The Boiler Maker

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JANUARY TO DECEMBER, 1924

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The Boiler Maker

JANUARY, 1924

The Trend in French Boiler Construction

Progress as Shown at the Y. & A. Niclausse Works—Tendency to Larger Units—Noteworthy Installations

By Captain Godfrey L. Carden

THE work at the Y. and A. Niclausse plant is representative of boiler progress in France today. The shops are located in Paris and have canal access to the seaboard. I first became acquainted with this plant when collecting power items for the St. Louis Exposition. The Niclausse boiler which was secured formed one of the units in the power plant at St. Louis and received much favorable comment, as I recall, at the time. Today the Niclausse shops are largely concentrating on power plant installations, and have been called upon to construct important generating groups in cities devastated during the war. Their most important installations comprise 21 boilers for the Société Lilloise d'Electricité for a steam yield of 350,000 kilograms (772,000 pounds), and 17 boilers for the Société Intercommunale Belge d'Electricité to yield 200,000 kilograms (441,000 pounds) of steam. Right now the shops are engaged in the fabrication of a boiler for a total of 700,000 kilograms (about 1,545,000 pounds) of steam, and destined not only for France but for England and Belgium.

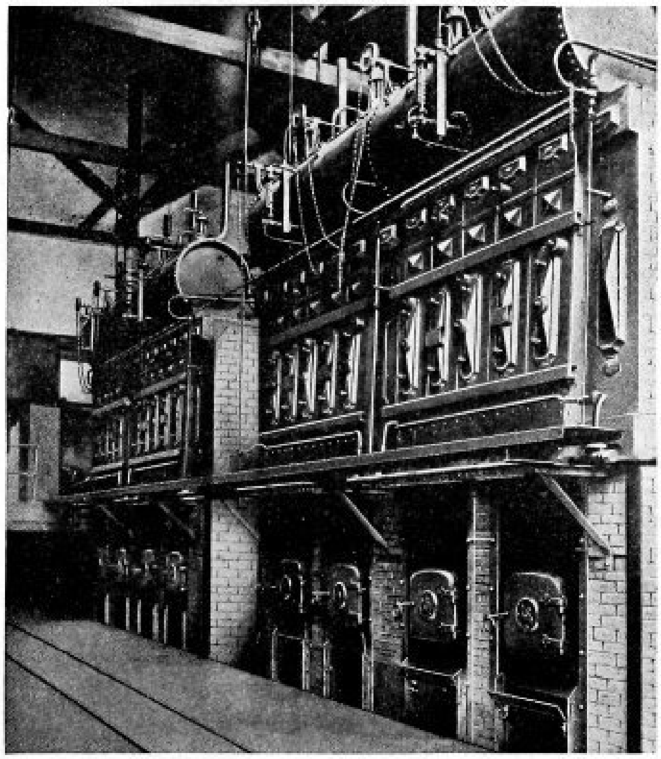


Fig. 1.—Niclausse Boiler Installation at Rio de Janeiro

Replacement of Boilers Destroyed in War

The replacement of boilers in those works destroyed or injured by the Germans, has also necessitated the construction of cargo quantities of material in the shape of accessories, in some cases to make good shortages in plants which were not destroyed but only stripped. The work in hand is sufficient to keep 750 men busy; in other words, the Niclausse plant is working to capacity. It is good to point out that the output per man is rather high, being secured by special machine-tools of high duty.

Every courtesy was shown me on the occasion of my recent visits when I had the pleasure of personally meeting the general director and his assistants. Still later I had an opportunity to discuss with Commandant Savin much of the detail work at the Niclausse shops, and to inspect the plant under the latter's guidance. The views as entertained by the Niclausse engineers, based on their experience of more than 40 years of boiler building, I have collected in brief form. Those views differ somewhat radically from German views which today tend in the direction of highly increased boiler pressure. The Niclausse engineers recognize the advantage of high pressure for turbine work but not for other prime movers.

Tendency in Boiler Design

For piston working engines, lubrication cannot be effected, it is declared, after the steam has reached a high temperature, but this difficulty disappears when turbines are considered. There is naturally some interest in securing high pressures because of the ability to secure with the same boiler a greater number of calories, and also that for a given power when compared with another boiler under less pressure the losses by radiation are sensibly diminished.

The Niclausse boilers of today are designed under two types—marine and land. While the principles are the same in both there is a modification in construction to suit the respective emplacements. Apart from this, the Niclausse engineers have made practically no changes.

These French Niclausse boilers, it was pointed out, are designed to work without interruption and with minimum loss, at high pressures. There is a limit, it is said, for evaporating apparatus having dugeoned tubes. It was necessary to hunt for a method which would insure pressure augmentation with a temperature increase proportional to such pressure rise. So that when passing from 12 to 14 kilograms (about 170 to 200 pounds) of pressure the temperature would rise from 187 degrees to 194 degrees C. (368.6 degrees to 381.2 degrees F.), representing an increase of 7 degrees C.; and when passing from 20 to 22 kilograms (about 284 to 312 pounds) pressure, the temperature would rise from 211 to 216 degrees C. (411.8 degrees F. to 419 degrees F.), representing an increase of 5 degrees C. This result has been secured.

The second method employed is superheating, whereby steam can be raised as required to 400 or 450 degrees C. (752 or 842 degrees F.) and the calories greatly augmented, but there too is a limit, it is declared, that must not be passed because of the effect produced by high steam temperature when coming in contact with metals. It is believed that the Niclausse superheaters are working at the highest pressures permissible under these limitations.

The Niclausse engineers sum up the situation in France today by saying that the actual tendency in boiler construction is the building of very strong units. One boiler furnishing 50,000 kilograms (about 110,000 pounds) of steam per hour, they say, offers advantages over three boilers of 17,000 kilograms (about 37,420 pounds) power. This advantage is seen in weight on the ground, in the number of accessories, less work on attendants, and reduced personnel.

The disadvantages appear in case of accident, and the possible loss of the total power for the works, which would be a loss of 50,000 kilograms (about 110,000 pounds) instead of the possible cutting out of one boiler with its 17,000 kilograms (about 37,420 pounds). The facility with which tubes can be removed from the Niclausse boiler disposes to a great extent of this inconvenience. The boiler can be quickly dismounted, bad tubes replaced, and because of its straight tubes, the type is one which can readily be cleaned and inspected. Having in view the enlarging of units, the French tendency as shown in late type Niclausse boilers is to increase size vertically, rather than extend over ground area. The latest Niclausse designs show three nests of tubes from bottom to top.

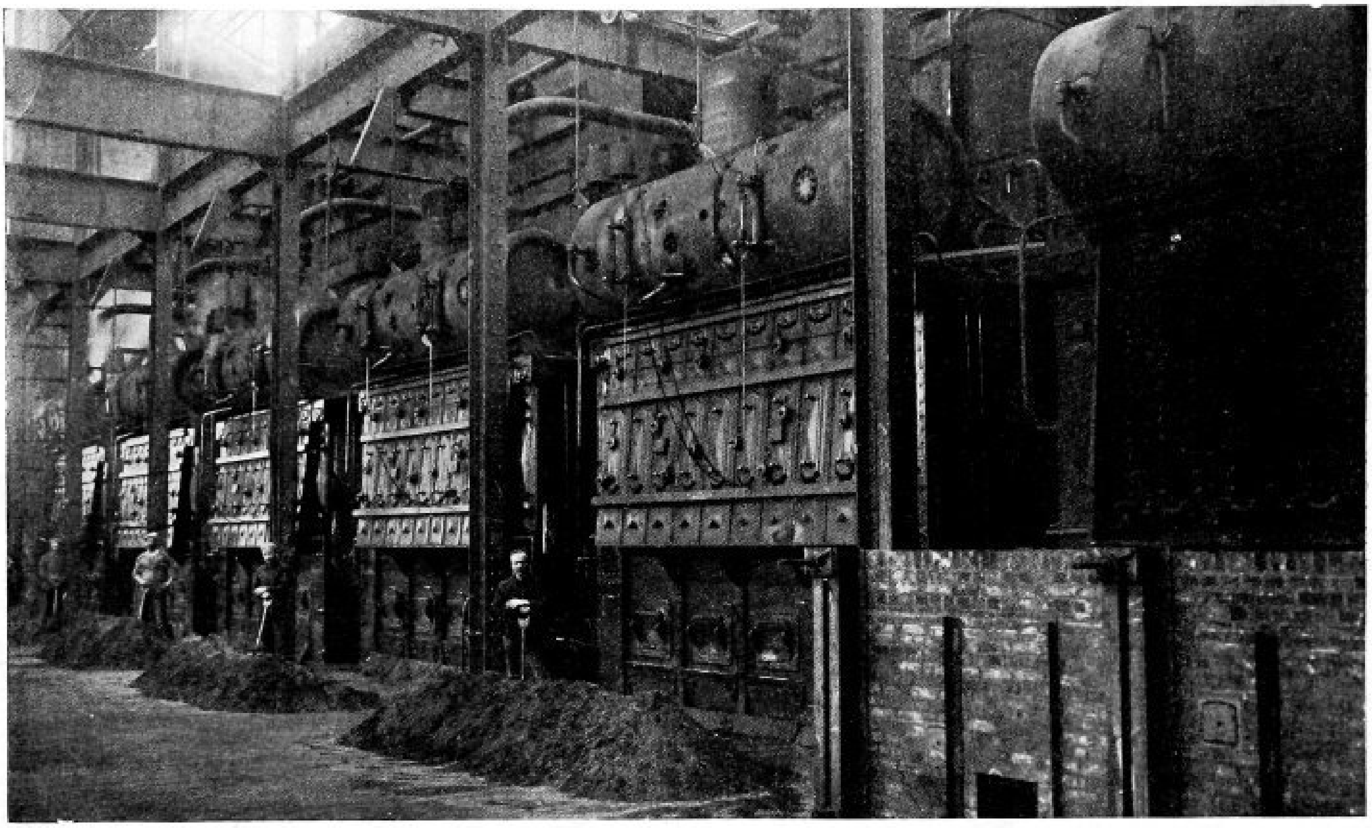


Fig. 2.—Typical Power Plant Battery of Niclausse Boilers

Advantages of New Niclausse Boiler

In this form of construction we find (1) the normal vaporizing nest, (2) a steam superheater and (3) an economizer. The design is also equipped with a special form of mechanical grate.

Under the design as now developed the Niclausse engineers claim that it is possible to utilize to the extreme the calories of fuel used whether coal or masout. The especial advantage is reduction in fuel cost. The disposition in vertical steps allows of the building of powerful units with relative small ground area covered.

The vaporizing nest has a series of elements varying in number according to the power. Mild steel is employed. All junctions are metallic and assure maximum tightness under the highest pressures. The tubes can be readily removed. Each element is bound by means of a metallic conic juncture installed between the top of the collector and a torsion, to a water and steam drum. All the vaporizing tubes are supplied with internal tubes.

The superheater is made up of steel tubes, divided into independent elements. Their number corresponds to the number of collectors in the vaporizing nest. The superheater is placed above the nest of tubes in a manner which will allow of a rational circulation of fuel gas and to assure at the various stages a nearly constant superheating degree.

The *utilizateur* designed to hold water at a high degree of temperature is placed above the superheater. It consists of elements like those of the evaporator nest (collector and tubes) and can readily be opened for inspection and if necessary removed.

The feed water forced by pumps into the interior of the *utilizateur* passes through same, going to the feed water regulator which is fixed on the steam and water drum, whereupon it is fed into the vaporizing nest and there vaporized, and the generated steam passes through the superheater before entering the engine cylinder.

SPECIAL MECHANICAL GRATE INSTALLED

The mechanical grate employed is of a special type. Its plane is composed of longitudinal bars of cast iron. Coal is distributed on the front side of the grate by a distributor varying in order to proportion the quantity fed to the result to be obtained. Ventilation is effected under varying pressure as needed. The air is underfed the zone as required. It is found in practice that this mechanical grate gives good service, regulates well the firing, accords normal smoke and diminishes the fuel expenditure and lessens the number of firemen required.

Following the close of the war, the Niclausse Works ceased the building of war material, and resumed the construction of their type generators. The plant has since been extremely busy, especially in making good power installations of works in the devastated regions of France and Belgium. This fact was fully attested by the busy appearance in the shops on the occasion of my visit this day. The manager, Commandant Savin, informed me that there was little difficulty in securing all help needed and that working conditions were all that could be desired.

I was afforded an opportunity to judge of the facility with which tubes could be dismounted and shifted, and while I recognized that the work was being done by expert men, it was evident that the same could be repeated anywhere with equal ease and rapidity by first class boiler attendants. The mechanical construction on these boilers is carried on in a very scrupulous manner, and all machining is carefully attended to. The material for the boilers is secured from outside works, as are also the heavier castings, the Niclausse shops confining attention largely to machining the various elements and assemblies.

In addition to the boiler plant the Niclausse Works have organized a shipyard on the canal which is able to turn out small craft the length of which does not exceed 40 meters (127 feet). The size imposed is regulated by the canal locks.

The Niclausse works have built throughout during the war 18 patrol boats and motor barges for the French Admiralty.

They make use of the canal to convey boilers from the yards at Vilette to all parts of France accessible by canal, and to seaboard both on the North and South.

Progress Toward Simplification

By William R. Basset*

ABOUT the most significant thing in industry right now is the effort that manufacturers are making to reduce the number of lines of product they have to turn out. Popularly this movement is called "Simplification."

Any manufacturer knows that it is far more expensive to make a dozen varieties of a product in a single plant than it is to make one; and that conversely it is cheaper to make a dozen than to make 150. There are many reasons why this is so. The most important are, first, that labor is most effective when kept on the same operation on a single type of product. Second, switching machines from one product to another results in a lot of lost time.

Some men succumb easily to the arguments of their salesmen and keep adding new products for them to sell without regard to whether the factory is equipped to turn them out economically. What they gain in easier selling they usually lose in uneconomical manufacturing.

Those who have attempted to reduce their lines have often found that selling is no harder. Sometimes it is easier.

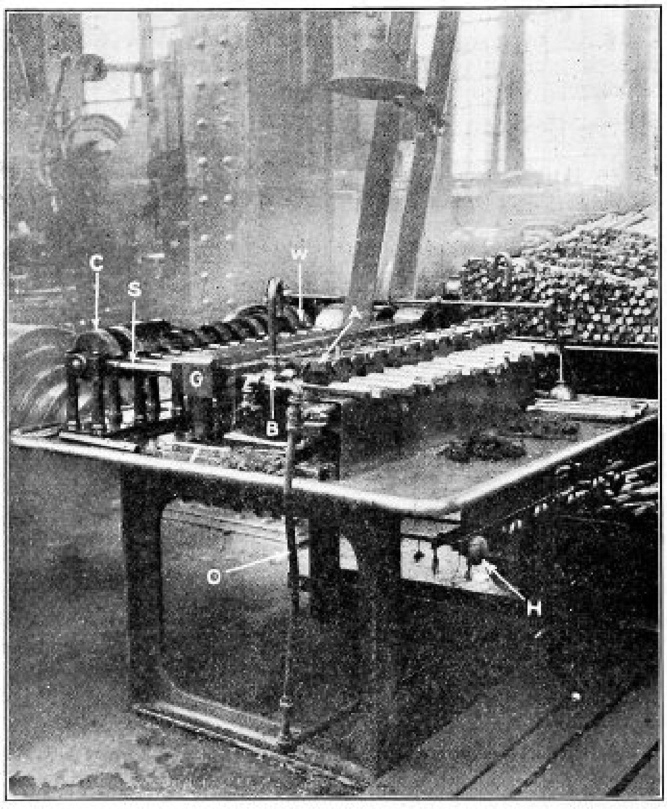
There is hardly a manufacturer who cannot benefit from this policy.

*President of Miller, Franklin, Basset & Co., Inc., New York.

An Efficient Machine for Drilling Staybolt Telltale Holes

THE machine illustrated is installed at the Readville shops of the New York, New Haven & Hartford, being used for drilling telltale holes in rigid staybolts before application to the boilers. While by no means a new machine, it effects an important saving in time and labor for this operation, and may not be familiar to all railroad shopmen.

Referring to the illustration, the machine is seen to consist of a compact and substantial table on which is mounted mechanism for holding the staybolts, driving the drill spindles, and feeding the spindles. Six air chucks, one of which is shown at *A*, are arranged to hold two staybolts each and be operated by six handles as at *H*. Suitable adjusting screws are provided on the chucks and this arrangement enables the staybolts to be put in and released from the machine with a minimum effort. It is evident that 12 stay-



Twelve Staybolt Telltale Holes Can Be Drilled at the Same Time on This Compact and Efficient Machine

bolts can be accommodated in the machine at one time and 12 drill chucks as at *B* are therefore provided, direct connected to 12 spindles *S* and driven by a train of spur gears from the tight and loose pulley shaft indicated.

Drill spindle feed is obtained by the action of six pairs of cams *C*, driven by worm gear *W*. Twelve coil springs which, together with the driving gears, are carefully inclosed under guard plate *G*, provide for the return of the spindles after the holes are drilled. Suitable connections are made from the oil pipe *O* to permit flooding the drills, insuring that they are well lubricated and cooled. The air chucks operate independently so that staybolts can be removed and new ones supplied in one pair of chucks while the others are working. It is obvious that with a suitable arrangement, whereby staybolts are within easy reach of the operator, a very large production of drilled telltale holes can be obtained with this machine.

Mercury Vapor Boiler Made Practical

Experiments by General Electric Company Over Period of Years Result in Commercial Application of New Boiler

POWER from mercury vapor, making possible a double vapor power plant in which turbines for generating electricity are driven both by mercury vapor and water vapor from the same fuel source, resulting in a gain of about 50 percent in power per pound of fuel, is the outstanding achievement of a new boiler perfected by the General Electric Company.

Two such boilers have been built to date, an experimental apparatus operated at the Schenectady Works of the General Electric Company and an experimental installation now under observation at the Dutch Point generating station of the Hartford Electric Light Company, at Hartford, Conn.

This installation is the first of its kind in the world. Experiments have been conducted by the General Electric Company over a period of several years. The success of these experiments warranted the manufacture of a set of commercial size and it was arranged between the two companies that this installation should be made in Hartford. The equipment at Hartford is now being operated with a partial load for the purpose of getting experience with continued running without mercury risk of injury through overloading.

The rising cost of coal and its transportation makes it more and more desirable to reduce to a minimum the fuel consumption for the manufacture of power. Any substantial savings warrant a very large investment in power station equipment and the expenditure of considerable sums of money in devising methods of operation with better fuel economy.

W. L. R. Emmet, consulting engineer of the General Electric Company and inventor of the mercury process, estimates that if the mercury boiler comes up to all expectations, it will produce with 35 pounds gage pressure, when compared with a steam turbine generating plant which uses 200 pounds steam pressure, about 52 percent more output in electricity per pound of fuel.

"And if," Mr. Emmet adds, "in such a plant the boiler room is re-equipped with furnaces and mercury apparatus arranged to burn 18 percent more fuel, the station capacity with the same steam turbines, condensers, auxiliaries, water circulation, etc., would be increased about 80 percent."

Difficulties Encountered in Designing Boiler

The process is novel in every particular, and it was necessary elaborately to study the characteristics of mercury and its vapor. During the earlier experiments it was found that no form of packing or calking of the joints would resist the mercury vapor and it is the development of arc and acetylene welding which has made such apparatus possible.

It was necessary for the inventor not only to design and manufacture the apparatus, but also to devise methods of operation, as there was naturally no precedent by which to work. The apparatus was shipped and erected and was started and successfully operated just as designed.

The mercury vapor process involves the vaporization of mercury in a boiler, driving of a turbine by the mercury vapor and the condensation of the exhaust in a condenser where its latent heat is delivered to water and thus used to generate steam at pressure suitable for use in existing steam plants.

The condensed mercury runs back by gravity into the mercury boiler. Thus the mercury vapor acts as a heat conveyor and, at the same time, delivers energy to the mercury turbine. This affords a means by which the temperature range of operation is more than doubled as compared with ordinary steam processes, and the efficiency consequently greatly increased. Means are also provided by which the flue gases are brought to temperatures equivalent to those used in steam processes by being carried through a steam superheater and a feed water heater.

Large Generator Built

An application of this process on a large scale was built at Schenectady and operated experimentally on many occasions. This equipment was originally designed to give 1,500 kilowatts from the mercury turbine but it was never run above 1,050 kilowatts. Of the 1,050 kilowatts so delivered in these tests, 800 constitutes net gain as compared with a 200 pounds steam process operating with similar firing conditions. With such a performance of the mercury turbine, and with the steam produced used as in the best power stations, this result is equivalent to about 11,300 British thermal units from fuel per kilowatt hour. Eighteen thousand British thermal units per kilowatt hour is considered extremely good in large existing steam stations. This equipment operated with about 12 pounds pressure in the mercury boiler. "By using a pressure of 35 pounds, which seems to be possible," Mr. Emmet says, "the efficiency could be considerably increased."

The present installation is not of sufficient capacity to have much effect on the total cost of power produced by the electric company at the present time. It is large enough, however, to learn much about the results which may be expected when used on a large scale. This initial success indicates that there is no insurmountable obstacle to manufacture sets of a size to replace the present large steam boilers now installed in modern power stations.

The last great step of several years ago in improving the efficiency of manufacturing power was the replacement of the reciprocating engine by the steam turbine.

The modern steam turbine under similar conditions is about 40 percent more efficient than the best reciprocating engines and the attainment of this degree of gain has been the work of 20 years. "It would seem," Mr. Emmet says, "that the introduction of the mercury process would accomplish a much greater gain. And this may be greatly increased because it is believed possible to make mercury turbines much better than those which have been tested and also to use higher pressures in the mercury vapor."

Slight Changes in Altering Old Plants

The change from reciprocating engines to steam turbines necessitated complete redesign of the old station. But in applying the mercury process it is only necessary to replace the steam boiler in the large modern plants by a mercury boiler which will give greatly increased output in the same space. In other words, there will be no general redesign of a station to obtain the benefit of the better economy and at the same time materially increase the output from the building. Like all great steps in advance, time will be required to develop and perfect a system before this process can be expected to reflect on the operating costs of the public utilities.

Naturally, the question which will arise in connection with this mercury process is the danger from mercurial poisoning, either to the community or to the attendants. In the first place, as previously stated, all joints are welded, so that it is impossible for mercury to escape except through

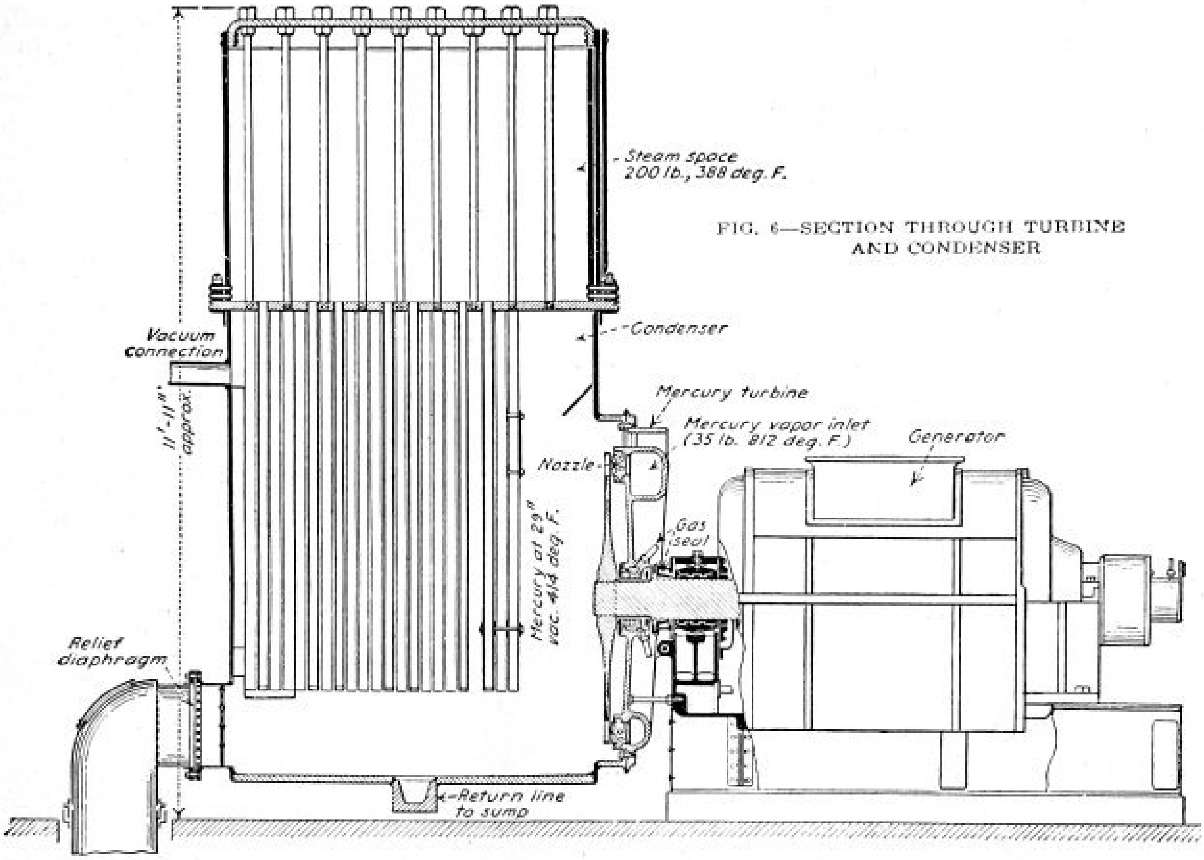
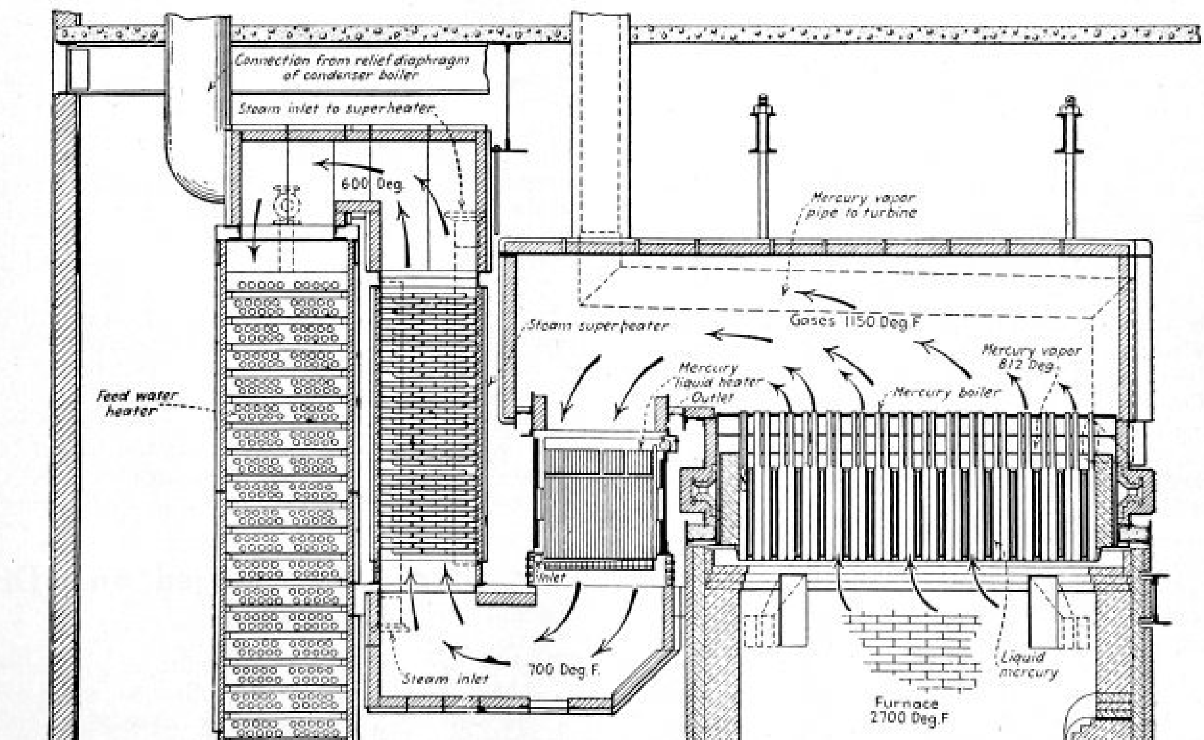


FIG. 6—SECTION THROUGH TURBINE AND CONDENSER



Section Through Mercury Boiler, Heater and Superheater

Note:—Published through the courtesy of "Power".

accident, and arrangements are such that leakage if it should occur will go into the stack where it can do no harm.

Mercury boils and condenses much like water, except that its density is much greater and its boiling temperature much higher. At atmospheric pressure mercury boils at 677 degrees F. and water at 212 degrees. Mercury condenses in a 28-inch vacuum at 455 degrees F. and water at 100 degrees.

At present mercury sells for about 80 cents a pound. The boiler installed in Hartford contains 30,000 pounds of mercury, and is designed to give from mercury and steam about 4,100 kilowatts, giving about 7.3 pounds of mercury per kilowatt. Recent experiments indicate that in future designs 4 pounds per kilowatt will be sufficient.

Mr. Emmet, inventor of the mercury vapor process, has had an important part in the designing of electrical apparatus for the General Electric Company and in the development of its uses from the time of the company's formation.

He was responsible for the development of the Curtis turbine and the promotion and direction of the company's steam turbine activities for many years. Mr. Emmet has also been the father of electric ship propulsion and has promoted and very largely designed the very large applications of it which have been made in the United States Navy and elsewhere.

Mr. Emmet has been elected a member of the National Academy of Sciences and the American Philosophical Society. He was awarded the Edison Medal in 1919, and other medals and degrees. He is a graduate of the U. S. Naval Academy and is a member of several engineering societies.

Developments in the Boiler Field

THERE have been fewer changes in boiler design from the days of Watt to, say, fifteen years ago than perhaps in any other part of the modern power plant. In the field of prime movers the uniflow engine, and especially the steam turbine, look utterly unlike anything in existence at the beginning of the nineteenth century. Entirely new members of the power plant family have appeared since that time, such as economizers and air preheaters; and while the surface condenser resembles very much the apparatus built by James Watt some seven score years ago, the jet condenser is a decided innovation, working on a principle radically different from that of the original surface condenser.

That the modern boiler has a performance vastly superior to the Cornish or Lancashire types of 100 years ago there can be no doubt, and yet there is no question but what the steam engineer of days far gone by would feel at home in the boiler plant of today after an hour's acquaintance with the indicating and recording instruments. (This refers, of course, to the steam-generating end of the boiler only and not to the firing system.)

It seems to be a rule, however, the reason for which is fairly obvious that no sooner does a piece of mechanical equipment reach its final stage of perfection than it is displaced by something radically different. The Corliss engine shown at the Centennial Exhibition in 1876 was the biggest engine of its kind and in size it has never been surpassed, because only a few years after the exhibition the steam turbine appeared as a commercial product and the attention of engineers was diverted to this new prime mover.

NEW TYPES DEVELOPED

Similarly in the last fifteen years there has been a tendency to break away from the Watt type of boiler and to build something that would work in an entirely new way. There are several such types now offered to the engineering trade. Blumquist, in Sweden, recently built a 1,500-horsepower boiler for the power plant of a sugar factory and adopted rotary tubes, throwing the water to the wall of the tube by centrifugal force and thus leaving a free steam passage through the center. Benson, in England, working along entirely different lines and utilizing in certain ingenious ways the balance between the critical temperature of the liquid and the critical pressure of steam formation at that critical temperature, has produced a steam generator operating with vapor having a pressure of the order of 3,200 pounds per square inch.

Another revolutionary development which is being promoted by the General Electric Company is that of the mercury-boiler plant (described elsewhere in this issue), the invention of W. L. R. Emmet, Member A.S.M.E. The principle of the Emmet plant is very simple and by now well known. The difficulties involved, many of which had not been initially suspected, were tremendous, and it took more than ten years, coupled with the expenditure of very large amounts of money and effort, to overcome them.

DIFFICULTIES TO OVERCOME

There are still probably many stumbling blocks ahead of the new power plant on its way to commercial success. Statements have been made, for example, that should an attempt be made to introduce the mercury-vapor prime mover into general use there would not be enough mercury to go around. Dire predictions have also been made as to the effect of the "wet" mercury vapor, i. e., vapor containing globules of liquid mercury, on the turbine blades, and so on. To those, however, who remember the truly stupendous difficulties that lay in the path of the designers of steam turbines and that were successfully overcome when it became evident that the steam turbine had a great commercial future before it, it would seem that there is no valid reason for any decided pessimism on that account. Some difficulties have been overcome and there are more to be overcome, and the chances are that they will be. There is an undoubted shortage of mercury today, but it has been the experience of the past that whenever a mineral or material became really necessary to industrial progress, in some manner or other supplies were discovered. This, it will be remembered, was the case with iron ore, with tungsten, and quite recently with helium, and there are good reasons to believe that the prosecution of a vigorous search for cinnabar will disclose new supplies of this now desirable material.

From the point of view of the mechanical engineer the essential fact is that a new type of prime mover has passed the fi st and most critical stage of development and has become a mechanical if not yet a commercial reality to be reckoned with. Mr. Emmet and his associates in the General Electric Company are to be congratulated on bringing through its "teething" troubles what appears to be a husky and promising youngster.—*Mechanical Engineering.*

New Extras on Flanged and Dished Heads

PLATE mills which specialize in flanged and dished heads have published a new card of extras, which constitute a considerable advance. The advances are graduated, being relatively higher on the small than on the large sizes. For example, flanged heads 12 inches and under 17 inches of 3/16-inch plate, which formerly took an extra of $1, now take an extra of $3.90, while heads 53 inches and under 57 inches of 3/16-inch plate, formerly $4, are now $5.50 extra. On dished heads the advances correspond. A dished head of 12 inches outside diameter, with maximum depth of dish 1⅝ inches of 3/16-inch plate, formerly $1.50 extra, now is $3.

Printed cards containing the full list of extras are being distributed by the companies which do this class of work. The new list became effective January 1.

Locomotive Inspection Bureau Makes Annual Report

Boiler Explosions Increase Seventy-five Percent Over Previous Year—Crown Sheet Failures Principal Cause of Disasters

THE twelfth annual report to the Interstate Commerce Commission by A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, for the fiscal year ending June 30, 1923, shows a marked increase in the number of defects and accidents due to the abnormal prevailing conditions. An abstract of the report follows:

The percentage of locomotives found defective increased from 48 percent during the preceding year to 65 percent, and the total number of defects increased approximately 70 percent. The deteriorated condition of motive power is sharply reflected in the increased number of accidents and casualties. A comparison of accidents and casualties during the year as compared with the preceding year shows an increase of 117 percent in the number of accidents, 118 percent in the number killed, and 120 percent in the number injured.

Records covering locomotive failures indicate that the number of locomotive miles per locomotive failure decreased as much as from 50 to 70 percent during the year as compared with the preceding year. Every locomotive failure caused by physical defects carries with it potential injury to persons, serious delay to traffic, and heavy property damage.

Fig. 1.—Back End of Boiler After Crown Sheet Failure

Boiler Explosions Increase

During the year there were 57 boiler explosions which resulted in the death of 41 persons and the serious injury of 88 others, an increase of 75 percent in the number of such explosions, 86 percent in the number of persons killed, and 93 percent in the number injured, as compared with the preceding year. While most of these explosions were caused by the crown sheet having become overheated due to low water, the number of such cases where contributory defects or causes were found increased approximately 135 percent as compared with the preceding year. The contributory causes found clearly establish the necessity for proper inspection and repair of all parts and appliances of the locomotive and tender.

