working pressure equal to 60 percent of that for heads of the same dimensions with the pressure on the concave side.

Design of Cylindrical Heads

Q.—Please inform me if you have any information or data relative to the design and construction of the cast heads used in vulcanizers, digesters or similar vessels. I would like to obtain formula for the calculation of same. B. B. B.

A.—Cylindrical heads when flat may be proportioned as flat plates supported at the edges.

$$t = .5\,D\sqrt{\frac{5P}{6f}}$$

where

t = thickness of plate in inches
f = intensity of stress, pounds per square inch, 3000 for cast iron and 8000 for cast steel
P = pressure pounds per square inch
D = diameter in inches taken at point of support

When heads are dished and ribbed, the same formula may be used for determining the maximum limit of dimension and the actual thickness made from 20 to 40 percent less, depending upon the ribbing.

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States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkesburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.
	Evanston, Ill.	

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash	Parkersburg, W. Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

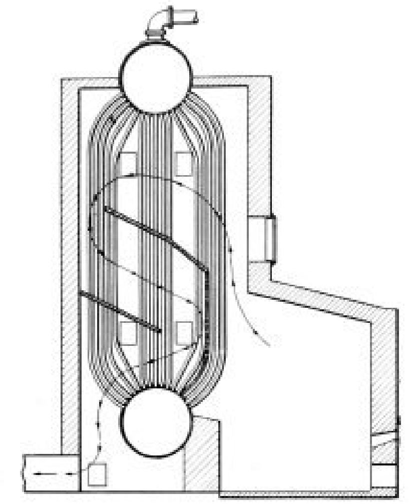
Selected Boiler Patents

Compiled by
DWIGHT B. GALT, Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

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

1,707,627. WATER-TUBE BOILER. ALFRED C. DANKS, OF CLEVELAND, OHIO, ASSIGNOR OF ONE-HALF TO KINGSLEY L. MARTIN, OF MONTCLAIR, NEW JERSEY.

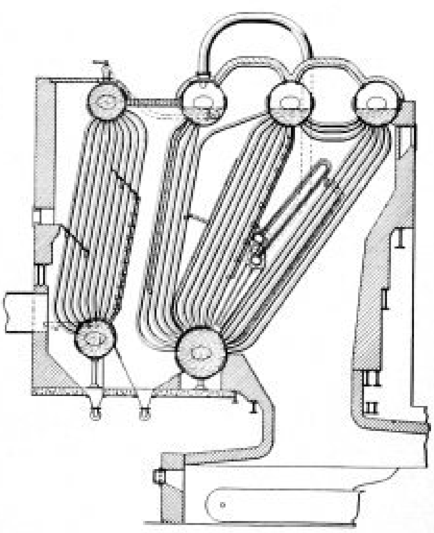
Claim.—In combination in a boiler of the vertical type, having a lower drum and an upper drum arranged in substantially vertical alinement one above the other and three sets or banks of watertubes extending upward from the lower drum to the upper drum, a firebox, an outlet flue at the



rear of the boiler at the lower portion thereof, a baffle extending from the lower drum longitudinally of the tubes of the front bank for a portion of their length and then transversely of such tubes and across the middle bank of tubes and across the space between the middle and rear banks of tubes and terminating short of the rear side of the rear banks of tubes, and a second baffle extending inward from the vertical rear wall of the boiler setting across the rear bank of tubes and into the middle bank of tubes and spaced below the transverse portion of the first baffle. Two claims.

1,704,132. STEAM-BOILER ECONOMIZER. WILLIAM A. JONES, OF WEST NEW BRIGHTON, NEW YORK, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

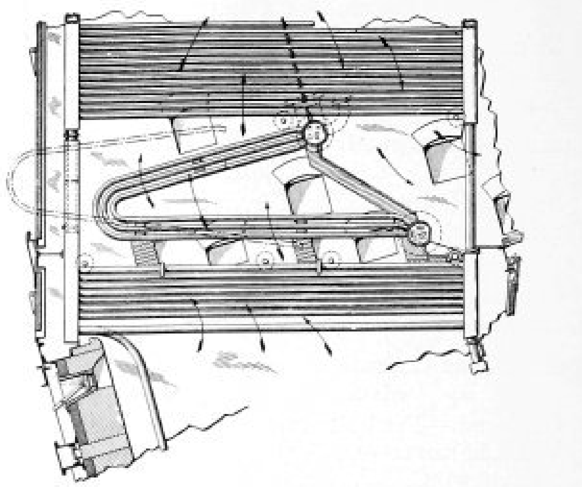
Claim.—In a fluid heater, a pair of drums of substantially equal diameter spaced apart, a bank of tubes connecting the drums and having their ends entering the drums normal to the surfaces thereof with their ends expanded into said drums, each tube of the bank having the greater portion thereof



straight and parallel to the straight portions of the other tubes of the bank and extending at an angle to the line connecting the centers of said drums, each tube being curved to a substantial amount at at least one end, and each tube on one side of the center line of the bank being a duplicate as to shape and length of a tube on the other side of said center line. Five claims.

1,707,638. STEAM BOILER. WILLIAM S. MONROE, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

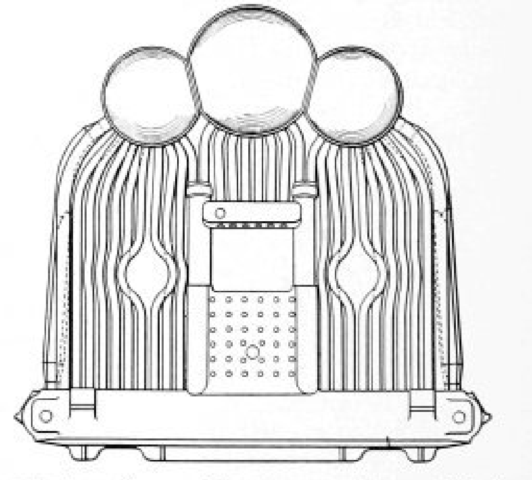
Claim.—A superheater boiler having horizontally inclined watertubes arranged in separated upper and lower banks, a superheater between the banks with tubes extending lengthwise of the watertubes, headers connecting the ends of the watertubes in each bank and extending at right-angles



to the watertubes, and connections between the uptake headers and other connections between the downtake headers of the two banks, some of the headers at one end of the banks being spaced apart and being long enough to extend substantially across the space between the banks and the other headers at such end being disposed in the spaces between the first named headers and being connected by long nipples. Eight claims.

1,706,357. BOILER. VINCENT L. JONES, OF NEW HAVEN, CONNECTICUT, ASSIGNOR TO McCLELLON LOCOMOTIVE BOILER COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

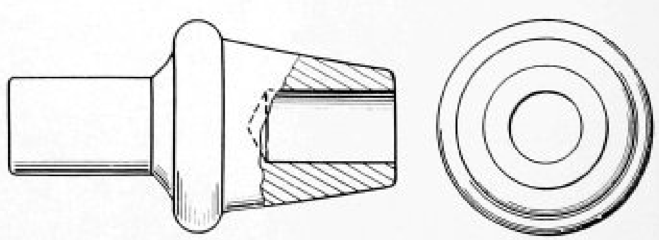
Claim.—A locomotive firebox comprising a longitudinally extending crown chamber having cylindrical side walls, an upwardly and rearwardly inclined



mudring and side walls comprising tubes entered perpendicularly to the top wall of the mudring and raking upwardly and forwardly and having upper ends bent and entered radially through said cylindrical surfaces. Fourteen claims.

1,707,124. BOILER-MAKER'S TOOL. HARRY A. LACERDA, OF WATERVLIET, NEW YORK.

Claim.—A tool comprising a shank and a head at one end of the shank, said head having a flange at its inner end and a tapering combined centering and swaging member extending from the center of the flange at the



side of the latter opposite to the shank and in axial alinement with the shank, said shank being adapted to be actuated by a pneumatic hammer or like power device and said centering and swaging member being adapted to enter and engage with an end of a locomotive engine flue tube so that said end of the tube will be simultaneously flared and set in an associated flue sheet when the tool is actuated by said power device. Two claims.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX | October, 1929 | Number 10

PUBLISHED MONTHLY BY THE
SIMMONS BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

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The Boiler Maker is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Boiler Welding in Europe

OBSERVATIONS made by G. A. Orrok, consulting engineer, at the recent joint meeting of the American Welding Society and the Iron and Steel Division of the American Society of Mechanical Engineers held at Cleveland, might indicate that the state inspection laws of this country were somewhat backward in not permitting the use of welding in boiler construction. In many European countries the use of welding for boiler and pressure vessel work is widespread and practically no restrictions against its development exist.

According to Mr. Orrok, in shell boilers both longitudinal and circumferential seams have been welded by both the acetylene and the electric process, and as this practice is growing it would appear that no serious trouble has been encountered. In boilers of the Cornish and Lancashire type, and their modifications, the suspension furnaces of the Morrison type are quite commonly provided with Galloway circulation tubes welded in by the oxy-acetylene process. Bosses, nozzles, and short pipe connections are generally welded and re-inforced.

In general, welding is being much more used in European boiler shops than ever before. The test above the elastic limit, with subsequent annealing, has made it easy for the designer to cut down the factors of ignorance of the older school of boiler construction. Research on boiler design problems, on boiler materials, and on full-sized structures is rapidly clarifying the mass of knowledge so that the boiler constructor of the future can build a boiler without waste metal and one in which pressure and heat strains are properly considered.

The two objections to welded joints most commonly heard in the last few years—lack of resiliency and the welder's skill factor—are heard less and less often, due to improved methods of welding, proper inspection, accumulated experience, and the large amount of test data. This is especially evident in Germany, where extensive welding has been adopted for the hulls of warships.

In discussing Mr. Orrok's statements, C. W. Obert, honorary secretary of the A. S. M. E. Boiler Code Committee and consulting engineer for the Union Carbide & Carbon Research Laboratories, pointed out that in spite of the present code restrictions on the use of welding in this country it must be remembered that it is even now possible to use welded boilers in many "non-code" states. Large-scale experiments made in certain states may supply some of the necessary preliminary experience. One thing that is now hampering the industry is the lack of experience on full-sized welded boiler structures.

Most of the criticism directed against the Boiler Code Committee has been without foundation. Under the circumstances, the committee has been wise to go slowly with welding. It very properly demands that the American Welding Society go along with it in its studies of the application of welding to boiler structures.

At the present time it is practically certain that the Unfired Pressure Vessel Code will shortly be revised to permit the welding of larger vessels with higher unit stress and greater maximum pressure, where the welding is carried on under a prescribed procedure. It is a bit early now to look for a revision of the boiler code proper, permitting the welding of boilers. However, it has been discussed to some extent and a start has been made in the way of revisions of the requirements for welding in the Unfired Pressure Vessel Code. It is possible that considerable progress will be made within the next twelve months. In this the recently developed nondestructive tests of welds may be very helpful.

Cracks in Boilers

CRACKING around rivets in the seams of boilers has been a subject that has given no end of trouble to manufacturers and operators. These cracks, having the appearance of fatigue cracks, generally occur in the circumferential seams of the boiler, running from one rivet hole to another. But while the effects of these cracks are evident, the cause is not definitely known.

Professors Parr and Straub of the University of Illinois contend that cracks result from a combination of stress of the metal beyond the yield point and a large ratio of sodium hydrate to sodium sulphate or sodium carbonate in the feed water. But they also state that "the steel must be stressed beyond its elastic limit before it can become embrittled by caustic."

Howard L. Miller, metalluragist of the Central Alloy Steel Corporation, Massillon, O., speaking before the annual convention of the Master Boiler Makers' Association brought out the fact that steel boiler plate is not stressed beyond the elastic limit by steam pressure in good boiler design. Additional stresses due to the expansion of flues and due to the temperature difference between the flues and the shell, are set up. He has estimated that each tube along the bottom of the boiler exerts a pressure on the flue sheets of about 49,700 pounds when the difference in temperature between the flues and the barrel is around 300 degrees F.

Dr. Preuss in Germany in investigating the stresses around a hole in a plate, shows that the stresses adjacent to the hole are over twice that of the plate stress. Dr. Wolff, as reported in the transactions of the British Iron and Steel Institute, 1927, shows that plates when riveted together and tested under tension have the same unequal distribution of stress. Thus, if the fatigue limit of steel is 36,000 pounds per square inch and a stress of 14,000 pounds per square inch is set up across the plate between holes, a stress of two and one-half times this or 35,000 pounds per square inch may be set up at the rivet hole.

Two solutions are advocated by Mr. Miller for building a boiler so as to eliminate the localized overstraining of the steel; the first is by changing the method of joining the plates together so as to get rid of the uneven strain in the joints; the second is to use riveted joints but raise the factor of safety.

The proposed joint consists of a single riveted lap with welded seams on both sides of the joint; the weld is designed to carry the load and the rivets will give additional support.

The second method consists of raising the factor of safety of the boiler from 4 or 5 to 7 or 8 and of reducing the required thickness of the plate by heat treating each boiler ring after fabrication or using a high-tensile plate which is toughened by addition of alloys.

Of the two solutions suggested, it is evident that the change in the type of seam joint would increase the strength of the joint and reduce the possibility of localized stresses at a lower manufacturing cost than the employment of high-tensile steel. For higher pressures and temperatures, the use of special steels will solve the problem of boiler shell thickness and strength.

Communication

Staybolt Breakage

To the Editor:

An unusual case of staybolt breakage came under the writer's observation some time ago, which may be of interest to your readers. Two adjacent flexible bolts were reported broken off at a point adjacent to the top thread. This is not unusual, but we also found both bolts fractured for three-quarters of the diameter at a point about one inch below the ball head. The question arises, were these fractures and breakages simultaneous; if so, why and how? We of the craft accept the given reason for staybolt breakage; i.e., unequal expansion and contraction. The flexible bolt was designed to aid in the elimination of staybolt breakage, still they break.

Among the readers of and writers for The Boiler Maker are men whose opinion upon this subject would be valuable. As a working boiler maker, my ideas may bring out some discussion along the line of staybolt breakage. Observation for a long time has forced me to the conclusion that there are two possible causes for the breakage of flexible staybolts.

First, the improper application as shown where two adjacent bolts are reported faulty by the inspector. One is reported as broken; the other one reported for examination; that is if the cap is taken off, this bolt will not be found seated in the cup within one-eighth to three-sixteenths of an inch, resulting in one bolt carrying more than its share of the load. The removal of both bolts is thus necessary for service. Again, where the top row of bolts in a side sheet are flexible and the next row solid, we will find the flexible bolt broken. This is a case of improper application again, the bolts are screwed in tight, then driven without the usual half turn back for relief, resulting in flexible bolts having extreme tension and carrying more than their share of the load.

Second, a greater number of broken bolts are broken within one-half to one inch below the ball head. Now I am not at all familiar with the manufacture of these bolts but surmise that the bars of material are heated and the heads then formed by upsetting the material between suitable dies.

Is it possible that the material is not sufficiently heated below the amount necessary to form the head to avoid the possibility of destroying the homogeneity of the material, thus weakening the metal below the head? Not very often do we find a bolt broken at the neck, or just at the junction of the head and the stem.

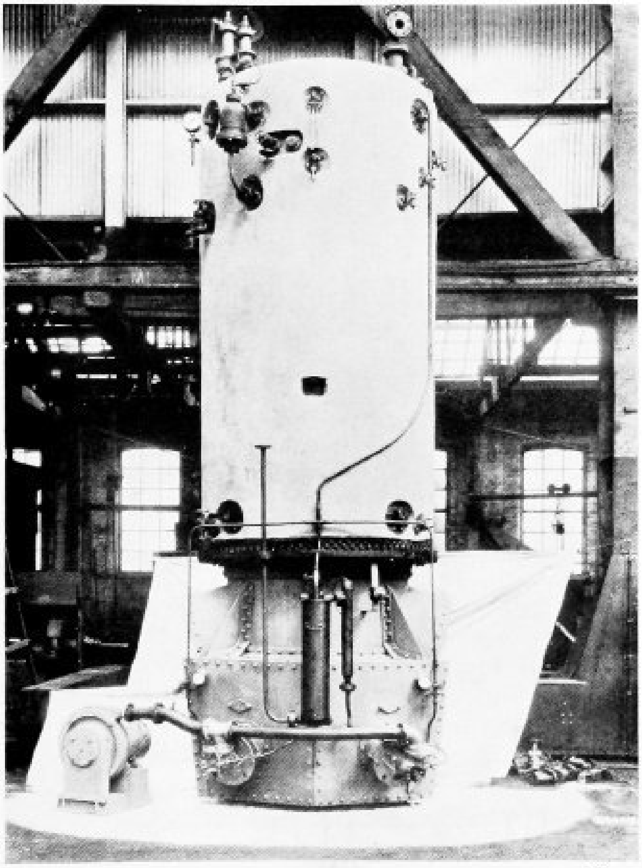
The writer is interested in the staybolt question, because, when one has had to cut out solid bolts by hand and drive by hand, it is but natural that one wants to see the articles, that are brought forward for the elimination of so much hard labor, given the opportunity to function as they were intended.

Lorain, Ohio. Joseph Smith.

Big Silencer Boiler Installed On World's Largest Motorship

By G. P. Blackall

FOUR Clarkson exhaust gas silencer-boilers, generating steam at 100 pounds pressure per square inch, are being fitted to the main engines of the new White Star liner *Britannic*, the largest motor vessel ever constructed, and are capable of passing the whole of the exhaust gases. The boilers are 5 feet 3 inches in diameter by about 11 feet 5 inches overall, and may be regulated to generate between 10,000 and 16,000 pounds of steam per hour total, according to requirements. A



Silencer boiler of type installed on M. S. Britannic

smaller silencer, 4 feet by 9 feet overall, and capable of generating 1800 pounds of steam per hour with a working pressure of 100 pounds per square inch from the exhaust gases of two Diesel generators is provided.

The total is the largest Clarkson silencer-boiler installation yet fitted to any one ship, totalling as it does about 20,000 horsepower.

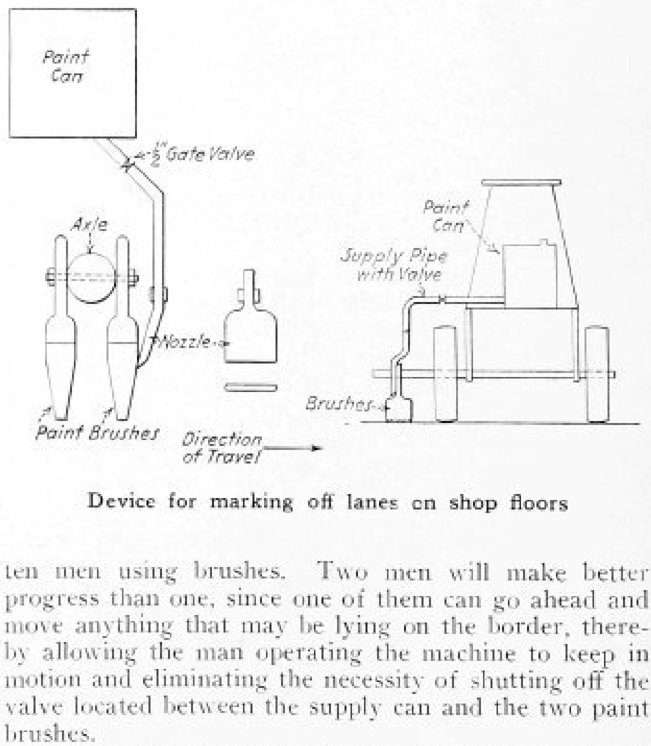
A Clarkson gas silencer-boiler suitable for passing the exhaust gases from the two main engines is fitted in the *Westralia*, an 8000-ton motor vessel recently built by Harland & Wolff, Ltd., for an Australian firm. It is fitted with alternative oil-burning equipment. Its dimensions are 5 feet diameter by 14 feet 6 inches overall, including combustion space. Working pressure is 100 pounds per square inch. As the total quantity of steam that could be generated is not required, this boiler is designed to generate a maximum of 2800 pounds of steam per hour only, from exhaust gases, and 3000 to 3500 pounds per hour when oil fired.

Marking Off Working Lanes On Shop Floors

IN MANY large industrial plants and railroad repair shops it has become common practice to mark off with white lines lanes or paths which are to be kept clear at all times. These lanes are used by industrial trucks with trailers, or by hand trucks, to deliver material and supplies to and from the store rooms and between departments. It is, therefore, important that the borders of these lanes always be kept marked plainly to avoid delays in the handling of supplies and materials through the various departments of the shop.

A recent inspection of several railway shops showed that the borders of these lanes were painted on by hand and, upon inquiry, it was found that it required from ten to twelve man-days each week to keep them in shape.

A small border painting rig, similar to the one shown in the illustration, can easily be made in any shop to do this work. Two men using it can do the same work as



Device for marking off lanes on shop floors

ten men using brushes. Two men will make better progress than one, since one of them can go ahead and move anything that may be lying on the border, thereby allowing the man operating the machine to keep in motion and eliminating the necessity of shutting off the valve located between the supply can and the two paint brushes.

The border marker is made by mounting a pair of hand-truck wheels on an axle, one end of which is extended and on which are mounted the two paint brushes. These brushes are made the width of the border line desired. A frame is built onto the axle which serves as a support for the five- or ten-gallon paint tank. A feeder pipe leads from the tank down to the front paint brush. The outlet of this pipe is placed against the brush near the top of the bristles. A control valve is placed in the supply line between the brushes and the supply tank.

The front brush distributes the paint and the second brush smooths it out to an even finish. The brushes are placed on the right side so that the man operating the rig will be going with traffic and will not be walking on the fresh markings. Placing "fresh paint" signs at intervals along the line will serve as a reminder to workmen, not to step on the line.

Checking the throat sheet layout prior to drilling

Assembling *and* Applying

Fabrication methods employed in building

sheets connected with the firebox are laid out by the layout department in bay No. 12, prior to the receipt by the firebox fitting department. The crown sheets, however, are laid out and rolled to shape before they are sent to bay No. 6.

LOCOMOTIVE boilers, as constructed by the win Locomotive Works, Eddystone, Pa., are built with due regard to the most modern production methods, the organization of the boiler shop being divided into a number of departments, each specializing in a particular phase of boiler manufacture. Among the numerous groups of specialists is the firebox fitting department whose sphere of activity lies generally in the upper section of bay No. 6.

Bay No. 6 is divided into two sections; the lower of which is occupied by the rivet storeroom, and the upper section of which comprises the firebox fitting floor. This floor, extending between panels 2 and 17, occupies an area of 30,720 square feet and is equipped with 29 modern machine tools, a tabulation of which is given together with the floor layout on pake 282.

This section of the bay is served by a 20-ton Pawling & Harnischfeger crane and a 50-ton Sellers crane, while two 25-ton Niles-Sellers cranes, each spanning half the width of the bay, serve two bull riveters located in panels 2 and 3.

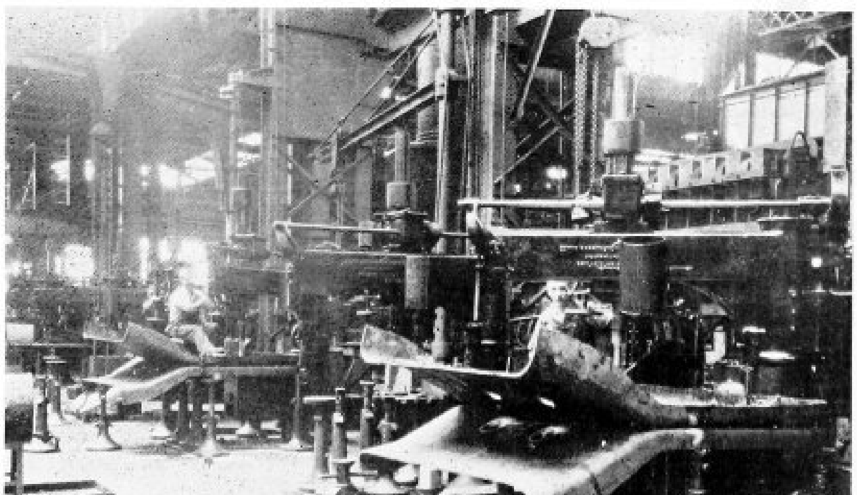
It is in this bay that back tube sheets, firebox throat sheets, door sheets and crown and side sheets are received and assembled into the firebox unit preparatory to the fitting of the firebox to the boiler proper. All flanged

The firebox tube sheets are drilled and reamed in a similar manner to the front tube sheet, the tube holes being drilled and reamed, using lead holes as is the general practice in such cases. The method for drilling the front tube sheet was described in the August, 1929, issue of THE BOILER MAKER. After drilling the tube holes, the flange of the tube sheet is laid out for depth and the flange rivet line is laid out. The rivet holes are then drilled on the horizontal drill press located in panel 12.

Instead of machining the tube sheet flange in a boring mill, as was the case with front tube sheets, the flange is trimmed by means of an oxy-acetylene torch and then chipped by means of hand-operated pneumatic chipping hammers, thus finishing the flange edge.

The tube sheets of some types of locomotive boilers are required to be scarfed and in such cases they are taken to milling machines and milled in bay No. 10. The tube sheets are then ready for application with the other sheets comprising the firebox assembly.

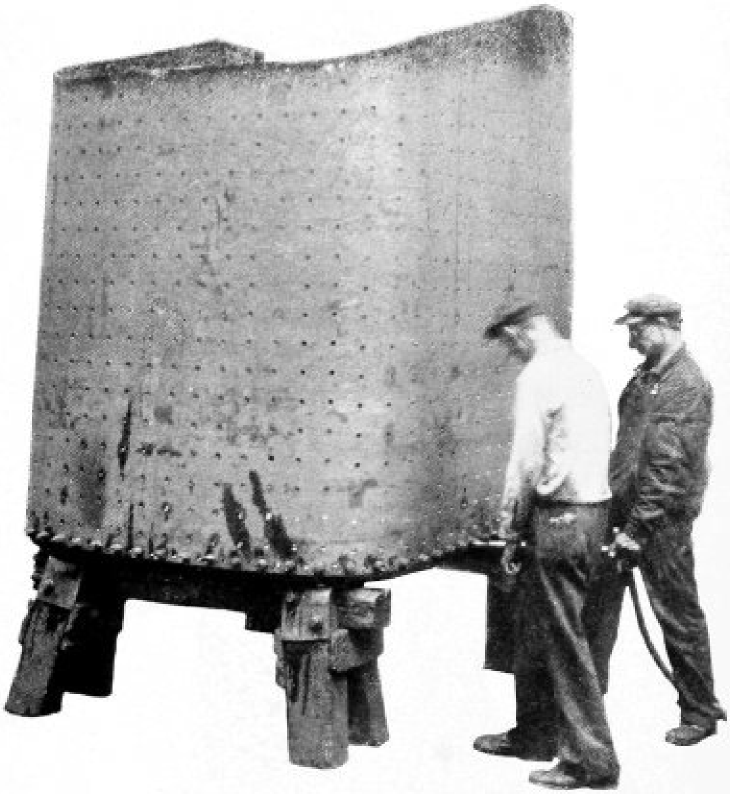
The crown and sides sheets may be manufactured in one piece or in several, but in either case they are laid out, drilled, planed, and rolled to



Door sheets set up in vertical radial drills for drilling

Fireboxes Syphon Units

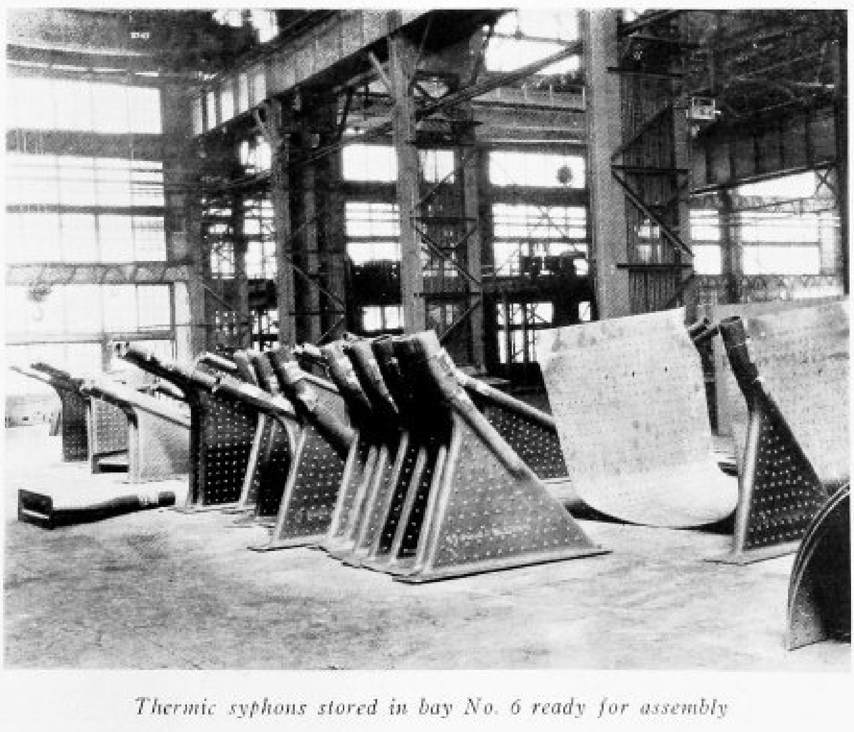
and welding practices Baldwin locomotives



Reaming the crown and tube sheet rivet holes

shape before being received by the firebox fitting gang. Where the crown and sides sheets are made in several pieces, these sheets are joined by this department, the sides sheets being bolted to the crown sheet and usually electrically welded in place. For the purpose of keeping the plates in alinement during the welding operation, a continuous plate, extending the full length of the seam, is bolted to the crown and sides sheets through the staybolt holes. This is placed back of the weld or on the water side of the sheets, the seam being planed to a full V in shape on the fire side of the sheet. After the V-seam is welded, the continuous plate is removed and the under or water side of the weld is gouged out to a depth of about 1/8 inch. A re-enforcing bead is then welded to the water side of the weld, the gouge serving to clean the surfaces to be welded and assure a satisfactory fusion of weld in bottom of the V.

In the case of fireboxes with combustion chambers, it is usually necessary to apply the bottom of the combustion chamber when the crown and sides sheets are being welded. The chamber bottom is welded in place using a full V weld with the re-enforcing bead as in the case of other crown and sides sheet welds. Extreme care must be taken in assembling the combustion chamber bottom to the crown sheet to insure the proper alinement of and spacing of staybolt holes. This is thoroughly checked before the sheet is welded or riveted together as the case may be.

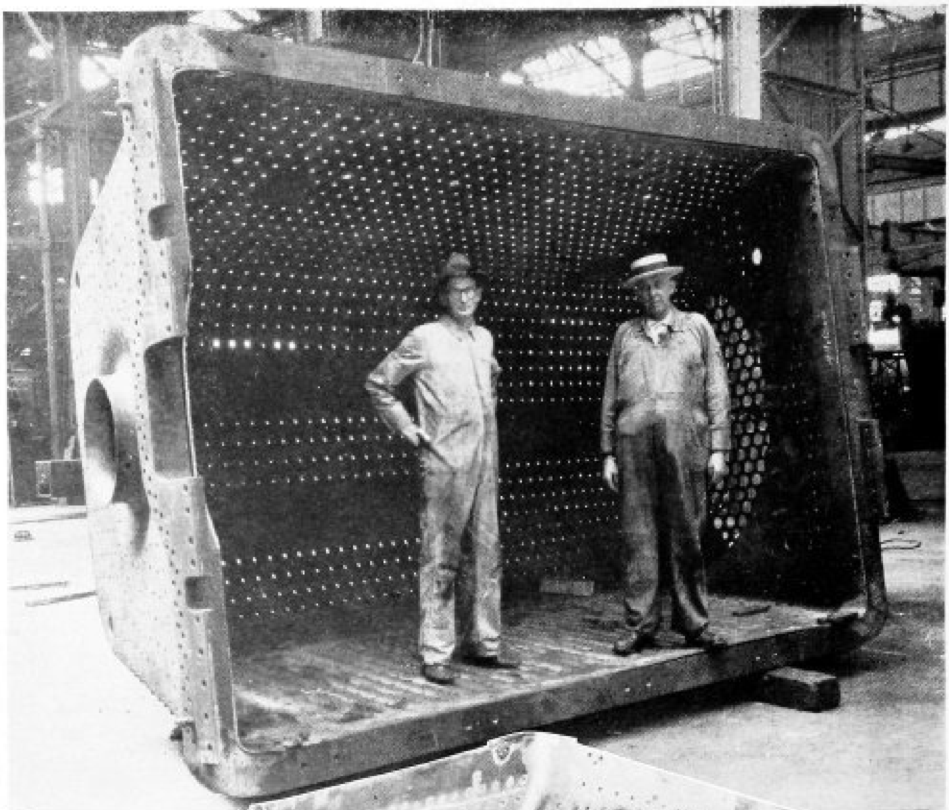


Thermic syphons stored in bay No. 6 ready for assembly

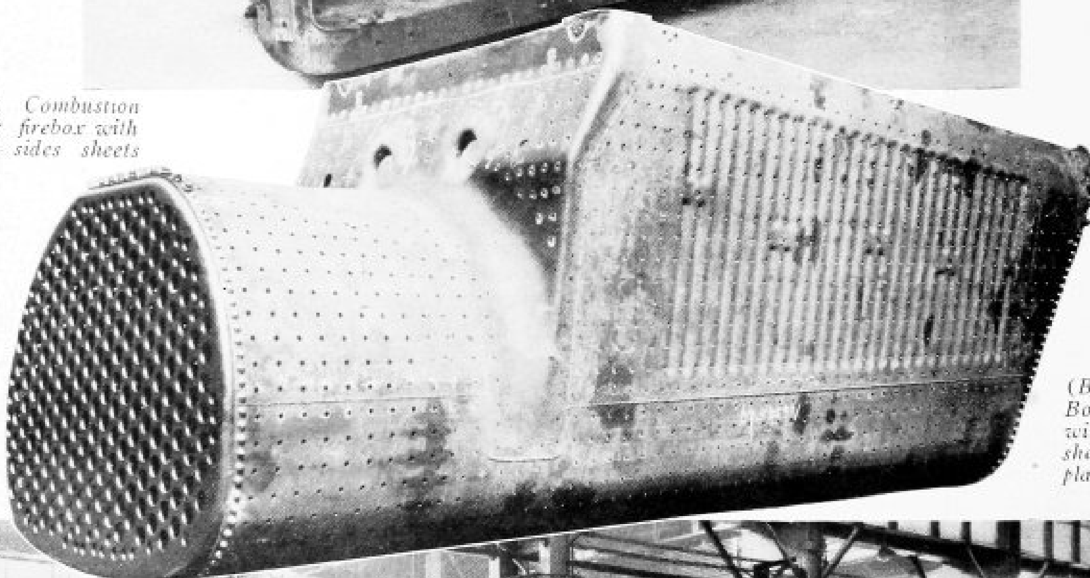
Throat sheets, having been laid out, flanged and scarfed, in other departments are trimmed, drilled and assembled to the firebox by the firebox fitting department. The staybolt holes located in the apron of the throat sheet are drilled on one of nine vertical drill presses located at the side of bay No. 6. The belt and side wings are drilled on one of two horizontal drill presses located in this department. These machines are located in panels 11 and 15.

In the case of a combustion chamber firebox, the throat sheets must be trimmed and fitted in place carefully so as to maintain the accurate spacing of staybolt rows forward and rear.

The firebox throat sheet is usually applied to the assembly after the crown and sides sheet is bolted to the waterspace frame, in order to accurately line up the throat sheet in the assembly, the waterspace frame serving as a guide. Rivet holes along the bottom of the sides sheets adjacent to the mud ring

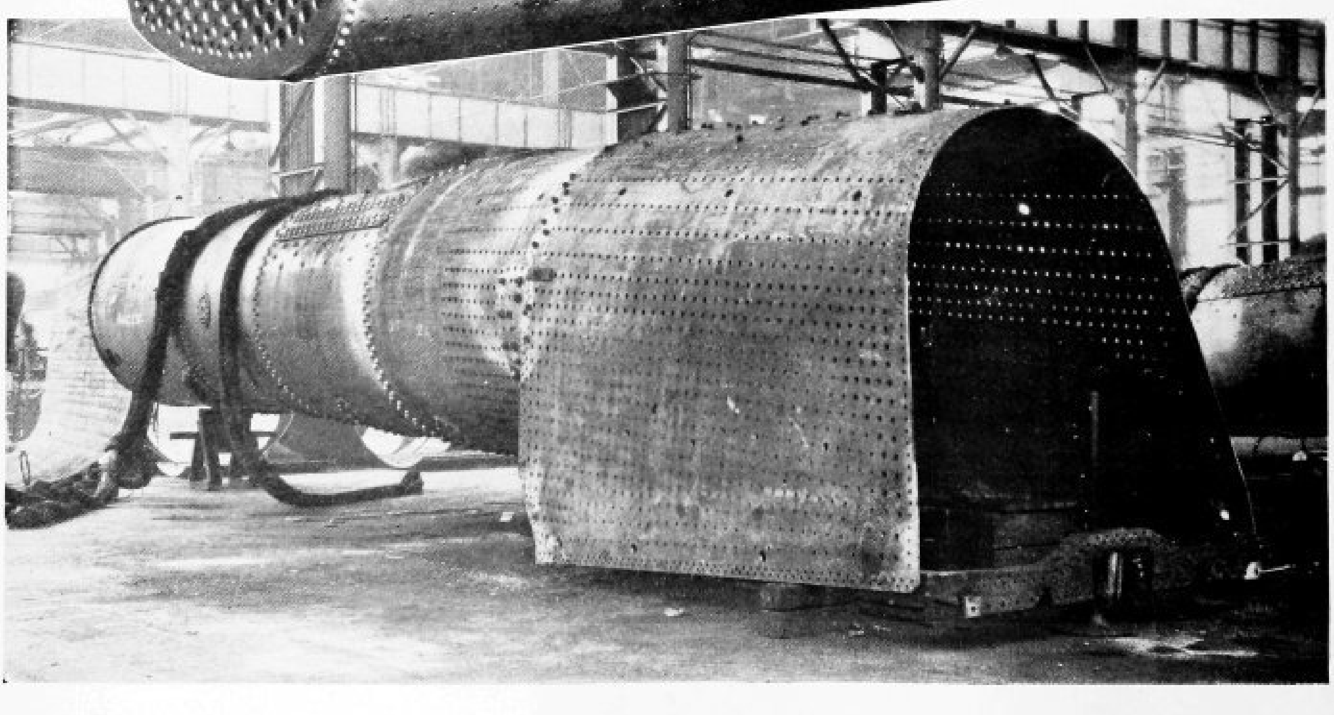


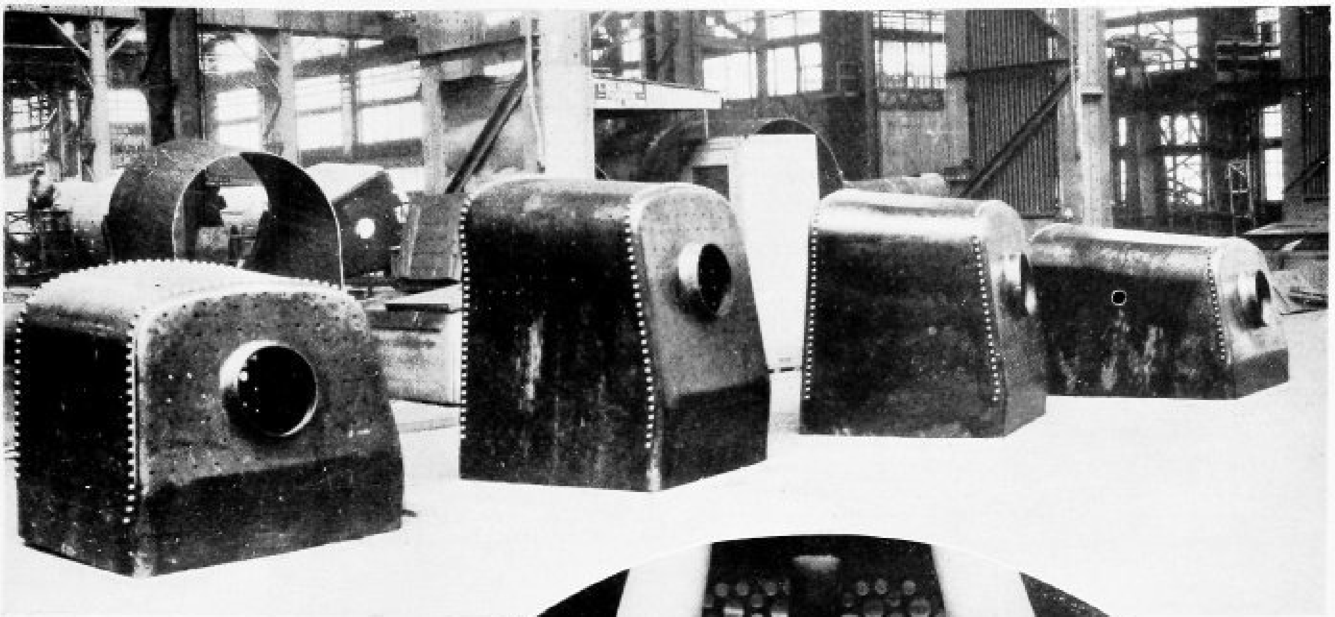
Assembled firebox ready for application of syphons



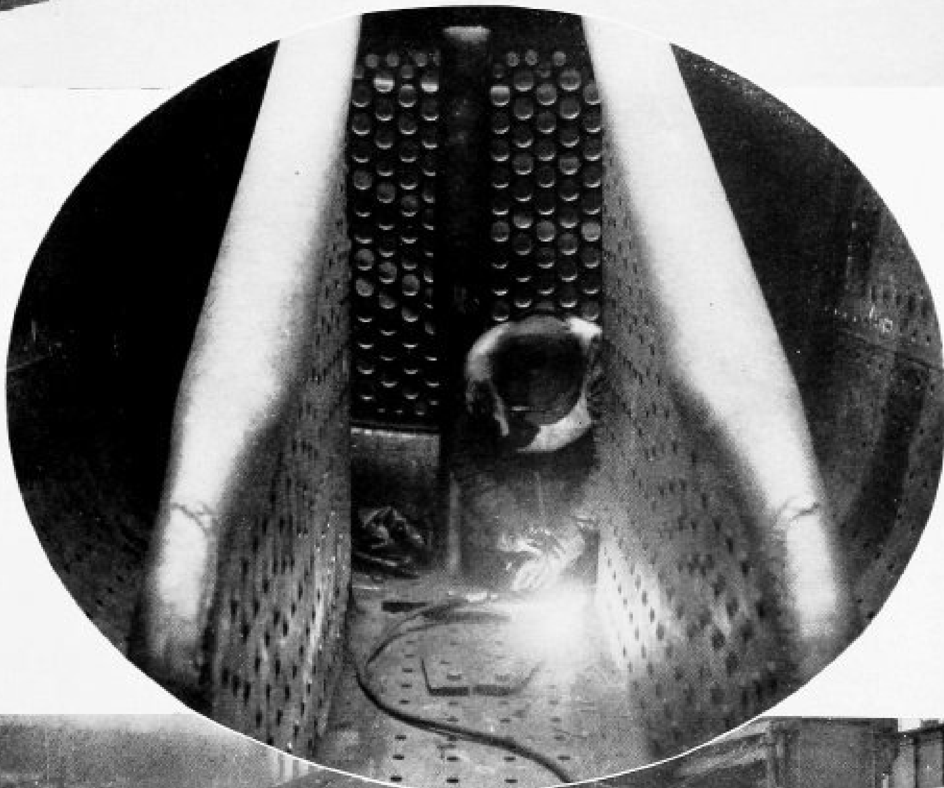
(Right) Combustion chamber firebox with corrugated sides sheets

(Below) Boiler barrel with wrapper sheet in place



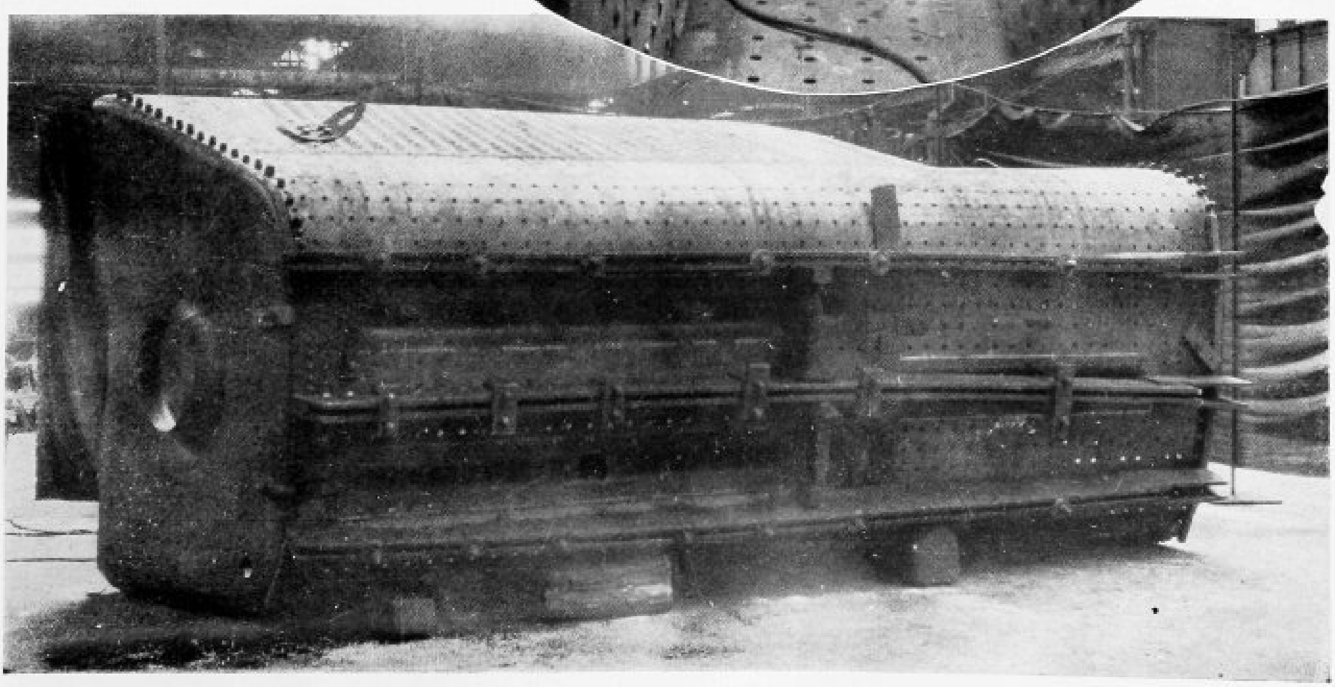


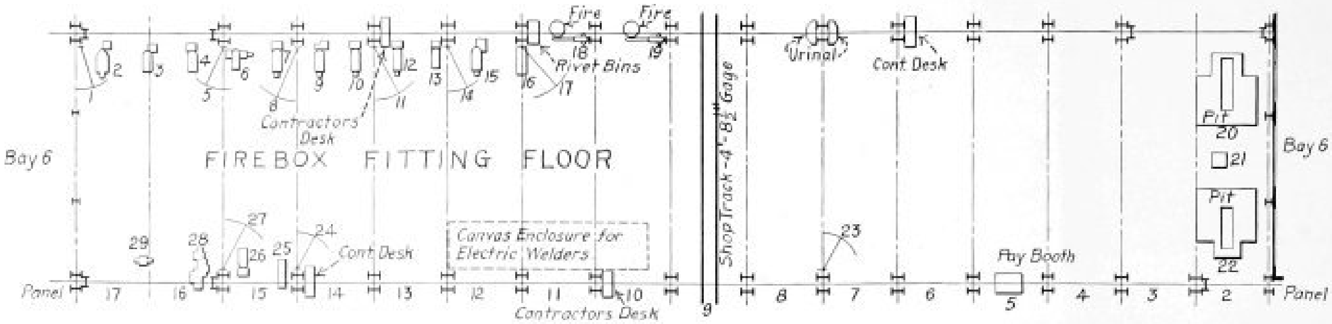
(Above) Completely fabricated small fireboxes



(Right) Welding the fireside of the crown sheet syphon seams

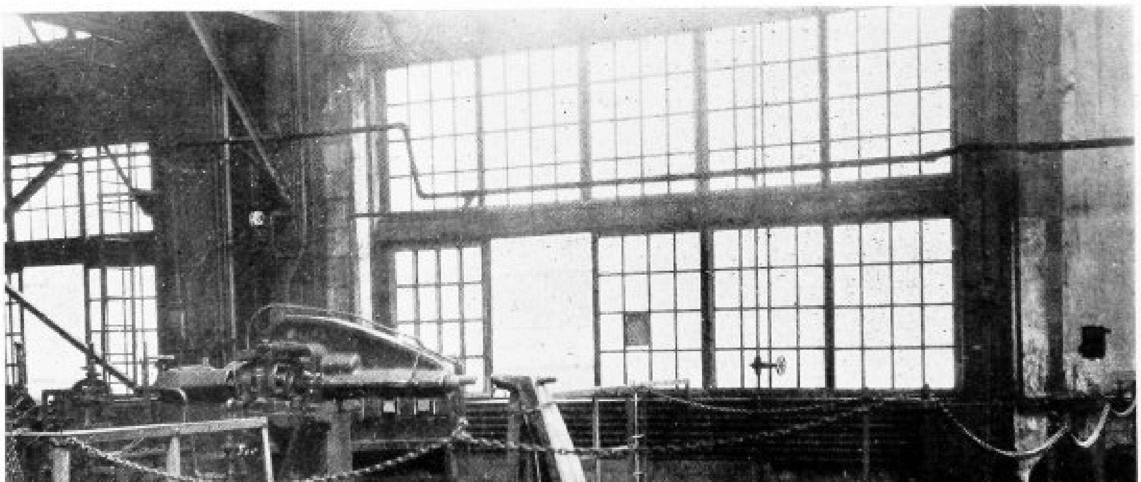
(Below) Arrangement of strongbacks to prevent crown sheet sag during welding





Machinery located on the firebox-fitting floor in the upper section of bay No. 6

1.—Baldwin 1½-ton hand jib crane, having a 14-foot 6-inch reach.
2.—Harrington 60-inch radial drill, motor on separate stand, belt drive.
3.—Harrington 48-inch radial drill, motor on separate stand, belt drive.
4.—Harrington 48-inch radial drill, motor on machine, direct drive.
5.—Baldwin 3-ton hand jib crane, having a 13-foot 9-inch reach.
6.—Harrington 48-inch radial drill, motor on machine, direct drive.
7.—Harrington 60-inch radial drill, motor on machine, direct drive.
8.—Baldwin 3-ton hand jib crane, having a 17-foot 9-inch reach.
9.—Harrington 60-inch radial drill, motor on separate stand, belt drive.
10.—Harrington 60-inch radial drill, motor on machine, direct drive.
11.—Baldwin 3-ton hand jib crane, having a 17-foot 9-inch reach.
12.—Harrington 60-inch radial drill, motor on machine, direct drive.
13.—R. H. Barr 52-inch reaming machine, motor on separate stand, belt drive.
14.—Baldwin 1½-ton hand jib crane, having a 15-foot 6-inch reach.
15.—Harrington 60-inch radial drill, motor on separate stand, belt drive.
16.—Baldwin 1¼-inch horizontal drill press, motor on separate stand, belt drive.
17.—Baldwin 3-ton hand jib crane, having a 17-foot reach.
18.—Sturtevant No. 6 blower, motor on bracket, on building column, belt drive.
19.—Sturtevant No. 5 blower, motor on bracket, on building column, belt drive.
20.—Sellers 74 to 23-ton hydraulic bull riveter, having a 16-foot 8-inch stake.
21.—Baldwin 18-inch die dresser, motor on bracket, on building column, belt drive.
22.—Bement 162 to 54-ton hydraulic bull riveter, having a 17-foot 1-inch stake.
23.—Baldwin 3-ton hand jib crane, having a 12-foot reach.
24.—Baldwin 1-ton hand jib crane, having a 14-foot 6-inch reach.
25.—Baldwin 1¼-inch horizontal drill press, motor on separate stand, belt drive.
26.—Harrington 48-inch radial drill, motor on machine, direct drive.
27.—Baldwin 1½-ton hand jib crane, having a 15-foot 8-inch reach.
28.—Baldwin ⅞-inch hole, ¾-inch plate, horizontal punch, motor on machine, direct drive.
29.—Baldwin fire door hole facer, motor on separate stand, belt drive.



Sellers bull riveter with 16-foot pit for use in firebox fabrication are not drilled until the firebox is finally assembled on the finishing floor. The same is true in the case of the throat sheet rivet holes adjacent to the mud ring. Several tack holes, however, are drilled at convenient locations, these being placed in exact alinement with the staybolt holes. These tack holes are laid out at the time of the sheet layout and enable the firebox fitting gang to bolt the various sheets to the mudring in correct position.

After the throat sheet is bolted up, it is either welded or reamed and riveted to the crown sheet, depending upon the requirement set forth in the boiler plans.

The back tube sheet which has previously been fabricated, is bolted in place with the crown and sides sheet. As is the practice at The Baldwin Locomotive Works, every other rivet hole is bolted in order to eliminate any slack that might be present when the assembly goes to the bull riveters. After the seam between the tube sheet and crown and sides sheet is tried with a thin feeler gage to assure a close fit, the rivet holes are reamed out by hand-pneumatic reamers. After reaming out alternate holes, the bolts are changed to these holes and the other holes reamed. After reaming, the tube sheet is bull riveted in either of the two bull riveters located in panel 2 of bay No. 6. Where the tube sheets are scarfed, however, hand riveting is employed.

The staybolt holes in the door sheet are drilled on one of the vertical drill presses while the flange rivet holes are drilled on a horizontal drill press, these locations having been laid out before receipt of the sheet by the firebox fitting department.

The door sheet is usually the last sheet to be applied, this being bolted in place to the mudring and crown and sides sheet. When this is done, the backhead of the boiler is temporarily pinned to the mudring in order to line up and mark off the door hole in both the door sheet and backhead. In case the door hole is found out of alinement, the flange is heated with an oxy-acetylene torch and shaped to the correct alinement by means of flatter tools. The door sheet is usually hand riveted to the crown sheet.

The firebox is then transferred to the finishing floor in bays No. 1, 2, 3, & 4, where the last rivets are put in by hand. When this has been done, the seams and rivets are caulked and the firebox is ready for fitting to the boiler proper.

Thermic syphons when called for in boiler construction, are applied in bay No. 6, but are not applied until the firebox is assembled and partially tied up with rivets to keep the crown sheet from creeping.

The syphons when received by the Baldwin Locomotive Company are completely fabricated ready for assembly as they arrive from the syphon manufacturing company. These are examined by the shop inspectors prior to their use in the boilers.

In ordinary fireboxes, syphons may be fitted with a lap weld or a butt weld. Riveting, however, is never used. The methods employed in applying syphons to ordinary fireboxes will be understood from the description given below for the application of syphons to combustion chamber boilers. The following steps are taken in such application.

The combustion chamber syphon is first lined up and chipped to card size after which the crown sheet is lined up, cut and chipped for the combustion chamber syphon only. The syphon is then applied in the chamber and tack welded.

Every effort is made to preserve the straightness of the crown sheet and to this end, special strongbacks are applied. It is found that best results are obtained by using strongbacks which stretch the entire length of the crown and rest on spacers lying directly on the flange of the tube and door sheets. The strongbacks each consist of two pieces of one-inch plate, 16 feet long, straight on the bottom and curved on the top with a height of 12 inches at the top and seven inches at the ends. The two plates are joined with a number of staybolts holding the plates at sufficient distance to allow the passage of the holding-on bolts between the plates.

Two of these strongbacks are applied on the outside to hold the crown and then the inside combustion chamber syphon seam is welded completely.

The rear syphons are then tried out in the firebox and trimmed to size after which the crown sheet is cut and chipped for the rear syphons. The rear syphons are applied to the firebox, held with clamps and then tack welded.

With three strongbacks again in place running the full length of the firebox, the crown sheet is drawn up from ¼-inch to ⅜-inch above normal to prevent sagging of the sheet. Experience has shown that this is necessary to give the straightest crown sheet after the job is finished.

After the strongbacks have been applied, one layer of metal is welded between the bolts or clamps. The clamps are then moved and the weld is made continuous, finishing the inside welding.

Similarly to the welding of the crown and sides sheets, all welds are gouged out on the waterside or back of the crown sheet. These welds are then re-enforced by welding beads on the waterside of the sheet.

The syphon necks are set up to the combustion chamber and throat sheet and are welded. The strongbacks are then removed and the staybolt holes in the syphon flanges are drilled, after which the syphon necks are chipped to the correct clearance, thereby completing the syphon installation.

All electric welding in the boiler shop at the Baldwin Works, while done in different sections, comes under the direct supervision of the firebox department. Individual Lincoln motor-generator sets on portable trucks are employed and appropriate outlets, into which the welding set may be plugged, are distributed at strategic points throughout the shop. Small areas are curtained off with canvas to protect the eyesight of the workmen in the shop. Coated wire electrodes are generally used.

Future issues of The Boiler Maker will contain additional articles dealing with the layout, equipment and methods employed at the Baldwin Locomotive Works. These articles will cover the fitting of shells, manufacture of staybolts, and the completion of the locomotive boiler prior to its shipment to the erecting shop.

Riveters and Presses.—This is the title of a catalogue recently published by the Hanna Engineering Works, 1765 Elston avenue, Chicago, Ill. Complete specifications, workings, drawings and numerous illustrations of 18 types of riveters and pneumatic presses are described. Among these riveters are the Standard rapid-speed riveter, the deep gap riveter, the turret riveter, the yolk riveter, and the push type riveter. High-speed pneumatic presses, portable presses, and special size gap riveters are also included in this description.

The Central Iron & Steel Company, Harrisburg, Pa. announces a change in the address of their Boston office which, effective immediately, will be Statler Office building, Park Square, Boston, Mass.

Applying Barrel Patches to Locomotive Boilers

Methods employed in England differ from those used in this country

By "Boilers"

THE DEFECTS which occur to the barrels of locomotive boilers usually consist of pitting and corrosion of the parts below the water level, and grooving at the circumferential seams.

Access for inspection of these parts with tubes and flues in position is very limited and consists of screwed washout plug holes or small sight holes. It is not often that defects can be estimated with any degree of accuracy from these openings, and it is not until the tubes are withdrawn for renewal that the condition of a locomotive barrel can be properly obtained.

Each time the tubes of a locomotive boiler are withdrawn the barrel should be inspected. In England retubing will be required after about 70,000 running miles, to complete which an express passenger engine will take about a year. Tube renewals during this period are often carried out in the running sheds but when a locomotive goes into the shops for periodical overhaul usually all the tubes are withdrawn for safe ending or renewal. Under this system the barrels of express passenger locomotives will be inspected at intervals of about 12 or 18 months.

The tubes and flues of freight and shunting locomotives do not wear so quickly as those in passenger locomotives and a period of two to three years may elapse between complete barrel inspections.

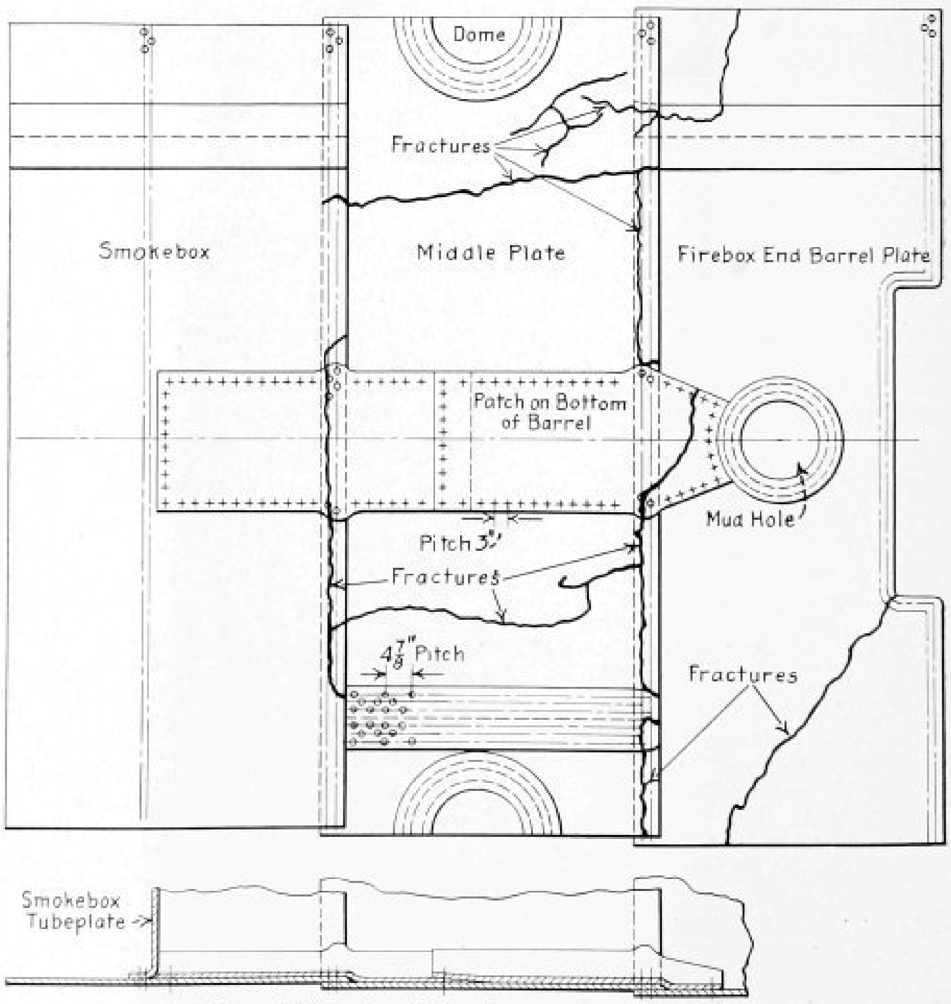
When deciding on repairs, it is necessary to consider the period which may elapse before the barrel is again accessible for inspection and also the average quality of water used in the district in which the locomotive will operate. Fairly deep isolated pitting may be repaired by welding, providing the strength in a longitudinal direction is not impaired and the defects not near a longitudinal seam. Welding in cases of this kind will arrest further corrosion and avoid the possibility of the plate perforating during service.