During the year numerous accidents were investigated where welds made by the fusion or autogenous process were involved. The investigations fully support the position previously taken that this process has not reached a state of development where it can safely be depended upon in boiler construction and repair where the strain to which the structure is subjected is not carried by other construction, nor in firebox crown sheet seams where overheating and failure are liable to occur, or on any part of the locomotive or tender subject to shock or strain where, through failure, accident and injury might result.

Numerous accidents have occurred due to the failure of autogenously welded seams and cracks in the boiler back head. One fatal accident of this nature occurred where an autogenously welded crack 21½ inches long in the boiler back head failed while the locomotive was hauling a passenger train, resulting in death to the engineer and the serious injury of the fireman. The scalding water and steam escaping through the rupture compelled the engineer to leave the cab without being able to close the throttle or apply the brakes in the usual way. The engineer and fireman climbed out of and around the left side of the cab to the running board and to the front end of the locomotive, where the angle cock was opened and the brakes applied.

Accidents caused by defective grate-shaking apparatus increased from 48 during the preceding year to 138 during the present year, an increase of 187 percent. The major portion of these accidents were caused by the shaker bar not having a proper fit on the fulcrum lever. Since it is impossible to avoid the changing of shaker bars from one locomotive to another, each carrier should adopt a standard whereby shaker bars are made interchangeable with a proper fit on the fulcrum levers.

Accidents due to the failure of injector steam pipes increased from 9 during the preceding year to 40 during the year. A majority of these accidents were due to the injector steam pipe pulling out of the brazing collar due to defective workmanship and to breakage caused by weak, light construction and to defective material. In many instances the failure of injector steam pipes was contributed to by the injector not being properly fastened so as to relieve the steam pipe from the weight and vibration of the injector and its connections.

Accidents which reflect the general condition of driving gear, running gear, etc., increased materially. For instance, main and side rod accidents increased from 23 to 53; valve-gear accidents increased from 18 to 59; and accidents due to failure of reversing gear increased from 53 to 100.

During the year 230 applications were filed for extension of time for removal of flues. Investigation disclosed that in 34 cases the condition of the locomotives was such that no extension could be granted. Fourteen were in such condition that the full extension requested could not be authorized, but an extension for a shorter period was allowed. Fourteen extensions were granted after defects disclosed had been repaired. Thirty applications were withdrawn and the remaining 138 were granted.

There were filed 5,076 specification cards and 11,187 alteration reports necessary in determining the safe working pressure and other required data for the boilers represented. These cards and reports were analyzed and corrective measures taken with respect to numerous discrepancies which were found. It was required that many older and weak boilers be reinforced or the working pressure reduced.

In two instances appeals were taken from the decision of inspectors and after careful consideration of existing conditions the appeals were partially sustained and partially dismissed. The decisions of these inspectors were technically in error, but practically correct.

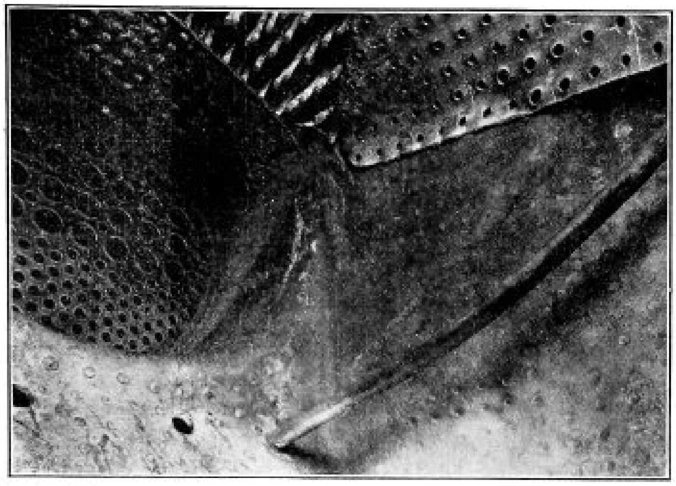


Fig. 2.—Another Low Water Crown Sheet Failure

RECOMMENDATIONS

The recommendations for betterment of service made at the close of the report were the same as last year. The following is a brief summary of these recommendations:

That the act of February 17, 1911, be amended to provide for not less than 50 additional inspectors and increased compensation adequate to carry out the purpose of the law.

That all coal-burning locomotives have mechanically operated fire doors so constructed that they may be operated by pressure of the foot on a pedal or by some other suitable device.

That a suitable power reverse gear be applied to all locomotives.

That all locomotives be provided with an automatic, power-operated bell ringer.

That the cab of all locomotives not equipped with front doors or windows of such size as to permit of easy exit, have a suitable stirrup or other step and a horizontal handle on each side approximately the full length of the cab.

That all locomotives where there is a difference between the readings of the gage cocks and water glass of 2 inches or more under any condition of service, be equipped with a suitable water column, to which shall be attached three gage cocks and one water glass, also one water glass with not less than 6 inches clear reading on the left side or back head of the boiler.

LOCOMOTIVES INSPECTED AND DEFECTS FOUND

	1923	1922	1921	1920
Locomotives reported	70,242	70,070	70,475	69,910
Locomotives inspected	63,657	64,354	60,812	49,471
Locomotives defective	41,150	30,978	30,207	25,529
Percentage inspected found defective	65	48	50	52
Locomotives ordered out of service	7,075	3,089	3,914	3,774

PERSONS KILLED AND INJURED, CLASSIFIED ACCORDING TO OCCUPATIONS

	1923		1922		1921		1920	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Members of train crews:								
Engineers	19	484	11	213	15	237	16	272
Firemen	16	597	10	277	25	360	20	404
Brakemen	12	137	7	66	13	64	9	77
Conductors	1	35	..	25	2	20	2	19
Switchmen	2	32	1	13	3	15	4	19
Roundhouse and shop employees:								
Boiler washers	3	19	1	10	1	7	2	9
Machinists	2	14	..	9	1	3	1	20
Foremen	1	6	..	1	1	3	..	3
Inspectors	..	2	..	2	..	5	..	1
Watchmen	1	6	..	3	..	4	4	3
Bailer washers	1	9	..	1	..	7	..	13
Hostlers	..	31	..	10	..	8	..	13
Other round house and shop employees	4	29	1	15	1	25	3	30
Other employees	4	36	2	23	2	16	4	26
Non-employees	6	123	..	41	..	21	1	7
Total	72	1,560	33	709	64	800	66	916

ACCIDENTS CAUSED BY THE FAILURE OF SOME PART OR APPURTENANCE OF THE BOILER

	1923	1922	1921	1920
Number of accidents	509	273	342	439
Number killed	47	25	51	48
Number injured	594	318	379	503

ACCIDENTS CAUSED BY THE FAILURE OF SOME PART OR APPURTENANCE OF THE LOCOMOTIVE AND TENDER, INCLUDING THE BOILER

	1923	1922	1921	1920
Number of accidents	1,348	622	735	843
Number killed	72	33	64	66
Number injured	1,560	709	800	916

DERAILMENTS AND ACCIDENTS DUE TO DEFECTS IN OR FAILURE OF SOME PART OF THE LOCOMOTIVE OR TENDER

	1923	1922	1921	1920
Number of derailments*	38	22	8	7
Number killed	4	5	..	7
Number injured	157	61	30	18

* Only derailments reported by carrier as being caused by defect in or failure of parts of the locomotive or tender were investigated or counted.

ACCIDENTS AND CASUALTIES RESULTING FROM FAILURES OF LOCOMOTIVES AND TENDERS AND THEIR APPURTENANCES

Part of appurtenance	Year ended June 30: 1923			1922			1921		
	Accidents	Killed	Injured	Accidents	Killed	Injured	Accidents	Killed	Injured
Air reservoirs	6	..	7	3	..	3	1	..	1
Aprons	8	..	8	11	..	11	16	..	16
Arch tubes	12	2	17	4	..	5	5	..	5
Ash-pan blowers	19	..	19	7	..	7	5	..	5
Axles	6	..	7	5	..	17	5	..	6
Blow-off cocks	28	..	29	16	..	16	14	..	14
Boiler checks	12	..	12	4	..	4	7	1	7
Boiler explosions:									
A. Shell explosions	.....	..	.....	1	..	1	...	..	...
B. Crown sheet; low water; no contributory causes found	19	24	27	13	15	23	20	19	26
C. Crown sheet; low water; contributory causes or defects found	34	15	56	14	6	27	33	24	52
D. Firebox; defective stay bolts, crown stays, or sheets	4	2	5	5	1	5	1	2	...
Brakes and brake rigging	27	1	56	10	2	24	6	..	6
Couplers	25	1	27	21	..	23	11	1	13
Crank pins, collars, etc	12	..	13	10	..	10	6	3	8
Cross heads, and guides	10	..	10	4	..	4	4	1	4
Cylinder cocks and rigging	11	..	11	3	..	3	4	..	4
Cylinder heads and steam chests	8	..	8	3	..	3	6	..	6
Draft appliances	13	..	14	6	..	9	8	..	9
Draw gear	16	2	16	7	..	7	8	1	8
Fire doors, levers, etc	26	..	26	2	..	2	8	..	8
Flues	44	..	59	28	..	32	32	1	35
Flue pockets	2	..	5	1	1	...	1	1	...
Foot boards	36	1	35	11	1	10	8	3	5
Gage cocks	.....	..	.....	2	..	2	...	..	...
Grease cups	6	1	6	3	..	3	7	..	7
Grate shakers	138	..	138	49	..	49	85	..	85
Handholds	34	2	32	12	1	11	19	..	20
Headlights and brackets	8	..	8	2	..	2	8	2	6
Injectors and connections (not including injector steam pipes)	33	..	33	21	..	24	15	2	13
Injector steam pipes	40	..	46	9	..	9	15	..	17
Lubricators and connections	22	..	22	9	..	9	12	..	12
Lubricator glasses	10	..	10	3	..	3	3	..	3
Patch bolts	3	..	3	...	..	...	...	..	...
Pistons and piston rods	14	1	13	6	..	6	3	..	3
Plugs, arch tube and washout	18	3	27	12	1	19	15	..	18
Plugs in firebox sheets	.....	..	.....	2	..	3	2	..	2
Reversing gear	100	..	100	53	..	53	65	..	65
Rivets	5	..	8	...	..	...	4	..	5
Rods, main and side	53	3	57	23	..	27	18	..	21
Safety valves	.....	..	.....	...	..	...	...	..	...
Sanders	4	..	4	2	..	2	...	..	...
Side bearings	.....	..	.....	1	..	1	...	..	...
Springs and spring rigging	25	2	25	10	1	9	3	..	3
Squirt hose	67	..	69	54	..	54	82	..	82
Staybolts	7	..	8	6	..	8	...	..	...
Steam piping and blowers	19	..	19	9	..	11	9	..	9
Steam valves	16	1	16	6	..	6	11	..	12
Studs	6	..	8	7	..	8	7	..	7
Superheater tubes	10	..	15	...	..	...	1	..	2
Throttle glands	1	..	1	1	..	1	...	..	...
Throttle leaking	6	..	6	3	1	2	3	..	3
Throttle rigging	19	2	19	5	..	5	1	..	1
Trucks, leading, trailing or tender	25	5	101	11	2	25	6	..	8
Valve gear, eccentrics and rods	59	2	59	18	..	18	10	..	10
Water glasses	35	..	35	19	..	19	25	..	25
Water-glass fittings	7	..	7	6	..	6	2	..	2
Wheels	10	1	19	8	1	7	4	1	4
Miscellaneous	170	1	179	61	..	61	91	2	117
Total	1,348	72	1,560	622	33	709	735	64	800

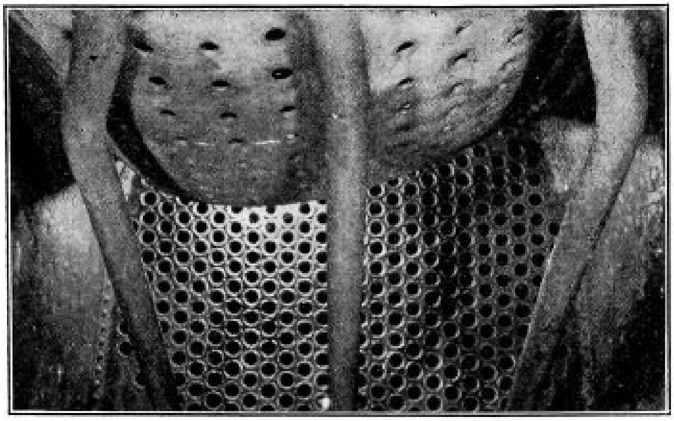


Fig. 3.—Crown Sheet in This Case Pulled Away from 238 Radial Stays

Examples of Boiler Failures

The results of a boiler explosion caused by the overheating of the crown sheet due to low water, which resulted in the death of 4 persons and the serious injury of 3 others is shown in Fig. 1.

Fig. 1 shows the back end of the boiler in which the crown sheet failed, in a badly damaged condition with the mud ring broken at all four corners. The line of demarcation caused by overheating showed that the water was 12 inches below the highest part of the crown sheet at the time of the accident. The boiler appurtenances were damaged to such an extent that their previous condition could not be determined. The force of the explosion tore the boiler from its frame, it landed on top of the cab of the leading locomotive, rebounded and came to rest 264 feet from point of accident. The fireman in the leading locomotive was killed and the engineer and brakeman, who were riding in the cab, were seriously injured.

Fig. 2 shows a crown sheet which failed due to low water, the initial rupture evidently occurring in the autogenously welded seam, which failed approximately its entire length.

The water-registering devices on this locomotive consisted of one water glass and three gage cocks applied directly in the boiler back head. The water glass was broken en route, leaving only the gage cocks for determining the general water level in the boiler. Many tests have established that gage cocks when applied in this manner do not correctly

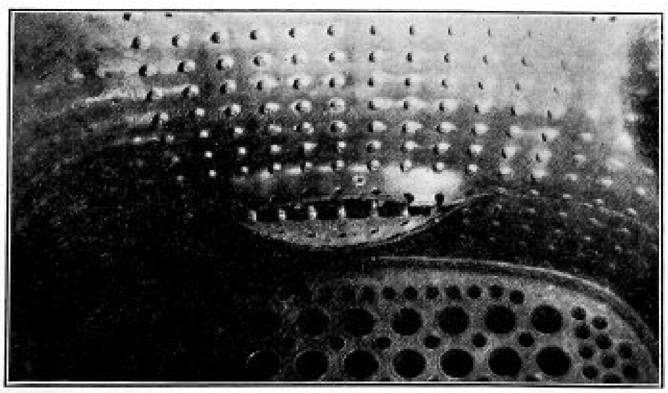


Fig. 4.—Three People Were Seriously Injured in This Crown Sheet Failure

indicate the general water level while steam is being rapidly generated and escaping from the boiler.

After our investigation of this accident a test was made by our inspectors, the superintendent of shop, the assistant superintendent of shop, and general boiler inspector on a locomotive of exactly the same class and type which showed that, with water at its lowest reading in the glass and safety valves blowing at capacity, the three gage cocks registered full of water, or at least 6 inches higher than the water glass. Had a suitable water column such as has been recommended, and which is very generally being applied, been applied to this boiler, it is entirely likely that the accident might have been avoided.

In Fig. 3 is shown a crown sheet failure caused by low water on a locomotive while being used in freight helper service, moving at an estimated speed of 12 miles per hour. The crown sheet pulled away from 238 radial stays and pocketed to a depth of 17½ inches at the deepest point, pulling the top of the back flue sheet down and off of 13 flues in the two top rows. The crown sheet was highly dis-

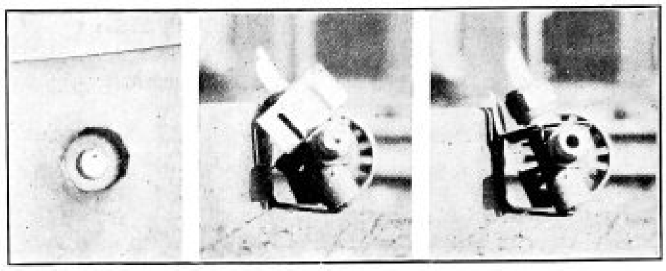


Fig. 5.—Gage Glass Connection Practically Closed with Scale

colored due to overheating and the line of demarcation was clearly defined, showing the water to have been approximately 8 inches below the highest part at the time of the accident.

The absence of material damage to this locomotive is noticeable as compared with other accidents of the same

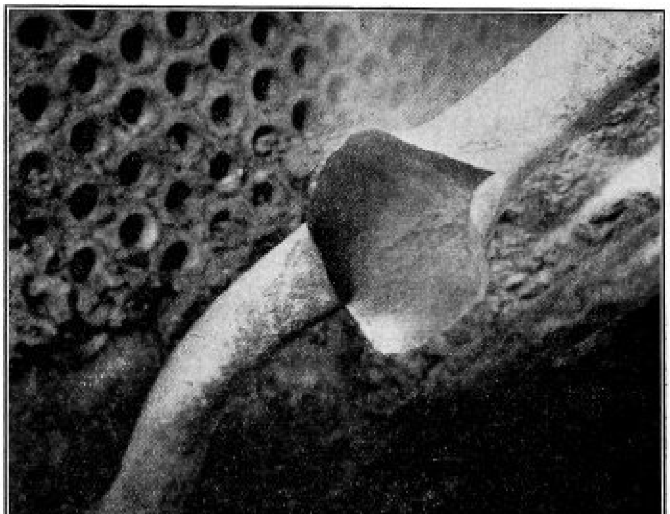


Fig. 6.—Arch Tube Rupture Caused By Overheating

nature where sheets tore, and presents a strong reason for constructing firebox seams in the strongest possible manner, especially so in the so-called low water zone, or within 15 inches of the highest part of the crown sheet, where it has been our experience that sheets so frequently rupture, causing the boiler to be thrown from frames and practically ruined.

Our records indicate that fatalities are seven and one-half times greater where sheets tear as compared with where they do not tear under such conditions.

Fig. 4 shows the result of a crown sheet failure due to low water which caused the serious injury of three persons. The crown sheet combustion chamber seam failed for approxi-

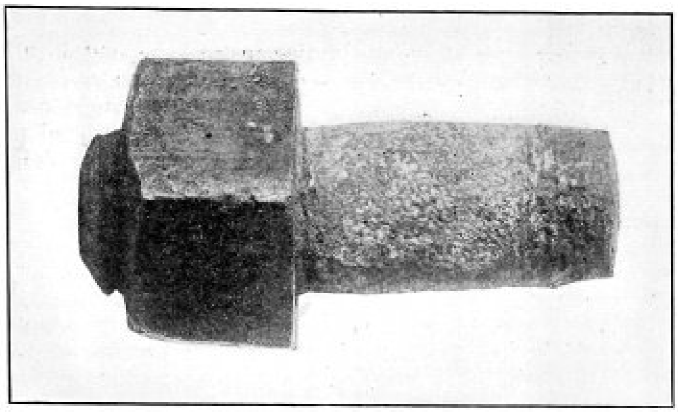


Fig. 7.—Stud Blown from Boiler Back Head

mately 36 inches where it had been autogenously welded. The line of demarcation showed that the water at the time of accident was about 2½ inches below the highest part of crown sheet.

The left view in Fig. 5 shows opening in the boiler practically closed with hard scale, from which the bottom water-glass cock was removed. The center view, Fig. 5, shows bottom water glass cock after it was removed with the opening practically closed with hard scale. At the right is shown the same water glass cock after the hole had been opened.

This locomotive was found in service by a government inspector and it was observed that the movement of the water in the water glass was very slow and sluggish. The inspector then issued special notice for repairs withholding it from service and found the condition as shown above. Records of this carrier showed that this boiler had been washed four days previous and the water glass spindles removed and cocks thoroughly cleaned, which records were evidently incorrect, as such a condition could not have developed in a period of four days in the territory where the locomotive was operated. Such conditions have been strong contributory or direct causes for some of the most disastrous explosions of which we have record. There is no plausible excuse or reason that can be accepted for allowing such a condition as this to develop.

Fig. 6 shows a ruptured arch tube caused by overheating, permitting steam and scalding water to escape into the firebox and cab, seriously injuring two persons.

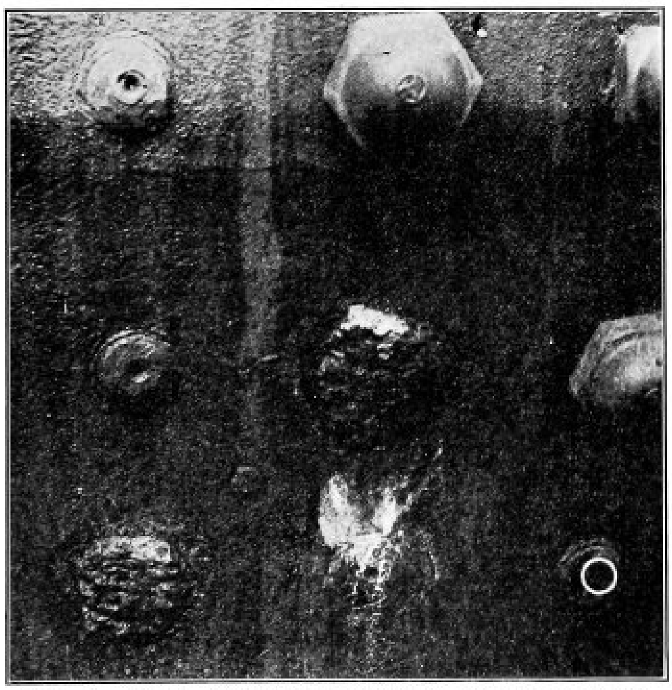


Fig. 8.—Crude Methods of Repairing Broken Staybolts

The investigation disclosed that mud and scale had been allowed to accumulate in the front water leg to a height that prevented water from entering the tube in sufficient volume, which caused it to become overheated and burst.

Arch Tube Failures

Dirty arch tubes and washout holes in a throat sheet and the accumulation of mud and scale which restrict the flow of water through the tube, causing the tube to overheat and burst can not occur if boilers are properly washed as often as water conditions require—a strict requirement of rule 45. Arch tubes are subjected to high stress and high temperatures under working conditions and, if accidents of this nature are to be avoided, it is essential that they be kept free from scale and sediment and free water circulation maintained through them.

Fig. 7 shows a stud which blew out of the boiler back head causing the fireman to be seriously scalded. The threads were entirely worn and corroded away by constant and long leakage.

Such accidents as this usually result very seriously and can be prevented if proper attention is given to leaks around the threads of studs, which is always an indication of an unsafe condition. No locomotive should be permitted to remain in service with any stud leaking around its thread.

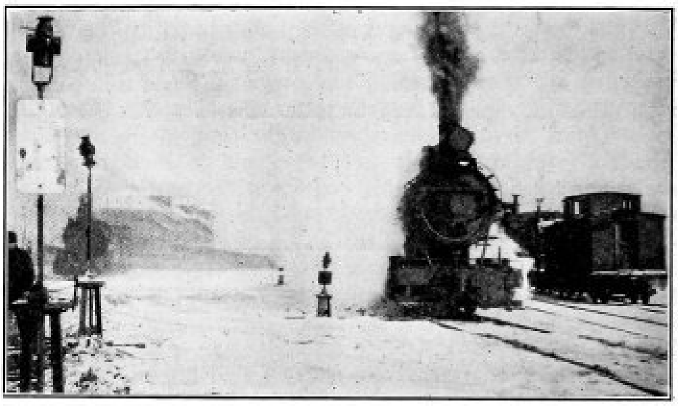


Fig. 9.—Switching Locomotive with Serious Steam Leaks

Fig. 8 shows three broken staybolts, two of which have heads welded over and one adjacent plugged with nail to prevent leakage. Such methods can not be too strongly condemned and show utter disregard for the requirements of the law and of safety.

Personnel of Commissions

THE new year found the Interstate Commerce Commission with two temporary vacancies, owing to the failure of the Senate to confirm before the end of the year the appointments of Mark W. Potter and Frank McManamy. Mr. Potter's term expired on December 31 and Mr. McManamy was serving under a recess appointment. The Senate committee on interstate commerce, to which the nominations were referred by the Senate, has not held a meeting because of the deadlock in the Senate over the election of a chairman. In the past when the Senate has delayed action on the confirmation of a reappointment of one of the commissioners, the commission has followed the practice of appointing them as special examiners until the Senate could act. Officers of the organizations of commercial travelers have been trying to stir up opposition among some of the senators to Commissioner Potter's reappointment.

What Is the Value of the Hydrostatic Test?*

Method of Determining Stretch in Boiler Shell Under Test—Dangers of Using Test to Determine Working Pressure

By Thomas H. Fenner†

IT may safely be said that if hydrostatic tests were carried out in every case with all the necessary precaution and careful taking of measurements, no danger would be involved and each test would be efficient. Unfortunately, in the great majority of cases where the test is applied on boilers that have been in use for any length of time, none of these precautions is observed. On this account the last state of these boilers is very often worse than the first.

Reduced to its elementary principle, the application of a hydrostatic test may be said to be the subjecting of the object tested to something more than its working pressure, in an effort to discover if this object comes through without signs of weakness. It is equivalent to testing a bridge by putting on it a load greater than it will ever be expected to bear in ordinary practice, the deduction being that if it comes through safely, there will be no danger of its failing under the working load of everyday practice. However, in both the bridge and the boiler the safe working load has been determined by careful calculation, and the hydrostatic test on the boiler and the load test on the bridge bear a definite relation to the working load. The tests, as carried out in new construction, are intended to discover any local weakness, such as defective workmanship, that may develop under stress. If the stress is greater than that to be encountered under ordinary conditions, and no such weaknesses develop, it is proof that the construction and workmanship are sound. The hydrostatic test on new boilers almost invariably discloses small defects such as leakage at the seams and rivets, which are remedied by calking. It is the usual practice to make the test pressure on new boilers double that of the safe working pressure as determined by calculation. The pressure is applied gradually, and the small defects that appear as the pressure is increased are followed up and remedied before going further. If pressure is applied suddenly, it is difficult to locate accurately the number of small leaks that are liable to appear, and the job is made that much harder and the time taken longer in proportion.

THE question of applying a hydrostatic test to pressure-containing vessels, and particularly to steam boilers, is one that frequently arises. It is a subject on which there is considerable difference of opinion, as between operating engineers, manufacturers, and those whose duty it is to pass upon the fitness of the vessels for their appointed service. It is the object of this article to show where the hydrostatic test can be of great assistance in determining the condition of the object under examination, and also other cases where it may be a detriment to the safety which it seeks to insure.

Tests on Horizontal Boilers

In the ordinary type of horizontal firetube boiler there is little possibility of deformation of a new boiler while undergoing a test. In boilers of the internally fired type, such as the vertical firetube and the Scotch marine, and locomotive type, where portions of the boiler are under compressive stress, local deformations may appear. The shell of the boiler in either type will of course undergo a slight increase in diameter. These deformations will disappear with the removal of the pressure, but it is possible, when the boiler is on the floor of the shop, to measure the various parts accurately, before, during and after the test, to determine the amount of deformation under the stress and also if the parts resume their original dimensions when the test pressure is removed. Mr. Stromeyer, an eminent English authority on boiler construction and operation, states that the increase in the length of a boiler shell while under test is about one-thousandth of the circumference.

Measuring Stretch in Circumference of Boiler

The method of making the measurement of the circumferential stretch is to coil a piano wire one and a half times round the shell and hang a weight on each end. If a mark is made on the two parts of the wire on top of the boiler before the test is made, then, when the test is on, the distance these two marks have moved can be measured. After the pressure is removed, they should again coincide. Mr. Stromeyer states that in most cases they do *not* exactly coincide, neither is the stretch quite as much as one-thousandth of the circumference, but he gives the friction of the wire on the shell as the reason for this discrepancy. Measurements of furnaces and combustion chambers subject to compressive stress can be made by trammels or telescopic gages. It is possible by means of these measurements, the tensile strength of the materials and the yield point being known, to calculate accurately the stress actually carried by each part during the test. It is not necessary to go into that here, and it is outside the scope of the operating engineer, for whom this article is intended. These particulars are given to impress the fact that stress is always accompanied by strain, and undue stress may result in a permanent strain or deformation of the material.

While it is not the usual thing for a boiler manufacturer to make the measurements given herein, there is sufficient experience of tests made under these conditions to show what generally takes place. With boilers constructed of material, every chemical and physical characteristic of which is known and in which rigid inspection has been made at every step of the manufacture, such refinement in testing would be a waste of time and money. The ordinary hydraulic test, to double the working pressure, carried out carefully and followed up step by step by remedying such defects as do appear, provides a reasonably safe guarantee to the purchaser and the public that all is well with the boiler before it leaves the manufacturer's hands.

It may be said then that such a test has a definitely useful object, and achieves it as far as possible.

Before going on to the other aspects of hydraulic testing,

*Reprinted through the courtesy of *Power*.
† Chief Engineer, General Accident Assurance Company of Canada.

it is perhaps opportune to give a few brief definitions of the terms used and some few figures on the subject. Thus, when we speak of a stress, we mean a force applied to an object which tends to alter its original shape. If the force is applied in a manner tending to increase the length of the object, it is called a tensile stress. If the force seeks to reduce its length, as in the case of a column supporting a weight, it is a compressive stress. If the stress is such as to cause the material to break by sliding one part over another, it is a shearing stress. That is the kind of stress that a rivet is subject to when the two plates it joins are pulling in opposite directions.

Strain is the result of a stress. If a stress of 30,000 pounds per square inch is applied to a bar or rod and the rod is lengthened a fraction of an inch, then the increase in length is the strain caused by the stress applied. These two terms are often confused. Stress is the cause, strain the effect.

Factor of Safety and Yield Point

Most operating engineers are familiar with ultimate or breaking stress, working stress and factor of safety. Briefly stated, ultimate stress is that stress which is sufficient to cause a rupture or break of the material under stress. The factor of safety is a factor determined by experience, which is divided into the ultimate stress to give the safe working stress. In the case of boilers the factor of safety varies from 4.8 to 5.5, which means that the safe working stress allowed is from $\frac{1}{4.8}$ to $\frac{1}{5.5}$ of the ultimate stress.

There is another property of the material that is important in its relation to safety of operation. That is the "yield" point. All materials when subjected to tensile stress, suffer deformation, or increase of length, the amount per unit of stress applied varying with each material. The ultimate tensile strength of boiler plate is approximately 60,000 pounds per square inch. That is, if a tensile stress is applied to a piece of plate, when its magnitude reaches 60,000 pounds per square inch the material will break. But before that point is reached something else has occurred. The material of boiler plate, in common with other materials, possesses a certain amount of elasticity. Up to a certain point the material will, after the stress is removed, return to its original shape in exactly the same manner as a piece of elastic. When a certain stress is reached, this will no longer occur. The material will retain a permanent set, or increase in length in the case of tensile stress. Naturally, if the material has suffered a permanent increase in length, its other dimensions must have decreased. That is, there is a reduction in area to correspond with its increased length, the volume being the same. Any further stress applied will result in greater increase in length and greater reduction in area, until the metal breaks exactly as a piece of putty can be drawn out until it parts. The point where permanent deformation starts, or elasticity ceases, is called the "yield" point, and in the case of boiler plate is usually at half the ultimate stress, or 30,000 pounds per square inch.

A new boiler, built of first-class material and under first-class supervision to standard designs is allowed a factor of safety of 4.8 by most authorities. This means that the material, having an ultimate stress of 60,000 pounds per square inch can safely bear a working stress of 12,500 pounds per square inch. The boiler is completed and ready for the hydrostatic test, which is to be double the working pressure. That is, the stress during the hydrostatic test will be 25,000 pounds per square inch. The yield point of the material is 30,000 pounds per square inch. Therefore, when the test pressure is on, the stress on the material is within 5,000 pounds per square inch of the point where permanent deformation will occur.

Where Danger Enters

It has been in the past, and is unfortunately at the present time, the practice of many engineers and some boiler inspectors to apply the hydrostatic test to determine working pressure. This is a distinct reversal of the proper method, which should be to determine from the proper working pressure, as found by calculation, the correct test pressure. As has frequently occurred in the writer's experience, the conditions are something like this: An owner has a boiler of uncertain age and condition, which has not been used for some time. He wishes to operate a sawmill or some other type of factory. He requires, we will say, 100 pounds pressure. An engineer or an inspector is called in, depending on the locality, and informed that 100 pounds pressure is required. "Very good," says this individual, "we'll just put 200 pounds water pressure on her. If she stands that, she is all right." Perhaps he is a bit conservative and thinks that 150 pounds should be enough. The pressure is applied, the boiler comes through with perhaps only a few slight leaks, which amount to nothing, and the owner is given a certificate for 100 pounds working pressure. Everyone is satisfied. Now what has happened? What is the actual condition of this boiler after the test is finished?

Let us come back to our piece of elastic. When it is new, it can be stretched and released, stretched and released, indefinitely, without any apparent effect. In course of time, however, it loses that property. If we tested a new piece of elastic till it broke, and then tested a similar piece that had lost its spring, we should find the old piece broke much easier than the new. Well, the material of the boiler is just like that elastic. Through years of use it has been expanding and contracting with every variation of steam pressure and condition of fire, so that it has lost some of the elasticity it had when new. Furthermore, its actual breaking limit has decreased to some extent, besides the yield point having been lowered. When it was new, the test pressure came within 5,000 pounds per square inch of the elastic limit. It is impossible to tell, without making careful measurements, whether the test made on the old boiler has not reached or exceeded the decreased elastic limit caused by years of work. If so, the boiler is in a condition where the shock caused by the sudden opening of a safety valve may be enough to cause a rupture of a plate. There is no question but that many boiler explosions could be traced to this cause.

A recent case in England, reported by the Board of Trade, where an explosion can be traced to this cause, will serve as an illustration. A vertical firebox boiler was examined by an insurance inspector, who reported thinning of the furnace plate in places. The working pressure was reduced. However, subsequent to this inspection some minor repairs were made and the boiler was tested hydraulically to 200 pounds by the boiler maker who made the repair. The safety valve was set for 75 pounds, but a few days after the test, when steam was being raised, the boiler exploded, the pressure being only 35 pounds. One man was killed and several injured.

We have shown that a hydraulic test may be in one case a pretty good guarantee and in another a dangerous experiment. The following points will serve as a guide to those who may be called upon to make tests on boilers that have been in service for any considerable length of time: Wherever it is possible to enter a boiler and examine it, this should be done first. The general condition should be noted and careful measurement of plates, pitch of rivets in joints, size of rivets, condition and diameter of stays, etc., all carefully noted. The plates and heads externally should be carefully examined. It is not the purpose here to explain the methods of inspection or what to look for, as that would take too much space, and it is presumed that anyone taking the responsibility of examining a boiler should be familiar with these points. The working pressure should then be calculated from the data obtained, and if there is any reasonable doubt of the condition, or if the boiler is over ten years old, the factor of safety should be increased to allow for this. If it is desirable after this examination to apply a hydrostatic test, the test pressure should not exceed one and one-half times the working pressure as determined by calculation.

The boiler should then be filled with water, taking great care to exclude all air, which can be done by opening a valve or cock on the highest point of the boiler or by easing back the safety valves to allow the air to escape as the water comes in. A steam pump should not be used for raising the pressure, as it is very difficult to control the increase of pressure. Serious shock may be sustained by reason of sudden raising of pressure by the stroke of a steam pump. A hand force pump should be used and the pressure gradually applied, careful examination being made after the working pressure has been reached. Leaks that develop should be carefully traced to their source, to make sure if they are from rivets or coming through the seams. After the test is made and the boiler emptied, a thorough examination should again be made internally and externally. In general, where a boiler has been under regular periodical inspection a test is necessary only after major repairs, to make sure of the workmanship of the job.

In the case of boilers that cannot be entered, such as small vertical firebox boilers and very small horizontal boilers, the hydraulic test forms the only means of discovering defects. In these cases the same general rules should be observed in applying the pressure, and as thorough an external examination as the circumstances may permit should be carried out during the test.

Conclusion

In general, hydraulic tests should never be carried out on boilers in the field except by men of experience and training in this class of work. By this, of course, is not meant the ordinary tests applied to watertube boilers after an overhaul, the object of which is to ascertain if the caps and joints are tight.

Subjecting a boiler to an abnormal pressure, on the assumption that if it stands such pressure without showing weakness it can safely be worked at a lower pressure, is absolutely wrong. It would almost seem too obvious to write an article calling attention to it, but unfortunately, it is this method that is all too common. If this article causes some boiler owners and operating engineers to think a little more deeply on this subject, it will have performed a useful service.

Methods of Making Welded Crowfoot Braces

Calculations Necessary in Designing Braces to Conform with A. S. M. E. Boiler Code Requirements

By J. E. Londregan

THERE are several boiler manufacturers whose product requires the use of a double ended crowfoot brace as shown in Fig. 1. The simplest and most accurate way of constructing this brace is by selecting the size of material desired and welding the crowfeet on each end.

This is accomplished by heating the iron to the welding point and bending the ends back upon the body of the intended brace, as illustrated in Fig. 2.

After the welds have been completed, the brace is placed on edge and the ends are split open with a cutting tool at points marked on Fig. 2 and are then hammered back, shaping the brace into its proper form, as shown in Fig. 1. The brace is then punched for rivets.

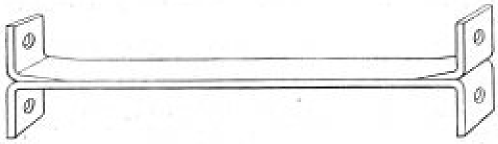


Fig. 1.—Double Ended Crowfoot Brace

Difficulties in Designing Brace

In designing the welded crowfoot brace, the designer often finds it difficult to get the proper proportions to his brace, as designated by the A.S.M.E. Boiler Code, and at the same time utilize the greatest permissible value of the material he puts into it.

By figuring on an allowable load of 6,000 pounds per square inch of cross-sectional area for welded braces and designing his brace in accordance with the A.S.M.E. Code specifications, making the combined cross-sectional area of the two rivets in the crowfoot equal to 1¼ times the cross-sectional area of the brace, and each branch of the crowfoot capable of supporting ⅔ of the load, the designer will find that his calculations are elusive and merely lead him around, in circles.

Calculating Dimensions of Brace

Let us for example, suppose we were required to design such a brace, made of 2 inch by ½ inch material:

Naturally, the body of our brace would have a cross-sectional area of 1 square inch, and being a welded brace we would assign an allowable load of 6,000 pounds. These figures form the basis for our calculations.

As the two rivets we select for our crowfoot must have a combined cross-sectional area equal to 1¼ times the body of the brace, or 1.25 square inches and that each rivet must contain one half, or 0.625 square inch, we would, by referring to the table of "area of circles" find that a 15/16 inch diameter rivet is the closest we can get for our actually required 0.625 square inch.

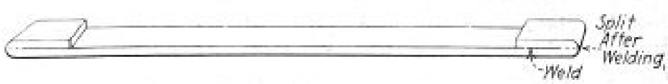


Fig. 2.—Ends for Brace Feet Are Bent and Welded Back on Body of the Brace

Now since each branch of our crowfoot must carry ⅔ of the load, it is evident that each branch must have a cross-sectional area through the rivet hole of at least ⅔ by 1 square inch, or 0.66 square inch.

This is impossible, as will be determined, because with the diameter of the rivet hole subtracted from the width of the crowfoot we have:

2 inches — .9375 inch = 1.0625 inches, and this multiplied by a thickness of ½ inch gives an net area of 0.53125 square inch, which is considerably less than the 0.66 square inch required.

We cannot reduce our rivets because, by doing so would reduce the value of our brace.

If we increase the body of our brace we must also increase the size of our rivets, and we would again come to the same stopping point when we calculated the crowfoot. Try it. One dimension will continually affect the other and nothing can be definitely accomplished.

To get a welded brace to conform to A.S.M.E. specifications, and from which the greatest value of material can be obtained, it is necessary to supply the allowable value of the brace at each point in the brace.

BOILER CODE LIMITS FOR WELDED BRACES

By referring to Table 5 of the A.S.M.E. Code, giving the maximum allowable stresses for stays, it is seen at "description C," that unwelded stays and unwelded portion of welded stays have an allowable stress of 9,500 pounds per

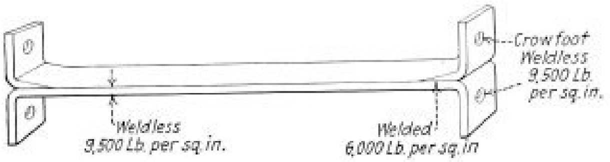


Fig. 3.—Relative Strengths of Brace Sections

square inch for braces not exceeding 120 diameters in length, and 8,500 pounds per square inch for braces which do exceed 120 diameters in length.

Since the brace we are considering is assumed to have 1 square inch of cross-sectional area, it would be equivalent to one approximately 1⅛ inch in diameter. And we shall intend it to be of a required length to permit us to assign a load of 9,500 pounds per square inch to the unwelded portions.

In Fig. 3 the relative values of each point in the brace are given.

Considering the loads on the brace as given, the allowable area of such a brace would be proportionate to the relative value of 9,500 and 6,000, or 6,000 divided by 9,500; which in this case would make the allowable area of the brace 0.631 square inch.

To carry ⅔ of the load, each branch of the crowfoot would need a cross-sectional area through the center of rivet holes of 0.66 by 0.631 square inch or 0.4164 square inch.

The combined cross-sectional area of the two rivets in the crowfoot would be 1.25 by 0.631 square inch, or 0.7887 square inch or ½ of 0.7887 square inch for one rivet.

Again referring to the table of "area of circles" it will be seen that the nearest size to the required area of 0.394 square inch is 0.441 square inch which is the area for a ¾ inch diameter rivet.

The two rivets having a combined cross-sectional area of 0.882 square inch would make them substantially larger than required but will not affect the value of our crowfoot since (2 inches — .75 inch) × ½ inch = 0.625 square inch = area of crowfoot through center of rivet hole, and is also considerably over the required area of each branch of the crowfoot.

Although the allowable area of the body of the brace is relative to both the 9,500 and 6,000, the crowfoot and rivets are given greater value as unwelded portions and in computing the size of brace required for a given load it affords the advantage of dividing our load by 9,500 instead of 6,000 for the greatest value obtainable.

Also, it is the only method by which such a brace can be designed and obtain the specified proportions.

Number of Types of Range Boilers to Be Reduced

A GENERAL conference of representatives of manufacturers, distributors and jobbers of range boilers, together with plumbers and other interested groups, held at the Department of Commerce October 30, resulted in a definite reduction in varieties and sizes of range boilers and their component parts; viz., from 130 to 13. Survey data collected in pursuance to a resolution adopted by the manufacturers at a preliminary conference held on February 28, 1923, was used as a basis for discussion and final eliminations.

R. M. Hudson of the Division of Simplified Practice opened the meeting with a descriptive outline of the service offered by the Department of Commerce in reducing variety as a means of eliminating waste in production, distribution, and consumption.

Frank Sutcliffe, president of the John Wood Manufacturing Company, of Conshohocken, Pa., was asked to preside as chairman and opened the discussion with a brief explanation of the purpose of the conference and the subjects to be considered.

The manufacturers present represented a large percentage of the industry. They expressed the opinion that the simplifications affected would be of great benefit not only to their own industry, but also to the consuming public at large.

It was suggested that the recommendation pertaining to preferred tappings be made applicable to copper as well as steel range boilers.

Prior to adjournment it was agreed that those present at the conference are to act as a "Committee of the Whole" to give the simplified practice recommendations their fullest support and to secure their widest possible adoption and use by the industry and other groups interested. This committee will reconvene subject to the call of the chairman.

The recommendations unanimously adopted by the conference are as follows:

1. Range boilers shall have one side tapping 6 inches from the top and one 6 inches up from the bottom (measurements to be made from the edge of the shell plate), and two tappings in the top and one in the bottom. All tappings are to be one inch. One-half inch top and the ¾ inch side and bottom tappings on vertical boilers to be eliminated. This recommendation effective at once and July 1, 1924, set as the final date for clearance of present stocks.

2. "Short Size" boiler (e. g. 12 inches by 58 inches), now used in New York city, to be eliminated.

3. Range boilers to be made in sizes and capacities as follows:

12 by 36 inches or	18 gallons	18 by 60 inches or	66 gallons
12 by 48 " "	24 "	20 by 60 " "	82 "
12 by 60 " "	30 "	22 by 60 " "	100 "
14 by 48 " "	32 "	24 by 60 " "	120 "
14 by 60 " "	40 "	24 by 72 " "	144 "
16 by 48 " "	42 "	24 by 96 " "	192 "
16 by 60 " "	52 "		

Sizes are inside diameters., Lengths mean, lengths of sheet, net overall lengths of boilers.

4. Five (5) 1-inch openings be considered as standard for horizontal boilers.

5. The 16 by 48-inch boiler be advertised as of its actual capacity (viz. 42 gallons), in lieu of No. 18, to avoid confusion with present 18-gallon boiler.

6. Rate all range boilers and combination boiler and gas water heaters by their actual water capacities in gallons.

7. Expansion tanks to be made in sizes and capacities as follows:

12 by 20-inches or	10 gallons	16 by 30 inches or	26 gallons
12 by 30 " "	15 "	16 by 36 " "	32 "
14 by 30 " "	20 "	16 by 48 " "	42 "

Gage glass tappings to be 13½ inches between centers to provide for exposure of 12 clear inches of gage glass.

Marine Boiler Explosion On a British Trawler

An Accident to a Previously Welded Reinforcement—Some Notes on the Preliminary Board of Trade Inquiry

On May 15 last, the steam trawler *Strathearn* was fishing at sea, 30 miles northeast of Buchan Ness, Scotland; her trawl was down and she was steaming at about 2 knots. An explosion occurred in the boiler when the steam pressure was 140 pounds per square inch, and the boiler emptied itself in 20 minutes. The *Strathearn* is owned by T. L. Devlin & Sons, Granton, and has the following dimensions:

Length, between perpendiculars	102.1 feet
Breadth, molded	21.6 feet
Depth, molded	11 ft. 7 in.
Gross tonnage	152 tons
Net tonnage	56 tons

The vessel was built in 1898 by Hall, Russell & Co., Aberdeen.

Particulars of the Boiler

The following particulars have all been abstracted from the Report of Preliminary Inquiry. From this it would

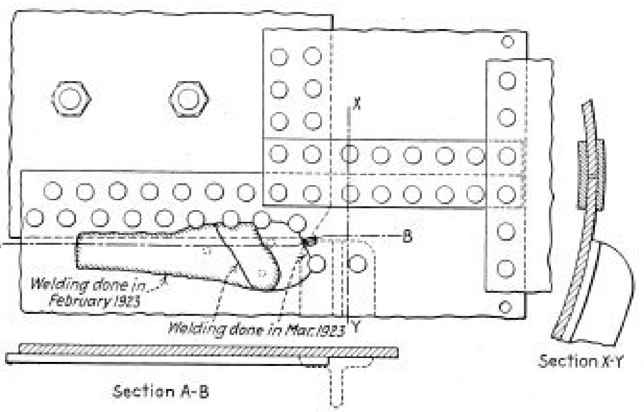


Fig. 1.—Details of Patch on Boiler Which Failed Due to Corrosion of Plate

appear that the boiler was made by Hall, Russell & Co., Ltd., engineers and shipbuilders, Aberdeen, in 1898, and that it was therefore 25 years old at the time of the explosion. It was built of steel and was the usual cylindrical multitubular marine type. It was 11 feet in diameter and 9 feet 6 inches in length, having two plain furnaces 41 inches in diameter, with separate combustion chambers. A tee-bar stiffener was fitted under each furnace where it joins the combustion chamber. The usual boiler mountings were fitted and the working pressure was 140 pounds per square inch.

Both the furnaces were renewed in May, 1912, being riveted, in each case, to a remaining portion of the old furnace. In March, 1920, 14 combustion chamber stays were renewed, and in February, 1921, the lower part of the port combustion chamber back plate was cut out and renewed. The bottom plate of the starboard combustion chamber was reinforced by electric welding in February, 1923, and on this occasion the boiler was re-tubed. One month later, on March 20, 1923, a small crack close to this welding was cut out, plugged, and covered with welded material. The boiler was inspected regularly each year since March, 1920, by the owners' superintendent engineer, his last examination being in February, 1923. It was also examined by two engineer surveyors to the insurance association, the vessel and boiler being insured with the United Kingdom Steam Tug & Trawler Insurance & Indemnity Association, Ltd., Aberdeen.

The original furnaces in the boiler were 41 inches in diameter inside and they had two double butt strap seams, the bottom plate extending to the back of the combustion chamber. When they were cut to receive new furnaces, this part in the combustion chambers remained in position. The owners' superintendent engineer, who has a Board of Trade first-class engineer's certificate, was examining the boiler in February, 1923, and found that the starboard combustion chamber bottom plate was thin in places, and he drilled two test holes. The thickness of the plate was 5/16 inch. He drew the attention of an engineer surveyor to the insurance company, to this defect, and on consultation it was agreed that this part should be reinforced by electric welding extending well past the two holes. This was done, and the position is shown on the drawing below, but the inspector did not see the repairs, which included re-tubing the boiler, nor was a hydraulic test applied. The vessel proceeded to sea early in March on completion of the refit. On March 19, while in dock at Granton, the engineman discovered a leak in the starboard furnace, but he was able to keep water in the boiler with the donkey pump. The steam pressure at the time was 70 pounds per square inch. After drawing fires, an examination was made, and it was then seen that a crack had developed in the bottom plate of the combustion chamber at the margin of the welded patch. The crack was cut out, forming a hole ¾ inch in diameter, which came close to the edge of the wing wrapper plate, and the manager stated that the thickness of the surrounding metal appeared to be quite ⅜ inch. He decided at this time to lay up the vessel at the end of May, in order to renew this plate, and to fit a new bottom portion to the back end plate of this combustion chamber.

The hole was plugged, and the plate further reinforced by electric welding extending over the previous patch and also towards the furnace. The superintendent engineer stated that he felt confident that this would be sufficient, and he allowed the vessel to proceed to sea.

Details of the Explosion

The *Strathearn* resumed fishing operations, and on May 15, 1923, and when the trawl was down, the speed being about 2 knots, the explosion occurred, as has been mentioned. The engineer stated that the pressure in the boiler was 140 pounds per square inch, and that the boiler emptied itself in 20 minutes. The skipper was informed that nothing could be done to the boiler, and assistance was obtained, the vessel being towed into Aberdeen. It was found on examination that a portion of the bottom plate, close to the edge of the more recent patch of welding done in the starboard combustion chamber, had been blown out, leaving a hole 1 inch long by 9/16 inch wide, through which water and steam escaped from the boiler. The engineer stated that he had not any warning of the explosion, and that he had particularly examined this back end a few days previously.

The bottom plate was gaged and found to be between ½ inch and 9/16 inch in thickness generally, but only ⅜ inch for a distance of 9 inches below the riveted seam at the wing. Extensive and deep corrosion was found on the water side of the bottom plate near this seam, and in line with it. This extended from mid-length of the combustion chamber to the far side of the stiffener, and, with the exception of this portion, it was covered by the patches of welding on the fire side of the plate. The original thickness of the plate was 11/16 inch, and this had been reduced by more than 1/8 inch all over on the fire side due to leakage and to rusting during the periods of laying up. The part which failed was situated at the place where the stiffener beneath is close to the corner of the wing wrapper plate. It was difficult to clean this part and also to judge of the condition by feeling, on account of its position, and it is doubtful whether hammer testing would have disclosed the thin portion owing to the support afforded by the heavier material close beside it.

Operation of a British Type Boiler Tube Blower*

Details of Parry Tube Cleaning Device as Applied to Marine and Locomotive Boilers

THE deleterious effect of layers of soot on boiler tubes and other heating surfaces is well recognized. Even after only an hour or two's steaming the flue gases of all types of boilers rise considerably in temperature, this rise being due to deposits of soot and scoriæ on surfaces that were originally clean. On removing the deposit the flue temperature immediately drops, because more heat has passed through the tubes or surfaces to assist evaporation. Manifestly, if the heating surfaces can be swept bare and maintained continuously in a clean condition while the boiler is working, not only will improved evaporation be assured, but the necessity, to say nothing of the expense of tube cleaning by hand, compressed air or other means at the end of a run will also be eliminated.

An example of a device specially intended for this purpose is the Parry steam blower, details of which are herewith given.

We are informed that many blowers of this type are in successful service in marine boilers, and that they have proved equally satisfactory in watertube boilers of various types. The most recent development in this country of this type of blower is its application to locomotives, and the accompanying illustrations show it applied to engine No. 205 of the "Claughton" class of the London, Midland and Scottish Railway.

How the Blower Functions

The Parry blower is, in effect, a combination of a De Laval steam nozzle with a deflecting nozzle fitted with accurately machined guide vanes, which is mounted in the boiler in such a manner that it commands all tubes. In operation the potential energy of the high-pressure steam is converted into kinetic energy at atmospheric pressure by a tapered orifice, and the steam is then guided by the vanes in the deflecting nozzle from which it issues at a speed of about 3,000 feet per second. In traversing the firebox towards the tubes the steam jet is said to entrain from seven to ten times its own weight of furnaces gases, with the result that the blast through the tubes is hot and dry, although its speed is considerably reduced—to between 300 feet and 400 feet per second in fact. However, as 300 feet per second is over 200 miles per hour, which is more than double that of the fiercest hurricane, the blast is sufficiently strong to carry everything before it through the tubes into the smokebox, whence, of course, the *débris* must be periodically removed through the door, or ejected through the chimney by a separate blower.

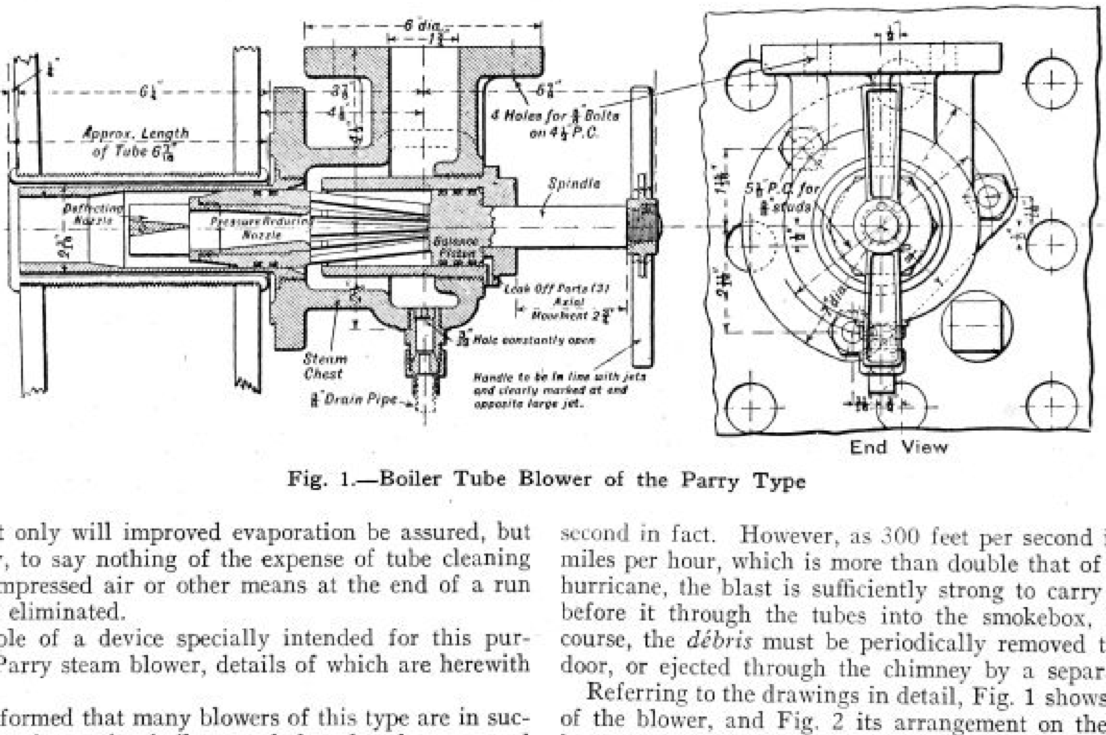


Fig. 1.—Boiler Tube Blower of the Parry Type

Referring to the drawings in detail, Fig. 1 shows a drawing of the blower, and Fig. 2 its arrangement on the particular locomotive referred to above. It will be noted that the steam nozzles are balanced for steam pressure by a piston so that, during operation, they may be moved easily, both rotationally and axially. The complete operation of the blower is as follows: The steam is turned on when the blower is in the position shown in Fig. 1 and Fig. 4. Since the deflecting nozzle, when in this position, is retracted into its housing, the steam jets cannot spread but are projected in a straight jet directed towards the central zone marked *C* in Fig. 3. The blower is left in that position for about 10 to 15 seconds, during which time all tubes in the zone *C* are, so it is claimed, thoroughly cleaned. The apparatus is then pushed forward until the handle touches the back of the steam chest. The

*Reprinted from *The Engineer*, September 28, issue.

deflecting nozzle has then been brought into the position shown in Fig. 5, with the result that the issuing steam is deflected by the guide vanes in the deflecting nozzle into two separate jets, which are at different angles of inclination to the axis of the blower. The small jet at any particular instant acts upon a group of tubes in the annular zone marked *E*, while the larger jet acts on a similar group in the zone *F* on the diagram—Fig. 3. It should be explained that these jets are actually diametrically opposite to one another, although for clearness in the diagram—Fig. 3—they are not shown quite opposite.

PROTECTION OF BLOWER VANES

With the nozzle in the position just referred to the driver slowly rotates the handle once or twice through complete revolutions, thus causing the jets to command all the tubes in the zones *E* and *F*. The guide vane is, the maker states, accurately machined within an error of a quarter of a degree in order that the steam jet may be directed to strike the tubes with mathematical precision. When the blower is not in action the nozzle should be retracted—as in Figs. 1 and 4—to protect the vane against excessive temperatures; but even if this were not done the vanes would probably have a long life, since they are protected by the air which circulates constantly through the tube housing the blower.

By the courtesy of Mr. Geo. Hughes, M. Inst. C.E., chief mechanical and electrical engineer of the London, Midland and Scottish Railway, we are enabled to publish the following abstract of a report which he recently made on the operation of this blower:

ENGINE NO. 205, "CLAUGHTON" CLASS

(Working between Crewe, Carlisle, and London on express work)

"The mileage run up to date is 12,000, during which period no trouble has been experienced nor any maintenance incurred. The blower has been found simple in operation and capable of cleaning a set of tubes in approximately 75 seconds. It, therefore, does not distract the attention of the engineman from other duties. Both large and small tubes have been efficiently cleaned and kept free from soot throughout their entire length. Ash can be removed from the top of the brick arch provided the cleaner is operated when the regulator is closed and the steam jet employed so as to insure no ash dropping into the blast pipe.

Results of Preliminary Trial

Total engine-miles	Total train-miles	Coal consumption lb. per ton-mile
(a) 1978	1956	160
(b) 1533	1512	176

(a) No. 1 period; tubes cleaned entirely by Parry tube cleaner.
(b) No. 2 period; tubes cleaned entirely by standard practice.
Coal consumption includes shed duties and lighting up.

"Economy in coal consumption shown by trial derived by the regular cleaning of tubes by the tube cleaner is equivalent to 9.09 percent.

"This blower was operated every hour on the road."

In the locomotive in question the tubes are 15 feet long and the blower is 8 feet 6 inches from the tube plate, making a total distance to be blown through of 23 feet 6 inches. The tubes, including those containing the superheater tubes, which are, of course, veritable traps for cinders, ashes, and soot,

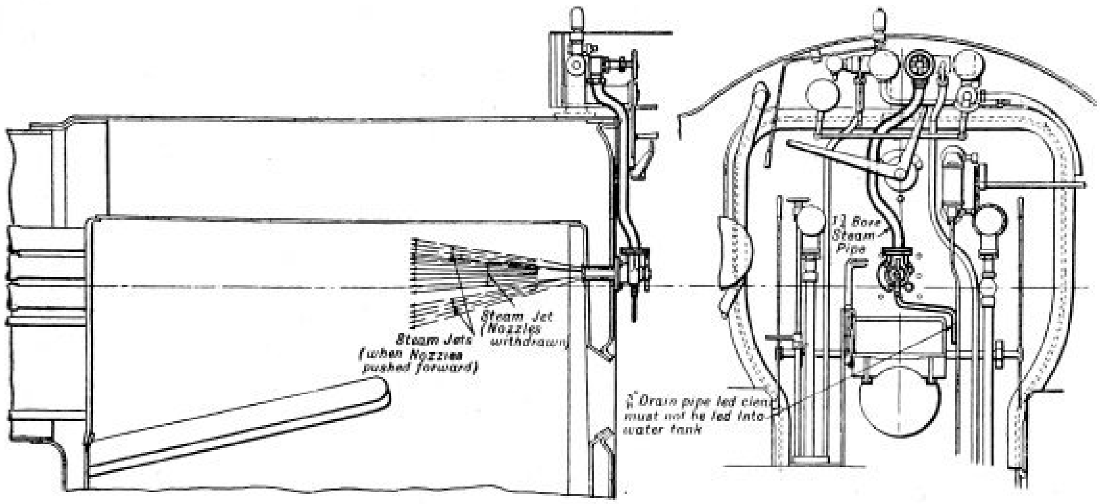


Fig. 2.—Cleaner as Applied on an L. M. S. Locomotive

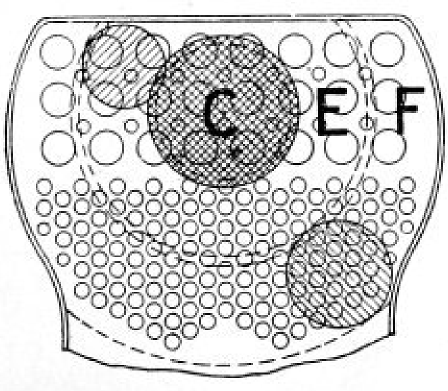


FIG.3.

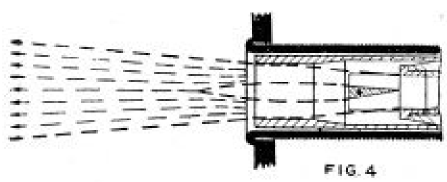


FIG.4

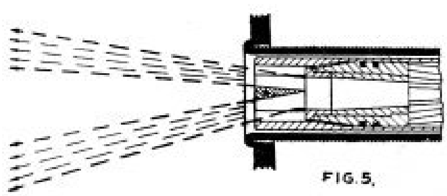


FIG.5.

Figs. 3, 4 and 5.—Action of Parry Cleaner have, so we gather, been maintained perfectly clean for a period of over three months by the use of the blower alone, the brush not having to be used at all during that time. The maker thinks that greater economy even than that experienced by Mr. Hughes may reasonably be expected as a general thing, since, during the above tests, there were very heavy weather conditions against the blower.

Apprentice Education Makes Rapid Progress

AN encyclopedia of information on the subject of apprenticeship in the United States is now available in the Bulletin on Apprentice Education which has just been issued by the Federal Board for Vocational Education.

New methods of apprentice training have been made necessary by the introduction of large scale production in industry, the bulletin shows. During the last fifteen years, we have witnessed the development of the class room method of apprentice education to supplement job experience. Such education has arisen, either in the form of vocational training in the public schools, or through corporation schools under the auspices of employers, or through classes controlled by the trade unions.

The most surprising progress has been made along the lines of part-time apprentice training classes organized by the public schools, according to the bulletin. Such training dates from the passage of the Federal Vocational Education Act in 1917. At the close of the fiscal year 1921-22, a total of 265,494 pupils were enrolled in such continuation classes. The bulletin believes that the public school is destined to fill a role of increasing importance in apprentice education, since it supplies a neutral training agency, acceptable to both capital and labor.

Sharp issue is taken with the belief of many educators that the part-time school is only a temporary make-shift to be displaced as soon as the age of compulsory full-time education can be raised to a desired point. The bulletin questions the wisdom of full-time education for boys and girls over 14, whose minds are set on employment. For such youths, industrial experience will prove of greater educational value than unwilling attendance at high schools, it is declared. At the same time, the part-time school holds these young workers within the influence of the public school system.

Too many educators hold the "Camel" theory of education, says the bulletin. They assume that the child is an intellectual camel, who can take his education in a prolonged meal—an educational gorge—store it up in an intellectual hump, and live off the hump all the way across the journey of life. They assume that the school is able, by itself, to furnish a balanced ration. They overlook entirely the educational value of work for youth, as well as for older people.

Part-time vocational education bridges the gap between the job and the school, and enables the child to gain the cultural benefits of both, during his formative years, declares the bulletin. The increasing use of the public school for apprentice training by both employers and trade unions will be a mighty stimulus to the growth of part-time education, it asserts. At the same time, it will give a new practical value to the public school.

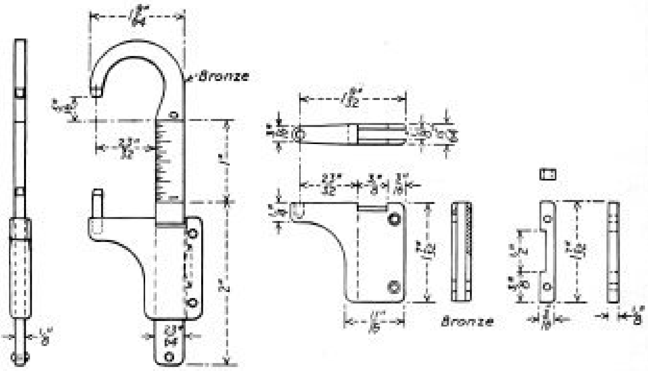
Copies of this bulletin are obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Boiler Plate Gage

By E. A. Miller

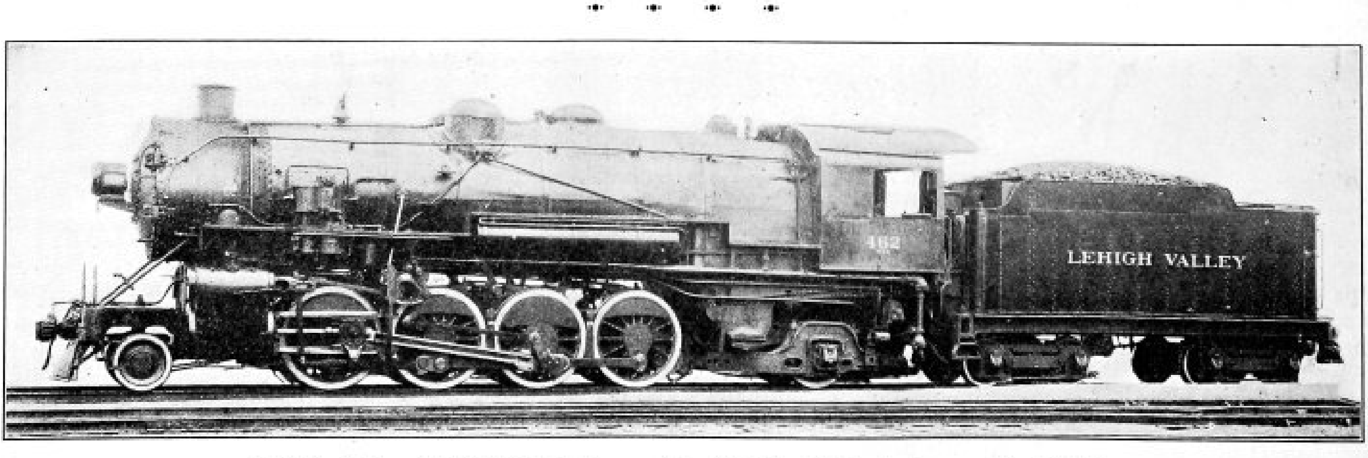
A CONVENIENT boiler plate gage for the use of inspectors and foremen is shown in the illustration, the goose neck effect being provided so that sheets having a rolled edge can be readily gaged. For plates thicker than 5/16 inch and having a rolled edge all around, a larger goose neck gage will be necessary of the same type as illustrated.

Referring to the illustration, the body of the tool is made



Simple but Convenient Boiler Plate Gage for Boiler Inspectors

of bronze, finished all over and graduated as shown. The slide likewise is made of bronze, slotted on one side to receive the filling piece after the small spring has been put in place. The filling piece is riveted using 1/8 inch rivets in countersunk holes, the slide then being capable of movement on the body with just the required spring tension. A 1/8 inch bronze stud or anvil 1/2 inch long is sweated in the hole in the slide as shown in the assembly view. This anvil projects 5/16 inch beyond the slide so that when the calipering points touch, the slide is at zero on the scale.



Lehigh Valley N-4-B Mikado Locomotive Built by Baldwin Locomotive Works

The Boiler Maker

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CONTENTS

Certain portions of the report on the "Possibilities and Limitations of Fusion Welding" presented at the fall meeting of the American Welding Society, held at Pittsburgh, October 24 to 26, 1923, offer food for thought to all of our readers either directly or indirectly interested in oxy-acetylene welding and cutting or in applications of the electric arc process. This report was divided into two sections, the first dealing with phases in the development of electric arc welding and cutting and the other to the applications of oxy-acetylene welding and cutting. Since the report reviewed the processes in other fields other than boiler or tank work, a great deal of the subject matter would be of slight benefit to our readers, but certain portions are here outlined that apply specifically to the every-day work of the boiler shop.

Structural steel firms are now gaining experience in the use of arc welding on smaller welded sections which do not require approval and which, it is believed, will eventually supplant the rivet. Since the pioneer work on electric welding was carried out in the railroad shop, it is fitting that experience with the process by the railroads has been justified, as demonstrated by the adoption of electric welding all flues in the firebox as standard practice by many roads and the increase in the practice of welding fireboxes on new locomotives and in firebox repairs. Although the belief has been common that the electric arc is not as efficient for cutting metals as the oxy-acetylene torch, it actually can be used both rapidly and with economy for cutting brass, copper, zinc, lead, cast-iron, malleable iron, high carbon or alloy steels and the like. Metal under 6 inches in thickness is given as the limit for economically applying the arc cutting process. A striking example of economy is found in rivet cutting with the arc where records are available of one man cutting from 100 to 200 rivets an hour.

As in electric welding, the oxy-acetylene process has found one of its widest applications in the railroad shop—particularly in boiler work. Portions of the report are necessarily devoted to developments made outside the boiler field in pipe line construction and in oil storage tank fabrication and erection. In this work it is interesting to note that one of the outstanding applications of the year was the welding by means of the gas process of two 1,000 barrel oil storage tanks.