Where pitting and corrosion is extensive, even though the strength in a longitudinal direction is not materially affected it is usual to apply a patch. It is not usual to cut out the old plate before patching and the patches are invariably single riveted in a longitudinal direction. Where the corrosion affects the strength of the barrel new courses are fitted. New lower halves of barrels are not fitted as this method of repair would necessitate two additional longitudinal seams both of which would be in the water space.

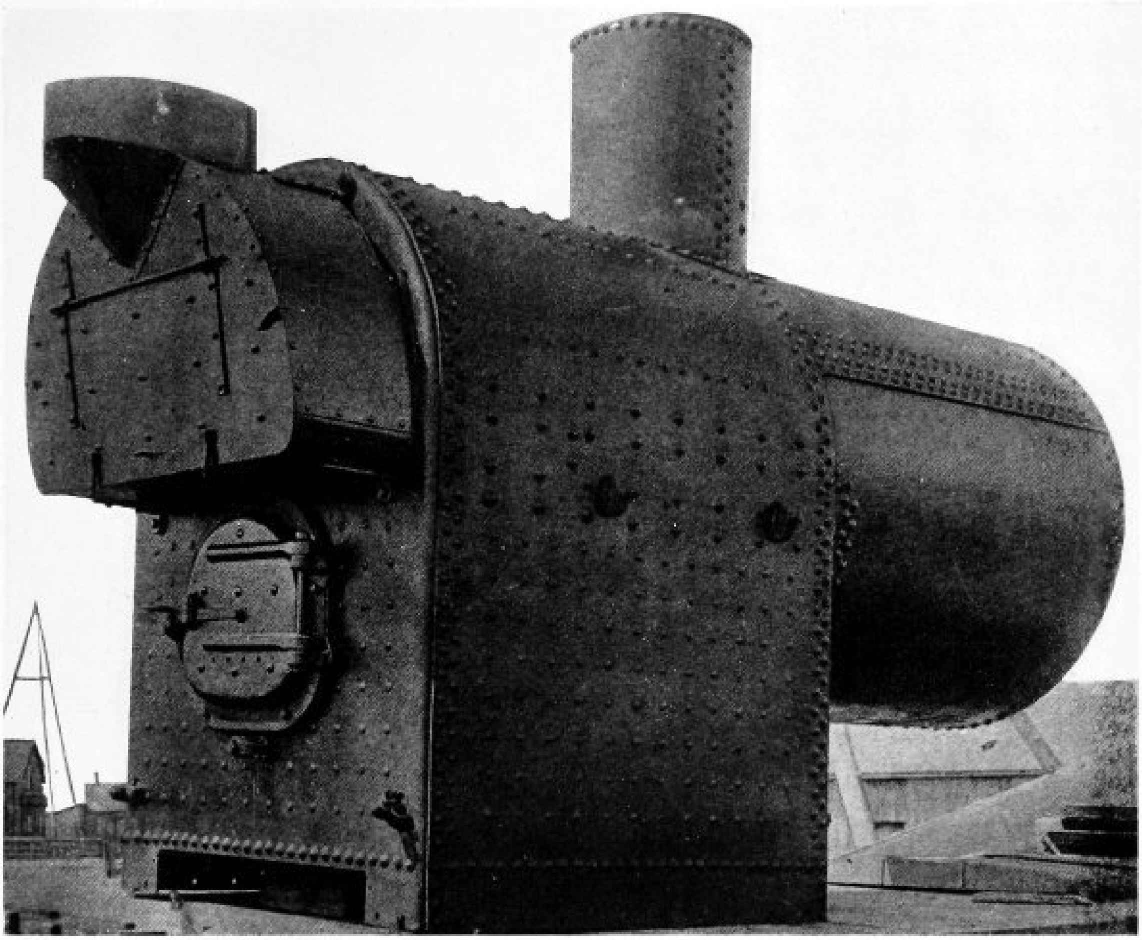
Generally speaking, cover patches are applied on the lower parts of locomotive barrels to arrest further corrosion and not to reinforce the barrels which have become weakened by extensive corrosion. A wide pitch of rivets can be employed without the possibility of trouble from leaky seams and the strength of the rivet section (usually weaker than the plate section in single riveted joints) is assisted by the strength of the plate through the corroded part covered by the patch. It is not therefore necessary to have more than one row of rivets in the longitudinal seam of a cover patch, where the strength of the plate covered is substantial. It is always desirable to pitch the rivets in the patch as far apart as practicable in order that the strength of plate between the rivet holes will be similar to that of the existing longitudinal seams. Where the pitch of the outside row of rivets in the original longitudinal seams is wide, cover patches on barrel bottoms should be double riveted with the pitch of the outside row equal to that of the original longitudinal seams. The strength of the plate section between the inner row of rivets would then be increased by the shearing strength of the rivets in the outside row.

In issues of THE BOILER MAKER, some time ago, ref-

(*Continued on page 286*)



Expanded view of boiler barrel showing patches and longitudinal seam



A hand-riveted marine boiler of forty years ago

The Evolution of Riveting

By J. A. Anderson

HAND riveting, as it was done fifty and more years ago, by the standard gang, composed of the right and left-hand riveters with a holder-on and a rivet heater, was the accepted practice for many years.

As boiler making grew and the demand for riveters increased faster than they could be trained, other methods were tried with more or less success.

One of the first departures from the then standard practice was the so-called down-hand riveting. This could only be done on special jobs such as large flues and small cylindrical work.

This method required the riveters to stand on either side of the work, and, after plugging the rivet into the hole, each man worked the rivet down to the sheet on the near side. In this way both riveters could continue the work until the rivet was finished, thus the rivets were driven somewhat faster than the standard practice of turn-about riveting.

The hammers used for this kind of riveting were called "picks", and were long from the eye to the face and short handled, allowing the riveters to lower the hands while finishing the rivets without coming in contact with the cylinder.

The next step was swap riveting, which came into practice as shops tried to speed up riveting and reduce the cost. It was done with a tool made of steel, cupped at one end to the shape of the head, either steeple or buttonhead. It was about 6 or 8 inches long; some were made with eyes, the same as a hammer, to take the handle, while others were handled with a wire twisted around the center. The snap was held on the rivet by the boiler maker and flogged by a helper until the rivet head was formed. The usual way to hold on for this kind of riveting was with a jam bar, also cupped on the end to receive the rivet head.

This kind of riveting could be done by handy men instead of boiler makers and became popular in many shops, although some shops were loath to adopt it except for tank work.

The demand for speed in riveting brought about the development of the power riveter. The first one, so far as the writer knows, was operated by steam. It was a two-cylinder machine, with one cylinder operating a plate-clamping device and the other cylinder driving the rivets. As compared with our present riveters it was a crude machine and yet it did good work when operated properly.

After the steam riveter came the hydraulic riveter and later the riveter operated by compressed air.

It has been said that necessity is the mother of invention, and perhaps this is as true when applied to boiler making as to any other line of work.

Forty years ago the boiler plate used had grown to such thickness, and the rivets to such size that to drive them by hand taxed the strength of the riveters to the limit. When compressed air came and the air-operated hand hammer was used, where the rivets could not be driven by the stake riveter, what a relief it was to the riveters who had been driving rivets 1 inch and over in diameter by hand including overhead! Before the use of overhead traveling cranes became general, some shops would finish the large boilers without turning them over, and so all rivets had to be driven regardless of their location.

There may be some of the old boiler makers living who can remember driving rivets 1 inch and over in diameter overhead in the crown braces of a marine boiler, or other overhead work. It took a lot of muscle and experience to do this kind of riveting successfully. When we come to consider the present-day riveting equipment in modern boiler shops, and with what ease the largest rivets are driven, we are not sure that the present-day boiler makers appreciate the great strides that have been made in providing labor-saving machinery for the boiler shop.

The boiler shown was entirely riveted by hand by the riveter and his partner forty years ago.

Applying Barrel Patches to Locomotive Boilers

(Continued from page 284)

erence was made to patching barrels of locomotive boilers in England, and some difference of opinion was expressed on this subject. Reference to the report on the inquiry into the circumstances of a locomotive boiler explosion at Buxton, November 1921, will show that the boiler in question was fitted with two barrel patches which were single riveted. An expanded view of the boiler showing the patches and the longitudinal seam riveting are shown in the illustration. It will be noticed that although the explosion was due to over pressure the longitudinal seam of the patches remained intact. In this case, the riveting of the patches reduced the strength of the barrel in a longitudinal direction about 10 percent. It would seem that although a chain may have a weak link, the hook may fail. In the case of the Buxton boiler the firebox crown failed first.

Testing Boiler Liners

By George M. Davies

GUIDE yoke and waist sheet angle liners on locomotive boilers, unless properly secured, are often a continual source of trouble from leaky rivets.

The customary method of applying a hydrostatic test to the boiler after the liners have been applied to the boiler has in many cases not proven satisfactory, for the reason that should any of the rivets in the liner leak, it is practically impossible to tighten them without removing many flues in order to get to the leaking rivets.

Fig. 1 is a typical example of a guide yoke angle liner.

The rivets in this type of liner are as a rule so spaced that caulking for tightness is impractical. The following method of testing this type of liner at the time it is applied or before the tubes are placed in the boiler has been used with good results.

For a leak to develop with this type of a liner, the water must leak through where the rivets pass through the shell of the boiler. It is therefore important that the rivets in the shell of the boiler be tight.

To test this liner, drill a hole on the bottom center line of the liner and tap same with a ½-inch pipe tap.

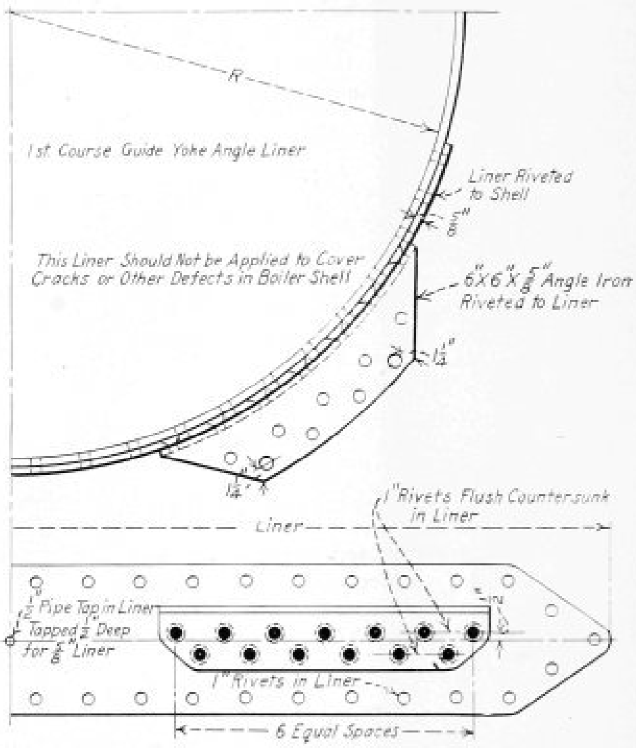


Fig. 1

Boiler liner with angle-iron attachment

The liner must not be tapped its entire thickness. This is to prevent the test pipe applied at this point from seating itself against the shell of the boiler.

Apply a ½-inch pipe at this point; connect same to the pressure line and apply a hydrostatic test to 10 or 20 pounds above the working pressure. The evidence of any leaky rivets in the shell course will be detected on the inside of the shell and these rivets can either be caulked or renewed as the case may warrant.

Economic Boiler.—The Erie City Iron Works, Erie, Pa., has recently issued two booklets covering the Erie City three-drum boiler and the economic boiler. These describe thoroughly the boilers of these types including illustrations of various installations of both types of boilers. Tables of dimensions, together with complete specifications are included.

Seamless Steel Tubes.—A description of the plant of the Globe Steel Tube Company, Milwaukee, Wis., is contained in a booklet entitled "Globe Seamless Steel Tubes", recently issued by that company. The process of manufacturing these tubes is outlined together with a description of both equipments, and operation. Special reference is given to the locomotive and merchant boiler field.

Revisions and Addenda to A.S.M.E. Boiler Construction Code

It is the policy of the Boiler Code Committee of the American Society of Mechanical Engineers to receive and consider as promptly as possible any desired revision of the rules and its codes. Any suggestions for revisions or modifications that are approved by the committee will be recommended for addenda to the code, to be included later on in the proper place in the code.

The Boiler Code Committee has received and acted upon a number of suggested revisions which have been approved for publication as addenda to the code. These are published below, with the corresponding paragraph numbers to identify their locations in the various sections of the code.

The revisions will be published in the form of addenda data sheets, distinctly colored pink and offered for general distribution to those interested.

For the convenience of the reader in studying the revisions, all added matter appears in small capitals and all deleted matter in smaller type.

PAR. CA-5. REVISED:

CA-5. Cracks in riveted joints are generally attributable to steel of unsuitable quality, to excessive internal stresses in the plates caused by high riveting pressures, imperfect thermal or mechanical treatment during fabrication, unskilled or abusive treatment during the repair of leaky seams, also to extremely severe operating conditions. Cracks from such causes ARE, IN GENERAL, TRANSCRYSTALLINE IN CHARACTER AND OCCUR BOTH EXTERNAL OR INTERNAL TO ANY JOINT IN A BOILER [occur in riveted joints, both above and below the water level in boilers].

CRACKS OF A DIFFERENT CHARACTER OCCUR IN HIGHLY STRESSED PORTIONS OF A BOILER WHERE SALT CONCENTRATIONS TAKE PLACE. THESE CRACKS, WHICH ARE INTERCRYSTALLINE IN CHARACTER, ONLY OCCUR WITHIN RIVETED OR OTHER JOINTS AND ARE USUALLY TERMED "EMBRITTLEMENT."

IN ALL EMBRITTLEMENT CASES, THE ANALYSIS OF THE CONCENTRATED BOILER WATER SHOW THAT THE SULPHATES ARE LOW IN PROPORTION TO THE COMBINED SODIUM HYDROXIDE AND SODIUM CARBONATE.

[The attention of the Committee has been called to the following exceptional cases in rivet joint cracks, described as intercrystalline in character and under the water level only: (*a*) Boilers in certain localities fed with well water containing sodium bicarbonate, but not an appreciable quantity of sodium sulphate (similar cracking has not been reported in the same localities in boilers fed with surface water free from sodium carbonate or containing sodium sulphate equal to or exceeding the sodium bicarbonate); (*b*) boilers fed with water in part composed of condensate from leaky caustic evaporators; (*c*) boilers fed with sea-water distillate to which compounds were added resulting in high concentrations of sodium alkalinity.]

IN ORDER TO INHIBIT THIS TYPE OF FAILURE [in view of the particular cases of embrittlement cited above] and pending further research, the maintenance of not less than the following ratio of sodium sulphate to the TOTAL (soda) methyl orange alkalinity is recommended [as a precautionary measure]:

Working Pressure of Boiler, Pounds Gage	Relation of TOTAL [Sodium Carbonate] alkalinity	to	Sodium Sulphate
[0 to 150]	[1]	[to]	[1]
BELOW 150	1	TO 2	
150 TO 600, INCLUSIVE	1	TO 0.14 × STEAM PRESSURE	
[150 to 250]	[1]	[to]	[2]
[250 and over]	[1]	[to]	[3]

EXAMPLE: WHERE BOILER PRESSURE IS 265 LB., THE RELATION IN THE BOILER CONCENTRATES SHOULD BE 265 × 0.014 OR 3.71 SULPHATE OF SODA TO ONE METHYL ORANGE ALKALINITY.

[Cracks of this particular character have not been reported in cases where water-softening equipment has been intelligently used, maintaining close control over boiler concentrations, and the boilers have been properly operated.]

IT IS ALSO RECOMMENDED THAT THE MENTIONED CONSTITUENTS BE DETERMINED BY THE STANDARD METHODS OF WATER ANALYSIS, PUBLISHED JOINTLY BY THE AMERICAN PUBLIC HEALTH ASSOCIATION AND AMERICAN WATER WORKS ASSOCIATION, 1925 EDITION.

Pending further operating data from boilers in service, it is recommended that the requirements of Par. I-44 of Section VI of the Code be extended to all riveted AREAS OR EXPANDED JOINTS [seams], and that careful examination of all seams be made if leaks occur and do not remain tight after proper calking.

PAR. P-195. REVISE SIXTH SECTION, AS PRINTED IN APRIL ISSUE, TO READ:

A blank head of a semi-elliptical form in which HALF the minor axis OR THE DEPTH OF THE HEAD [of the ellipse] is at least EQUAL TO ONE-QUARTER OF [one-half] the INSIDE diameter of the HEAD [shell], shall be made at least as thick as the required thickness of a seamless shell of the same diameter. If a flanged-in manhole which meets the Code requirements is placed in an elliptical head, the thickness shall be the same as for an ordinary dished head with a DISH radius equal to 0.8 the diameter of the shell and with the added thickness for the manhole.

WHEN HEADS ARE MADE TO AN APPROXIMATE ELLIPTICAL SHAPE, THE INNER SURFACE OF SUCH HEADS MUST LIE WITHOUT AND NOT WITHIN A TRUE ELLIPSE DRAWN WITH THE MAJOR AXIS EQUAL TO THE INSIDE DIAMETER OF THE HEAD AND ONE-HALF THE MINOR AXIS EQUAL TO THE DEPTH OF THE HEAD. THE MAXIMUM VARIATION FROM THIS TRUE ELLIPSE SHALL NOT EXCEED 1.25 PERCENT OF THE INSIDE DIAMETER OF THE HEAD.

PAR. P-260. REVISED:

P-268. Manhole frames on shells or drums shall have the proper curvature, and on boilers over 48 in. in diameter shall be riveted to the shell or drum with two rows of rivets, which may be pitched as shown in Fig. P-16. The strength of manhole frames and reinforcing rings ON ANY LINE PARALLEL TO THE LONGITUDINAL AXIS OF THE SHELL shall at least be equal to the tensile strength OF A CROSS-SECTIONAL AREA COMPUTED BY MULTIPLYING THE REQUIRED SHELL-PLATE THICK-

NESS (CALCULATED BY THE FORMULA IN [required by] Par. P-180 USING E EQUALS 1) BY the maximum LENGTH [amount] of shell plate removed by the opening plus the rivet holes for the reinforcement, on any line parallel to the longitudinal axis of the shell through the manhole [or other] opening.

When a flanged manhole is used the flanged portion of the frame may be considered as reinforcement up to a height (h) of 3 times the flange thickness (see Fig. P-17).

Par. P-261. Revised:

P-261. The strength of the rivets in shear on each side of a frame or ring reinforcing manholes [or other openings such as those cut for steel nozzles and boiler flanges over 3 in. pipe size] shall be at least equal to the tensile strength (required by Par. P-180) of the maximum amount of the shell plate removed by the opening and rivet holes for the reinforcement on any line parallel to the longitudinal axis of the shell, through the manhole [or other] opening.

Par. P-274. Revised:

P-274. The minimum aggregate relieving capacity of all of the safety valve or valves required on a boiler shall be that determined on the basis of 6 lb. of steam per hour per sq. ft. of boiler heating surface for water-tube boilers. For all other types of power boilers, the minimum aggregate relieving capacity shall be that determined on the basis of 5 lb. of steam per hour per sq. ft. of boiler heating surface for boilers with maximum allowable working pressure above 100 lb. per sq. in., and on the basis of 3 lb. of steam per hour per sq. ft. of boiler heating surface for boilers with maximum allowable working pressures at or below 100 lb. per sq. in. In many cases a greater relieving capacity of safety valves will have to be provided than the minimum specified by this rule, and in every case the requirements of Par. P-270 shall hold.

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 and size of safety valves required shall be determined on the basis of the aggregate relieving capacity and the relieving capacity marked on the valves by the manufacturer. Where the operating conditions are changed, or additional heating surface such as water screens or water walls is connected to the boiler circulation, the safety-valve capacity shall be increased, if necessary, to meet the new conditions and be in accordance with Par P-270. THE ADDITIONAL VALVES REQUIRED ON ACCOUNT OF CHANGED CONDITIONS MAY BE INSTALLED ON THE STEAM LINE BETWEEN THE BOILER AND THE MAIN STOP VALVE EXCEPT WHERE THE BOILER IS EQUIPPED WITH A SUPERHEATER OR OTHER PIECE OF APPARATUS, IN WHICH CASE THEY MAY BE INSTALLED ON THE STEAM PIPES BETWEEN THE BOILER DRUM AND THE INLET OF THE OTHER APPARATUS, PROVIDED THAT THE STEAM MAIN BETWEEN THE BOILER AND POINTS WHERE A SAFETY VALVE OR VALVES MAY BE ATTACHED HAS A CROSS-SECTIONAL AREA AT LEAST 3 TIMES THE COMBINED AREAS OF THE INLET CONNECTIONS TO THE SAFETY VALVES APPLIED TO IT.

Par. P-296. Revised:

P-296. *Steam Gages.* Each boiler shall have a steam gage connected to the steam space or to the water column or its steam connection. The steam gage shall be connected to a siphon or equivalent device of sufficient capacity to keep the gage tube filled with water and so arranged that the gage cannot be shut off from the boiler except by a cock placed near the gage and provided with a tee or lever handle arranged to be parallel to the pipe in which it is located when the cock is open. Gage connections which are filled with water AT A TEMPERATURE NEVER GREATER THAN THAT OF SATURATED STEAM AT A PRESSURE OF 250 LB. PER SQ. IN., OR 406 DEG. FAHR., shall be of brass, copper, or bronze composition. Connections that are filled with steam OR WATER OF A TEMPERATURE GREATER THAN THAT OF SATURATED STEAM AT A [shall for] pressure [s] OF [over] 250 lb. per sq. in. OR [and temperatures in excess of] 406 deg. Fahr. SHALL be of steel pipe or of other material capable of safely withstanding the temperatures corresponding to the maximum allowable working pressure. Where steel or wrought-iron pipe connections are used they shall not be less than 1-in. pipe size.

Par. U-74. Revised:

U-74. *Dished Heads.* Dished heads convex to the pressure shall have a flange not less than 1½ in. long and shall be inserted into the shell with a driving fit AND WELDED AS SHOWN IN FIG. U-3K. [in excess of the full length of the flange, welded to the shell with a V'ed weld, heated to the annealing point, the shell to be constricted on the end to a diameter not less than 1 in. smaller than the original diameter].

Dished heads concave to the pressure shall have a length of flange not less than 1 in. for shells not over 24 in. in diameter. For vessels over 24 in. diameter this length shall not be less than 1½ in. It is, however, recommended that the length of flange shall not be less than 12 percent of the diameter of the shell.

When the heads are thicker than the shell they shall be reduced in thickness as shown in Figs. U-3*J* or U-3*K*.

Ford to Install World's Largest High Pressure Boilers

The Ford Motor Company, Detroit, Mich., has awarded a contract to Combustion Engineering Corporation, New York, N. Y., for two complete steam generating units for the Fordson Plant.

These units are designed for 1350 pounds steam pressure and the steam will be superheated to a total temperature of 750 degrees Fahrenheit. Each unit will have a maximum capacity of 700,000 pounds of steam per hour. This is the highest steaming capacity of any boiler ever built for pressures as high as 1350 pounds.

These boiler units will be fired by pulverized coal, the fuel entering the furnaces tangentially at the corners to give a turbulent mixing action of fuel and air for combustion.

The furnaces will be of the all metal, water-cooled type and air preheaters will be installed to use the heat of the exit gases for preheating the air used for combustion.

The Ford Motor Company was the pioneer industrial company in the use of pulverized coal for steam generation. The first installation made in 1921 at the Fordson plant has been consistently followed by additional installations until today, the Ford Motor Company has nearly a half million square feet of boiler heating surface fired by pulverized fuel.

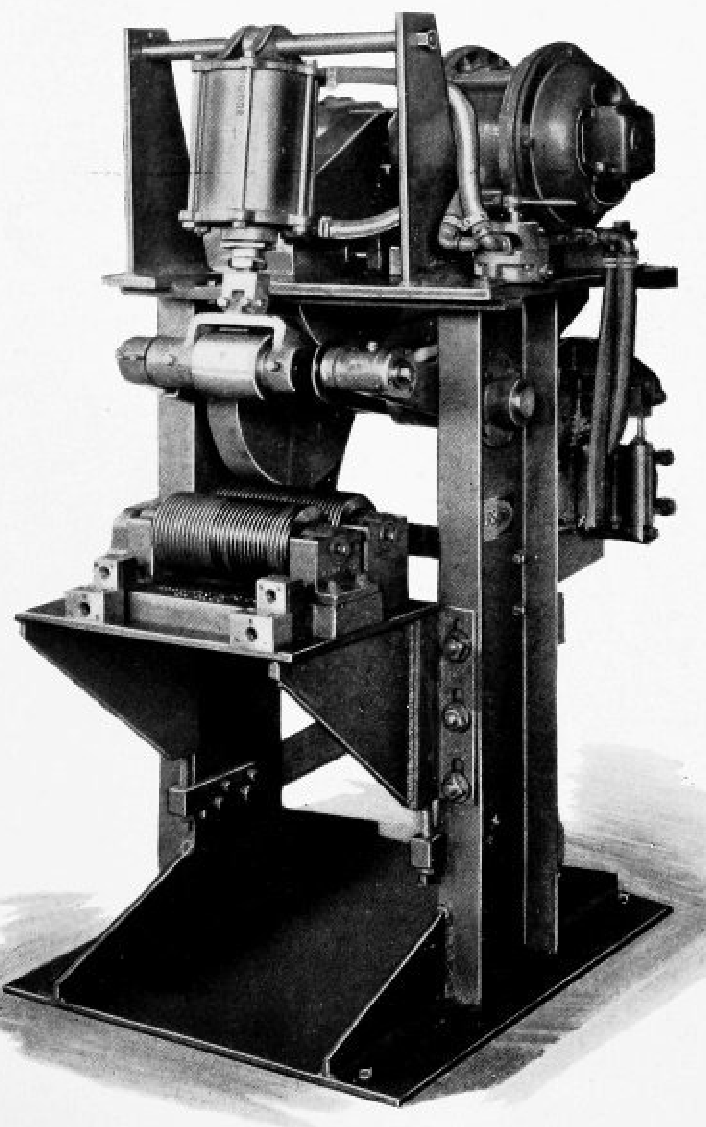
The new high pressure units are scheduled for installation early in 1930.

Ryerson Develops

New Flue Shop Equipment

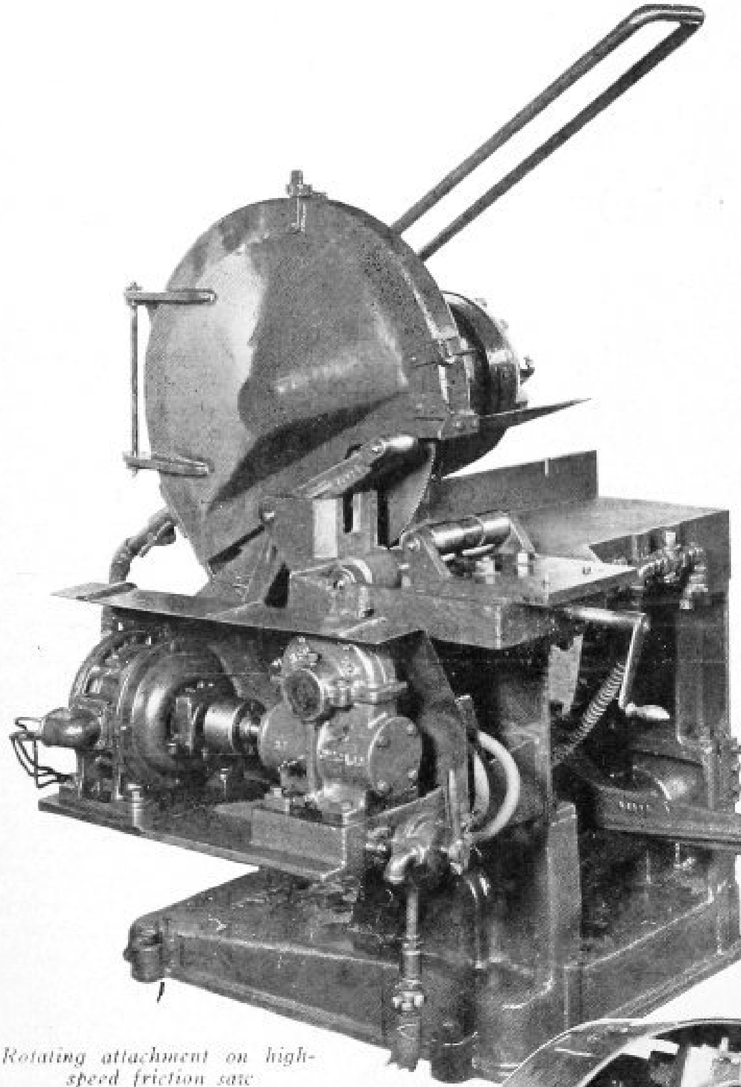
AT the recent national machine tool builders exposition held in Cleveland, O., Joseph T. Ryerson & Son, Inc., Chicago, Ill., had on display a number of new machines designed to promote production in the flue department of the boiler shop. These included: A flue cutting and polishing machine, a new rotating attachment to increase the capacity of the Ryerson high-speed friction saw, and a new type flue roller. For general boiler shop or industrial production, the company also exhibited a combination shear punch and coper, also new in design.

The flue cutter and polishing machine has been developed for locomotive flue shops where boiler tubes and flues are welded by the electric butt-weld method. This machine combines the two operations of cutting off the fag end of the tube or flue and polishing the end which is to be placed in the welder. The machine has a welded steel frame on which is mounted a bracket with two large spiral rollers to hold the tube. When a tube is placed in position an overhead drive roller which is operated by an air cylinder is brought down on top of the tube rotating it over the two spiral rollers. This causes a slight scraping action against the tube, removing all the scale and exposing the bare metal. A separately operated cut-off attachment is mounted on the machine and is operated by an air cylinder arranged with an oil dash pot to provide slow movement of the arm. A cut-off disk at the end of this arm is brought down on the tube which is being rotated and cuts off the fag end of the tube while it is being polished. Both cylinders are operated from one air valve which allows the drive roller to come down first on the tube and later the cut-off disk. It is driven by a 5-horsepower, 1200 revolutions per minute motor and will handle tubes from 1½ inches to 6 inches in diameter. It is claimed that this machine will effectively polish and cut off a flue in less than one minute.



Flue cutter and polishing machine

A rotating attachment for the Ryerson No. 0 friction saw has been developed which practically eliminates the burr in cutting round tubing, pipe, and bar stock. The No. 0 saw was designed for manufacturers requiring a high-production output in cutting smaller sizes of material. This new rotating attachment increases the capacity and at the same time reduces the load on the saw motor. It consists of a special work table on which are mounted supporting rollers for holding the stock in position while being cut. One set of rollers is driven by direct gearing from a fractional horsepower motor, through a speed reduction unit and gearing. A second set of rolls is mounted on an adjustable bracket which may be moved in or out to accommodate various sizes of stock. A third roller is brought down on top of the stock by means of an air cylinder arrangement which holds the stock firmly in position while it is being rotated. This attachment provides rotation of constant peripheral velocity to any size of round stock which may be

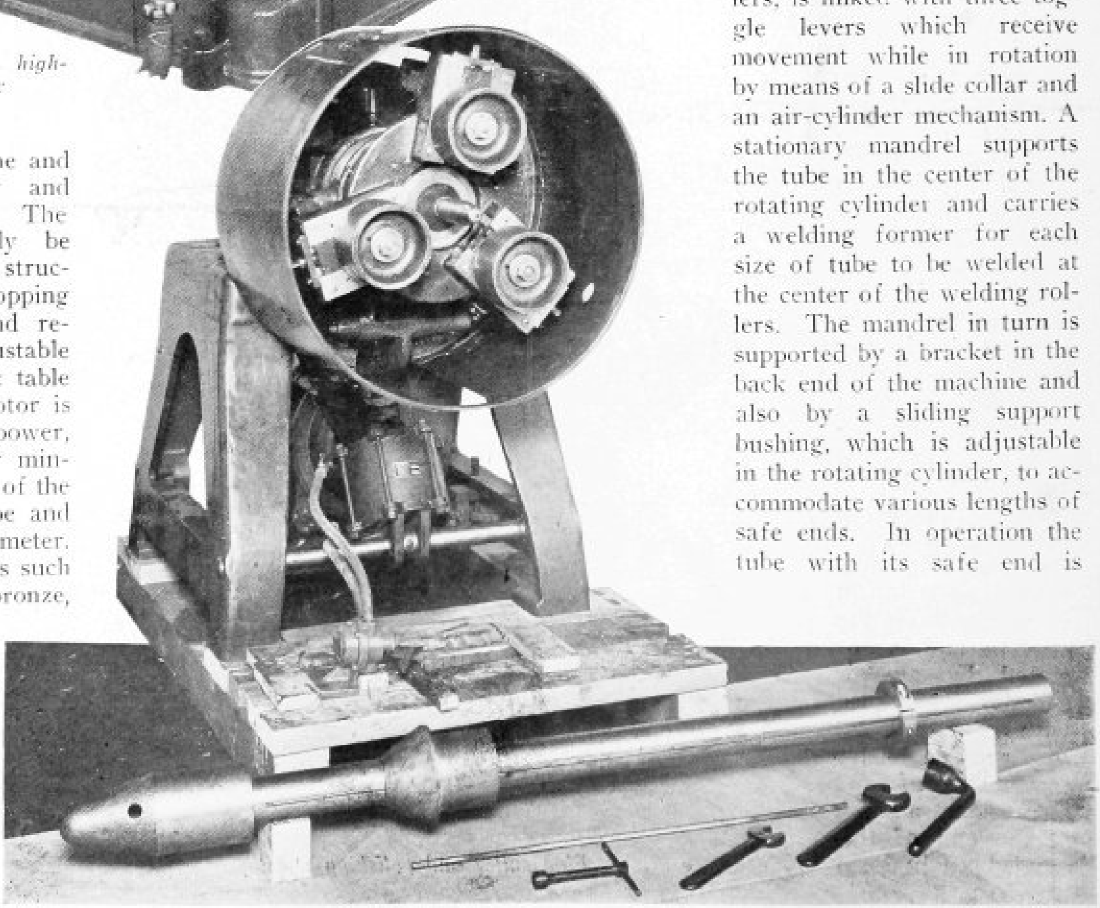


Rotating attachment on high-speed friction saw

placed in the machine and eliminates chucking and change-speed gears. The machine may easily be changed for cutting structural shapes by dropping the drive rollers and replacing the adjustable bracket with a work table plate. The main motor is rated at 10-horsepower, 3600 revolutions per minute. The saw blade is of the standard hobbed type and is 24½ inches in diameter.

Non-ferrous metals such as aluminum, brass, bronze, zinc, and babbitt, which have heretofore required a slow speed cut-off saw, may now be handled on a high speed friction saw. A special blade with sharp inserted teeth makes this possible, increasing the cutting speed nearly 100 percent for this type of material at the same time maintaining the same quality of cut. This machine is the same as the standard No. 0 friction saw except that it has a positive screw feed which replaces the hand-lever and foot-treadle feed, and a 7½-horsepower, 1800 revolution per minute motor. The blade is 24 inches in diameter and is cooled with water through the same type of adjustable water head as on the standard No. 0 saw.

The flue roller is another addition to the company's extensive line of flue-shop equipment. This machine rolls down the weld of the tube and safe end after they have been welded together by using the same welding heat and not requiring reheating. This machine has a cast frame supporting a large hollow cylinder rotated by silent chain drive from a 5-horsepower, 1200 revolutions per minute constant-speed motor. The front of the rotating cylinder carries three idler rollers each 120 degrees apart, being adjustable in or out from the center by means of a separate screw and slide arrangement. The slide, supporting the rollers, is linked with three toggle levers which receive movement while in rotation by means of a slide collar and an air-cylinder mechanism. A stationary mandrel supports the tube in the center of the rotating cylinder and carries a welding former for each size of tube to be welded at the center of the welding rollers. The mandrel in turn is supported by a bracket in the back end of the machine and also by a sliding support bushing, which is adjustable in the rotating cylinder, to accommodate various lengths of safe ends. In operation the tube with its safe end is



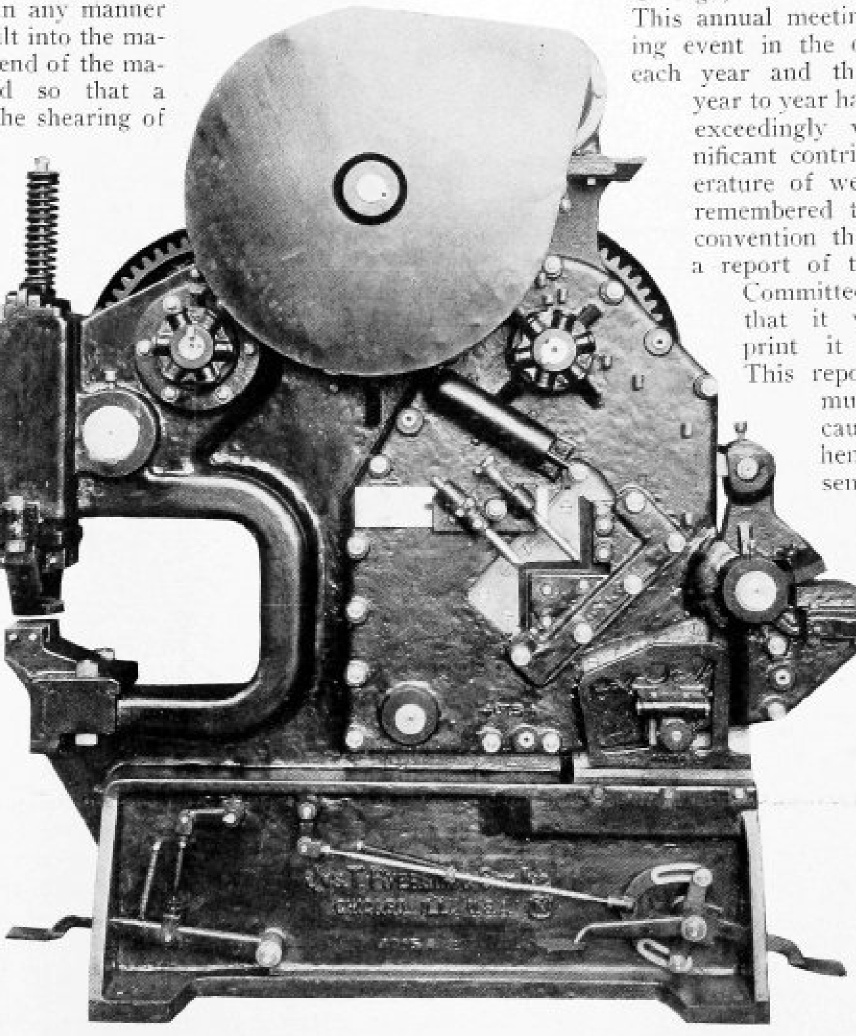
New flue roller

pushed over the welding former to length so that the weld is directly under the roller. These are then brought down on the heated weld by means of a foot valve which operates the air cylinder, and the rotation of the head revolves the roller around the weld smoothing it down on both the outside and inside of the tube. This machine will weld tubes from 1½ inches to 6 inches in diameter.

The Ryerson No. 7 combination shear, punch and coper has been completed recently to meet the demand for a large capacity machine handling these various operations and is especially adapted to boiler shop work.

The operation of this punch is not interfered with in any manner by the other units built into the machine. The shearing end of the machine is constructed so that a single slide handles the shearing of angles, bar cutting, plate shearing, and coping. The angle shear attachment handles both inside and outside miter cutting as well as straight shearing. The blades in this unit are made in sections for economical and easy replacement. Bar cutting blades are located directly below the angle shear blades. The full range of rounds and squares is handled by one set of blades.

The punch attachment has a 24-inch throat and a capacity for punching 1 5/16 inch through 1 inch. The plate shear will handle ¾-inch material of any length or width. Other capacities include flat bar shearing 7 inches by 1 inch; round bars 2¼ inches; square bars 2 inches; angles 6 by 6 by ½ inches; angles in miter 4 by 4 by ½ inches; notches 4 by 4 by ½ inches angles and tees.



Combination shear, punch and coper

It is not often that production machines are specially developed for boiler shop work, and so the foregoing flue department machines are of considerable interest. This department represents one in which the principles of repetitive operations can be applied to the maximum degree, for tube and flue safe ending can be classed as a purely production process. Any class of tool that speeds up the work is of importance, and since the advent of the electric safe-ending machine, tools of the old type for the polishing and cutting off operations have hardly been able to keep pace with the welding machine. From the production records made with the new Ryerson machines, this deficiency has probably been overcome.

Acetylene Welding Association Convention

ANNOUNCEMENT has been made that the annual convention of the International Acetylene Association will be held at the Congress Hotel, Chicago, November 13, 14 and 15. This annual meeting is an outstanding event in the oxy-acetylene field each year and the programs from year to year have furnished some exceedingly valuable and significant contributions to the literature of welding. It will be remembered that at last year's convention there was presented a report of the Oxy-Acetylene Committee of such length that it was necessary to print it for distribution. This report has been very much in demand because of the comprehensive picture it presents of the uses of oxy-acetylene welding in all of the major industries of the country. Since that time the same committee has been working constantly to amplify some portions of last year's report and to assemble new material on subjects which were not covered last year. In addition to this, there have been a number of interesting developments in the field of oxy-acetylene welding and cutting, all of which will be covered in interesting detail by technical papers which are in course of preparation and will be presented.

The program committee has made definite arrangements for a number of papers of unusual interest and it is expected that some detailed information on this subject will be available very soon. However, L. F. Loutrel, president of the association, has advised all members that suggestions for making the program more complete and more constructive will be gladly received. Those interested in the promotion of oxy-acetylene welding and cutting can be sure of finding both pleasure and profit in attending the coming meeting.

Locomotive Boiler Construction-XIV

Assembling, reaming and riveting rings-Assembling back and front ends-Lining up the boiler

By W. E. Joynes*

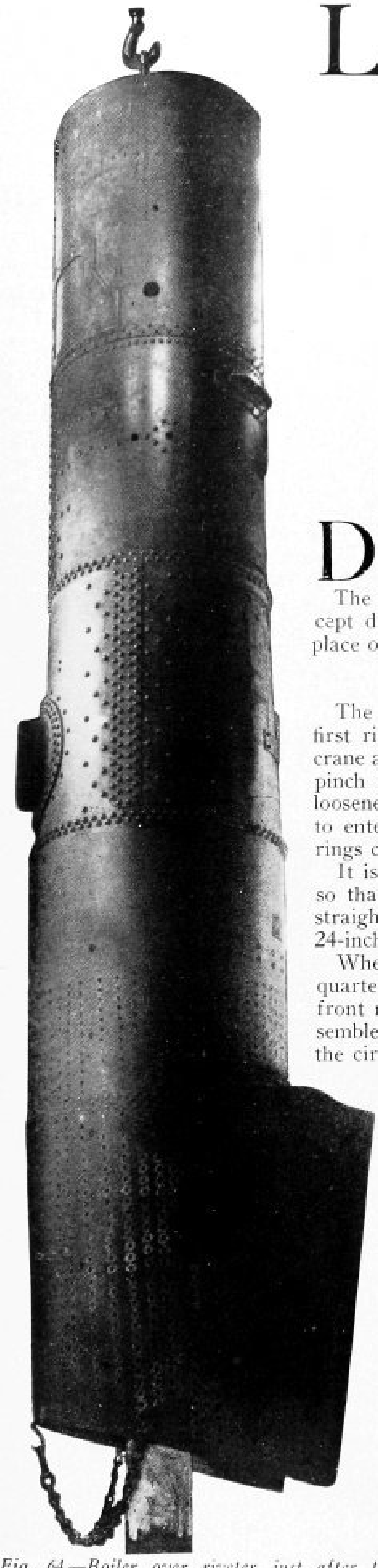


Fig. 64.—Boiler over riveter just after the casing and throat sheet seams have been riveted

DETAIL information having been given in the October, 1928, issue for assembling and riveting the first course and the smokebox shell, the remaining rings of the boiler are to be assembled for reaming and riveting.
The longitudinal-seam welt strips and the boiler details and attachments (except dome and dome liner) for the second, third or more rings are bolted in place only, for riveting before the rings are connected together.

Connecting and Riveting Operations

The second ring is placed, standing on end, surrounded by a platform. The first ring and smokebox shell are raised vertically with an overhead traveling crane and lowered to the top of the standing ring, then worked into the same with pinch bars. The bolts in one-half of the second ring longitudinal seam are loosened, to permit the end of the ring to spring open slightly, for the first ring to enter. When the corresponding circumferential seam rivet holes of the two rings come in line, drift pins are applied in a number of these holes.

It is, of course, essential to have the rings connected exactly even all around so that when all of the rings are riveted together they will be plumb or in a straight line with the center line of the boiler. This feature is checked with a 24-inch long gage as follows:

When the plates are laid out a light center punch hole is made on the four quarter-centers of the plates, which is exactly 12 inches from the center of the front row of the circumferential seam rivet holes and 24 inches apart when assembled. The gage must be tried at three of the centers and bolts are applied in the circumferential seam when the center punch points check with the gage.

If the front end of the longitudinal seam is to be welded, one bolt only is retained in the back end of the outside welt strip to permit the same to be swung to one side for the welding operation.

The welt strip is bolted into place after the welding has been done. The circumferential seam rivet holes and the rivet holes for connecting the details are next reamed, after which the rings are raised with the overhead traveling tower crane and held suspended for riveting with the hydraulic bull riveter.

The circumferential and longitudinal seams and the details are tack riveted at this time only, after which the rings are lowered inside of the platform on the floor to remove the holding bolts for reaming these holes.

The rings are again raised to the riveter for riveting the details and laying up the circumferential seam, the inside and outside welt strips of the longitudinal seam, the re-inforcing liners and the riveting.

When all of the rivets in the second ring have been driven, the third ring is then connected and the operations repeated for this course.

If the boiler has only three courses, the front end of the boiler is now ready for the throat sheet to be connected for marking off the rivet holes on the front flange of the same.

The steam dome and liner should be riveted to the dome course before the rings are connected for riveting.

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* Boiler designing department, American Locomotive Works, Schenectady, N. Y.

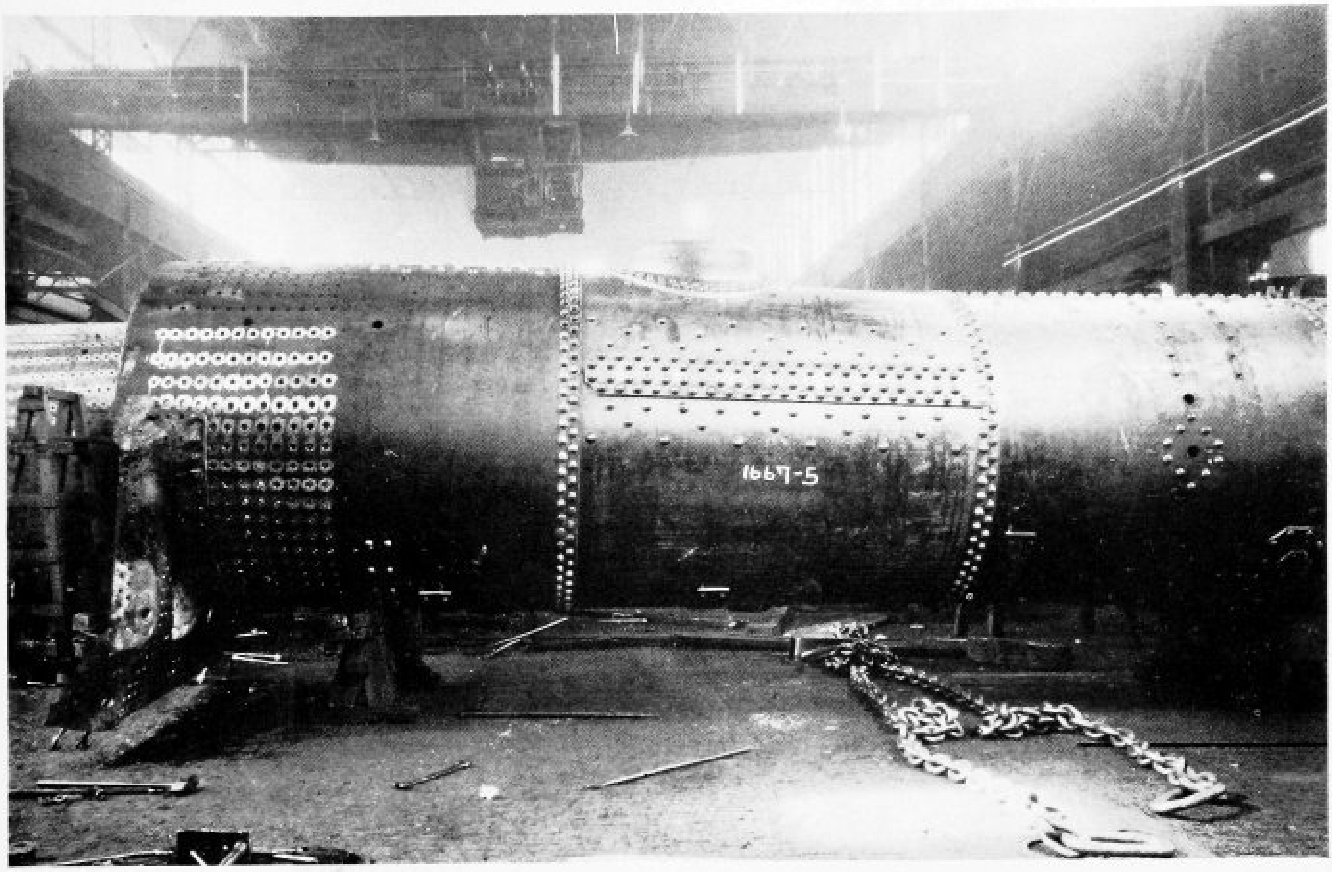


Fig. 65.—Front end assemblage with the throat sheet being bolted and laid up to the back shell course

Marking off the Front Flange of the Throat Sheet for Drilling

The back part of the throat wing is drawn out (scarfed) to a sharp edge, under a power hammer, to allow the roof sheet to be laid up over the same to have a fair or circular appearance.

Two horizontal throat seam rivet holes in the back shell course are located and drilled in the throat wing. These holes are used now for bolting the sheet to the shell and are drilled small to allow for adjustment, if necessary, to line up the boiler.

The throat sheet is lifted with the traveling crane, brought under the shell and raised against the same to allow two drift pins to be driven in the holes in the wings. When the sheet has been drawn tight to the shell with the drift pins, bolts are applied in the other two holes. A draw bolt is also applied to either side of the throat and shell, about 45 degrees off the bottom center, to draw the throat to the correct longitudinal location.

The casing (roof sheet) is bolted to the firebox ring, after which the backhead is applied and bolted to the casing and ring.

If the firebox has a sloping bottom the back end of the assembled shell and firebox ring is blocked up on the floor in approximately the correct sloped position.

A lifting chain is next placed around the front assemblage of the boiler, a little ahead of the center of gravity to allow the back end to tip down slightly, with the throat sheet assembled as written above. This assemblage is raised to a level which will permit the top of the back course to come on the inside of the casing when slowly moved to the back end assemblage.

The two top rivet holes in the front row of the back seam of the back course have been drilled only. When these rivet holes come in line with the two corresponding rivet holes in the casing, drift pins are slipped into the holes. The front end of the boiler is then gently lowered while the throat sheet is worked within the casing with pinch bars. A few drift pins are driven through the casing and back flange and the firebox ring rivet holes of the throat sheet, after which bolts are applied to hold the same in place.

Lining Up the Boiler

The boiler as assembled is now blocked up on the floor, leveled and checked for height and length.

This work consists of fastening a line to an adjustable support which is bolted in the center of the bottom part of the backhead sheet and extends below the back end to a depth which is below the bottom of the front end of the firebox ring or ring lug and then fastened to a floor stand beyond the front end of the smokebox. A plumb line is dropped from the back center firebox ring rivet hole and from the top center, front face of the smokebox ring. The longitudinal line is then moved to touch the plumb lines. A plumb line is also thrown over the first course to check the alignment of the boiler.

The front end of the firebox is then measured on either side of the line to check the central position.

The bottom outside surface of the front and back course and the smokebox shell is next measured above the line.

When these measurements have been made correct, the length from the bottom front end of the firebox ring to the front face of the smokebox ring is checked with a tape measure.

After the boiler has been leveled and lined up to check with the boiler drawing dimensions, the seam rivet holes in the front flange of the throat are marker punched through the ring rivet holes on the flange.

The front row of the front seam rivet holes in the casing are lightly marker punched in the top half of the ring, so that the rivet lap can be marked for trimming the excess stock which was retained at this end of the plate for allowance to obtain the correct length of the boiler.

The throat sheet is now disassembled for drilling the front flange rivet holes, trimming and bevel chipping the flange.

If the gusset plate type of bracing is to be applied in the boiler instead of the longitudinal rod type of bracing, the casing with the backhead and firebox ring as now bolted together is turned upside down (on back) and placed on block supports above the floor.

The top part of the backhead is then heated with an oil burner torch and laid up to the casing.

The angle iron braces are next bolted to the backhead sheet and each gusset plate is held in place while two of the connecting rivet holes are marked through the casing on the plate flange after which these holes are drilled. The plates are then heated, bolted to the casing and laid up to the same. The remaining rivet holes are then marked on the flanges and the bolt holes are also marked from the angle braces on the plates, then removed for drilling.

Final Assemblage of the Throat Sheet and Back End to the Front End

The throat sheet is returned to the connecting gang for this work.

The front flange of the sheet is heated to a bending head, raised with the overhead traveling crane and worked into place on the back shell course. Drift pins and bolts are applied. The flange is laid up to the shell by pounding with mauls when the bolts are being tightened, after which the front and back of the boiler are again assembled, leveled, lined up and tightly bolted in place for reaming the seam rivet holes in the casing, back throat sheet flange, the shell and front flange.

The rivet holes in the top half of the shell course are also drilled directly from the holes in the casing at this time.

The front and back flange and casing seam are then rigidly bolted for laying up the casing over the scarfed part of the throat sheet and for riveting these sheets together.

The backhead is now removed from the casing and firebox ring, after which the shell is heated about the throat scarf and the casing is laid up to the same. The ring is then removed from the casing and throat sheet.

The boiler is now delivered to the hydraulic bull riveting section for the riveting of the front and back ends together.

The boiler is raised vertically by the smokebox end for the riveting work.

All driven rivets are given a hammer test on the inside of the boiler as soon as the riveting of each shell course and other connections has been completed.

The boiler is next delivered to the pneumatic riveting section where the backhead, with the gusset braces attached, is applied and riveted in place.

Fig. 65 shows a completely riveted front end of a combustion chamber boiler with the throat sheet being bolted and laid up to the back shell course. All of the rivet holes are in the throat flanges and along the bottom for the firebox ring connection. All of the washout and arch tube plug holes and the staybolt holes are drilled with the exception of the two circumferential rows of staybolt holes in the front flange which are drilled after the throat sheet has been riveted to the shell course.

The illustrations also show clearly, the riveting for the longitudinal and circumferential seams of the second ring. The dome and dome liner rivets can be seen. A casing bolted to the firebox ring may be seen in the background. The lifting chains can be seen on the floor, under the boiler, and the traveling crane in the top background.

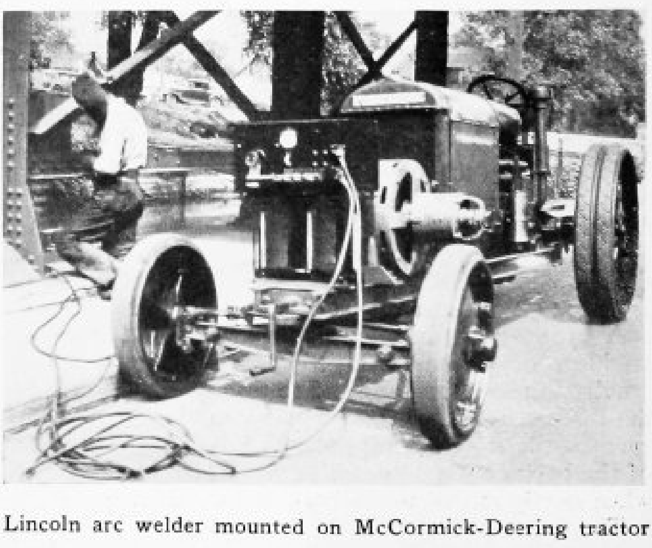
Fig. 64 shows the boiler over the bull riveter, in riveting tower, the riveting of the roof sheet and throat sheet together and to the back shell course have just been completed. Following this step, the boiler will be raised until the bottom of the throat sheet is clear of the riveter; a main shop traveling crane will then be hooked to the chains seen at the bottom of the casing. The back end will then be gradually raised and the front end simultaneously lowered to a horizontal position and then lowered to the floor. Chains are then placed around the center of gravity of the boiler and one of the main shop traveling cranes carries it to the pneumatic riveting section for applying and riveting in the backhead.

(To be continued)

Tractor Mounted Arc Welder

THE new Lincoln stable arc welder mounted on the McCormick-Deering Tractor is announced by the Pontiac Tractor Company, Pontiac, Mich. This unit is furnished with either the 200 or 300 Ampere machine and gives a wide range of utility.

The extension frame in this mounting is such that the tractor is simply set into a 4-inch "I" beam frame and the front axle assembly is set ahead under the frame thereby lengthening the wheel base. This construction reinforces the tractor and gives sufficient balance to make easy steering with the added weight. The welder unit, complete with the panel, is mounted on this frame member ahead of the tractor and takes its drive from the power pulley at the side of the tractor through a belt. This makes a compact self contained unit capable of moving about under its own power.



Lincoln arc welder mounted on McCormick-Deering tractor

National Board Meeting

Boiler and pressure vessel inspectors continue discussions of A.S.M.E. Boiler Code revisions

PREVIOUS installments of the National Board of Boiler and Pressure Vessel Inspectors' report of the annual meeting appeared in the August and September issues. The work of the Board is so broad in scope and the proceedings of such widespread interest that a further section appears in this issue and a final installment will be published next month.

At the closing period of the first day's session, C. W. Obert, honorary secretary of the A. S. M. E. Boiler Code Committee outlined the various phases of Boiler Code work that dealt specifically with the inspectors and their problems. Several such points were covered in the previous instalment published in September and the final presentation at this session follows:

Relieving Basis for Computing Safety Valve Capacity

The Boiler Code Committee has been urged by your organization to simplify its requirements for safety-valve relieving capacity for firetube boilers by specifying a single relieving basis instead of two valves as at present. This matter has been given careful consideration by a sub-committee that investigated the matter in co-operation with the Safety Valve Manufacturers' Association. It was finally decided that the matter could be best adjusted by a compromise between the present value of 5 pounds of steam per hour per square foot of heating surface for boilers operating at above 100 pounds and 3 pounds of steam per hour per square foot of heating surface for boilers operating at 100 pounds or less, and make the relieving basis 4 pounds of steam for all firetube boilers. This was considered by the committee, as well as the safety valve manufacturers, to be logical and practical, but objections thereto were raised by certain boiler manufacturers who have been in the habit of selling boilers for operation at pressures under 100 pounds, who would be required thereby to increase their safety-valve equipment if such a change were to be made. These objections led to the consideration of the lower figure (3 pounds of steam per hour per square foot of heating surface) for all firetube boilers, but the safety valve manufacturers objected to this and criticisms were also heard from certain sources where boilers previously equipped with safety valves based on 5 pounds of steam per hour would be under-valved if changed to equipment based on 3 pounds of steam per hour. As a result nothing has been done because the situation has been deadlocked by the manufacturers of the lower pressure boilers. If, as it now appears, your body needs this change for simplification of the safety-valve problem, I think it may be well for you to give this detail of the Code your careful consideration. The Boiler Code Committee has gone as far as it can because of the commercial deadlock. If the members of the National Board feel that this situation can be improved by any particular solution of the problem, it should be made a forceful recommendation to the Boiler Code Committee thereon.

Cold flanging is a question that has been before the Boiler Code Committee for the past two years or more. Cold flanging is coming into extensive use, particularly in connection with railway and locomotive boilers, and the practice is being introduced into stationary boiler work. The manufacturers of the McCabe flanger are extensive advertisers of the capabilities of their machine and the successful results of cold flanging. The Boiler Code Committee has in the past, however, been opposed to this practice but it was prevailed upon early in 1927 to appoint a special committee to consider this matter. The sub-committee which presented a report last year recommended that cold flanging be recognized to a limited extent at least. It was the feeling that cold flanging might perhaps be permitted on straight-edge plates not over 1 inch in thickness and on curved or circular outlines on plates not over ¾-inch thickness. It was, of course, proposed that limits be placed on the knuckle radius of such flanging and also on the depth of such flanging, but as yet it has been impossible for the committee to come to an agreement thereon. It has proven difficult to establish a general rule that will be practical for all cases, classes and conditions. There appears to be need for information for all cases, classes and conditions. There appears to be need for information on this general subject and the committee would appreciate anything that the members of your organization may be able to offer. If you learn of anything either in favor or against the practice of cold flanging, the Boiler Code Committee will be greatly pleased to be advised thereof.

Discussion

W. E. GLENNON (Hartford Steam Boiler Insp. & Ins. Co.): The railroads have made, of course, as everyone knows, extensive use of cold flanging. Some years ago Mr. Jim Stanwood, who was then alive, came into my office and told me he had decided to buy a flanger. I told him the Boiler Code Committee would not accept cold flanging. He said, "Why not?" And off hand I could not give him any good reason, why they should not accept cold flanging. One of the principal reasons, I understand, was that you exceeded the elastic limit of the material in cold flanging. That is true of any kind of flanging, if it was not, it would not retain its shape. My objection to the cold flanging was that while you may have exceeded the elastic limit, it was throughout the sheet, whereas, when you turned over a sharp flange you had a concentrated stress. That seemed to satisfy Mr. Stanwood and he did not do any cold flanging.