Without the oxy-acetylene process the present motive power maintenance requirements could hardly be met, for major repairs to locomotives are largely limited to the speed of the boiler shop. Experience has shown that the boiler work not only keeps pace with mechanical repairs but because of the facility with which boiler side sheets, flue sheets, tubes, flues, crown bolts, stays and rivets are cut out and renewed by means of the torch that the boiler shop keeps its production close to the 100 percent mark all the time. An expert cutter, for example, can cut off a broken staybolt one inch in diameter or less in 10 to 12 seconds and maintain the performance for hours. Records of burning out staybolts at the rate of 300 to 350 per hour have been made, while replacement bolts have been cut to length for heading at a somewhat faster rate.

What promises to be one of the most interesting mid-winter meetings of the American Boiler Manufacturers' Association will be held at the Hotel Hollenden, Cleveland, O., Tuesday, February 12. Fred Low, editor of "Power" and newly installed president of the American Society of Mechanical Engineers, will be present to discuss the Power Conference to be held at Wembley, England, June 30 to July 12. Special reports will also be given on the work of the smoke prevention committee and by the commercial committee. Definite progress has been made in the formulation of engineering standards and the report of the standards committee, members of which represent the American Boiler Manufacturers' Association on the national committee of standards, will prove of special interest to all members of the association who attend.

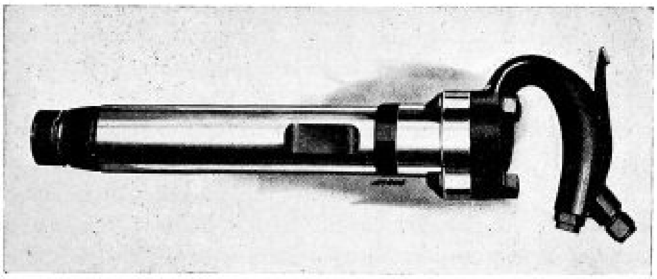
Engineering Specialties for Boiler Making

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

New Type Riveting Hammer

THE Ingersoll-Rand Company, New York, has developed and is now offering a new type of pneumatic riveting hammer with improved features, including bolted construction for holding the handle to the barrel, heavy section valve with liberal bearing surfaces; combination poppet and piston type throttle valve; power in excess of all ordinary requirements; low air consumption and easy operation.

The new style hammers are manufactured in three styles, A, B and C and are available in a complete range of sizes from a 5-inch to a 9-inch stroke. Each size can be purchased with any one of three types of barrels and with either outside or inside trigger handles. The standard A type has a barrel machined to accommodate a rivet set clip only and is furnished on all orders which do not specify either a bridge type or retainer type barrel.



Ingersoll-Rand No. 8A Riveter with Outside Trigger Handle

Three alloy steel bolts of substantial size, fitted with lock washers, hold the handle to the barrel. This is an exclusive feature of Ingersoll-Rand hammers, and enables them to be taken apart anywhere for inspection or cleaning with the aid of only a wrench.

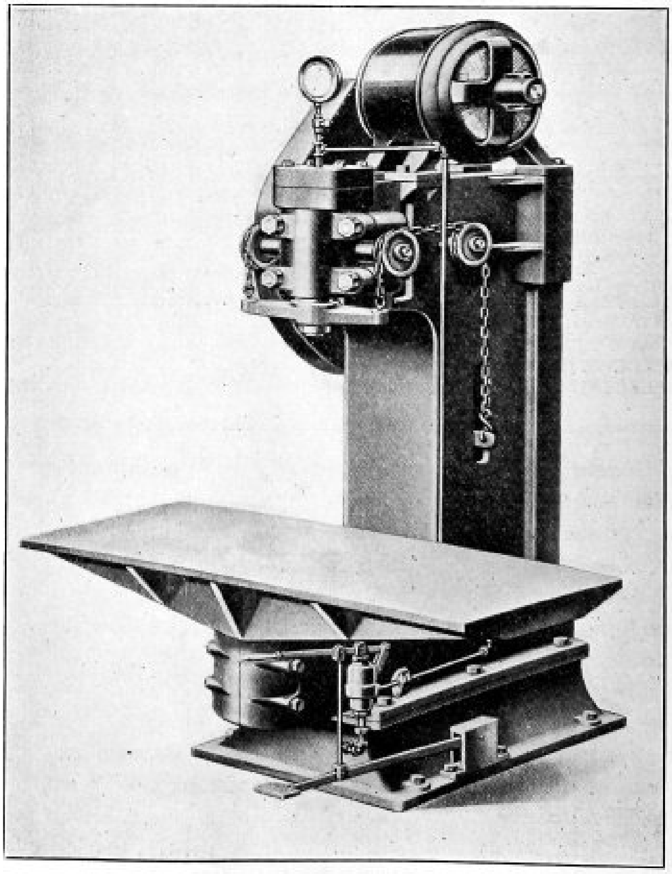
The throttle valve (except on inside trigger handles) is a combination of the piston and poppet types, having the nicety of control of the piston valve and the freedom from leakage of the poppet type. The beveled seat will remain tight throughout the life of the tool, preventing leakage. The throttle lever or trigger is made in one piece from special heat treated spring steel and has a long bearing in the handle.

The valve is a sturdy sleeve made from special alloy steel. It has liberal bearing surfaces and its walls are free from holes or ports. It operates in a valve box of strong construction, located in the head of the barrel. The valve box is constructed with a solid end which enables it to be easily taken apart by the use of a piston for the removal of the valve, without recourse to the use of a screwdriver or similar instrument. This construction also insures a compression chamber in the valve box which cushions the piston on the return stroke and prevents its striking the handle. The handles are of high quality steel, drop forged to a shape that fits the hand and are sand blast finished to give a positive grip. Either outside or inside trigger handles can be furnished although the outside type is standard. The exhaust is through the side of the barrel near the handle and can be deflected in any direction desired by merely turning the deflector.

Hydraulic Straightening Press

THE Watson-Stillman Company, New York, has recently brought out a rapid working hydraulic press for use in bending, straightening or forcing operations. It is designed to handle any work requiring pressure up to the full capacity of the press. It is a self-contained unit, being driven by a motor and requiring no auxiliary water or power supply. The operation is fast and under absolute control of the operator both as to speed and pressure. Movement of the ram is controlled by means of a valve operated either by a hand or foot lever. The pump is arranged so that the movement of the press ram through the idle portion of its stroke is rapid and the change from low to high pressure for the actual straightening operation is effected automatically. A feature of importance is that the whole table can be removed. This leaves an open jaw forcing press that can be utilized in any kind of shop work, such as mandrel forcing, broaching, force fitting and assembling.

The whole unit is built with all the working parts under detachable dirt proof guards. The frame is made of a steel casting with a copper-lined cylinder, bolted and keyed to the frame. The ram is made of high carbon steel. The base is of cast iron and serves as a reservoir for the pump. The pump body is of bronze and the plungers are of hardened



Rapid Working Press Equipped with Slow Speed Motor

tool steel packed with hemp under bronze glands. All packings are easily accessible. The pump valves are made of Monel metal and are of the metallic seated type. The ram is equipped with a positive stop which is intended to prevent over-stroke.

Hydraulic pressure is used only for the pressure or downward motion of the ram; the return is accomplished by a counterweight inside of the frame. The illustration shows the press equipped with a slow speed motor with single reduction gearing to the pump shaft. A high speed motor can also be used, with compound gearing to the crankshaft.

Throatless Rotary Type Sheet Metal Shear

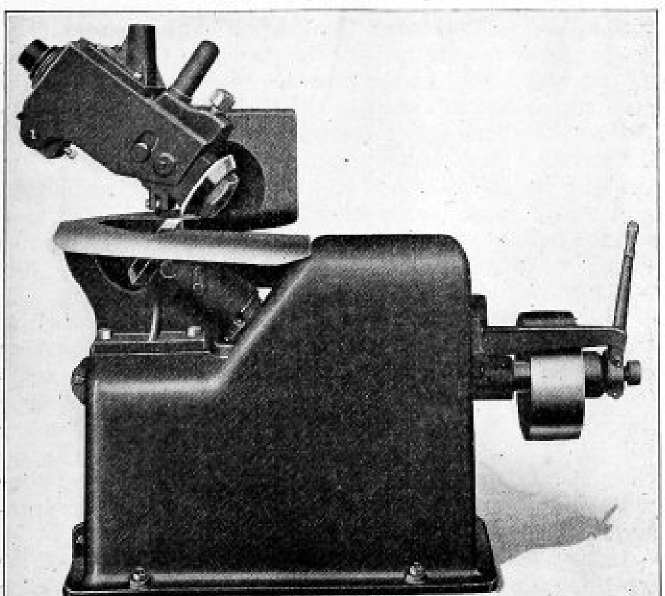
A SHEARING machine of the rotary type, known as the throatless shear, has been placed on the market by the Marshalltown Manufacturing Company, Marshalltown, Iowa. This machine, built in a number of sizes, cuts sheet metal up to ½ inch thick, but its particular feature, as may be inferred from the name, is ability to cut sheets of any size, no matter how large. The machine is adapted for cutting in and out curves and complete circles, also for straight splitting. Circles as small as 20 inches in diameter can be cut.

The head of the machine as well as most of the parts are made of cast steel. They are strongly built, designed with a large factor of safety, and it is said that not one has ever sprung or broken in operation. The cutters are set almost perpendicular, and are made of special tool steel 1⅛ inches thick and 10 inches in diameter, tempered. One of the cutters is knurled and driven which makes the shear self-feeding.

Belt or Motor Drive

The machine can be provided with either belt or motor drive, in the former case a friction clutch pulley being furnished as illustrated. With motor drive a friction clutch gear enables the operator to stop the shear with the motor still running. The speed of the pulley is 270 revolutions per minute and sheets are cut at the rate of 6 feet per minute. The floor space required for the machine is 2 feet 8 inches by 4 feet 2 inches, the distance from the floor to the cutters is 42 inches. When motor driven, a 5-horsepower motor running at 1,759 revolutions per minute is required. The net weight is 4,600 pounds.

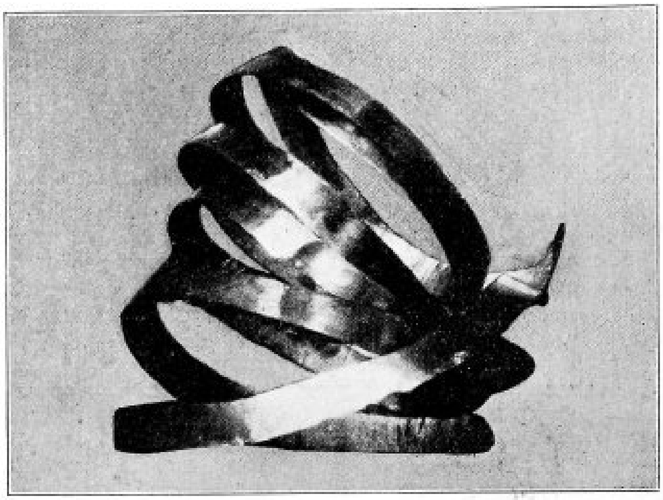
This machine is adapted for use in locomotive boiler shops and tin shops, but should prove especially valuable in steel car shops where large and often irregular-shaped sheets have to be cut to replace those which are worn out in service or damaged in wrecks.



Rotary Shear for Plates Up to ½ Inch Thick

Long Air Hammer Chip

AN unusual example of air hammer cutting power and smoothness of operation is afforded by the long steel chip illustrated. This chip is 1/16 inch thick and 112 inches long, having been cut from a locomotive firebox side sheet by a No. C Thor chipping hammer with 3-inch stroke, made by the Independent Pneumatic Tool Company, Chicago. The air hammer in question had been in practically constant service for four years, and this long chip therefore shows both the durability of the hammer and the uniform strokes and accurate hammer control, without which boilermakers cannot do a good job in trimming firebox sheets.



Air Hammer Chip 112 Inches Long Cut from Locomotive Side Sheet with Thor Chipping Hammer

Black and Decker Announce Price Reductions for Portable Electric Tools

THE Black and Decker Manufacturing Company, Towson, Maryland, has announced a new standard of prices for portable electric tools, which went into effect December 29, 1923.

This company reduced the prices on ⅞ inch, ⅝ inch, 9/16 inch, ½ inch and ⅜ inch heavy duty portable electric drills approximately 12 percent and also the prices on 4-inch, 5-inch and 6-inch portable electric grinders by the same amount. This is the second reduction in prices of the heavy duty tools made by the Black and Decker Manufacturing Company during the past year, quite a substantial reduction having been made June 1, 1923. It is also interesting to note that on November 12, 1923, the half-inch special was reduced from $68 to $58 and the electric valve grinder from $45 to $34.

Fred M. Ball has been appointed district manager of the Franklin Railway Supply Company, Inc., with headquarters at Philadelphia, Pa.

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Furnace for Flue Welding

Q.—Please give me drawings of an oil furnace and burner for welding flues.—R. H. M.

A.—There are a number of flue welding furnaces but in general they are built for oil or gas fuel in the general form shown in Fig. 1. The body of the furnace support may be made of steel or castings, and standard refractory brick of

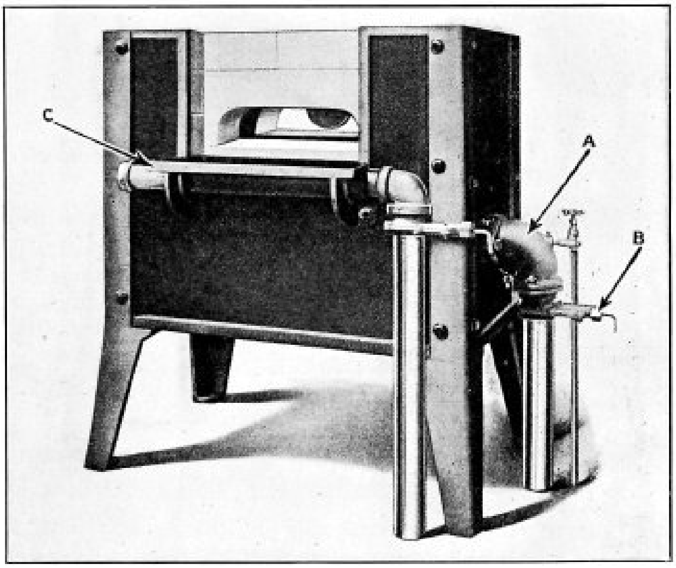


Fig. 1.—Furnace Using Gas or Oil for Fuel

high heat-resisting quality is used for the furnace. For a furnace to heat three tubes the width across the front should be about 22 inches and the depth not over 5 inches. The entrance arch, which is usually elliptical in shape, should be at least 15½ inches and the height is about 6 inches. The total height of the furnace and stand is from 46 to 48 inches.

Since these furnaces are fired with oil or gas special burners *a* are connected with a blast gate adjustment *b*. To protect the operator from the intense heat a blast pipe shield *c* is located at the front of the furnace opening.

It is advisable to use equipment of this kind that has proven efficient and we would therefore suggest that you write manufacturers of furnaces regarding the installation of such a furnace. A list of manufacturers of this type equipment will be found in the directory section of this issue.

Intersection of a Conical Stack and Elliptical Breeching

Q.—Will you please publish a development of an elliptical breeching intersecting a conical stack on 45-degree slope as shown in sketch?—A. P.

A.—The perspective drawing, Fig. 1, shows a general arrangement of the intersection. By referring to this figure and to the drawing, Fig. 2, the principles of projection as applied in the construction of the miter line should be readily understood.

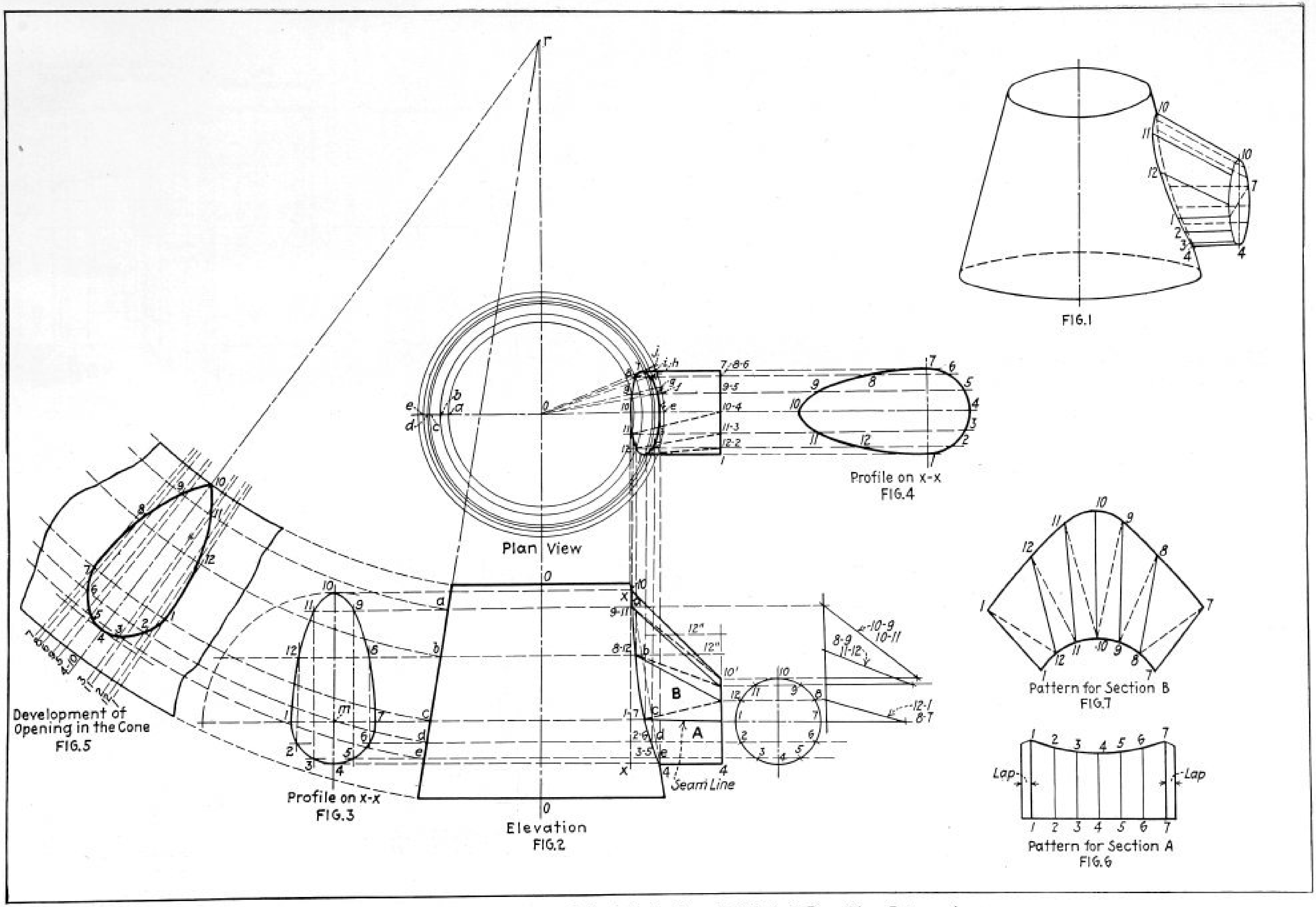
The shape of the transition piece, along the plane *x-x* of Fig. 2, is shown in Fig. 3. The upper part above 1-7 is elliptical and the part below these points is semi-circular in shape. The profile *a* of the other end of the transition piece is circular in form. To obtain the shape of the profile in Fig. 3, extend the line 1-7 from Fig. 2 to Fig. 3 and with *n* as a center draw the semi-circle equal in diameter to the profile *a* of Fig. 2. Divide the semi-circle into a number of equal parts and at right angles to 1-7 from the points *2, 3, 4, 5*, etc., draw the lines shown. Make *m-10* equal to the vertical distance between points *1-7* and *10* of Fig. 2, with *m* as the center and a radius *m-10* draw an arc. Divide this arc into one-half the number of parts as contained in the semi-circle. Projectors drawn from the points on the arc to intersect the lines drawn from points *2, 3, 4* and *5* etc. as at *8, 9, 11* and *12* are the points for drawing in the ellipse. Locate the profile in Fig. 4 and make it equal in size to Fig. 3.

With the aid of these profiles, the miter can be determined as follows: Consider a number of planes as *a-a, b-b, c-c*, etc., to be passed through the frustum of the cone, Fig. 2. These planes are drawn from the points on the profile, Fig. 3, and where they cut the cone the resulting sections of the cone are circles, as shown in the plan view. The intersections, of the lines drawn from points *1, 2-12*, 3-*11*, etc., of the profile, Fig. 4, to the plan, with the circles of that view, establish the points *1, 2, 3, 4, 5, 6*, etc., on the miter line.

After the points on the miter in the plan are located, project the points to the elevation, by drawing the lines parallel with *o-o* and to intersect the traces of the planes *a-a, b-b, c-c.*, etc., as at *9-11, 8-12, 1-7* and *2-6*.

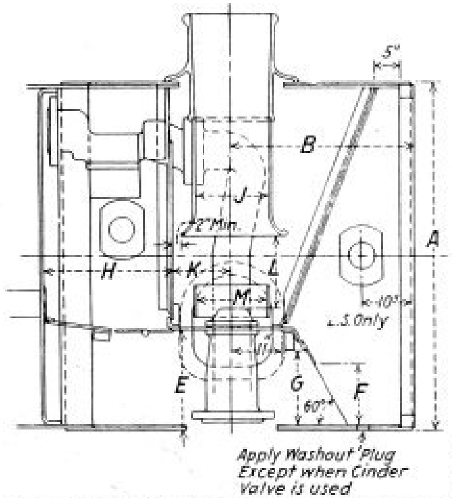
Fig. 5 is a development of the opening in the pattern of the frustum of the cone, for connecting with the transition piece. To determine the respective widths through the opening first draw the radials from point *o* in the plan, through the points as shown at *5, 6, 7, 8, 9* and *10*, thus locating the arc lengths *e-f, f-g, g-h*, etc., in the base circle of the frustum. Transfer these arc lengths to Fig. 5 and draw the radial line connecting with point *r″*. Points on the opening are then projected from Fig. 2.

In Fig. 6 is shown a pattern of the lower part *A* of the transition piece and Fig. 7 is the pattern of the upper section *B*. Fig. 6 can be laid off directly from Fig. 2 but for Fig. 7 the triangulation method is used.

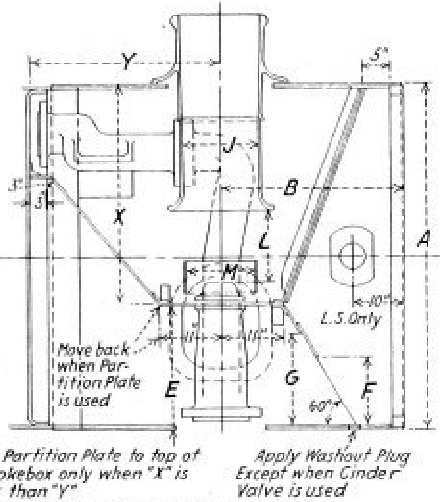


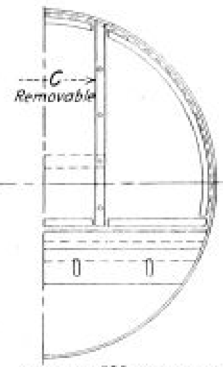
Perspective View and Layout of Conical Stack and Elliptical Breeching Intersections

SUPERHEATED STEAM
OIL BURNING



SATURATED STEAM
COAL BURNING





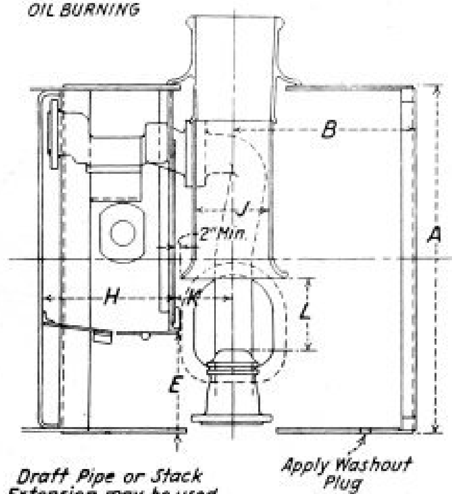
M	L	K	J
	STANDARD C.I. STACK EXTENSION		
9"	13"	11"	11"
10"	13"	12"	12"
11"	14"	12"	13"
12"	14"	13"	14"
13"	15"	13"	15"
14"	15"	14"	16"
15"	16"	14"	17"
16"	16"	15"	18"
17"	17"	15"	19"
18"	17"	16"	20"
	18"	16"	21"
	18"	17"	22"
	19"	17"	23"
	19"	18"	24"

D	C	B	A	D	C	B	A	D	C	B	A
	27"	44"	90"		21"	37"	70		14"	31"	50"
	28"	44"	91"		21"	38"	71"		14"	31"	51"
	28"	45"	92"		21"	38"	72"		15"	31"	52"
	28"	45"	93"		22"	38"	73"		15"	32"	53"
	29"	45"	94"		22"	39"	74"		15"	32"	54"
	29"	46"	95"		22"	39"	75"		16"	32"	55"
	29"	46"	96"		23"	39"	76"		16"	33"	56"
	30"	46"	97"		23"	40"	77"		16"	33"	57"
	30"	47"	98"		23"	40"	78"		17"	33"	58"
	30"	47"	99"		24"	40"	79"		17"	34"	59"
	31"	47"	100"		24"	41"	80"		17"	34"	60"
	31"	48"	101"		24"	41"	81"		18"	34"	61"
	31"	48"	102"		25"	41"	82"		18"	35"	62"
	32"	48"	103"		25"	42"	83"		18"	35"	63"
	32"	49"	104"		25"	42"	84"		19"	35"	64"
	32"	49"	105"		26"	42	85"		19"	36"	65"
					26"	43"	86"		19"	36"	66"
					26"	43"	87"		20"	36"	67"
					27"	43"	88"		20"	37"	68"
					27"	44"	89"		20"	37"	69"

Dimension "B" tabulated to give a clear area through netting of 125% of total gas area using netting having a clear area of 50% or more, increase dimension "B" to give 125% when using netting having less than 50% clear area. Dimension "C" tabulated to bring the three strips of netting of the same width and to allow a proper width of door. Door to extend full height for smokeboxes up to 90" diam., for 90" diam. and over use door 30" high. Dimension "E": 1st. to give 100% gas area under plate for outside steam pipes and 115% for inside steam pipes. 2nd. to bring dimension "E" in a figure ending in ½". 3rd. to bring table plate not higher than bottom of lower flues. Dimension "F" to be 63% to 68% of total gas area. Dimension "G" to be 85% to 90% of total gas area. Dimension "H" is governed by the type of header. Dimension "K" is the minimum for a standard cast iron stack extension with 2" clearance from deflecting plate, but can be decreased 2" by cutting off the back of the extension. The improved through-bolt type of header is preferred and must be provided for on all new designs, on duplicate designs where this header is not provided for, the question of header design is to be submitted to the Superheater Co. by N.Y. office. Letter J.B. Ennis 4, 24, 20.
Dimension "J" is taken from standard practice sheet 75 S 2294. Dimension "M" draft pipe may be used in place of stack extension on oil burners. Draft pipe around nozzle aids the draft to sweep the table plate clear of cinders.

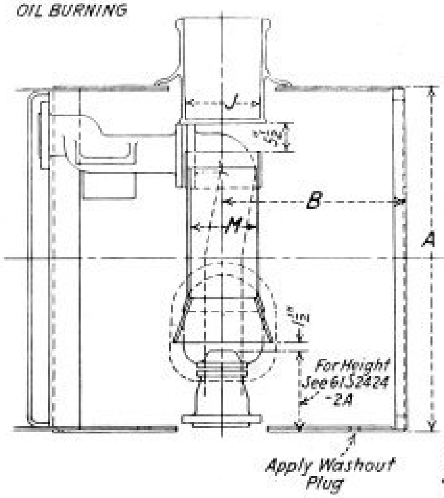
Netting 2½" x 2½" x No. 13 B.W.G. Exceptions: When Otherwise Specified and Canadian and N.Y. State Laws.
Deflecting Plates 3/16" Thick. Deflecting Plate Angles 1¾" x 1¾" x ⅛" for Smokeboxes up to 72" Diameter Incl. But Over 72" diam. use 2" x 2" x ¼"

SUPERHEATED STEAM
OIL BURNING

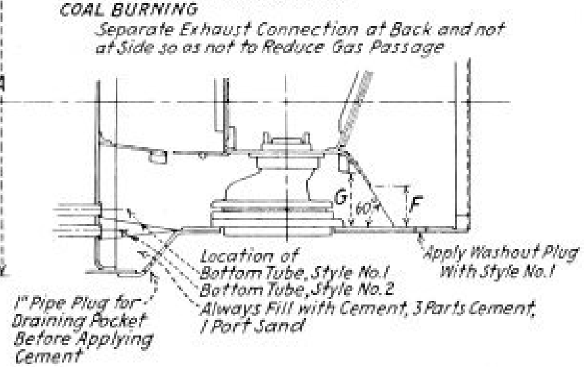


Draft Pipe or Stack Extension may be used

SATURATED STEAM
OIL BURNING



(MALLET) SUPERHEATED STEAM
COAL BURNING



HEADER	No. of Rows Deep	H — No. of Rows Wide: 5 to 7	8 & 9	10 to 12
IMPROVED THROUGH-BOLT	2	19"		
	3	24"	25"	
	4	28"	29"	30"
	5	30"	33"	37"
	6		37"	38"
TEE BOLT				
	3	16"	16"	16"
	4	18"	18"	18"
	5	21"	21"	21"
	6		24"	24"

Front Ends for Locomotives Using Various Kinds of Fuel

Smoke Box Dimensions

Q.—Will you please publish in the next issue of The Boiler Maker sketch and dimensions of how to apply and get dimensions of a master mechanic front end in a railroad locomotive. I have applied several of these front ends from blue prints but have been unable to obtain how these dimensions were obtained.—J. A. K.

A.—The different front ends for the various boilers as required for coal and oil burning, also for saturated and superheated steam are illustrated in the accompanying drawings. The proportions are given in the tables for the different diameters. These data are in accordance with the practice of the American Locomotive Company.

Determining Size of Receiver-Separator Tank

Q.—I have several rather puzzling questions that have bothered me, on one of which I would ask assistance herewith.

I inclose a copy of an inquiry on a steam separator to meet the requirements specified and which condensed are as follows:

Working steam pressure	350 pounds
Superheat	220 degrees F.
Diameter inlet opening	16 inches
Diameter outlet opening	18 inches

Required: The proper size, or diameter and length of separator shell, or tank, to serve the purpose, and how to arrive at same with correct method, and which would apply to any similar problem?

Reading further, include guarantee as to pressure drop through separator when discharging steam.

Required: The proper method to arrive at such pressure drop so as to make any such guarantee with any assurance that one is correct.

Upon request for more specific information, the writer was told that he had all the information that any other bidder had, and to "go to it"; "went to it" but from my general idea of the use of steam tables and the data on flow of steam, and trying to dig up data on superheated steam that would apply I had to "give it up" as "a bad job"; probably very simple if proper method is used; spent several evenings on this with unsatisfactory results.

Can you solve both problems? They should prove interesting to your readers in general. R. C. W.

A.—The separator in this case of the type known as a *receiver-separator* is used for the following reasons:

(1) To prevent vibration in long high pressure pipe lines. Vibration is liable to occur in a steam pipe supply system to an engine, when the steam cut-off is made, which results in an impact of the steam against the back of the steam valve. The constant volume of the steam in the receiver set close to the engine acts as a buffer in taking up shock at each steam cut-off.

(2) It tends to prevent a drop of pressure between the boiler and engine. If a receiver separator were not used, a pressure drop as high as 10 percent may arise in the steam supply line.

(3) It tends to prevent excessive priming of the boilers which might otherwise occur when a sudden overload is placed on the boilers.

As the conditions under which the supply of steam is to be taken from the receiver separator are not given, it is impossible to give a definite answer. The following example, however, will demonstrate the method of determining the size for one condition.

Assume that 300,000 pounds of steam per hour at the pressure and temperature stated in the example, is to be taken off uniformly at 1 second intervals.

The number of pounds of steam taken off in that period of time equals

$$\frac{300{,}000 \times 1}{60 \times 60} = 83\tfrac{1}{3} \text{ pounds.}$$

The volume of 1 pound of steam at 350 pounds pressure and 200 degrees superheat is 1.81 cubic feet.

The volume of the tank required equals $83\frac{1}{3} \times 1.81 = 150.83$, say 151 cubic feet. The volume in cubic inches equals $1{,}728 \times 151 = 260{,}928$ cubic inches.

Assume that a tank 60 inches in diameter is used. The area of a circle 60 inches in diameter equals $60^2 \times 0.7854 = 2{,}827.4$ square inches. The required height of the tank equals $260{,}298 \div 2{,}827.4 = 92\frac{1}{4}$ inches.

Separators of ample storage capacity stop vibration of steam piping and reduce the drop in pressure in the steam line. The separator should be covered with a heavy coating of asbestos to maintain the high temperature of the steam. There is practically no loss in pressure through the separator provided it is of ample capacity and properly connected up.

Areas of Sectors of Circles

Q.—Received your useful information re area of circle, etc., but I don't seem to be able to work out my problem. Enclosed you will find sketch of same. What I would like to know is what would be the diameter of circle left after 4 triangles have been subtracted from it? I can go a certain length but am stuck. Would like very much if you could help me out. Thanking you for your recent information.—J. C. W.

A.—The area of the small sectors is slightly greater than the triangles, but for most purposes the difference in this case is negligible.

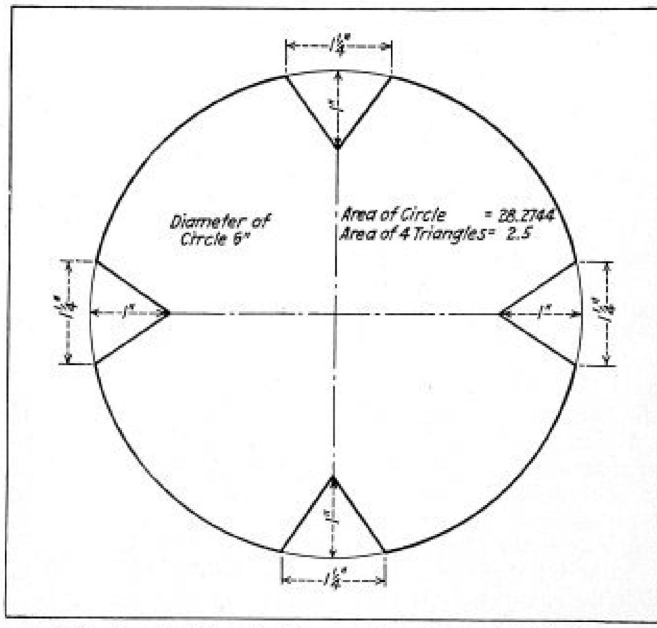


Fig. 1.—Problem in Computing Areas of Circles.

To find the area of any triangle, multiply the base by the height, and divide the product by 2.

In accordance with this rule, the area of one triangle equals

$$\frac{1\tfrac{1}{4} \times 1}{2} = 0.625 \text{ square inch.}$$

The area of four triangles of this size equals $0.625 \times 4 = 2\frac{1}{2}$ square inches.

The area of a circle 6 inches in diameter equals $6^2 \times 0.7854 = 28.274$ square inches.

$28.274 - 2.5 = 25.774$ square inches.

The diameter of a circle containing 25.744 square inches equals

$$\sqrt{\frac{25.744}{0.7854}} = 5.717 \text{ inches. Ans.}$$

Calculations for and Layout of Compound Bends

Q.—Would you please show me a method of laying out a pipe with a compound bend? I would also like a formula to figure out the true angle of a compound bend and determine the correct position of the top and bottom center lines of the pipe on the end plates of the bend.—S. R. B. C.

A.—The solutions for both of these problems have been fully described in the columns of The Boiler Maker. Refer to the May issue, 1922, and on page 136 is given the calculation for a compound bend as applied for a Y connection. In February's issue, 1923, is a layout of a blast furnace pipe.

Letters from Practical Boiler Makers

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

Boiler Inspection in New York State

THE Industrial Commission of the State of New York provides rules for the construction, installation, inspection and maintenance of steam boilers. Under Section 91 it states that all boilers used for steam or heat and carrying over 15 pounds to the square inch of steam pressure shall be inspected by an authorized insurance company inspector or an insurance inspector of the Commission at least once a year.

Rule 801 provides that whoever owns, uses or causes to be used a portable boiler subject to inspection, as provided in Section 91 of the Labor Law, shall report the location of such boiler to the Industrial Commission or to the boiler insurance company insuring such boiler 30 days prior to the expiration of the certificate of inspection of such boiler.

Rule 802 provides for preparing the boiler for inspection and requires that the owner or user be notified at least 15 days in advance. Rule 809 provides for certificate of inspection being posted. Rule 810 provides in case a defect affecting the safety of a steam boiler is discovered, the owner or user shall immediately discontinue the boiler from service and notify the Industrial Commission, an inspection shall be made and a certificate of inspection issued before the boiler is again placed in service.

Rule 811 provides for boilers that were in the state at the time the rules took effect if installed thereafter may be operated after a thorough internal and external inspection and a hydrostatic test. The equipment shall conform to that of the new installation. Rule 817 provides for the daily use of safety valve water column and water blow-offs, also try cocks when the boiler is in operation.

Failure to Report Boilers

I cite the above rules in order to bring to a point the subject I would like to see discussed by our readers.

It is an absolute impossibility to get the owners and users of boilers to report them to the Commission, and I cite from experience. I can have the names of several persons operating boilers and drop them a line, giving the law, and inclose a stamped and addressed postal card requesting the specific location of the boiler in question, and in one case out of fifteen I will receive no reply; therefore it becomes necessary to go and get them personally. Rule 801 is not lived up to for they will not comply thereto.

Also in sending out preparation blanks as provided by Rule 802 when you arrive at the boiler you will not find the handhole plates or the grates out as required. Nor the boiler cleaned, but mud up to the flues in the barrel and two or three rows high on the mudring.

Inspection Certificates Not Posted

The certificate of inspection is another hard problem, for it is quite difficult to get them posted.

I have found several cases of the operating of boilers with the crown sheet considerably bagged and necessary to pull the fire; also staybolts leaking a stream around the top row on the wrapper sheet. The owner or user will put up a terrible argument if you ask him to pull the fire when you discover his boiler in a dangerous condition, and one must put his foot right down for they always have their hard luck stories to try and get you to allow them to operate a few days more.

Then it is coming rather slowly, but is beginning to take root, the problem of getting prospective buyers to demand that the inspector put his O. K. on a second-hand boiler before he purchases it. In 9 out of 10 cases the boiler he is to buy is not worthy of anything but junk and is cast out. If we keep after the prospective buyers we will soon have them taught a lesson and there will not be so much bringing into use boilers that only answer junk purposes.

It is also a hard matter to get Rule 817 lived up to and, after a thorough explanation to the user of the reasons why this rule should be lived up to, we are able to get them to use the appliances more often. The gage cocks are generally out of order with broken handles or wheels and a plug in the blow-off pipe line.

The fusible plug is a detriment to the boiler in the eyes of many an operator, for he is continually complaining about its leaking and does not fully comprehend its value. In many cases he removes it and screws in a gas pipe plug.

Taken as a whole, though we are gradually gaining ground in regard to the movement in safety of boilers, we cannot expect to accomplish the desired purpose in days or weeks, but must be patient and keep after the violators and those who are rather lax. If we all do our part and report the violators to the boiler inspection department heads in each state we will also gain a decided advantage for you, or I might know of someone in our vicinity whose boilers have never been inspected and never will be if someone does not inform the commission. So let us all get together and see that the Rules and laws as set forth by the different states are enforced. Inspector.

Port Dickinson, N. Y.

Causes of Barrel Sheet Failure

NOTING the story of a shell crack under the caption of "Unusual Barrel Sheet Failure" in your December issue, page 354, and the statement that no cause was known, would suggest a reasonable theory for such occurrences.

Boiler shells and seams are proportioned by rules derived from theory and practice which, no doubt, were used in this case, and the failure was likely the result of temperature stresses, set up in the sheet by lack of water circulation in the boiler.

Unless there is active circulation to pick up, mingle and distribute the incoming feed water, introduced a short distance ahead of the seam in question, its tendency is to drop to the belly of the boiler where no heat is imparted to it and relatively chill the shell at the bottom as compared with the shell farther up at the sides and over the flues. These variations of structural temperature set up stresses and strains that are accountable for much sheet and flue maintenance in locomotive boilers, as compared with watertube and other designs wherein an active water circulation more nearly equalizes or lessens the range of structural temperatures.

Chicago, Ill. C. A. Seley.

Closed Arches in Boiler Rooms

THE writer was amused not long ago in observing a photograph of the outside of a boiler room. The walls of this boiler room were so built that part of the brick work could be knocked out, leaving two arches through which to remove or insert the two boilers. The author wrote regarding these arches as follows:

"The big arch is 14 feet 6 inches wide and the small one 8 feet wide. The former is large enough to permit the passing of two 72-inch by 18-feet boilers, while the latter will accommodate one boiler of the same size. Three 150 horsepower boilers of the size mentioned are used in the power plant."

Since seeing the photograph I have been wondering why one of the arches is large and the other one small. Why are there two arches? I am reminded of the proud owner of the dog and cat who was showing his home to a visitor. In passing a wooden fence the visitor espied two holes through the fence at the bottom. He inquired, "What are the two holes for, Jim?" "For my dog and cat," explained the possessor of the animals. "The large one is for the dog and the small one is for the cat. W. G. SCHAPHORST.

Newark, N. J.

There is No Substitute for Business Ability

By William R. Basset

President of Miller, Franklin, Basset and Company, Inc., New York

SOME men have looked upon the various developments of scientific management as substitutes for old fashioned business ability, shrewdness and the trading instinct. They constitute a large part of those who claim that scientific management is a failure.

Thirty years or so ago, no one expected to succeed in business unless he was a good trader. Then along came the developments of cost accounting, production planning, time study and wage incentives. Executives began to use reports and charts. Some grasped at these new methods with an almost childish belief that they would solve all business troubles, and that systems would take the place of judgment, and make every man equally successful in business. Of course it couldn't be done. The man of natural business capacity who adopted the new methods, increased his lead. But he used systems as helps. A cost system will show the way to greater profits, a production planning system will reduce costs; but they will only do these things when they are *used* by an otherwise capable man.

The methods of scientific management are not substitutes—they are auxiliaries. They won't take the place of brains, nor will they run the business while the owner basks in Palm Beach.

A system, of itself, can't make money. It can only help the man of ability to make more money.

Repairing Defective Welds in Locomotive Boilers

NO matter how the weld was originally made all deposited metal must be cut out of a defective weld and considerably more on each side, depending upon the length of the defect and its location.

The reason for cutting out the weld on each side of the defect is to equalize the contraction stress over a length greater than that of the defect repaired. If the defective weld were only 2 inches long it would probably be advisable to chip out 4 to 6 inches on each side, thus making a total length of new weld of 10 to 14 inches.

It is advisable also to preheat the old weld several inches beyond the place to be gas-welded before starting welding. Then, as the weld metal cools, the contraction stress is distributed over the comparatively wide space.

If the attempt were made to simply cut out the defective weld and make a new gas weld, the probability is that the weld would crack in cooling. But if we have a large gas weld it will possess sufficient strength to draw the sheets while contracting in spite of the resistance of the sheet stiffness and the staybolts.

These suggestions regarding the repair of defective welds apply to both gas and electric welds which have developed defects. The defective seam must in all cases be rewelded for some distance each side of the defect, in order to make a sound, dependable job.—*American Machinist.*

NEW BOOKS

BOILER CHEMISTRY AND FEED WATER SUPPLIES. *Second edition. By J. H. Paul. Size, 5½ by 8½ inches. Pages, 252. Numerous illustrations and diagrams. London: 1923. Longmans, Green & Company.*

Although the first edition of this book was only published in 1919, interest in the subject of boiler temperature has grown so rapidly that a second edition has been found necessary. In preparing this the text has been carefully revised and certain clerical errors which unavoidably crept into the first edition have been rectified. In addition, 66 new analyses of British and other waters have been added which should increase considerably the value of the book as a work of reference, for experience has shown that these analyses have been useful and helpful to many chemists and engineers interested in the contents of waters used not only for boiler feed but also for other industrial purposes. The subject matter of the book includes chapters on the chemical compositions of earth, air and water, on acids, bases and salts, the constituents of natural waters, scales and deposits, methods of softening water, soluble salts, iron, carbonic acid, concentration of waters containing carbonate of soda, action of carbonic acid on iron, corrosion, condensed waters, the superheater, priming, external deposits, failure of clean tubes and water supplies.

DESIGN OF STEAM BOILERS AND PRESSURE VESSELS. *Second edition, revised. By George B. Haven and George W. Swett. Size, 6 by 9 inches. Pages, 435. Illustrations, 206; 2 folding diagrams of designs. New York: 1923. John Wiley & Sons, Inc., New York.*

As an introduction to the study of machine design the analysis of the stresses existing in pressure vessels such as boilers and tanks has many advantages. This book is intended primarily to teach rational methods of boiler design, while at the same time it is intended to be an introduction to a broader study of machine design. Problems of this character possess peculiar advantages as a basis for the study of design, since the definiteness of the loads in pressure vessels and the reliability of the materials usually employed in their construction are incentives to intelligent and accurate calculation. In general, results have been obtained in this work rather by rational than empirical methods, the usages of current boilermaking practice being kept constantly in view. Whenever assumptions have necessarily been made, a conservative reason has been given as their basis. In order to make the application of complicated formulæ as easy and rapid as possible, the book contains numerous plots and tabulations from which numerical results may be easily read and definitely applied. The application of the principles set forth at the opening of the book is ably illustrated in the last six chapters by working out from beginning to end complete designs for boilers and tanks of six different types. The definite program set down in these chapters is believed to be of considerable value to the boilermaking profession as well as to students. In this new edition the authors have included the logical design of a watertube boiler of the box-header type. While such designs have frequently been reached solely by experience and precedent, the authors have sought in this chapter to ascribe a sound theoretical reason for the various proportions of watertube boilers.

ELEMENTARY STEAM POWER ENGINEERING. *By Edgar MacNaughton. Size, 6 by 9 inches. Pages, 590. Illustrations, 468; tables, 44. New York: 1923. John Wiley & Sons, New York.*

This textbook presents in a clear and concise manner a discussion of the fundamental principles underlying the construction, operation, and testing of steam power plant equipment. The book is the result of the author's experiences while teaching courses in steam engineering at several engineering colleges. The arrangement of the material differs from that of other books in the same field in that an effort has been made to introduce the practical phases of the subject previous to the theoretical. This has been done by having a description of the apparatus precede the theory. The use of the more important equations is illustrated by examples and in addition a number of review questions and problems are placed at the end of each chapter. This gives the reader a ready means of testing his knowledge of the material contained in the chapter. The first chapter contains a discussion on the arrangement of the equipment used in common types of steam power plants. In succeeding chapters, the construction and theory of the various equipment are considered, and the final chapter describes briefly the equipment used in several modern steam power plants. The book naturally divides itself into two parts, the first part dealing with steam boilers and their auxiliaries, together with the underlying theory; and the second part with the various types of steam engines, steam turbines, pumps and condensers together with the underlying theory.

SELF TAUGHT MECHANICAL DRAWING AND ELEMENTARY MACHINE DESIGN. *By F. L. Sylvester. Size, 4¾ by 7⅜ inches. Pages, 345. Illustrations, 227. New York: 1923. Norman W. Henley Publishing Company.*

The demand for an elementary treatise on mechanical drawing, including the first principles of machine design and presented in such a way as to meet in particular the needs of the student whose previous theoretical knowledge is limited, has caused the author to prepare the present volume. The improvement has been to adapt these principles to the requirements of the practical mechanic and young draftsman and to present the subject in as clear and concise a manner as possible in order to make his study easy. In order to meet the demands of this class of students practically all the important elements of machine design have been dealt with and, in addition, algebraic formulas have been explained and the elements of trigonometry have been treated in a manner suited to the needs of a practical man. In its arrangement, the first section is devoted to mechanical drawing since a thorough knowledge of the principles of representing objects greatly facilitates further study of mechanical subjects. Following this, the mathematics necessary to the solution of problems in machine design are given and this section acts as a practical introduction to theoretical mechanics and strength of materials and to the various elements entering into machine design such as cams, gears, sprocket wheels, cone pulleys, bolts, screws, clutches, etc. Several important additions to the work have been made by Mr. Erik Oberg, associate editor of "Machinery" and special chapters on the technique of mechanical drawing and principles of hand lettering by C. W. Rhinehart. An outline of the contents indicates that the book is intended as a treatise comprising the first principles of geometric and mechanical drawing, workshop mathematics, mechanics, strength of materials and the design of machine tools.

TRADE PUBLICATIONS

SIDE HANDLE DRILL.—A two-page bulletin describing the new 5/16-inch capacity side handle equipped drill made by the Hisey-Wolf Machine Company, Cincinnati, O., has recently been distributed. This machine is designed with a Hisey-built universal motor and ball bearings which are on every part that rotates. The quick cable connector is also an important feature in that cable repairs and renewals can be made without dismantling the machine.

ENGINEEGING ACHIEVEMENTS.—The Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., has summarized in bulletin form its work during the year, including practically every possible field where electrical equipment is used. Investigaton and experimental work have been carried on exhaustively for the improvement of electrical products with the results as outlined in this bulletin which was primarily prepared for reprint in the trade and technical press.

REVIEW OF ELETRICAL DEVELOPMENTS.—The General Electric Company, Schenectady, N. Y., has arranged a bulletin for general publication outlining in brief the extensive development work carried on in the electrical industry during 1923 with special reference to equipment contributed by this company to the general progress. Turbine-generator improvements for power plants and marine propelling units have been made; a mercury boiler has been made practicable; great strides have occurred in the development of radio apparatus; steam railroad electrification has progressed as well as a great variety of other electrical lines improved upon.

RIVETING.—A pamphlet containing supplemental information pertaining to rivets and riveting has been issued by the S. Severance Manufacturing Company, Glassport, Pa., to be added to the data book on rivets published by the same company in 1920. This pamphlet takes up the subject of the requirements for good rivets, details of riveting the penstocks of the Niagara Falls Power Company at Niagara Falls, N. Y., a table for locating the first rivet of a gusset connection, proper oil tank riveting, special problems connected with the riveting of airships of the type of the *Shenandoah*. It also deals with the protection of air tools and with the production of pneumatic tools.

CAST IRON WELDING.—The subject of cast iron welding by the oxy-acetylene process has been dealt with at some length in a book compiled by T. C. Fetherston of the publicity department of the Linde Air Products Company, N. Y. The key note of successful cast iron welding is a complete understanding of the necessity for adequate pre-heating, proper welding practices and suitable annealing. The application of advanced methods in this work by many shops throughout the country is resulting in great savings in money, labor and time. The Linde Air Products Company offers this booklet as an evidence of its desire to give those interested in cast iron welding every facility and service in the use of its products. A great variety of cast iron welding jobs with suitable detailed descriptions and illustrations are contained in the book.

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, 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	Minnesota	Oklahoma
California	Missouri	Oregon
Delaware	New Jersey	Pennsylvania
Indiana	New York	Rhode Island
Maryland	Ohio	Utah
Michigan		Wisconsin

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

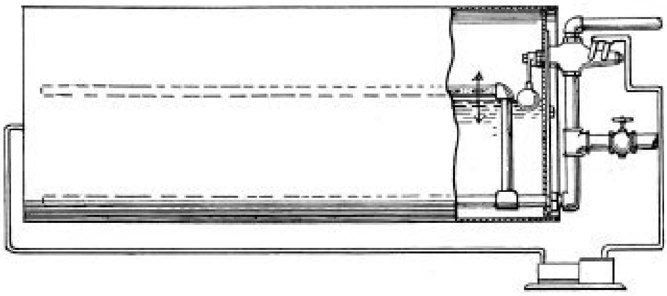
SELECTED BOILER PATENTS

Compiled by
GEORGE A. HUTCHINSON, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

1,442,581. BOILER-WASHING SYSTEM. SPENCER OTIS, OF CHICAGO, ILLINOIS.

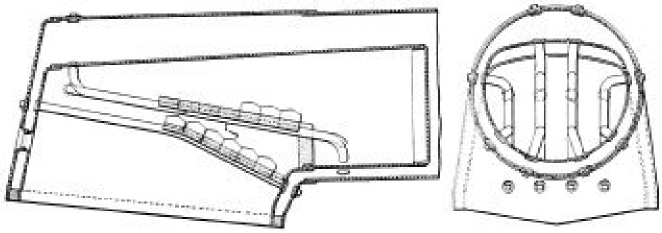
Claim 1.—In a boiler washing system, a washout tank, a washout line, a return pipe having two channels through which it returns water to the



washout tank, a temperature conditioning device introduced into one of said channels of communication, and a temperature controlled valve adapted to connect the return pipe with either of said channels of communication. Eight claims.

1,470,700. LOCOMOTIVE FIRE BOX. LE GRAND PARISH, OF MOUNTAINVIEW, NEW JERSEY, ASSIGNOR TO AMERICAN ARCH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

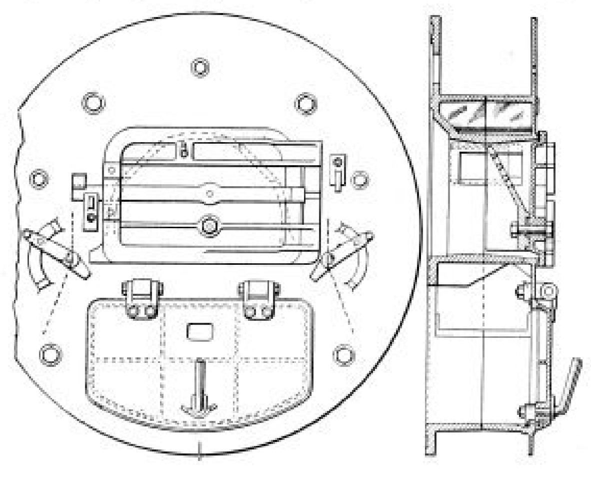
Claim.—In a barrel type locomotive fire box, the combination of two sets of upwardly and rearwardly extending arch tubes one above the other, said sets



converging rearwardly and having their forward ends substantially spaced apart, an arch carried on the upper set and an arch carried on the lower set, the lower arch having a gas circulation space extending longitudinally thereof and one extending transversely at the forward portion thereof, and said arches forming a combustion chamber in the forward portion of the fire box. Seven claims.

1,470,875. FURNACE FRONT. JOHN REID, OF LONDON, ENGLAND.

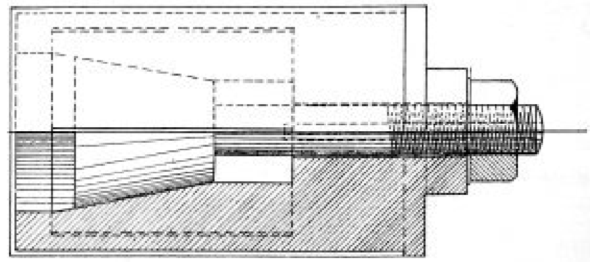
Claim.—A furnace front comprising front and back plates, intermediate ash-pit flare, fuel passage casing, air casing thereover, a removable sill, openings



between the air casing sides and the flare, pivoted valves controlling said openings, each of which valves is common to the air space between the sill and the flare and the air space within the air casing, outwardly turned extensions on the fuel passage casing projecting towards the valve pivots and means for setting said valves so as to open said air spaces to the air supply. Ten claims.

1,470,767. EMERGENCY BOILER-TUBE REPAIR PLUG. GUSTAV A. SCHAPER, OF NEW YORK, N. Y.

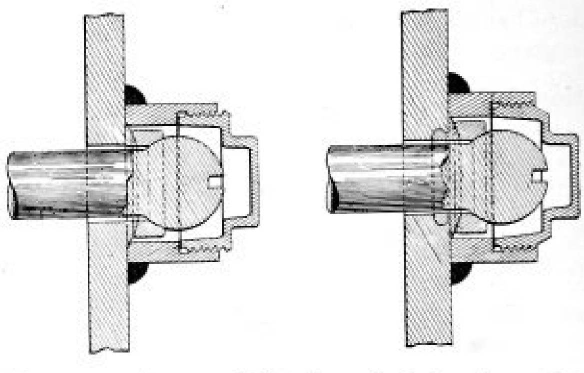
Claim.—The combination of a tube end having a hole, circular in cross section, a similarly shaped cup of soft annealed metal fitted into the hole and a plug shaped to fit inside the soft metal cup, an outwardly projecting square



shank on the plug, a screw-stem fitted onto an expanding wedge, said expanding wedge fitted to the interior of the plug, a washer on the screw-stem and bearing against the square shank of the plug and a nut on the screw-stem bearing against the square shank of the plug and a nut on the screw-stem bearing against the washer.

1,467,366. STAYBOLT STRUCTURE FOR BOILERS. JOHN ROGERS FLANNERY AND ETHAN I. DODDS, OF PITTSBURGH, PENNSYLVANIA, ASSIGNORS, BY MESNE ASSIGNMENTS, TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF DELAWARE.

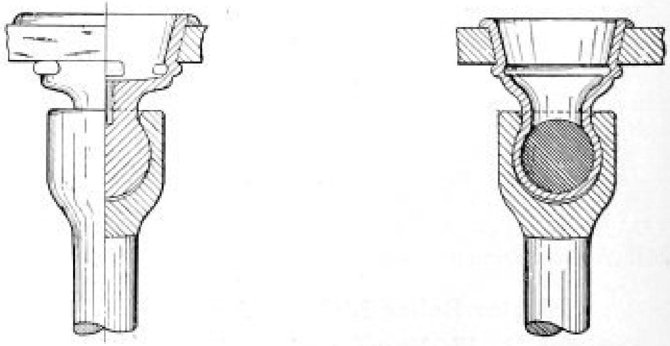
Claim 1.—In a staybolt structure, the combination with a boiler sheet having a bolt opening, and a staybolt having a rounded head, of an annular



threadless seat member mounted directly on the boiler sheet and rigidly secured thereto, a movable bearing ring for the bolt head disposed between the latter and the seat member, and means secured to the boiler sheet for enclosing the bolt head, bearing ring and seat member. Two claims.

1,469,688. STAY BOLT FOR STEAM BOILERS. ARTHUR F. PITKIN, OF SCHENECTADY, NEW YORK.

Claim.—In a stay bolt structure, the combination of a bolt, having a socketed head; and a sheet plug articulated thereto, said plug having an annular wall, on which there is formed a plurality of peripheral swells or projections, adapted to bear against the sides of a boiler sheet. Three claims.



1,459,807. STEAM BOILER. ISAAC TODD, OF BELFAST, IRELAND.

Claim.—In a steam boiler, a water circulating device comprising in combination, a pump casing, a cover for said casing, a tubular member attached, at one end, to the boiler and, at the other end, to said cover, means securing said cover to said pump casing so as to leave discharge orifices therebetween, a pipe leading from the interior of said casing to the bottom of the water space of the boiler, a pump rotatably mounted in said casing, a spindle for said pump extending through said tubular member, a steam tight joint round said spindle, and a pulley on said spindle outside the boiler, all substantially as set forth.

THE BOILER MAKER

FEBRUARY, 1924

Fig. 1.—Looking Down the Flanging Department at the Schenectady Plant of the Alco Works

Flanging Locomotive Boiler Domes in One Piece

Throat Sheets, Heads, Tube Sheets Are a Few of the 80 Other Flanged Products of the Presses at the Alco Works

AS a result of many years' experience, the American Locomotive Company has reduced the operations of flanging parts going into locomotive construction—boiler heads, throat sheets, domes, small fittings and the like—to their simplest form. At Schenectady the flanging department is located in the boiler shop and comes directly under the supervision of the general boiler foreman and his assistants, supported by an able and experienced staff of flangers.

The equipment in this department includes a main press of the hydraulic 4-post type having a capacity of 650 tons. The upper table of this press is adjustable on the posts while the lower is a power table having a capacity of about 400 tons. An upper and lower ram are also included, the upper having about 250 tons available pressure and the lower any pressure up to 400 tons. Four auxiliary rams for elevating and clamping work in position of about 20 tons pressure each are part of the lower table equipment.

A smaller hydraulic press of a similar type having a capacity of about 450 tons pressure is used for flanging lighter work and small brackets and fittings. Two oil burning furnaces, each 17 feet long and 9 feet wide complete the flanging equipment. Jib cranes and the overhead traveling cranes located in this bay of the shop are available for serving the presses.

Forming domes from a single sheet of metal and flanging plates in one heat are the specialties of this department.

Types of Dies for Forming Domes

For forming one-piece domes by means of what is practically a drawing down process, a three-piece die is employed. The die consists of an inside die and an outside and a holding die. For a given size dome two or more sizes of rings for the outside and the holding dies are used depending upon the height to which the dome is to be raised. As can be seen in Fig. 3A, the openings in the two rings used in the first operation are different. For this operation the ring with the larger opening is fastened to the top table of the press. The radius at the top of this ring opening is smaller than that at the base. On the lower table the holding die is fastened. The inside die is clamped to the ram on the lower table.

In order that the metal in the dome plate may not be reduced beyond the allowed limit or the metal stretched, which would occur if the dies held the plate rigidly while the plunger pressed out the dome, it is the practice to place

4 metal spacing blocks between the rings around their circumference to hold them at least one-quarter inch clear of the plate. Now, when the inside die comes into action and the curvature first introduced into the sheet, the edges of the plate between the rings slip, so that the process in effect becomes one of drawing the plate to the form of the dome rather than of forcing it into shape.

This drawing process is continued with the rings in their first arrangement until the limit of plate curvature and height possible with the size opening in the top ring is reached. Several heats are taken on the plate during the process so that the metal will be constantly in a state of plasticity allowing it to form without danger of distorting or cracking.

When a number of domes are required on a given locomotive order, the whole series is put through this first operation before the die rings are changed for a continuation of the drawing process.

To reduce the dome to its finished size and shape, if the dome height permits this to be accomplished with two dies, the rings are reversed—that with the smaller opening becoming the outside die and the other the holding die. Spacing blocks are again inserted between the rings to allow clearance for the drawing action as above.

As many heats are taken with the dies in this position as are necessary to keep the metal soft while it is being brought into the form of a finished dome.

When the required height of dome is reached the spacing blocks are removed and the dies pinched together against the plate while the inside die is pressed tightly against the dome to smooth out any buckles in the surface caused by the heating or working of it. If the dome height has not been reached with the use of two rings, a third and fourth ring having smaller openings are used successively, but generally the work can be done on the original two rings.

This first step in the process leaves the dome somewhat in the shape of a flat brimmed derby hat. After the body is thus formed in order to obtain the proper curvature and to make the dome conform to the radius of the boiler shell it must be put through another pressing operation. For this a set of dies is used having the required sweep of the shell as shown by Fig. 3B.

Curvature Introduced in Dome Rim

This sweeping operation is carried out exactly as the last step in forming the dome, except that the dies are arranged with the outside die fastened to the lower table of the press and the holding die to the top table. The inside die is clamped to the top ram. The partly completed dome is then heated and dropped into place on the lower of the sweep dies which is set to the correct height using the bottom table as a base plate. The plunger is then inserted, which forces the dome to the table insuring the correct height. The sweep dies are brought close together in the final sweeping operation forming the plate to the correct curvature of the boiler shell.

When the dome is taken from the press it is still at a dull red heat and, by allowing it to cool slowly, the metal is normalized or, in other words, the crystalline structure which may have been slightly changed by heating or working the metal, is reduced to practically its original condition.

The whole success of this method of forming one-piece domes depends upon the care with which the gradual drawing action is controlled and by not attempting to bring the plate down to its required shape and size too rapidly. The heat too must always be maintained in the metal so that it is more or less plastic. If too great a stress is set up at any point in the process, the plate is in danger of being reduced at points of contact with the inside die, below the allowed limit of thickness and, if carried on too rapidly, it is liable to crack at these points of maximum strength.

As noted above, it may be necessary in the case of higher domes to use more than two rings, each ring as it is used as an outside die having a somewhat smaller diameter than that previously employed. The number of drawing operations carried out with the aid of each diameter ring is limited to the height which can be obtained without introducing undue stress into the metal. When this limit is reached a ring of smaller diameter is used as the outside die.

Plate Thickness Reduced in Process

It is interesting to note the dimensions of the dome through the various steps of the drawing process and, for an example, we will take into consideration a dome which is to have a finished inside diameter of 33 inches and a height of about 20 inches. In a completed dome of this size the length of the neutral axis taken through the cross section of the plate would be about 85 inches but it has been found by experience that a plate having a diameter of 72 inches when it is first laid out will draw out to this increased length.

When being prepared for forming, a plate which is 1⅛ inches thick for this size dome has a 1¾-inch hole drilled in its center. This hole serves for purposes of handling on the cranes and also to relieve the pressure of gas which is formed between the inside die and dome head while the plate is being drawn on the press. In the first operation of drawing, the top ring has an opening of 45 inches and the dome is raised to a height of about 15 inches in several heats. The bottom ring with an opening of 40 inches then becomes the top ring or outside die and the dome is brought to its height of 20 inches. In this case a third ring of about 35¾ inches in diameter is necessary to bring the dome down to its finished size which is to be 33 inches inside diameter.

A study of the cross section of the finished dome shows the metal in the flat top to be above its limit of 11/16 inch while that in the body is in no place less than ¾ inch. At the radius between the top and body the minimum allowed is ½ inch. The ¾-inch hole in the top has been enlarged in the process to nearly 5 inches.

No definite rules exist for the size plate and thickness of plate that will be required for given size domes. It has been necessary to experiment very extensively on domes of all sizes and thicknesses to determine what the possibilities are in each case. The results of these tests have been tabulated so that it is possible for the design department and flanging department to estimate very accurately what the dimensions should be and how the material should be cut to obtain the dome or casing required.

Drawing Processes Used on Other Boiler Parts

Similar methods of drawing metal are used on a number of boiler and locomotive parts other than the domes—sand domes, cylinder heads, steam chest casings, dome casings and the like are all formed in one piece. These casings may take a round or rectangular form and must be finished absolutely smooth and free from irregularities which is extremely difficult with the light metal used.

The dome is practically the only one of these parts that requires more than one heat, for the majority of them are made of light metal—casings for example being only ⅛-inch thick. These casings are brought down to size and shape in the usual way and then completed with a final pressing operation that removes all buckles or irregularities that might have formed in the process.

Flanging Throat Sheets

The special feature of throat sheet flanging at the American Locomotive Works is that the process is carried out in a single heat. For throat sheets, a 4-piece die is employed consisting of a male die, a female die, a plunger and a tie clamp.