PROFESSOR JASPER: I think the question of cold flanging should be a matter of degree. I can see where thin materials can be shaped up much more readily than thick materials, and I think cold flanging ought certainly to be a matter of how thick materials should be cold flanged. I am just simply giving you something from our experience in the making of automobile frames, which are made in all kinds of shapes and we do it cold, and we have tested those out very thoroughly and it is not detrimental from the standpoint of carrying the stresses, nor from the standpoint of safety. We can get shapes that will carry a load much more effectively than if we did not have those shapes.

C. W. Obert: I think what Professor Jasper brings out is entirely in line with the thought that the Boiler Code Committee is giving to this matter. In the early stages, back in 1915 or 1916, the committee expressed the opinion that cold flanging of a head was not safe practice, and was not permissible, or something to that effect, and that was the opinion at the time.

Well, now as Professor Jasper has brought out that practice has been growing in recent years. The wonderful work they are doing on frame work at the A. O. Smith Corporation is marvelous. There is nothing that the world knows today that is more marvelous than what they are doing. At the same time, we have the cold flanging in the manufacture of railroad cars. That has been developed to a tremendous extent, and that came to the attention of the Boiler Code Committee some years ago, that some of the manufacturers were using cold flanging for stationary boiler work to a considerable extent, and then the curious element that gets into commercial antagonism, when one boiler manufacturer hears that his competitor is doing this, they immediately called upon the Boiler Code Committee and said, "Why can't we do it?" Well, to be perfectly truthful I think it was received with something of a shock by the Boiler Code Committee, to get this information, but as they began to throw mud at each other, we learned quite a little and it has developed that some of our best boiler manufacturers are using the cold flanging to quite a considerable extent. I just wanted the National Board to be aware of what is going on in the committee's thoughts.

W. E. Glennon: I think Professor Jasper's position is very well taken, but the cold flanging of automobile frames and also the cold flanging of material that might go into the construction of a steel car is an entirely different proposition from a vessel under pressure and it would be my recommendation that the Code Committee proceed with a great deal of caution in the cold flanging of vessels subjected to great pressure.

C. W. Obert: In answer to Mr. Glennon I will say that the Code Committee is proceeding with a great deal of caution. They have been unable, after two or three years' work, to make a decision on the matter. My thought in bringing up the matter here is to have you gentlemen informed of the various things in respect to your organization. And your asking that question in writing of the Boiler Code Committee, it occurred to me that I would just outline the situation here in a brief way and save some correspondence.

Caustic Embrittlement

The question in regard to caustic embrittlement causes and methods of abatement, is as live a topic as it was the last time you heard it discussed at one of your annual meetings. More instances of drum failures from this cause are coming to light and conclusive evidence is afforded of the necessity for keeping eternally vigilant in this direction. The Boiler Code Committee receives frequent inquiries concerning this phenomenon and particularly in regard to its relation to modern high-pressure operation. The committee is at the present time considering a change in the recommended ratio of sodium sulphate to total alkalinity in boiler waters so that instead of setting up the ratio from one to three according to the pressure, there will be only two recommendations, namely, the ratio of two for working pressures below 150 pounds per square inch, and a variable ratio from 150 to 600 pounds. At the present time it is not felt that there is enough information available to recommend a ratio for pressures above 600 pounds. This proposed action is not as yet completed, however, and is being given further consideration.

Discussion

W. E. Glennon: Just recently we discovered in our department a very prominent case of so-called caustic embrittlement, namely in The Phillip Carey Company, of Cincinnati. One of our men went to this plant and found eleven riveted heads from a longitudinal seam of a Sterling boiler, lying on the baffle plate. I went to the plant, and removed from the boiler some 30 or 40 rivets, and we found fine cracks around the holes. The plates were found cracked the whole length of the drum. Some sections of the plates were sent to Professor Straub, at the University of Illinois, and up to now I have not had a report as to his microscopic study. I then talked with the chief engineer, who had just returned from a trip to Germany, and during his sojourn Professor Straub consulted a great many engineers in that country. He saw the installing of a high-pressure plant to use some 1800 pounds pressure, triple expansion steam engines. The German engineers told him this was all wrong, there was no such thing as caustic embrittlement, that those cracks were attributed to high riveting pressures and the excessive use of the bull in the shop.

Question: How old were those boilers?

W. E. Glennon: About seven years old. The General Motors Company, at the Frigidaire Plant at Dayton, had four Wayne boilers, embrittled after a period of less than a year, perhaps two years. Those boilers were replaced by the Wayne Company. I examined them. The workmanship and construction were up to standard.

In the Phillip Carey Plant, their water analysis showed that they had maintained for a long time the sulphate carbonate ratio as required by the A. S. M. E. Code. However, in delving into this subject we found that they had operated on a feed-water treatment some years before that would have produced a highly alkaline water, and there is no doubt in my mind but that the embrittlement of the boiler took place not shortly before the discovery, but some time long in advance of the discovery.

The General Motors case, involving four boilers was the first case of tube embrittlement that I had ever seen, although I understand there have been others, but it was my first case. The inspector reported continued leakage of the tubes. This thing went along from day to day; they renewed a number of tubes and finally we went out there with Professor Straub and found the tubes in the tube sheet cracked, and the nature of the cracks would lead the ordinary inspector, who was not schooled in embrittlement, to believe that they had over-rolled the tubes, but I do not believe that that was the case. I think the tubes were actually embrittled. We later removed one of the reinforcing straps on this boiler and found it cracked. I do not think there is any question but what the nature of this trouble could be attributed to the feed-water condition. There certainly wasn't anything wrong with the materials; there wasn't anything wrong with the workmanship, and if that be true, isn't it feasible to figure that a concentration of caustic solution in the capillary spaces of the joint, in all likelihood brought about the condition from which they suffered? If this trouble is the result of high riveting pressures in the shop, excessive use of the bull, I would certainly like to know it.

QUESTION: What kind of bending test was made of the metal after the so-called caustic embrittlement was found? Did you take the strap and bend it over on itself to see if it showed any defects in the material itself?

W. E. GLENNON: The material, following the embrittled action, would stand every test that it would stand prior to the discovery of this embrittlement.

QUESTION: There would be no change at all?

W. E. GLENNON: No, none.

QUESTION: Has there ever been any failures in the steam drum? If the defect was in the shop, in the manufacture of this boiler, wouldn't we occasionally get those troubles in the steam drum, as well as in the boiler itself?

W. E. GLENNON: I would think so.

QUESTION: How do you account for a sufficient concentration in or around the tubes to cause this crystallization, or trouble?

W. E. GLENNON: Well, I would prefer that you ask Professor Straub that question, who I understand is on the program tomorrow.

QUESTION: Was that reinforcing strap on the plate where this crystallization of the tube was supposed to have taken place?

W. E. GLENNON: The cracking took place in the tube sheet where the metal was under stress.

QUESTION: I thought it was the tube itself that you said had cracked?

W. E. GLENNON: Yes, but in the tube sheet, the cracking developed right in about the center, where the tube was rolled into the tube sheet. Mr. McCabe, in his very intelligent discourse on the probable cause of the cracking of boilers in Pontiac, laid a great deal of stress on the differential in temperatures in the place, and I would like to ask Mr. McCabe if he attributes the cracking alone to that differential in temperature?

J. C. MCCABE: No, but it was a contributing factor. I cannot say that, because I have not been able to prove that. It is entirely possible that it might have been that, but I don't know.

PROFESSOR JASPER: I am very much interested in what Mr. McCabe has said and I think he has carried out a very fine piece of work. I do believe that the attack on metal is increased when we have an increased stress. I will tell you something that we did with it, with reference to crystallization on these very large oil vessels. We put about fifteen different kinds of steel under the same stress, in one of those large vessels, and we found that if it happened to be a stress of the boiler near to the yield point of the steel, the attack was much more rapid than if it was not stressed so high. Whether or not it embrittles is not for me to say. I believe it is established that if you remove the portion that is embrittled you have a ductile metal left. Therefore, I think the term is a misnomer; if you say, "Caustic attack" I would say that would be a better term. The attack is most violent when the stress is high. It is due to the stress, I think, as well as the caustic medium in contact with the steel at that point.

C. W. OBERT: I might say one thing, in regard to the discussion that is going on between the adherents of the mechanical and the chemical explanations for this phenomenon, the Boiler Code Committee is trying to keep in the middle of the road. In referring to what was found, I used the term "so-called caustic embrittlement." The Boiler Code Committee recognizes fully that one school has a mechanical explanation to bring forward and the other school has a chemical explanation. This proposed change in the requirements of the rules for greater sodium carbonate to alkalinity ratio is being put on the basis of pressure differential. That is to say, that a ratio of a certain type should be maintained, but no chemical explanation or reason is given in the Code.

The annual dinner was held at the Hotel Fort Shelby, Tuesday evening at which time a series of five-minute addresses were made, followed by discussions of the various topics. These addresses included:

"The Importance of the Hydrostatic Test in Boiler Inspection," by H. H. Mills, chief of the Bureau of Safety Engineering, Department of Buildings and Safety Engineering, Detroit, Mich.

"The Essentials in Shop Inspection," by Thos. P. Hetu, chief inspector of the Hartford Steam Boiler Inspection & Insurance Company, Detroit, Mich.

"What Shall We Do With Bulged Shells and Drums on Steam Boilers," by Allan A. Grant, chief inspector of the Travelers' Insurance Company, Detroit, Mich.

"Second Hand Boilers," by Thos. H. Quiery, engineer, London Guarantee & Accident Company, Detroit.

"Pressure Vessels," by Wesley McLean, chief inspector of the Ocean Accident & Guarantee Corporation, Detroit, Mich.

"The Desirability of Organization of Commissioned Boiler Inspectors," by Otis L. Schooley, chief inspector of the Maryland Casualty Company, Detroit, Mich.

Wednesday Session

Further addresses, as follows, occupied the morning session on Wednesday, while the afternoon was devoted to an inspection trip to the Ford Airport:

"Boiler Water Correction Through Application of Colloidal Gels," by L. D. Betz, chemical engineer.

"Conditioning of Boiler Feed Water, Introducing the Colloidal Aspect," by George C. Reinhard, chief chemist, Feedwaters, Inc.

"Embrittlement in Steam Boilers," by Frederick G. Straub, special research chemical engineer of the University of Illinois.

All of the above addresses and discussions will be published in a later issue.

The Falls Hollow Staybolt Company, Cuyahoga Falls, O., has appointed Thomas Cardwell as representative for Missouri, Kansas, Texas and surrounding states, with headquarters at 770 Paul Brown building, St. Louis, Mo.

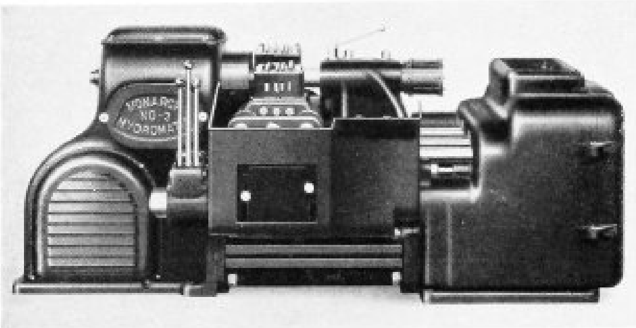
The Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, Illinois, announces the following organization changes: R. E. Kelly, formerly manager of the Boston office has been made sales engineer for the Eastern district with headquarters in New York. John Ashton, salesman in the New York district has been appointed manager of the Boston office.

TWIST DRILLS.—The Morse Twist Drill & Machine Company, New Bedford, Mass., has issued an open letter inviting those interested to visit New Bedford and inspect the plant where Morse tools are made. Morse tools are characterized by a uniform high quality and painstaking care in which they are made.

Hydraulic Automatic Lathe

AN entirely new application of hydraulics is employed in the new Monarch hydraulic automatic lathe which results in higher spindle speeds, better feed control and longer tool life. A new mechanical principle makes it possible to secure quicker set-up and more positive action. On work within its range, this new lathe has demonstrated its ability to greatly increase production and lower production costs.

Both front and rear carriages of this new Monarch lathe can be equipped with length feed and quick traverse. The front and rear tool slides can be provided with cross feeding travel and quick traverse. Complete cycle of both carriages and tool slides is automatic. All controls are hydraulic. Positive adjustable diameter and length stops insure perfect duplication of cuts and minimum of set-up time. Automatic variation of feeding rate can be provided. Changes of feeding rate are almost instantly made.



Hydraulic type production lathe

The headstock unit is a separate casting. All bearings are Timken. A powerful, easily adjusted, Monarch Edgemont multiple disc driving clutch takes its power from the motor mounted in the base. The spindle is worm-driven. Pick-off gears on the front of the headstock provide a quick means of securing any spindle speed desired. All working parts dip in oil. A coolant pump of 80 gallons per minute capacity is mounted in headstock housing and is driven from the main motor. One starting lever starts spindle, coolant and hydraulic feeds on both carriages.

The middle section is the cast iron chip and coolant reservoir. It is keyed and bolted to the headstock and tail-end housing.

The tail-end housing contains the hydraulic mechanism which is easily accessible through large doors on the end. A two-horsepower motor in this housing drives the two oil-gear hydraulic pumps.

The carriages slide on round steel bars 5 inches and 6 inches in diameter. The two inside 6-inch diameter bars are anchored in head and tail-end housings. The carriages clamp on the two outside 5-inch diameter bars which slide in bushings in the head and tail housings, giving wide support to the carriages and preventing any cocking under the heaviest turning cuts. A positive but easily adjustable length stop determines the length of carriage travel.

The tool slides are supported on two round hardened steel bars and have split taper adjustable bushings to compensate for wear. The cross-feed hydraulic cylinder is placed in the tool slide between the two supporting bars. A positive but easily adjustable diameter stop determines the depth of cut and the cross tool travel of the tool slides. Either tool slide can be instantly reversed and returned to the starting position from any point in the cycle, should the occasion arise.

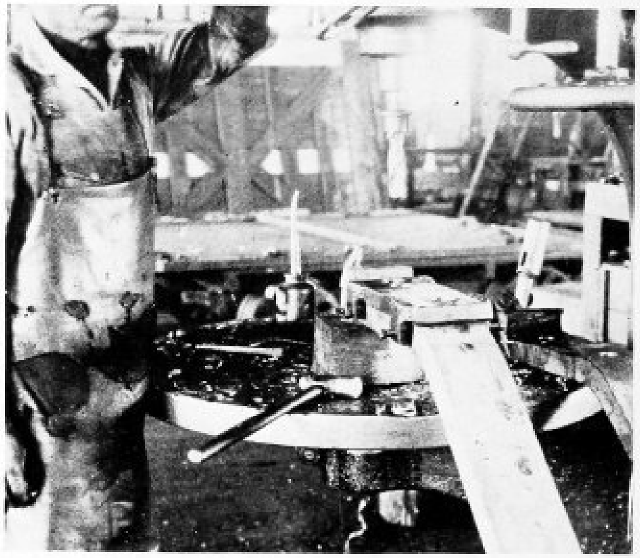
The tailstock clamps on the two inside 6-inch diameter bars. Tailstock spindle can be controlled manually, hydraulically, or by air. This lathe is built by the Monarch Machine Tool Company, Sidney, Ohio.

Special Templates Designed for the Drill Press

By Joseph C. Coyle

WHEN drilling holes in a quantity of flat steel bars, all laid out alike, a considerable saving of time may be made by the preparation of a special template fitted with case-hardened floating bushings which can be used for laying out the holes for guiding the drill and for holding the coolant.

The template is made of a section of $\frac{7}{8}$-inch steel with sufficient width to accommodate the widest bar to be drilled. A $2\frac{1}{2}$-inch or 3-inch section of $\frac{1}{2}$-inch by 2-inch metal, with a set screw inserted near one end, is welded to each corner of the template. By using long set screws, the template may be held firmly on bars of different widths. The holes in the template are made large enough to receive the floating bushings, which serve to center the drill. A series of templates may be made for different kinds of work. The length of the template is determined by the maximum number of holes that will be bored at one setting.



A template for drilling holes in flat stock

Record Breakers

AT midnight, August 8, the East Works plant of the Middletown, Ohio, division of The American Rolling Mill Company had completed 1,158,000 man-hours without a lost time accident. This is 45 consecutive days for over 3700 men. This is thought to be a world's record for a steel plant and supplants the record ending June 29 made by Butler Works of the Columbia Division of The American Rolling Mill Company. The Pennsylvania plant completed 66 consecutive days but only 1,006,135 man-hours.

R. S. Cooper Elected President of Independent Pneumatic Tool Co.

At a special meeting of directors of the Independent Pneumatic Tool Company, held in Chicago, September 12, Ralph S. Cooper was elected president to fill the vacancy caused by the death of the late John David Hurley on August 15. Neil C. Hurley was elected a member of the executive committee and Raymond J. Hurley was elected a director. The new president will carry on the Hurley policies in every detail, having been closely associated with the late John D. Hurley for over twenty-six years. Mr. Cooper graduated from Cornell in 1903 as a mechanical engineer and immediately joined the Hurley forces. After a year in the shop, he went into the sales department at Pittsburgh, shortly being moved to New York as manager of the New York office and later becoming eastern manager. In 1917 he was elected vice-president in charge of eastern sales, and was transferred to Chicago early in 1918 as vice-president and general sales manager. Mr. Cooper spent 1920 and 1921 in Europe, opening the Company's office in Great Britain and establishing the Thor Agencies throughout the Continent. On his return to the United States in 1921 he became also general manager in charge of all departments of the Company, which work he has carried on for the last eight years.

Ralph S. Cooper

The death of John David Hurley, president and founder of the Independent Pneumatic Tool Company, Chicago, Ill., was announced on page 264 of the September issue. Mr. Hurley was born in Simsbury, Connecticut. At an early age his parents went West and settled in Galesburg, Illinois, where he received his education. After leaving school young Hurley, having come from a family who had long been identified with railroads, entered this line of work. His early employment was with the Chicago, Burlington and Quincy Railway; then later with the Louisville and Nashville Railway at Louisville, Kentucky. Later he took an active part in the building of railroads in Old Mexico where he spent several years of his early business career. About 1898 he, with his brother Edward N. Hurley, Sr., organized the Standard Pneumatic Tool Company which was one of the first concerns to introduce air tools in railroad shops and other industries.

John D. Hurley

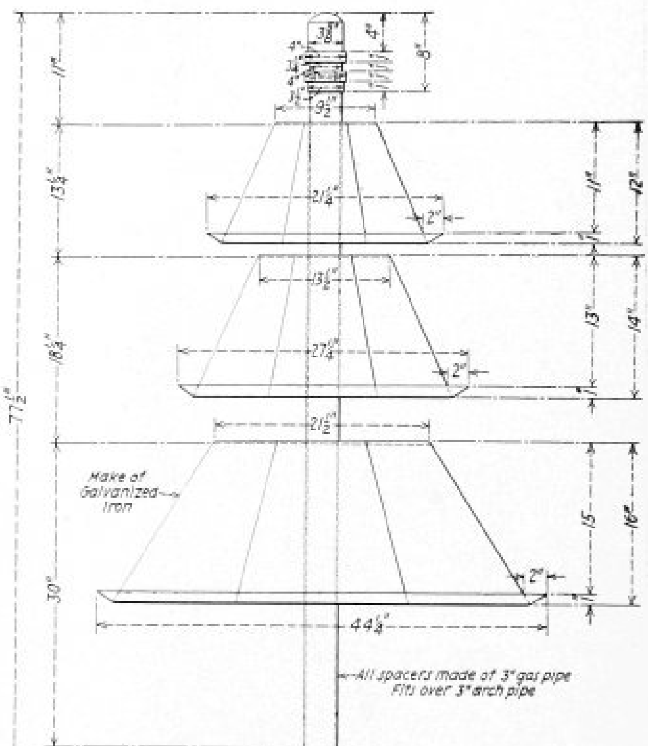
On March 1, 1902 this company was absorbed by the Schwab interests and Mr. Hurley became identified with the Rand Drill Company of New York. In 1905 Mr. Hurley returned to Chicago and organized the Independent Pneumatic Tool Company, which under his leadership became one of the largest industries of its kind in the world.

Revolving Metal Rack Designed for Small Tools

By H. H. Henson*

IN THE toolroom reamers, taps and large drills are usually kept on wooden shelves which require considerable floor space and are difficult to keep clean. The illustration shows a revolving metal tool rack that provides a means of keeping small tools in a compact orderly fashion.

The rack consists of a length of 3-inch arch pipe

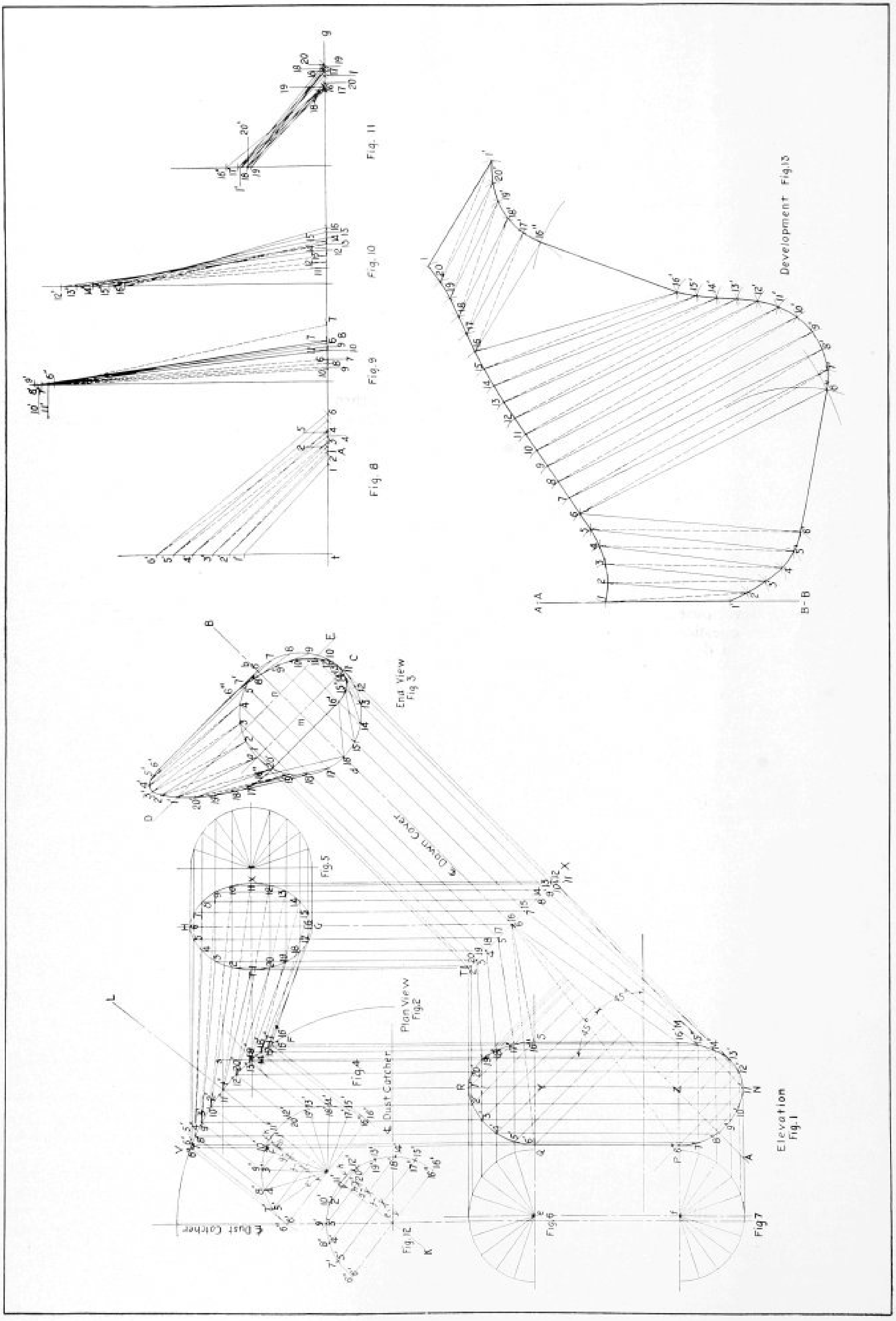


Working drawing of a small revolving tool rack

which is welded into a base made from a piston-head spider. Three octagonal cone-shaped tool trays, made of galvanized iron riveted to ⅜-inch boiler plate, revolve about the pipe center. The trays are held in place on the pipe by spacers made of 3-inch gas pipe that fit over the center pipe.

The larger tray is at the bottom with the smaller at the top. The dimensions of the three trays are shown by the drawing. Each tray is divided into eight sections by angle strips welded in place. The ends of the tools rest on 2-inch ledges which run around the bottom of each tray. The overall height of the rack is 77½ inches and it rests on a base 24 inches in diameter.

* Machine Shop Foreman, Southern, Chattanooga, Tenn.



Layout and development of a downcomer connection piece

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Development of Downcomer Connection Piece

Q.—Will you please outline the method of developing the connection marked in red on the inclosed drawing? Thanking you for any information you can give us, we are, H. C. L.

A.—In making developments as complicated as the one requested in this question, it is necessary to assume that some knowledge of developing plates by triangulation is familiar to the reader. If this is not the case, it would perhaps be well to attempt a simple development by triangulation as outlined in most any handbook, in order to become familiar with this type of development, as the fundamental principle is the same no matter how complicated the layout may become.

To develop the connection between the downcomer and the dust catcher body as shown on the blueprint submitted, it is first necessary to lay out the elevation (Fig. 1), the plan (Fig. 2) and the projected end view (Fig. 3).

In order to do this it is necessary, first to project the line *T-X* of the elevation into the plan view. This is done by dividing the circle *a-b-c-d* of the end view, which is projected along the line *A-B*, into any number of equal parts, as twenty in this case. The greater the number of parts taken, the more accurate is the final development. Number these divisions from *1* to 20 as shown. Parallel to the line *A-B* draw lines through to points 1 to 20 on the circle *a-b-c-d* cutting the line *T-X* of the elevation; number the intersections with the corresponding numbers of the end view. Erect perpendiculars at each of the intersections of the line *T-X* of the elevation, cutting the line *T-X* of the plan view. Draw the semi-circle in Fig. 5 equal in diameter to the circle *a-b-c-d* of the end view. Divide same into ten equal parts (or ½ of the total divisions taken in the end view). Parallel to the line *T-X* of the plan view draw lines passing through the divisions of the semi-circle, as shown, cutting the perpendiculars drawn to the line *T-X* of the elevation, locating the points 1 to *20* on the plan view. Connect these points with a curve forming an ellipse.

It is now necessary to project the line *J-F* of the plan view into the elevation. This is done by bisecting the arc *F-J* giving the line *K-L* which will pass through the center of the dust catcher.

On the line *K-L*, draw a semi-circle as shown in Fig. 4, same to have a diameter equal to the length of the chord of the arc *J-F*. Divide the semi-circle into ten equal parts; i.e., half the number of parts taken on the circle *a-b-c-d* of the end view. Parallel to the line *K-L* and through the intersections on the semi-circle of Fig. 4, draw lines cutting the arc *J-F* of the plan. Drop perpendiculars from these points down into the elevation. On the line *R-N* step off the distances *R-Y* equal to the radius of the semi-circle of Fig. 4 and at *Y* erect a perpendicular as *Y-Q*; extend same.

With *e*, any point on the extended *Q-Y*, as a center draw a semi-circle, with a radius equal to *R-Y*, in Fig. 6. Divide same in ten equal parts (the same number as taken in Fig. 4). Parallel to the line *Q-Y* and through the intersections on the semi-circle of Fig. 6 draw lines cutting the perpendiculars dropped from the line *J-F* of the plan, locating the points *6', 5', 4', 3', 2', 1', 20', 19', 18', 17', 16"*, of the elevation. In the same manner construct Fig 7 and locate the points *6", 7', 8', 9', 10', 11', 12', 13', 14', 15', 16'* of the elevation. Connect these points; this completing the line *Q-R-S-M-N-P*.

The plan and elevation views are now complete and the end view, Fig 3, is now made by projecting the various points from the plan and elevation. Number the points in the end view with corresponding numbers of the same points in the elevation.

The next step preparatory to obtaining the lines of the pattern will be to construct a series of right angle triangles in order to obtain the true lengths of the surface lines of the object.

To construct the right angle triangles as shown in Fig. 8, draw a line *t-g* and at *t* erect a perpendicular. Then take the dividers and using *t* as a center and the vertical distance between the line *T-X* and the point *1'* of the elevation (This distance is taken vertical to the line *T-X* of the elevation in all cases) as a radius, scribe an arc cutting the perpendicular at *1'*. Then taking the distance *1-1'* in the end view as a radius and the point *t* as a center, scribe an arc cutting the line *t-g* at *1*. Connect *1'-1* of Fig. 8, forming the right angle triangle *t-1'-1*, and the distance *1'-1* will be the true length of the line *1'-1* in the plan or end view.

Then with *t* as a center and the vertical distance between the line *T-X* and the point *2'* of the elevation as a radius, scribe an arc cutting the perpendicular *2'*. Then taking the distance *1-2'* in the end view as a radius and the point *t* as a center, scribe an arc cutting the line *t-g* at *1A*. Connect *2'-1A* of Fig. 8 with a dotted line, forming the right angle triangle ***t-2'-1***, and the distance *2'-1* will be the true length of the line *1-2'* of the end view.

Then taking the distance *2-2'* in the end view as a radius and the point *t* as a center, scribe an arc cutting the line *t-g* at *2*. Connect *2'-2* of Fig. 8 with a line forming the right angle triangle *t-2'-2* and the distance *2'-2* will be the true length of the surface line *2'-2* of the end or plan view.

Continue in this manner using the vertical distances between the line *T-X* of the elevation and the points *3'*, *4'*, *5'*, *6'*, etc. as the altitudes of the right angled triangles in Fig. 8, and the distances *2-3'*, *3-3'*, *3-4'*, *4-4'*, *4-5'*, *5-5'*, *5-6'*, *6-6'* as the bases giving the true lengths of the surface lines *2-3'*, *3-3'*, *3-4'*, *4-4'*, etc.

Figs. 9, 10 and 11 are constructed in the same manner until the true lengths of all the surface lines are obtained.

I find that it is less confusing in constructing the triangles to obtain the true lengths of the surface lines at the same time as constructing the development; i. e., after determining the length of the surface line *1-1'*, use same for the development before proceeding to make the next triangle, thus avoiding the possibility of taking the wrong lengths from Figs. 8, 9, 10 and 11.

The next step before proceeding with the development is to find the true length of the lines *O-R-S* and *P-N-M* of the elevation by making the development of the opening in the dust catcher. Fig. 13 shows the true lengths of these lines, they being the same both top and bottom.

The distances *e*, *f*, *g*, *h* and *k* of Fig. 12 are taken equal to the distances *e*, *f*, *g*, *h* and *k*, of Fig. 4 and are stepped off on line *K-L* as shown. Erect perpendiculars to *K-L* at each point. To locate the points *2'* and *20'* Fig. 12 step off on the perpendicular line, just drawn, the distance *1'-2'* and *1'-20'* taken on the arc *J-F* of the plan view. To locate the points *3'* and *19'* Fig. 12, step off on the corresponding perpendicular line the distance *1'-3'* and *1'-19'*, taken on the arc *J-F* of the plan view. Continue in this manner until all points are located as shown. These points are numbered as shown to correspond with numbering in elevation.

Construction of the Pattern

To construct the pattern, first set a pair of dividers equal to the spaces *1-2*, *2-3*, *3-4*, etc. of the circle *a-b-c-d* of the end view.

Begin by drawing the line *A-A = B-B* Fig. 13, and with the trams set equal to the distance *1'-1*, Fig. 8, and with *1* as a center scribe an arc cutting the line *A-A = B-B* setting off the distance *1-1'*. Then with the dividers set equal to the distance *1'-2'*, Fig. 13, and with *1'* as a center, scribe an arc. Then with the trams set equal to the distance *2'-1A*, Fig. 8 and with *1* as a center scribe an arc cutting the arc first made locating the point *2'*.

With the dividers that have been set equal to the spaces on the circle *a-b-c-d* of the end view and with *1* as a center, scribe an arc, and with the trams set equal to the distance *2'-2*, Fig. 8, and with the *2'* as a center, scribe an arc cutting the arc first made, locating the point *2*. Continue in this manner until the line *6-6'* of the development is completed. Then with the point *6'* as a center and the trams set equal to the distance *P-O* of the elevation, scribe an arc. Then with the point *6'* as a center and the trams set equal to the distance *6-6"*, Fig. 9, scribe an arc cutting the arc just made, locating the point *6"*.

Proceed as before, setting the dividers equal to the distance *6"-7'*, Fig. 13, scribe an arc. With *6* as a center and with the trams set equal to *6-7'*, Fig. 9, scribe an arc cutting the arc just made locating point *7'*. Continue in the same manner until the line *16-16'* is reached.

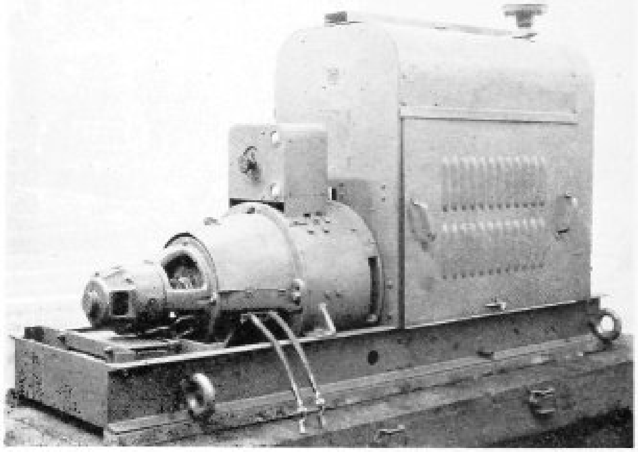
The distance *16'-16"* is taken equal to *M-S* of the elevation, and the same procedure continued until the line *1-1'* is reached, completing the developments. Using all the surface lines of Figs. 8, 9, 10 and 11 keeping in mind that the distances *1-2*, *2-3* to *20-1* being equal to the arcs *1-2*, *2-3* to *20-1* of the circle *a-b-c-d*, and the distances *1'-2'*, *2'-3'* to *20'-1'* with the exception of *6'-6"* and *16'-16"* being taken equal to their corresponding distances in Fig. 13. Thus completing the development.

It will be necessary to add the required amount for seams as these are not included in the development.

Arc Welding Set

THE Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has developed a new 300-ampere, gas-engine driven, single operator arc welding set. This type of set is employed for supplying welding current where a local power supply is not available as in the case of pipe line and storage tank construction, general construction and repair jobs in isolated places.

The complete set consists of a model P-35 Continental, 4-cylinder, gas engine direct connected to a new



New gas engine driven arc welding set

type Westinghouse 300-ampere, single-operator, type SK, arc-welding generator, with flexibly-coupled exciter overhung from the generator bracket. The generator has a special bracket which fits into the engine housing, so as to make the complete equipment as compact as possible. The generator control panel is mounted on top of the generator frame and fully enclosed by a sheet-metal cabinet. The welding current is varied over the entire range by means of a single dial rheostat. Protective covers over generator commutator and engine hood make the complete equipment suitable for service in all weather conditions without the use of a canopy. The set can be made portable by the addition of running gear parts.

The Continental Red Seal engine has the S.A.E. rating of 28.9 horsepower. Under average operating conditions, the fuel consumption is approximately 1½ gallons per hour, the gasoline tank holding 28 gallons. For lubrication the pressure feed system with a gear type pump is used.

Associations

Bureau of Locomotive Inspection of the Interstate Commerce Commission

Chief Inspector—A. G. Pack, Washington, D. C.

Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

Steamboat Inspection Service of the Department of Commerce

Supervising Inspector General—D. N. Hoover, jr., Washington, D. C.

American Uniform Boiler Law

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—Fred R. Low.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 W. 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—C. D. Thomas, Salem, Oregon.

Secretary-Treasurer—C. O. Myers, Commercial National Bank Building, Columbus, Ohio.

Vice-Chairman—William H. Furman, Albany, N. Y.

Statistician—L. C. Peal, Nashville, Tenn.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

International President—J. A. Franklin, suite 522 Brotherhood Block, Kansas City, Kansas.

Assistant International President—William Atkinson, suite 522 Brotherhood Block, Kansas City, Kansas.

International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.

Editor-Manager of Journal—John J. Barry, Suite 524, Brotherhood Block, Kansas City, Kansas.

International Vice-Presidents—John J. Dowd, 142 Pearsall Ave., Jersey City, N. J.; M. A. Maher, 2001 20th St., Portsmouth, O.; R. C. McCutchan, 226 Lipton St., Winnipeg, Man., Canada; H. J. Norton, Alcazar Hotel, San Francisco, Cal.; C. A. McDonald, Box B93 Route 2, Independence, Mo.; J. N. Davis, 1211 Gallatin St., N. W. Washington, D. C.; M. F. Glenn, 1434 E. 93rd St., Cleveland, O.; W. J. Coyle, 424 Third Ave., Verdun, Montreal, Canada; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; J. F. Schmitt, 25 Crestview Rd., Columbus, O.

Masters Boiler Makers' Association

President, George B. Usherwood, supervisor of boilers, New York Central, Syracuse, N. Y.

First Vice-President—Kearn E. Fogarty, general boiler inspector, Chicago, Burlington & Quincy Railroad, Aurora, Ill.

Second Vice-President—Franklin T. Litz, general boiler foreman, Chicago, Milwaukee, St. Paul & Pacific Railroad, Milwaukee, Wis.

Third Vice-President—O. H. Kurlfinke, boiler engineer, Southern Pacific Railroad, San Francisco, Cal.

Fourth Vice-President—Ira J. Pool, district boiler inspector, Baltimore & Ohio Railroad, Baltimore, Md.

Fifth Vice-President—L. E. Hart, boiler foreman, Atlantic Coast Line, Rocky Mount, North Carolina.

Secretary—Albert F. Stiglmeier, general foreman boiler maker, New York Central Railroad, Albany, N. Y.

Treasurer—W. H. Laughridge, general foreman boiler maker, Hocking Valley Railroad, Columbus, Ohio.

Executive Board—Charles J. Longacre, chairman, foreman boiler maker, Meadow Shops, Pennsylvania Railroad, Elizabeth, N. J.

Boiler Makers' Supply Men's Association

President—Harry Loeb, Lukens Steel Company, Coatesville, Pa.

Vice-President—Irving H. Jones, Central Alloy Steel Corporation, Massillon, Ohio.

Treasurer—George R. Boyce, A. M. Castle & Company, Chicago, Ill.

Secretary—Frank C. Hasse, Oxweld Railroad Service Company, Chicago, Ill.

American Boiler Manufacturers' Association

President—H. E. Aldrich, The Wickes Boiler Company, Saginaw, Mich.

Vice-President—Owsley Brown, Springfield Boiler Company, Springfield, Ill.

Secretary-Treasurer—A. C. Baker, 801 Rockefeller Building, Cleveland, O.

Executive Committee—Homer Addams, Fitzgibbon Boiler Company, Inc., New York, N. Y.; G. W. Bach, Union Iron Works, Erie, Pa.; H. H. Clemment, Erie City Iron Works, Erie, Pa.; J. R. Collette, Pacific Steel Boiler Corp., Waukegan, Ill.; F. W. Chipman, International Engineering Works, Framingham, Mass.; E. R. Fish, Heine Boiler Company, St. Louis, Mo.; C. E. Tudor, Tudor Boiler Company, Cincinnati, O.; A. C. Weigel, Walsh and Weidner Company, Chattanooga, Tenn.; S. G. Bradford, Edge Moor Iron Company, Edge Moor, Del.

States and Cities That Have Adopted the A.S.M.E. Boiler Code

	States	
Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii
	Cities	
Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich.	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W. Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.
	Evanston, Ill.	

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

	States	
Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	
	Cities	
Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash.	Parkersburg W. Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

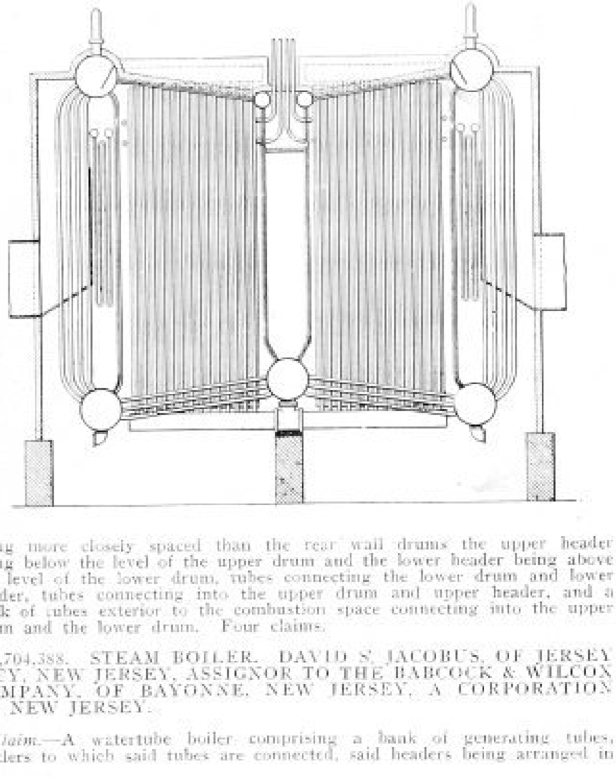
Compiled by
DWIGHT B. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

1,709,356. BOILER FURNACE. GEORGE T. LADD, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO LADD WATER TUBE BOILER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

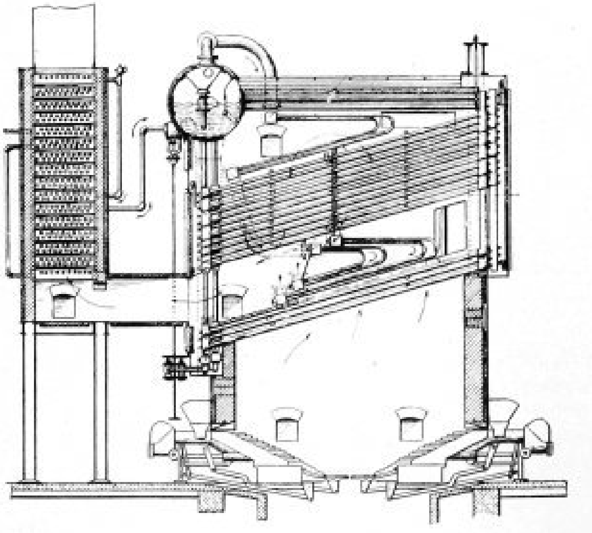
Claim.—A tubular boiler-furnace having the combustion space primarily defined by tubes subject to radiant heat, the rear wall of said combustion space being formed of an upper drum, a lower drum, and tubes connecting into said drums, the front wall being formed of an upper header, a lower header, and tubes connecting into said headers, said front wall headers



being more closely spaced than the rear wall drums the upper header being below the level of the upper drum and the lower header being above the level of the lower drum, tubes connecting the lower drum and lower header, tubes connecting into the upper drum and upper header, and a bank of tubes exterior to the combustion space connecting into the upper drum and the lower drum. Four claims.

1,704,388. 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.

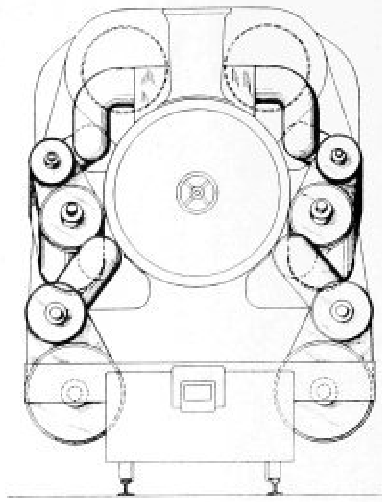
Claim.—A watertube boiler comprising a bank of generating tubes, headers to which said tubes are connected, said headers being arranged in



rows and those of one row staggered relatively to those of the other row, calking in the spaces between the headers to secure a gas-tight joint, and retaining members to hold the calking material in position. Seven claims.

1,704,142. STEAM LOCOMOTIVE. JOHN E. MUHLFELD, OF SCARSDALE, NEW YORK.

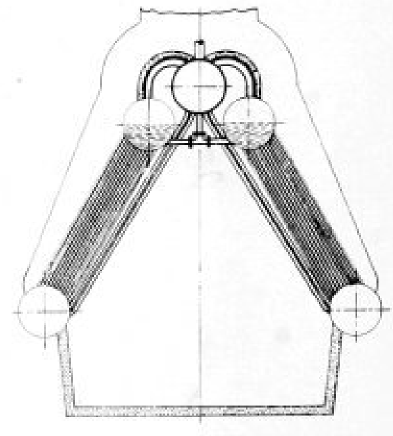
Claim.—In a steam locomotive, structurally independent high and low pressure cylinders mounted upon each side thereof in longitudinally spaced



relation, the rear cylinders being obliquely inclined with respect to the front cylinders, and direct driving connections between the respective cylinder pistons and separate drive wheels of the locomotive. Five claims.

1,694,936. LIQUID VAPORIZER. HARRY G. DONALD, OF PHILADELPHIA, PENNSYLVANIA.

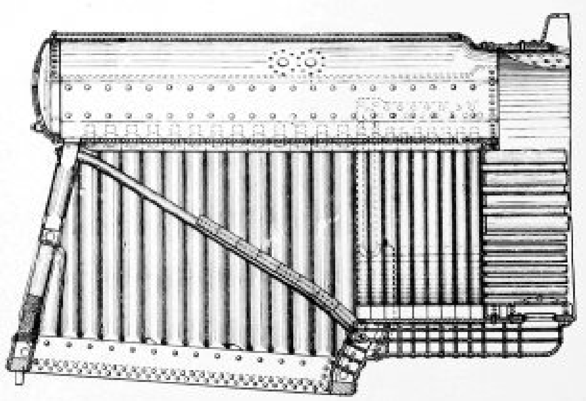
Claim.—In a watertube boiler, a mud drum, a set of tubes exposed to heat of radiation and extending from said drum, a vapor collector for said



tubes, a second set of tubes exposed to heat of convection and also extending from the drum, a vapor collector for said second set of tubes, the first collector being above the water level of the second collector, and a common vapor take-off for the collectors.

1,708,229. BOILER. JAMES M. McCLELLON, OF EVERETT, MASSACHUSETTS; HAROLD B. McCLELLON ADMINISTRATOR OF SAID JAMES M. McCLELLON, DECEASED.

Claim.—A boiler firebox comprising in combination a longitudinal chamber and a longitudinal water-containing wall comprising a plurality of tubes having cylindrical body portions set closely together side by side, the ends of the tubes being shortened longitudinally and extended transversely to



provide elongated, spaced discharge portions of capacity approaching that of the tube body, said portions entering correspondingly shaped openings in the chamber wall and secured therein. Ten claims.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX | November, 1929 | Number 11

PUBLISHED MONTHLY BY THE
SIMMONS BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

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THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Locomotive Boiler Orders

INCREASING volume of business in the locomotive boiler construction field is indicated by a recent report of the Department of Commerce, in which the output of locomotives for the first 10 months of 1929 exceeds that of the same period in 1928 by 70 percent. For the first 10 months of 1928, 311 domestic steam locomotives were delivered in addition to 71 foreign steam locomotives and the total orders unfilled at that time amounted to 139.

At the end of October, 1929, the total number of steam locomotives delivered this year was 650 of which 570 were for domestic service and 80 for foreign. Unfilled orders on hand at the end of October totaled 374 or 235 more than at that time last year.

If the present indications are correct, business in the locomotive construction field and therefore in the locomotive boiler field has increased over 100 percent during the past year.

Among the orders placed within the past few months are those for 11 of the world's largest locomotives. These locomotives, for the Northern Pacific Railway, were ordered from The Baldwin Locomotive Works, and are duplicates of the ones constructed last year for the same railway by the American Locomotive Company. They are of the simple articulated 2-8-8-4 type and have a total heating surface of 7673 square feet. Each boiler weighs 165,000 pounds.

Precision in Riveting

WITH the higher steam pressures in use today the boiler maker is required to work with greater precision than ever before in the laying out, fabricating, assembling and riveting of boilers. Higher pressures mean thicker plates, heavier rivets, closer fits and better joints. Skilled workmanship of the highest order, of course, is a prime requisite, as it always has been in first-class boiler work. The chief difference is that the shops today are equipped with more and better machinery; hand work has been superseded by machine work, and, as a result, larger and heavier plates are being fabricated to exact size and shape and fitted together with a machine-like precision that was unknown a generation ago. Nowhere, however, is greater precision required than in the riveting of high-pressure work.

Precision in riveting starts with the rivet itself. If the rivets are out-of-round, have die marks or fins under the head or along the shank, or are coated with scale, it will be impossible to obtain a full metal-to-metal contact between the rivet and the plate and trouble will develop in the riveted joint later on when the boiler is operating under high pressure. Rivets for high-pressure work are now being made of alloy steel to fit holes reamed to within 1/64 inch of size. The surface of the rivet along the shank and under the head is machined, and, in some cases, ground, to obtain the close fit required in the accurately reamed holes. In the heating and driving of the rivets, advances have also been made so that the heating of the rivet can be accurately controlled within the temperature limits best suited for the particular job in hand, and the proper pressure for closing the rivet can be efficiently applied exactly at the center of the rivet hole. Precision in riveting also depends upon the accuracy and speed with which the work can be handled at the riveting machines. In this respect the manufacturers of hoisting machinery have kept pace with the advances made in other directions by supplying equipment that permits the quick movement of heavy shells and drums into accurate alinement with the riveting dies so that the rivet heads are formed exactly concentric with the center of the rivet hole. All of these improvements, of course, have added something to the cost of riveting, but in spite of this extra cost it is believed that riveting is still the cheapest method of joining plates for pressure work that has been devised.

Fatigue Tests on Drums

THE Babcock & Wilcox Company is making an interesting series of tests on drum shells of various types under repeated applications of pressure in order to ascertain the relative strengths of riveted, welded and solid drums. These drums are of the type used in high-pressure watertube boilers. In the United States, for pressures up to 800 pounds per square inch these drums are of riveted construction, while for pressures up to 1500 pounds per square inch solid or forged drums are used. Although these experiments are still in progress, a report on the work, containing certain tentative conclusions, was given in a recent issue of the *Iron Age* by Professor H. F. Moore, research professor of engineer materials at the University of Illinois, who served as a special consultant in the conduct of the fatigue experiments.

The specimens tested were full-size boiler drums, or shells, about 3 feet inside diameter. It was assumed that if, under test, a boiler drum shell withstood without fracture 150,000 cycles of stress varying from zero to a stress 50 percent above the working stress, it might be concluded that a similar drum shell made of the same material would not fail by fatigue under normal length of service at the working pressure. One of the specimens was a manganese steel riveted drum, the material having a tensile strength of 106,500 pounds per square inch. This drum failed in the head below the manhole after 130,225 cycles of pressure had been applied. An A. S. M. E. standard riveted drum withstood 1,013,840 cycles of pressure without developing any fracture. A specimen, arc-welded by hand using ordinary bare welding wire, fractured in the welded seam after 5530 cycles of pressure. Three other specimens, welded by hand but using processed electrodes, fractured at a tapped hole where a ½-inch pressure-gage connection was made, after over 400,000 cycles of pressure had been applied. A forged shell failed in the same manner after about the same number of cycles of pressure had been applied.

These tests show that welded joints in drum shells have been made which do not weaken the fatigue strength of the shell as much as does the tapping of a hole for a gage connection, that welded joints in drum shells have been made which withstand 50 times as many cycles of stress, varying from zero to 50 percent above the allowable working stress, as would be developed in the normal life of the boiler and that the strength of a welded seam under repeated cycles of pressure is greatly affected by variation of welding practice, showing the necessity of developing and maintaining uniformly good welding and careful inspection of the welding.

Communication

Staybolt Practice

TO THE EDITOR:

I would like to know the methods employed by some of the different railroads both here and abroad in correcting enlarged staybolt holes. Since we have the human element to contend with in industry and, as all workers are not mechanically perfect, it so happens that occasionally staybolt holes are gouged out more or less and sometimes burned through. This does not concern me so much as to know how an efficient repair can be made. Also, when new locomotive fireboxes go out on the road they are standard. Staybolts 1-inch parallel; radials or crown bolts, 1⅛-inch parallel or 1 5/32-inch by 1⅛-inch eleven-thread pitch. After being out on the road some time a few broken bolts may be renewed in the roundhouse, and after each successive shopping more broken bolts are renewed, resulting in enlarged staybolt holes.

What is your method of dealing with them? How do you close them up or fill up the cracks and fissures that are burst out? It is obvious that you cannot put up size every time the bolts are taken out or pass enough reamers and taps through the holes to cut new threads every time. If you did, you would have to carry 1⅜-inch and 1½-inch or larger sizes of staybolt iron in stock.

Can you give me the definition of the eleven-thread pitch? What is meant by pitch and profile of the staybolt thread. Again, how are staybolts sized to the holes in the boiler and how do you go about mass production in your highest efficiency boiler shop?

What is the capacity of the modern staybolt lathe, or screw-cutting machine and how many changes can be rung in on these heads? That is, how can these machines take care of store orders, supply bolts for new fireboxes and make the various sizes for the running work?

In opening and closing these heads of the staybolt threading machine, what means are used? Does the operator have an adjusting key or screw-drivers to open and close dies, or is there some simpler method with less chance of guess work?

In tapping the crown of a new locomotive firebox, what style of tap is the most suitable and what is to be preferred for the crown or top?

[EDITOR'S NOTE: The foregoing communication is from one of our readers in Canada and since the scope of his questions is beyond the function of the Questions and Answers Department, some of our other readers who are familiar with the best staybolt practice might care to send short articles on the subject. The matter is of considerable interest and any replies received that are suitable for publication will be paid for at regular space rates, with additional payment for photographs, drawings or other illustrations.]

Caustic Embrittlement Ruins Four Watertube Boilers

CAUSTIC embrittlement recently cost a large midwestern concern $85,000 when, in less than a year and a half after four new watertube boilers of the longitudinal-drum type had been installed, they were found so badly affected by embrittlement cracks that replacement was necessary. The extreme rapidity with which deterioration progressed is explained by the fact that not only was the raw feed water of an embrittling nature, but the water softening system was such that it aggravated the condition, sending into the boiler a water that had a sulphate-to-carbonate ratio of about one to three.

The boilers and the water softening system were installed and put to use in December, 1926. In about a year an inspector discovered leakage at the rear tube end of boiler No. 4 and, on close examination, found that some of the tubes had developed cracks near the point where they entered the tube sheet. In a short time the leakage became so troublesome that the boiler had to be taken out of service. Then it was found that the highly concentrated water, leaking out at the watertube ends, had deposited a hard-baked, cement-like substance that literally matted the tubes together for a distance of four feet from the tube sheet, as shown in Fig. 1.

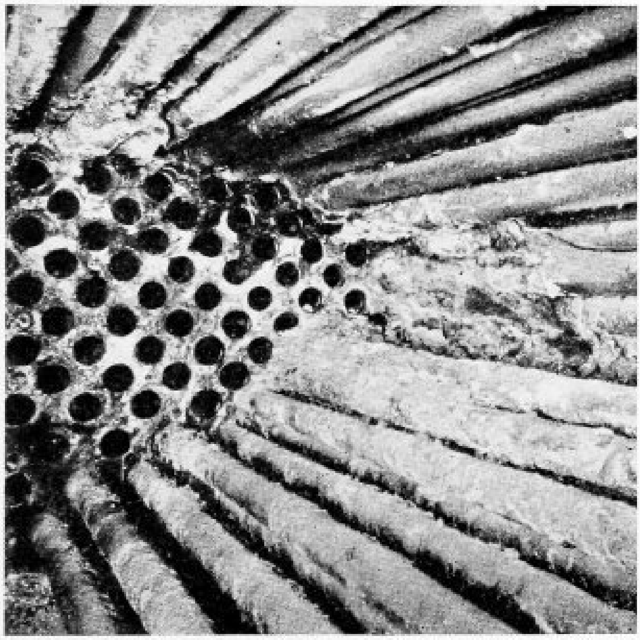


Fig. 1

At first it was thought that the cracks in the tubes might have been caused by too heavy rolling or by improper annealing, but five different laboratories, after independent analyses, agreed that the metal was up to the A. S. M. E. standard and had not been injured either in manufacture or when the tube ends were belled over. However, a microscopic investigation of the cracks themselves gave a clue to the true cause, for the fissures followed the borders of the grain—a condition typical of caustic embrittlement. Fig. 2 shows the nature of the failure in the tube ends.

Boiler No. 2 was next taken off the line and examined. A slight leakage was noted at four or five points along the longitudinal seam of the drum and several rivet heads were missing. Removal of the butt straps disclosed rivet-hole to rivet-hole cracks in both the straps and the plate. Similar conditions were found in two other boilers.

Satisfied that they were dealing with embrittlement, the investigators turned their attention to the feed water and found that even before passing through the softening apparatus the raw water contained more carbonate than sulphate. Such a condition would, in itself, be entirely capable of causing embrittlement, for in order to inhibit caustic action on the steel the sulphate content should exceed that of carbonate. However, the slight over-balance in favor of the carbonate might not have caused such rapid deterioration had it not been that the particular system of feed-water softening in use at this plant increased the unfavorable ratio, actually making the "softened" water more dangerous than the raw.

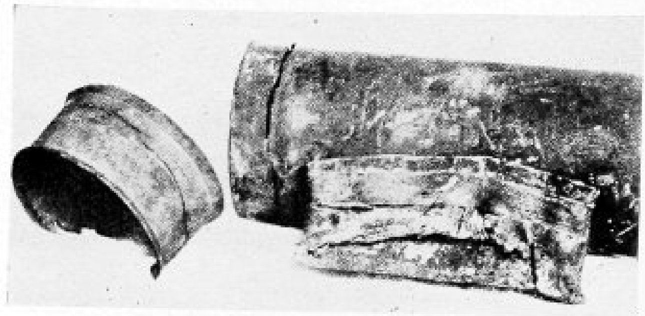


Fig. 2

The plant had no choice but to scrap the boilers for, weakened as they were, their continued use would have been dangerous. Pending the erection of new boilers, the water softening system was replaced by one that would correct the unfavorable carbonate-to-sulphate ratio.—*The Locomotive.*

Differential Chain Hoist Has New Features

A differential chain hoist possessing three new and exclusive features is announced by Robbins & Myers, Inc., Springfield, O.

Robbins & Myers chain hoist

Timken thrust bearings used in the lower hook permit easy turning of the load in addition to reducing chain and upper sheave wheel wear caused by chain twisting. The sheaves are of Aremite, an alloyed iron produced in the Robbins & Myers foundry, which because of a tensile strength twice that of ordinary gray iron and an unusual hardness, is remarkably durable. Aluminum finish is used throughout, chains excluded, and provides lasting protection against damage from exposure. The chains are of a special analysis steel, heat treated and electrically welded.

This hoist is manufactured in five sizes, with capacities ranging from 1/4 to 2 tons.

Testing Welds

Survey of available ability of welders

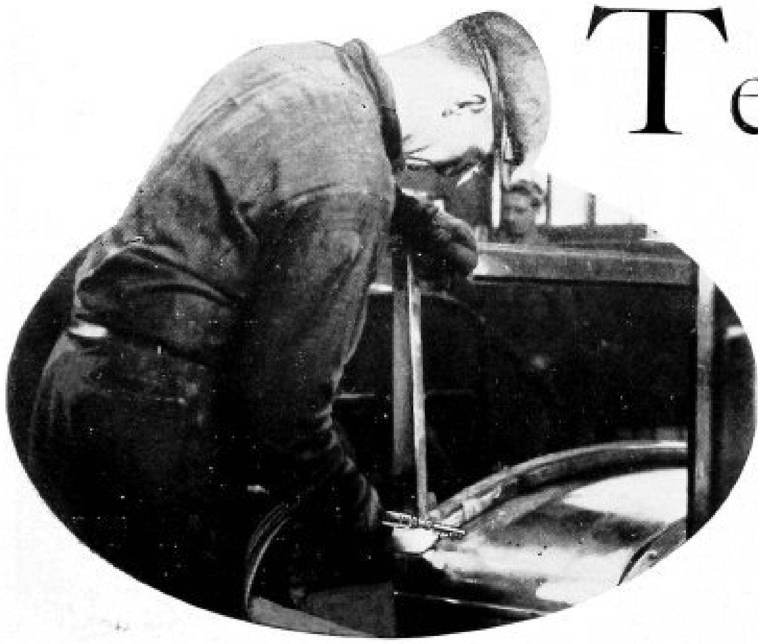


Fig. 1.—A non-destructive test

ADOPTION of procedure control as a method of insuring welded products of uniformly high quality has served to emphasize the practical importance of testing welds. Only a few years ago the testing of welds was confined almost entirely to research laboratories. Today it has assumed practical significance in almost every field where welding is used.

Experience with procedure control proved that by means of suitably devised qualification tests it was possible to obtain an accurate evaluation of a welder's ability; that periodic repetition of such tests would make certain that the welder's ability remained at the high standard desired; and that careful inspection and tests of the finished products would further insure successful results.

During recent years much serious study has been devoted to methods of testing welds. Many methods have been developed and applied in practice. The ideal of a simple, non - destructive test that will quickly and easily indicate the exact quality of every point in a weld in a finished product has not been attained but investigations are constantly in progress aiming toward such a method.

It is of interest to review the various testing methods that are in general use at the present time.

*Article compiled from data supplied by the Linde Air Products Company, New York. N. Y.

Fig. 2.—Pressure-impact test of pressure vessel

Tensile Test—For determining the strength of the welds that a welder is able to produce, the accepted practice is to have him prepare test specimens from which standard tensile test coupons can be cut and pulled.

For work on steel plate, for example, test specimens are made by welding together two pieces of steel plate, each 9 by 12 inches. The plate should be at least as thick as the material to be used in actual work. One12-inch edge of each plate should be beveled for single or double vee, according to type used. Type of welding rod and amount of reinforcement should also be specified.

It is also customary to have the welding foreman or inspector watch the operator while the test weld is being made, in order to observe details of the welder's technique. For production work, the rate of welding is also an important part of the qualification test and it is customary to specify that the test be completed within a certain time.

Unless a tensile machine is available, completed test pieces should be sent to an approved laboratory for test. From the center of each specimen, four standard A.S.T.M. coupons are cut. After removing the weld reinforcement, the coupons are pulled in a tensile testing machine. Where high-test welding rod has been used in making the welds in firebox-quality plate, the coupons should show an average ultimate tensile strength of not less than 52,000 pounds per square inch.

The qualification test may also contain a specification requiring a minimum of 50,000 pounds per square inch for any coupons that may fracture in the weld and a minimum of 48,000 pounds per square inch for coupons that break in the plate. If any fractures occur through the weld, they must show freedom from appreciable defects.

Test plates are usually welded in a horizontal position, but if the

for Strength

means for determining and quality of welds

work demands vertical or overhead welding, operators should be required to submit additional test specimens welded in these positions.

Tensile tests are also required in qualifying welders for work on pipe lines or high pressure piping systems. The usual procedure is to have the operator weld together two short pieces of pipe (about 9 inches in length), the pipe size and manner of welding being the same as used on the job. The pipe specimen should not be less than 6 inches in diameter, however. Thus, welders may be qualified for making rotating welds, position welds or, for piping work, welds of the type used in vertical risers. The method of beveling the pipe ends and the amount of reinforcement should be specified. During the test, the welding inspector or supervisor should observe the technique followed by the applicant and satisfy himself that the time required falls within the limits set for production work.

Upon completion of the weld and after the piece has cooled to room temperature, standard tensile test coupons should be cut at specified points, such as top, bottom and each side, with the weld in the center of each coupon. After removing the reinforcement by grinding or machining, the coupons are pulled in a tensile machine. See Fig. 5.

Bend Test for Strength—Where it is not feasible to have tensile tests made, the method of bending welded specimens in a vise may be used to give an indication of the strength and character of workmanship. Test pieces should be welded as outlined above, using plate or pipe, as the case may be. Strips at least 1½ inches wide and not less than 8 inches long should be cut from the test piece.

Without removing reinforcement, the strips should be tested by gripping the specimen in a vise with the weld flush with the jaws, Fig. 5, and sledging against the side from which the weld was made until the piece is bent through 90 degrees. A satisfactory test specimen should not fracture under this test.

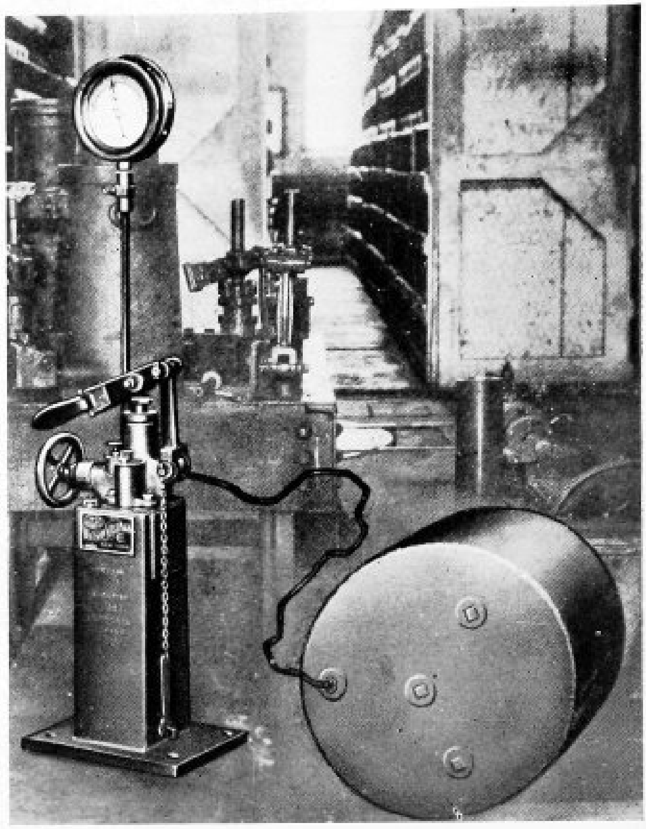


Fig. 3.—Pump for hydrostatic pressure test

The specimen should then be reversed and hammered from the opposite side until fracture occurs. The fracture of a satisfactory specimen should occur either outside the weld, or if in it, should show the following characteristics: full penetration, thorough fusion, no gas pockets, cold shuts or other defects.

Pressure Test—For products such as tanks, closed containers, pressure vessels of all types, pipe lines and piping systems, where absolute tightness of all joints is essential, the application of internal pressure affords a convenient means of determining the soundness of the welds. Pressure tests are applied to a variety of finished welded products as a part of routine production under procedure control. Such tests give definite assurance that the products will give satisfactory service under the operating conditions for which they were designed. Pressure tests are also frequently required in qualifying welders for

Fig. 4.—Impact test for longitudinal seam of pressure vessel

work on pressure piping systems such as high pressure steam lines.

Wherever possible, hydrostatic pressure should be used, as it has several definite advantages, which are listed below:

First, the pump does not need to be so large, since water can be compressed only slightly. The vessel is filled with water at ordinary pressure before bringing the pump into action.

Second, high pressure can be obtained more easily than in any other way.

Third, and of greatest importance, in case of sudden release of pressure there is little tendency for the parts to be thrown about violently.

Hydrostatic Pressure Test — The equipment necessary for making hydrostatic tests consists of a small pump, a pressure gage and some piping connections. Suitable pumps for this purpose are made small enough so that they can be easily carried and the prices are quite moderate. Such pumps are used by boiler inspectors in their routine work of testing boilers. The pump illustrated in Fig. 3, or even a smaller type, is suitable for an ordinary shop and can be also used in the field, since the pressures up to 6000 pounds per square inch are easily obtained.

In applying the test to pressure vessels and other closed containers, all lower openings and outlets are first closed and the vessel is filled completely full of water, making certain that no air pockets are left. Upper outlets are then closed. After connecting the pressure line to the tank, the pump is operated until the gage shows the desired pressure. This is usually at least one and one-half times the normal working pressure.

In the case of pressure vessels, procedure control specifications call for a hammer test while the vessel is under hydrostatic pressure of twice the designed working pressure. Figs. 2 and 4. The weight of the hammer in pounds is equal to the shell thickness in tenths of an inch and the blows must be struck at 6 inch intervals on both sides of the weld for the full length of the seam. Each seam is then given a thorough visual inspection. Following the hammer test, the hydrostatic pressure is raised to three times the designed working pressure and the seams again inspected. This pressure-impact method is used as a means of testing the strength and soundness of welds for high pressure service.

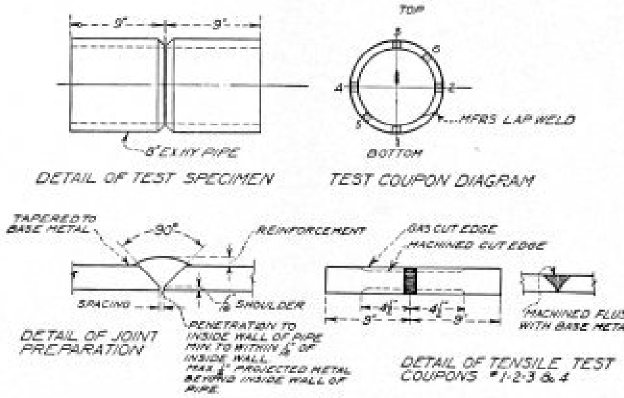


Fig. 5.—Tensile and bend test specimen for pipe welding

Pressure Qualification Test — Qualification tests for work on high-pressure steam piping systems frequently specify pressure tests as part of the requirements. A typical test is given in a procedure control for welded construction of a 400 pound pressure superheated steam-piping system, maximum temperature 750 degrees F. See Figure 8.

This test requires the welding of the joints in one pipe bomb to be made up of 6 or 8 inch extra-heavy pipe containing two circumferential-position butt welds approximately 8 inches apart, one of the joints to be welded with the bomb lying horizontally, the other to be welded with the bomb vertical. The bomb shall not be rotated during welding. The preparation of the joint shall coincide with the welded joint detail, as shown on the engineer's drawing. Weld reinforcement to be 1/8 inch gradually tapered where it approaches the base metal. Penetration shall be to the inside wall of the pipe. The ends of the bomb are to be closed in a suitable manner to withstand the test pressure to which it shall be subjected. At completion of welding and after the bomb has cooled to room temperature, the bomb shall be subjected to an hydrostatic test of 600 pounds per square inch, or one and one-half times working pressure, after all air has been expelled therefrom. While under this pressure the welds shall be struck with a 4-pound sledge at four equidistant points, the blows being struck with a full-arm swing. Under these conditions the welds shall not leak or develop any visible imperfections.

Air Pressure Test—For certain types of work, practical considerations make it undesirable to use hydrostatic pressure for testing. In the case of pipe lines for oil and gas, for example, it would frequently be difficult to obtain the large volumes of water necessary to fill long sections of line under test. In addition, there would be the difficulty of draining off and pumping out the water after the test was completed. It is customary to test such pipe lines with air pressure because it is more convenient to use.

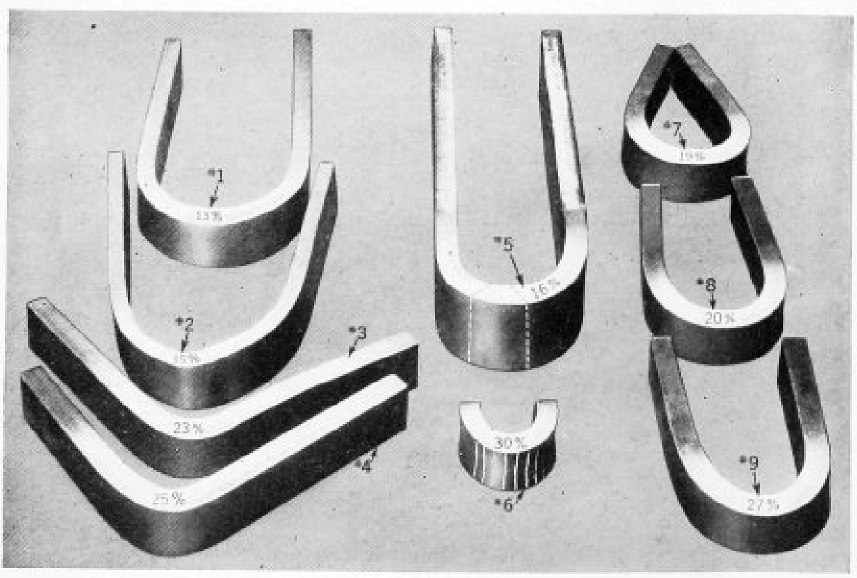


Fig. 6.—Results of bend test

After blanking off a section of line

by means of a bull plug, or other suitable closure, and attaching pressure gages, compressors are placed in operation until the test pressure is built up in the line. Each weld is then painted with soapy water and carefully inspected for bubbles, which would indicate pinhole leaks. Test specifications may also require that each weld be hammered vigorously while under pressure and then be tested again with soapy water.

In addition, gas lines are frequently required to hold the test pressure over a period of 24 hours or more, recording pressure gages being attached to the line to register changes in pressure. In the results, allowance must be made for temperature fluctuations.

Testing Low-Pressure Tanks—Air is also used for low-pressure testing of tanks, particularly the aluminum fuel tanks used in aircraft. These tanks are tested with 4- to 5-pound-per-square-inch air pressure. To determine the presence of possible pin-hole leaks, the welds may be painted with soapy water or the entire tank submerged in a large vat of water.

Inspection of Etched Sections—In pipe line work some method of cutting test specimens from welds in the line itself is very desirable. Splendid results have been obtained with a portable keyway slotting machine, Fig. 7, fitted with two thin milling cutters and a spacer. The procedure of handling this weld cutting machine may be along the following lines:

Within a day or two of a man's employment, the chief inspector will mark out one of his welds and may mark a particular spot on the weld, such as the final tie-in. Then in due course of taking weld samples, the slotting machine is brought to this weld and set up on the pipe at any reasonable angle, from 45 degrees on either side to the upright position.

Two men then operate the handles which transmit power through gearing to the milling cutters. The operation of cutting a single specimen should not exceed a time of more than ten minutes on pipe 3/8 inch thick.

When the cut has been made, a small drill, a cold chisel, or a cutting blowpipe can be used to cut across the ends of the specimen so that it can be removed. The welder's number should be stamped on one side for identification. The specimen should then be rubbed on a file held flat in a vise or backed up by a flat surface. This will give a flat surface finish on one side of the specimen, whereas the opposite procedure of rubbing a file over the spicimen will not. Subsequently to filing, the specimen should be lightly rubbed on fine emery paper, and then should be etched in a 10 percent solution of ammonium per-sulphate.

Visual inspection of the etched specimen will show the soundness and quality of the weld metal.

Reheating of Welds—A non-destructive test capable of application to light-gage sheet metal products which cannot be subjected to pressure test is used by a manufacturer of high-grade automobiles. The method may be illustrated as applied to steel welds in 20-gage steel sheet in the cowl apron.

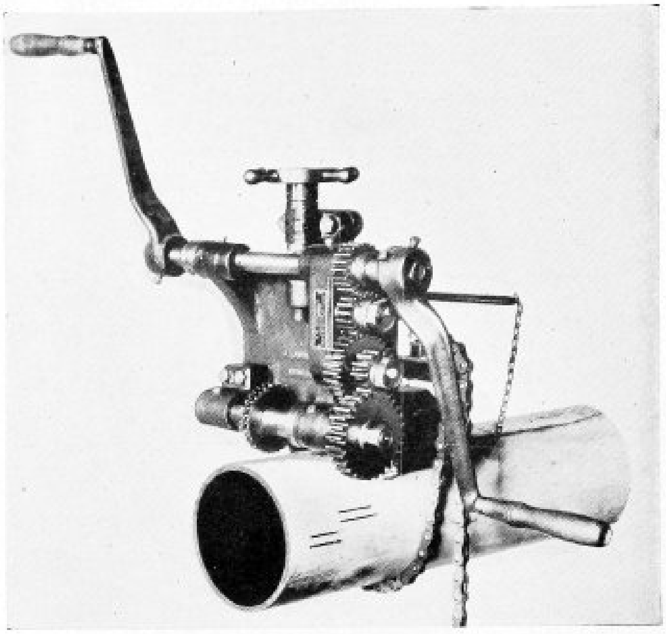


Fig. 7.—Slotting machine

Using an oxy-acetylene welding blowpipe with a fairly large head, the inspector heats the entire length of the seam gradually and evenly to a medium red, Fig. 1. As the weld is thicker than the adjacent sheet metal, it does not heat up as rapidly as the sheet. A perfect weld will show as a uniform, unbroken darker stripe in the heated area. The presence of any defective places in the welds due to incomplete penetration, blowholes, cold shuts or laps will be indicated by bright spots in the relatively darker weld area. Where thorough fusion has not been obtained between base metal and weld metal, these sections will also show up bright while the rest of the weld will remain dark.

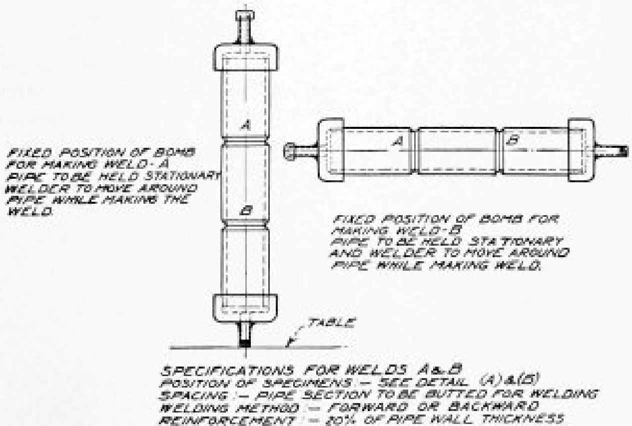


Fig. 8.—Specifications for pressure qualification test

The inspector melts out any defective spots with the blowpipe and returns the part to the operator for rewelding. Experience has shown this method to be rapid, accurate and economical.

Ductility is a desirable characteristic of weld metal. It may be measured simply and accurately by means of a special bend test.

Bend Test for Ductility—This test has the advantage of not requiring elaborate or expensive equipment and of this being available to even the smallest shop. All that is required is a vise, machinist's hammer and a flexible metal scale graduated preferably in hundredths of an inch. Test specimens are prepared by welding together two pieces of steel plate, usually 3/8 inch thick, with a single vee weld.

The plate is next cut into coupons about 1 inch or 1½ inch wide by 5 or 6 inches long.

These test coupons are first prepared by grinding or machining down the weld, especially if it has been reinforced, then laying off the weld and adjoining metal very carefully, using center punch marks. These may be spaced ¼ inch as shown in Fig. 9.

The sample is next placed in an ordinary machinist's vise, the jaws of which should come about 1 inch from the punch mark, and is struck with a hammer and bent over at an angle of about 10 degrees. The coupon is then reversed and the opposite end is bent in the same direction. It is best not to get the jaws of the vise

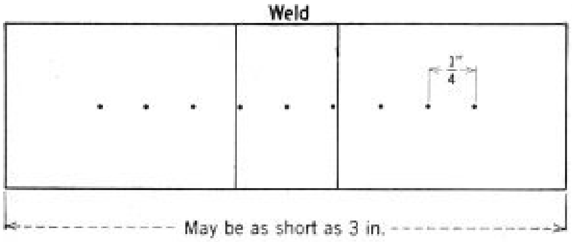


Fig. 9.—Specimen prepared for bend test

too far from the weld metal in this hammering test because the metal outside the weld will bend and the weld metal itself remain unaffected, thus making the test worthless. It is always necessary for the greatest part of the bending to come in the weld metal itself. The coupon is then bent in the vise, as shown in Fig. 10. This allows the bend to occur freely, which is essential for accurate and consistent results. In case the vise does not extend enough to take the coupon endwise in its jaws, the coupon can be placed between the two jaw shanks to start. If the

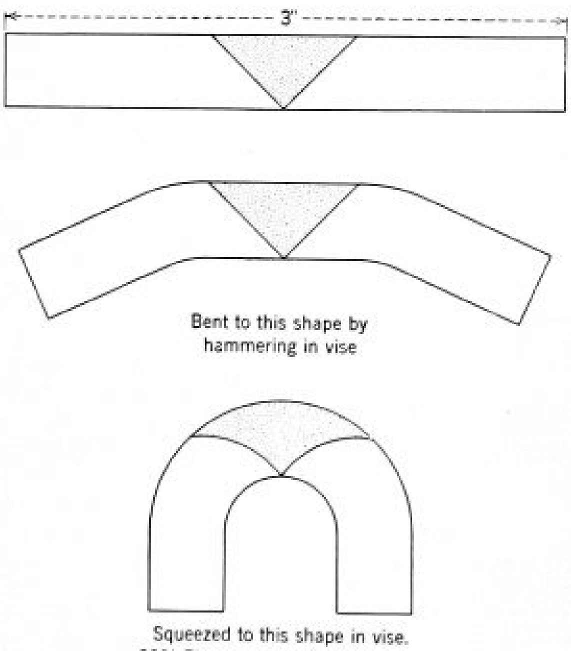


Fig. 10.—How bend test produces elongation

coupon does not start to bend immediately, a good plan is to exert additional pressure by means of a length of pipe slipped over the vise handle to give extra leverage.

As soon as the first crack in the weld metal is observed, the bending is stopped and the distance between the punch marks measured with a flexible steel scale reading to hundredths of an inch. When the original distance between the marks is 1 inch, the percent of elongation is identical with the number of hundredths of an inch in excess of 1 inch in the final measurement. Thus, if the first measurement between the points was 1 inch, and the final measurement was 1.17 inch, the elongation was 0.17 inch, or 17 percent. Results are shown in Fig. 6.

Careful measuring of elongation by the new method will show exactly the amount of ductility in the weld metal. Cracks should appear first in the weld metal of a specimen in which the base metal and the weld metal have been properly fused, and the coupon correctly prepared for the bending test as in Fig. 10.

For purposes of comparison, and to judge the ability

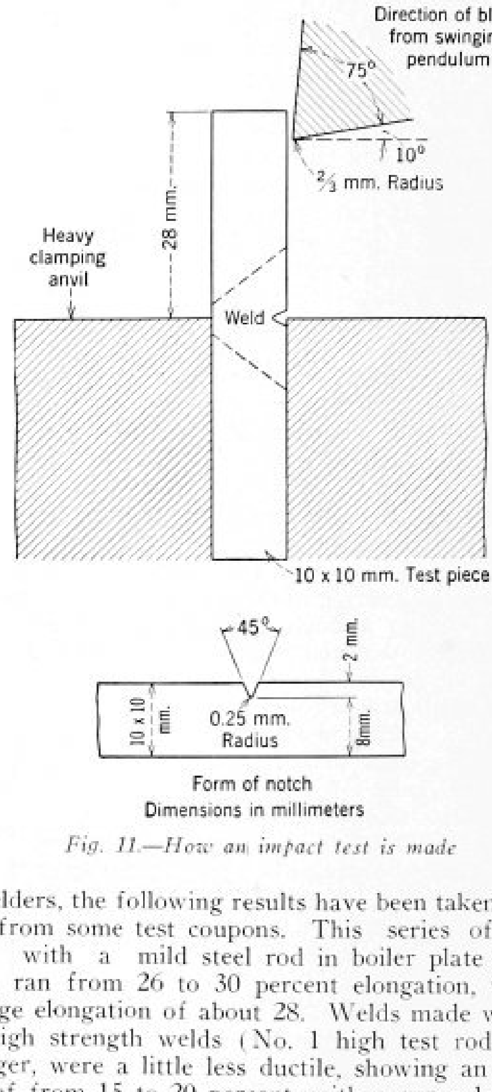


Fig. 11.—How an impact test is made

of welders, the following results have been taken at random from some test coupons. This series of welds, made with a mild steel rod in boiler plate ⅜ inch thick, ran from 26 to 30 percent elongation, with an average elongation of about 28. Welds made with rod for high strength welds (No. 1 high test rod) while stronger, were a little less ductile, showing an elongation of from 15 to 20 percent, with a general average of about 15. These welds were the ordinary run of good welders' work and can be considered of high standard as to ductility. In larger shops where periodic testing by the bend test is done, a further check may be made by a use of what is known as the bend test extensometer. This consists of a very sensitive micrometer gage, with two fixed points, one inch apart, and a center movable point which registers in percentage directly on the dial.

For certain purposes it is occasionally desirable to determine other properties of weld metal. Most of these tests are specialized and require laboratory facilities.

Resistance to impact or shock is a valuable property for certain applications, such as the welds made in double-length pipe which is subjected to considerable handling before it reaches the line. The standard Izod impact test consists of fracturing the projecting end of a notched specimen by striking with a swinging pendulum. Striking with the pendulum produces fracture with one blow under cantilever action. The energy in foot-pounds absorbed in producing fracture is taken as a measure of the resistance of the metal to fracture when subjected to shock, Fig. 11.

It may also be desirable at times to determine the behavior of weld metal under conditions that may produce fatigue or the resistance of the weld to corrosion. Standard tests for this are also available.

It is obviously impossible to determine the ultimate strength of the welds in every finished assembly, as this would involve destruction of the part tested. An occasional assembly may be tested to destruction particularly during experimental work in modifying or improving designs but the bulk of production must be tested by methods that do not impose stresses above the yield point.

At times, however, finished assemblies are subjected to most convincing tests accidentally after being placed in service. Such tests prove the worth of welds made and tested under procedure control.

The entire subject of testing welds offers unlimited opportunity for study and research. The welding industry is looking forward to a simple non-destructive method for testing various types of welds. Magnetic, X-ray, stethoscopic and other methods are all being carefully studied.

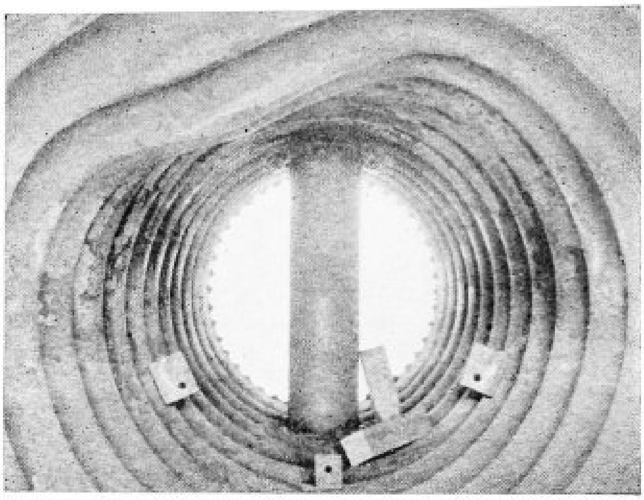
However, through the application of procedure control, splendid results are being obtained with the test methods now available as outlined above. Several years' experience in many fields has shown that welds of uniformly high quality can be produced consistently by welders who are properly qualified and given periodic tests and who are properly supervised in accordance with procedure control principles.

Oil Is Poor Medicine for Boiler Scale

AMONG various "dopes" that have been tried as boiler scale preventative, oil probably holds the record for causing the most damage. As a general rule engineers know the effect of oil inside a boiler and are careful to guard against even the small quantities in condensate from engines and turbines. Yet once in awhile when an inspector encounters a bulged sheet he finds that the operator has given the boiler a dose of oil to combat scale. Where and when such a practice originated no one can say. Even though warnings have been issued repeatedly, it seems that a few operators of small plants still do not know that oil is poison and not medicine when placed inside a boiler.

The illustration shows a corrugated flue furnace in a boiler that had been "oiled." Some well-meaning but misinformed friend told the operator that a pailful of cylinder oil would end his trouble with scale. As a result the flue overheated and bulged inward.

Cases where oil is deliberately fed into a boiler are not numerous enough to cause great concern. Usually when oil is present it is there quite by accident and by no design of the operator. One such case was discovered recently at a plant using steam coils to heat a tank of oil. When the boiler was examined the inspector found crown and firebox sheets bulged so badly they were in danger of collapse. Oil had entered the return line through a leak in the heating coils and had gradually accumulated until it comprised about 15 percent of the solution in the boiler. As none of



Bag in corrugated furnace caused by oil in the feed water

the steam was used in engines, the operator did not think it worth while to investigate the cause of the boiler priming. It was evident to the inspector that no one at the plant appreciated the danger of the condition.

Metal could not endure contact with the intense furnace heat were it not for the cooling effect of water inside the boiler. This cooling effect is dependent on the free, rapid transfer of heat from metal to water and when either poor circulation or some mechanical barrier such as scale or oil retards this heat flow the metal may be burned or softened to such an extent that it will collapse.

Oil is a better insulator than scale. Even a thin skin of oil resists the passage of heat so efficiently that wherever it forms the metal is almost certain to be damaged.—*The Locomotive.*

Milburn Contest

THE Alexander Milburn Company, 1416 West Baltimore street, Baltimore, Md., has announced a contest to be conducted during the years 1930, 1931 and 1932 for the development of systems or methods to use illuminating or city gas in place of the expensive manufactured gases now used generally for cutting and welding purposes. This company has offered prizes aggregating $3000 to further the development of such apparatus. These will be divided into three offers of $1000 for the years mentioned above for the best authenticated results accomplished with illuminating or by-product gases tending to lower the costs of present methods.

It is estimated that the cost of acetylene is about $3 per 100 cubic feet while that of illuminating gas is 7 cents per 100 cubic feet. These figures give some idea of the savings available by the use of illuminating gas when it is realized that approximately 1,000,000,000 cubic feet of acetylene is used annually. Further information in regard to the contest may be obtained from the Alexander Milburn Company.

Locomotive Boiler Construction—XV

Applying the backhead and firebox to the locomotive boiler assemblage—Narrow firebox application

By W. E. Joynes*

BEFORE applying the backhead for riveting in place, the scale and burrs are ground from the inside surface of the casing for the backhead fit. The lifting chain is hooked below the center of gravity of the backhead sheet, to permit the top flange of the sheet to tip to the correct angle for entering the casing when moved slowly to the same.

If the sheet has the gusset type of bracing applied, the location of the hook should be near the top of the sheet.

The gusset plates are bolted to the brace angles, which have been riveted to the backhead, on the floor and the ends of the bolts slightly hammered over and nicked with a center punch to prevent turning.

Drift pins are first driven in the rivet holes for drawing the sheet in place, after which the sheet is rigidly bolted and the holes reamed for riveting.

On combustion chamber boilers the drilling of the staybolt holes in the front flange of the throat sheet and the top half of the ring and casing seam is also done at this time. The seams of the throat sheet and shell are chipped where necessary, and calked on the inside and outside of the shell.

The rivets in the backhead and casing seam and the gusset plates have a steeple head formed on the outside with a pneumatic hand hammer and backed up with a holding-on hammer on the inside, which retains the manufactured cone-shaped head of the rivet at this end. These rivets are usually tested on the outside of the boiler.

Following these operations the boiler is rolled on its back, with cable operated by traveling crane, for calking the top part of the ring to the casing seam and for gaging the length between pins, of the longitudinal rod type of bracing.

The boiler is raised as its now lies, with back down, and carried to the pneumatic bull-riveting section. Here the firebox is applied.

When the design of the boiler is such that the firebox can be pinned to the firebox ring before being lowered into the outside shell, this procedure facilitates the work. When the fire-door opening flange is of the butt-welded design the firebox can usually be applied with the ring attached.

This procedure cannot be followed if the door-hole flanges are of the lap-welded or lap-riveted design.

When the firebox, with ring attached, has been lowered to the top of the firebox ring, pinch bars are then used for working the ring inside of the outside shell. Drift pins are applied in the shell and firebox-ring holes as soon as these holes come sufficiently in line to permit pins to enter, after which bolts are applied in the firebox-tack holes.

The waterspace at the firebox sides and the bottom of the combustion chamber is next measured and drawn to the correct waterspace dimension with an application of bolts.

As all of the firebox-ring rivet holes are now in the casing, ring and outside flanged sheets, these holes are next drilled through the inside sheets which only have tack holes as described in the layout work for these sheets.

The corners of the firebox and outside shell are next heated with an oil-burner torch and laid up tight to the firebox ring, after which the rivets in the sides, front and back of the ring are driven with the pneumatic bull riveter.

Holes for the screw rivets which are applied in the corners are located on the flanged sheets from the center punch lines on the bottom of the ring indicating the location of these rivets. The holes are drilled, tapped and the rivets applied with an air or electric-drilling machine.

The excess stock on the bottom of the flanged sheets is now trimmed off flush with the bottom of the ring and then chipped with a pneumatic gun to the boiler drawing dimension, above the bottom of the ring, after which the side and flanged sheets are calked against the ring. The firebox-ring rivets are also calked at this time which completes the assemblage of the outside shell and firebox and all of the boiler riveting.

When applying a combustion chamber firebox, the lifting hooks are attached in back of the center of gravity to allow the combustion chamber to tip down to enter the shell course.

The firebox of a narrow firebox boiler is applied in the back end of the casing before the backhead is riveted in place.

(To be concluded)

* Boiler designing department, American Locomotive Works, Schenectady, N. Y.

World's Largest Boiler Drums

AN order for the largest hollow forged steel boiler drums in the world has just been placed with a Sheffield, England, steel manufacturing concern by Babcock & Wilcox, Ltd. These boilers are intended for the new works of the Ford Motor Company at Dagenham, Essex. The drums which will be hollow forged from ingots each weighing about 165 tons, will be 45 feet in length, of 4 feet internal diameter, and with walls 5 inches in thickness. When complete they will be hydraulically tested to 2100 pounds per square inch.

Substantial contracts have also been placed in Sheffield for high-pressure boiler drums for the new super-power stations at Battersea and Liverpool, England.

The manufacture of hollow forged steel drums has lately increased so largely in Sheffield that it is now one of the city's important industries. The reaction chambers for the Anglo-Persian Oil Company, 16 of which have been ordered, are large hollow steel forgings made from high-grade steel, about 2800 tons of which will be required in their manufacture. They will be about 45 feet long and 5 feet in diameter, with 4-inch solid steel walls. The weight of the ingot required for making each chamber is nearly 180 tons, the completed forging will weigh 96 tons.

National Board Meeting

Further discussions of A.S.M.E. Boiler Code revisions by boiler inspectors

FOLLOWING is an outline of the discussions which occurred at the final session of the National Board of Boiler and Pressure Vessel Inspectors' annual meeting, previous instalments of the proceedings having appeared in the last three issues. Further special addresses delivered at the meeting will be published from time to time.

On Thursday the sessions were devoted to the discussion of executive affairs and was opened by the continuation of A. S. M. E. Boiler Code matters.

C. W. OBERT: The next subject is the matter of *"Standard Practice for Making Hydrostatic Tests."*

Par. P-247 provides for a hydrostatic test to destruction of any boiler or pressure part that cannot be calculated with a reasonable degree of accuracy, the test to be conducted in a manner prescribed by the Boiler Code Committee and in the presence of one or more representatives arranged to witness such tests. This provision has caused the committee a great deal of annoyance and expense, and for the past five years it has had under consideration a set of rules that would eliminate some of these difficulties. The result has been the adoption of a Standard Practice of Hydrostatic Testing of Boiler Pressure Parts which will be published in the Appendix to the Code, and Par. P-247 has been ordered to be revised so as to make the proper reference thereto. This change in the procedure will undoubtedly render it much more simple for any manufacturer to conduct his own tests, preferably in the presence of an inspector or some inspection agency, whereupon the results can be submitted for authorization as to suitable working pressure conditions. The text of this standard practice has already been submitted to you.

Tolerance for Ellipsoidal Heads: Since provisions have been made in the Code for the use of elliptical heads, the question of tolerances or departures from the true elliptical form, for such heads, has been raised by certain manufacturers. The committee has accordingly conferred with the various manufacturers of such heads, whereby the conclusion was reached jointly that a standard measurement be decided upon for this purpose. This measurement involves the use of a true semi-elliptical templet which is to be inserted inside of the head where it must not clear the center of the head or any part of the knuckle by more than 1¼ percent of the inside diameter of the head.

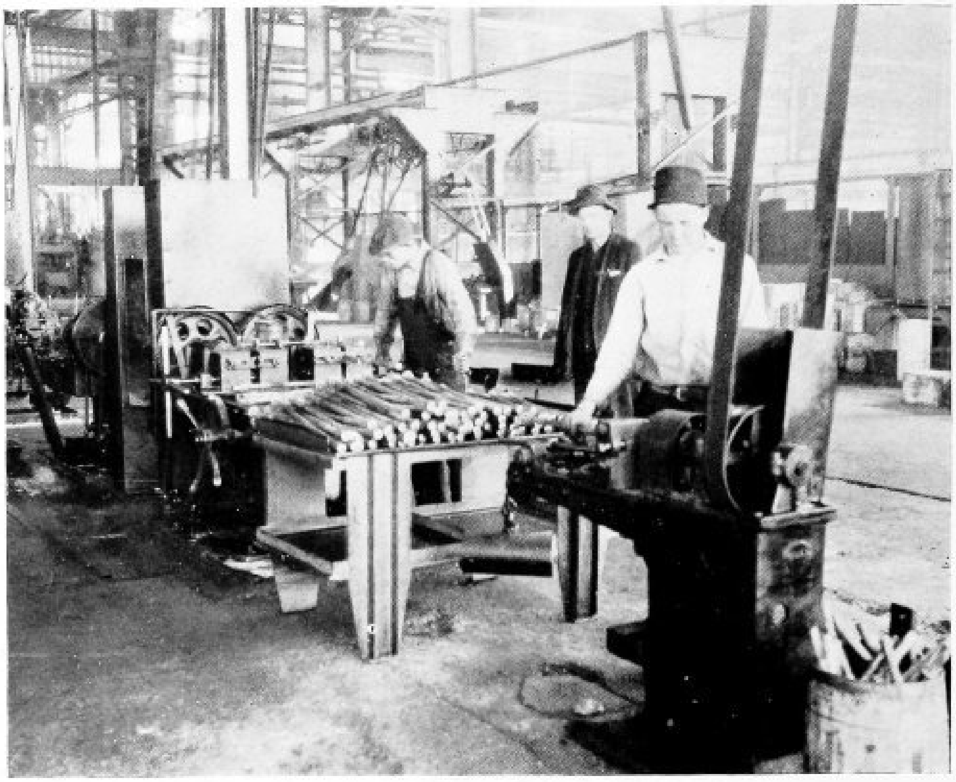
Inspection of Unfired Pressure Vessels: Recommendation has been made to the Boiler Code Committee that the Unfired Pressure Vessel Code be revised to call for more than one inspection (during the hydrostatic test) as is now required. It is claimed that the absence of any inspection requirement before the vessel is fabricated, permits the tank manufacturers who are careless or indifferent, to let defective work by without difficulty. The Boiler Code Committee is hesitant to act upon this matter until it learns of the desires of your organization, whereupon it will undoubtedly be called upon to act.

Flat Heads: Rules have been under consideration for several months for the calculation of flat heads that may be bolted or riveted rigidly to the ends thereof. It appears that such construction is considerably used in connection with autoclaves, heaters, electric boilers, and other corresponding apparatus where access to the interior is necessary. These rules are not as yet ready but if any problem arises, you may readily obtain information thereon by communicating with the Boiler Code Committee office.

Revision of the Unfired Pressure Vessel Code: It may interest you to learn that after many years of study and investigation, the rules for welded pressure vessels in the Unfired Pressure Vessel Code are about to be revised. This action on the part of the Boiler Code Committee is the result of the completion of a recommended procedure that was recently submitted by the American Welding Society with its complete backing and endorsement. The function of this procedure is to provide suitable rules and means for insuring good welding in the fabrication of the vessel, and it has been proposed to make liberal revisions in the welding rules in this section of the Code under the proviso that the procedure is followed. If the procedure is not followed, the existing requirements for welded vessels will, of course, remain in effect.

CHAIRMAN THOMAS: Are there any comments upon the different subjects? I might say, gentlemen, and I do not know how you feel about it, but it seems to me that one of the most important subjects spoken of is that of the revision of the Unfired Pressure Vessel Code. Now, under the present code it is impossible for any manufacturer to follow it, and make a welded vessel that can be used for any purpose. We know very few small vessels, welded vessels, or other types of small vessels, which are not operating at a greater pressure than 100 pounds, the present limits of the Code. The State of Oregon is violating the Code in permitting a pressure of 200 pounds. The State of California is violating the Code by increasing the size of the vessel and allowing a pressure of 200 pounds, and I doubt very much but what every state that is trying to supervise pressure vessels is operating in violation the regulations of the Code, and it is only a matter of time, unless we have a specific code from the A. S. M. E. Code Committee, that every state will have to promulgate rules of its own, and will face the same situation that we did with the Boiler Regulations prior to the adoption of the A. S. M. E. Code.

My impression is that even though the Code Committee cannot lay down hard and fast rules to govern us for the next two or three years, they could at least revise the rules, based upon the tests that have been made, so as to permit us to go ahead and manufacture tanks and stamp them with the Code Symbol, which will be the authorized stamping after the first of July, rather than to compel us to keep on operating with our irregular rules.



Rounding the points and cutting the heads of crown staybolts

Fabricating Staybolts

Methods and equipment employed in the staybolt machine shop of The Baldwin Locomotive Works

THE boiler shop layout of the Baldwin locomotive Works, Eddystone, Pa., provides for a definite and uninterrupted flow of materials through the entire building. The passage of raw material, fabricated parts, and assemblies in one direction, permits the employment of production methods with the greatest economy and the least transportation of material. While the flow of material moves from right to left from bay No. 13 towards bay No. 1, the minor flow in each bay moves toward panel 9, where the shop track carries the major flow through the bays. Located in the lower sections of bays Nos. 3 and 4 where the resulting products may be fed to the finished floor in the upper section of those bays, is the staybolt shop. From this location, the material enters the active boiler assembly at the point where it is required, thereby eliminating lost motion and unnecessary transportation of material.

This department is divided into two sections covering both fabrication and storage. The machine shop is located in bay No. 4 and extends between panels 18 and 25, covering an area of 15,360 square feet, and the storeroom in bay No. 3 occupies 13,440 square feet between panels 18 and 24. A spur track enters the end of bay No. 4 in panel 25.

The equipment in the machine shop includes 53 power-driven machine tools specially adapted to the process of staybolt manufacture. Tote pans and an Elwell-Parker lift truck with 6 low and 4 high skids serve for transporting material in the department.

All types of staybolts are machined at the Baldwin works, their fabrication being completed on machines set up for each special process. Iron is generally employed for staybolt manufacture but foreign practice frequently specifies copper or bronze.

In the case of ordinary waterspace staybolts, the bar stock is received in panel 25 and placed in racks located in panel 24. In the latter panel is located a Hilles & Jones 1¼-inch bar shear in which the bar stock is cut to size with a ⅛-inch allowance for rounding.

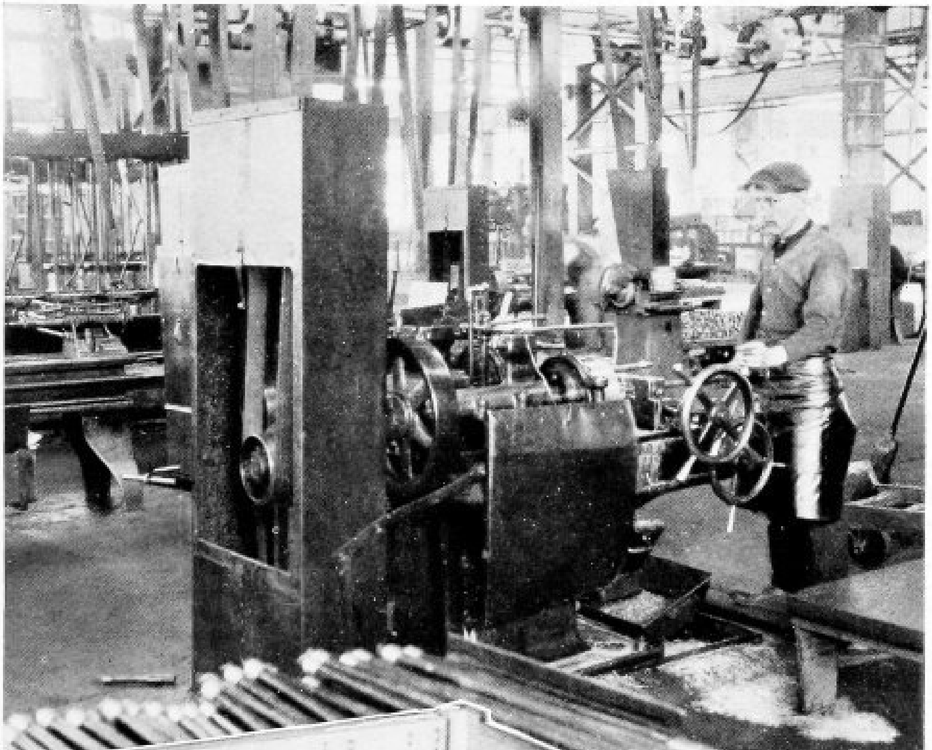
From this machine the cut bars are sent to one of two centering machines in panel 23 where the center is spotted on one or both ends, if specified.

Continuing in the line of progress, the stock next goes to one of the two 4-spindle drill presses in panel No. 23 where the telltale hole is drilled. This hole is 7/32 inch in diameter and is drilled to a depth of about 1¾ inches. The bars are held in the machine by means of a chuck, which holds work vertical and the telltale hole is drilled, the depth being estimated by the position of the drill in the work. After drilling, the finished work is dropped from the machine when the screw in the chuck is loosened. The bolts or bars are then collected in tote pans and moved along the line to one of two squaring machines in panel 22.

The two squaring presses were manufactured by the Ferracute Machine Company, Bridgeton, N. J., and the larger machine has a speed of 36 strokes per minute. The jaws of the press are fitted with 90-degree V-shaped dies which shape the bar stock to the required dimensions for the assembling wrench. The length of square on the staybolts is limited to ¾ or ⅞ inch and this is maintained by the insertion of a small piece of bar stock in the jaws of the press at the proper distance from the face of the jaws.

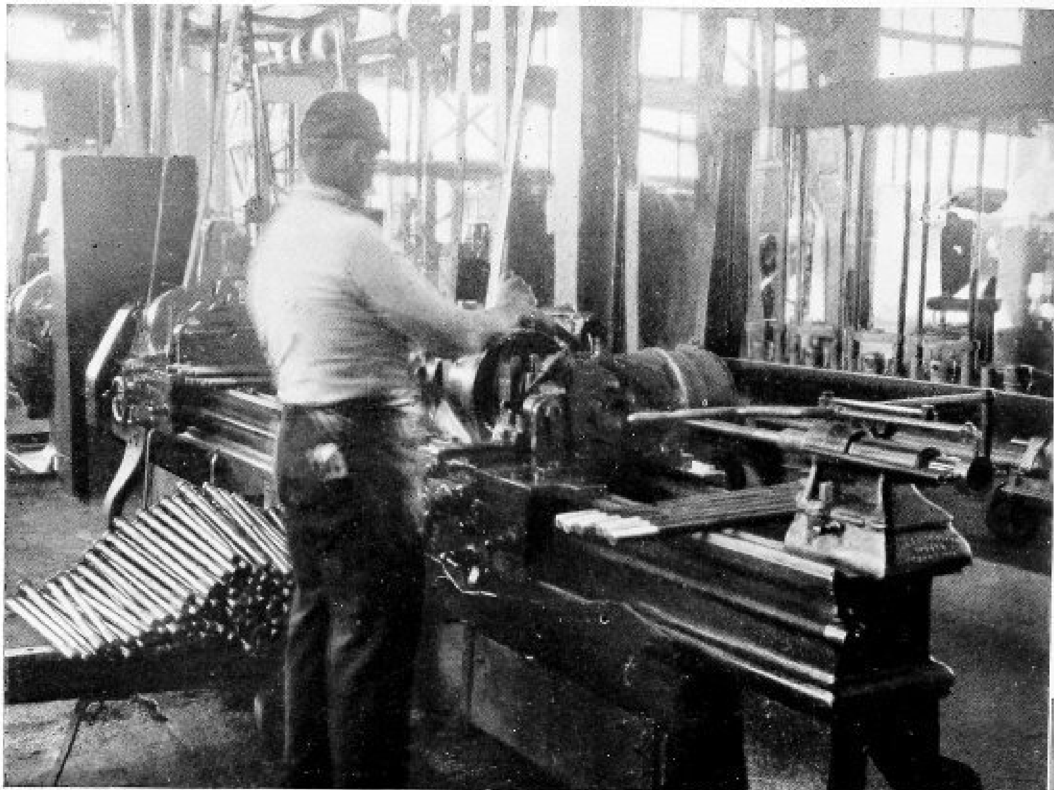
After the staybolt has been squared, the opposite end of the stock is rounded in a Pratt & Whitney double rounder located in panel 22. This machine has two horizontal spindles, the cutter being mounted in the rotating head. A carriage shaped to take the square end of the bolt may be moved forward and back by means of a foot pedal. This forces the stay into the rotating head and the end of the bolt is given a curvature of 1-inch radius.

Two new Landis machines thread the staybolts after the bolt is rounded. These machines, manufactured by the Landis Machine Company, Waynesboro, Pa., are



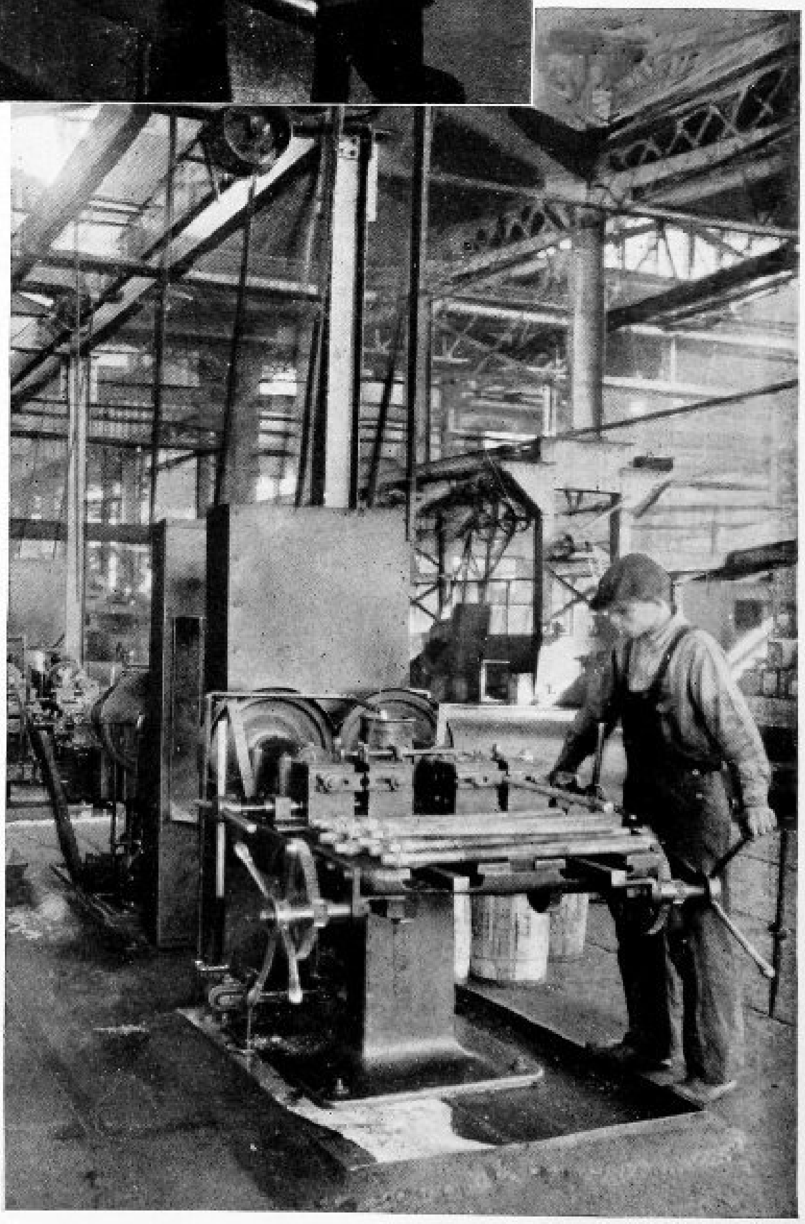
Threading the points of crown staybolts

(Below)—General view of staybolt shop



Threading the taper and cutting head grooves in crown staybolts

(Below) — Roughing out the crown staybolt taper head

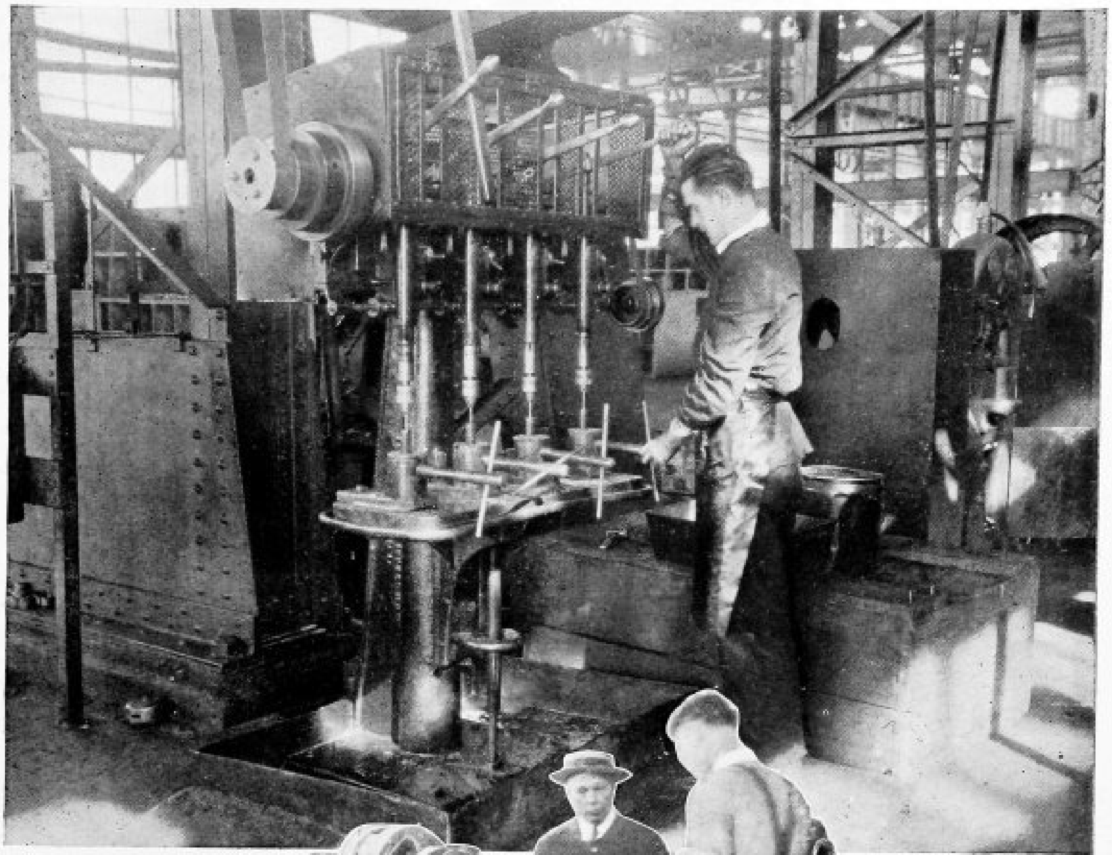


motor-driven, self-contained with lead screw and automatic cut-off. Each machine has two spindles and the two machines are run by one operator. These machines run at a maximum speed of 137 revolutions per minute and now handle the work formerly done on the six-spindle special machine. In these machines, the staybolts are threaded the entire length, four at a time.

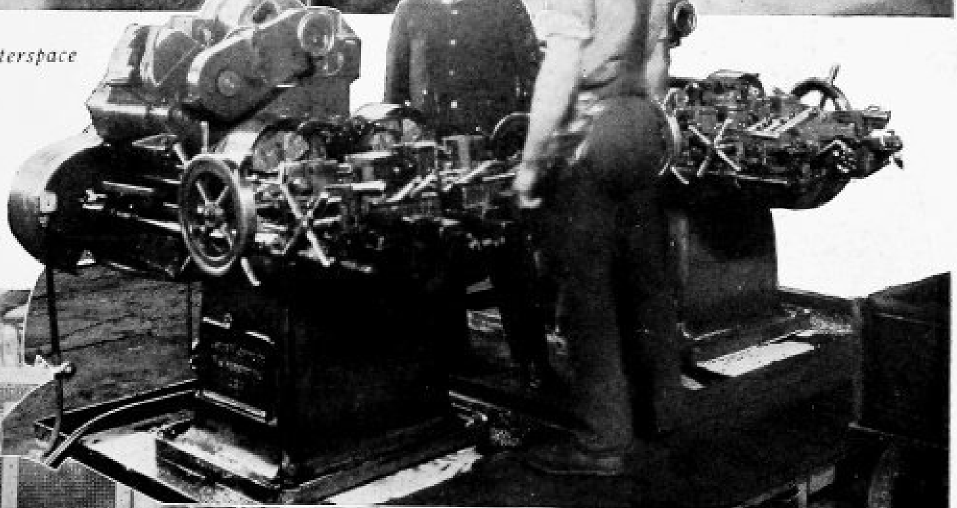
The final operation on waterspace staybolts before shipping them to the storeroom, is the turning down of the middle portion of the bolt. This work is done in one of four staybolt-cutting machines located in panel 19. In the revolving head of the machine is a set of jaws to take the square head of the staybolt. Into this the staybolt is fitted and given a rotary motion. The carriage is moved toward the head until a stop limits the travel thus gaging the depth of threaded length at the bolt head. A lever on the carriage allows a threaded portion on the carriage to engage with the bolt thread. This gives the carriage an outward movement. A 5/8-inch width cutter fitted in the carriage cuts the middle portion of the bolt to the proper depth and its travel is caused by that of the carriage. The length of thread at the end of the bolt is judged by marks on the carriage.

The waterspace staybolts are then taken to the storeroom where they are stored in bins according to size.

Hollow staybolts are fabricated similar to waterspace staybolts except that the bar stock is received with a 7/32-inch hole drilled the entire length and the first



Drilling the telltale hole in waterspace staybolts



(Right)—Threading the waterspace staybolts

(Below)—Rounding the ends of waterspace staybolts

centering and telltale hole-drilling operations are omitted. These stays, as the ordinary and waterspace stays, may be supplied with or without the reduced center area, whichever may be specified.

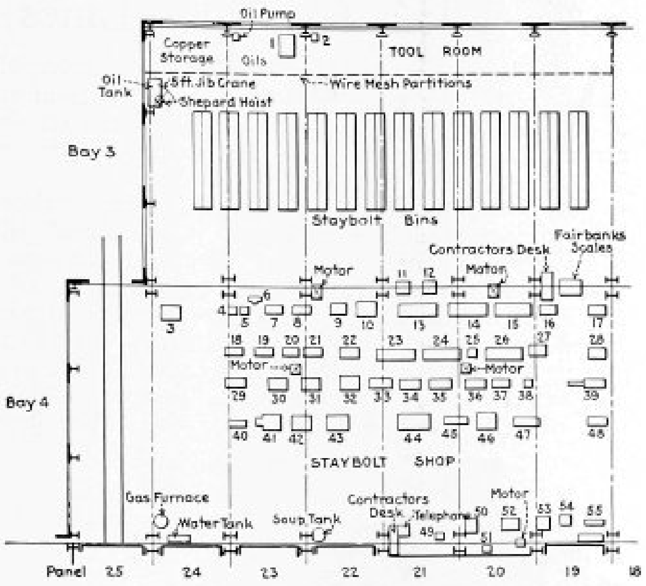
Radial staybolts of the buttonhead type or staybolts with oil-burning type heads are fabricated in a similar manner. The buttonhead type is generally made with a taper of 3/4 inch in 12 inches in the threaded portion under the head. The oil-burning head has a taper of 1 1/2 inches in 12 inches in the screw head. In some cases, however, a straight-threaded radial staybolt is used without a taper at the head.

The bar stock for radial staybolts is received in panel 24 of this department as a forging, this having been made in the black-

(Above)—Machine set up for threading flexible staybolts

(Left)—Weighing the department's output

(Below)—Crated flexible staybolts as received from the manufacturer



Machinery Located in the Staybolt Shop and Tool Room

1—Brown & Sharp No. 2—30-inch universal grinder, motor on steel work overhead, belt drive.
2—Willey 12-inch, double emery wheel, motor on machine, direct drive.
3—Hilles & Jones 1¼-inch bar shear, motor on machine, belt drive.
4—Harrington centering machine, belt drive from line shaft.
5—Baldwin ⅝ to 1¾-inch centering machine, belt drive from line shaft.
6—Baldwin double emery wheel, belt drive from line shaft.
7—Harrington 4-spindle drill press, belt drive from line shaft.
8—Harrington 4-spindle multiple drill, belt drive from line shaft.
9—Ferracute Machine Company special squaring press, belt drive from line shaft.
10—Ferracute Machine Company special squaring press, belt drive from line shaft.
11—Landis double-spindle, staybolt threading machine, motor on machine, direct drive.
12—Landis double spindle, staybolt threading machine, motor on machine, direct drive.
13—Harrington 6-spindle staybolt threader, belt drive from line shaft.
14—Harrington 6-spindle staybolt threader, belt drive from line shaft.
15—Baldwin 6-spindle staybolt threader, belt drive from line shaft.
16—Bement-Miles double staybolt cutter, belt drive from line shaft.
17—Bement-Miles double staybolt cutter, belt drive from line shaft.
18—Harrington 4-spindle multiple drill, belt drive from line shaft.
19—Harrington 4-spindle multiple drill, belt drive from line shaft.
20—Harrington 4-spindle multiple drill, belt drive from line shaft.
21—Harrington 2-spindle multiple drill, belt drive from line shaft.
22—Pratt & Whitney ⅝ to 1¼-inch double rounder, belt drive from line shaft.
23—Harrington 6-spindle staybolt threader, belt drive from line shaft.
24—Harrington 6-spindle staybolt threader, belt drive from line shaft.
25—Baldwin 10-inch emery wheel, belt drive from line shaft.
26—Harrington 6-spindle staybolt threader, belt drive from line shaft.
27—Bement-Miles staybolt cutter, belt drive from line shaft.
28—Bement-Miles staybolt cutter, belt drive from line shaft.
29—Harrington 16-inch by 3-foot rounder, belt drive from line shaft.
30—Acme staybolt turner, belt drive from line shaft.
31—Acme 1½-inch double staybolt cutter, belt drive from line shaft.
32—Acme 1½-inch double staybolt cutter, belt drive from line shaft.
33—Harrington 16-inch crown-bolt lathe, belt drive from line shaft.
34—Harrington 16-inch by 30-inch crown-bolt lathe, belt drive from line shaft.
35—Harrington 19-inch crown-bolt lathe, belt drive from line shaft.
36—Harrington 16-inch by 36-inch crown-bolt lathe, belt drive from line shaft.
37—Acme single staybolt cutter, belt drive from line shaft.
38—Baldwin 8-inch emery wheel, belt drive from line shaft.
39—Warner-Swasey No. 6 turret lathe, motor on machine, direct drive.
40—Acme 1-inch rounder, belt drive from line shaft.
41—Acme 1½-inch staybolt turner, belt drive from line shaft.
42—Baldwin double staybolt cutter, belt drive from line shaft.
43—Acme double staybolt cutter, belt drive from line shaft.
44—Hartness (Jones & Lamson) 3-inch by 36-inch turret lathe, motor on machine, direct drive.
45—Lodge & Davis 16-inch lathe, belt drive from line shaft.
46—Acme 1½-inch double staybolt cutter, belt drive from line shaft.
47—Cregar 2-inch single staybolt cutter, belt drive from line shaft.
48—Cooper, Jones & Company forming lathe, motor on machine, direct drive.
49—Baldwin single staybolt saw, motor on building column, belt drive.
50—Hilles & Jones No. 0 staybolt shear, belt drive from line shaft.
51—J. G. Blount, 6-inch twist drill grinder, motor drive.
52—Baldwin double, circular staybolt saw, belt drive from line shaft.
53—Hendey shaper, belt drive from line shaft.
54—Landis chaser grinder, motor on machine, direct drive.
55—Bradford 16 by 72-inch lathe for radial staybolts, belt drive from line shaft.

smith shop located elsewhere in the plant. The bar is formed by heating and shaping the ends in upsetting machines. The head end is formed with a rough button or curved head, straight or tapered throat and a square lug. The other end has a straight upset for the length of the thread.