In preparing the press for its operation on the throat, the female die is fastened to the lower table, the plunger to the top ram and the male die and tie clamp bolted up to the top table. The plate is laid out and cut to the required

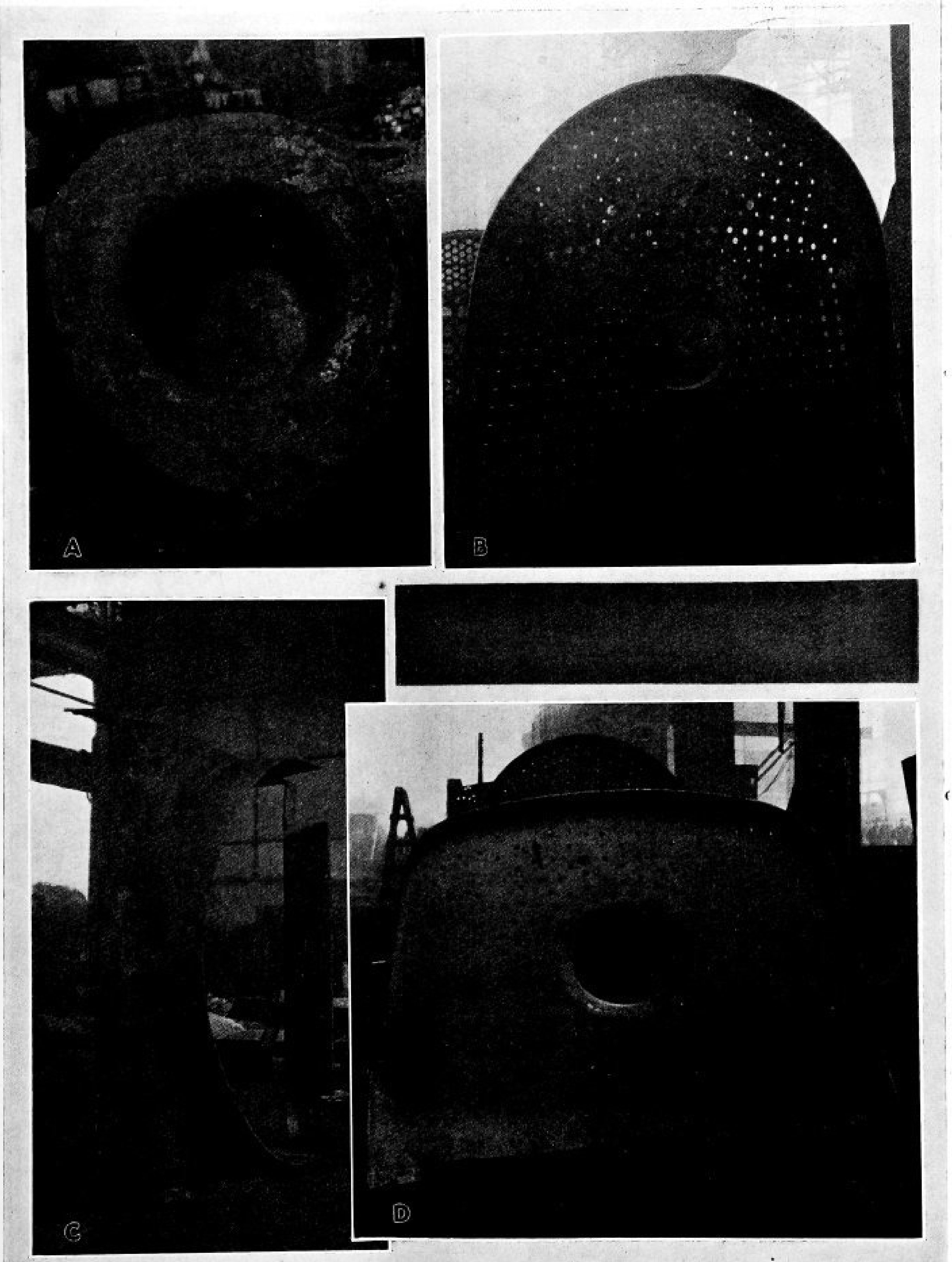


Fig. 2.—"A" Looking Into a Dome Flanged in One Piece; "B," Backhead Connected to Mud Ring; "C," Throat Sheet After Coming from Press With Tie Piece Still in Place; "D," Firebox Door Sheet for a Mallet Boiler

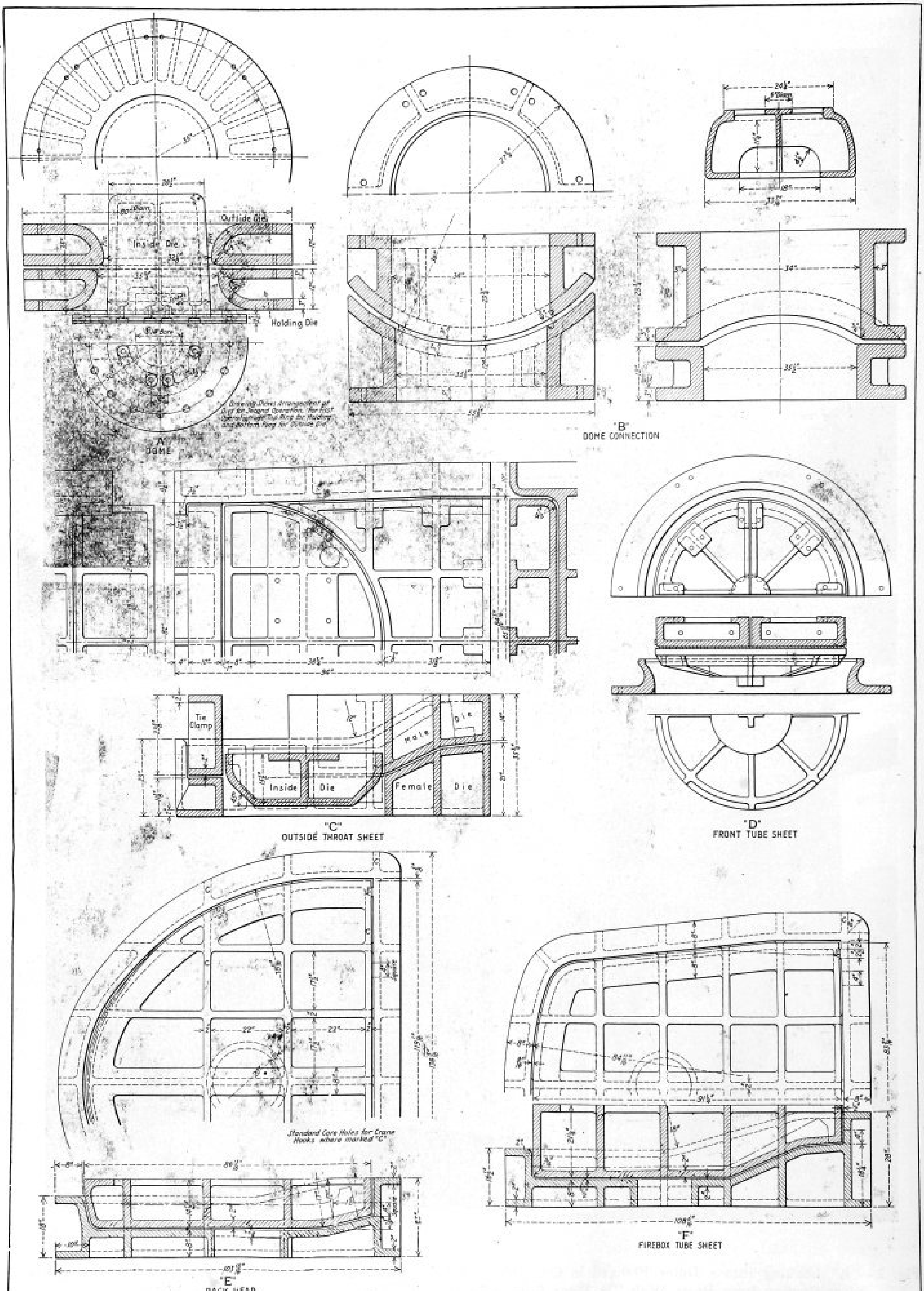


Fig. 3.—Dies Used in Various Flanging Operations

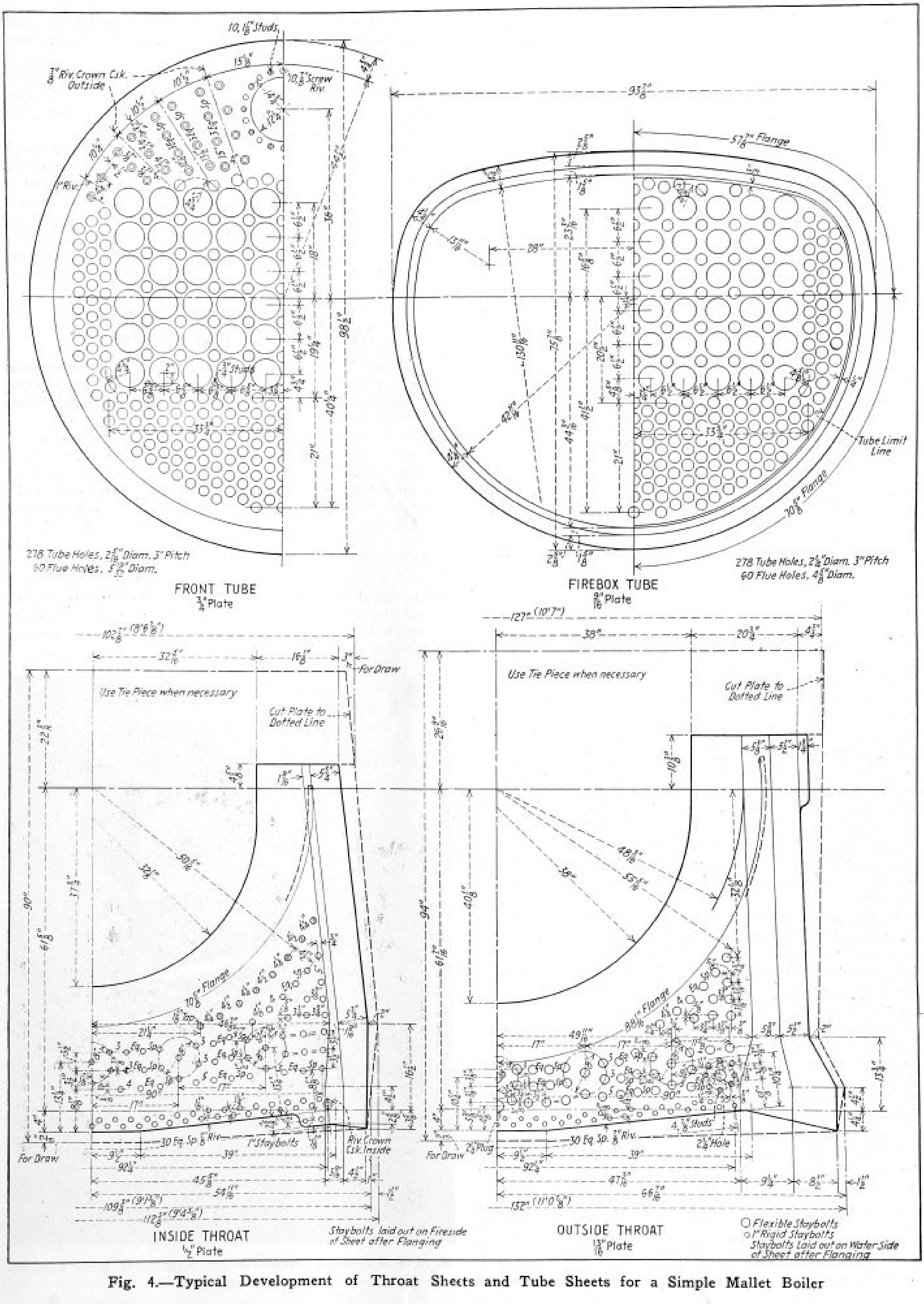


Fig. 4.—Typical Development of Throat Sheets and Tube Sheets for a Simple Mallet Boiler

size, excess material being left across the top of the throat wings to act as a tie piece in the flanging. The developed throat sheet of a simple Mallet locomotive is shown in Fig. 4, the tie piece being indicated by dotted lines.

After the dies have been lined up on the press, the developed throat sheet is laid out on the die to check up the dimensions. It is then heated and placed on the die in line with the marks previously made in checking the plate ready for the flanging operation. The back and side flanges are then formed by bringing the male and female dies and tie clamp together on the plate. This operation serves to hold the plate in place ready for forming the throat or front flange. Following this the plunger is forced through turning the front flange. At the same time, the lip of the tie plate is also flanged. A throat sheet as it appears when coming from the press with the tie plate still in place is shown in Fig. 2C.

After the throat sheet is removed from the press it is placed in the furnace for heating, then taken to a surface block where it is hammer dressed and straightened ready for fitting up.

After this operation, it is allowed to cool slowly so that the metal becomes normalized. The throat dies which are rough castings are given a clearance of one-quarter inch at all points to compensate for any slight movement in the sheet while it is being formed. Undue stress in the metal at flange corners of small radius is to a great extent avoided by this clearance.

In the accompanying illustrations a series of dies for numerous one-heat flanging operations are shown. In the shop about 80 distinct parts going into fabrication of a locomotive are worked on the press—the greater number of course being small brackets and fittings but all requiring special dies and a certain technique and skill in their forming that has been highly developed by the flanging gang.

Work of the Design and Drafting Departments in Connection with Flanging

While speaking of the practical shop work of flanging it is also necessary to mention the design and drafting departments which are wholly responsible for the high state of development of the flanging methods practiced. As in all work of this plant, the complete flanging process is brought to perfection on paper—dies are designed with correct clearances and of the proper shape before any attempt is made in the shop to carry out the work. Plates also are completely developed for all boiler and other work in the drafting department which includes a laying out section. Incidentally, the complete boiler layout process followed at this plant will soon be published in a series of articles in The Boiler Maker.

Flanging operations on other sheets going into the construction of the boiler are carried out in one heat in much the same way as the throat sheet work. The front tube sheet, for example, is flanged with the inside die fastened to the top table and with the holding die on the bottom. These dies are shown in Fig. 3D. The sheet is laid across the outside die and the inside die fastened to the top ram used to press it down through the outside die until it is shaped against the holding die. The smokebox front and doors are flanged by the same methods. In the case of the smokebox front the bottom ram to which the inside die is fastened goes into action after the front is pressed to shape to turn the small flange around the door opening.

The back head, the firebox door sheet and the door hole flanges are formed similarly in one heat. The back head dies are shown in Fig. 3E. The combustion chamber and firebox tube sheets are flanged in the same way as the front tube sheet.

Standardization a Feature of Process

The above outline indicates the general procedure followed in making what are actual standardized flanged parts, since all parts made from the same dies are completely interchangeable. The advantages of time saving and accuracy in turning out the flanged sheets and fittings on an extensive locomotive order are quite evident, not to mention the finer workmanship and appearance of parts done on the press as contrasted with hand methods.

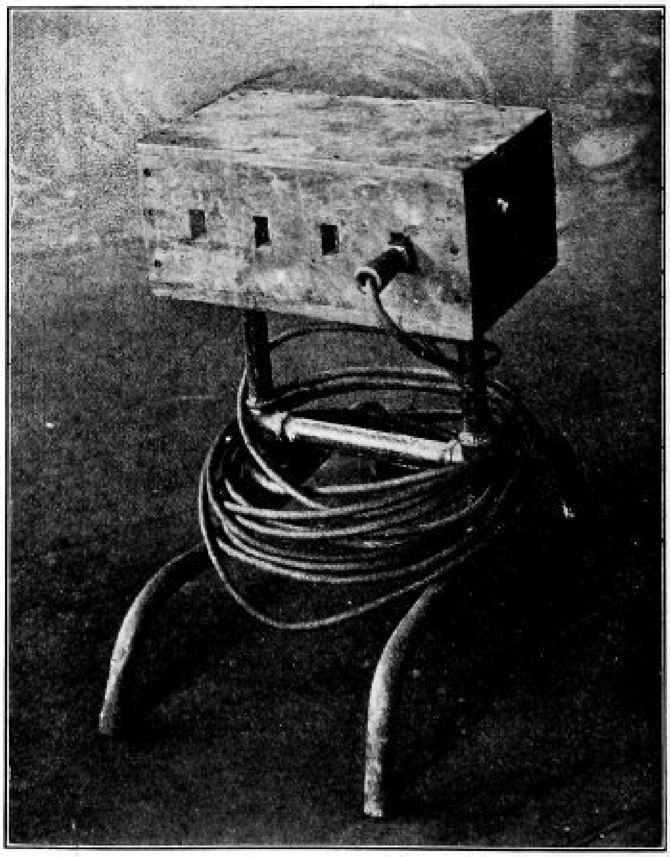
From the standpoint of the railroad repair shop this standardization is of vital importance since in a case of need any of these parts can be taken from one boiler and placed in another without previous fitting up being necessary. Where a number of locomotives of the same type and power are being operated, the railroads can to advantage maintain a stock or replacement sheets that are already flanged and immediately available for installation to replace a defective or burned out sheet.

Multiple Extension Outlet

The multiple extension outlet shown in the illustration is particularly suited for use in locomotive erecting shops. A number of them are in use in the Union Pacific shops.

The device consists simply of a rectangular wooden box mounted on a standard or frame made of 1-inch pipe. There are ten small rectangular holes cut in the box, four on each side and one on each end, and behind each hole is placed a special receptacle. All of the ten receptacles are connected in multiple. A piece of two-conductor reinforced cord with a plug at either end completes the outfit.

At times there are six or eight men at work on a locomotive, each of whom wants to use a portable extension light. It is not practicable to have that many extension outlets at each locomotive location and where all of the outlets are at an end of the locomotive on a column or post it is necessary to have long extension cords.



Multiple Extension Outlet Which Will Serve Nine Portable Extensions

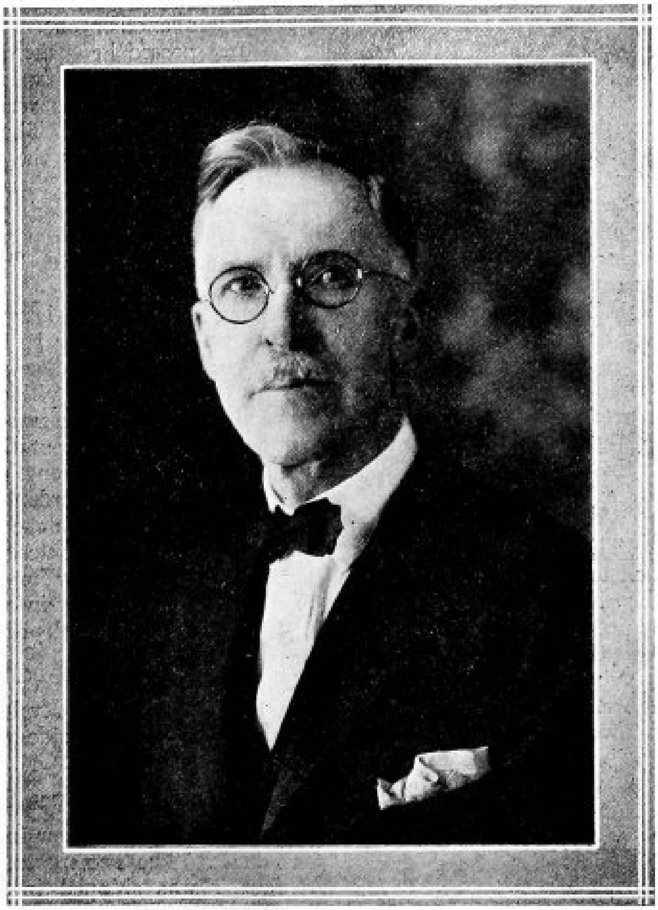
Fifty Years in a Boiler Shop

By J. A. Anderson

When a man has served 50 years in any trade or profession and has followed it through as Mr. Anderson has the trade of boiler making from the days of the crudest of machinery and materials, he is certainly entitled to receive the congratulations of his associates and friends. The story of Mr. Anderson's experiences from his apprentice days when his boss kept tools in a hollow stump to the completion of his thirty years as boiler foreman with the Industrial Works, holds much that is instructive to the younger generation of boiler makers and is of real personal interest to the many friends he has among the "old-timers" of the trade.—The Editors.

In the year 1873, or fifty years ago, the writer, a small boy then, might have been seen entering a low frame building from which was issuing much noise—the rap-rap of the riveting hammers as they were being yielded by the old-time riveting gang; then there was the more deliberate noise of the chippers and calkers, interspersed by the frequent boom of the sledge, as the husky men pounded the iron plates, rounding them up for oil stills.

This small boiler shop was located in the small Canadian town of Petrolia, in the center of the oil fields. This boy was looking for a job and he got one heating rivets. The proprietor of this boiler shop had been sent frequently, a few years before, from a large Canadian city to make repairs on the boilers in this territory, and seeing that there was an opportunity for a man who knew the boiler making business, he located in this town.



J. A. Anderson

His first equipment consisted of a screw punch, a ratchet for drilling, a riveting hammer, a chipping hammer, chisels and calking tools and several tube expanders. His first shop was a hollow stump where he stored the tools for safe keeping. At first all the boiler repairs were made at the oil wells. The water used in the boilers was bad, causing much tube trouble and corrosion of the sheets. In time the business increased so that this boiler maker rented a small frame building, in which he installed an alligator punch and shear, a drill press, a flange fire and several rivet forges. The flange fire and rivet forges were served with the old-fashioned bellows.

This was the shop into which the writer went to serve his apprenticeship to the trade of boiler making.

In the early days of distilling and refining oil, a company had been formed which imported several cast iron oil stills from the "Old Country." They were nothing more than large kettles with a goose neck at the top to carry the vaporized oil to the condenser, but the Canadian oil was so much heavier than the shale oil, that those stills were a failure as a money-making venture. After a time iron boiler plate was used for oil stills. These sheets were small and it took many of them to make even a small still.

The year before the writer went into this shop, some one had conceived the idea of making a large still and so one was constructed. It consisted of a large body, perhaps twenty feet in diameter; the sides were about ten feet high with a conical top and a large flue in the center extending from the flat bottom up through the conical top. The still was set on a brick foundation with many firing openings around the outer wall, all leading to the central flue.

The still was completed and filled with crude oil. The fires were started and the trouble began. The unequal expansion caused first the calking to leak and, of course, it leaked oil into the fire, which caused greater heat and greater expansion. Then the rivets in places gave way and some of the sheets ruptured, the result being that a great fire burned a day and a night, until all of the oil was consumed and the "big still," as it was called, was rendered a mass of buckled and twisted plate.

The Youngster Has His Chance

The foregoing facts are recorded as an introduction to this story, because it was the destruction of this oil still which gave this boiler shop the work which called for an addition to the working force, among whom was the new rivet heater.

The "big still" had been built by an outside concern, but the cutting apart of the distorted sheets, straightening and cutting to sizes, from which were constructed smaller oil stills, was done by the local boiler shop.

One of the first jobs other than heating rivets that this apprentice had to do was to gag the punch press for the operator who was punching the plates. The plates were laid out quite different then from the way they are laid out at the present time. Having determined the length and the width wanted—a multiple of the rivet pitch—a wooden strip would be bored with holes the size and the pitch of the rivet holes; this would be laid upon the plate and a round marker, dipped from time to time in a white lead mixture, would be used, leaving a round white mark wherever a rivet hole was to be punched. After this was done, a chalk line would be used to strike a line from end to end and from side to side of the plate—not in the center of the marks but at the outer side.

The punches were made without center guide, that is, they were flat on the end, so that the punch operator had to move the plate from point to point marked for the rivet holes, always seeing to it that each hole was punched to the chalk mark. The boy gagging the punch press stood up at the side of the head and watched the operator as he nodded his head when ready to punch a hole and then inserted the gag which was counterbalanced by a weight which removed it when the punch went through the plate.

Great Skill Developed by Punch Operator

To the shop operator of today this seems a slow way of punching plates, but considerable speed was made because the punch operator became so expert and he was given such good cooperation by the gang, that for some distance he would give the signal to keep the gagger in and he would punch hole after hole, moving the plate from mark to mark with almost the precision of a spacing table.

For some time after the writer went to work in this boiler shop, only oil refining work and boiler repairs were done, that is, up to that time new boilers had not been built.

The boilers used at the oil wells and the first oil refineries were of the portable firebox type, of comparatively small horsepower and low steam pressure (50 to 60 pounds). As before stated, the water was bad, heavy with salt deposit which caused no end of trouble in the boiler.

Boiler Work in the Oil Field

First would be the leaky tubes. The boiler makers would be sent out to this and that oil well to expand and bead the tubes. The only tube expander then in use in that shop was a sectional or prosser type. And let it be said in passing that it was then and is still a good tool and is doing some of the best work today in keeping tubes tight.

But this was not a permanent cure, for the trouble would occur again and more tube work would have to be done and after a time the tubes would have to be removed and cleaned. This was before tube welding was done to any great extent, in fact, none of it was done at this time in this shop; so in order to use the tubes again in the same boiler, the rivets were cut out of the so-called back head corresponding to the front head of a locomotive boiler. This head was driven into the barrel of the boiler about two inches and new rivet holes cut. The writer has often seen such boilers with four and five rows plugged up around the barrel, showing just how many times the tubes had been removed.

The scale was removed from the tubes by hammering and then scraping with half round files ground to a sharp edge. One man was kept busy going from oil well to oil well doing this work.

After cleaning they were annealed and cut to length while red hot with an ordinary buck saw—of course, they were iron tubes.

Patching Fireboxes

Other boiler repairs made in the early days of this boiler shop's history, were soft patches in the firebox and other parts of the boiler, on account of fire cracks and corrosion. This work was all done in the field. It was a new country, the roads were poor so that the boiler makers had much traveling to do on foot, back and forth to the oil wells, carrying tools and patches with them. The apprentice boys were sent along with them to help carry and to assist in any way possible.

"Holding the Light" a Regular Job for the Apprentice

"Holding the light" was one of the jobs for the boy in those days, for it was before the days of electric light, and the candle was used when the days grew short and darkness set in. And so the apprentice of those days had a close-up view of the way the work was done.

The proprietor of this boiler shop insisted upon good workmanship on all jobs, either on new oil stills or repairs to old boilers, and he was just as proud of making a good workman, as he became in later years of making a good boiler. "Any hand and any hammer" was one of his slogans to the apprentice boy, and "use your eyes more than your mouth" was another one.

As time passed he gathered around him a force of first-class workmen. The character of the work done soon became known and as the years passed the building of new boilers was undertaken. They were of the multitubular stationary type, as well as the portable firebox boiler. Many of the stationary boilers then in use were the two-flue boilers, but this type was being replaced by the multitubular boilers, and some of the repair work done by this boiler shop, was to change the two-flue boilers into those of multitubular type.

Having by this time learned at least part of the boiler making trade, the writer had been sent out more than once with a couple of new boiler heads, braces and a set of tubes to some distant town or village to take down the brick work supporting one of those two-flue boilers; roll it out of its bed onto timbers, cut out the old heads and large flues, cut the shell to proper length, put in the new heads, braces and tubes, in other words, change the type of boiler entirely. This being all done in the field, as well as many other jobs of like character, gave the young boiler makers the experience necessary to gain self-confidence. Thrown upon their own resources in a distant town or country places in the days before the telephone, it was up to them to find a way to make good.

The work was always interesting, with a growing business in a new and quickly developing territory. New work in the shop and much outside work of every description, kept everyone busy.

Tank Cars Come into Use

As the oil business grew in production, more oil refineries were built. The transportation of oil became a problem. At first it was shipped in barrels, but so great was the volume of business it soon became apparent that some other way must be found. The Grand Trunk Railway was one of the first to make a move in this direction. They made a contract with this boiler shop to build a number of oil tanks, small in diameter, the length of a railroad car. Those tanks were mounted on trucks and were known as tank cars.

This work was all done by hand. The riveting gangs had to be multiplied in order to get this order out on time. All the joints were chipped by hand and calked also.

The sheets in those days were of small dimensions as compared with the sizes to be had today, and this, of course, added materially to the labor when contracts of any size were taken.

Soon after this job was finished, a steam riveter was installed. It was a two cylinder hammer; one piston would clamp the sheets while the other would drive the rivets. While this riveter was being installed, some of the boiler makers thought that their days of usefulness would be over in that shop when "Johnny Bull" got busy, but strange to say, it was only another means of securing more work and so more men were needed.

The First Methods of Tube Safe Ending

Another thing which was attempted and which proved successful, was the safe ending and welding of boiler tubes, done in a crude way but nevertheless a success. The old-fashioned blacksmith forge served with the bellows was used, and an upper and lower swage to round the tubes and a steel mandrel to weld them upon, made up the equipment. This method was followed for years and thousands of tubes were welded every year.

As the years passed one by one this boiler shop continued to prosper. Saw-mills were built in the surrounding country, for there was much timber. Stave and hoop mills were also built. And then not far from this town salt was discovered. The pumping of the brine and the manufacture of salt began, all calling upon the boiler maker for boilers, tanks and salt pans.

About the time that the writer had worked in this shop fifteen years, the proprietor entered the marine field and several marine boilers were built. He also undertook the rebuilding of locomotive boilers, all of which added to the experience of the men employed in this shop.

The original small frame building had been enlarged. About the time of the building of the first marine boiler, this shop was destroyed by fire. A new location was secured and a brick boiler shop was built in the shape of a "T," with each part 50 by 100 feet.

We now had a good shop but the same tools and with the exception of the riveting, which could be done on the steam riveter, all work was done by hand.

At this time engine building was added to the boiler making business. The engines were the straight-line type used in deep well drilling.

Three more years passed. The writer had now come to his eighteenth year of service in this shop. From the small beginning of the tools in the hollow stump, this man, who was the sole owner, purchasing agent, sales agent, manager, foreman, layer-out, treasurer, and filling all other titles necessary to carry on a business, had continued to extend this business, until the product of this shop was being shipped to Australia, India, Africa and the Isles of the Sea. For many years all of the plates used in this boiler shop came from the "Old Country." The best brands were Lowmore and Donald. It was good material, standing the abuse of flanging, fully as well as the steel of the present day.

About the time that this shop was at its best, prospecting parties were being sent out from Great Britain to foreign countries to test for oil and other deposits in the earth's surface. This required men of experience in deep well boring and drilling, and so England looked to her colony, Canada, for such men and found them in Petrolia. They also learned of the Stevenson Boiler Works, manufacturers of steam boilers and engines for this work. So it came to pass that we were receiving boiler plate from England, manufacturing it into boilers and shipping those boilers to the far eastern countries by the way of England. This was done for several years.

Experience with the Wickes Boiler Company

In 1891, the business changed hands. The proprietor under whom the writer learned the trade, grew to manhood and served in several capacities for eighteen years; went to Australia to superintend a business which he and some friends had founded a year or two before. The writer quit the job and came to the United States, securing a job with the Wickes Boiler Company of Saginaw. It was just after this boiler shop had been built and equipped for heavy boiler work; that is, it was so considered thirty-two years ago. Much work was being done by hand—the chipping and calking and much of the riveting was done in the old way. It was during the two years' service of the writer in this boiler shop, that compressed air tools were installed. The flanging which had been done by maul and man-power, was soon after done by the flanging machine.

The increasing boiler pressure demanded and greater horsepower called for heavy machinery to form the heavy boiler sheets, and so began, as we all know, an era of progress in boiler making.

Industrial Works a New Field of Endeavor

After two years with the Wickes Brothers of Saginaw, the writer became foreman of the boiler shop, a department of the Industrial Works of Bay City, Mich. This was in the spring of 1893, or thirty years ago. It is of interest to note that it was in the year 1873 that the Industrial Works was founded, or in the same year that the writer began his apprenticeship to the boiler making trade.

Twenty years had passed with all the slow improvements in boiler making. The steel plate had come in larger sheets than the iron ones of bygone days. In some shops improved machinery had been installed, such as the hydraulic riveting machine, pneumatic tools of various kinds, but improvements of this kind had not been put into the boiler shop of the Industrial Works at this time.

The writer entered the employ of this company as boiler shop foreman about the time when they were developing the locomotive and wrecking cranes. Their business had been of a general kind, much similar to the Canadian shop mentioned above, but now they were specializing on cranes, so again the writer was to have an opportunity of beginning at the bottom and working up in a new industry.

As he stood upon this threshold, what was there in his experience of the past which would fit him for this new position with this new and growing industry? First, he had learned the trade under a good teacher, one who stood for strict honesty in all his dealings with his customers and his men. Second, he had been encouraged to study the principles of drafting for boiler and structural work. Third, he had had the actual experience of doing the work, all the work of boiler making, laying-out, punching, flanging, fitting-up, riveting, calking, tubing of all types of steam boilers.

While this was his first job as foreman of a boiler shop, yet his experience of twenty years working with men and the experience of much field work entrusted to him during those years would help him in this new position. He had worked with men; he also was a man and would he remember the different make-ups of men; did he know their strong points as well as their weak ones; did he know what team work was? Surely he had had the experience; could be put it into practice? The future was before him, what would be the results?

Thirty years ago boiler making in many shops was being done in a crude way compared with the present day methods. The riveting in this shop was done with the snap and flogging hammer. The chipping and calking was done with the hand hammer. The boiler makers were earning their bread by the sweat of their brow.

Great Strides in Boiler Making

Gradually improvements were made. New flange blocks were among the first. The boilers were the vertical type with the O. G. type of firebox, and the upper combustion chamber in the shape of the frustum of a cone. The flanging of the firebox and combustion chamber had been done in the open fire without flange blocks. With the new flange blocks the work could be done much faster and with less fatigue to the flange turner.

The first boilers were of small diameter—42 inches—and of low pressure—85 pounds. They were about 9 feet high and yet four sheets were used to make the shell.

As the years passed on, boilers of greater steam pressure and larger diameter were built. New and modern machinery was added to the equipment. Pneumatic tools have taken the place of the hand hammer. New boiler laws have been made, calling for the scientific building of steam boilers, eliminating to a great extent the disastrous boiler explosions with their loss of life and property damage.

In looking back fifty years in boiler making, what great strides forward have been made in the business! From the days of common and special iron, we have the high grade steel plate. From the crude and clumsy machines, we have modern equipment—electrically and hydraulically driven. Instead of the laborious hand work of riveting, chipping and calking, we have the pneumatic tools; and instead of the tallow candle, we have the electric light. And all of this in a period of fifty years.

Laying Out the Plates for Storage Tanks

Calculations for a Rectangular Plate Tank—Method Applied to a Cone Type Roof

By R. L. Phelps

I RECALL several instances where readers of THE BOILER MAKER have requested information as to a method for laying out individually the sketch plates of tops and bottoms of large storage tanks; however, I have never seen what I considered a complete and satisfactory procedure suggested in answer to the inquiries. The antiquated method of bolting a quarter or half bottom together in order to strike the circular rivet line from the center with a tape line involves too much wasted labor and is unknown in up-to-date contract shops. I have endeavored to outline in the following article the procedure commonly followed for detailing such sketch plates so as to permit individual layouts.

In most cases the drafting room relieves the layer out of this work and furnishes him with complete detailed drawings; however, the method of making such layouts is a good thing for any layer out to understand and for this purpose I submit it for the information of all those who are interested in the study of their trades. The necessary aids to performing the calculations involved are a table of logarithms and a table of log sines and log cosines—also the ability to use the same.

RECTANGULAR PLATE TANK

An an illustration I have used a tank bottom having a 49-foot 9-inch diameter rivet circle and made up of rectangular plates 72 inches by 120 inches (between rivet lines) arranged as shown in Fig. 1.

The first step is to calculate (Fig. 1) the lengths of the lines $O\text{-}H_2$, $a\text{-}V_1$, $b\text{-}V_2$, $c\text{-}V_3$, etc. It is known that in the case of any line such as $O\text{-}H_2$ intersecting the circumference at O and perpendicular to the diameter $H_1\text{-}H_3$, the proportion exists:

$$\frac{H_1\text{-}H_2}{O\text{-}H_2} = \frac{O\text{-}H_2}{H_2\text{-}H_3} \text{ or } O\text{-}H_2^2 = H_1\text{-}H_2 \times H_2\text{-}H_3$$

$$\text{then } O\text{-}H_2 = \sqrt{H_1\text{-}H_2 \times H_2\text{-}H_3}$$

substituting:

$$O\text{-}H_2 = \sqrt{29 \text{ feet } 10\tfrac{1}{2} \text{ inches} \times 19 \text{ feet } 10\tfrac{1}{2} \text{ inches}} = 24 \text{ feet } 4\ 13/32 \text{ inches}$$

In the same way we find that

$$a - V_1 = \sqrt{9 \text{ feet } 10\tfrac{1}{2} \text{ inches} \times 39 \text{ feet } 10\tfrac{1}{2} \text{ inches}} = 13 \text{ feet } 4 \text{ inches, etc.}$$

Next we will decide on the number of rivet spaces to be used in the circumference of the tank: in this case 936, or 234 to the quarter. Convenient factors of 234 are 18 and 13; therefore a quarter circle is constructed (Fig. 2) and divided into 18 spaces each of which represents 13 rivet spaces. Obviously each of these 18 spaces subtends a central angle of 1/18 × 90 degrees or 5 degrees, and we proceed with our calculations as follows:

Length *V*-1 or the horizontal distance of point 1 from the vertical center line = radius × cosine 5 degrees,

or 24 feet 10½ inches × 0.9962 = 24 feet 9 11/32 inches.

Similarly

V-2 = 24 feet 10½ inches × *cosine* 10 degrees = 24 feet 5 31/32 inches

V-3 = 24 feet 10½ inches × *cosine* 15 degrees = 24 feet 0 5/16 inches, etc.

Length *H*-1 or the vertical distance of point 1 from the horizontal center line = Radius × sine 5 degrees

or 24 feet 10½ inches × 0.0872 = 2 feet 2 1/32 inches.

Similarly

H-2 = 24 feet 10½ inches × *sine* 10 degrees = 4 feet 3 27/32 inches

H-3 = 24 feet 10½ inches × *sine* 15 degrees = 6 feet 5¼ inches, etc.

It will be necessary to make these computations for only half of the quadrant as it is obvious that *V*-9 = *H*-9, *V*-10 = *H*-8, *V*-11 = *H*-7, etc., and we simply transpose the dimensions.

DEVELOPING PLATES

The sketch plates may now be detailed as shown in Fig. 3. It is seen that the points *b* and *c* (Fig. 1) and 5, 6 and 7 (Fig. 2) determine the curved rivet line of sketch plate "*S*" and we have only to subtract from the dimensions *V*-5, *V*-6, *H*-5, etc., the lengths of the intervening rectangular plates. From the data indicated in Fig. 3 it is a simple matter to make the actual layout; having located the circumferential points on the plate, the rivet arc is drawn through them by means of a sweep or curved template previously prepared and the spaces subdivided with dividers.

For a cone roof which is made up in the same way of rectangular plates (Figs. 4 and 5) first ascertain the generating radius "*X*" of the roof as follows:

$$X = \sqrt{\frac{49 \text{ feet } 6 \text{ inches}^2}{2} + 3 \text{ feet } 0 \text{ inches}^2} = 24 \text{ feet } 11\ 3/16 \text{ inches}$$

To find the number of degrees in the stretch-out of a cone we use the formula $C = \frac{180\,D}{X}$

where C = central angle,

D = diameter of cone,

X = generating radius or slant height of cone.