The first operation after receipt from the blacksmith shop is the rounding of the point. This is done in one of two rounders located in panel 23 and designated as Nos. 29 and 40 on the shop layout plan on this page. These machines are similar to that used for waterspace staybolts except that the bolt is gripped in the midlength by double-V clamps.

High skids are located between these machines and staybolt-turning machines located adjacent to the rounders in the same panel. These skids serve as a table on which the bolts are passed between one machine and another.

The staybolt cutters involved in the second operation are used for roughing. They are double-spindle machines fitted with a special-shaped cutter ground to the proper throat taper and underside of head. Stops are set on the machine to ensure the proper diameter of staybolt at the throat and to limit the travel of the cutter in way of the head. By this means production is increased, each machine being operated by one or two operators, each operating one spindle.

The bolts are transferred by skid to one of two special lathes located in panel 21. These lathes, developed by The Baldwin Locomotive Works, have a special die head attached to the carriage so that when the bolt is once in the lathe, it is not removed until all of the operations, turning, grooving and threading are completed. This method ensures the thread and groove being concentric with the turning, while the facing of the heads are always at right angles to the axis of the bolt.

These machines, similar to those used in roughing, finish under the head, cut grooves in the head or cut a recess in bolts when specified and thread taper ends at one setting. The head is fitted with a square hole to take the head of the staybolt. The bolt revolves and the underside of the head and the groove is first cut. The taper thread cutter, a group of four blades mounted in a fixed head, is allowed to move horizontally and is brought up to the work, the limit being set by stops.

Still moving toward the upper bay, the bolts are transferred to the double-headed staybolt cutters in panel 20 where the straight end of the staybolt is threaded. In these machines, the body of the bolt is gripped by means of a double-V clamp. The cutter is movable and located in the head, the clamp being on a carriage which is power fed toward the head, thus cutting the threads. Four Landis thread chasers of high-speed steel are used.

Flexible staybolts are received from the makers as a forged blank with the head rounded and a slot cut in the head. The work on this type of bolt consists of threading.

These bolts are first rounded at the point on any one of the rounding machines. In the machines generally used for radial staybolts a double-V grip is used to hold the bolts, but in machine No. 22 the vise grip is specially made with screwdriver head to hold the bolts. The process is otherwise the same as for other bolts. Threading is done on one of the double-head threaders, the piece being held in a double-V grip.

Brace rods, brace pins, stem rivets, patch bolts and fitting up bolts are fabricated in this department. Throat stays and slotted or pinned brace pins are machined on the Cooper, Jones & Company forming lathe, located in panel 19.

The Baldwin expansion staybolts, a three-piece assembly consisting of a regular radial staybolt, nut and shaped forging, are made in this bay. The forging referred to consists of a threaded rod and eye with a drilled hole for passing the staybolt. The forging hole is drilled and faced on a Warner-Swasey turret lathe located in panel 19 and the complete assembly is formed in this department.

With the exception of eight machines, all are driven by belts. The power is received from 5 line shafts raised about 14 feet above the floor of the bay and supported from a frame work of girders extending over the major portion of the bay. Five electric motors supply the line-shaft power.

A completely equipped tool room is located between panels 19 and 24 of bay No. 3. This room, having a width of over 14 feet, is separated from the main bay by a wire mesh partition and is divided into a tool room, oil room and copper storage.

Throughout the manufacture of staybolts, every effort is made to save time, labor and transportation. Production methods and specialization of labor enable The Baldwin Locomotive Works to obtain the maximum output at the maximum efficiency, consistent with the equipment available. Every effort is made to specialize the operation of each machine in order to eliminate the necessity of setting up the tools for each operation. Through these methods that characterize the operations of the entire boiler shop, staybolt manufacturing costs are reduced to a minimum.

Air Filter for Pipe Lines

A NEW type air filter for removing dust, water, oil, rust, scale and other foreign matter from air passing through pipes has been placed on the market by the Staynew Filter Corporation, Rochester, N. Y.

This filter consists of an aluminum housing, enclosed in a pressed steel housing which, it is claimed, will withstand a working pressure of 125 pounds per square inch. The filter which is mounted inside consists of a felt filter medium formed in pockets over radial wire screen fins grouped around a central outlet. This form permits mounting a relatively large area of felt in a compact space and allows the use of the entire available area of felt with a minimum restriction. The large capacity inserts are designed to pass 250 cubic feet of free air per minute and contain 20 square feet of felt within a volume slightly smaller than a cubic foot.

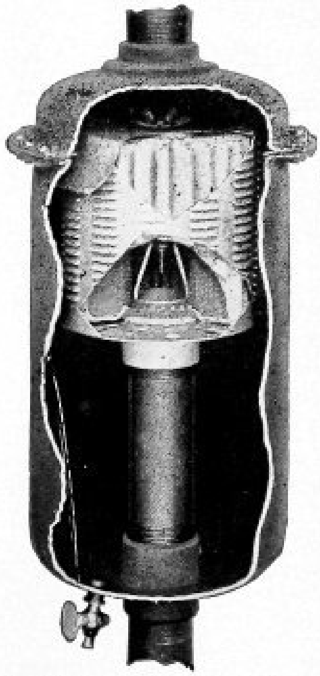


Fig. 1.—Sectional view of Staynew air filter

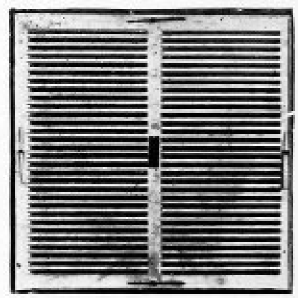


Fig. 2.—Panel filter unit

As air enters the top of the filter it is drawn against the inner wall of the steel housing by a shield over the top, the downward velocity carrying water, oil and most of the grit to the bottom of the shell. All remaining water, oil, dust and grit are caught by the filter. A drain cock is provided at the bottom to remove water, oil, etc.

By closing a valve to shut off the air going into the filter housing and opening the drain cock the air in the outlet pipes or hose is blown back through the filter proper, removing all material on the filter surface. In this way the filter can be cleaned in about 10 minutes while it is in operation. Under ordinary conditions, the filter requires cleaning only about twice a year.

A second type of filter made by this same company, which is used in filtering large volumes of air for ventilation, is shown in Fig. 2. This type, known as the panel filter, is supported in a heavy pressed steel frame capable of being mounted in any convenient formation to suit the space available for installation.

The panel consists of two pressed steel or aluminum frames which support a series of hollow fins or pockets formed of wire cloth and arranged in two rows. Each row of fins is covered with a single piece of an extremely fine texture filter material.

Methods of Finding Water Levels on Locomotives*

Best practice employed when applying a boiler to the frames or applying a new backhead

THE committee on finding water levels of the Master Boiler Makers' Association, has secured the methods used by some of the manufacturing plants, and also some of the railroads in finding water levels.

It is very evident in looking over the different methods that there seems to be one which is used almost universally and which is probably more positive.

1. *Method used by Pennsylvania Railroad.*—The practice is to first locate the boiler on the frames after which all holes for expansion plates and saddle bolts are drilled and bolts applied. The frames are then leveled up both lengthwise and crosswise, using a spirit level or straight edge to do the leveling crosswise, and a ½-inch gum hose with a round glass watertube in each end. The hose should be long enough to reach between the first and third or fourth drivers to level the frames lengthwise.

The same hose with the glass tubes in the ends and filled with water to locate the highest point of crown is used. This is done by one man going in the firebox and placing the end of the tube against the under side of the highest point of the crown. Water is added by the man on the outside locating the water level until it appears at the end of the tube against the crown sheet. After the level of the under side of crown is located, add the thickness of the crown to get the highest point.

2. *Method Used in Some of the Railroad Shops.*—The boiler, when placed in frame and cylinders, should be leveled with the facing of the cylinder. Then, after the boiler has been fastened in the frames, the spirit level should be used on the facing of the cylinder and set perfectly level. A long steel straight edge should be passed in through the fire door up against the back flue sheet, and blocked up until same is also found level.

Find the distance, then, from the top of the straight edge to the inside of the flange of the back flue sheet, allowing the thickness of the flange and crown sheet where the flange is on a flue sheet. Then have the man on the outside of the firebox at the back head, measure the same distance that was obtained at the front of the firebox at the tube sheet and mark on the back boiler head.

This will give you the high point of the crown sheet. Add to this the distance you wish to place the lower

Method used by
BALDWIN LOCOMOTIVE WORKS
Locating Gage Cocks and Water Columns

Fasten securely and watertight a piece of glass tubing, not less than 12 inches long and of as large a diameter as possible, in each end of a ½-inch rubber hose 20 feet long (hose having metallic wrapping preferred). The ends of the glass tubes should be ground a little uneven in order to allow water to leak out when tube is held against crown sheet.

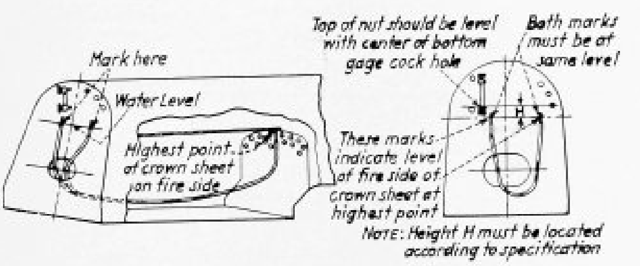
Fill hose with water and bring glass tubes side by side to observe water

Engine to be level longitudinally and laterally

level. If this is not the same, there is an air bubble or other obstruction in hose which should be removed.

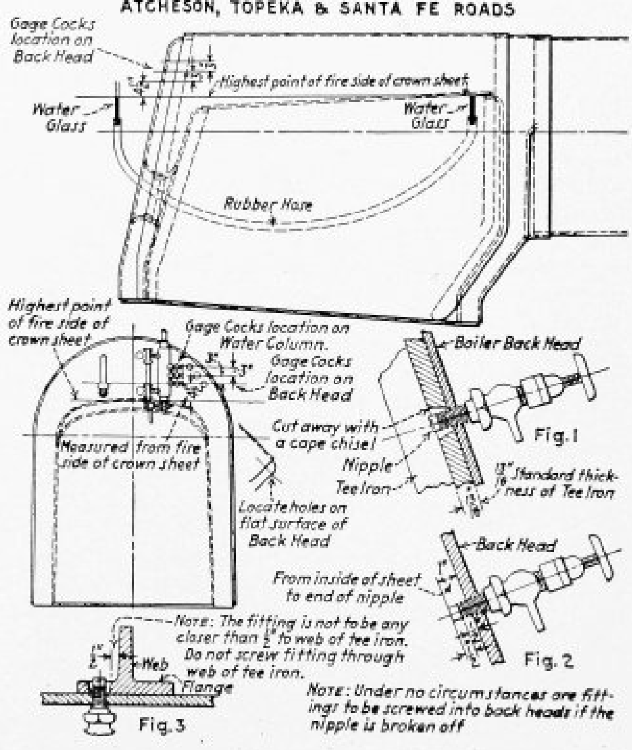
To level engine proceed as follows: With hose level points H and B, then points H and D and finally points C and D. Check by testing between points C and B, points A and C and points B and D.

To obtain height of crown sheet, place glass tube against crown and hold glass tube in other end of hose against back head and slowly raise



until water runs out of tube against crown. Hold quiet until water ceases to run out when level of water in tube in back head will show height of under side of crown, which should be marked on back head. Do this several times moving tube against crown to several positions to make sure highest point of crown has been used.

Method used by
ATCHESON, TOPEKA & SANTA FE ROADS



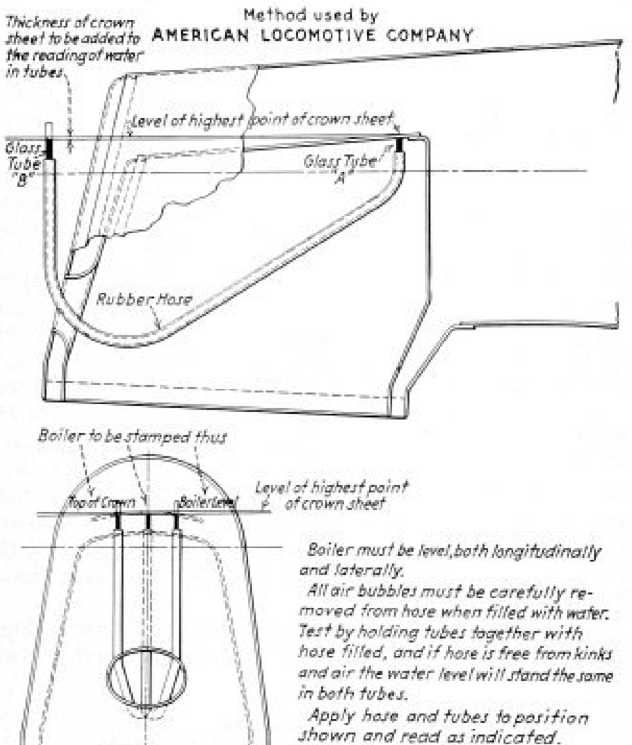
* Report presented at the twentieth annual convention of the Master Boiler Makers' Association, held at Atlanta, Ga., May 21 to 24,

gage cock over the high point of the crown sheet, which in most cases is 2½ inches to 3½ inches.

This report was prepared by a committee composed of L. C. Ruber, chairman, P. J. Conrath and L. E. Hart.

Discussion

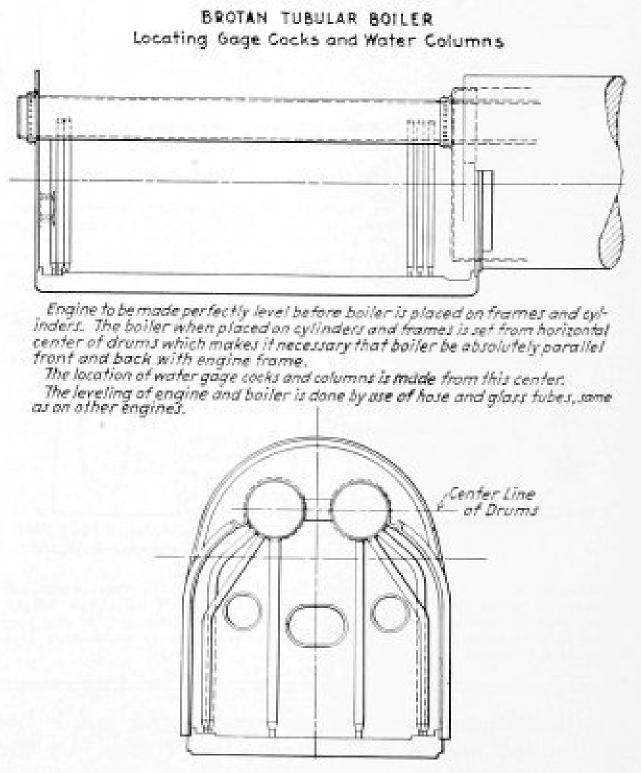
K. E. FOGERTY; (C. B. & Q): It is known by all the members of this association that the rubber hose is practically standard on all railroads of the country. However, I know of a railroad that used a piece of 1½-inch angle iron which is set on top of the crown sheet, then after the straight edge is placed on the side of the firebox, and leveled up and the measurements obtained,



they allow water to enter the boiler until it comes to the heighth of 4 inches. They get the level of the water in that manner while the railroad I am with uses the water glass and hose.

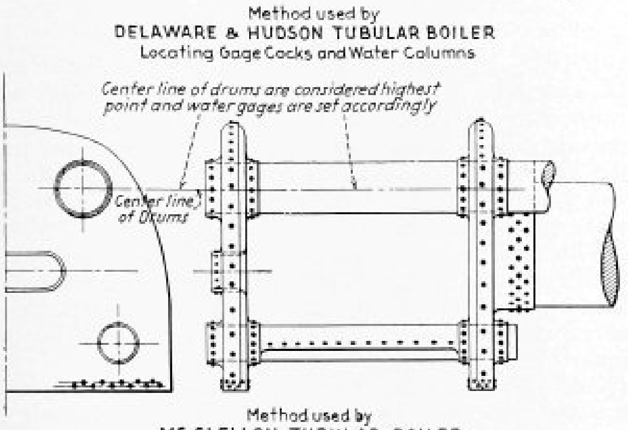
L. E. HART; (ATLANTIC COAST LINE): We have had quite a bit of correspondence on this question with the railroads and there were some points that we could not publish, but the practice that is most universal is as we reported. We have some reports where they would measure the actual water—drill a hole in the outside wrapper sheet and fill the boiler and find it by that method. Our method, as adopted by the railroads in the southeast, is by the water and hose method. I think we have the gentleman here who measures the actual water line. We have a number of railroads who have found different water levels in different shops by the same method. I know of some railroads that level their engines by the facing of the domes. If that is correct, you will find different measurements when you put in use a water hose or get it with a straight edge through the firebox door opening.

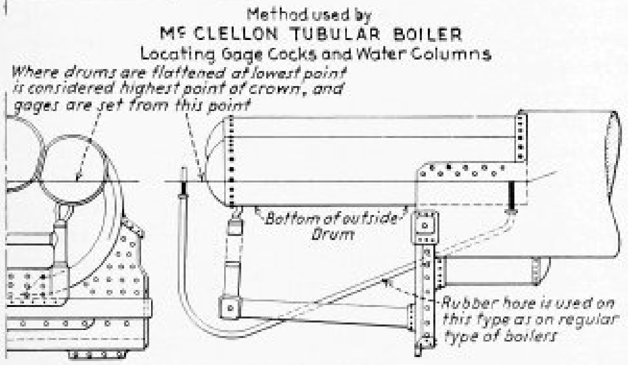
MR. WILSON (INTERSTATE COMMERCE COMMISSION): No one has mentioned about getting the bubble out of the hose before trying to measure the height of the crown sheet. Now, I have had a good deal of experience in measuring the height of crown sheets, especially on accidents that I have had to investigate. Many times, after the hose has been filled, when the men are moving it up and down there will be a bubble rise out of it. Now, you cannot get the proper height of the crown sheet if you have an air pocket in the hose. Another thing that they have not mentioned is water on some of our hill railroads. Now, we have had to investigate accidents caused from low water where the men operating on a hill railroad would have as much as 1 inch of water in the water glass and still the forward portion of the crown sheet would be bare of water. That has happened in several cases. Today we have large fireboxes, and in the district where I am located we have crown sheets that are 14 feet long. When you operate these long crown sheets on hill roads, especially when you get to hills that are as much as 2¼ and 2½ percent, the front end of the crown sheet rises a long way. Now, you turn out that locomotive to a crew to operate and they figure that you are giving it to them in the proper condition. The engineer figures if he has water in the water glass, that he has water over the top of the crown sheet. This has not been the case in several accidents that I have investigated myself. The methods of getting the water level are all right insofar as I can see, but be careful, if any of you have hill roads to operate be sure that you have some device or some method of letting your engine crew know what is happening when the engine is on a grade, because if you do not some time you are liable to get into trouble.



W. H. LAUGHRIDGE (HOCKING VALLEY): Mr. Wilson's point about taking care of the hose was in my mind. That is very easily remedied and the committee meant all right, but they failed to say anything about how you would prepare the hose. As Mr. Wilson says, a bubble in the hose will make a false registry. Now, while it is almost a universal practice to use the hose and glass, I believe that the best system for getting the water level is to take the hose and run water through it until we know it has been wet all the way through. It is dangerous to use new hose because it would take half an hour to get the bubbles out. Just lay it down and run water through it for a little while and then fill it and keep pouring a little water into the other end and keep it running out and work the hose a little bit until there are no bubbles. In that way you will get a correct registry. I believe the hose is the best system of getting the water level.

L. C. RUBER; (BALDWIN LOCOMOTIVE WORKS): I just want to correct a statement that was made by the





I. C. C. Inspector, Mr. Wilson. I think if he will read the report of the committee over carefully he will find that the questions of air bubbles and hose have been taken care of and called to the attention of the members of the association. Now, if you had had the privilege of reading the reports that we got from the different members of the association, you would have seen that the instructions that have been issued by superintendents of motive power are such that no one can go astray. Now, it does not only apply to the hose and the locating of the water glasses, etc., but it also takes care of the trouble which we spoke about. In fact, I think if the instructions were fully followed, there would be no excuse for any mistakes of any kind because instructions are complete in every case.

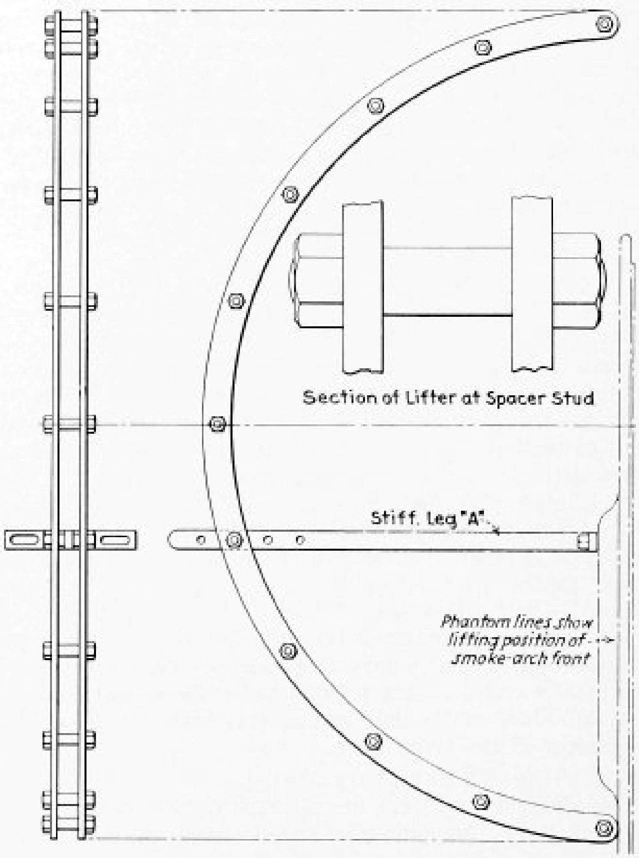
Offset Lifting Hook for Boiler Fronts

By F. H. Lewis

WITH certain classes of locomotive appliances being attached to the front plates of the smoke arches of locomotives, the application of the removable section of the smoke arch ring becomes a tedious and laborious job. The plate has to be lifted vertically to the proper height and then moved horizontally into place by means of long pulling studs or other devices.

To enable these front end door rings to be applied with a direct crane lift, the lifter shown in the sketch was devised by the writer. As will be seen on the drawing, the device consists essentially of a pair of ½-inch by 3-inch bars bent into semicircular form and spaced about 2½ inches apart from each other by ¾-inch studs with pipe-spool spacer washers. A "stiff leg" (A) is mounted between the hook bars and hinges upon one of the spacer studs, or upon an extra stud inserted for this purpose. This stiff leg is made of two ½-inch by 2½-inch bars welded or riveted together and has the outer swinging ends of the bars bent at right angles to "run" of the bars as shown. These bent portions of the bars are provided with slotted holes to serve as attachment footings for the work to be handled.

The phantom lines on the drawing show the lifting position of a front end ring with the attachment feet of the stiff leg bolted or studded to the ring to provide the hoisting grip on the work. It will be noticed that all space *above* the door ring up to the hook bars is clear to



Boiler front lifter of simple design

enable the lifter to be passed over piping, brackets, heaters, or other obstructions on the locomotive arch.

While this device is used principally for the application and removal of smoke arch plates as described, it is to be noted that it serves equally well in applying side sheet patches under running boards, backhead patches around bracket obstructions, tank sheets around temporary stagings, etc.

On its principal job, namely—the application of front end rings, the lifter has effected a saving of about one hour per ring with proportionate time savings on several other operations.

Revisions and Addenda to the A. S. M. E. Boiler Code

Changes in the requirements for the design of longitudinal and circumferential joints in boilers

IT IS THE policy of the Boiler Code Committee of The American Society of Mechanical Engineers to receive and consider as promptly as possible any desired revision of the Rules and its Codes. Any suggestions for revisions or modifications that are approved by the committee will be recommended for addenda to the Code, to be included later on in the proper place in the Code.

The Boiler Code Committee has received and acted upon a number of suggested revisions which have been approved for publication as addenda to the Code. These are published below, with the corresponding paragraph numbers to identify their locations in the various sections of the Code. The revisions will be published in the form of addenda data sheets, distinctly colored pink, and offered for general distribution to those interested.

For the convenience of the reader in studying the revisions, all added matter appears in small capitals and all deleted matter in smaller type.

PAR. P-183. REVISED:

P-183. On longitudinal joints OF ALL TYPES OF BOILERS AND ON CIRCUMFERENTIAL JOINTS OF DRUMS HAVING HEADS WHICH ARE NOT SUPPORTED BY TUBES OR THROUGH STAYS, the distance from the centers of rivet holes to the edges of the plates, except rivet holes in the ends of butt straps, shall be not less than 1½ and not more than 1¾ times the diameter of the rivet holes; this distance to be measured from the center of the rivet holes to the calking edge of the plate before calking. The plate edge shall be beveled to an angle not sharper than 70 deg. to the plane of the plate and as near thereto as practicable.

PAR. P-184*d*. REVISED:

P-184*d*. The distance from the centers of rivet holes of circumferential joints to the edges of the plate IN BOILERS HAVING HEADS WHICH ARE SUPPORTED BY TUBES OR THROUGH STAYS shall not be less than 1¼ times the diameter of the rivet holes.

PAR. P-186. ADD THE FOLLOWING:

ELECTRIC RESISTANCE BUTT WELDING, WHERE THE ENTIRE AREA IS WELDED SIMULTANEOUSLY, MAY BE USED AND THE ULTIMATE STRENGTH OF THE JOINT TAKEN AS 35,000 LB. PER SQ. IN. AS IN THE CASE OF FORGE WELDING. IT MAY, UPON THE REQUEST OF A MANUFACTURER, WHO SUBMITS PROPER SCIENTIFIC DATA AND EVIDENCE, BE GIVEN A HIGHER RATING BY THE BOILER CODE COMMITTEE THAN FOR FORGE WELDING, PROVIDED THAT AN AUTHORIZED INSPECTOR MAY DEMAND A TEST OF ANY ONE OF THE WELDED ARTICLES HE MAY SELECT FOR THE PURPOSE, AND IF, AFTER WITNESSING SUCH A TEST, HE SHALL DOUBT THE ADVISABILITY OF USING THE ASSIGNED RATING FOR THE WELD, THE CASE SHALL BE REFERRED TO THE BOILER CODE COMMITTEE FOR ITS DECISION.

PAR. P-193. REVISED:

P-193. In applying reinforcing plates to the drums of watertube boilers to strengthen the shell where the tubes enter, they shall be riveted to the shell, and where outside calking is used, the tubes shall be expanded into the inner and outer plates so that the rivets and tubes will hold the plates together in accordance with the rules for stayed surfaces.

The spacing of the rivets with respect to the tubes shall conform to Par. P-199 for stayed surfaces, using a value of 135 for *C*, and shall be based on a unit pressure equal to the pressure that can be carried by the inner plate with a factor of safety of 5.

(NOTE: Where a reinforcing plate is inside the steam drum it is the inner plate; where it is outside and there is no inner reinforcing plate, the unreinforced shell of the drum is the inner plate.)

The tension in rivets and tubes shall conform to Pars. P-220 and P-232.

The combined drum shell and reinforcing plate or plates, and riveted connections, shall have a factor of safety of not less than 5 in the ligaments, when calculated in accordance with Par. P-192. When reinforcing plates or butt straps are exposed to flame or gas of the equivalent temperature, the joints shall be protected therefrom.

THE LARGEST DIAMETER OF UNREINFORCED CIRCULAR OPENING IN THE SHELL OF A DRUM SHALL NOT EXCEED 8 IN. IN ANY CASE, NOR SHALL IT EXCEED THE VALUES GIVEN BY THE FOLLOWING EQUATIONS WHEN SUCH VALUES ARE LESS THAN 8 IN.:

$$d = 1.154\, t \sqrt{\frac{S}{P}\left(\frac{1.0 - E}{E}\right)} \quad \ldots\ldots(1)$$

or

$$d = \frac{1.154}{E}\sqrt{Rt\,(1.0 - E)} \quad \ldots\ldots\ldots\ldots\ldots(2)$$

$$d' = \frac{d + L\left(\dfrac{1.0 - E}{E}\right)}{2} \quad \ldots\ldots\ldots\ldots\ldots(3)$$

WHERE d = MAXIMUM DIAMETER OF UNREINFORCED CIRCULAR OPENING, IN., WHICH MAY EITHER BE SINGLE OR IN MULTIPLE ON A LINE PARALLEL TO THE AXIS OF THE DRUM AND SO SPACED THAT THE MINIMUM LIGAMENT EFFICIENCY, CONSIDERING ANY TWO HOLES, IS NOT LESS THAN THE MAXIMUM LONGITUDINAL JOINT OR LIGAMENT EFFICIENCY USED IN DETERMINING THE MAXIMUM ALLOWABLE WORKING PRESSURE OF THE DRUM.

d' = SAME AS d WITH THE EXCEPTION THAT THE PITCH OF THE HOLES ON ANY ONE ROW IS UNEQUAL (FOR EXAMPLE, PAR. P- *192b*).
t = MINIMUM THICKNESS OF SHELL PLATE.
S = ONE-FIFTH OF THE MINIMUM TENSILE STRENGTH STAMPED ON SHELL PLATES, LB. PER SQ. IN.
P = MAXIMUM ALLOWABLE WORKING PRESSURE, LB. PER SQ. IN.
E = EFFICIENCY OF LONGITUDINAL JOINT OR OF LIGAMENTS BETWEEN TUBE HOLES (WHICH EVER IS LEAST), OR THE RATIO OF THE STRESS IN THE SOLID PLATE, CIRCUMFERENTIALLY TO S.
R = THE INSIDE RADIUS OF THE WEAKEST COURSE OF THE SHELL OR DRUM, IN., PROVIDED THE THICKNESS OF THE SHELL DOES NOT EXCEED 10 PERCENT OF THE RADIUS. IF THE THICKNESS IS OVER 10 PERCENT OF THE RADIUS, THE OUTER RADIUS SHALL BE USED FOR R.
L = THE DISTANCE ON THE CENTER LINE BETWEEN THE EDGES OF THE TWO HOLES WITH THE SMALLEST PITCH WHERE THE PITCH OF HOLES ON ANY ONE ROW IS UNEQUAL, IN.

Par. P-197. Revised:

P-197*A*. The corner-radius of an unstayed dished head measured on the concave side of the head shall not be less than 3 times the thickness of the material in the head; but in no case less than 6 percent of the diameter of the shell.

[P-198] *B*. A flanged manhole opening in a dished head shall be flanged to a depth measured from the outside of the head at the major axis of not less than 3 times the required thickness of the head for plate up to 1½ in. in thickness. For plate exceeding 1½ in. in thickness the depth shall be the thickness of the plate plus 3 in. A manhole opening may be reinforced by a riveted manhole frame or other attachment in place of flanging.

Par. P-198. Revised:

FLAT HEADS

P-198. THE THICKNESS REQUIRED IN UNSTAYED FLAT HEADS, WHICH ARE UNPIERCED AND ARE RIGIDLY FIXED AND SUPPORTED AT THEIR BOUNDING EDGES BY RIVETED OR BOLTED ATTACHMENTS TO SHELLS OR SIDE PLATES, SHALL BE CALCULATED BY THE FOLLOWING FORMULA:

$$t = a\sqrt{\frac{0.145\,P}{S}}$$

WHERE t = THICKNESS OF PLATE IN HEAD, IN.
a = DIAMETER, OR SHORT SIDE OF AREA, IN.
P = MAXIMUM ALLOWABLE WORKING PRESSURE, LB. PER SQ. IN.
S = ALLOWABLE UNIT WORKING STRESS, LB. PER SQ. IN. $= \frac{TS}{5}$.
TS = ULTIMATE TENSILE STRENGTH STAMPED ON SHELL PLATES, AS PROVIDED FOR IN THE SPECIFICATIONS FOR STEEL BOILER PLATE, LB. PER SQ. IN.

Par. P-212*b*. Revise formula to read:

$$P = \frac{11{,}000t \times E}{R - \Sigma s \sin a}$$

Par. P-230*b*. Revised:

b In a form of reinforcement for crown sheets where the top sheet of the firebox is a SEMI-CIRCLE AND THE TOP part of THE [a] circle not exceeding 120 deg. in arc is REINFORCED BY [braced with] arch bars extending over the top and down below the top row of staybolts at the sides of the FURNACE BENEATH THE SEMI-CIRCULAR crown sheet, these arch bars being riveted to the water side through thimbles, the maximum allowable working pressure should be determined by adding to the maximum allowable working pressure for a plain circular furnace of the same thickness, diameter, and length determined by the formula in Pars. P-239 and P-240, the pressure P_1 determined from the following formula which is a modification of that in Par. P-241*a*:

$$P_1 = 10{,}000{,}000\,\frac{b \times d^3}{D_1 \times D^3}$$

provided that the maximum allowable working pressure must not exceed that determined by the formula for furnaces of the Adamson type, in Par. P-242 when L is made equal to p, and also provided that the diameter of the holes for the staybolts in the crown bars does not exceed ⅓b and the cross-sectional area of the crown bars is not less than 4 sq. in. Par. P-199 would govern the spacing of the staybolts, rivets, or bolts attaching the sheet to the bars, and Par. P-212*d* the size of the staybolts, rivets, or bolts

where b = net width of crown bar, in.
d = depth of crown bar, in.
D_1 = longitudinal pitch of crown bar, in.
D = 2 times radius of crown sheet.

FOR CONSTRUCTIONS IN WHICH THE CROWN SHEET IS NOT SEMI-CIRCULAR, A TEST TO DESTRUCTION SHALL BE MADE IN ACCORDANCE WITH PAR. P-*247* AND THE WORKING PRESSURE BASED THEREON.

Par. P-247. Revised:

P-247. Where no rules are given and it is impossible to calculate with a reasonable degree of accuracy the strength of a boiler structure or any part thereof, a full-sized sample shall be built by the manufacturer and tested in ACCORDANCE WITH THE STANDARD PRACTICE FOR MAKING A HYDROSTATIC TEST ON A BOILER PRESSURE PART TO DETERMINE THE MAXIMUM ALLOWABLE WORKING PRESSURE, AS GIVEN IN THE APPENDIX [a manner to be prescribed by the Boiler Code Committee and in the presence of one or more representatives appointed to witness such test].

Par. P-250. Revised:

P-250. A firetube boiler shall have the ends of the tubes firmly rolled and beaded, or rolled, beaded, and welded around the edge of the bead. Where the tubes do not exceed 1½ in. in diameter, the tube sheet may by chamfered or recessed to a depth at least equal to the thickness of the tubes and the tubes rolled into place and welded.

In no case shall THE DIAMETER OF THE FINISHED TUBE HOLE EXCEED THE NOMINAL DIAMETER OF THE TUBE BY GREATER THAN 1/32 IN. AT THE FIRE END OR 1/16 IN. AT THE OPPOSITE END OF THE TUBE, NOR the tube end extend more than ⅜ in. beyond the tube sheet. In the case of tubes not exceeding 1½ in. diameter, they may be expanded by the prosser method in place of rolling.

Par. P-251. Revised:

P-251. The ends of all tubes, suspension tubes, and nipples shall be expanded and flared not less than ⅛ in. over the diameter of the tube hole on all watertube boilers and superheaters, or they may be flared not less than ⅛ in., rolled and beaded, or flared, rolled, and welded. IN NO CASE SHALL THE DIAMETER OF THE FINISHED TUBE HOLES EXCEED THE NOMINAL DIAMETER OF THE TUBES BY MORE THAN 1/32 IN. Where pipe as provided in Par. P-21 is used for tubes in watertube boilers, it may be screwed instead of rolled and flared, and the minimum number of threads shall conform to the values given in Table P-10. The closed ends of stub tubes shall be welded by the forging process.

PAR. P-268. REVISED:

NOZZLE OPENINGS

P-268. *Threaded Openings.* *a* All pipe threads shall conform to the American Pipe Thread Standard and all connections 1 in. pipe size or over shall have not less than the number of threads given in Table P-10. For smaller pipe connections there shall be at least four threads in the opening. If the thickness of the material in the boiler is not sufficient to give such number of threads, the opening shall be reinforced by RIVETING TO THE SHELL OR HEAD a pressed-steel, cast-steel, or bronze-composition flange, or plate, so as to provide AT LEAST the required number of threads.

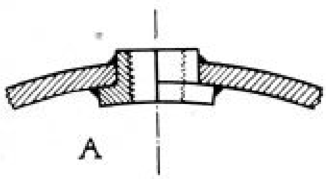


FIG. P-17½ (A)

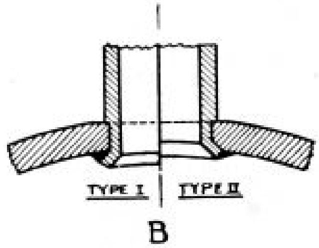


FIG. P-17½ (B)

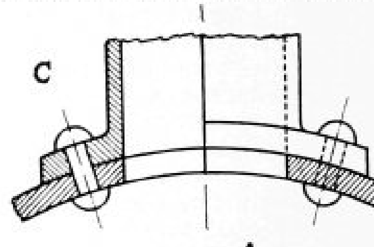


FIG. P-17½ (C)

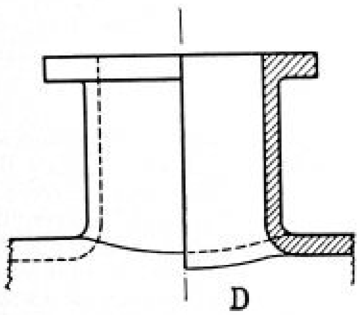


FIG. P-17½ (D)

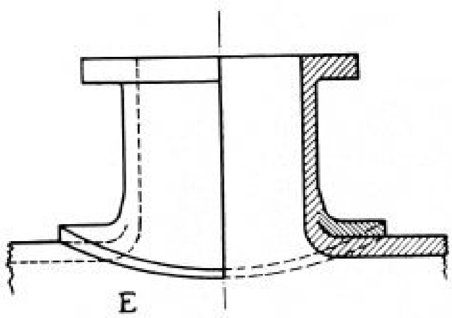


FIG. P-17½ (E)

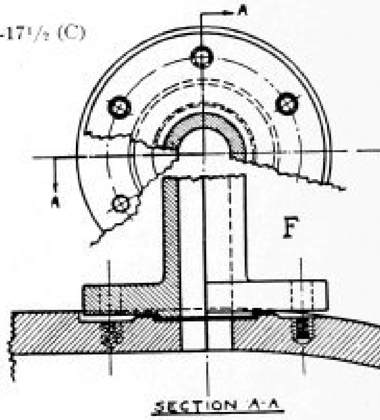


FIG. P-17½ (F)

FLANGES OR PADS WITH AT LEAST THE REQUIRED NUMBER OF THREADS MAY BE USED FOR THREADING OPENINGS PROVIDED SAME ARE INSERTED FROM THE INSIDE OF THE SHELL AS SHOWN IN FIG. P-*17½* (A) OR SPHERICAL PORTION OF THE HEAD, SUCH PADS OR FLANGES TO HAVE A RETAINING FLANGE OR SHOULDER MACHINED OR FORMED TO THE INSIDE RADIUS OF THE SHELL OR HEAD, OR SUCH FLANGE OR SHOULDER TO REST AGAINST A FLAT SURFACE MACHINED ON THE INSIDE OF THE SHELL OR HEAD, THE RETAINING FLANGE OR SHOULDER TO BE OF SUFFICIENT STRENGTH TO RESIST THE STRESS DUE TO THE MAXIMUM ALLOWABLE WORKING PRESSURE WITH A FACTOR OF SAFETY OF *5*, PROVIDED THE MAXIMUM CROSS-SECTION OF METAL REMOVED IN FORMING THE HOLE AND THE FLAT SURFACE IN A PLANE PASSING THROUGH THE OPENING AND THROUGH THE CENTER LINE OF THE SHELL DOES NOT EXCEED THAT ALLOWED BY THE RULES FOR UNREINFORCED CIRCULAR OPENINGS GIVEN IN PAR. P-*193*. SUCH OPENINGS MAY BE SEALED BY FUSION WELDING PROVIDED THE CARBON CONTENT OF THE STEEL DOES NOT EXCEED 0.30 PERCENT AND THE DIAMETER OF THE WELDED SEAL IS AT LEAST ½ IN. LESS THAN THE MAXIMUM DIAMETER ALLOWED BY THE RULES FOR UNREINFORCED CIRCULAR OPENINGS GIVEN IN PAR. P-193.

When the maximum allowable working pressure exceeds 100 lb. per sq. in., OPENINGS [outlet connections] over 3 in. pipe size shall not have screwed joints, but flanged fittings shall be used EXPANDED, riveted, OR FORGE WELDED directly to the shell or head, or a fitting with a raised flat face on the boiler side OF THE FITTING may be connected directly to the boiler or head of the boiler by means of studs, ALL AS HEREINAFTER SPECIFIED.

FLANGED FITTINGS, FLARED OR EXPANDED CONNECTIONS. *b* ON SHELLS AND SPHERICAL PORTIONS OF THE HEADS, FORGED STEEL NOZZLES SUCH AS SHOWN IN FIG. P-*17½* (B) MAY BE INSERTED THROUGH AN OPENING, FLARED OVER ON THE INSIDE TO AN AMOUNT EQUAL TO AT LEAST THE THICKNESS OF THE NECK OF THE NOZZLE UP TO AN OUTSIDE DIAMETER WHICH SHALL NOT EXCEED THAT GIVEN FOR UNREINFORCED CIRCULAR OPENINGS IN PAR. P-*193*. THE DIAMETER OF THE OPENING SHALL NOT BE MORE THAN *1/32* IN. GREATER THAN THE OUTSIDE DIAMETER OF THE PART OF THE NOZZLE WHICH PASSES THROUGH THE SHELL. SUCH NOZZLES MAY BE SEALED BY FUSION WELDING PROVIDED THE CARBON CONTENT OF THE STEEL DOES NOT EXCEED 0.30 PERCENT AND THE DIAMETER OF THE WELDED SEAL IS AT LEAST ½ IN. LESS THAN THE MAXIMUM DIAMETER ALLOWED BY THE RULES FOR UNREINFORCED CIRCULAR OPENINGS GIVEN IN PAR. P-*193*.

WHEN THE THICKNESS OF A SHELL OR THE SPHERICAL PORTION OF A HEAD IS GREATER THAN ¾ IN., FORGED STEEL NOZZLES, THE OUTSIDE DIAMETER OF THE NECK OF WHICH DOES NOT EXCEED *4½* IN., MAY BE ATTACHED THERETO BY INSERTING THROUGH AN OPENING AND EXPANDING INTO THE SHELL OR HEAD IN ACCORDANCE WITH THE REQUIREMENTS FOR SECURING BOILER TUBES; THE DIAMETER OF SUCH AN OPENING SHALL NOT EXCEED THAT GIVEN FOR UNREINFORCED CIRCULAR OPENINGS IN PAR. P-193.

ALL NOZZLES WHICH ARE FLARED OVER ON THE INSIDE OF THE SHELL OR HEAD, EXCEPT SMALL NOZZLES WHERE TUBE SEAT GROOVES ARE PROVIDED, MUST BE FORGED OR MACHINED WITH A SHOULDER WHICH RESTS ON A LOCALLY FLATTENED SURFACE ON THE OUTSIDE OF THE SHELL OR HEAD TO BE FORMED BY HOT FORGING, HOT FLANGING, OR MACHINING. WHEN THE OUTSIDE OF SHELL OR HEAD

IS MACHINED, THE MAXIMUM CROSS-SECTION OF THE METAL REMOVED IN A PLANE PASSING THROUGH THE OPENING AND THROUGH THE CENTER LINE OF THE DRUM SHALL NOT EXCEED THAT ALLOWED BY THE RULES FOR UNREINFORCED CIRCULAR OPENINGS GIVEN IN PAR. P-*193*.

FLANGED FITTINGS, RIVETED CONNECTIONS. *c* WHEN FLANGED FITTINGS ARE RIVETED DIRECTLY TO THE SHELL OR THE SPHERICAL PORTION OF THE HEAD AS SHOWN IN FIG. P-*17½* (*c*), THE CONNECTION SHALL BE DESIGNED IN ACCORDANCE WITH THE RULES FOR MANHOLES IN PARS. P-*260* AND P-*261*.

FLANGED FITTINGS, FORGE-WELDED. *d* NOZZLES MAY BE FORGE WELDED, WITH OR WITHOUT REINFORCEMENT, TO THE SHELL OR TO THE SPHERICAL PORTIONS OF THE HEAD. (SEE FIG. P-*17½* (D). WHEN THE INSIDE DIAMETER OF THE VESSEL IS *36* IN. OR GREATER, THE INSIDE DIAMETER OR UNREINFORCED FORGE-WELDED NOZZLE SHALL NOT EXCEED THAT GIVEN IN THE FOLLOWING EQUATION:

$$d = 0.1155 \frac{D}{E} \sqrt{6E - 5E^2 - 1}$$

WHERE d = MAXIMUM ALLOWABLE DIAMETER OF OPENING NOZZLE, IN IN.

D = INSIDE DIAMETER OF SHELL, IN IN.

$$E = \frac{\text{COMPUTED STRESS IN SOLID PLATE}}{\text{MAXIMUM ALLOWABLE STRESS}}$$

FORGED-WELDED NOZZLES WHICH REQUIRES REINFORCEMENT MAY BE OF THE REINFORCED TYPE AS DESCRIBED IN PAR. P-195 AND SHOWN IN FIG. P-17½ (E); THE THICKNESS OF THE REINFORCING PAD SHALL NOT BE LESS THAN THAT GIVEN IN THE FOLLOWING EQUATION:

$$t = T \ldots \left[3.75 \frac{d}{D} - 0.525 \frac{(1-E)}{E} \right]$$

WHERE t = REQUIRED THICKNESS OF PAD, IN IN.

T = THICKNESS OF SHELL OR HEAD, IN IN.

d = INSIDE DIAMETER OF NOZZLE, IN IN.

D = INSIDE DIAMETER OF SHELL, IN IN.

$$E = \frac{\text{COMPUTED STRESS IN SOLID PLATE}}{\text{MAXIMUM ALLOWABLE STRESS}}$$

THE THICKNESS OF THE REINFORCING PAD SHALL NOT BE LESS THAN ¾ IN. WHEN THICKNESS OF SHELL OR HEAD TO WHICH SAME IS FITTED IS 2 IN. OR LESS. WHEN THICKNESS OF HEAD OR SHELL IS GREATER THAN 2 IN., THE MINIMUM THICKNESS OF THE PAD SHALL BE 1 IN. THE WIDTH OF THE PAD ALONG THE LONGITUDAL AXIS OF THE SHELL SHALL NOT BE LESS THAN THE INSIDE RADIUS OF THE NOZZLE OPENING.

FLANGED FITTINGS, STUD-BOLTED CONNECTION. *e* A STUDDED CONNECTION OF THE TYPE SHOWN IN FIG. P-17½ (F) MAY BE USED FOR ATTACHING OUTLETS TO SHELLS OR SPHERICAL PORTIONS OF HEADS WITH A FLAT SURFACE MACHINED ON THE SHELL OR HEAD FOR A GASKET PROVIDED THE AREA OF THE MAXIMUM CROSS-SECTION OF THE METAL REMOVED FROM THE SHELL OR HEAD IN FORMING THE HOLE AND THE FLAT SURFACE AND IN TAPPING FOR THE STUD BOLTS, FOR ANY PLANE PASSING THROUGH THE OPENING AND THROUGH THE CENTER LINE OF THE DRUM, DOES NOT EXCEED THAT CORRESPONDING TO A CIRCULAR HOLE THROUGH THE SHELL OF THE MAXIMUM DIAMETER ALLOWED BY THE RULES FOR UNREINFORCED CIRCULAR OPENINGS GIVEN IN PAR. P-193. THE DIMENSIONS OF THE FLANGE OF THE STUDDED CONNECTION SHALL CONFORM TO THOSE GIVEN IN TABLE A-*5b*. THE STUDS SHALL CONFORM TO THE DIMENSIONS FOR BOLTS GIVEN IN TABLE A-*5b* AND SHALL BE SPACED AS DESIGNATED IN THIS TABLE. THE NET THICKNESS OF THE SHELL OR HEAD MUST BE AT LEAST EQUAL TO THE TOTAL DIAMETERS GIVEN IN TABLE A-*5b*. STUD HOLES SHALL STRADDLE THE CENTER LINE OF THE DRUM.

[If studs are used they must be not less than ¾ in. diameter and must have not less than ten threads per inch. The thickness of the boiler plate must be not less than the diameter of the studs. The allowable tensile stress on these studs must not exceed the streses indicated by the bolted connections given in Table A-6.]

PAR. I-32. ADD THE FOLLOWING:

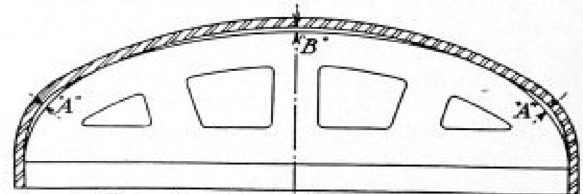
b TOLERANCES FOR ELLIPSOIDAL HEADS HEADS OF ELLIPSOIDAL FORM SHALL BE CHECKED FOR THEIR CONFORMITY TO THE TRUE ELLIPTICAL SHAPE. THE MANUFACTURER OF SUCH HEADS SHALL FURNISH THE INSPECTOR WITH A TEMPLATE MADE OF WOOD OR METAL WHICH MUST BE MADE AS NEARLY EXACT, TRUE SEMI-ELLIPTICAL AS PRACTICABLE. THE TOTAL TOLERANCE AT POINTS "A" OR "B" IN FIG. I-2 SHALL NOT EXCEED 1¼ PER CENT OF THE INSIDE DIAMETER OF THE HEAD:

PAR. L-43*b*. REVISE FORMULA TO READ:

$$P = \frac{55{,}000}{FS} \times \frac{t \times E}{R - \Sigma s \sin \alpha}$$

PAR. U-38. REVISED:

U-38 *A*. The corner radius of an unstayed dished head measured on the concave side of the head shall not



True Semi-Elliptical Template

FIG. I-2

be less than 3 times the thickness of the material in the head; but in no case less than 6 per cent of the diameter of the shell.

[U-39] *B*. A flanged manhole opening in a dished head shall be flanged to a depth measured from the outside of the head at the major axis of not less than 3 times the required thickness of the head for plate up to 1½ in. in thickness. For plate exceeding 1½ in., the depth shall be the thickness of the plate plus 3 in. A manhole opening may be reinforced by a riveted manhole frame or other attachment in place of flanging.

PAR. U-39. REVISED:

FLAT HEADS

U-39. THE THICKNESS REQUIRED IN UNSTAYED FLAT HEADS, WHICH ARE UNPIERCED AND ARE RIGIDLY FIXED AND SUPPORTED AT THEIR BOUNDING EDGES BY RIVETED OR BOLTED ATTACHMENTS TO SHELLS OR SIDE PLATES, SHALL BE CALCULATED BY THE FOLLOWING FORMULA:

$$t = a \sqrt{\frac{0.145P}{S}}$$

WHERE t = THICKNESS OF PLATE IN HEAD, IN.

a = DIAMETER, OR SHORT SIDE OF AREA, IN.

P = MAXIMUM ALLOWABLE WORKING PRESSURE, LB. PER SQ. IN.

S = ALLOWABLE UNIT WORKING STRESS, LB. PER SQ. IN. $= \frac{TS}{5}$

TS = ULTIMATE TENSILE STRENGTH STAMPED ON SHELL PLATES, AS PROVIDED FOR IN THE SPECIFICATIONS FOR STEEL BOILER PLATE, LB. PER SQ. IN.

PAR. U-59. REVISED: NOZZLE OPENINGS

U-59. *Threaded Openings.* *a* All pipe threads shall conform to the American Pipe Thread Standard and all connections 1 in. pipe size or over shall have not less than the number of threads given in Table U-5. For smaller pipe connections there shall be at least four threads in the openings. If the thickness of the material in the pressure vessel is not sufficient to give such number of threads the opening shall be reinforced by a pressed-steel, cast-steel, or bronze-composition flange, or plate, riveted or brazed on, or a boss may be built up by an autogenous welding process for an opening not to exceed 2 in. pipe size and for a pressure not to exceed 100 lb. per sq. in., so as to provide AT LEAST the required number of threads.

FLANGES OR PADS WITH AT LEAST THE REQUIRED NUMBER OF THREADS MAY BE USED FOR THREADED OPENINGS, PROVIDED SAME ARE INSERTED FROM THE INSIDE OF THE SHELL OR SPHERICAL PORTIONS OF THE HEAD AS SHOWN IN FIG. U-2½ (A),[1] SUCH PADS OR FLANGES TO HAVE A RETAINING FLANGE OR SHOULDER MACHINED OR FORMED TO THE INSIDE RADIUS OF THE SHELL OR HEAD, OR SUCH FLANGE OR SHOULDER TO REST AGAINST A FLAT SURFACE MACHINED ON THE INSIDE OF THE SHELL OR HEAD, THE RETAINING FLANGE OR SHOULDER TO BE OF SUFFICIENT STRENGTH TO RESIST THE STRESS DUE TO THE MAXIMUM ALLOWABLE WORKING PRESSURE WITH A FACTOR OF SAFETY OF 5, PROVIDED THE MAXIMUM CROSS-SECTION OF METAL REMOVED IN FORMING THE HOLE AND THE FLAT SURFACE IN A PLANE PASSING THROUGH THE OPENING AND THROUGH THE CENTER LINE OF THE SHELL DOES NOT EXCEED THAT ALLOWED FOR AN UNREINFORCED CIRCULAR OPENING OF A DIAMETER DETERMINED BY THE FORMULAS GIVEN BELOW. SUCH OPENINGS MAY BE SEALED BY FUSION WELDING PROVIDED THE CARBON CONTENT OF THE STEEL IN THE SHELL DOES NOT EXCEED 0.30 PERCENT AND THE DIAMETER OF THE WELDED SEAL IS AT LEAST ½ IN. LESS THAN THE MAXIMUM DIAMETER ALLOWED FOR AN UNREINFORCED CIRCULAR OPENING, AS GIVEN IN THE FORMULAS BELOW.

THE DIAMETER OF AN UNREINFORCED OPENING FOR A THREADED OUTLET SHALL NOT EXCEED 8 IN. IN ANY CASE, NOR SHALL IT EXCEED THE VALUES GIVEN BY THE FOLLOWING EQUATIONS WHEN SUCH VALUES ARE LESS THAN 8 IN.

$$d = 1.154\,t\sqrt{\frac{S}{P}\left(\frac{1.0-E}{E}\right)} \quad \ldots\ldots\ldots (1)$$

OR

$$d = \frac{1.154}{E}\sqrt{Rt\,(1.0-E)} \quad \ldots\ldots\ldots (2)$$

$$d' = \frac{d + L\left(\dfrac{1.0-E}{E}\right)}{2} \quad \ldots\ldots\ldots (3)$$

WHERE d = MAXIMUM DIAMETER OF UNREINFORCED CIRCULAR OPENING, IN., WHICH MAY EITHER BE SINGLE OR IN MULTIPLE ON A LINE PARALLEL TO THE AXIS OF THE DRUM AND SO SPACED THAT THE MINIMUM LIGAMENT EFFICIENCY, CONSIDERING ANY TWO HOLES, IS NOT LESS THAN THE MAXIMUM LONGITUDINAL JOINT OR LIGAMENT EFFICIENCY USED IN DETERMINING THE MAXIMUM ALLOWABLE WORKING PRESSURE OF THE DRUM.

d' = SAME AS d WITH THE EXCEPTION THAT THE PITCH OF THE HOLES ON ANY ONE ROW IS UNEQUAL.

t = MINIMUM THICKNESS OF SHELL PLATE.

S = ONE-FIFTH OF THE MINIMUM TENSILE STRENGTH STAMPED ON SHELL PLATE, LB. PER SQ. IN.

P = MAXIMUM ALLOWABLE WORKING PRESSURE, LB. PER SQ. IN.

E = EFFICIENCY OF LONGITUDINAL JOINT OR OF LIGAMENTS BETWEEN TUBE HOLES (WHICHEVER IS THE LEAST), OR THE RATIO OF THE STRESS IN THE SOLID PLATE, CIRCUMFERENTIALLY TO S.

R = THE INSIDE RADIUS OF THE WEAKEST COURSE OF THE SHELL OR DRUM, IN., PROVIDED THE THICKNESS OF THE SHELL DOES NOT EXCEED 10 PER CENT OF THE RADIUS. IF THE THICKNESS IS OVER 10 PER CENT OF THE RADIUS, THE OUTER RADIUS SHALL BE USED FOR R.

L = THE DISTANCE ON THE CENTER LINE BETWEEN THE EDGES OF THE TWO HOLES WITH THE SMALLEST PITCH WHERE THE PITCH OF HOLES ON ANY ONE ROW IS UNEQUAL, IN.

When the maximum allowable working pressure exceeds 100 [125] lb. per sq. in., AND THE SHELL THICKNESS IS LESS THAN ¾ IN., [all pipe] openings over 3-in. pipe size shall NOT HAVE SCREWED JOINTS, BUT FLANGED FITTINGS SHALL BE USED, EXPANDED, RIVETED, OR FORGE WELDED DIRECTLY TO THE SHELL OR HEAD, OR A FITTING WITH A RAISED FLAT FACE ON THE PRESSURE VESSELSIDE OF THE FITTING MAY BE CONNECTED DIRECTLY TO THE PRESSURE VESSEL OR HEAD OF THE VESSEL BY MEANS OF STUDS, ALL AS HEREINAFTER SPECIFIED. [be provided with a flanged fitting adapted to receive a pipe flange and which may be attached to the pressure vessel by riveting, brazing, or any of the methods of welding prescribed in this section of the code. For pressures less than 125 lb. per sq. in. a screwed fitting may be used.]

FLANGED FITTINGS, FLARED OR EXPANDED CONNECTIONS. *b* ON SHELLS AND THE SPHERICAL PORTIONS OF THE HEADS, FORGED STEEL NOZZLES AS SHOWN IN FIG. U-2½ (B)[2] MAY BE INSERTED THROUGH AN OPENING, FLARED OVER ON THE INSIDE TO AN AMOUNT EQUAL TO AT LEAST THE THICKNESS OF THE NECKS OF THE NOZZLE UP TO AN OUTSIDE DIAMETER WHICH SHALL NOT EXCEED THAT GIVEN FOR UNREINFORCED CIRCULAR OPENINGS IN THE FORMULAS ABOVE. THE DIAMETER OF THE OPENING SHALL NOT BE MORE THAN 1/32 IN. GREATER THAN THE OUTSIDE DIAMETER OF THE PART OF THE NOZZLE WHICH PASSES THROUGH THE SHELL. SUCH NOZZLES MAY BE SEALED BY FUSION WELDING PROVIDED THE CARBON CONTENT OF THE STEEL DOES NOT EXCEED 0.30 PER CENT AND THE DIAMETER OF THE WELDED SEAL IS AT LEAST ½ IN. LESS THAN THE MAXIMUM DIAMETER GIVEN FOR UNREINFORCED CIRCULAR OPENINGS IN THE FORMULAS ABOVE.

WHEN THE THICKNESS OF A SHELL OR THE SPHERICAL PORTION OF A HEAD IS GREATER THAN ¾ IN., FORGED-STEEL NOZZLES, THE OUTSIDE DIAMETER OF THE NECK OF WHICH DOES NOT EXCEED 4½ IN., MAY BE ATTACHED THERETO BY INSERTING THROUGH AN OPENING AND EXPANDING INTO THE SHELL OR HEAD IN ACCORDANCE WITH THE REQUIREMENTS FOR SECURING BOILER TUBES; THE DIAMETER OF SUCH AN OPENING SHALL NOT EXCEED THAT GIVEN FOR UNREINFORCED CIRCULAR OPENINGS IN THE FORMULAS ABOVE.

[1] Same illustration as Fig. P-17½ (A).

[2] Same illustration as Fig. P-17½ (B).

ALL NOZZLES WHICH ARE FLANGED OVER ON THE INSIDE OF THE SHELL OR HEAD, EXCEPT SMALL NOZZLES WHERE TUBE SEAT GROOVES ARE PROVIDED, MUST BE FORGED OR MACHINED WITH A SHOULDER WHICH RESTS ON A LOCALLY FLATTENED SURFACE ON THE OUTSIDE OF THE SHELL OR HEAD, TO BE FORMED BY HOT-FORGING, HOT-FLANGING, OR MACHINING. WHEN THE OUTSIDE OF SHELL OR HEAD IS MACHINED, THE MAXIMUM CROSS-SECTION OF THE METAL REMOVED IN A PLANE PASSING THROUGH THE OPENING AND THROUGH THE CENTER LINE OF THE DRUM SHALL NOT EXCEED THAT ALLOWED BY THE RULES FOR UNREINFORCED CIRCULAR OPENINGS GIVEN ABOVE.