In the case of our roof

$$C = \frac{180 \times 49 \text{ feet } 6 \text{ inches}}{24 \text{ feet } 11\ 3/16 \text{ inches}} = 357 \text{ degrees, 22 minutes, 30 seconds}$$

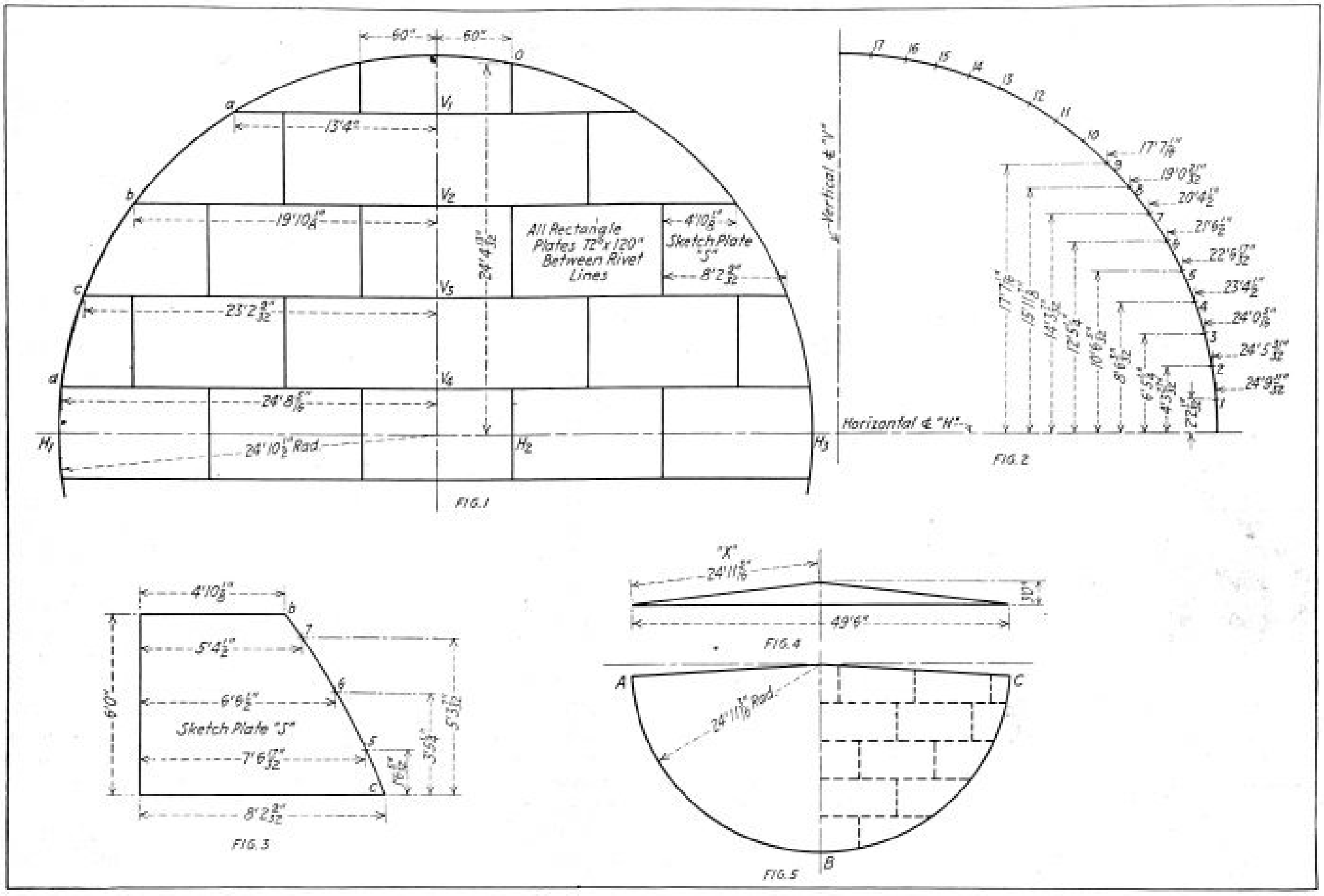


Plate Development for a Storage Tank

and the half stretch-out of the roof indicated in Fig. 5 will subtend a central angle of 178 degrees, 41 minutes, 15 seconds. The arc *A-B* of the quarter stretch-out may now be divided into a convenient number of equal spaces and detailed exactly as the bottom was. Due to dealing with an uneven number of degrees and fractions thereof the computations will be a little more tedious and care should be observed to insure accuracy.

If the work be correctly done every hole will be fair to the thirty-second part of an inch and after the layer-out or draftsman becomes familiar with the procedure an entire tank bottom can be detailed in a surprisingly short time.

Cost Figures That Will Help You to Sell

By William R. Basset

President of Miller, Franklin, Basset & Company, Inc., New York

EVERY manufacturer realizes that when his plant operates at less than capacity, the cost of his product rises. He cannot, however, raise prices to correspond with the costs. Rather, he lowers prices so as to get more work into the plant and by enabling him to spread the overhead expense over more product to reduce his costs. In this way he attempts to get back the cost of labor and material plus a part of the overhead that goes on whether the plant is busy or not.

Usually the shading of prices for this purpose is done by guess work without a cost system properly designed for the purpose; if so the prices may be cut to an extent that makes the loss greater than it would be if the plant were shut down.

Informative figures can be obtained without an unduly complicated cost system. It simply requires that a normal figure for each item of expense in a department be determined based upon the normal activity of that department.

Each month the normal and actual figures are compared. Those items which fluctuate with the activity of the plant are in one group and those which do not are in another.

Knowing accurately the labor and material cost of the product it is then possible to accurately determine what the result on profits will be if a given amount of business is taken at a given price. Unless you have such a method of forecasting costs, your cost system is of doubtful value as a guide in setting selling prices, for business is seldom exactly normal. Actual cost figures must therefore be aided by a knowledge of normals and abnormals.

Locomotive Production

THE Department of Commerce announces January shipments of railroad locomotives from the principal manufacturing plants, based on reports received from the individual establishments.

The following table compares the January, 1924, figures with the previous month and with the corresponding month of 1923, as well as cumulative totals of seven months ending January, 1924, compared with the corresponding period ending January, 1923, in number of locomotives:

	January, 1924	December, 1923	January, 1923	July to January, 1924	July to January, 1923
Shipments:					
Domestic	147	305	217	1,800	1,053
Foreign	4	24	12	135	88
Total	151	329	229	1,935	1,141
Unfilled orders (end of month):					
Domestic	344	365	1,699	....	....
Foreign	32	22	89	....	....
Total	376	387	1,700	....	....

Boiler Inspecting in Austria

Requirements for Becoming Inspectors —Life in Vienna and in the Tyrol

By George Cecil

THE Austrian boiler inspector has never been too well burdened with the good things of the earth. Before the war his economies certainly enabled him to put by a little something every month, while he managed to live more or less in comfort. But Fritz was wont to deplore that he had not embraced a more remunerative calling, one which yielded an income really worth having. And this, perhaps, is why the present generation of young boiler inspectors is principally recruited from families which have no traditional connection with the important and honorable calling. For when, upon hostilities ceasing, things were adjusted, few among those who presented themselves before the State examiners could advance an hereditary claim. Nor, for that matter, were some of the young aspirants particularly well equipped. War service had interfered with their studies; under ordinary conditions they would relentlessly have been turned down. The department, however, was under-staffed, and the minister for machinery could not afford to pick and choose. Fortunately, the Austrian is an intelligent fellow and quick to learn, with the result that practically all the newcomers have justified their nomination. They may at first have blundered into passing worn plates as sound, besides erring in other directions. Not, however, for long—practice has made them perfect.

Pay is Small

The pay and allowances scarcely are generous, rigid economy being insisted upon in the matter of traveling. Where Fritz once was allowed to hire a carriage, he now must walk the Government having no money to throw away. The boiler inspector is expected when on tour to put up in the cheapest inn and to order none but the simplest food, such as *gulash,* a stew consisting of beefsteak cooked in mustard, the filling dish having been imported from the neighboring Hungary. After a few mouthfuls the diner's appetite is satisfied, owing perhaps to the superfluity of mustard.

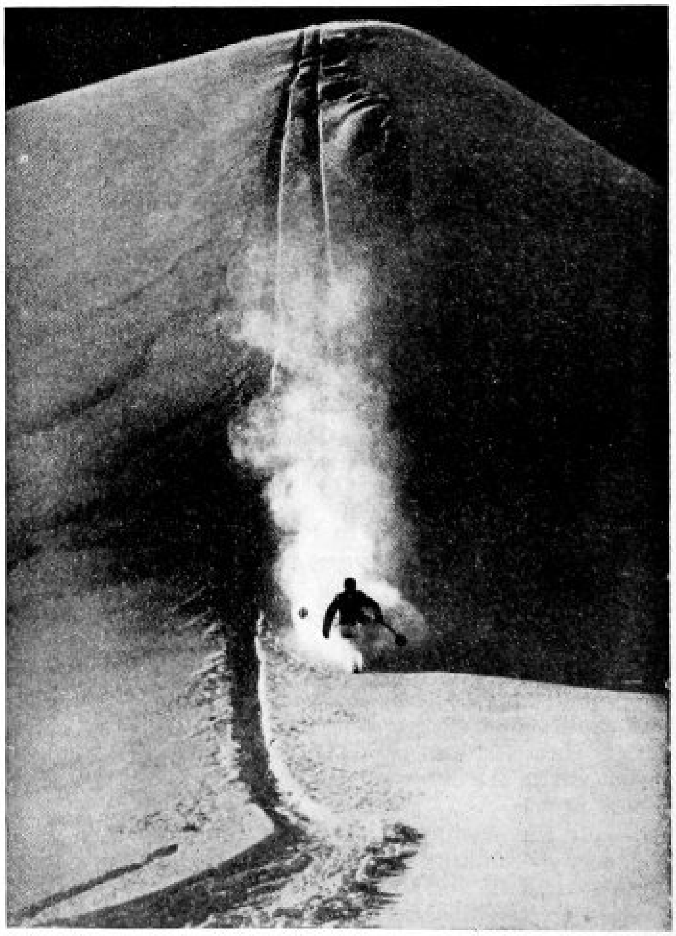
No longer does the subsistence allowance run to the excellent light wine of the country, beer taking its place. In the happy days of not so very long ago Fritz lived like a fighting-cock on the ration allowance and, with the balance, bought a present for his wife, or for himself. Now-a-days there is nothing left over. If at the end of the month the boiler inspector has paid his way, he is thankful, particularly as the State, while granting little more than a bare living wage, frowns upon all *employes* who find themselves in debt. Charged with extravagant habits, they are hauled before the head of the department and severely dressed down. A second offence may result in Fritz having to seek other employment, which, owing to the overcrowded condition of the labor market, is excessively hard to find. 'Tis almost safer to pass a defective boiler than to owe money.

Still, the boiler inspector is not too badly off. As a bachelor Fritz at least can live on the emoluments of the post, if the luxuries of life are mostly denied him; and he who marries sees to it that his wife brings him a dowry. Indeed, nothing will induce the average unattached man to wed unless there is money in the business. Though gallant by nature, he is as cautious as the most canny Scotchman when it comes to embarking on so very speculative a thing as matrimony. And not a bad combination either.

The Ideal Post

'Tis the dream of many boiler inspectors to be stationed in Vienna, the gay and extremely attractive capital. They like, upon the day's work being over, to *bummel* (stroll) in the *Graben,* a symmetrically curved street, where one-half of the populace exchanges the time of day with the other half. To flatten his nose against the super-alluring shop-windows affords Fritz exquisite delight, while to sip a modest glass of beer in one of the many snug *Graben* cafés is the height of bliss. A millionaire food profiteer could not extract more pleasure from his palatial surroundings. And, if funds run to it, an evening at the *Volksoper* (popular opera-house) is the acme of enjoyment, particularly as the average boiler-inspector is an excellent judge of singing, and, perhaps, no mean performer.

But Vienna, is so expensive a city that the man with a lean purse cannot afford to live there but must content him-



Steep Ski-ing in the Austrian Tyrol

self with one of the smaller towns, where "the wind is tempered to the shorn lamb." Nor is the economist greatly to be pitied, for life is anything but dull in the provinces. He may dance to his heart's content and, the women of Austria being the best waltzers in the whole world, an unsatisfactory partner is a rarity. Opera companies from time to time rent the local theatre; the cinema has penetrated the most recondite spots; famous actors and actresses do not disdain the country towns, and music-hall performers of note follow their example. No end of gaiety for light-hearted Fritz, though it means patronizing a cheap seat.

Life in the Mountain Regions

The older men prefer to find themselves in the Austrian Tyrol, where the rarefied air from the mountains, descending, in a diluted form, to their valley homes, keeps them healthy and happy. Nor are these people too badly off, for, if meat is dear, they are able to live partly on the vegetable and fruit produce of the *chalet* garden.

A boiler inspector with a taste for gardening experiences no difficulty in growing all the potatoes, cabbages, spinach, plums, apples and pears that are required for the kitchen. On a Sunday he takes his gun; and the odds are that venison will be the principal dish at supper for several days to come. His wife is a first-rate *haus-frau* with a positive genius for shopping in a favorable market. The children also contribute to the larder, being set to catch fish.

Nor do clothes greatly trouble Fritz, especially in the provinces. His coat, buttoning up to the neck, makes a tie superfluous; the pantaloons, being loose, are subjected to little wear; and the material, a sort of corduroy, lasts for years. When on inspection duty the *Herr Inspektor* sports a very ancient suit which is specially kept for such occasions. It is the Methusaleh of his limited wardrobe.

Racial Hatred

On the Italian border there is so much racial hatred between the two countries, and especially since the war, that it is not always easy to keep the peace; the Austrian boiler inspector and the Italian engineers who have found their way across the frontier simply cannot agree. They are forever hurting each other's feelings, and, the "Dago" being quite ready to assert his rights at the point of the *stiletto,* bloodshed may follow a dispute. There also is the language difficulty, for nothing will induce an Italian to learn Fritz's puzzling tongue, while the boiler inspector refuses to master a word of the dulcet *lingua toscana* in which Antonio expresses himself so dramatically. Consequently, when Fritz informs the Italian user of steam machinery that the boiler, which is hopelessly beyond repair, must be replaced by a new one, Antonio merely regards him with a vacant stare. Some weeks later, the boiler inspector, paying a second visit to the factory, again is confronted by the venerable ruin—and trouble follows. In rare instances an interpreter is employed, it being his business to carefully translate the dignified remarks of Fritz and the impassioned eloquence of Antonio. Unfortunately, the man of learning seldom is infallible, the examination to which he is subjected (by the Austrian educational authorities) being rather a haphazard affair. But the interpreter sometimes is a diplomatist, and smoothes away difficulties.

When post-war appointments to the department were made, several candidates who are more Italian than Austrian found themselves borne on the strength. If not bi-lingual in the fullest sense of the word, they at least understand the drift of a mill-manager's voluble explanation as to why he has not obeyed orders. The man of mixed nationality is equally capable of excusing himself to the authorities for having passed a boiler which should by rights have been condemned. Despite these linguistic advantages he is not held in esteem; the Minister of Machinery, looking upon him as an Italian, resents his presence and is only too glad of an opportunity to dispense with his services. Let the Austrianized borderer make a blunder, or display a lack of energy, and a vacancy occurs.

The semi-alien boiler inspector often is regarded by the suspicious Republic as a spy, particularly if he speaks *la lingua toscana* better than he does the vernacular of the department which pays him to be loyal to Austria. Branded as a suspect, the unhappy fellow is quickly sent packing, a full-blooded Austrian filling the appointment. Short is his shrift.

Temptation

Should Fritz be stationed at Trieste, countless steamer boilers have his attention, while duty also calls him to the shipbuilding yards, of which there are several. Railway shops and factories necessitate the boiler inspector's presence from one end of the country to the other, as also do the river steamers and coal mines. At the last-named, the boiler connected with the engine operating the pit-head cage sometimes is in a parlous state. If an accident occurs, the Government, moved to righteous wrath, comes down upon the department, and the chances are that Fritz—blamed for having allowed the boiler to be used—is dismissed with ignominy. Vainly does he protest that at the last periodical inspection all was well; that had there been anything wrong with the boiler his searching examination would have revealed the defect. The ingenious defence scarcely is honored with a hearing; the boiler inspector is thrown upon a hard, cold world. Lucky the man who escapes prosecution and imprisonment.

Occasionally the proprietor of a boiler which should be condemned endeavors to propitiate Fritz. Wine and cigars are brought out in his honor, a roll of notes being slyly pushed across the table. A certain *Herr Inspektor,* who recently was tempted, pocketed the money and handed it, with a report of the affair, to his superior. He was acclaimed in the Government official *Gazette* and promoted, it being argued that so marked an instance of honesty and circumspection merited the reward of virtue. The other party to the transaction is languishing in jail.

Although a percentage of Austrian machinery users will go to any length to avoid the expense of a new boiler, they distinctly are in a minority. The pains and penalties for endangering human life are severe, and few dare risk them. All dread fine and imprisonment.

Welding Schools Given Valuable Assistance in Perfecting Instruction

THE work of the educational committee of the Gas Products Association, with headquarters at 140 S. Dearborn street, Chicago, Illinois, takes the form of a general movement to render personal service to principals of welding schools and welding instructors, through the medium of representatives and service men in the territories served by the various schools.

The committee has adopted a schedule of instruction which covers the knowledge and skill to be acquired by the student welder to make him a satisfactory apprentice at this trade. The association recommends a definite amount of instruction to be given in the school, and offers assistance in arranging courses to cover the amount of ground indicated. In cases where the stipulated amount of instruction is given, the name of the school will be placed on an accredited list.

Every effort will be made to decrease the cost of instruction in accredited schools by supplying apparatus and gas at the lowest possible figure; to provide desirable positions for graduates from these schools through the recommendation of representatives who are in touch with the needs of employers and to secure students for these schools by solicitation, and by advertising. The cooperation given to welding schools is not limited to those on the accredited list of the association, although in the case of such schools, extra effort is made to help maintain the standard of instruction at the highest possible level.

The committee is prepared to render personal service in all cases where it is requested. By means of special bulletins, the committee will furnish all schools which desire such service, with information and suggestions on the conduct of a training course, and act as a clearing house for ideas which will be helpful in this work.

A Million Calls for Information on Foreign Trade

A RECORD of nearly a million requests for assistance for American firms engaged in foreign trade is announced in the annual report of Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce. This figure for 1922-23 is just double that for 1921-22, the previous high record. This striking increase in the demands for services from the government trade promoting bureau indicates impressively the growing appreciation of the importance of foreign sales in maintaining American prosperity and in relieving the possible depressive influence of surplus farm products and manufactures, the report says:

"International trade is characterized now as never before by extreme fluidity and swift readjustment," Director Klein declares, "violent exchange fluctuations, shifts in consumptive capacity and standards of living, sudden upsets of trade balances, dislocations of old trade routes, restrictive commercial legislation and taxes—all these are now entailing confusing changes of vital concern to the American manufacturer and farmer having increasing surpluses to sell abroad. These growing complexities must be followed and studied if American merchants and producers are to compete successfully with their foreign rivals."

The maintenance of a fact-finding organization comparable to this bureau would be financially impossible for any private corporation, whereas the government agency, because of the exceptional collaboration it enjoys with foreign officials, American trade organizations and journals, and large numbers of exporters and manufacturers, has been able to handle trade inquiries and problems at an average cost to the tax-payer of about $2 per assignment or case. Against this average $2 outlay, the director enumerates a long list of specific export transactions effected through the bureau's facilities by individual firms, ranging in value from $6,000 up to $750,000.

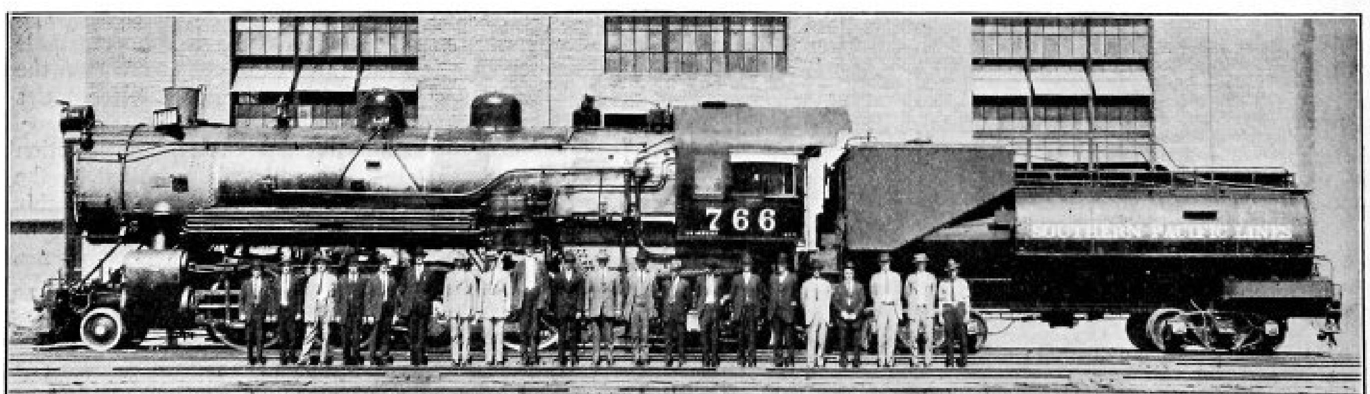
The American trade and news press, according to Director Klein, deserves much credit for the success of this unusual achievement in government service. Through the cordial cooperation of leading dailies and trade periodicals throughout the country the Department of Commerce has placed information regarding specific sales openings and trade opportunities before a weekly audience of not less than 7,500,000.

Strengthening of the Commerce Department's foreign offices, material improvement in its thirty-five "service stations" throughout the United States, the expansion and speeding up of its statistical work, the addition of new experts for its commodity and technical divisions and the enlargement of its domestic commerce promotion service are mentioned by Director Klein as features in the program of the Department for the coming year. "The ability of the bureau to take an effective part in recent crises in the coal industry and in transportation, because it had on its commodity staff highly qualified experts in those lines, has been convincing proof that experts equally well qualified in other commodities can render unique service in the distribution field and will not in any way duplicate or overlap the activities of any other organizations, public or private," Dr. Klein declares in support of his discussion of plans for the enlargement and improvement of the staff of the bureau.

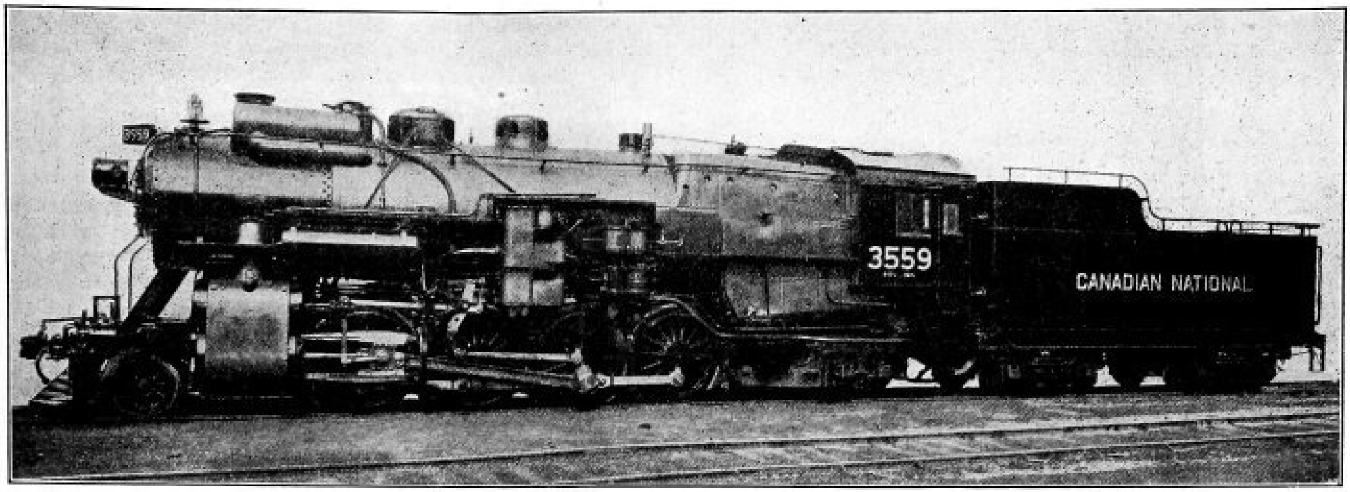
Class "Two" Repairs Completed in Nine Days

A NEW record for class 2 locomotive repairs was established last fall at the El Paso, Texas, shops of the Atlantic System of the Southern Pacific Company. This job involved the general overhaul of one of the Mikado type locomotives and was accomplished in nine 8-hour working days. The engine went into the shop at 7 a. m. on September 15 to have a new firebox and flues and to overhaul the machinery generally, including the turning of all tires or their replacement.

The job was completed and the engine approved for service at 4 p. m., September 25, making a total of 11 days in which period there were two Sundays when no work was done on the engine. The total time taken was thus 72 working hours. As far as known, this is the speediest repair of this type ever accomplished in the whole country, and the credit is entirely due to the men in the shops, nearly everyone of whom was engaged in a greater or lesser capacity on the work.



Mikado Locomotive Given Class 2 Repairs, Including a New Firebox, New Flues and General Machinery Repairs in 72 Working Hours at the El Paso Shops of the Southern Pacific. Master Mechanic W. Bleick and His Staff in the Foreground



Canadian National 2-8-2 Type Locomotive with Belpaire Firebox

Canadian National Mikado Type Locomotive

Belpaire Fireboxes and Extended Side Sheets Reduce Troubles from Bad Water in Western Canada

By C. E. Brooks*

WHEN considering the type and design of locomotive to proceed with for handling the increasing traffic of the Western Region, the motive power officers of the Canadian National decided on a Mikado type with a Belpaire boiler as this type of boiler permitted of greater heating surface and steam space. Forty-five of these engines have recently been completed, 35 at the Montreal Locomotive Works and 10 at the Canadian Locomotive Company, Kingston. The locomotives without the booster are classified on the road as S-2-a and are numbered from 3525 to 3559 inclusive. The locomotives with the booster are classified as S-2-b and numbered from 3560 to 3569 inclusive.

A large number of the details used in the construction of these locomotives are also common to the previous orders of Mikados and many of the details are common to all Canadian National modern power. The ten engines built at Kingston are identical with those built at Montreal, except for the few changes made necessary on account of the application of the booster to these engines.

The Boiler and Accessories

The boiler is designed with a Belpaire firebox and extended wagon top and conical bottom barrel, the first course being 78 inches and the largest course 90 inches in outside diameter. The firebox proper is 108⅛ inches by 84¼ inches inside and the combustion chamber is 22½ inches long. The boiler horsepower in percent of cylinder horsepower is 96 percent.

There are 240, 2-inch tubes and 40, 5⅜-inch flues, 18 feet 0 inches long; the flues are electrically welded into the back tube sheet according to Canadian National standard practice.

The railway company's standard method of crown staying has been carried out on these boilers.

The fireboxes are provided with what is known as extruded side sheets. This form of side sheet is being developed on the Canadian National in an effort to overcome troubles due to bad water. With the ordinary flat side sheet, any hammering of the staybolts has a tendency to open up the sheet around the thread of the stay until eventually nothing but the bat head of the stay is holding the sheet. The extruded sheet referred to is so arranged that any hammering of the stays will close the sheet in onto the thread.

These locomotives have been equipped with Duplex stokers and the feedwater supply to the boiler is by means of a Worthington feedwater heater and pump on the left side and that on the right is supplied by a Hancock type E. A. inspirator equipped with 3,500-gallon tubes.

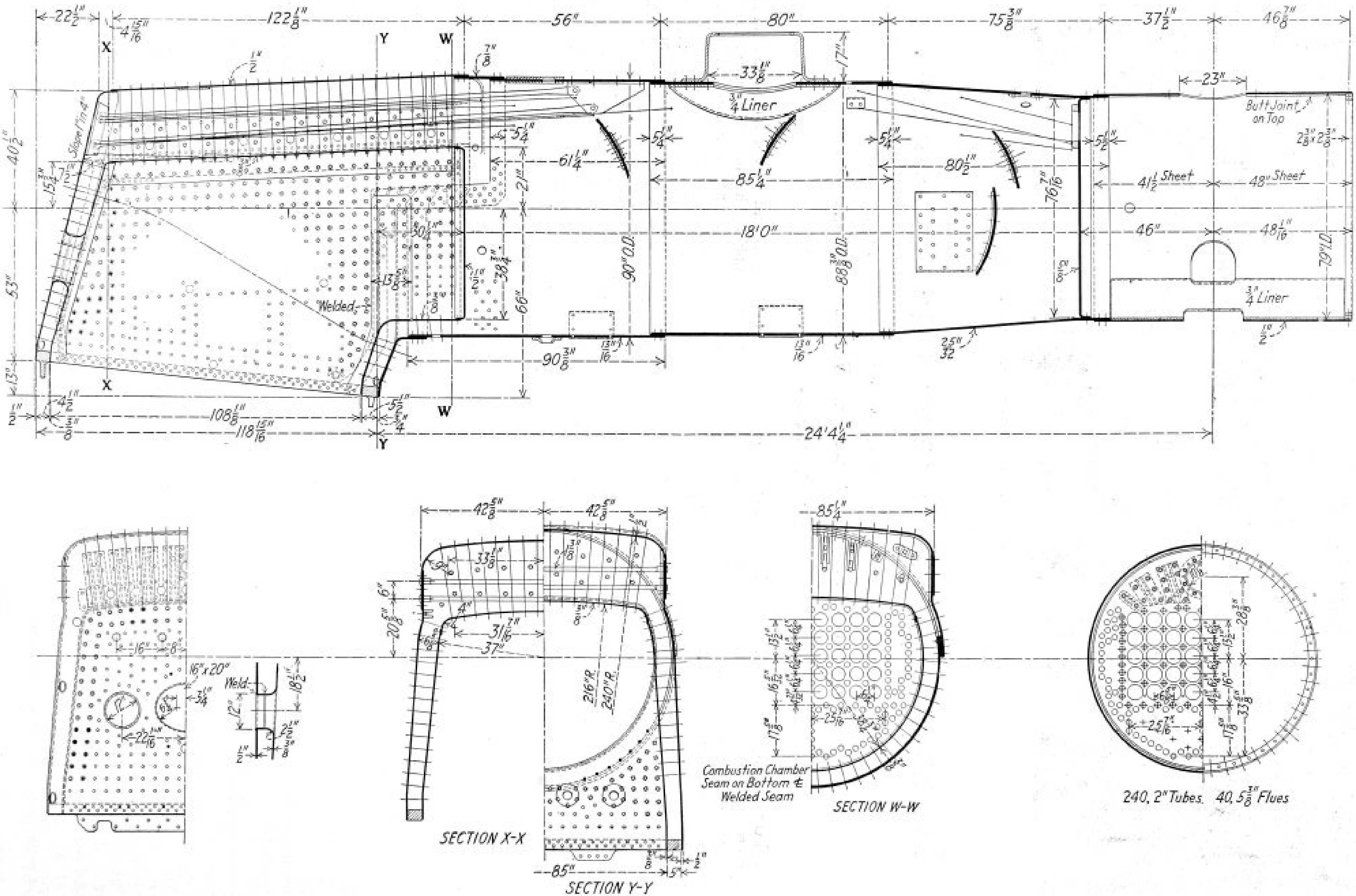
The grates are of Canadian National standard design, the rocking grate bars being of alloy cast steel with detachable lugs. They are operated by Franklin power grate shakers. The ash pans are the Canadian National standard hopper type, the location of the hinges being such that the doors close of their own weight. It was feared that on account of the flatness of the ash pan, owing to the application of the Delta trailing truck frame in connection with the booster, that the grates would be liable to burn out quickly and, in order to overcome this possibility, an auxiliary hopper has been placed on each side of the ash pan, outside of the trailing truck frame. These auxiliary hoppers greatly facilitate the cleaning of the pan and prevent the collection of cinders on the coping.

The ash pans are also equipped with a sludge ejector which consists of a 1¼-inch pipe from the delivery pipe of the inspirator to the ash pans, with a branch extending into each hopper and a valve operated from the cab. The arrangement is specially valuable as it permits the direction of hot water into the pans to thaw them out when the locomotives arrive at a terminal in freezing weather with the pans partly filled.

The superheater, which has 885 square feet of heating surface is the type A supplied by the Superheater Company and is equipped with forged return bends.

The smoke stack is the railway company's standard three-piece type, the center piece forming the base and fitted to the smokebox, extending down into it. The stack proper and the stack extension fit inside and butt together in the base extension, thus forming protection from the impinging action of

*Chief of motive power, Canadian National Railways.



Canadian National Mikado Locomotive Boiler of the Extended Wagon Top and Conical Bottom Type with Belpaire Firebox the exhaust for the center piece, which constitutes the part that must be fitted to the smokebox.

The cab is of the railway company's standard short vestibule type and has many unique features. This type of cab makes it possible to have almost all the short stays in the sides of the firebox out clear of the cab. The few that remain inside are of the F. B. C. flexible type. The cab is securely riveted to the boiler with a 3-inch by 4-inch angle iron around the whole front of the cab and on the boiler and, in order to take care of expansion, the cab brackets are provided with a groove permitting the cab to slide on the cradle casting.

The tank is of the water-bottom type of Canadian National standard design and construction, somewhat modified for the application of the Duplex mechanical stoker. The tank has a water capacity of 8,300 Imperial gallons (10,000 U. S. gallons) and a coal capacity of 12 tons.

The sand box is fitted with Hanlon sanders; World type safety valves are used, three in number, one muffled and two plain. These engines are fitted with Shoemaker firedoors.

The accompanying data table is for the locomotives to which a booster was not applied. The addition of the booster brought the total weight of the engine up to 322,450 pounds and increased the total tractive force to 65,000 pounds.