FLANGED FITTINGS, RIVETED CONNECTION. *c* WHEN FLANGED FITTINGS ARE RIVETED DIRECTLY TO THE SHELL OR THE SPHERICAL PORTIONS OF THE HEAD AS SHOWN IN FIG. U-2½(C),[3] THE CONNECTION SHALL BE DESIGNED IN ACCORDANCE WITH THE RULES FOR MANHOLES IN PARS. U-55, U-56, AND U-57.

FLANGED FITTINGS, FORGE-WELDED. *d* NOZZLES MAY BE FORGE-WELDED, WITH OR WITHOUT REINFORCEMENT, TO THE SHELL OR TO THE SPHERICAL PORTIONS OF THE HEADS AS PERMITTED IN PAR. U-88.

FLANGED FITTINGS, RIVETED CONNECTION. *c* WHEN STUDDED CONNECTION OF THE TYPE SHOWN IN FIG. U-2½ (D)[4] MAY BE USED FOR ATTACHING OUTLETS TO SHELLS OR SPHERICAL PORTIONS OF HEADS WITH A FLAT SURFACE MACHINED ON THE SHELL OR HEAD FOR A GASKET PROVIDED THE AREA OF THE MAXIMUM CROSS-SECTION OF THE METAL REMOVED FROM THE SHELL OR HEAD IN FORMING THE HOLE AND THE FLAT SURFACE AND IN TAPPING FOR THE STUD BOLTS, FOR ANY PLANE PASSING THROUGH THE OPENING AND THROUGH THE CENTER LINE OF THE DRUM, DOES NOT EXCEED THAT CORRESPONDING TO A CIRCULAR HOLE THROUGH THE SHELL OF THE MAXIMUM DIAMETER ALLOWED BY THE RULES FOR UNREINFORCED CIRCULAR OPENINGS GIVEN IN PAR. P-193. THE DIMENSIONS OF THE FLANGE OF THE STUDDED CONNECTION SHALL CONFORM TO THOSE GIVEN IN TABLE A-5*b*. THE STUDS SHALL CONFORM TO THE DIMENSIONS FOR BOLTS GIVEN IN TABLE A-5*b* AND SHALL BE SPACED AS DESIGNATED IN THIS TABLE. THE NET THICKNESS OF THE SHELL OR HEAD MUST BE AT LEAST EQUAL TO THE TOTAL DIAMETERS GIVEN IN TABLE A-5*b*. STUD HOLES SHALL STRADDLE THE CENTER LINE OF THE DRUM.

PAR. U-65. REVISED:

U-65. Every pressure vessel shall be inspected at least TWICE [once] by the state or municipal inspector of boilers, or an inspector employed regularly by an insurance company which is authorized to do a boiler-insurance business in the state in which the vessel is built, or in the state in which it is to be used, if known, which inspections shall be made ONE BEFORE REAMING RIVET HOLES OR FINALLY CLOSING THE VESSEL TO INSPECTION, AND THE OTHER when the hydrostatic pressure test is on. A data sheet shall be filled out and signed by the manufacturer and the inspector, which data sheet, together with the stamping on the vessel, will denote that it is constructed in accordance with these Rules. Every pressure vessel fabricated in whole or in part by a welding process, shall, when the size of the shell permits, be internally inspected before being finally closed to inspection.

PAR. U-88. REVISED:

U-88. *Inlet and Outlet Connections.* Pipe connections may be made as provided for in Par. U-59.

Nozzles which are attached by forge welding shall be of forged or rolled steel material, seamless tubing or forge welded pipe, using either of the three methods shown at (*B*), Fig. U-4, or attached to a head by forge welding as shown at (*A*), Fig. U-4. Either the nozzle or shell may be flared for this purpose.

NOZZLES MAY BE FORGE-WELDED, WITH OR WITHOUT REINFORCEMENT, TO THE SHELL OR TO THE SPHERICAL PORTIONS OF THE HEAD [SEE FIG. U-4½ (A)].[5] WHEN THE INSIDE DIAMETER OF THE VESSEL IS 36 IN. OR GREATER, THE INSIDE DIAMETER OF AN UNREINFORCED FORGE-WELDED NOZZLE SHALL NOT EXCEED THAT GIVEN IN THE FOLLOWING EQUATION:

$$d = 0.1155 \frac{D}{E} \sqrt{6E - 5E^2 - 1}$$

WHERE d = MAXIMUM ALLOWABLE INSIDE DIAMETER OF NOZZLE IN IN.

D = INSIDE DIAMETER OF SHELL, IN IN.

$E = \dfrac{\text{COMPUTED STRESS IN SOLID PLATE}}{\text{MAXIMUM ALLOWABLE STRESS}}$

FORGE-WELDED NOZZLES WHICH REQUIRE REINFORCEMENT MAY BE OF THE REINFORCED TYPE AS DESCRIBED IN PAR. U-36 AND SHOWN IN FIG. U-4½ (B).[6] THE THICKNESS OF THE REINFORCING PAD MAY NOT BE LESS THAN THAT GIVEN IN THE FOLLOWING EQUATION:

$$t = T \left[3.75 \frac{d}{D} - 0.525 \frac{(1-E)}{E} \right]$$

WHERE t = REQUIRED THICKNESS OF PAD, IN IN.

T = THICKNESS OF SHELL OR HEAD, IN IN.

d = INSIDE DIAMETER OF NOZZLE, IN IN.

D = INSIDE DIAMETER OF SHELL, IN IN.

$E = \dfrac{\text{COMPUTED STRESS IN SOLID PLATE}}{\text{MAXIMUM ALLOWABLE STRESS}}$

THE THICKNESS OF THE REINFORCING PAD SHALL NOT BE LESS THAN ¾ IN. WHEN THE THICKNESS OF SHELL OR HEAD TO WHICH THE SAME IS FITTED IS 2 IN., OR LESS; WHEN THICKNESS OF HEAD OR SHELL IS GREATER THAN 2 IN., THE MINIMUM THICKNESS OF THE PAD SHALL BE 1 IN. THE WIDTH OF THE PAD ALONG THE LONGITUDINAL AXIS OF THE SHELL SHALL NOT BE LESS THAN THE INSIDE RADIUS OF THE NOZZLE OPENING.

Joseph T. Ryerson & Son Inc., Chicago, Ill., has purchased the business, equipment, and stock of the Penn-Jersey Steel Company, Camden, N. J., effective November 16. This firm carries on hand complete stocks of steel shapes, plates, sheets, hot and cold finished bars, reinforcing bars, etc. They serve all industry and construction trades in the Philadelphia district. The Ryerson company plans to add to the stock and increase the facilities in order to improve and extend the service for which this company is known.

Alexander L. Schuhl, manager of the Philadelphia office of the Independent Pneumatic Tool Company, Chicago, Ill., died on October 20 after an illness of only a few days. Mr. Schuhl was born in Philadelphia May 25, 1884. After finishing school, he entered the services of Wm. Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa., as a machinist apprentice and worked there until he became foreman of the pneumatic tool room. Resigning in 1917, he joined the sales organization of the Independent Pneumatic Tool Company, and was appointed manager of the Philadelphia office in 1924.

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[3] Same illustration as Fig. P-17½ (C).
[4] Same illustration as Fig. P-17½ (D).
[5] Same illustration as Fig. P-17½ (D).
[6] Same illustration as Fig. P-17½ (E).

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

Locomotive Firebox Layout

Q.—Please show me how to lay out a firebox wrapper sheet. I am sending you blue prints of a firebox which gives different views and dimensions. C. F. B.

A.—Figs. 1 and 2 show the layout of the longitudinal and cross section of the firebox submitted with the question. This is an advanced problem and requires a good general knowledge of the principles of triangulation as relating to constructions combining curved and flat surfaces joined at various angles.

The first thing to do is to make an accurate end view and side view of the firebox, as shown in Figs. 3 and 4. These views are laid out from Figs. 1 and 2, the outline representing the neutral axis of the sheet. The wrapper sheet is symmetrical about the line *A-B* and therefore a development of one side can be duplicated, to complete the layout of the plate.

The next step is to locate the points *17* and *17'* of the end view. This is done by passing a perpendicular to the line *A-B* through the centers of the radii *R* and *R'*, cutting the side at points *17* and *17'*.

Next divide curve *1-17* of the end view into any number of equal parts as sixteen in this case, the greater the number of equal parts taken the more accurate the final development. Number these points from *1* to *17* and project them to the side view cutting the line *C-D* and number these points correspondingly from *1* to *17*. Then divide the curve *1'* to *17'* of the end view into the same number of equal parts numbering same from *1'* to *17'* and project these points to the side view, cutting the line *E-F* and number these points correspondingly from *1'* to *17'*. The line *E-F* is taken at the back of the seam, joining the boiler course or at the start of the slope of the wrapper sheet.

Connect the points *1* and *1'*, *2* and *2'*, *3* and *3'*, etc., of the side and end views with full lines and the points *1* and *2'*, *2* and *3'*, *3* and *4'*, *4* and *5'*, etc., with dotted lines as shown.

As the fire door sheet has considerable slope, it is necessary to determine the true lengths of the arcs on the edge of the wrapper sheet at the small end as shown in Fig. 5. The method of getting the true lengths of these arcs is to project lines from the various points, these projecting lines, *2-2"*, *3-3"*, *4-4"*, etc., being square to the sloping end *C-D* of the firebox. On each one of these projecting lines lay off its respective length as taken from the lengths of the lines across the end from the curve to the center line on the end view, Fig. 3. Then draw a curve *C-G* through these points and the various arcs will be the true lengths of the corresponding arcs in the end

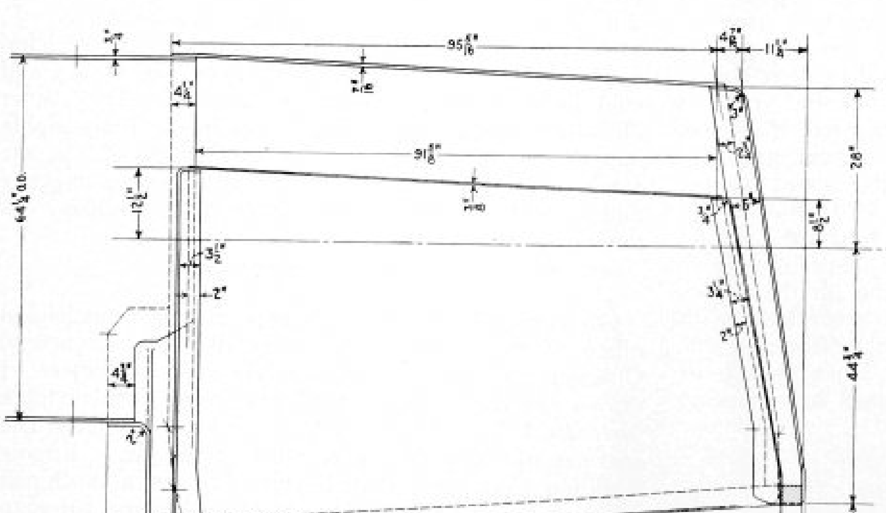

Fig. 1

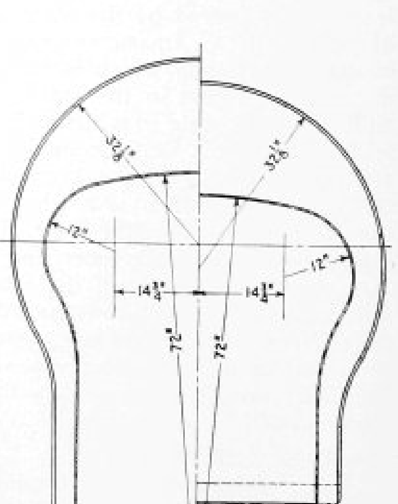

Fig. 2

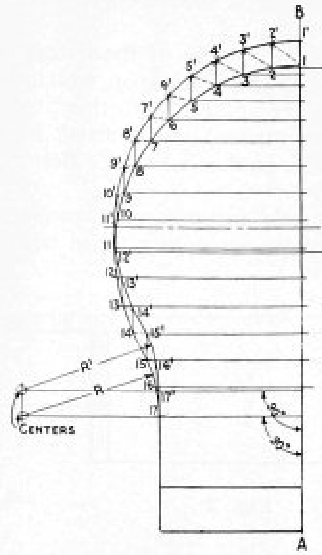

Fig. 3

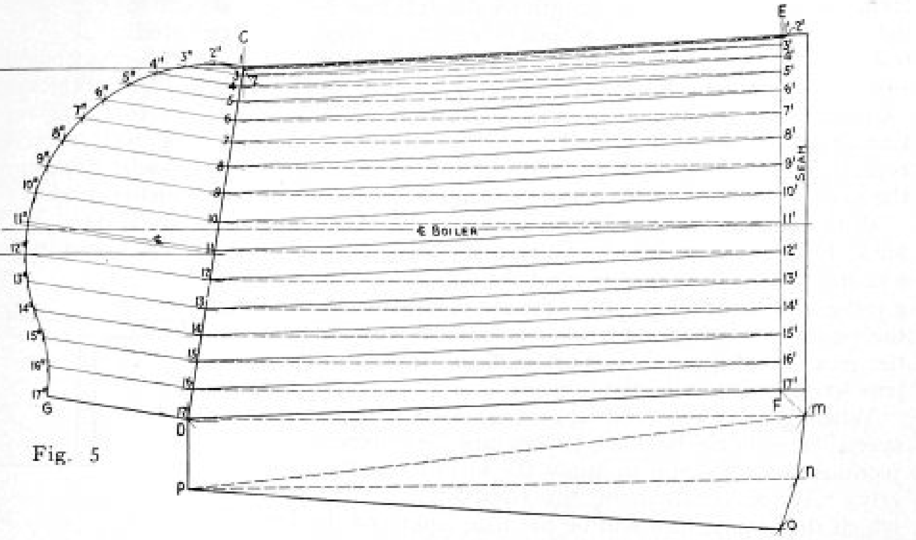

Fig. 5

Fig. 4

view. Note that the true lengths of the arcs on the large end will be as shown in the end view, Fig. 3, as *1'-2'*, *2'-3'*, *3'-4'*, etc.

In order to lay out the pattern, it is necessary to get the true lengths of the long construction lines drawn on the side view. These are found after the method shown in Fig. 6. A perpendicular line is drawn; and on this a distance is laid off equal to the distance measured parallel to the center line between the two ends of the sheet in the side view as *1-1'*, *2-2'*, *3-3'*. This distance must be measured for each of the points, because the sloping point increases the lengths counting downward. Then draw a horizontal line through this point laid off in Fig. 6. On this horizontal line lay off a distance equal to the lengths of the solid lines *1-1'*, *2-2'*, *3-3'*, etc., of the end view. Also lay off a distance equal to the length of the broken lines *1-2'*, *2-3'*, *3-4'*, etc., of the end view. Then in each case the sloping lines in Fig. 6 between these respective points will be the true length of the solid or broken lines in the side view.

Construction of the Pattern

To construct the pattern, first set a pair of dividers equal to the spaces *1'-2'*, *2'-3'*, *3'-4'* of the end view, Fig. 3. Begin by drawing the line *A-B*, Fig. 7, and with the trams set equal to the distance *1-1'* of the side view, Fig. 4, and with *1* as a center scribe an arc cutting the line *A-B* setting off the distance *1-1'*. Then with the dividers set equal to *1'-2'*, *2'-3'*, etc., of Fig. 3 and with *1'* as a center, scribe an arc. Then with the trams set equal to the true lengths of the broken line *1-2'* of the side view, Fig. 4, this distance being taken from Fig. 6, and with *1* as a center scribe an arc, cutting the arc just made, locating the point *2'*.

With the dividers set equal to the distance *1-2'*, Fig. 5, and with *1* as a center scribe an arc. Then with the

Fig. 7

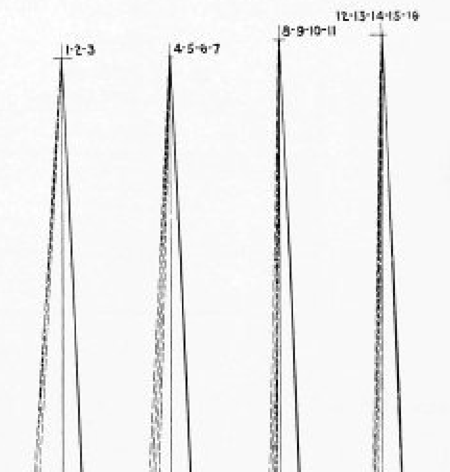

Fig. 6

trams set equal to the true length of the full line *2-2'* of the side view, Fig. 4, this distance being taken from Fig. 6 and with *2'* as a center, scribe an arc, cutting the arc just made, locating the point *2*.

Continue in this manner until the line *17-17'* is reached. Connect the points *1* to *17* and *1'* to *17'* with curved lines completing the pattern to this point. Now parallel to the line *1'-17'* add on the necessary amount for the seam.

With *17'* as a center and the distance *17'-M* of the side view, Fig. 4, as a radius, scribe an arc. Then with *17* as a center and the distance *17-m* of the side view, Fig. 4, as a radius, scribe an arc, cutting the arc just made, locating the point *m*. The pattern is completed in this manner, the remaining lines of the pattern being shown in their true length in the side view, Fig. 4.

When getting the true lengths of each of the lines, special care should be taken to measure the different projections correctly and to apply the measurements properly. When constructing the right-angle triangles in which the hypotenuse will be the true length of the line required, instead of using a single diagram as in Fig. 6 for getting the true lengths of the construction lines, lay out a special diagram for each line, numbering the points corresponding to the points taken from the different views. This method will avoid the risk of making mistakes in the measurements.

It was necessary to assume the contour of the plate at the firebox ring corners as the drawings of the firebox ring corners were not submitted, and there was not enough information on the blue prints submitted to locate the correct contour of the sheets at these points.

Tank Design Problems

Q.—As a subscriber to your valuable journal and an interested reader of your section, I would appreciate your help in some problems in tank work. How can I determine the proper thickness for the flange on a pressure tank manhole? Working pressure on tank to be 125 pounds per square inch. Diameter of manhole, 18 inches inside. T. J. G.

A.—Tank manhole frames and reinforcing rings should be made so that the strength of the frame and reinforcing ring used shall be at least equal to the tensile strength of the maximum amount of shell plate removed by the opening and the rivet holes for the reinforcement

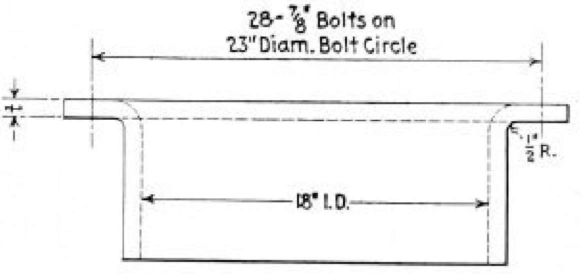

Fig. 1

on any line parallel to the longitudinal axis of the shell through the manhole, or other openings.

When a flanged manhole frame is used, the flanged portion of the frame may be considered as reinforcement up to a height *h* of three times the flange thickness.

In order to determine the thickness of the flange *t* for the manhole submitted with the question, and shown as Fig. 1, it is first necessary to compute the tensile strength of the tank plate removed, taken on a line parallel to the longitudinal axis of the shell.

The thickness *t* is then made so that the strength of the cross-sectional area of that portion of the flange shown in Fig. 2 is equal to the strength of the plate removed.

In no case should the thickness of the flange be taken less than the thickness of the plate upon which it rests.

The following rules are applicable to this problem: The Rules for Construction of Unfired Pressure Vessels, Section VIII of the A.S.M.E. Boiler Construction Code.

Par. U-54. All vessels for use with compressed air over 36 inches in diameter, excepting those whose shape

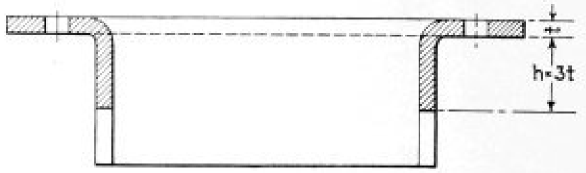

Fig. 2

or use make it impracticable, shall have a manhole. An elliptical manhole opening shall be not less than 11 by 15 inches, or 10 by 16 inches in size. A circular manhole opening shall be not less than 15 inches in diameter.

U-55. A manhole reinforcing ring, when used, shall be of rolled, forged or cast steel, shall be at least as thick as the shell plate, and shall have a net cross-sectional area, on a line parallel to the axis of the shell, not less than the cross-sectional area of shell plate removed on the same line.

U-56. Manhole frames on shells shall have the proper curvature and, when the diameter exceeds 48 inches, shall be riveted to the shell with two rows of rivets.

U-57. The strength of the rivets in shear on each side of a frame or ring reinforcing manholes or other openings such as those cut for steel nozzles and flanges over three-inch pipe size, shall be at least equal to the tensile strength (required by Par. U-20) of the maximum amount of the shell plate removed by the opening and rivet holes for the reinforcement on any line parallel to the longitudinal axis of the shell, through the manhole, or other opening.

Tube Company Expands Plant

THE $400,000 plant expansion program of The Ohio Seamless Tube Company, Shelby, O., will be completed by December 1, it is announced by A. C. Morse, president of the company. The new buildings and equipment will be in operation by the first of the year, increasing the productive capacity of the company by 40 percent, in line with expanding requirements for the company's products.

The company has declared a quarterly dividend of $1.00 a share on the no par common stock. The dividend is payable November 15 to stockholders of record October 31. The company this year is paying $4.00 a share on its common stock, as against $3.50 in 1928 and $3.00 in 1927. The Ohio Seamless Tube Company is the country's largest producer of cold-drawn seamless steel tubing.

The Chicago headquarters of the American Cable Company have been moved to the recently completed Chicago Daily News Building, 400 West Madison street, Chicago, Ill.

Associations

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Assistant International President—William Atkinson, suite 522, Brotherhood Block, Kansas City, Kansas.

International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.

Editor-Manager of Journal—John J. Barry, Suite 524, Brotherhood Block, Kansas City, Kansas.

International Vice-Presidents—John J. Dowd, 142 Pearsall Ave., Jersey City, N. J.; M. A. Maher, 2001 20th St., Portsmouth, O.; R. C. McCutchan, 226 Lipton St., Winnipeg, Man., Canada; H. J. Norton, Alcazar Hotel, San Francisco, Cal.; C. A. McDonald, Box B93 Route 2, Independence, Mo.; J. N. Davis, 1211 Gallatin St., N. W. Washington, D. C.; M. F. Glenn, 1434 E. 93rd St., Cleveland, O.; W. J. Coyle, 424 Third Ave., Verdun, Montreal, Canada; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; J. F. Schmitt, 25 Crestview Rd., Columbus, O.

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States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W.Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.
	Evanston, Ill.	

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash.	Parkersburg W. Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

Selected Boiler Patents

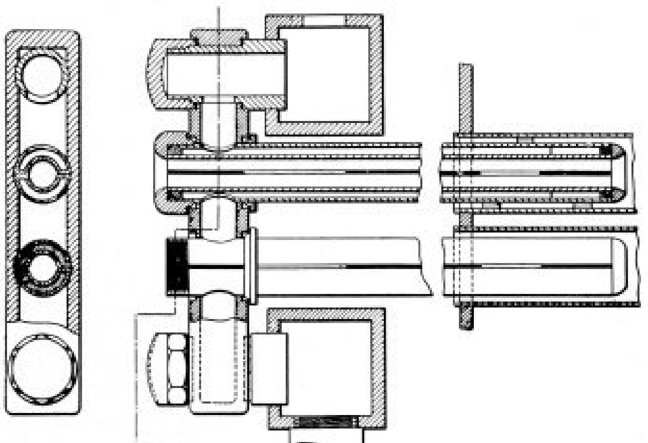
Compiled by
DWIGHT G. GALT, Patent Attorney,

Washington Loan and Trust Building,
Washington, D. C.

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

1,708,054. STEAM SUPERHEATER. HENRY CRUSE, OF HYDE, ENGLAND.

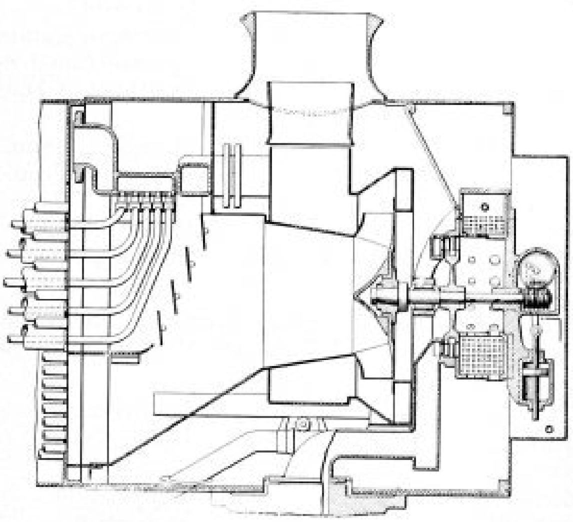
Claim.—A superheater element comprising two substantially semi-annular tubes connected at their longitudinal edges to form a tubular passage for the flow of hot gases, openings provided on the outer walls of each near



one end for admission of steam to one and discharge of steam from the other, means closing each semi-annular tube at this end, and means at the other end of said tubes forming an annular passage connecting the two tubes to enable steam flowing up one tube to flow down the other tube in contrary direction. Six claims.

1,709,533. LOCOMOTIVE-BOILER-FEED APPARATUS. NATHAN M. LOWER, OF BELLEVUE, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE STANDARD STOKER COMPANY, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

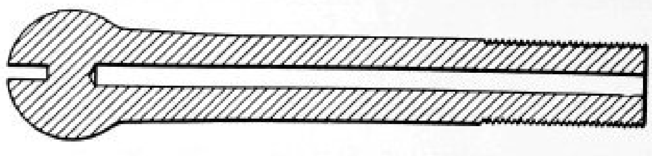
Claim.—The combination with a steam locomotive smokebox and a draft fan therein receiving gases from boiler flues and discharging to the



stack, of a turbine on the fan shaft operated by the locomotive exhaust steam, a feedwater heater for the locomotive around the shaft receiving the turbine exhaust; and a feed pump for the locomotive in front of said feedwater heater driven by the shaft. Three claims.

1,711,196. MANUFACTURE OF STAY BOLTS. HENRY M. CURRY, JR., OF PITTSBURGH, AND LEO FINEGAN, OF ZELIENOPLE, PENNSYLVANIA, ASSIGNORS TO THE PREMIER STAYBOLT COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

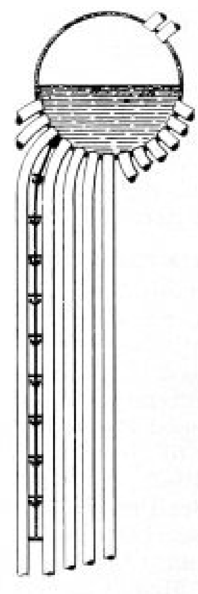
Claim.—The method of making hollow staybolts, which includes providing a cylindrical blank of greater diameter and less length than the finished bolt, boring out the center of said blank for part of its length to form a bore of materially greater diameter than the bore in the finished bolt, reducing said blank over its entire length without providing an internal support for said bored out portion so as to simultaneously elongate and reduce the diameter of said blank and said hollow center, upsetting the solid end of said blank to form a head portion extending



beyond the closed end of said bore, permitting the metal of said blank to flow both outwardly and inwardly over a short length of the bored out portion of said blank adjoining the solid end during said upsetting operation to form a tapered portion of shank adjoining said head and to prevent the closing of the bore of said shank, said upsetting operation resulting in reducing the diameter of but not closing the bore in said blank adjacent its closed end and in shortening said blank to the length of the finished bolt, reaming out said bore adjacent said head end of said blank to true up its diameter, and finally threading the unheaded end of said blank to finish the bolt.

1,680,314. BAFFLE FOR WATERTUBE BOILERS. NORMAN APPENZELLER, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO KIDWELL BOILER COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

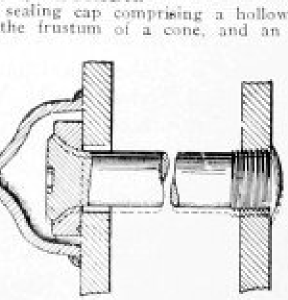
Claim.—In a boiler of the series drum and tube type, the combination with the rearward bank of watertubes and the overlying drum to which they are connected, of integral cast iron baffle plates assembled in successive rows between adjacent tubes, the abutting longitudinal edges of the



plates of the respective rows having articulated joints, said joints being formed by similar laterally extending flanges along the edges of the plates of one row, there being a relatively wide arcuate groove between the flanges in which are seated the edges of the plates in adjacent rows, and means supporting the assembled plates and maintaining the uppermost row thereof in close relation to the said drum. Nine claims.

1,691,828. STAY-BOLT CONSTRUCTION. FRANK W. SHUPERT, OF SANFORD, FLORIDA.

Claim.—A staybolt sealing cap comprising a hollow ring-like base portion in the form of the frustum of a cone, and an integral hollow ap-



proximately conical outer portion, the external surface of which is inclined to a greater degree with respect to the axis of the cap than the external surface of the base portion, said base and conical portions having internal surfaces substantially conforming in angularity to the external surfaces of said portions to provide a compartment in the cap which is largest at the base portion and therefrom restricted to the top of the conical portion.

The Boiler Maker

Name registered U. S. Patent Office

Volume XXIX — December, 1929 — Number 12

PUBLISHED MONTHLY BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

THE BOILER MAKER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

Subscription price: United States, Canada and Mexico, $2.00; foreign countries, $3.00. Single copy 35 cents.

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Contents

Annual Index

THE annual index of THE BOILER MAKER for the year 1929 will be published separately from the magazine before the end of this month. As the complete index will be useful only to those who have kept a complete file of the magazine for the year, only a sufficient number of copies will be printed to meet the requirements of readers who notify us of their desire for a copy.

A copy of the annual index will be mailed without cost to each subscriber whose request for it is received at our New York office on or before January 1, 1930.

Revision of the Steamboat Inspection Boiler Rules

SOME time ago the United States Steamboat Inspection Service invited from steamship companies, shipbuilders, boiler makers, steel manufacturers and others interested criticisms of a tentative revision of its boiler rules which it proposes to submit to its Board of Supervising Inspectors for action at its next annual meeting. The copies of the proposed rules that were sent out for criticism were made by the American Society of Mechanical Engineers. The bulk of the text of the proposed rules was taken bodily from the A. S. M. E. boiler code for stationary boilers, with no modification or adaptation to marine requirements. The head of the Steamboat Inspection Service is a lawyer. Its staff is composed of practical men qualified by sea-going experience to perform their duties as inspectors but not by technical training to undertake the difficult engineering task of compiling a set of boiler rules to serve as a new standard for marine practice. In view of its lack of a technical staff it is apparent that the Steamboat Inspection Service, in attempting to revise its boiler rules, has gone outside the marine field and depended largely upon the established boiler standards in the stationary field for the substance of its new rules. The proposed rules are so unsatisfactory to the shipbuilders and shipowners that the council of the Society of Naval Architects and Marine Engineers appointed a committee at the recent annual meeting of the society to present to the Secretary of Commerce a protest against the adoption of these rules.

There is no question of the need of a thorough revision of the Steamboat Inspection boiler rules. This has long been recognized, and, in order to establish a single standard to which all American marine boilers might conform, the marine industry itself, through the American Marine Standards Committee has compiled standard rules for the design and construction of marine boilers and pressure vessels which are based on marine practice which has proved satisfactory not only in this country but abroad and which embody the latest developments in marine boiler design. These rules conform to the modern rules of the ship classification societies and they were made in collaboration with the United States Steamboat Inspection Service, the American Bureau of Shipping, the A. S. M. E. Boiler Code Committee and all other interests concerned. The common sense solution of the matter is obviously the adoption of the American Marine Standards boiler rules by the Steamboat Inspection Service.

Boiler Welding

IT seems apparent from a study of the report of H. M. Longridge on the status of welding in England, as applied to boiler and pressure vessels (abstract elsewhere in this issue), that the same need for procedure rules exists as does in this country. The activity in this direction in the United States is probably more advanced, however, and tentative rules covering various phases of the work are now in the course of preparation by the American Society of Mechanical Engineers Boiler Code Committee and a Conference Committee of the American Welding Society. These rules will undoubtedly be issued shortly for criticism before action is taken on them.

No objection can be raised to the fusion welding processes as such; the difficulty in the past having been their proper application in various fields. In boiler and unfired pressure vessel construction requirements to be met are extremely severe and, until comparatively recent times, the element of uncertainty of welding methods and particularly of the human factor has reacted against its use for this form of construction. Control of the procedure or technique and the development of satisfactory tests have so rapidly advanced that now specific rules can be safely adopted, and absolutely safe pressure structures built in conformity with them. The lapse of time, that has occurred in bringing welding to the point where it can so be used, has not in any sense been wasted, for the improvements in methods and equipment of all processes has made success certain from the time that the rules, as finally developed, are put into effect.

Census Bureau Survey

EVEN before President Hoover's move to stabilize the industries of the country, after the recent financial break in Wall Street, the Bureau of the Census had underway a complete survey of production and methods of the various manufacturing industries of the country. In conjunction with the Bureau, the work was undertaken by a sub-committee of the Advisory Committee on Manufactures appointed by Secretary Lamont of the Department of Commerce.

The United States has been divided into 17 districts. Every community of any size in each of these districts has been card-indexed, and the local trade association and service clubs within 100 miles of the above cities have been requested to send delegates representing the local manufacturers and distributors to a conference of all community representatives of the district.

Several of these conferences have already been held with marked success while the remaining meetings will occur within the present month. The final report of the survey of the Census Bureau will be awaited with considerable interest as it will undoubtedly have a beneficial effect on the tone of business during the next year.

Communications

Staybolt Practice

TO THE EDITOR:

Your correspondent on "Staybolt Practice" in the November issue of THE BOILER MAKER by his questions brings out the problem which every foreman boiler maker has to contend with to a greater or lesser degree. How can I secure tight fitting staybolts and at the same time keep sufficient staybolts on hand ready for the staybolt men? is a question which a foreman is continually asking himself if he is on to his job. He knows from experience that seldom are there two taps alike. The makers are allowed a tolerance in diameter and pitch, then there is the wear of the tap, consequently a staybolt made to follow one tap will be either too large or too small to follow another tap.

The practice followed by most railroad shops is for the boiler maker to tap out a hole in the firebox, have a bolt threaded to suit the hole, and, when this is done, to have the head on the staybolt machine reserved to supply staybolts for this one man only. This slows up the output of staybolts considerably.

There are three main questions asked by your correspondent which I will answer. The question of machine capacity, threading heads, etc., is governed by the type of machine used and local facilities, and it is up to the man on the job to study how to get the best out of what he has.

(1) What is your method of connecting enlarged staybolt holes?

Holes on firebox sides, throat sheet and face sheet may be enlarged up to 1⅛ inches, and in the crown sheet up to 1 5/16 inches. When holes become too large to take these maximum size staybolts, the holes should be countersunk and reduced in size by welding. Leave hole in center and drive in ¾-inch drift pin while the metal is hot. This will save the cost of drilling, and drifting the hole round will facilitate reaming. Slight gouges made by a round nose chisel or acetylene torch can be cleaned and built up with the electric arc.

(2) How are staybolts sized to holes in boiler?

As stated before, the general practice is to make the bolts suit each individual tap. A better method is to have all holes made to suit a standard-size staybolt. This will permit mass production of staybolts. Care, however, should be taken to see that these stock staybolts are true to size. Frequent checking of bolts with standard gage will be necessary. The boiler maker will then tap out the holes in the firebox and try a standard staybolt. Should these bolts be too tight for the tapped holes, he will run in a sizing tap which is made 5/1000 oversize. A description of this staybolt sizing tap will be found on page 350 of the December, 1928, issue of THE BOILER MAKER. This tap will clean up the thread sufficiently to allow the staybolt to fit snugly. The threaded section of the sizing tap being only 1⅝ inches long will enable the holes to be cleaned up in a few seconds.

(3) What style of tap is most suited for tapping crown sheet?

The best style of crown taps are short taps about 12 inches long with plain and threaded spindles about 26 inches long. The thread of the threaded spindle must synchronize with the thread of the tap. Threaded spindle should be 3/4 inch in diameter and plain spindle 15/16 inch.

The outside holes are tapped first using a plain spindle tap. Afterwards tap the inside holes with a threaded spindle tap using a guide nut in the outside hole. If the guide nut is split in two lengthwise and fastened together with a hinge the operation will be speeded up considerably, as the split nut saves the necessity of having the threaded spindle run all the way through the nut.

Stratford, Ontario, Canada. R. W. BARRETT.

Oversize Staybolt Holes

TO THE EDITOR:

In answer to your communication re staybolt practice in the November issue. In my experience the practice we have followed on oversized staybolt holes in old sheets is to countersink the holes to allow the welder to get to the base, then apply a light bead weld, after which the holes are reamed out and retapped to the required size, and the weld chipped and dressed to make a finished job. I have found this practice very satisfactory and the same method may be applied to cracks which are chipped out and welded.

The definition of 11 or 12 threads means so many threads per inch. The profiling of staybolts does not mean the threads, but the bolts which generally come on the radius of the sheets over 10 inches in length, called radial bolts. These bolts are profiled; that is, the diameter between the thread at each end is reduced thus allowing about 2 1/2 or 3 inches of thread at each end. Owing to these bolts coming on the radius and at difficult angles for application, and the length, they would have a tendency to tear the thread on either bolt and sheet or at times both.

Staybolt sizing of bolts: A staybolt jig is made which consists of two plates of the same thickness as the firebox and wrapper, drilled the same size as the staybolt holes in the boiler, with four pieces of pipe of approximately the same length as the waterspace of the boiler placed between the plates and then bolted. Holes are then tapped with the same taps as you intend to tap your boiler. The bolts are then made to suit. Every two or three bolts are then tried in the jig and with pitch gage to see that they do not vary in size. It has been found that the best policy is to keep only a boiler or so ahead of the shop, as taps break and get worn and sometimes vary a few thousandths either way. Bolts have to be made accordingly or you will be getting tight and loose bolts which causes a lot of waste and unnecessary labor and loss of time which increases the cost.

A screwdriver is generally used to adjust the threading machine, and the chucks should be kept ground and in good condition at all times, or you will find the bolts out of pitch and at times the thread will be found tapered. This takes constant supervision by a good mechanic.

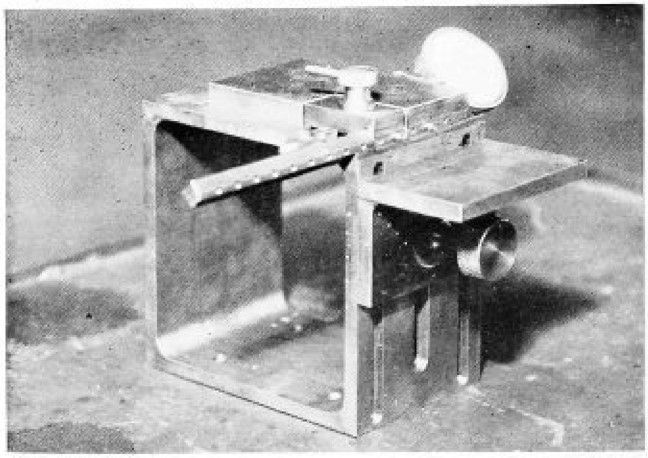
Crown bolts: After years of experience I have found taper-end bolts the best. These are generally tapered 1 1/2 inches in 12 inches, by 1 1/4 inches long at taper end, 11 and 12 threads, 1 5/32 inches and 1 1/8 inches at straight end, applied from the firebox to within 2 1/2 or 3 threads, then squares burnt off and riveted over, except four rows in front. The latter are generally flexible expansion bolts instead of old-style sling stay and tee irons. These bolts are applied with either welded or tapped sleeve riveted on inside of boiler.

Montreal, Canada. A. J. COADY.

Gage for Checking Tap Lead

R. B. LOVELAND, tool foreman of the Norfolk and Western Railroad, Roanoke, Va., in the report of the locomotive shop devices committee at the 1929 convention of the American Railway Tool Foremen's Association, submitted a device for checking the lead of taps.

The body of the tool illustrated for checking tap lead is constructed of four pieces of soft steel, 4 inches wide by 5 inches long by 5/16 inch thick, welded together in the form of a box, which is machined square. An

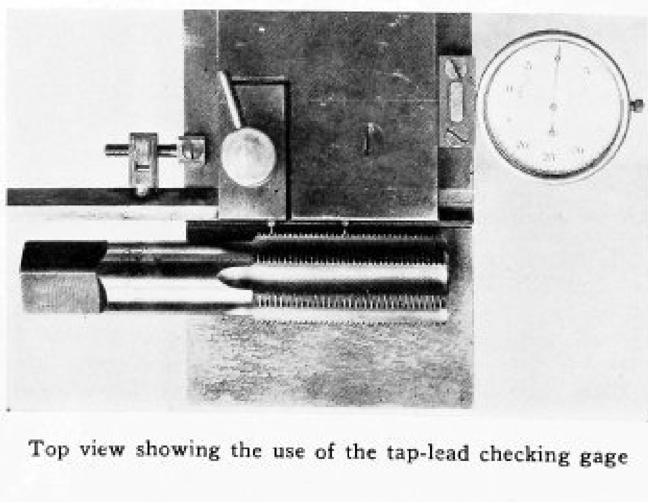


Gage for conveniently and accurately checking tap lead

angle cutter having an included angle of 90 degrees is run across the top at the front edge to make the seat for the adjustable and movable bars, which carry the ball points.

A piece of cast iron is machined 3 inches wide by 4 inches long by 1/2 inch thick, and the 90-degree cutter is then run across the front edge of this top piece near the end so as to make the other half of the seat for the adjustable and movable bars. Then a piece 1 inch wide by 1 3/4 inches long is sawed out of the front left-hand corner and 1/64 inch machined off the bottom so it will clamp the adjustable bar. A 3/8-inch hole is drilled and tapped through this piece and the body to accommodate the thumb screw. The rest of the top plate is doweled and screwed on the top of the body.

There are two bars, 7/16 inch square, which work through the seat made by the 90-degree cutter, one of them being adjustable and the other movable. The



Top view showing the use of the tap-lead checking gage adjustable bar is 7 inches long and has an adjustment screw. The front corner is machined off so as to leave a $\frac{3}{16}$-inch flat. It is then drilled and tapped at ½-inch intervals with a No. 5-40 tap to receive the ball point. The movable bar is 2 inches long and is drilled and tapped on the front ⅜ inch from the left end of the bar, with the same size tap to receive the second ball point. This bar is lapped in so it will fit free with no shake. On the back of this bar, in the center, a $\frac{3}{16}$-inch hole is drilled and tapped for a ¼-inch pin, 1¼ inches long. At this point a depression is milled in the frame and top piece to allow for this pin to move sideways .025 inch, and a clamp for holding the dial indicator is made.

A small angle plate is attached on the front of the body to act as a shelf to support the tap. The angle plate, which is held by a thumb screw, is graduated on the left side figuring from the center of the points so it can be quickly set at half diameter of the tap. For taper taps, a wedge having half the taper of the tap to be checked is used.

The ball points are made of tool steel and must be made in pairs, having the same distance from the shoulder to the center of the ball. They are hardened and ground.

For 12 U. S. threads per inch the ball is 0.49 inch in diameter; 14 threads, 0.42 inch in diameter; 16 threads, 0.36 inch in diameter, etc. By having a ball point of the proper diameter, it is made possible to check on the pitch diameter which is the correct method. For checking taper taps a washer is used to get the point out a distance of half the taper of the tap.

It will be noted that with the holes in the adjustable bar it is possible to check one inch of the length of the tap or at ½-inch intervals to 6 inches, as desired. Gage blocks are used to set up this instrument, but it is possible to set up with micrometers.

John Amos Stevens Dies

JOHN A. STEVENS, engineer, for many years chairman of the American Society of Mechanical Engineers committee for standardizing steam boiler construction, known as the Boiler Code Committee, died at his home in Lowell, Mass., on November 18, after a long illness. He was 61 years old. Mr. Stevens was born at Galva, Ill., September 16, 1868, the son of a merchant. He was educated in the public schools and after graduation from the Saginaw, Mich., high school attended the University of Michigan for one year. He then became an apprentice machinist in the shop of Mitts and Merrill, of Saginaw, where he remained for three years. Another year was spent with the Pere Marquette Railroad as assistant toolmaker. It was at the end of this period that Mr. Stevens turned his attention to steam engineering, his first work along this line being as engineer on a number of Great Lakes steamers.

In 1893 he came East and entered the transatlantic steamship service, in the employ of the International Navigation Company of New York. He served on a number of this company's liners and devoted himself to this work with so much efficiency and ability that in less than three years he was first assistant engineer of the *St. Paul*, then one of the crack transatlantic liners. At the age of only 27 he obtained an unlimited engineer's license for ocean steamships, the highest classed license issued.

In 1896 he withdrew from marine work and accepted the position as chief engineer of the Merrimac Manufacturing Company of Lowell, Mass., one of the largest industrial establishments of New England. Mr. Stevens held this position for 13 years and during this time practically rebuilt the entire steam plant at Lowell, and at the same time superintended the design and building of the power departments in the company's new southern mills.

In 1909 he resigned his position with the Merrimac Company and went abroad for three months for the purpose of gathering special information for steam boilers, steam turbines and condensers. On his return from Europe he opened an office as general consulting engineer, specializing, however, in light, heat and power work.

Mr. Stevens had been granted thirteen patents containing 113 claims on watertube boilers as well as on the American steam superheater. He is also co-inventor of the Stevens-Pratt boiler, which is especially designed for large central-station service. He had also been allowed eleven patents on shock absorbing devices.

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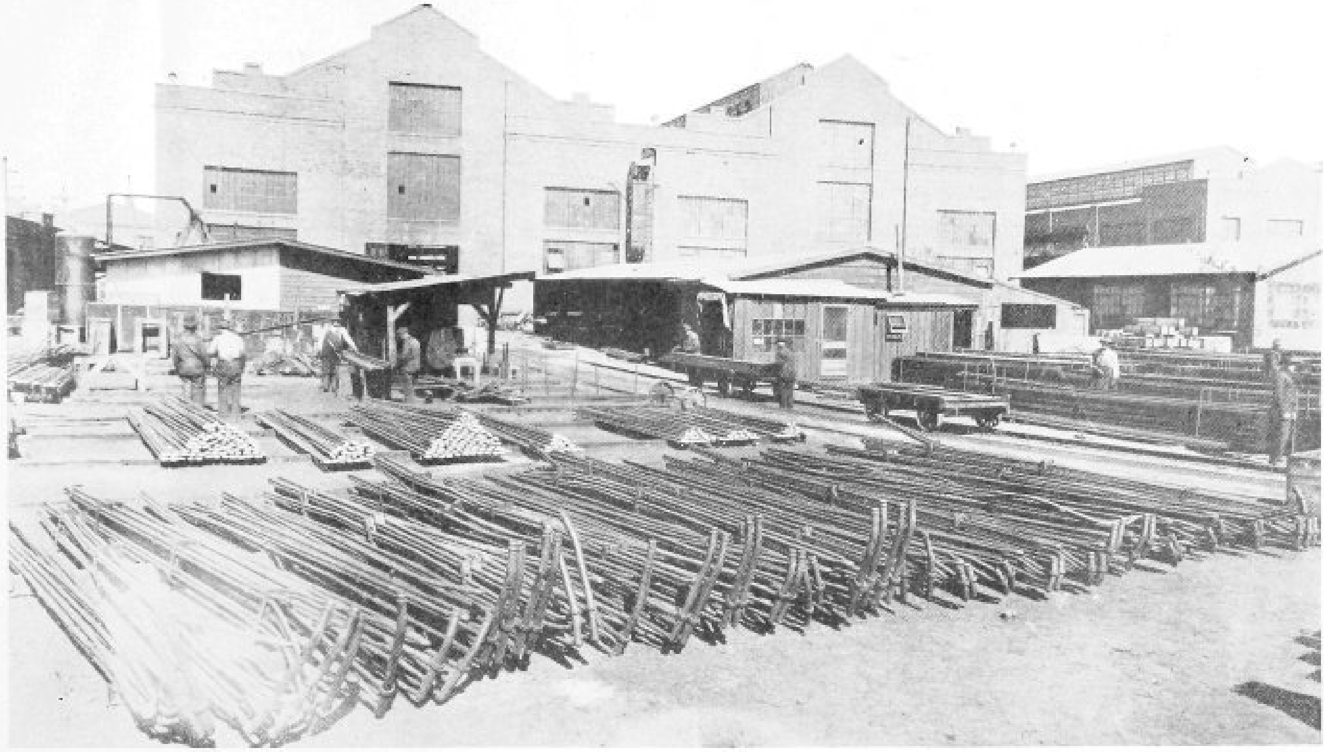
John Amos Stevens

He was a member of the original Massachusetts Board of Boiler Rules, on which he represented the boiler-using interests. He continued his membership on this board for a number of years and was most effectively active in the compilation and publication of the rules for the manufacture and inspection of stationary steam boilers in Massachusetts issued by the Board in 1909.

In 1911 he was appointed chairman of the Boiler Code Committee by the American Society of Mechanical Engineers, for the purpose of preparing a standard boiler code in a more complete manner than was pos-

(*Continued on page 364*)



Re-manufacturing unserviceable superheater units

Reconditioning Superheater Units

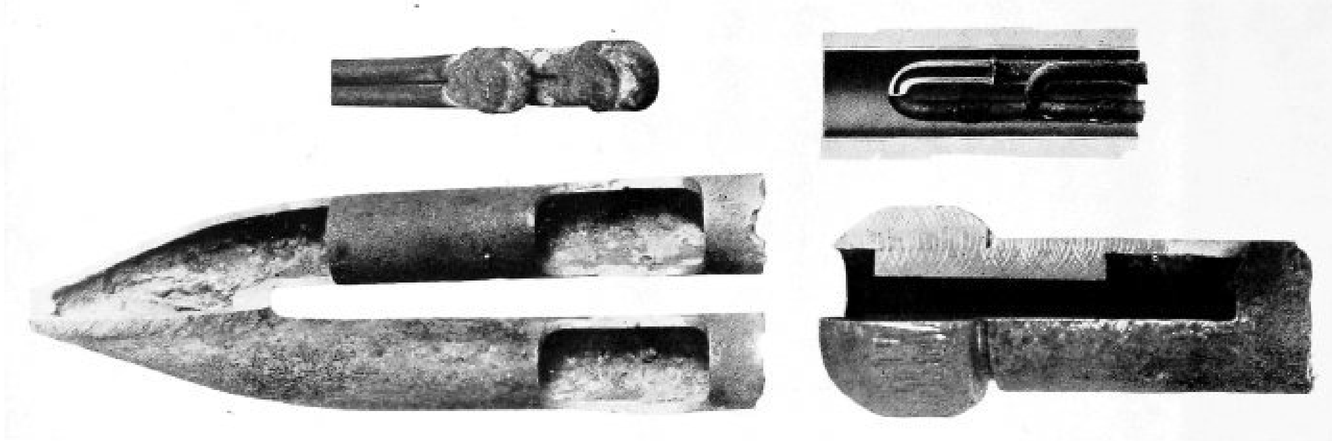
Methods used by Superheater Company in re-manufacturing worn units

THE value of the superheater in American locomotive practice has for a number of years been so well established as to require no further demonstration. And yet, maximum returns from the investment in superheater equipment cannot be realized unless the units are maintained tight against leaks, of the proper length and diameter, to provide a minimum restriction to steam flow through the units and to the flow of gas through the flues.

Experience has shown a very satisfactory service life for superheater units, in all types of locomotives under a wide range of operating conditions, where reasonable care has been exercised in handling and maintenance. In some cases, superheater-unit tubing shows no appreciable deterioration after 15 years of hard service; however, the average effective life under normal service has been found to be about 10 years. Occasionally a careful examination of units shows corrosion of the tubing which apparently could only have been caused by exposure to the weather, or improper storage of the locomotive. Whatever may be the cause, when superheater units become unserviceable, a railroad is faced with two alternatives, namely to make temporary and more or less makeshift repairs which in the long run prove uneconomical, or to have the units overhauled and completely reconditioned, providing a subsequent life practically the same as new.

Steps in the manufacturing process of the return bend

Railroads are not in a position to recondition superheater units with

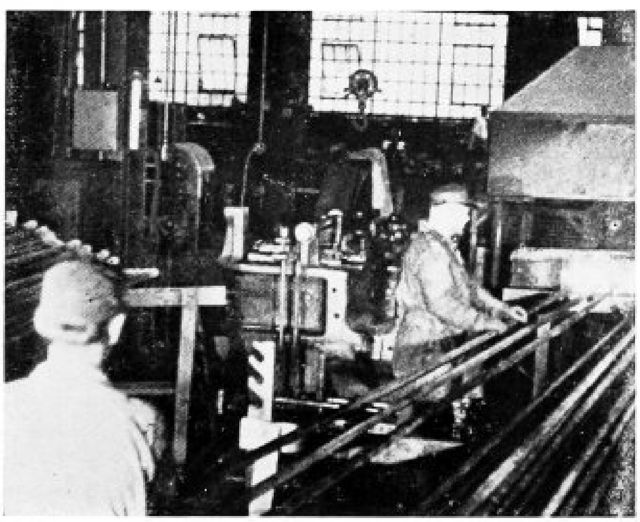


Typical examples of expensive departures from standard superheater unit design

entire satisfaction for themselves, because regular railway shop machinery does not contain the special equipment required, nor the volume of work to justify investment in the special machinery.

With its specialized experience, carefully developed equipment and methods in manufacturing new superheater units, The Superheater Company and The Superheater Company, Ltd., are fitted to provide the railroads with an efficient re-manufacturing service at their respective plants in East Chicago, Ind., and Sherbrooke, Que.

Several thousand sets of units, received from railroads throughout the United States, Canada and Cuba at these plants during the past twelve months, were stripped, obsolete and defective return bends and ball ends cut off, new tubes applied where necessary, new return bends and ball ends machine forged integral with the tubing, the units restored to their original length, tested, rebanded, ball ends ground, blocked, painted and shipped back to the railroads, tagged by locomotive classifications ready to go directly into their stores. In fact, these units moved through the same schedule of operations as new units, being in a real sense of the word "re-manufactured," and possessing practically the same potential service life as new units. Their similarity in appearance to new units is such that railroad managements have requested that their manufactured units be painted red as a means of identification from new units, which are painted black, and this is now standard practice.



Pipe ends being heated preparatory to upsetting ends for ball ends

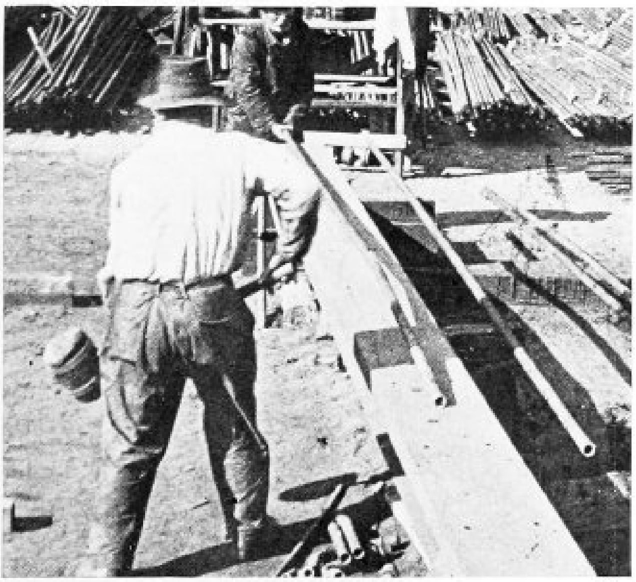
Unserviceable superheater units, received at the plants of The Superheater Company for remanufacturing, are unloaded by crane on a stock pile, adjacent to which is a classifying bench with a graduated channel-iron upright for readily checking dimensions and identifying the class of unit. An inspector at this bench, hammer tests each unit carefully, inspects the return bends, ball ends and pipe, and classifies each unit as to the kind of service necessary. A special metal tag is then wired to each unit designating the class of service, class of locomotive and name of road.

Ends of unit pipes being heated preparatory to the forging process by which pipes are joined together by forged return bends

Class A service calls for no new tubing. But the return bends are re-forged. In the case of Class B service, only the two straight or shorter pipes are again used, the long bent pipes being removed and all return bends and ball ends also renewed. Both classes of service include applying new bands and supports; facing, grinding and blocking the ball ends; and furnishing one new heat-treated bolt, washer and nut with each unit.

The first operation following inspection consists of cutting the bands on each unit with heavy hand shears and shearing off the return bends and ball ends on a small power-operated machine with V-knife which removes the ends without flattening the tubing. Faulty return bends, resulting from attempts to repair with facilities at hand in the railroad shops, frequently are found enlarged 10 percent in outside diameter and with a 25-percent reduction in steam carrying capacity, reducing the efficiency of the superheater correspondingly and indicating a serious lack of appreciation of the necessity for maintaining original superheater-unit dimensions. After shearing, the good tubing is straightened carefully on a long straight metal table, a wooden maul of large dimensions being used to avoid denting the tubing. The tubing is then ready for the forge shop.

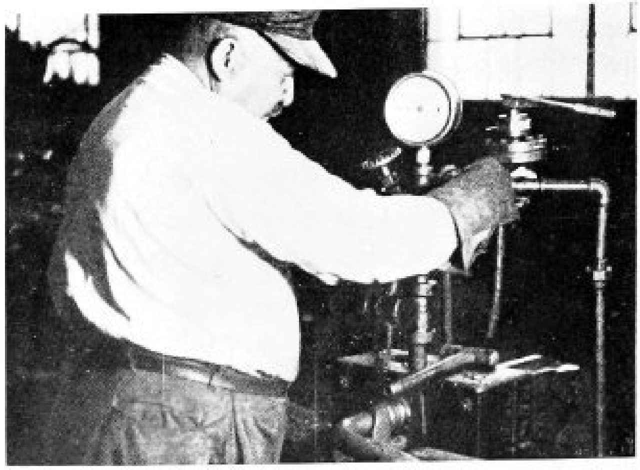
The first operation in the forge shop consists of forming the ball ends which is done by upsetting, a three-operation die being used in this process to prevent "cold-shut" creasing of the pipe. The tubing with ball ends is then bent cold in a special machine which performs this operation without denting the pipe or reducing the full cross-sectional area. The pipes are offset a proper amount in the same type of machine, and then are assembled for the forging of return bends. Temporary key clamps placed on the pipes keep them in the correct position during the forging operations.



All unit tubing must be straight and true to gage before going to the forge shop. Man straightening a length of pipe with a wooden maul

A battery of special machines performs successive operations in forging the return bends, this being a machine-forging job throughout. In the initial operation, the breeches piece is formed in one operation. A preliminary swaging operation follows and then the final closing of the weld with two subsequent flattening and finishing operations. A total of five forging operations is thus required with three heats to forge each return bend completely. This form of return bend gives a construction stronger than the original metal and presents a minimum obstruction to the flow of the gases. The greatest care is exercised in controlling the forging-machine operations, test return bends being cut open after each die change and, at least, twice daily to make sure that the proper wall thickness is maintained. The cross-sectional area is also checked by means of a planimeter.

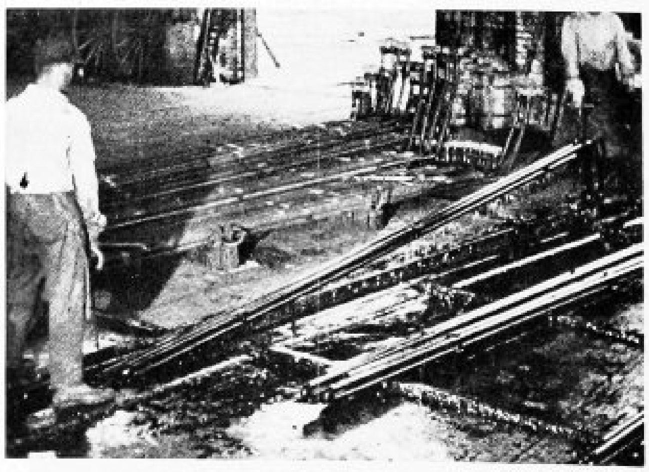
Following the forging operations, each unit is given a 1000-pound hydrostatic test which shows up any defect quickly. The bands and supports are then placed on the unit to hold the tubes tightly together, prevent vibration and keep the unit at the proper location in the flue. A spot weld on either side of the support maintains its correct position on the unit. When the units have been completely assembled, the ball ends are carefully ground, having been previously reamed and filed to removed any burrs. Special tools and gages that are hardened and kept ground to precision assure a correct contour on the unit joint. Wooden blocks filled with grease are then bolted in place over the ball ends to protect the ground surfaces. Before shipping, the units are dipped in a red paint bath for protection.



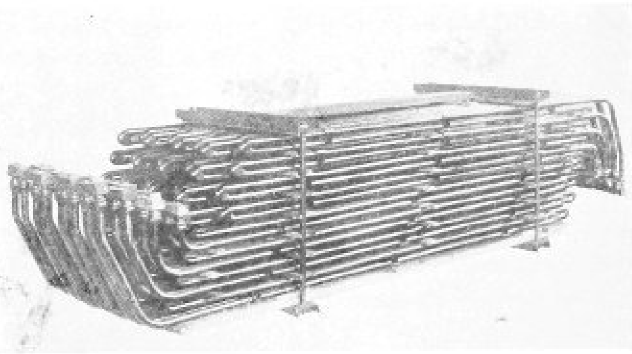
Every unit is given a 1000-pound hydrostatic test

An entire department at the East Chicago plant is devoted to the question of superheater headers. These headers, poured from a mixture of high-grade pig iron and steel scrap, are designed to have the close-grained, uniform softness and smooth texture of the best gray iron. The machine shop is provided with the latest equipment for the rapid and accurate machining of these headers. Unit ball-end seats in the header are finished and tested with the same precise methods described in connection with making the ball ends.

A special department is also maintained for the manufacture of the bolts and nuts, with which the units are held in place against the header. To prevent the stretching of the unit clamp bolts and consequent leaking of the joints at the header, all bolts are made of alloy steel, specially heat-treated. These bolts, as determined



Painting units before shipment—Re-manufactured units are painted red to distinguish them from new units



A complete set of re-manufactured units ready to ship

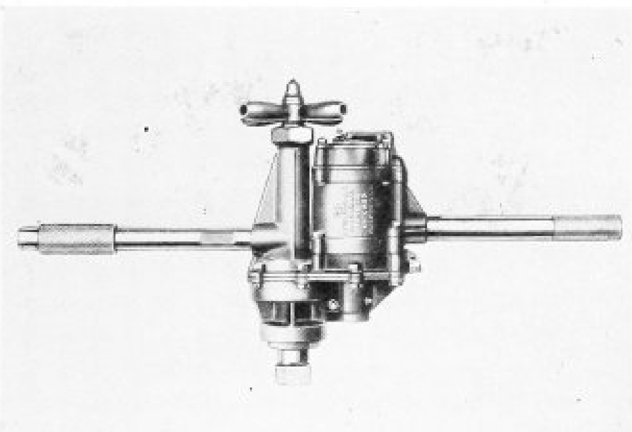
by frequent tests in the laboratory testing machines, develop a tensile strength in excess of 100,000 pounds per square inch and an elastic limit of 75,000 pounds per square inch. These bolts, in connection with special nuts, are designed to provide the necessary physical qualities for permanently holding the units tight against the header under widely varying temperature conditions encountered in the smokebox.

Rotary-Type Pneumatic Drill

THE Independent Pneumatic Tool Company Chicago, Ill., has developed a new rotary pneumatic drill, the Thor 275. It was designed to eliminate the mechanical inefficiency in the piston-type tools, which eat up power and have speed limitations, due to the recipracating motion of pistons, connecting rods and valve gear. In the Thor 275 drill, there are no inertia forces to overcome in starting and stopping pistons and connecting rods over top and bottom centers of a crank motion.

The drill has a drilling capacity of 1½-inches and a reaming capacity of 1⅛-inches. Its governed free speed is 350 revolutions per minute and the weight is 35 pounds.

It is a one man drill and operates smoothly and without vibration. One of its features is that it carries a 50-pound load at the same speed that it runs free. It carries a 100-pound load at a reduction in speed of only 30 percent. This is made possible because the governor has opened the throttle. It is claimed that between holes the Thor 275 does not race or tear itself to pieces, wasting air, but because its speed is governed, it idles along consuming only a few feet of air. Because of its construction, it gets in close on the side without removing the dead handle. Special cast iron with nickel is used in the cylinder to withstand rotor blade wear. Ball bearings are used throughout the tool, including the spindle and gear.



Thor drill has increased efficiency over piston-type tools

Work of the A.S.M.E. Boiler Code Committee

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Any one desiring information as to the application of the code is requested to communicate with the secretary of the committee, 29 West 39th St., New York, N. Y.

The procedure of the committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the secretary of the committee to all of the members of the committee. The interpretation, in the form of a reply, is then prepared by the committee and passed upon at a regular meeting of the committee. This interpretation is later submitted to the council of the society for approval, after which it is issued to the inquirer.

Below are given records of the interpretations of the committee in Cases Nos. 630-636, inclusive, as formulated at the meeting on September 20, 1929, all having been approved by the council. In accordance with established practice, names of inquirers have been omitted.

CASE No. 630—*Inquiry:* Is it permissible to rivet cast-iron nozzles to the shells or heads of steam drums or purifiers to be installed ahead of the boiler stop valve, this construction to be limited to operating pressures less than 250 pounds per square inch, and steam temperatures not exceeding 450 degrees F.? If it is not permissible up to these limits, to what limits of pressure and temperature may this construction be employed?

Reply: A steam drum or reservoir connected to a boiler without any intervening stop valve will be classified for construction requirements as a part of a steam boiler and the provisions of Par. P-12 must therefore apply.

CASE No. 631—*Inquiry:* Is it the intent of Par. P-230*a* of the code that the factor *W* in the formula, referring to extreme distance between supports, should refer to the points of bearing of the crown bar or girder stay; or does it refer to the width of the furnace or combustion chamber?

Reply: It is the intent of the factor *W* in the formula in Par. P-230*a* to refer to the distance between the inside of the tube sheet to the inside of the back connection plate.

CASE No. 632—*Inquiry:* Is it not permissible, under the revised Par. U-59 of the code, to use screwed fittings for pressures up to and including 125 pounds per square inch? As the third section of the paragraph is worded, there is no provision made for the pressure of 125 pounds.

Reply: As this revision has been worded, it inadvertently omits reference to the working pressure of 125 pounds per square inch. It is the opinion of the committee that the last sentence of this paragraph should be corrected to read as follows: "For pressures of 125 pounds per square inch or less, a screwed fitting may be used."

Case No. 633 (In the hands of the Committee).

Case No. 634—*Inquiry:* Will a water-relief valve, which has several markings of the pressure at which it is set to blow, meet the requirements of Pars. H-51 and H-104 of the code, provided the adjusting screw has an indicator which points toward several stamped figures corresponding to relieving pressures at which it will operate within a limit of error of 5 percent, and the adjusting screw is so designed that the valve cannot be set for a higher relieving pressure than the largest relieving pressure stamped thereon?

Reply: It is the opinion of the committee that the relief valve described meets the code requirements. The rules in the code are not sufficiently explicit to cover this type of valve, and it is the intention of the committee to so modify the requirements that they will require a relief valve that cannot be set at a higher pressure than the maximum allowable working pressure of the boiler.

Case No. 635—*Inquiry:* Is it necessary to adhere to the requirement in Par. P-265 of the code for a washout plug in the front head at or about the line of the crown sheet, when this space is obstructed by a smokebox? It is the practice with such firebox-type boilers having return tubes with the smokebox at the front head to place washout plugs in each of the side sheets at or about the line of the crown sheet.

Reply: It is the opinion of the committee that if washout plugs are located in either side sheet at or about the line of the crown sheet so as to afford convenient access to the crown sheet for purposes of cleaning, the spirit of the requirement in Par. P-265 will be met. Attention is called, however, to the requirements of Par. P-268.

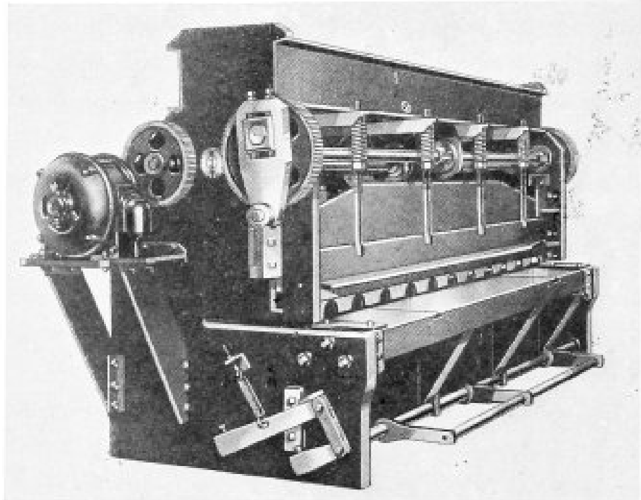
Case No. 636—*Inquiry:* Is it necessary to disregard the relieving capacity of a safety valve mounted on a superheater, if a soot-blower connection is made to a tee inserted between the safety valve and the superheater as is provided for in Case No. 548? It is noted that Case No. 600 requires that the full complement of safety valves be installed on the boiler in case there is a shut-off valve located between a superheater and its safety valve, but it is pointed out that a soot-blower connection will not prevent operation of the superheater safety valve.

Reply: The installation of a soot-blower connection between a superheater and its safety valve, as is provided for in Case No. 548, will not affect the application of the requirement in Par. P-288 of the code relating to computation of relieving capacity, and the relieving capacity of the superheater safety valve may be included as therein provided.

Overhead-Drive Gap Shears

The Dries & Krump Manufacturing Company, makers of the Chicago steel power squaring shears, Chicago, Ill., has recently perfected an overhead-drive gap shear for use in shearing and cutting metals of all kinds. This type shear is of all-steel welded construction, similar to the under-drive shear manufactured by this company. It is unbreakable and non-deflecting. Timken roller bearings on the flywheel shaft, insures ease of operation and the safety of power and the super-uniform pressure holddown used in all of the Chicago steel power shears, assures the utmost in the equalization of the enormous holding pressure produced.

A feature of this type of shear not found in other shears is the simple adjustment in the connecting bars in raising and lowering the upper knife bar. This adjustment is necessary in the change from shearing of sheets requiring one stroke only of the upper knife bar to the shearing of sheets requiring more than one stroke of the upper knife bar. In shearing a sheet requiring just one stroke, the blades should pass one another at the finishing point, while in shearing a sheet requiring more than one stroke, the blades should meet within the



Dries & Krump gap shears having overhead drive

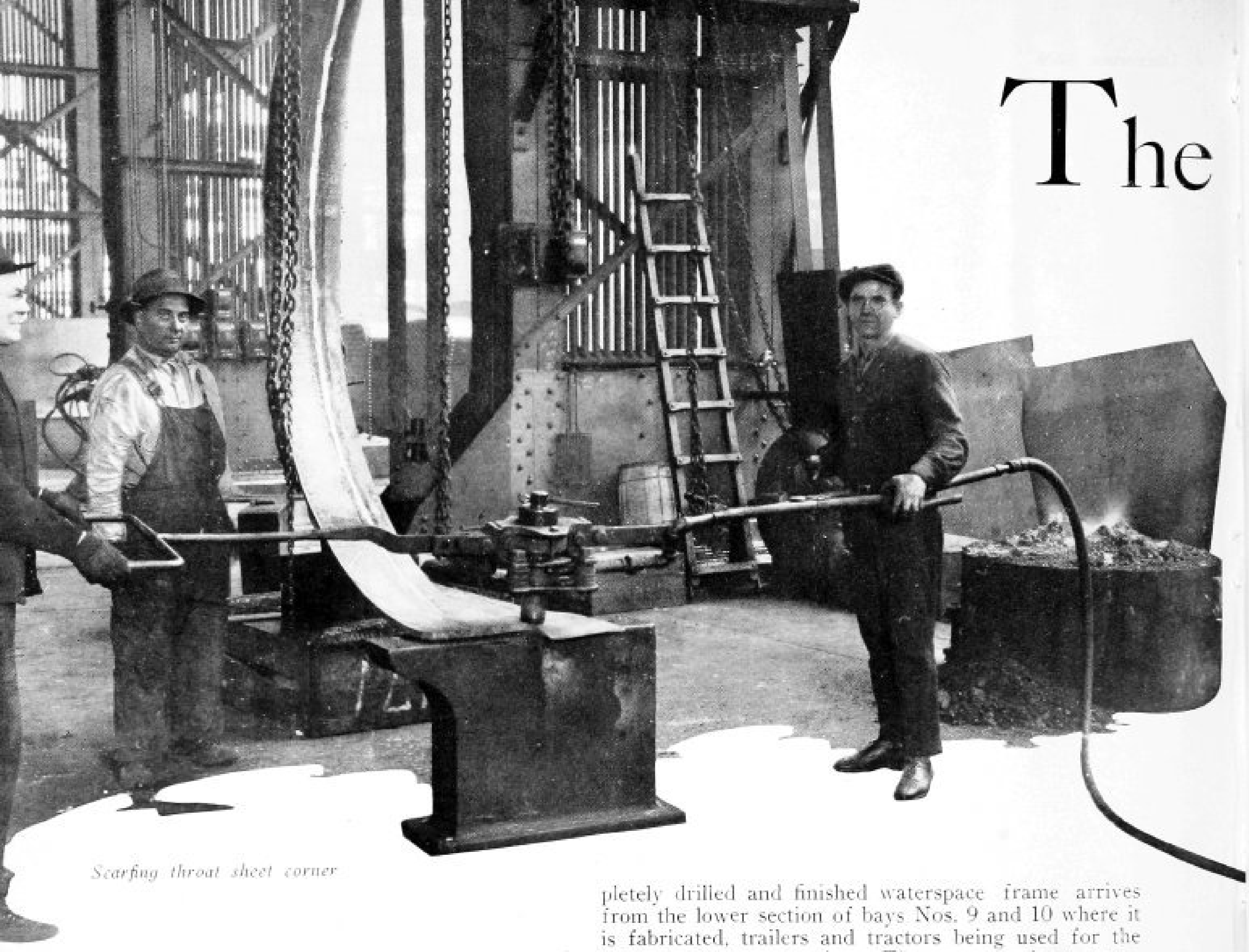
thickness of the material being sheared at the finishing point. This new arrangement in the connecting bars is an improvement over the old method and the proper adjustment is attained in a few seconds.

Overhead drive gap shears may be furnished belt driven or motor driven. In the case of motor drive the motor is directly geared to the machine, the motor drive arrangement being attached outside of the housing and the motor pinion being constructed of micarta. Gap shears are furnished in standards of 18 and 24-inch gap.

Hascrome Welding Rod

The Haynes Stellite Company of Kokomo, Ind., has placed on the market a manganese-chrome-iron welding rod called Hascrome. This is self-hardening alloy, designed primarily for building up badly worn parts preparatory to surfacing them with Haynes Stellite, which is also supplied in the form of welding rod. Since the cost of Hascrome is materially less than that of Haynes Stellite, the resulting composite surface is much cheaper than if entirely built up of the latter alloy. Hascrome may be used for building up large sections of steel or cast iron, and forms an excellent base for Stelliting because it is sufficiently hard to resist deformation under impact, and because of the ease with which Haynes Stallite flows onto it. The Hascrome deposit has a tensile strength of 40,000 and a compressive strength of 177,000 pounds per square inch. It can be forged and ground, but it can not be machined.

The



Scarfing throat sheet corner

BACK ends for locomotive boilers built at the boiler shop of The Baldwin Locomotive Works, Eddystone, Pa., are applied to the barrel or waist of the boiler by what is known locally as the shell gang. While the back end of the boiler may be taken to include not only the shell but the firebox as well, only the shell of the back end, consisting of the outside throat sheet, top and side sheets, backhead and mud-ring is installed by this department. Thus the shell gang assembles and checks the outer section of the back end and attaches this portion of the boiler to the barrel before it is delivered to the finishing floor.

This department is located in the upper section of bay No. 5 of the boiler shop at Eddystone and extends between panels 2 and 17 covering a floor area of 30,720 square feet. Thirty-five machine tools are served by seven overhead cranes, including one 50-ton Niles and one 70-ton Pawling & Harnischfeger traveling crane serving nearly the entire length of the department. One 50-ton Niles traveling crane arranged to travel across the bay serves panels 2 and 3 while a 50-ton Pawling & Harnischfeger and a 50-ton Morgan crane serve panels 16 and 17; two 7½-ton Milwaukee wall cranes serve bull riveters located in panels 14 and 15.

Material to be fabricated in this department arrives in bay No. 5 from five sources. The completed waist or barrel is received from bay No. 8, after being riveted and checked ready for application to the back end. The flanged throat sheet with the holes laid out but not trimmed or drilled is forwarded to this department from the layout gang located in bay No. 12. The completely drilled and finished waterspace frame arrives from the lower section of bays Nos. 9 and 10 where it is fabricated, trailers and tractors being used for the purpose of transportation. The wrapper sheet, sometimes received in more than one piece, comes directly from the plate rolls located in the upper section of bay No. 10 while the backhead, laid out and drilled with the exception of the flange line, is received from the drill presses in the upper section of bay No. 12.

The throat sheet is the first material required by the shell gang for fabrication, as prior to its application to the back end, it is necessary to be trimmed, drilled and scarfed in this department. On receipt, the work is taken to one of the 48-inch or 60-inch radial drills where the staybolt holes are cut, after which the rivet holes in the flanges are drilled in one of two horizontal drills located in panels 12 and 13. After drilling, the plate is trimmed by means of hand-operated pneumatic chipping hammers, cutting the material to the proper distance from the line of rivet holes.

The scarfing operation is done in panel 11 where a pneumatic hammer and coal fires are located. The plate is heated to a yellow heat successively at each waterspace corner and the top of each wing and the sheet is raised by means of a differential hoist and the hot section is laid metal to metal against an anvil where the corners are drawn to a fine taper by means of a specially-designed pneumatic hammer. This hammer, shown in the illustration, was designed and constructed at The Baldwin Locomotive Works. Being suspended from a jib crane, two men operate the hammer by means of long handles while the third member of the gang controls the sheet which is suspended from a second jib crane. After scarfing, the flange of the throat sheet is chipped to the line of the lap and is then ready for application.

Installation of Back Ends

Methods employed by the shell gang in fitting outside throat sheets and wrapper sheets at The Baldwin Locomotive Works

The waterspace frame is checked to make sure that it is square before the top and side is applied.

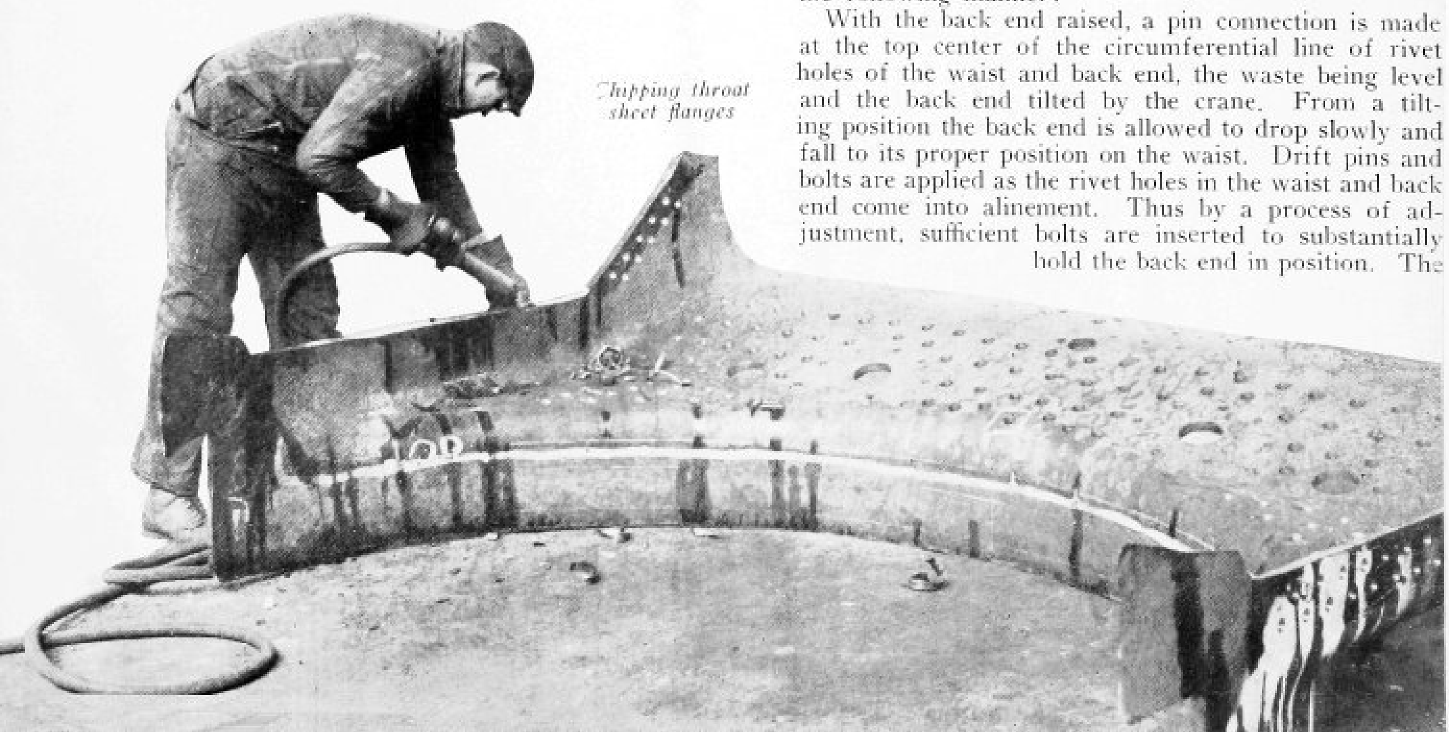
Before applying the throat sheet, the wrapper sheet or top and sides sheet is first fastened to the waterspace frame or mudring by means of bolts and dowel-pins. To properly secure the mudring and the wrapper sheet, selected tack holes in each piece of material have been previously drilled full size, the same template being used for laying out the location of the holes in both cases. These sheets are set up with full size dowel-pins and full size bolts, care being taken at this time to obtain a perfect fit in order to insure the additional holes being correctly located. This care is necessary in order to obtain the correct alinement of staybolt holes later on when the firebox, which is also supplied with tack holes located in the same way and with the same template, is applied.

In the case of three-piece top and sides sheets, the plates are bolted, reamed and bull riveted before the application of the throat. In fitting the top and sides sheets, and in order to insure the proper spacing of staybolt holes, a tram center punch mark is placed on the sheet on a line 6 inches from the center of the line of rivet holes. This line is placed on each sheet so that a total of 12 inches lies between the lines when fitted up. This distance is checked the entire length of the sheet by means of a trammel iron. Thus by a simple means, the staybolt holes are properly spaced.

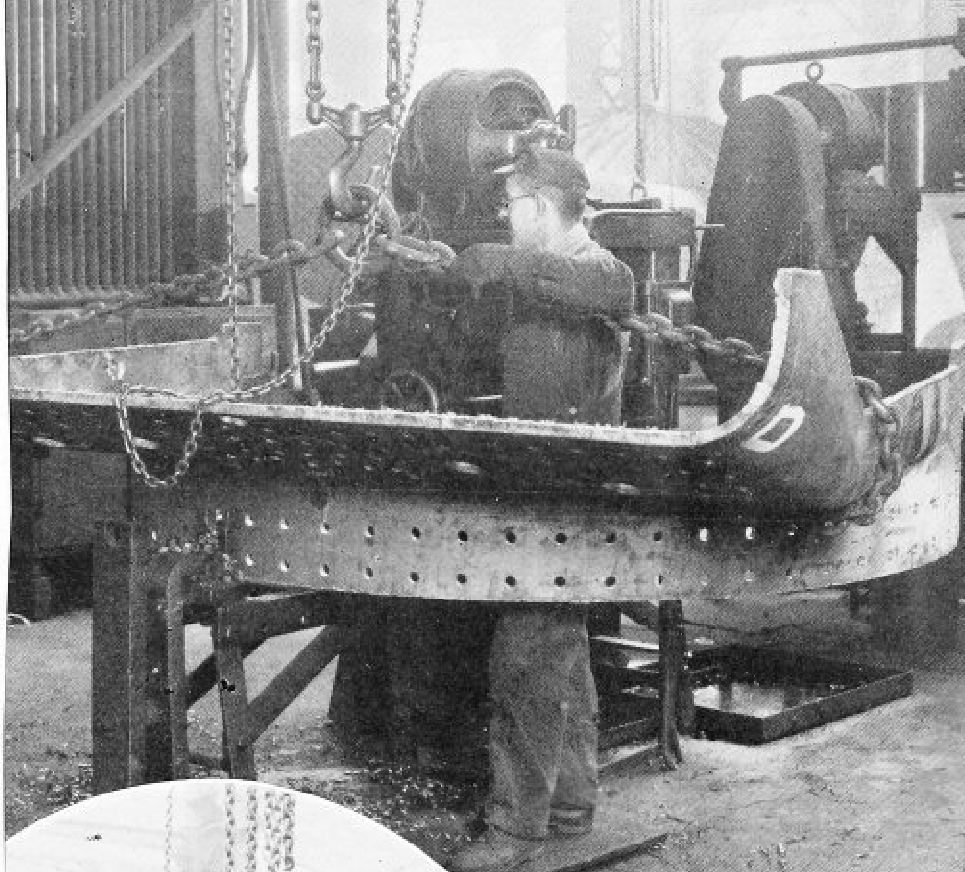
After the wrapper sheet is bolted to the mudring, the throat sheet is applied and bolted in place to the wrapper sheet and mudring. To provide a tight fit at the corners where these three pieces meet, corners are heated and shaped. For this purpose oil torches are used which burn fuel oil vaporized by a compressed-air line. The torch as developed at The Baldwin Locomotive Works has a special suction burner and operates in conjunction with a portable oil tank. In time past this tank was used under direct air pressure, but due to the hazard accompanying such practice, this was discontinued; so at the present time, a suction system is used with the burner so designed that heavy fuel oil is continually sucked through the nozzle. Fitted to the torch is a short combustion chamber to enable the concentration of heat at the desired point. This sort of torch is used throughout the shop for fitting up all heavy plate work, the heat being retained at the back of the work by various means.

After the corners have been raised to a temperature indicated by an orange heat, the plates are set up tight against the mudring by means of flatters and hammers manipulated by two or more men. The throat sheet is then unbolted, removed from the back end and bolted directly into place on the barrel or waist. The barrel has been previously transported to a position directly in line with the back end, the waist being raised from the floor to a height of about two feet by means of two metal horses. In this position, the throat sheet is fitted to the waist with bolts placed every two holes to guarantee a tight fit of the plates. This is the final bolting job for the waist sheet and throat sheet seam. After the throat sheet is completely bolted, the back end is lifted by means of cranes and applied to the waist in the following manner:

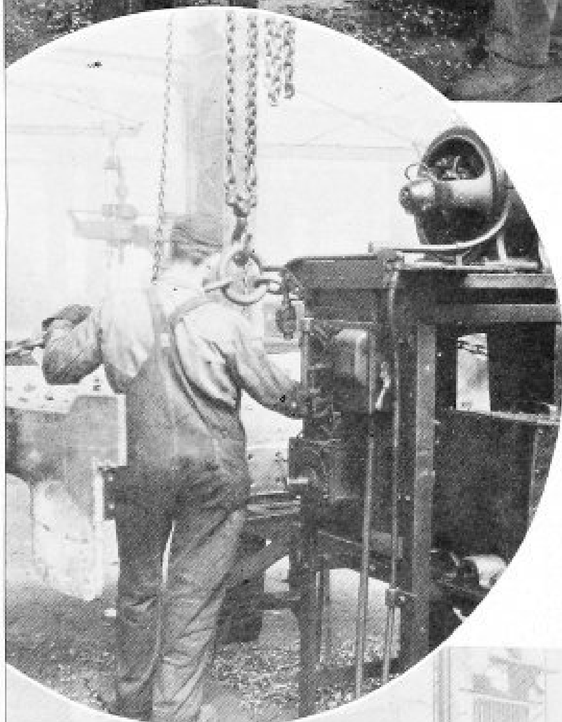
With the back end raised, a pin connection is made at the top center of the circumferential line of rivet holes of the waist and back end, the waste being level and the back end tilted by the crane. From a tilting position the back end is allowed to drop slowly and fall to its proper position on the waist. Drift pins and bolts are applied as the rivet holes in the waist and back end come into alinement. Thus by a process of adjustment, sufficient bolts are inserted to substantially hold the back end in position. The



Chipping throat sheet flanges

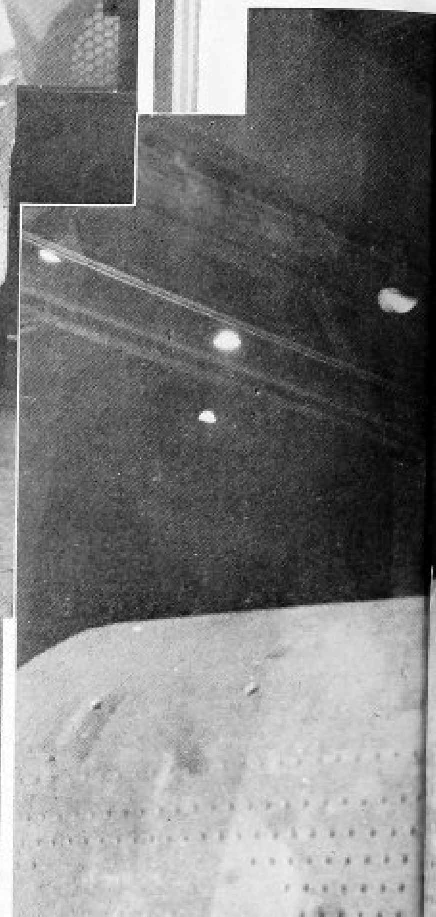


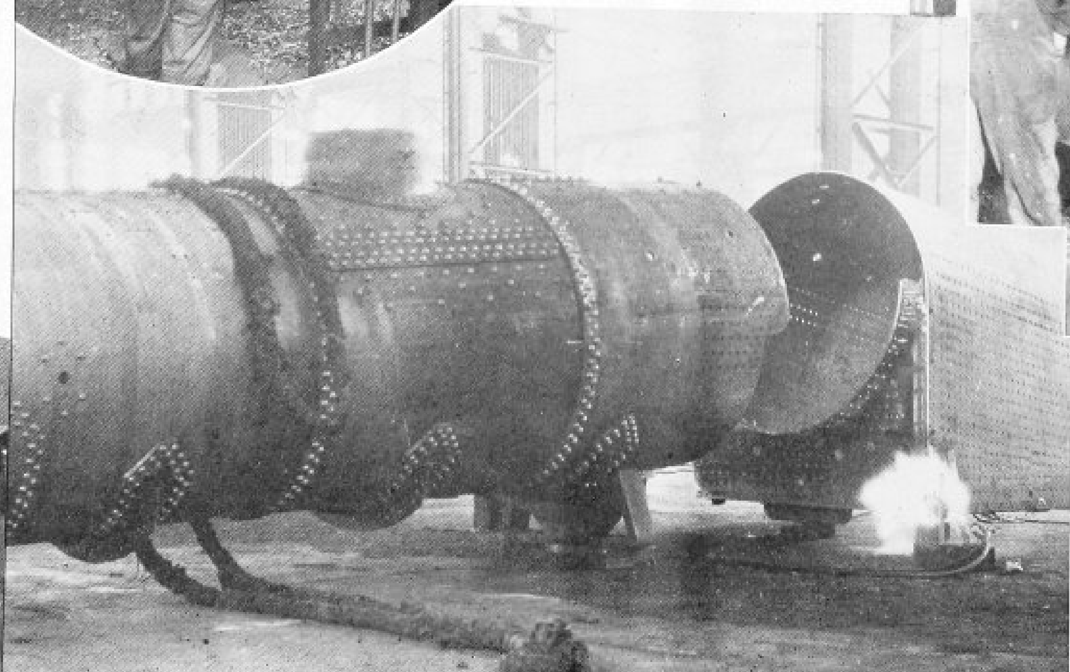
(Left) — Throat sheet flanges are drilled with a special holding jig



(Left) — Drilling throat sheet rivet holes on a horizontal drill

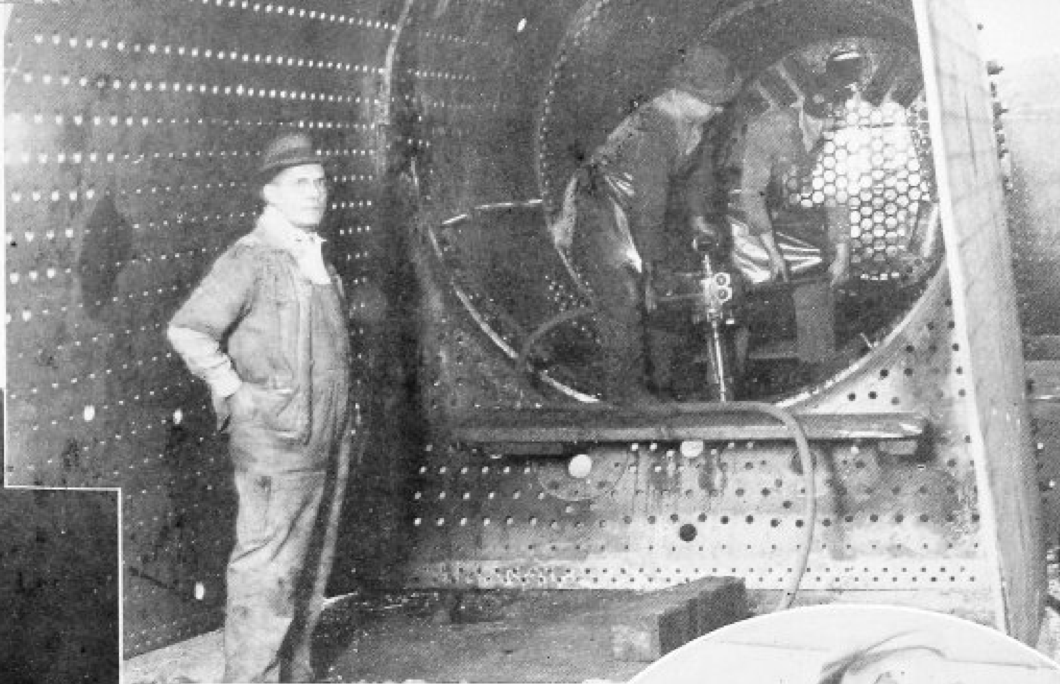
(Below) — Heating the throat sheet corners for fitting to mudring





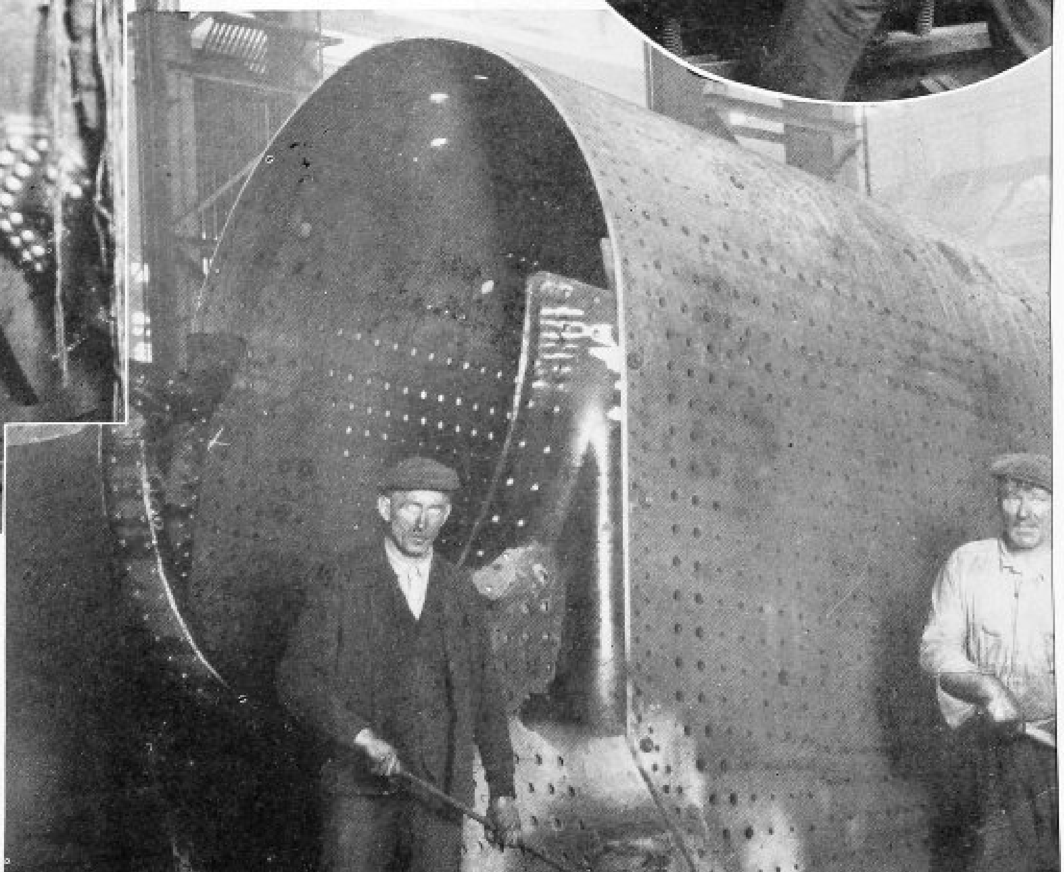
(Above) — Bolting the throat to the boiler barrel

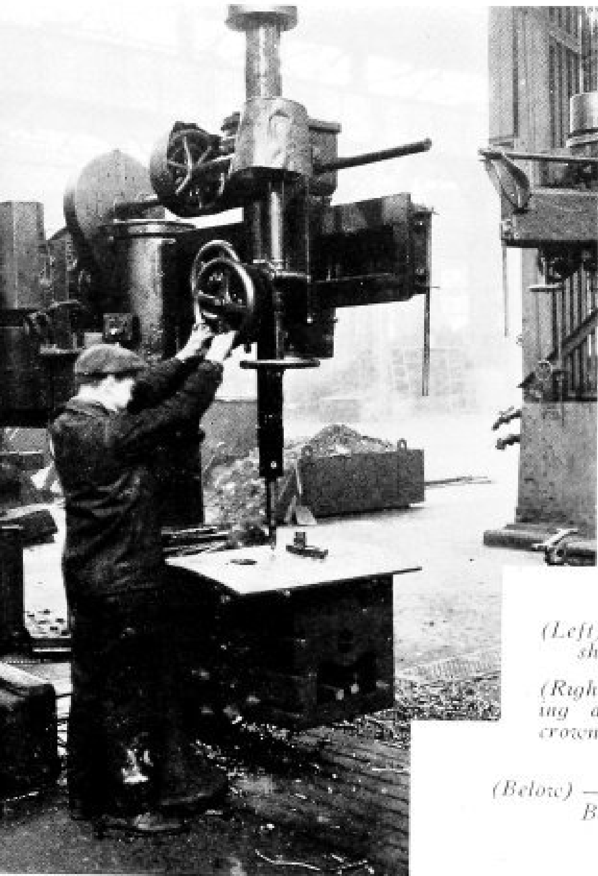
(Right) — Rivet holes are drilled by gangs of two men each

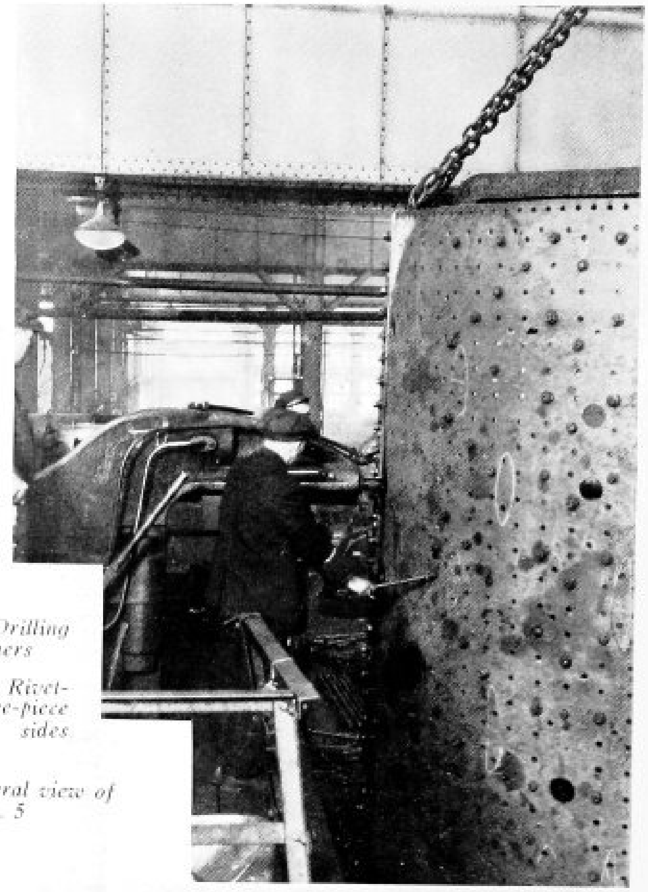


(Right) — Each bull riveter is equipped with a Berwick electric rivet heater

(Below) — Drawing up the throat sheet corners with sledges and flatter tools



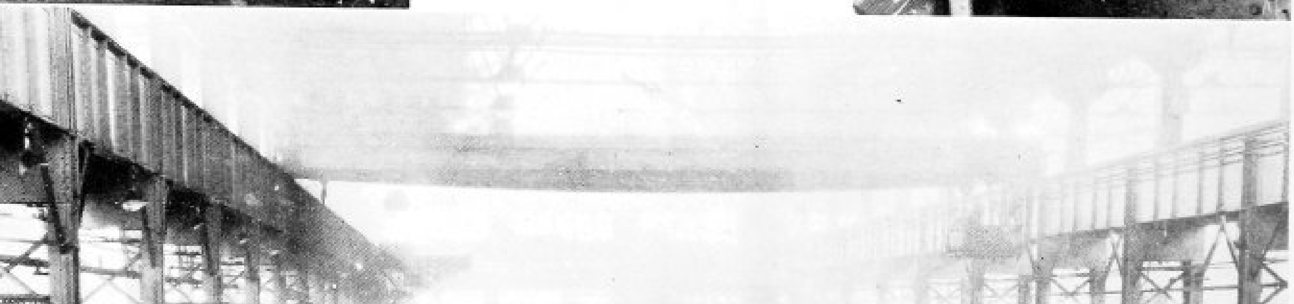




(Left) — Drilling shell liners

(Right) — Riveting a three-piece crown and sides sheet

(Below) — General view of Bay No. 5



backhead is applied when this work is completed.

As previously mentioned, the backhead comes to bay No. 5 completely drilled with the exception of the flange rivet line. In this department the backhead is scarfed by the shell gang at the waterspace corners in a similar manner to the throat sheet and several tack holes are drilled on the flange rivet line to permit fitting in the shell. When fitted in place the whole shell is given a preliminary line-up to determine any deviation from the boiler card or drawing. Any deviation noted at this time must be taken care of and corrected in the final fitting-up process.

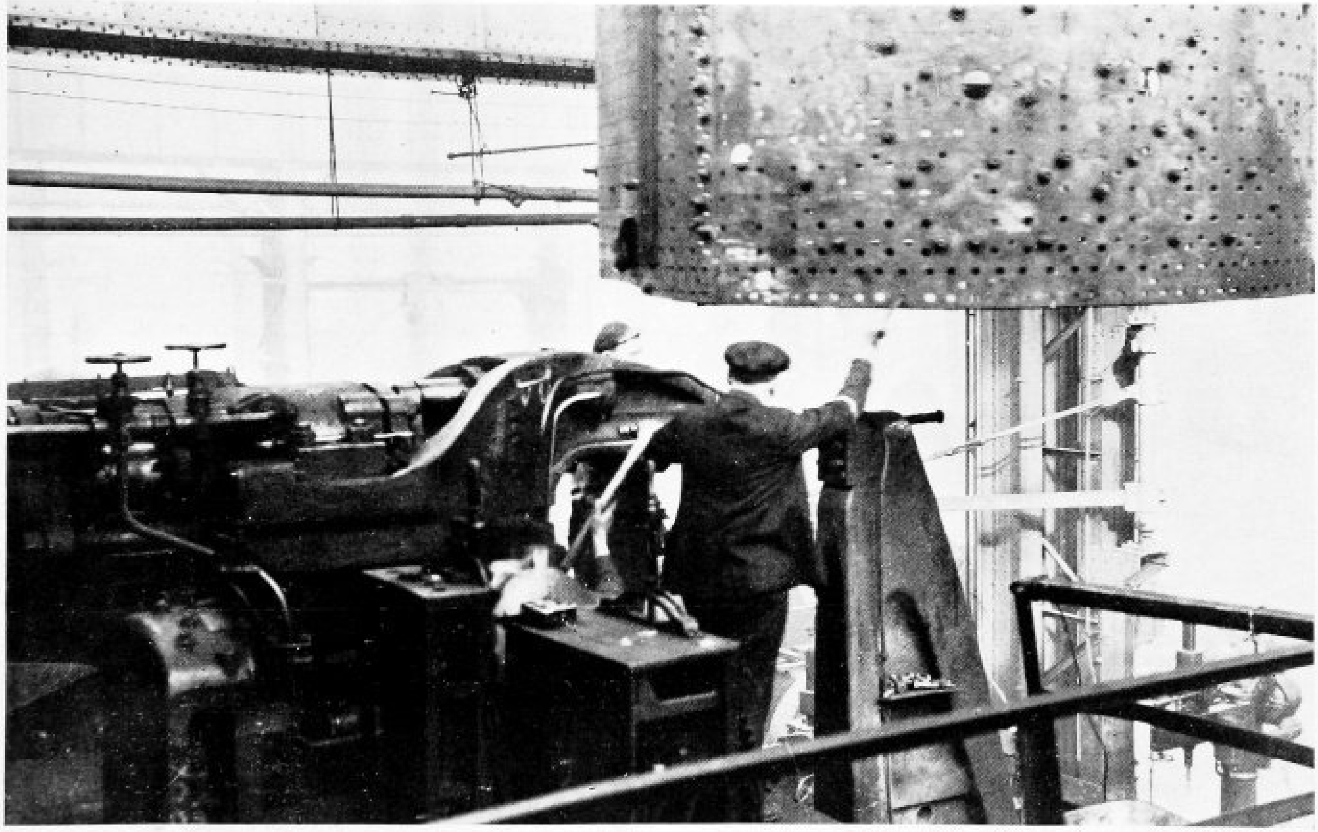
The boiler is now ready for the detailed setting up of the sheets. The laps on the middle of the sides between the waist, throat and back end, are first fired, as it is here that three sheets come together and the most slack is likely to occur at this point. The sheets are set up closely and are bolted in every other hole in such a manner that the plates are tight enough to prevent the entrance of a thin feeler gage at the point of lap. This assembly is continued down both sides after which the boiler is turned on its side and the top seam is bolted. Any internal liners in the back end are installed in this department; they are laid out, drilled and assembled at this time.

After the entire seam between the throat and wrapper sheet has been tightly bolted, the boiler is again placed erect and the backhead, which has had its flange rivet holes marked off during the preliminary line-up and subsequently drilled, is put in place ready for the final line-up. The line-up proceeds as follows.

Plumb lines first are hung down the vertical center of the front tube sheet and outside the backhead and smokebox for comparison to insure no twist in the courses. A line is stretched underneath the bottom of the assembled shell parallel to the longitudinal axis of the boiler and measurements are taken to determine the vertical alinement of the waist and shell. Lines are then stretched from the corners of the backhead parallel to the sides of the waterspace frame and forward past the smokebox. Measurements from these side lines to the lines dropped over the smokebox are made to determine the side alinement of the shell. The smokebox ring and also the last rim on the waist are tested for roundness.

After the final line-up about a dozen selected rivet holes, located around the throat and wrapper sheet seam, are reamed full size. Into these are fitted full-size hard-steel dowel-pins which are kept in the boiler until sufficient rivets have been applied in the boiler or until the bull riveting is partially completed.

The backhead is again removed and the backhead brace tee irons are marked off, bolted, reamed and bull riveted to the backhead. The backhead and mudring are then sent back to the firebox gang to enable that department to complete the firebox, the backhead being used to line up the door hole of the firebox after the mudring is bolted to the firebox. In this position the mudring permits the setting up of the firebox corners by the firebox gang, after which it goes to the finishing floor as part of the firebox assembly.

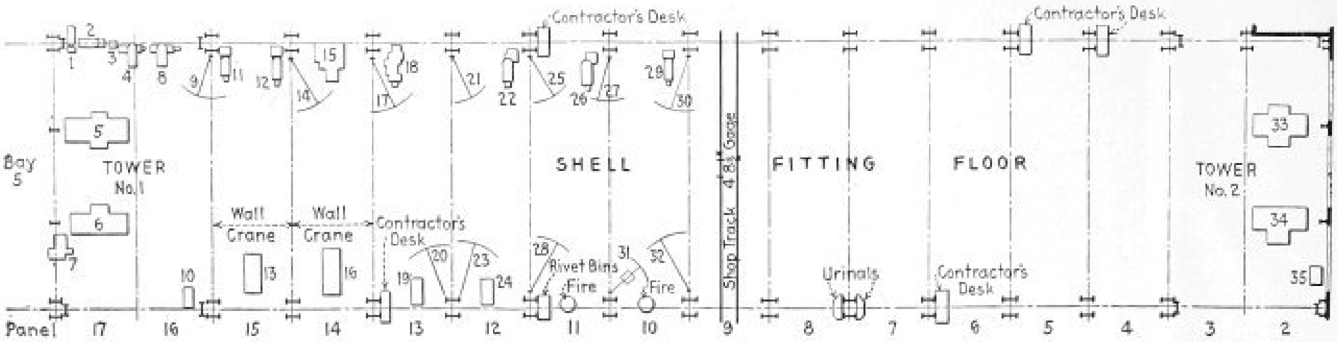


Lowering the boiler shell into the jaws of the bull riveter

The backhead is shipped separately to the finishing floor where it is later riveted to the shell by the hand pneumatic riveting process. Bull riveting of the backhead is prevented due to the awkwardness of the rivet locations.

Following the line-up of the boiler and the removal of the backhead and mudring, the shell rivet holes are reamed out and bull riveted in bay No. 5. Reaming is done by hand pneumatic reaming machines, two men being included in each gang.

The bull riveters in bay No. 5 are six in number, two



Machinery located on the shell-fitting floor in the upper section of bay No. 5

1.—Harrington 48-inch radial drill, motor on machine, direct drive.
2.—Harrington 48-inch radial drill, motor on machine, direct drive.
3.—Hisey-Wolf 4-LA double emery wheel, motor on machine, direct drive.
4.—Harrington 48-inch radial drill, motor on machine, direct drive.
5.—R. D. Wood hydraulic bull riveter, pressure range 154 to 37 tons, having an 18-foot 6-inch stake.
6.—Southwark hydraulic bull riveter, pressure range 154 to 37 tons.
7.—Hilles & Jones rivet shear, motor on building column, belt drive.
8.—Harrington 48-inch radial drill, motor on machine, direct drive.
9.—Baldwin 1-ton hand jib crane with a 12-foot 6-inch reach.
10.—Bement & Dougherty 48-inch post goose-neck drill, motor on floor, belt drive.
11.—Harrington 48-inch radial drill, motor on machine, direct drive.
12.—Harrington 60-inch radial drill, motor on machine, direct drive.
13.—Bement 50-ton hydraulic bull riveter having a 6-foot stake.
14.—Baldwin 4-ton hand jib crane with a 15-foot 9-inch reach.
15.—Sellers 1¼-inch hole, 1-inch plate punch, motor on machine, direct drive.
16.—Bement 50-ton hydraulic bull riveter having an 8-foot stake.
17.—Baldwin 3-ton hand jib crane with a 16-foot 2-inch reach.
18.—Hilles & Jones No. 3 punch, motor on machine.
19.—Baldwin 1¼-inch hole, horizontal drill press, motor on separate base, belt drive.
20.—Baldwin 2-ton hand jib crane with a 15-foot 10-inch reach.
21.—Baldwin 4-ton hand jib crane with a 13-foot 5-inch reach.
22.—Harrington 60-inch radial drill, motor on separate base, belt drive.
23.—Baldwin 3-ton hand jib crane with a 17-foot 5-inch reach.
24.—Baldwin 1¼-inch hole, horizontal drill press, motor on separate base, belt drive.
25.—Baldwin 1-ton hand jib crane with a 13-foot 3-inch reach.
26.—Harrington 60-inch radial drill, motor on separate stand, belt drive.
27.—Baldwin 3-ton hand jib crane with a 13-foot 5-inch reach.
28.—Baldwin 2-ton hand jib crane with a 17-foot 3-inch reach.
29.—Harrington 48-inch radial drill, motor on machine, direct drive.
30.—Baldwin 1-ton hand jib crane with a 17-foot reach.
31.—Baldwin 2-ton hand jib crane with pneumatic hammer and a 12-foot reach.
32.—Baldwin 3-ton hand jib crane with a 17-foot 10-inch reach.
33.—Chambersburg hydraulic bull riveter, pressure range 177 to 38 tons, having a 17-foot, 1-inch stake.
34.—Southwark hydraulic bull riveter, pressure range 154 to 37 tons, having a 20 foot stake.
35.—Hilles & Jones No. 1 rivet shear, motor on machine, direct drive.

of which have a total gap of 20 feet. These operate at 2000 pounds per square inch hydraulic pressure and have from three to six pressure changes, varying from 25 to 175 tons' pressure. Any pressure between these limits within small limitations may be obtained on one machine or another. The bull riveters throughout the shop are equipped with Berwick rivet heaters which act on the resistance principle. Low voltage and high amperage act to heat the rivet to a yellow heat when placed between the terminals of this machine. Foot levers release the tension between the terminals and allow the rivets to be placed in or removed from the machine. Several of the larger bull riveters are equipped with electric holding-on devices to insure the rivet being held under pressure a sufficient length of time before release. This device provides a uniformity of work in riveting and enables consistent results to be turned out by these machines.

From five sources of supply, the various fabricated parts making up the back end of the boiler are received in bay No. 5. Here the shell gang takes the boiler barrel, completely fabricates the back end and rivets the outside throat sheet and wrapper sheet to the barrel. Then following the predetermined method of routing material at The Baldwin Locomotive Works, the boiler, by means of a car on the shop track in panel 9, is transported to the finishing floor in bays Nos. 2, 3, and 4, where the boiler is completed ready for assembly on the locomotive chassis in the erection shop.

The boiler shop at The Baldwin Locomotive Works is one of the largest in the world, being equipped with modern machine tools and employing the most up-to-date production methods adaptable to locomotive boiler construction. Predetermined routing of material along one direct line of transportation and the employment of highly skilled mechanics serve to insure efficient boiler manufacture.

Ryerson Appointments

Arthur C. Allshul, formerly manager of the Buffalo, N. Y., plant of Joseph T. Ryerson & Son, Inc. has been appointed manager of the company's new unit in the Philadelphia district.

As previously announced, the Ryerson Company has purchased the business, equipment, and good will of the Penn-Jersey Steel Company at Camden, New Jersey and is also making other arrangements to provide adequate facilities for a comprehensive stock to meet the requirements of the trade in the Philadelphia metropolitan district.

Clarence S. Gedney has been appointed manager of the Buffalo plant succeeding Arthur C. Allshul. Mr. Gedney has been connected for many years with the specialty sales division of the Ryerson business in the Chicago territory.

Boiler Welding in England*

Code of rules needed properly to control pressure vessel construction—Types and strength of welds

THE technical report for 1928 by Harry M. Longridge, managing engineer of the British Engine Boiler and Electric Insurance Company, would seem to raise considerable doubts about the safety of welded seams in boilers. This report is not limited to electric welding but covers also the oxy-acetylene method. It states that during recent years there has been an increasing tendency to employ fusion welding in the production of pressure vessels. There are no official rules or regulations in England which would guide the design of such welded vessels. From the point of view of the insurance company, the report states, the riveted joint is preferable to the welded joint. At the same time, in view of the fact that welding is very often the most economic method of making a joint and that it is a convenient method of obtaining tightness, a welded joint is entitled to consideration as an approved form of construction for an unfired pressure vessel, provided that it is properly designed and constructed. The disfavor with which welding is sometimes regarded is in a large measure due to lack of control in matters of design and manufacture, whereas with vessels made to rigid regulations the undesirable elements would, to a large extent, disappear. The main bulk of the accidents that have occurred have been due to welding having been carried out in a manner that no supervising authority could tolerate.

As to welded boilers, the inquiry was for the most part limited to the construction of non-fired pressure vessels.

Longridge himself seems strongly opposed to welding for boilers under steam, even if welding be suitable for vessels subject to cold-water pressure. In the numerous examinations the company has made of faulty joints, it is said faults have never been found of the same magnitude in a riveted as in a welded seam. Though welded boilers are in service on the continent, says the report, evidence is still lacking that this class of construction, even when of the highest order, will reduce the troubles so common at seams. If welded seams in a boiler are to have the same margin of safety as riveted seams, a radical departure from present design and practice will be necessary and thus make the welded construction much less attractive to the manufacturer. The Board of Trade Rules in England lays down that no joint in tension shall be welded.

Form of joint	η	Remarks
Non-reinforced butt weld.	100%	
Lap weld with single fillet (subjected to bending).	50%	Up to ½ plate for circular seams. Quite unsuited for longitudinal seams of pressure vessels.
Single butt strap (Of the same thickness as the plate)	50%	ditto. For modification of strength with shape of fillet see Section IV Figs. X to XV
Lap weld (no bending).	60%	
Lap weld with two fillets (subjected to bending)	100%	l not less than 3t. Only suitable for longitudinal seams of pressure vessels when t does not exceed 3/8".
Half-lap joint with two fillets (no bending). (Of the same thickness as the plate.)	120%	
Double butt straps. (Of the same thickness as the plate)	120%	
Joggled lap joint	133%	l not less than 2t. Only suitable for longitudinal seams of pressure vessels when t does not exceed [illegible]
Joggled lap joint.	133%	ditto.
Butt weld with single strap of half the plate thickness.	-	An unsatisfactory form of joint. Bending stresses are introduced & complex stresses set up at the fillet welds, with the result that the strap only increases the strength of the joint inappreciably above that of a plain butt weld
Butt weld with single strap of full plate thickness. (Of the same thickness as the plate.)	Say 120%	An unsatisfactory form of joint not recommended for pressure vessels.
Butt weld with double straps of half the plate thickness.	160%	
Special form of lap joint. Weld metal in shear.	80%	$\eta = \frac{\text{strength in shear}}{\text{do in tension}}$ Owing to the difficulty in making a weld of the form shown, the efficiency should be taken not higher than 70%
Transverse cover straps, welded at the sides only.		The strength depends on the form of fillet & in general fracture takes place at the place indicated below.
Double straps of half the plate thickness, opposite one another. (Fracture)	90%	The strength of the weld per unit length is 75% that of a lap weld at the end of the strap
Single strap of full plate thickness.	75%	
Single strap of half the plate thickness.	45%	The result is relatively higher than before, owing to the strap receiving greater support against bending.
Transverse cover straps welded at all sides.		
Double straps of half the plate thickness, opposite one another.	150%	For information on butt joints with cover straps see, Section II, Table I & the subsequent letterpress.
Single strap of full plate thickness.	125%	
Welded flanges.	-	See subject matter relating to Figs. XI to XIII, Section IV.
Branches & other fittings affixed by a fillet weld.	-	See subject matter relating to Fig. XXVI, Section IV.

Table of efficiencies of principal welded joints

The efficiencies of some of the principal joints are given by the author in tabular form as shown on this page. The values given have been found readily obtainable with reasonably well-made welds. The following explanatory notes are given:

1. The efficiencies compare the strength of joints in plates of thickness t with the strength of a plate of the same thickness when butt welded, but without reinforcement.

2. The efficiencies refer to joints of the same width as the plate.

3. With fillet welds the efficiencies apply when the fillets have an approximately straight contour, lying at 45 degrees with the surface of the plate. The efficiencies also apply to other contours as long as the throat thickness is not less than 0.69 t.

4. A joint may be readily made stronger than the

* Abstract of report in *The Electrical Times*, September 12, as made by *Mechanical Engineering*.

body of the plate away from the joint. As the efficiency refers to the joint itself and not to the plate, it follows that a higher efficiency than 100 percent can readily be obtained. It has been possible to record efficiencies where they exceed 100 percent by the adoption of specially designed test pieces.

5. It must not be inferred that all the joints shown are permissible for pressure vessels; the figures given apply to a static tensile test, and it does not follow that the behavior of joints subjected to the stresses of service will be in proportion to the efficiencies given.

6. The strengths quoted apply only when the load is applied in the manner shown in the sketches. The efficiency is therefore in some instances superior with the joint applied to the circumferential seam of a pressure vessel, and sometimes inferior when it is applied to a longitudinal seam.

Mr. Longridge does not propose, he remarks, to enter into a dissertation on the relative qualities of various electrodes. This forms too large a subject and would be out of place. Likewise a summary of all the qualities essential for satisfactory operation would form too long a list. He therefore limits himself to stating only what are considered to be the most necessary properties for metallic electrodes used for welding pressure vessels. These are:

1. The electrodes should contain not more than 0.3 percent of phosphorus, not more than 0.05 of sulphur, and not less than 0.50 percent of manganese. A higher percentage of manganese is strongly recommended.

2. The rod should have a covering which has strong deoxidizing properties, and which will react chemically with the mill scale and any rust on the plate being welded, and cause a slag to be formed which will protect the surface of the weld from exposure to atmosphere.

3. The covering should have a melting temperature below that of the steel, preferably not more than 1000 degrees C., in order that the operating current may be kept low, reducing the expansion of the welded part and the liability of the metal to be overheated and allowing the molten slag to separate readily from the weld metal.

4. The slag should have a coefficient of contraction greater than that of the metal, so that it may be removed easily.

5. The electrode should be protected against rusting in a damp atmosphere, either by covering or by some other suitable means.

6. The covering should be capable of withstanding temperature changes and the usual rigors of service that are to be expected during manipulation without cracking.

7. The electrodes should deposit weld metal free from porosity and high in ductility.

The following additional properties are deemed necessary to meet special conditions of service:

8. When an electrode is used in a position where it has to be bent, the covering should be sufficiently plastic for a portion of the electrode 9 inches long to be bent to a right angle without the coverings showing any signs of flaking off, the test being made after the electrode has been dipped in water and redried.

9. When the electrode is used for fireboxes of boilers, the quality of the deposited metal should be such that strips cut from the welded plates can, while at red heat, be bent and flattened without showing defect.

10. When welds are hammered hot while metal is being deposited, or when the welded article is subsequently forged or subjected to deformation when hot, the quality of the weld metal should be such that strips of welded plate can, when at red heat, be forged down to half their original area without showing defect.

It is not denied that many excellent welds are made, and indeed a number have been examined during the course of the inquiry; but the quality of the ordinary commercial weld falls far short of the ideal, while many welds are definitely bad. Regulations, Mr. Longridge feels, are required if the legitimate development of welding is not to be retarded, and until such regulations are framed and enforced it is inevitable that trouble and disappointment will be the lot of makers and purchasers alike.

Flapper-Valve Type Hammers

Ingersoll-Rand Company, 11 Broadway, New York, has developed a new line of high speed pneumatic chipping hammers that are said to be a considerable improvement over older types.

An interesting feature of these hammers is the use of a plate valve of the flapper type that results in several important advantages. The flapper valve, being a thin beveled plate permits the hammers to be made shorter in overall length and also lighter in weight. The valve flaps down on its seat in a valve box to close the air ports and rises to open them. This action gives quick and full opening and closing of the air ports—resulting in exceptional power and speed. There is no sliding movement to the valve, and, consequently, it has a smooth

New I-R high speed chipping hammers

and positive action. This accounts for easy holding and sensitive throttling. Furthermore, the valve does not wear, but its fit on the valve box improves with use. It is claimed valve maintenance is reduced materially.

Another feature is the throttle valve, of a combination piston and poppet type that gives very fine graduation of port opening and that remains tight for a long period of service.

Open type handles are standard on these chippers. The handles screw on the barrels and are securely locked in place by a new type of pinch-bolt arrangement. The exhaust is through the side of the barrel and can be deflected in any desired direction by means of an adjustable exhaust deflector.

The hammers are furnished in five sizes, having strokes varying from ¾ inch to 4 inches. These five sizes meet all the conditions encountered in the various classes of chipping and calking work. It is claimed these new hammers will turn out more work with less fatigue to the operator and that their high power gives both faster and heavier cutting. Their high speed makes possible an extremely smooth cut.

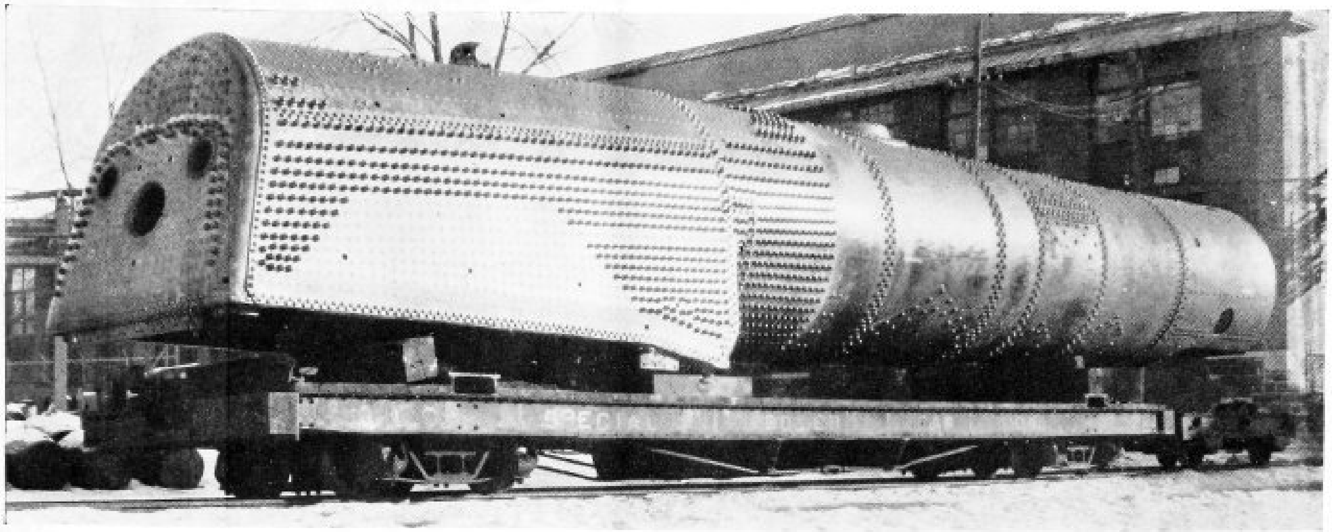


Fig. 66.—Locomotive boiler as completed in the boiler shop, before test

Locomotive Boiler Construction-XVI

Applying the rigid and flexible staybolts — Setting the tubes—Testing the completed boiler

By W. E. Joynes*

THE firebox and outside shell having been riveted to the firebox ring, applying the radial stays and staybolts is the next work to be done to the boiler.

The first operation in connection with this work is to taper-ream and tap the crown sheet for the taper-end, or crown stays. Separate reaming and tapping tools are used to do the work. The holes in the casing for these stays are then reamed and tapped with a combination reaming and tapping tool. The tools have a guide extension that is long enough to reach through the hole in the casing or the hole in the firebox, when tapping the straight-end radial stays and the staybolts. The stays are then run in from the firebox side, with an air machine, and the ends burnt off for riveting over.

The sides of the firebox and outside shell, and the backhead are next carefully straightened and braced with a number of strongbacks to hold them in place for running the staybolts.

All of the rigid staybolts are first applied in the throat, sides and backhead.

These bolts are then tested by the inspector. Any bolts that turn too easily are removed and replaced with other bolts.

In applying the flexible staybolts, flexible radial stays and the expansion stays, the holes for the sleeves in the outside sheet are first taper-reamed to fit the sleeve, in alinement with the holes in the firebox. The holes in the firebox are next reamed and tapped with a combination reamer and tap.

The tapered sleeves are dropped into the holes of the outside shell, the inside end of the staybolts are then put through the sleeves and run into the threaded holes of the firebox sheet.

The strongbacks are now removed and the staybolt holes which could not be tapped until the strongbacks were removed are now tapped and the rigid and flexible staybolts are applied to the boiler at this time.

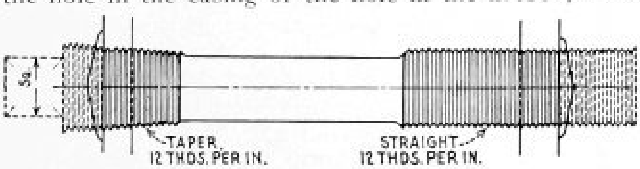


Fig. 67.—Taper-end crown stay

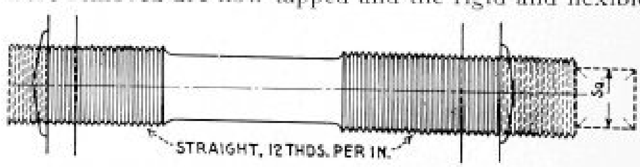


Fig. 68.—Straight-end radial stay

The sleeves can now be welded to the sheet.

The firebox end of the staybolts are burned off to the correct length for heading over. Both ends of the rigid bolts are now riveted over with an air hammer. The other end of the bolt is backed up with a holding-on hammer while being riveted.

A riveting plug is held against the sleeve end of flexible staybolts while the firebox end is being riveted.

The tell-tale holes are opened and drilled out after the bolts have been riveted.

The riveted end of all bolts are finished with a dressing tool operated by an air hammer. This work completes all of the operations in connection with applying the staybolts with the exception of bobbing or calking the weld around the flexible staybolt sleeves.

* Boiler designing department, American Locomotive Works, Schenectady, N. Y.

The finishing of the weld is done with a knurled-end chisel-like tool, operated by an air hammer. The work is usually done while the tubes are being put in the boiler.

Fig. 67 shows in detail a taper-end crown bolt before and after the ends have been riveted over. Fig. 68 illustrates a straight end radial stay and Fig. 69 shows the detail and application of a flexible staybolt in the boiler sheets. The sleeve or cap of a flush flexible staybolt does not extend beyond the outside surface of the shell.

The waterspace bolts are termed staybolts. The maximum length of rigid staybolts, is about 8 inches, and the bolt is threaded full length. Rigid bolts more than 8 inches long, have threaded upset ends.

The fire-door flanges can be welded together any time after the staybolts in the backhead have been applied.

Setting the tubes and flues is the final work to be done on the boiler before the test.

Fig. 70 shows a tube as set in the tube sheets, the setting operations follow and must be done by experienced tube setters to assure tight joints in a fired boiler.

The outside diameter of the copper ferrule is usually the same as the outside diameter of the tube, there-

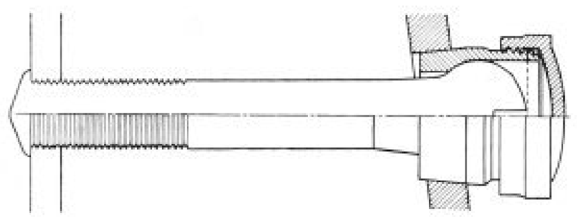


Fig. 69.—Flexible staybolt

fore the firebox end of the tube has to be swaged down to enter the ferrule.

The end of the tube is heated and the diameter of small tubes reduced in an air operated machine. Swaging of large tubes and flues, however, cannot be done with this type of machine.

The distance between tube sheets is gaged at four points; tubes are cut with allowance for beading, inserted in the four gaged holes and rolled in place to brace the sheets.

The tube-setting operations in the back tube sheet are as follows: The ferrules are first inserted in the tube-sheet holes and lightly expanded by hand.

Secondly, the tubes are cut to length with rotary cutters and pushed through the front tube-sheet holes into the back tube-sheet holes. With all tubes in the sheets, the tubes are next rolled tight against the ferrules. The roller is designed with a collar for bearing against the sheet. The depth of the collar is such that the tubes will be drawn to the correct allowance outside of the sheet, during the rolling operation, for beading. The roller is operated with an air or electric machine.

Tube end is next flared out 45 degrees. This operation is done with a 45-degree-bevel tool operated with an air hammer.

Then the tubes are prossered. The result of this operation is shown in Fig. 70. The work is done with a tool made in sections which expands against the tube on the inside of the tubesheet when a pin is driven through the center of the tool with an air hammer.

Finally the tubes are beaded. The bead is formed with a piece of hexagon tool steel flattened at the end, with a semi-circular notch for forming the bead when driven against the tube with an air hammer.

All tubes in the front tube sheet are rolled. A small percent of the total number of tubes only are flared and beaded where indicated on the boiler drawing.

The operations for flue setting are similar to those of tube setting. All flues are beaded on both ends. The tube and flue holes in the front tube sheet should be 1/16 inch larger in diameter than the tubes and flues.

The boiler is now given a final inspection to see if all seams, rivets and flexible-staybolt sleeves have been properly calked for the steam test.

Before the boiler is tested all studs for supporting brackets, valves etc., should be located according to the boiler and engine erecting drawings; holes drilled, tapped and the studs applied. Studs showing leaks under test pressure should be removed and replaced with other studs. All turrets, valves, washout plugs, dome cap, superheater header, etc., should be in place for the test.

An oil-burning torch is used to fire a boiler for the boiler steam tests.

A lighted-wick torch is used to find the invisible leaks appearing under the steam test. The escaping steam, of course, blows the flame.

Five tests are necessary before passing a boiler.

First, the boiler is cleaned inside by filling full of

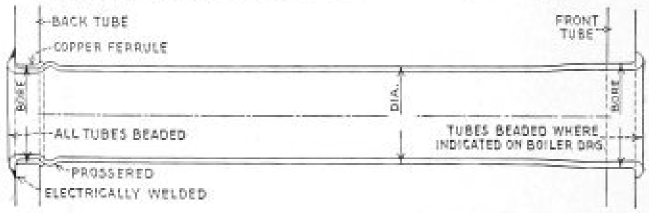


Fig. 70.—Setting tube in sheet

warm water (not over 150 degrees F.) mixed with soda ash, generally using the city water pressure of about 90 pounds per square inch to fill the boiler. The boiler is drained free of this water.

Second, the boiler is refilled with warm water (not over 150 degrees F.) and tested under hydrostatic pressure to 25 percent above the working pressure.

Third, the water is drained down to the first gage cock. The boiler is fired and tested to a steam pressure of 20 percent above the working pressure.

Fourth, the steam and water are blown off and the boiler is allowed to thoroughly cool.

Finally, the boiler is refilled wth warm water (not over 150 degrees F.), fired and the test is repeated.

Any leaks appearing under each test should be calked before the next test.

It is hoped that this article and the preceding articles in this series have satisfactorily covered the manufacture of locomotive boilers, as outlined in the beginning.

The author wishes to acknowledge at this time his appreciation of the answers so cheerfully given to all questions which it was necessary to ask in the shop and elsewhere to compile the information given in this series.

In conclusion, summing up the work of producing a locomotive boiler, it is certain that there is no part or detail of the work that does not have to be done by experienced and skilled workmen, to produce a first class boiler.

A locomotive manufacturer has to have and retain experienced men to turn out first class work for the various designs of boilers required by the railroads, which means that starting with the layout work, the flanging and fitting up must be correct in order that the riveting, running of the staybolts and other detail work can be done correctly and efficiently.

National Board Meeting

Concluding the discussions held at the annual meeting of boiler inspectors

THE following pages conclude the discussion of various subjects dealt with at the last annual meeting of the National Board of Boiler and Pressure Vessel Inspectors Previous instalments have appeared in recent issues. The discussion follows:

WILLIAM P. EALES (Pennsylvania): As long as the Unfired Pressure Vessel Code is up for revision, it seems to me the time is appropriate to cut out the word "unfired." Generally, this Unfired Pressure Vessel Code applies only to air tanks. Air tanks are small, compared with cracking stills. Those are vessels used in the petroleum industry, real vessels, and I think the word "unfired" should be eliminated, and if there is to be a revision, include vessels other than steam vessels, covering the whole scope of the thing. Else it will only be ten or fifteen years before it is all up again.

J. C. MCCABE (Detroit): As a matter of fact in cracking stills, you have conditions that happen to be far more severe than ordinarily occur in steam boilers. We have the vessels elevated to unusual temperatures, which you do not get ordinarily in steam boilers, and I think that Mr. Eales' suggestion deserves considerable attention.

CHAIRMAN THOMAS: The next on the program is the Report of the Standing Committees. Now, we do not have what you would call any regular standing committees. However, the secretary some time ago requested the chairman to appoint a committee, at the request of Mr. Aldrich, President of the American Boiler Manufacturers' Association, regarding support and suspensions of boilers and that request came in in plenty of time to give this committee a chance to deliberate to a certain extent, so that it could probably investigate it enough to make an intelligent report.

WILLIAM P. EALES (Pennsylvania): While the committee which was appointed by the chairman was in correspondence with Mr. Aldrich, President of the Boiler Manufacturers' Association, it was intimated that the two groups of manufacturers, the watertube group and the horizontal return tubular group were not in agreement on certain things, and that they agreed on certain things. We were really trying to harmonize these different views and the report was prepared to be presented here, but since reaching Detroit we find that the watertube group were not in agreement between themselves as regards what should be the maximum stresses on cross girders, and on hanger posts. Now, I think the only thing to do is to refer it back to the boiler manufacturers and let them come to some agreement among themselves, between the two groups, that is the watertube group and the firetube group.

For example, it was proposed to have the maximum stress 8000 pounds per square inch of cross section on hanger rods. Now, in suspending some of the large types of watertube boilers, with tremendous weights, they are using very high tensile steel, up to 120,000 pounds and they actually have 24,000 pounds stress on the hangers, which is three times the eight thousand pounds which at present is indicated as agreeable.

Now, of course, it is out of the question to use 8000 pounds on 120,000 pounds steel. It is out of the question to use 6-inch hanger posts for some of those boilers, so the only thing I can see is to report progress that far, and we are going to refer it back to the manufacturers, that is the watertube group of the manufacturers.

Now, in going into this thing, there is one feature that has developed, and that is the desire to support large, lofty watertube boilers by some of the pressure carrying parts, outside headers, use them as headers to connect the watertubes and also use those headers to support the boilers. Perhaps we can prevent any of that and I think it should be one of our proposed recommendations in the report, that the pressure carrying part should not support the boiler. I am not for that; I don't like it. I do not think it is a good thing to have any stress on the pressure carrying parts, I mean, such as vertical tubes and outside headers, like that. The pressure on them is enough as it is. Again, if repairs were necessary, it is necessary to jack up the boiler, and perhaps the failure of a tube or header would cause the boiler to topple over. I don't know how you feel about that, but so far as the report of the committee which was appointed for this work is concerned, we have nothing to submit formally now, until they agree between themselves.

C. O. MYERS: Another subject here, that the chairman said he would like to have disposed of before the other committees report, is one that was acted on at our last meeting at Erie. At the last meeting, the Board unanimously ruled that the executive committee be requested to consider the use of a symbol for the stamping of boilers, in lieu of the lettering now used, and that such symbol so selected be copyrighted. This question was thoroughly discussed by the executive committee and it was unanimously agreed that the demand for changing the stamping is not of sufficient importance to make a change at this time.

This was discussed at the executive committee meeting on Monday.

CHAIRMAN THOMAS: Gentlemen, you have heard the action of the Committee, what is your pleasure?

(Upon motion duly made, seconded and unanimously carried, the action of the executive committee was unanimously approved.)

CHAIRMAN THOMAS: Now, I think we are ready, so far as I know, for the report of the Committee on Questions. Mr. Lukens, Mr. Speed and Mr. Barringer, I don't know whether that committee has had any questions submitted to it or not.

JOHN M. LUKENS (Philadelphia): There have been three questions submitted to the Committee on Questions.

The first was the paper read before our society by H. H. Mills, on the Importance of the Hydrostatic Test in Boiler Inspection. There was no question in this to be answered.

The second question before the Question Committee came up in reference to the placing of valves and connections to the pipes of main steam lines. This is from Mr. Farmer of Rhode Island:

Mr. Chairman, I wish to bring the question of a uniform ruling among boiler inspectors who enforce the boiler laws in the various political districts, states, cities, etc., on installations and inspection. Several cases have come to my notice recently in the State of Rhode Island, most notably the distance that the first stop valve may be placed on the intervening pipe between the boiler and the main steam line. The pipe engineers installing the valves both together and near the main steam line with a steam loop between the first valve and the outlet of the boiler. The engineers making the installation contended that the first valve may be placed 20 feet, 30 feet or even 50 feet, if case required and yet conform to the Code. My ruling was that they should make the installation so that it would not be necessary for them to so place the first stop valve, and they replied that other Code states permitted the placing of first stop valve next to steam main, why should not the State of Rhode Island? There was also the question of placing a by-pass around the feed-water regulator on the feed-water line which they contend is not required in other Code states.

John M. Lukens: The action of the Committee was:

Paragraph P. 301 and P-302, of the Code, also interpretations of A. S. M. E. Boiler Code, Case 615, states that:

It is not necessary under the requirements that the first stop valve be located directly at or upon the nozzle of the boiler. Par. P-301 permits of intervening pipe or connections but indicates a preference for the shortest and most direct connection possible between them—7 or 8 feet from boiler.

Chairman Thomas: If I understand it, Mr. Lukens, the Committee recommends a limit of 7 feet?

Wm. P. Eales: If I recollect rightly in this same building that we are now in, they had up the question a few years ago, about the location of the stop valves; they almost forgot the boilers; they put them in afterwards. I think that a distance of 7 feet is a little too short. It is not the boiler manufacturer's fault at all. They run the main steam connection to the end of the boiler and then put the stop valve on it. With a 20-foot drum and with the main steam connection on the drum, I cannot but feel that distance should be extended to whatever is the approximate length of the drum, or half the length of the drum. It is impossible where there is not head room to do that. That arbitrary distance of 7 feet, it seems to me, would complicate matters. In some instances, I think it should be right on the nozzle. I would like to have it predicated more on the length of the drum, so that they cannot run off into the next block or the next adjoining building.

F. A. Page (California): I was wondering how it would work out on some of the drums that we were installing in San Francisco, 39 feet long.

H. H. Mills: I don't know that referring to the length of the drum will help you. You might have a battery of boilers and you might have to go the length of four or five drums before you got to a stop valve.

E. W. Farmer: Having been responsible for this question, I would like to say that I have had several cases recently in regard to the maximum distance from the boiler that I would permit the location of the stop valves, and I told them about 5 feet, I thought, would be a good maximum distance.

A little later the insurance inspector came in and asked me about it, and then I saw right away why I had been called on the telephone and asked for a ruling.

So, I went down there and I told them they would have to change the location of the first stop valve as I thought it did not conform to the intent of Par. 301.

Then the same question came up in the state institutions, and similar cases, and the people at first demurred and said that I must have considerable Scotch in me because I would not retract my ruling. They claimed that other states, the State of Massachusetts and the State of New York, and other states in the A. S. M. E. permitted such installations. I told them that I did not think they would permit the Code to be stretched, to place a stop valve any place that it seemed desirable to them. I thought that the intent of the Code was that the first stop valve should be placed as near as possible to the boiler, and that they said that 20 or 30 or 40, or perhaps 50 feet, might be the nearest location to the boiler possible, and I told them that I did not think that would be according to the intent of the Code, that it was possible to make an installation where it would not be necessary to have the first stop valve located so far away from the boiler; otherwise, it would not have been put in the Code in that way.

Since that time, I have just let it stand as I have made my decision. They did not ask for any arbitration at all, but later on they came to me and told me that hereafter they would make the location of the stop valve within the limitation as given them.

Jos. T. Scott (New Jersey): That is 5 feet?

E. W. Farmer: Yes. So, I thought that was very fine, but that I would ask that the question be brought before the National Board to have a uniform ruling among the inspectors, so that if somebody went to New York State, or some other state, to have the first stop valve as near the boiler as possible, and not have some engineering concern come in and say, "Well, your other states operating under the A. S. M. E. Code will permit installations where you can set them any distance." At that time I did not know that these engineering concerns decided to conform with my wishes in the placing of these stop valves.

C. O. Myers: I suggest that the motion be read again. It seems to me as though there is some misunderstanding here.

John M. Lukens: The recommendation of the Committee in a few words, is not to go over 8 feet from the boiler outlet.

Chairman Thomas: Then the question is on the accepting of the report of the Committee.

John M. Lukens: The next question has to do with the definite fixing of the water level on horizontal tubular boilers.

Paragraph P-291 sets forth the regulation. There has been considerable discussion backwards and forwards, especially in the State of Pennsylvania. The Board of the State of Pennsylvania requested that a definite interpretation be made of that paragraph. The report of your Committee is:

"It is the recommendation of the National Board of Boiler and Pressure Vessel inspectors that the Boiler Code Committee of the A. S. M. E. interpret Paragraph P-291 of the Boiler Code as follows:

"'It is interpreted that the second sentence of Paragraph P-291 means that there shall be at least 3 inches of water over the upper row of tubes of horizontal tubular boilers at all times when the boiler is in operation and this shall be the lowest permissible water level.'"

M. A. Edgar (Minnesota): As I understand the question, the lowest permissible water level is to be 3 inches above the tubes. That means that the lower end of the glass is to be placed 3 inches above the tubes. We have horizontal tubular boilers 27 inches in diameter. They build horizontal tubular boilers as small as 24 inches in diameter. Now, the A. S. M. E. adopted their present ruling on the location of water glasses, on a suggestion that I made several years ago, I think. We had difficulty in enforcing that rule; at that time the lowest permissible water level was 2 inches, and that was the location for the fusible plug, and the glasses had to be located above that, and when I pointed out to the Code Committee that if they should fix that location for the fusible plug, it would be not lower than the top row of tubes, and then with the glass placed 2 inches above that, there still was not much steam space. As far as low water is concerned with horizontal tubular boilers, I think we over estimate the importance of that, and I think that we set our glasses a little too high. I don't say that as far as 72-inch boilers are concerned, because we have ample steam space there, even though we place the glass 4 inches above the tubes, but the worst that I have ever seen done is the springing of the tubes at the low end, and if the water gets too low you are liable to spring the tube head. I have looked up dozens and dozens of explosions of horizontal tube boilers and I don't know of any that exploded as a result of low water. On crown sheet boilers, or boilers with large surfaces which are almost instantaneously exposed to heat, it is different. I do not think that we need be so particular about having the water glass so high on these horizontal tubular boilers.

J. C. McCabe: I agree with what Mr. Edgar says.

J. M. Wood: I would very much suggest that we leave the American Society's ruling just as it is. I think it is well adapted to the different sizes of boilers and the different kinds and it has been given a considerable amount of study, and I think it is a very good ruling. I would like to back Mr. Edgar in leaving it just as it is.

The afternoon session was occupied with the discussion of routine matters of business and future expansion of activities of the Board.

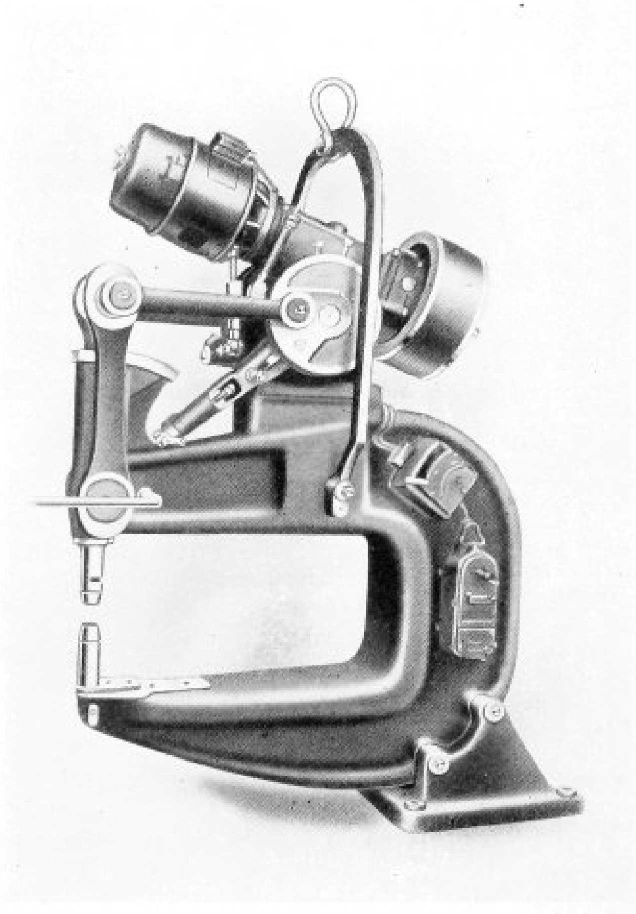
Electro-Mechanical Riveting Machines

The United Machine Tool Corporation, 75 West street, New York, has placed on the market seven sizes of electro-mechanical toggle-lever riveting machines having working pressures ranging from 27 to 145 tons, and capacities to drive from 5/8 to 1 1/16-inch boiler rivets.

This machine, known as the L. M. G., is entirely self-contained and is said to drive up to 24 rivets a minute.

The arrangement of the machine may be seen in the illustration. From the motor, the drive is through a steel worm and phosphor bronze worm-wheel, contained in a housing between the motor and the flywheel, to a set of driving disks that are connected to the toggle levers. Between the worm-wheel and the driving disks there is a clutch that is controlled by a handle just above the upper jaw of the yoke frame. The machine can be adjusted to operate continuously, or so that the plunger stops at the top and the bottom of each stroke, permitting the rivets to cool under pressure as long as desired. The plunger is adjustable.

The distance between the jaws is regularly 15 3/4 or



L. M. G. electro-mechanical toggle-lever riveting machine

19 3/4 inches but other heights can be furnished. The depth of throat ranges from 1 foot to 13 feet 2 inches. The machine will work in any position. Special types of hangers, such as swing-cradle hangers that permit sideways tilting of the machine, semi-universal or full-universal hangers can be furnished. The flywheel, which runs at 1000 revolutions per minute, is connected by friction to the main driving shaft, and is disconnected automatically in case of overload. The motor starter is mounted on the yoke frame, just below the flywheel, and the main switch, fuse box and socket for the cable connecting block is mounted on the side of the frame, as shown. A detachable foot that adapts the machine for stationary use is provided.

The net weight of the smallest machine ranges from 1540 to 6270 pounds and the weight of the largest from 10,560 to 42,000 pounds. Motors ranging from 2 to 7 1/2 horsepower are used.

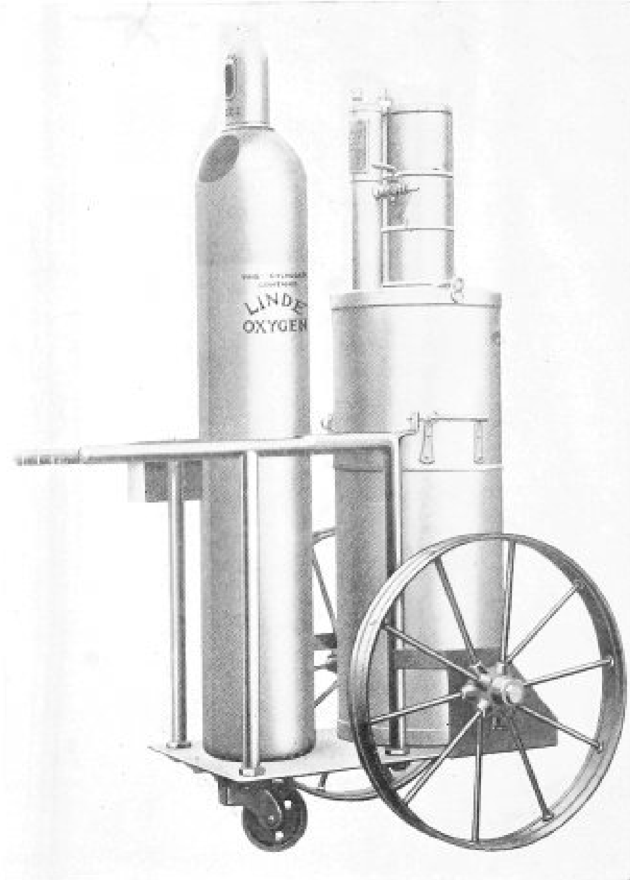
Bulletin 92-A from the general catalog of the Revolvator Company, Jersey City, N. J., describes briefly the new Red Giant hand-power revolvator. This device is a portable elevator with a revolvable base.

Two New Trucks For Carbic Generators

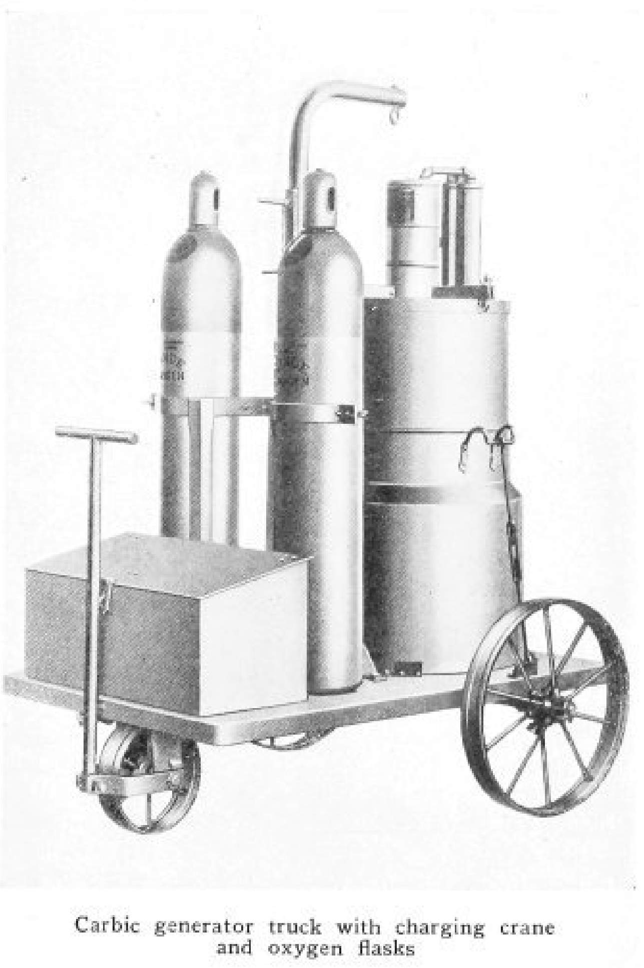
THE Oxweld Acetylene Company, 30 E. 42nd street, New York City, has recently introduced two new types of trucks to accommodate type CLP-3 and type CLP-2 carbic low-pressure acetylene generators, respectively.

The truck designed to carry the CLP-3 carbic generator also carries two cylinders of oxygen. It is sturdily constructed throughout and oxy-acetylene welded. Two large wheels carry the back part of the truck; a third wheel, in the front, is of the castor type and allows the truck to be turned in a radius about equal to its own length. The generator is secured to the steel deck of the truck by means of angle-iron braces and two long bolts which are inserted in the handles of the generator and tightened by means of turnbuckles.

The truck is provided with a steel tool box with loop fastenings. This box can be used for wrenches, small tools, or for a welding or cutting outfit. The oxygen cylinders are chained to a steel rack which is fastened to the deck of the truck beside the generator. A sturdy crane is provided to be used in charging and emptying the generator. With this crane it is an easy matter to lift the gas bell out of the generator. The water and residue can then be drained off through the outlet at the bottom. The crane jib is made in three sections which can be telescoped when not in use to decrease the height. The truck has two 24-inch steel wheels with 3-inch tires, and a caster-wheel which is 12 inches in diameter by 2 inches. All wheels are provided with grease cups for lubrication.



Welded truck for small type carbic generator and single oxygen flask



Carbic generator truck with charging crane and oxygen flasks

The smaller truck will accommodate one cylinder of oxygen in addition to the type CLP-2 carbic generator. It is designed for extreme portability and can be wheeled anywhere with ease. There are two 24-inch steel wheels and one 5-inch caster-wheel operating on a roller bearing. All wheels are provided with grease cups for lubrication.

Carnegie Tech has Largest Welding School

THE Carnegie Institute of Technology now has the largest school for the training of welders of any college in the United States. New equipment, recently installed, enables this institution to handle the largest classes in welding in this country. The classes at Carnegie consist of two groups, one to teach skill in welding considering the torch and electrode as tools, and the other to teach the young engineer the possibilities of welding in his profession.

The night classes in welding have an enrollment of over 250 students. These are selected from a long list of applicants from the various metal trades in Pittsburgh. The night instruction is conducted to perfect skill and to give some ideas of the reasons for fusion of metals, penetration, expansion and contraction, etc. The day classes have an enrollment of over 350 and special attention is given to structural, aeronautical, automotive, pipe and container welding.

The welding is done in separate booths, each containing a control panel, a rheostat, a reactor, a work table, a head shield, and electrode holder and accessories. Welding current is furnished by a General Electric 1000-ampere, 60-volt constant-potential welding set. Ten welding booths and two portable single-operator sets are available.

Gas welding is carried on with 16 modern torches conveniently piped from gas manifolds. Work tables, preheat muffles and accessories are available.

Kant Slip Pliers

THE three most powerful principles in mechanics have been combined for the first time to produce an outstanding advancement in plier construction. The cam, the fulcrum and the wedge are the action which bring about the favorable results in the Kant Slip plier, a recent product manufactured by the Kant Slip Plier & Tool Company, 6036 Wentworth Avenue, Chicago, Ill.

This tool has a powerful parallel grip, enabling it to perform the work that has heretofore been done by the monkey, stillson or other wrench. It is the first plier to eliminate the pin as a point of strain. Kant Slip uses the pin solely for the purpose of holding the two members together. The cam slides the fulcrum to its correct position, irrespective of the load.

The cam, fulcrum and wedge as employed in the new Kant Slip pliers

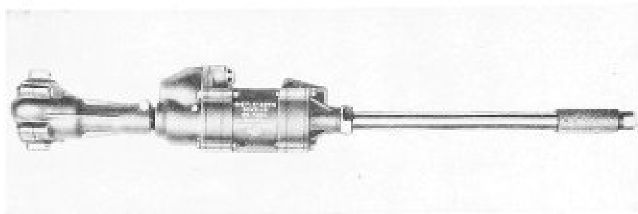
Kant Slip is a drop-forged tool made of a special-formula alloy chrome-vanadium steel, properly hardened. It is not case hardened. The teeth are accurately machined and will not batter or crumble. Handles are shaped to fit the hand to make it an easy working tool and to prevent slipping.

Rotary Pneumatic Wrench

THE Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, Ill., has designed a new type wrench—the Thor 278 rotary pneumatic wrench. A particular feature of the Thor wrench is that it develops more horsepower at a higher speed than any other wrench made.

On actual work it has demonstrated that it will pay for itself on all fourteen boilers. Locomotives usually have 600 to 750 flexible staybolt caps. In one large shop, where it required two boiler makers and two helpers eight hours to remove them by hand, the Thor 278 wrench did the entire job in six hours with only one boiler maker and helper.

An example of its great power is that it can be used for removing rusted staybolt caps. On the throat sheet where it has always been difficult to get in with any tool, the Thor fits perfectly and does the job. Because of its exceptionally fast starting torque the new wrench is said to break nuts loose from the cylinder studs without backing the stud out.


Staybolt-cap wrench

The speed of the wrench is governor controlled and heavy duty ball bearings are used at all vital points. A renewable rotor liner is an interesting feature because it saves the cylinder from excessive wear and reduces upkeep costs. The Thor wrench has a speed of 170 revolutions per minute. The weight is forty pounds.

National Tube Company Installs Synchronous Motors

THE largest single installation of synchronous motors in steel mills will soon be made at the National Works of the National Tube Company, McKeesport, Pa. The six large synchronous motors that will be used for driving two seamless-tube mills are being manufactured by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. One of these mills will have installed in it two 3500-horsepower synchronous motors and one 2000-horsepower, synchronous motor. The two 3500-horsepower motors will drive piercing mills and the 1000-horsepower motor will drive the tube-rolling mill. A second mill will have installed in it two 2000-horsepower synchronous motors and one 1000-horsepower synchronous motor. The two 2000-horsepower motors will drive piercing mills and the 1000-horsepower motor will drive the tube-rolling mill.

When the installation is completed it will be the first seamless-tube mill installed in the McKeesport Plant. The National Tube Company, which is the largest manufacturer of seamless tube in this country, has not utilized the McKeesport Plant for seamless-tube production, as only the plants at Gary, Ind., Lorain, O., and Elwood City, Pa., have been producing all of its seamless-tube products. When this installation is made, however, the National Works will have a larger installation than any of the other plants except the Lorain Plant located at Lorain, O.

Joseph T. Ryerson & Son, Inc., Chicago, Ill., has sold its complete line of table and floor-type horizontal boring, drilling, and milling machines to the Ohio Machine Tool Company, Kenton, Ohio. The Ryerson company, however, will retain the sole rights as exclusive distributors of the line. The Ohio Machine Tool Company has been building these machines for some time for the Ryerson company and will expand and improve the line now that it has the ownership. This move concentrates the full manufacturing responsibility with the Ohio Machine Tool Company and will enable the Ryerson company to center its activity on sales and distribution of these machines.

Questions and Answers

Problems in design, construction and repair of boilers, heavy plate and tank work

Conducted by George M. Davies

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. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.*

White Marking Paint

Q.—What is the best formula for white stencil metal marking ink or paint for marking steel plate; such as the layout man is required to use in a boiler and tank shop? R. J. R.

A.—No doubt there are many formulas and compositions used for this purpose and each layerout has his own idea as to which is the best.

"Whiting" is perhaps the most common and is a composition of calcium carbonate mixed with cold water to the desired consistency and is applied with a paint brush; a little glue as used on woodwork may be added if it does not adhere to the metal.

"Whiting" is also a commercial product sold cheaply in a powdered form to save cost of a watertight package. In this, the glue is in the form of a fine powder intimately mixed with the pigment and thus rapidly swells and goes more or less into the solution when the powder is mixed with cold water.

If the surface to be laid out has been machined and oil has worked its way into the metal, the same can be removed by rubbing with an asbestos block before applying the "Whiting" mixture.

Water paint is also used for this purpose but is no doubt more expensive.

Purpose of a Thermo Tank

Q.—The following question was recently set by the British Civil Service at an examination for inspector of boiler makers: Describe the purpose and general construction of a thermo tank. What advantage would be derived from a tank 1000 cubic feet capacity if the boiler pressure be 200 pounds per square inch and the engine receiver pressure be 150 pounds per square inch? S. H. L.

A.—There are two possibilities as to what piece of equipment is referred to, the first would be a receiver set in the steam line for the purpose of bringing about an expansion, thereby reducing the vibration. This is done many times where the size of the pipe is small for the amount and velocity of the steam flowing through it. The tank would have to be designed and manufactured so as to sustain the higher pressure of 200 pounds per square inch.

The second possibility would be the thermo storage tank. By this system heated water, under a pressure greater than is required for the engines, may be stored in a cylindrical tank from which steam may be taken through a pressure-reducing valve when required. In storing steam, the boiler and the thermo storage tank are coupled by pipes. The boiler is operated full of water and a continuous current of hot water flows from it into the thermo storage tank, under a pressure of 200 pounds per square inch or 50 pounds higher than that of the steam used by the engine. It is preferable to have the boiler pressure at least 100 pounds per square inch higher than the steam used by the engine. Steam is withdrawn from the storage tank through a pressure reducing valve.

Heat may be recovered from hot water in the form of steam, for if the pressure is reduced, the water gives up some of its heat which generates steam at a lower pressure. The quantity of steam stored is that given up by it in falling from its temperature in the thermo-storage tank to that corresponding to the pressure of the steam used by the engine. For instance, if the water of the thermo storage tank be under a pressure of 200 pounds per square inch, its temperature is 388 degrees F.; and if the engine be worked by steam of a pressure of 150 pounds per square inch, its temperature is 365.7 degrees F. The heat of evaporation of the water in the thermo storage tank (this may be obtained in any standard engineering handbook), is 360.0 thermal units per pound, and that of the water corresponding to the pressure of the steam used by the engine is 337.2 thermal units per pound. Each pound of water, in falling through this range of temperature, gives up $360—337.2=22.8$ thermal units. The total latent heat of evaporation of steam of a pressure of 150 pounds per square inch is 856.3 thermal units, therefore $856.3\div22.8=37.5$ pounds of water will produce one pound of steam.

Water at a temperature of 388 degrees F. weighs 54.1 pounds per cubic foot, and assuming that 15 pounds of steam are used by the engine per indicated horsepower, the capacity of the thermo storage tank should be at least 37.5 pounds of water $\times$ 15 pounds of steam $=582.5$ pounds $\div54.1=10.7$ cubic feet per feet per indicated horsepower developed by the engine per hour.

In storing hot feed water, the boiler and thermo storage tank are connected by pipes and the steam produced by the boiler during the hours of small demand for steam is used to heat all the feed water in the thermo storage tank required by the boiler when there is a great demand for steam. By this arrangement the scale forming matter in the water is deposited in the storage tank, and the water is sufficiently purified before entering the boiler.

Open-Top Water Tank Design

Q.—What is the method of determining stresses, plate thickness, size and number of stiffeners required to prevent excessive deflection of beams and plate in the open-top water tank shown in Fig. 1? J. M. C.

A.—The stresses imposed upon flat plates under pressure, as in the case of the open-top water tank, as submitted in the question, have not as yet been accurately determined, and no doubt the experiences of the various builders of this type of tank play a large part in the design.

The following formula while not theoretically correct is sufficiently accurate for a basis of determining the

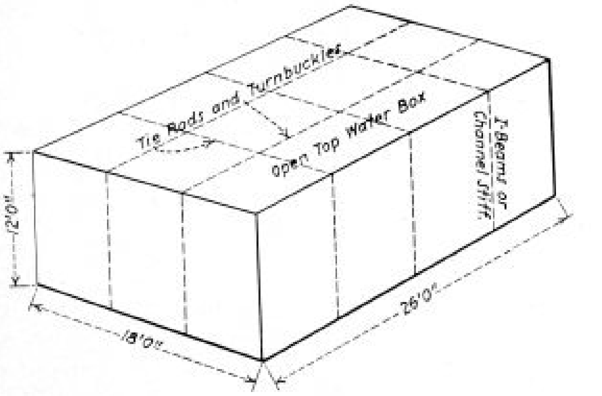


Fig. 1.—Open-top water tank showing location of tie rods and stiffeners

thickness of plate and the spacing of the stiffeners or bracing for rectangular tanks of this type.

The formula is developed by Unwin and is:

$$L = 2t\sqrt{\frac{S}{P}}$$

where

L = length of square plate between stays in inches.
S = working stress in pounds per square inch.
P = working pressure in pounds per square inch.
t = thickness of plate in inches.

The formula is for square plates firmly fixed around all four sides and uniformly loaded over the whole surface.

In practice the plate is held by rivets which are spaced more or less closely, depending upon whether they are in a seam which has to be calked or in a stay fastened to the plate. In the first case, the rivets are usually spaced sufficiently close to enable us to consider the plate as firmly fixed all along the riveted edge. In the second case, it is general practice to space the rivets quite far apart, too much so as to really fix the plate as called for by the conditions under which the formula was derived.

It is impossible to say exactly how much the stress is increased by a wide spacing of the rivets, but experience seems to show that the pitch of the rivets should never exceed six times their diameter and that little or nothing is gained by making the pitch less than four times the diameter of the rivet.

It will be noticed that in the above formula there are two variables; namely t, the thickness of the plate, and L, the pitch of the stays. To calculate these involves assuming one, and working out the other from the formula. If this gives an undesirable size, another combination must be tried. In order to eliminate this amount of labor the chart as shown in Fig. 2 has been figured out so as to give all the combinations of thickness of plate and pitch of stays which will carry a given pressure.

This chart is based upon the formula already given, using a safe stress of 10,000 pounds which gives a factor of safety of about five. This will be found to give good results in practice and insure a reasonable life to tanks made to these dimensions.

To increase the convenience of the chart, there is marked off along the bottom line, the equivalent of the pressures in feet of head of water, so that it can be used with equal facility when given either the head of water or the pressure, without having to convert either one into the other.

Taking the tank submitted in the question into consideration, to determine the required thickness of plate and pitch of stays for the plate in the bottom of the tank, which is 12 feet deep; following up vertically, on the chart shown in Fig. 2, from the point on the bottom line marked 12-foot head, as indicated on the chart by the dotted line, read at the points where this line crosses the horizontal lines for the various thickness of plates, the pitch of stays that is required for each thickness; we have a choice of the following:

Thickness of plate	Pitch of stays
3/16 inch	16 1/2 inches
No. 6 gage	17 7/8 inches
No. 5 gage	19 3/8 inches
No. 4 gage	20 3/4 inches
1/4 inch	22 inches

The pitch of stays is read from the diagonal line at or next below the intersection of the vertical line drawn from the head-of-the-water point with the respective thickness-of-plate line.

The pitch of stays is, more correctly speaking, the maximum length of the side of a square plate which will safely carry the pressure in question and this square plate must be firmly fixed all along each edge; that is, the plate will not be safe for the pressure if

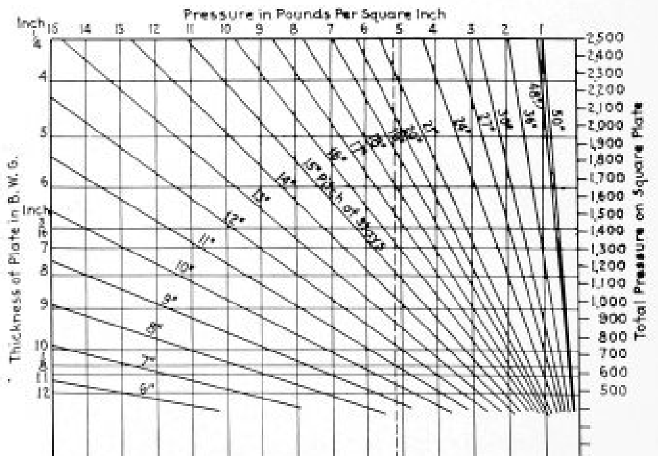


Fig. 2.—Thickness of plate required in tanks subject to pressure

merely supported by a stay at each corner of the square as is done in the staying of flat surfaces of boilers.

Assuming ¼-inch thickness of plate for the tank in question, the next step is to work out the scantlings of the stays. To facilitate this calculation, there is added at the right hand side of the chart a scale showing the total pressure per square inch multiplied by the area of the square. This is found by drawing a horizontal line from the intersection of the head or pressure line with the pitch of the stays diagonal line, to the scale at the right and there reading off the total pressure which will be for a 12-foot head imposed on a 22-inch square plate and is found to be at 2500 pounds.

If the tank is for a ship or moving conveyance, it will be necessary to fit swash plates to prevent the water from surging around in the tank and unduly straining the sides; these swash plates will be amply strong to serve also as stays, otherwise these stays must be provided either in the shape of angle bars, tee-iron stiffeners, stay plates, or a combination.

The size of angle-iron or tee-iron bracing used can be determined by the following formula:

$$2 = \frac{W + L}{6 \times S}$$

where

z = section modulus of angle or tee.

W = total load on angle or tee.

L = length of angle or tee between supports in inches.

S = safe stress (10,000 pounds per square inch).

The size of the braces can be reduced by relieving the load from any given area by the use of cross braces which have the required cross-sectional area in tension to support the load.

The Gunderson Process

Q.—I am very much interested in your article in the August issue concerning the Gunderson process for eliminating boiler corrosion. Is it necessary to treat the water with soda ash when using this process? Does this process cause the boiler to foam? G. E. C.

A.—The Gunderson process as outlined in the August issue does not eliminate the necessity for the use of soda ash.

Soda ash is used to prevent scale which is formed on the boiler heating surfaces by the deposition of impurities in the feed water in the form of a more or less hard, adherent crust. Such deposits are due to the fact that the water loses its soluble power at high temperatures, or, through evaporation, the concentration becomes so high that the impurities crystallize and adhere to the surfaces. The salts usually responsible for this incrustation are the carbonates and sulphates of lime and magnesia.

The Gunderson process is for use in the prevention of corrosion, such as pitting.

The corrosion or pitting of steel and other metals takes place only under water or at least in the presence of moisture, and proceeds only by the solution of atoms of iron in the water. Iron can dissolve in water only when an equivalent number of hydrogen ions can be released from the water at some other point on the metal and therefore to prevent corrosion or pitting, it is necessary to prevent the escape of hydrogen ions from the water in the boiler.

The Gunderson process accomplishes this by keeping the metal coated with metallic arsenic, which prevents the access of hydrogen ions to their only door or escape, the cathodic iron surface. This method can be used, it is believed, equally well on soft and hard waters.

The Gunderson process is for use in the prevention of pitting only and is used in conjunction with soda ash. However, where there is no trouble with scale, the Gunderson process can be used alone, for the prevention of pitting.

There is nothing about this process that should cause the boiler to foam.

Foaming is generally caused by organic matter in suspension and may be largely overcome by filtration or by the use of a coagulant in connection with filtration, the latter combination having come into considerable favor. Alum, or potash alum, and iron alum, which in reality contains no alum and should rather be called potassia ferric, are the coagulants generally used in connection with filtration.

Where foaming occurs as the result of overtreatment of the feed water, the obvious remedy is a change in such treatment.

John Amos Stevens Dies

(Continued from page 340)

sible with any state board. At the time of his death, Mr. Stevens held the position of honorary chairman of that committee. He has been responsible in no small measure for the success of the committee's work, which included a comprehensive code, issued in 1914, with subsequent revisions from time to time and which has been adopted in a number of states.

Mr. Stevens was always a firm believer in the importance of research and invention, and for many years did everything in his power to encourage both. In accordance with these views was the creation of a trust fund under the auspices of the American Society of Mechanical Engineers, known as the John A. Stevens Trust Fund. The principal of this fund amounts to $24,000, the income of which is to be paid annually, after 1932, to Mr. Stevens' two sons, during their lives, after which it reverts to the American Society of Mechanical Engineers forever to the persons who have in any year invented or been responsible for the invention of a noteworthy progress in engineering having to do with the conservation of fuels in the generation of light, heat and power.

During the World War he was standardization engineer of the United States Shipping Board, Emergency Fleet Corporation, and as such assisted in formulating "Allowances, Tolerances and Clearances of Marine Machinery and its Inspection." In 1918 the National Association of Cotton Manufacturers presented to Mr. Stevens its Association Medal for his paper on the "Evolution of the Steam Turbine in the Textile Industry," and for having contributed the most to the advancement of the cotton industry during the year 1917.

He was a member of the American Society of Mechanical Engineers, of which he was vice-president during the years 1918-1920, inclusive; the American Society of Heating and Ventilating Engineers; the American Society for Testing Materials; the Society of Naval Architects and Marine Engineers; the National Association of Cotton Manufacturers; the Lowell Board of Trade; the Boston Chamber of Commerce; the Old Colony Club of New York; the Engineers' Club of Boston; the Yorick Club of Lowell; the Vesper Country Club of Tyngsboro, Mass.

Joseph P. Fletcher, manager of the Buffalo, N. Y. office of the Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, Ill., has been appointed manager of the Philadelphia office to succeed the late A. L. Schuhl. W. O. Becker, who has been working out of the Toronto office, has been named manager of the Buffalo office.

Associations

Bureau of Locomotive Inspection of the Interstate Commerce Commission

Chief Inspector—A. G. Pack, Washington, D. C.

Assistant Chief Inspectors—J. M. Hall, Washington, D. C.; J. A. Shirley, Washington, D. C.

Steamboat Inspection Service of the Department of Commerce

Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law

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Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—Fred R. Low.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 W. 39th Street, New York.

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Vice-Chairman—William H. Furman, Albany, N. Y.

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Assistant International President—William Atkinson, suite 522, Brotherhood Block, Kansas City, Kansas.

International Secretary-Treasurer—Chas. F. Scott, suite 506, Brotherhood Block, Kansas City, Kansas.

Editor-Manager of Journal—John J. Barry, Suite 524 Brotherhood Block, Kansas City, Kansas.

International Vice-Presidents—John J. Dowd, 142 Pearsall Ave., Jersey City, N. J.; M. A. Maher, 2001 20th St., Portsmouth, O.; R. C. McCutchan, 226 Lipton St., Winnipeg, Man., Canada; H. J. Norton, Alcazar Hotel, San Francisco, Cal.; C. A. McDonald, Box B93 Route 2, Independence, Mo.; J. N. Davis, 1211 Gallatin St., N. W. Washington, D. C.; M. F. Glenn, 1434 E. 93rd St., Cleveland, O.; W. J. Coyle, 424 Third Ave., Verdun, Montreal, Canada; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; J. F. Schmitt, 25 Crestview Rd., Columbus, O.

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Treasurer—W. H. Laughridge, general foreman boiler maker, Hocking Valley Railroad, Columbus, Ohio.

Executive Board—Charles J. Longacre, chairman, foreman boiler maker, Meadow Shops, Pennsylvania Railroad, Elizabeth, N. J.

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Vice-President—Irving H. Jones, Central Alloy Steel Corporation, Massillon, Ohio.

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Executive Committee—Homer Addams, Fitzgibbon Boiler Company, Inc., New York, N. Y.; G. W. Bach, Union Iron Works, Erie, Pa.; H. H. Clemment, Erie City Iron Works, Erie, Pa.; J. R. Collette, Pacific Steel Boiler Corp., Waukegan, Ill.; F. W. Chipman, International Engineering Works, Framingham, Mass.; E. R. Fish, Heine Boiler Company, St. Louis, Mo.; C. E. Tudor, Tudor Boiler Company, Cincinnati, O.; A. C. Weigel, Walsh and Weidner Company, Chattanooga Tenn.; S. G. Bradford, Edge Moor Iron Company, Edge Moor, Del.

States and Cities That Have Adopted the A.S.M.E. Boiler Code

States

Arkansas	Missouri	Rhode Island
California	New Jersey	Utah
Delaware	New York	Washington
Indiana	Ohio	Wisconsin
Maryland	Oklahoma	District of Columbia
Michigan	Oregon	Panama Canal Zone
Minnesota	Pennsylvania	Territory of Hawaii

Cities

Chicago, Ill.	St. Joseph, Mo.	Memphis, Tenn.
Detroit, Mich	St. Louis, Mo.	Nashville, Tenn.
Erie, Pa.	Scranton, Pa.	Omaha, Neb.
Kansas City, Mo.	Seattle, Wash.	Parkersburg, W.Va.
Los Angeles, Cal.	Tampa, Fla.	Philadelphia, Pa.
	Evanston, Ill.	

States and Cities Accepting Stamp of the National Board of Boiler and Pressure Vessel Inspectors

States

Arkansas	Missouri	Pennsylvania
California	New Jersey	Rhode Island
Delaware	New York	Utah
Indiana	Ohio	Washington
Maryland	Oklahoma	Wisconsin
Minnesota	Oregon	

Cities

Chicago, Ill.	St. Louis, Mo.	Nashville, Tenn.
Kansas City, Mo.	Scranton, Pa.	Omaha, Neb.
Memphis, Tenn.	Seattle, Wash.	Parkersburg W. Va.
Erie, Pa.	Tampa, Fla.	Philadelphia, Pa.

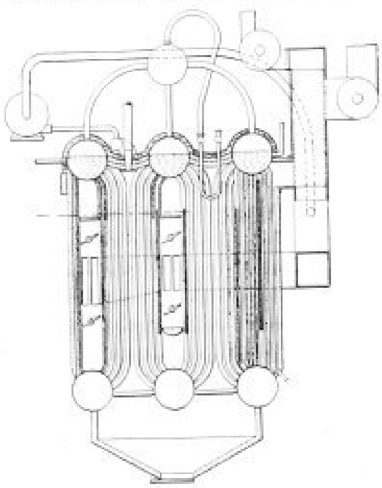
Selected Boiler Patents

Compiled by
DWIGHT B. GALT, Patent Attorney,
Washington Loan and Trust Building,
Washington, D. C.

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

1,709,358. FURNACE FOR BURNING PULVERIZED COAL. EDWIN LUNDGREN, OF FREDERICK, MARYLAND, ASSIGNOR TO INTERNATIONAL COMBUSTION ENGINEERING CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

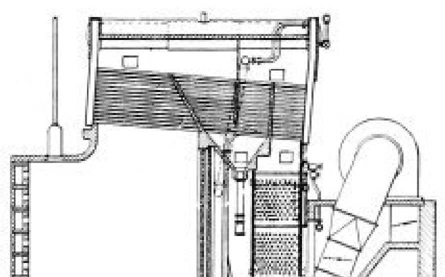
Claim.—In a pulverized-coal-burning furnace a row of alternating flattened burners and flattened air delivery members so arranged that the



longer dimensions of the outlets of the air delivery members are disposed at right angles to longer dimensions of the outlets of the burners, said members discharging in substantially the same direction. Three claims.

1,685,898. ECONOMIZER BOILER. JOHN E. BELL, OF BROOKLYN, NEW YORK, ASSIGNOR TO FOSTER, WHEELER CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

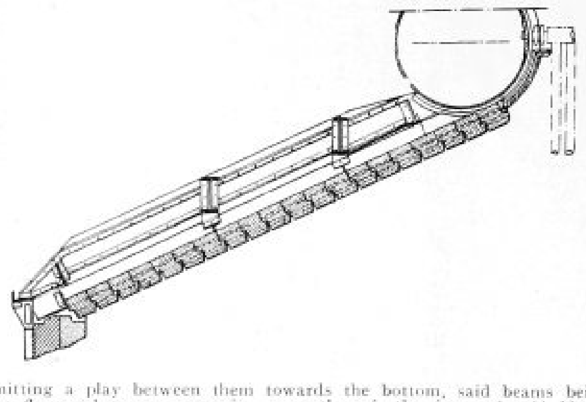
Claim.—The combination with a horizontal water tube boiler having a housing therefor and baffled to provide four transverse passes for the heating gases, of a chamber beneath the first pass through which heat-



ing gases pass upward into said first pass, an economizer located within said boiler housing beneath the fourth pass and comprising a closely spaced bank of heating tubes, and means providing a flow path for the discharge of heating gases from the bottom of the economizer including separate portions at opposite sides of a plane transverse to said tubes and intermediate the ends of the latter. Seven claims.

1,683,963. FURNACE ARCH. CAMILLE DUQUENNE, OF PARIS, FRANCE.

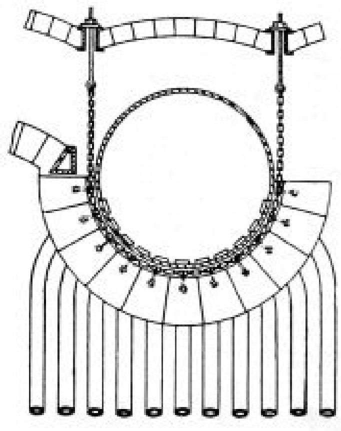
Claim.—A roof for furnaces having a metal framework, a plurality of supports carried thereby and arranged in longitudinal alinement inclined from front to rear of the furnace, the said framework comprising transverse members to which the supports are secured, a plurality of successive sections of alined beams having flanges adapted to engage said supports, the ends of two consecutive sections of said beams resting in contiguity in a common intermediate support and bearing against each other at their upper part, the ends of said beams being cut on a bevel



permitting a play between them towards the bottom, said beams being provided with lower flanges and refractory blocks suspended from said lower flanges between successive rows thereof, the faces of said blocks being bevelled to permit increasing play toward their lower ends. Four claims.

1,684,691. WATERTUBE BOILER. LEBRECHT STEINMULLER, OF GUMMERSBACH, GERMANY, ASSIGNOR TO FIRMA L. & C. STEINMULLER, OF GUMMERSBACH, RHEINLAND, GERMANY.

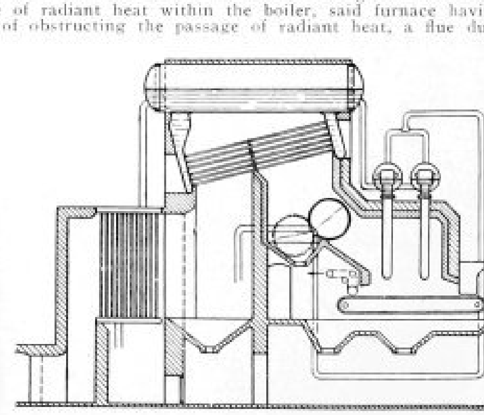
Claim.—In combination with a boiler drum, spaced rows of tubes entering said drum and means for protecting the walls of said drum



from direct flame action comprising strings of refractory blocks located in the space between the rows of tubes and refractory tiles located between said blocks and the wall of the drum and held in position by said blocks. Eight claims.

1,707,143. SUPERHEATER. ADOLPH SCHNEIDER, OF KELHEIM-DONAU, GERMANY, ASSIGNOR TO NIEDERBAYERISCHE CELLULOSEWERKE AKTIENGESELLSCHAFT, OF KELHEIM ON THE DANUBE, GERMANY.

Claim.—In combination, a steam boiler having a furnace constituting a source of radiant heat within the boiler, said furnace having a wall capable of obstructing the passage of radiant heat, a flue dust bunker



within the furnace behind said wall, and a superheater comprising a plurality of tubes bent into the form of annular loops and pivoted in the boiler in proximity to said furnace wall and eccentrically with respect to the centres of the loops so as to be capable of being turned into a position projecting beyond said wall for enabling it to be heated by radiant heat from the furnace and of being turned out of said position behind said wall into the flue dust bunker, as set forth. Two claims.