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

Railroad	Canadian National
Type of locomotive	2-8-2
Service	Freight—Western region
Cylinders, diameter and stroke	27 in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	6½ in.
Outside lap	1 in.
Exhaust clearance	0 in.
Lead in full gear	⅛ in.
Weights in working order:	
On drivers	227,600 lb.
On front truck	29,500 lb.
On trailing truck	57,700 lb.
Total engine	314,800 lb.
Tender	185,100 lb.
Wheel bases:	
Driving	16 ft. 6 in.
Rigid	16 ft. 6 in.
Total engine	35 ft. 9 in.
Total engine and tender	68 ft. 10 in.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	36 in.
Trailing truck	43 in.
Journals, diameter and length:	
Driving, main	11 in. by 13 in.
Driving, others	10½ in. by 12 in.
Front truck	6 in. by 12 in.
Trailing truck	9 in. by 14 in.
Boiler:	
Type	Belpaire, Ext. wagon top
Steam pressure	185 lb.
Fuel, kind and B. t. u.	Bituminous coal
Diameter, first ring, inside	76 7/16 in.
Firebox, length and width	108⅛ in. by 84¼ in.
Height mud ring to crown sheet, back	87 in.
Height mud ring to crown sheet, front	68¾ in.
Arch tubes, number and diameter	4—3 in.
Combustion chamber, length	22½ in.
Tubes, number and diameter	240—2 in.
Flues, number and diameter	40—5⅜ in.
Length over tube sheets	18 ft. 0 in.
Grate area	63.26 sq. ft.
Heat surfaces:	
Firebox and comb. chamber	268 sq. ft.
Arch tubes	26 sq. ft.
Tubes	2,249 sq. ft.
Flues	1,008 sq. ft.
Total evaporative	3,551 sq. ft.
Superheating	885 sq. ft.
Comb. evaporative and superheating	4,436 sq. ft.
Tender:	
Style	Water bottom
Water capacity	8,300 Imp. gal.—10,000 U. S. gal.
Fuel capacity	12 tons
General data estimated:	
Rated tractive force, 85 percent	54,600 lb.
Cylinder horsepower (Cole)	2,427 hp.
Boiler horsepower (Cole) (est.)	2,322 hp.
Speed at 1,000 ft. piston speed	37.5 m. p. h.
Steam required per hour	50,480 lb.
Boiler evaporative capacity per hour	48,300 lb.
Coal required per hour, total	7,890 lb.
Coal rate per sq. ft. grate per hour	123.8 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, percent	72.3
Weight on drivers ÷ tractive force	4.16
Total weight engine ÷ cylinder hp	129.7
Total weight engine ÷ boiler hp	135.5
Total weight engine ÷ comb. heat. surface	71.0
Boiler proportions:	
Boiler hp. ÷ cylinder hp., percent	95.7
Comb. heat. surface ÷ cylinder hp	1.83
Tractive force ÷ comb. heat. surface	12.31
Tractive force × dia. drivers ÷ comb. heat. surface	775
Cylinder hp. ÷ grate area	38.1
Firebox heat. surface ÷ grate area	4.55
Firebox heat. surface, percent of evap. heat. surface	8.28
Superheat. surface, percent of evap. heat. surface	24.92

Safety in Gas Welding and Cutting*

Precautions To Be Observed in Handling Oxygen and Acetylene Cylinders and in Operating Acetylene Generators

By H. S. Smith†

THE record of the oxyacetylene industry is a wonderfully good one, and the number of accidents that occur is really infinitesimal when one takes the time to consider the exceedingly rapid growth of the process and the enormous extent to which it is now employed. I do not think it is possible today to cite a single industry in which some of the ramifications of oxy-acetylene welding are not employed.

Before you can use oxy-acetylene welding you have to purchase equipment, and in order to safeguard yourself right at the start your purchasing agent should specify acetylene generators, blow pipes, regulators and other apparatus in strict conformance with such types as are officially recognized and approved in the list of inspected mechanical appliances published by the Underwriters' Laboratories in Chicago. Likewise, when he is purchasing supplies of oxy-acetylene in cylinders he should call for the gases to be supplied in cylinders that are manufactured according to the specifications of the Interstate Commerce Commission and that are marked as signifying that they so comply. Instructions supplied by the manufacturers of acetylene generators and other equipment to be installed should be followed very closely.

*Paper read at the joint safety conference of the Engineering Section National Safety Council and American Society of Safety Engineers, New York, January 22.

†Union Carbide and Carbon Corporation, New York City.

CALCIUM CARBIDE NOT A FIRE HAZARD

Calcium carbide does not constitute a fire hazard, but when brought in contact with water acetylene is generated and acetylene is an inflammable gas. Therefore, calcium carbide should be stored only in dry and well ventilated places. It should be appreciated that no matter whether calcium carbide is stored in a separate building or in a acetylene generator house, the location should only be illuminated with incandescent electric lights, which should be properly guarded so as to prevent the globes from being broken by accident; all switches should be located outside the building as should other spark-emitting devices, including the telephone. In cases where calcium carbide is stored in large quantities, and a separate building or compartment is used for this purpose, it is desirable, where feasible, to have the floor level with the floors of cars and trucks.

Storage of Oxygen and Acetylene Cylinders

In the matter of storage of cylinders of compressed oxygen and compressed acetylene: It is bad practice to have these stored and located indiscriminately around the premises. Where compressed gases are used you will naturally have to have a cylinder of oxygen and a cylinder of acetylene at each point where the welding work is being carried on, but cylinders on hand in excess of those in actual use should be properly and methodically stored. Acetylene cylinders when being loaded for storage should be handled carefully. In the case of carbide, it is desirable, where possible, that the warehouse in which the acetylene is to be stored, to have the floor level with the car and truck floors, but this is only possible in establishments having their own car siding.

Location of Acetylene Generator

There is one of three things to do with the acetylene generator—it can be housed in a separate building, away from other buildings; it can be housed in the lean-to building or shed adjoining the plant, or it can be installed inside one of the plant buildings. A separate isolated gas house is the ideal method, especially so if you go to the expense of having a substantial structure with floors at truck floor level and divide the building into three or four compartments, using one section for housing the acetylene generators, one or two sections for the housing of calcium carbide and acetylene cylinders and another section for the storage of oxygen cylinders.

Be sure to see that the generator stands on a substantial and firm foundation. I have known of cases where generators were put up on a flimsy foundation, which was later undermined by the water discharged from the generator and, as a result, the generators canted over and broke off certain piping connections, causing serious trouble.

Freezing of Generators

A generator room must be protected from freezing. This is most important. Freezing up of acetylene generators is the cause of fifty percent of the accidents that have happened with them. Generator houses should be provided with plenty of daylight illumination and plenty of head room. It must necessarily be well ventilated and also be provided with good and sufficient artificial illumination. This must necessarily be of the incandescent electric type, with globes properly protected and with switches outside the building.

In the majority of cases oxygen is used direct from a standard oxygen cylinder, a separate cylinder being used for each welding station or blowpipe in use. In some instances, however, a number of oxygen cylinders are manifolded together, the gas being supplied to the shop through a system of piping. In rare cases oxygen is manufactured on the premises, the gas being first collected in a gas holder and then compressed in the receivers to a pressure of a few hundred pounds, after which it is passed through a regulator and supplied through a system of shop piping.

When assembling the manifolds in the piping system, great care must be taken to see that fittings, etc., are handled with clean hands. Grease on a joint or on the interior of the piping might cause severe trouble. The interior of the piping must be clear of all scale and rust, and should be washed out with caustic soda before being put in service.

When starting up an acetylene generator the first time, the instructions of the manufacturer must be followed in detail.

Pressure on Acetylene Pipe Lines

Under normal and proper working conditions the pressure of the acetylene pipe line generator will never exceed 17 pounds per square inch. Pure acetylene gas (that is, acetylene without any air mixture) at any pressure below 15 pounds per square inch is non-explosive. If the same cylinder were filled with acetylene at 30 pounds pressure, and there was no air present and a spark plug was flashed, there would be a violent explosion. The action of acetylene under pressure between 15 and 30 pounds per square inch is somewhat uncertain, but all the best authorities have definitely decided that acetylene should never be used in the free state at a pressure in excess of 15 pounds per square inch.

In the recharging of acetylene generators it is most important to follow the orders and instructions for consecutive operations as laid down by the manufacturer.

Special attention should always be given to make sure that the hydraulic seals and backflash devices at the discharge of the generator are properly filled with water and are in proper working order.

If any repairs have to be made to an acetylene generator, the whole machine should be thoroughly flooded with water to make sure that all gas has been expelled.

Manifolding Oxygen Cylinders

In those cases where the shops are piped for oxygen supply, and the oxygen is supplied from a number of cylinders manifolded together, it will probably be arranged for the same man who looks after the acetylene generator to look after the oxygen manifold and replace the exhausted cylinders with full ones when necessary.

A careful search should then be made for leaks, which will be detected by a hissing sound. Connections where leaks occur should be tightened up immediately. If any cylinders are found that leak around the valve stem, they should be disconnected and returned to the manufacturer.

Under no circumstances whatever should workmen be permitted to attempt to make any repair to the valves and valve fittings on an oxygen cylinder.

It is very important that periodic tests be made of the working pressure gages on the regulators. These are the pressure gages that indicate the delivery pressure of the gas from the regulator. As previously mentioned, acetylene should never be used in a blowpipe or in a hose or piping system at pressure over 15 pounds per square inch, and it is on this account that I emphasize the importance of making sure that the working pressure gages, particularly those on the acetylene supply, are periodically tested for accuracy.

Let me warn you against using long lengths of hose of too small a diameter. Quite a number of blowpipes only function properly when the acetylene is delivered to the inlet to the blowpipe at a pressure somewhere between ten and twelve pounds to the square inch.

It is found that if acetylene is compressed into a porous substance, and where the porosity does not exceed 80 percent, the acetylene cannot be exploded or ignition propagated when the pressure is over fifteen pounds per square inch, as it could be if the cylinder contained no porous mass. Therefore, a cylinder properly constructed and containing the proper porous mass can safely be used for the storage of acetylene at over fifteen pounds pressure per square inch.

Welders employed on heavy work should be supplied with fireproof gauntlets and aprons as a protection against radiated heat, and it is considered advisable where welding is being performed in the interior of some structures to insist that all outer clothing be fireproof.

Welding must only be used for work where welding can be considered good and safe practice for construction and repair. Some users become over enthusiastic and attempt to employ welding on certain work where it should never be attempted and consequently fall down badly, with the result that it tends to give welding a bad name and creates a feeling of insecurity about the process in the minds of those who are considering its use.

Note:—A paper delivered at this Safety Conference, on the subject "Safety in Electric Welding and Cutting" will appear in the March issue of THE BOILER MAKER.

The Boiler Maker

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Boiler standardization—an eminently desirable condition—is advancing. In the stationary boiler field the work of various committees of the American Society of Mechanical Engineers working in conjunction with numerous associations and bodies of individuals interested in the power problem have adopted standards for boiler materials, fittings and flanges and are working on a number of other standards that will more or less affect the boiler industry. Stationary boilers are, to a great extent, a matter of special design for individual installations and their standardization will probably be limited to materials and parts entering into their construction.

The case of the locomotive boiler, however, is somewhat different and partial standardization within classes of locomotives is not only possible but is actually in effect in the shops of the builders.

The article on flanging boiler sheets and domes in this issue of THE BOILER MAKER is an example of partial standardization and probably represents the limit to which the principle can be extended except in the matter of certain small parts common to all engines. For example, on a locomotive order for a given road where fifty engines of a single type are required, it is possible to make every boiler part and, in fact, every part on the whole engine standard for that order—domes, heads, tube sheets, firebox sheets, barrel sheets—all these can be developed in the drafting room and laid out, flanged and drilled in the shop, so that any one of them will fit equally well in any of the fifty boilers.

The great cry in the shop has been that when a new head or throat sheet or firebox had to be installed in a boiler, it was necessary to fit up the new sheet by cut-and-try methods and by using the old one to line up the holes. On locomotives coming within a given class when built by methods holding sheets and parts within close limits, the repair and replacement of sheets no longer makes cut-and-try methods necessary but becomes as mathematically certain as the prints from which the sheets were originally laid out. An entire firebox can be taken from one boiler and connected to another. Spare sheets can be kept in stock for replacement and the shop can feel certain that when they are assembled in the boiler they will fit the first time.

Locomotive standardization can actually be carried between classes to a limited extent if the mechanical departments of the railroads will, when planning a design, apply parts to it that are used on other classes. The further this principle is carried, so much easier will maintenance become and the less capital will have to be tied up in a variety of material for similar parts on different engines.

The recent record for carrying through a class "two" repair at the El Paso, Texas, shop of the Southern Pacific Company in 72 working hours represents a record that so far as we have been able to learn is unequalled. Efficient shop equipment and, above all, cooperation and good will of the shop staff are necessary for records of this kind and too much cannot be said in praise of the spirit that makes such things possible.

Shops are not required to make records every day, however, but this same enthusiasm and willingness to "dig in"—morale, in other words—should be apparent in every shop in doing the day's work and should be maintained consistently.

To expect such a spirit of willingness, the supervisory force and the mechanical department have a duty to perform—that of understanding the problems of the men and of using every man in the place for which he is best fitted.

We should like to hear from our readers of other records of this kind whenever they are made and the details of shop management and facilities that make them possible. Every bit of information that will help the other fellow do his work a little easier is worth while and deserves consideration.

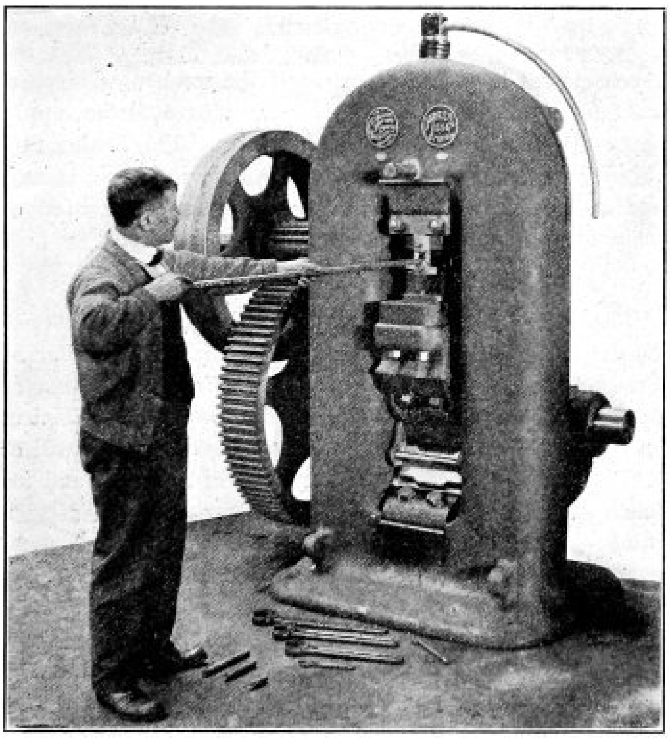
Engineering Specialties for Boiler Making

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

Press for Producing Staybolt Blanks

THE illustration shows a coining press built by the Ferracute Machine Company, Bridgeton, N. J., fitted with dies and attachments required to produce staybolt blanks. The square head is formed and the bolt blank is cut from the end of the bar in the same operation. The average production for this machine is at a rate of 30 blanks per minute.

The press is of compact construction, the frame being constructed from a solid casting with but 14 inches between the columns. The stroke of the press is 2 inches. The ram is forced upward by the action of steel toggles which are actuated by a 6-inch steel shaft at the back of the press. The head, to which the upper die is attached, can be adjusted downward as much as ½ inch by means of a wedge adjustment operated by a screw. A bolt at the top of the press keeps the head firmly up against the frame, the spring shown in the illustration has sufficient tension to take the entire weight of the head when operating the wedge adjustment. The form-



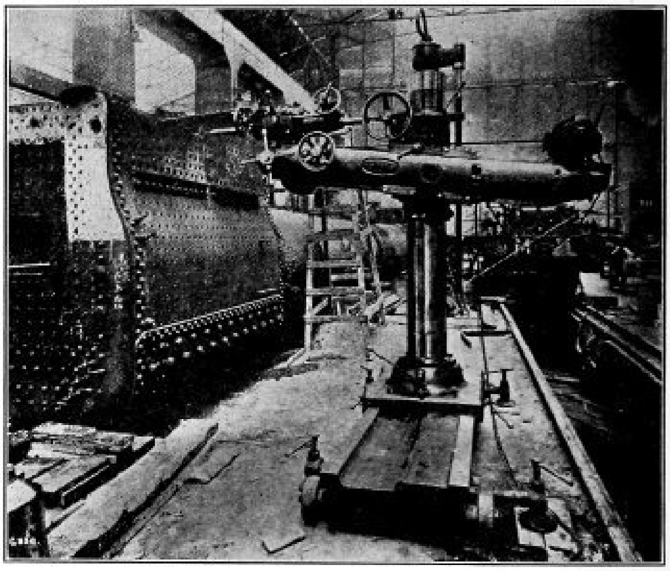
Making ⅞-inch Staybolt Blanks from a Steel Bar

ing dies are V-shaped and there is an adjustable gage at the back of the press so that bolt blanks of various lengths may be cut off.

The operator is shown in the act of making ⅞-inch staybolt blanks from a steel bar of that diameter. This press is known as EG54 Special and will be found specially useful in the equipment of the boiler ship.

Portable Drilling Machine

A PORTABLE universal drilling machine with a broad field of utility has recently been placed on the market by Wm. Asquith, Ltd., Halifax, England, and is available in the United States through C. I. Wroe, New York. The machine, it is claimed, has the advantage of ready portability with the addition of greater rigidity than usually found in portable drills. Although the nature of the machine precludes any great rigidity for high speed drilling,



Drilling Holes for Staybolts in a Locomotive Firebox

it is capable of reasonable cutting rates, and considerable saving is obtained in the combined drilling and handling time on the kinds of work for which it is intended. It is claimed that the low power consumption of this machine gives it an advance over pneumatic drills in the matter of maintenance costs as well as the necessity for extra labor and assistance. It is also said that the breakage in twist drills has been considerably reduced.

This machine is made in four sizes with a maximum radius of the drilling spindle of 3 feet 9 inches, 4 feet 9 inches, 5 feet 9 inches and 7 feet 0 inches, respectively. There is also a No. 5 size, but this type does not embody a radial arm. The spindle is of high tensile carbon steel and is provided with variable rates of self-acting feed motion. It is provided with a fine hand feed through a worm and worm wheel and can be adjusted quickly by a conveniently placed hand wheel. The reversing motion to the spindle is controlled by a lever placed in easy reach of the operator. The action of reversing the spindle automatically increases the reverse speed in the ratio of about 3 to 1. The drilling head is so arranged that it can be adjusted in either the horizontal and vertical planes to any angle, and it is equipped with a locking device that holds the head securely in all positions.

All controls are conveniently arranged. The radial arm can be traversed across the column by means of a hand wheel, and by power in the case of the 7-foot machine, and can also be elevated on the column either by hand or by power, or moved radially through a complete circle. The arm can also be tilted in a vertical plane through about 30 degrees. Secure locking provision is made for all these movements as well as an automatic trip motion for the power elevating and lowering of the arm on the column.

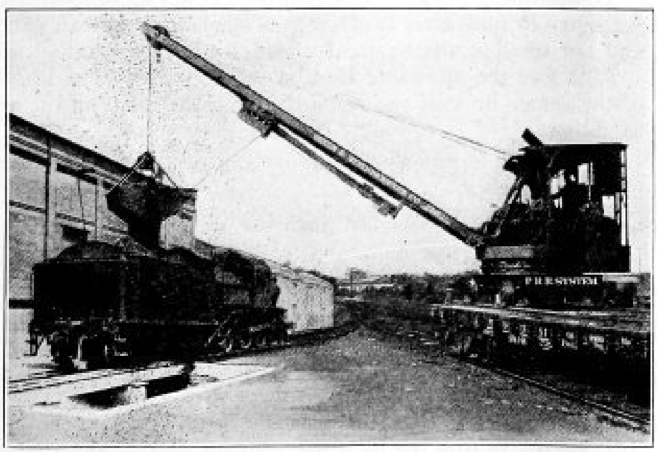
The base slides easily on the truck bed and is traversed thereon by a ratchet lever. It can be rigidly locked in any position desired. The column is securely bolted to the base and is fitted at the top with a plug that carries the lifting hook. On the 7-foot machine, the column consists of an internal pillar and sleeve to insure the necessary rigidity, in which case the arm and sleeve rotate on the pillar. This latter motion is facilitated by a patent arrangement of ball and roller bearings.

The truck bed is arranged on four wheels, except in the case of the 7-foot machine, with screw jack supports to take the weight when drilling and also to give additional support. The drive is by means of a self-contained, reversible electric motor, mounted on the arm end plate. A belt from the motor to a single pulley on the gear box completes the driving mechanism. On the 7-foot machine, the drive is operated from the motor by means of a driving shaft to the gear box. The gear box provides six speed changes, with the exception of the No. 4 size, which has eight speed changes. These speed changes are obtained by hand wheel control through clutch and sliding gears and are doubled by the double gear on the head.

Small Crane for Shop Service

THE light, general-purpose crane illustrated is now being produced by the Orton & Steinbrenner Company, Chicago, for use about railroad shops, enginehouses, scrap docks, yards, etc. It is designed for mounting on a flat car traveling the length of the car, revolving in a full circle, and yet keeping within all railroad clearances. The length of the boom is 28 feet, which enables it to be shipped anywhere on a 40-foot car.

The crane is equipped to handle with equal facility, hook, bucket or magnet. The maximum capacity is seven tons at



Orton & Steinbrenner Gasoline Motor-Operated Crane Coaling a Locomotive

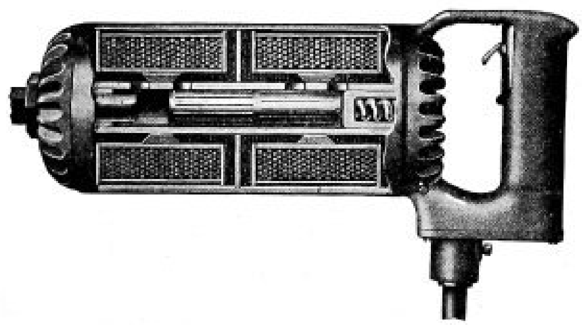
12 foot radius; or it will handle a ½- or ¾-cubic yard bucket with the boom extended to 28 foot radius; or a 36-inch electromagnet.

Power is furnished by a four-cylinder, 5-inch by 6½-inch, heavy duty gasoline motor, with high tension magneto. This motor is geared directly to the hoisting, swinging and traveling gears. It is operated by one man only. A generating set, belt-connected to the engine, furnishes current for a 36-inch electromagnet. Bucket handling drums are also furnished on the machine. A ¾-cubic yard bucket will hold on an average one-half ton of coal, and at a rate of two trips per minute, the machine will handle about 30 tons of coal an hour. As an emergency locomotive coaler, this crane can therefore be used to advantage. At the maximum radius, that is, 30 feet from the center of the machine, the crane can handle 4,400 pounds.

A separate shaft with two niggerheads, is supplied on the front of the crane. These are useful in pulling cars and dragging in loads to a position where they can be handled on the boom. Being gasoline motor driven, it is always ready for service without any preliminary firing, nor is any trouble encountered from bad weather or lack of ready coal supply.

Portable Electric Hammer

A PORTABLE tool known as the Syntron electric hammer is being manufactured by the National Electric Manufacturing Company, Pittsburgh, Pa. It is designed to run on 60-cycle current and at this frequency strikes 3,600 blows per minute. It is suitable for drilling through masonry walls, drilling holes for expansion bolts, chipping castings, light riveting and assembly work, chipping and



The Syntron Electric Hammer Showing the Coils and Piston Slide in Section

cracking stone, calking pipe and tank plates. A similar tool designed for 25 cycles which will strike 1,500 blows per minute can be used for heavier riveting.

The hammer proper consists of two windings which are energized alternately to impart a reciprocating movement to a movable core or piston, which is the only moving part. In its forward stroke, the piston strikes a tool, which may be a drill, chisel, rivet set or the like. In its backward stroke the piston strikes an elastic bumper in which it stores its kinetic energy until it is moved forward again. The energy stored in the bumper is then returned to the piston on the forward stroke.

Hammer Operates on Alternating Current

To operate the hammer, alternating current is supplied to the two windings to energize them alternately so as to impart a reciprocating movement to the piston, which will move in synchronism with the frequency of the alternating current supplied to the windings. The current alone produces the operating forces to move the piston. No mechanical devices are used. The hammer is at present available in three sizes, one weighing 10 pounds, the second weighing 17 pounds, and the third weighing 24 pounds. All sizes are available for 110 or 220 volts and any frequency.

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Special Heel Development Problem

Q.—I would like to have shown the layout of a heel of the form shown in the sketch. As we cannot press it at the shop, we will have to roll it, then heat it, and form it over a block.—W. F.

A.—There is no method of development that will give an accurate layout of the pattern. As will be noted in the perspective, Fig. 2, the heel is bent to several curvatures, thus each half of the heel is shown bent from an inside radius of $2\frac{5}{8}$ inches to an inside radius of 5 inches. A good plan to follow in this development is to pass a number of planes as along the lines *a-a*, *b-b* and *c-c* and approximate the curves *g-b* and *h-c*. It will be necessary to locate the straight section of the heel as from *a-f* to *d-c*. Pass a number of planes as *1-1*, *2-2*, *3-3*, etc., through the curved section. With this data construct a plan and elevation and lay off the pattern by triangulation for the segments of the heel.

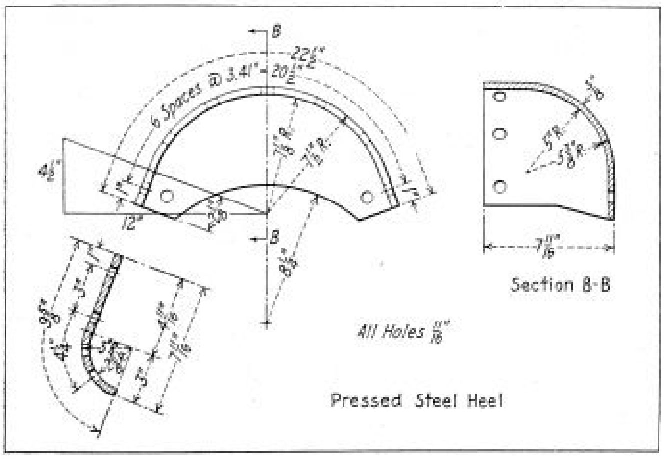


Fig. 1.—Type of Heel to Be Developed

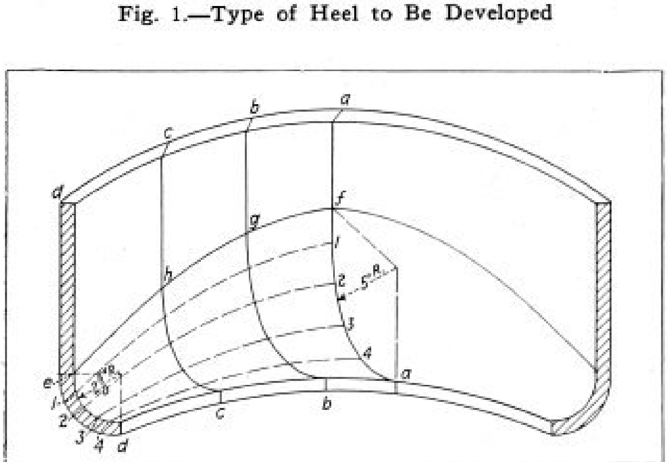


Fig. 2.—Perspective Layout of Heel

Jib Crane Calculations

Q.—I would be much obliged if you would give me the strength of the two jib cranes (sketches inclosed). These cranes were installed at my place of occupation, and their carrying power is unlimited, so I would like to know the various formulas for calculating the strength of same. The crane, Fig. 4, was fixed on to a building column built up of four 5-inch by $3\frac{1}{2}$-inch by $\frac{3}{8}$-inch angles and one plate $20\frac{1}{2}$ by $\frac{7}{16}$. The unsupported part of the column is 20 feet. What additional area is required for this column, and is it subject to rupture? I appreciate the information you have given me in the past and hope you will give me the necessary details for the above.—G. C.

A.—The proportions of the crane, Fig. 1, are incorrect as the tie rod is too small for the load that can be carried by the beam. The column or post of the crane should be made of larger sections than indicated in the illustration. The riveting for the gusset is entirely too strong for the size of members used and for the maximum load the crane can carry. From the following explanations and calculations given these points are brought out.

The stress imposed in the members of the crane will be understood from Fig. 2.

In the tie rod *a* there is a pull or tension stress; in the beam *b* a crushing stress and a bending stress, the column *c* is also subjected to a crushing and bending stress.

To determine the safe load that the crane can support it is necessary to find what load each member of crane can carry and the smallest of these calculated loads is the safe load.

First find the allowable load on the tie rod *a*. The length of the center lines of the respective members *a*, *b* and *x* are as follows:

$b = 11$ feet or 132 inches.

$x = 28$ inches.

$a = \sqrt{132^2 + 28^2} = 135$ inches.

The tension stress in *a* may be found from the formula

$$W \frac{a}{x}$$

in which

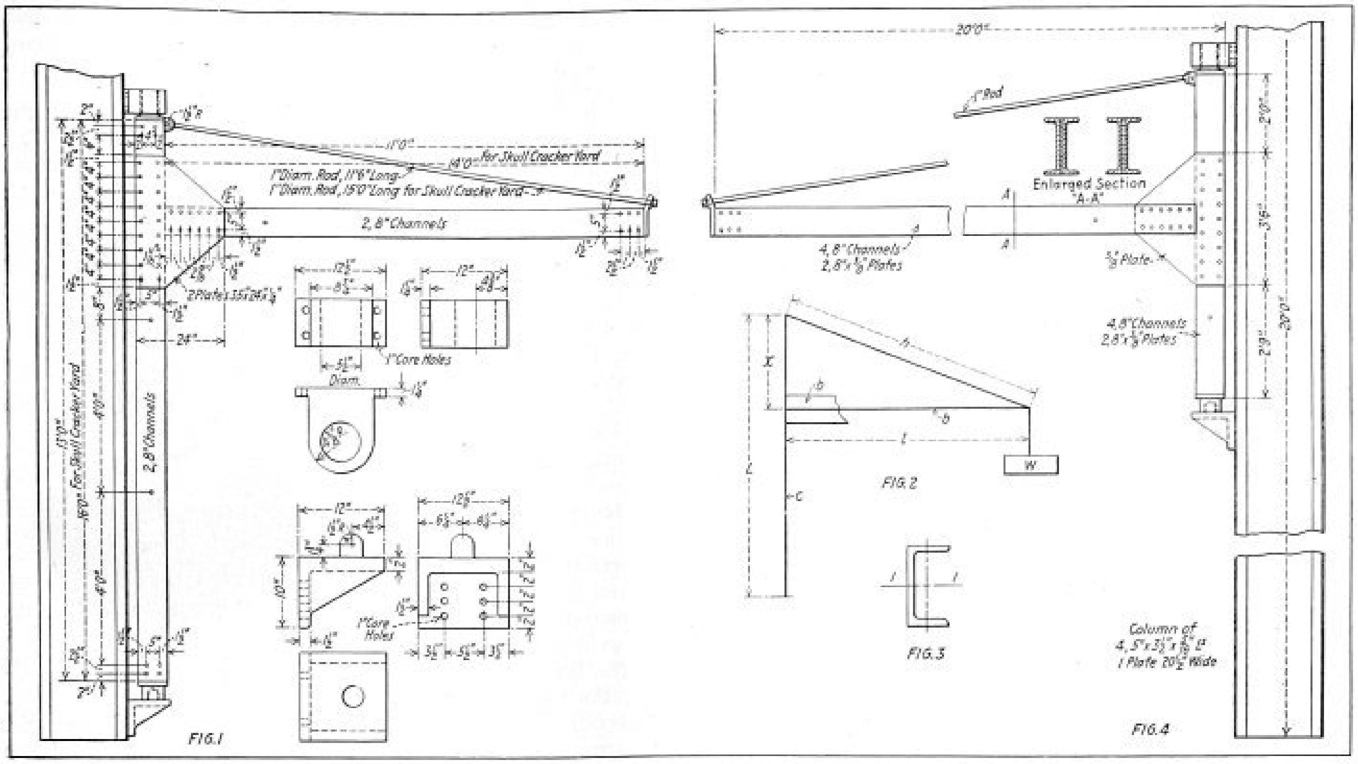
$W =$ load at the extreme end of the crane in pounds
a and $x =$ distances measured as shown in Fig. 2, inches.

The load W that the tie a will support may be determined in the following manner:

$$W \frac{135}{28} = 16{,}000 \times 1^2 \times 0.7854$$

$$W = \frac{16{,}000 \times 1^2 \times 0.7854}{4.82} = 2{,}586 \text{ pounds.}$$

The value 16,000 is the unit tensile stress allowed in the tie rod per square inch.



Method of Determining Stresses in Crane Members

The bending stress in the beam b may be figured from the formula:

$$M = \frac{W\,l}{A}$$

in which,

M = bending stress, inch = pounds.
W = load taken at the center of the crane in pounds.
l = length of beam, inches.

Use the values of the example and substitute them in the formula:

Then,

$$M = \frac{2{,}586 \times 132}{4} = 85{,}338 \text{ inch-pounds.}$$

Section modulus of the section about the axis 1-1, Fig. 3, may be found for the formula $S = \frac{M}{s}$

in which

S = section modulus.
M = bending stress, inch-pounds.
s = unit stress, or 10,000 pounds per square inch.

Then using the values of the example in the formula:

$$S = \frac{85{,}338}{10{,}000} = 8.5338$$

The smallest standard 8-inch channel has a section modulus of 8.1 and since two channels are used, the section modulus equals $8.1 \times 2 = 16.2$.

Then $16.2 \div 8.5338 = 1.898$, which shows that the two channels will withstand a bending stress of 1.898 times greater than the load allowed on the tie rod; or $2{,}586 \times 1.898 = 4{,}687.5$ pounds.

The next calculation is to find if the beam b will stand the compressive stress which may be determined from the formula:

$$W \frac{l}{X} = 2{,}586 \times \frac{132}{28} = 12{,}190.4 \text{ pounds.}$$

The permissible unit stress equals

$$16{,}000 - 70 \times \frac{l}{r}.$$

in which $l = 132$ inches.
r = radius of gyration = 3.11 for an 8-inch channel weighing $11\frac{1}{4}$ pounds per foot.

Substitute these values in the formula:

$$\text{Then } 16{,}000 - 70 \times \frac{132}{3.11} = 13{,}029 \text{ pounds per square inch.}$$

The cross-sectional area of an 8-inch channel equals 3.35 square inches. The safe load or stress that the two channels b can stand in compression equals $13{,}029 \times 3.35 \times 2 = 87{,}294$ pounds or a little over 6 times the compression stress on the beam.

The crushing stress in the column c is equal to the weight of the beam b, the rod and the weight supported by the crane. The greatest load on the column c is due to the bending stress produced by the compression stress in the beam b. This stress may be determined from the formula:

$$M = \frac{W\,(L - X)\,X}{L}$$

In this formula substitute the following values of the example:

W = 12,190.4.
L = 13 feet, or 156 inches.
X = 28 inches.

$$\text{Then, } M = \frac{12{,}190.4(156 - 28)\,28}{156} = 278{,}272 \text{ inch-pounds.}$$

$$\text{Section modulus} = \frac{278{,}272}{10{,}000} = 27.83$$

The largest standard 8-inch channel has a section modulus of 11.9 and weighs $21\frac{1}{4}$ pounds per foot. If two of these channels are used, then the allowable load that the crane can carry may be found by the following calculation:

$11.9 \times 2 = 23.8$ section modulus of two 8-inch channels.
$23.8 : 27.82 = 2,587 : X$.

$$X = \frac{23.8 \times 2,587}{27.83} = 2,182.4 \text{ pounds.}$$

These calculations show that the members of the crane will carry the following loads:

On the tie rod *a*..........	2,587 pounds
On the beam *b*...........	4,687.5 pounds
On the column *c*..........	2,182.4 pounds

Therefore the allowable load on the crane is 2,182.4 pounds.

To determine the allowable load on the crane, Fig. 4, attached to the column of the building, proceed along the lines explained for the crane, Fig. 1. In addition, calculate the stress imposed by the weight of the building on the column support.

The stress in the rivets attaching the beam to the column must resist the crushing stress in the column *c* and the crushing stress produced in the beam *b*.

Since the stress in the beam *b* is the greatest, which equals 12,190.4 pounds, the required number of rivets is based on this load. The allowable shearing stress on a ¾-inch rivet is 3,090 pounds.

$12,190.4 \div 3,090 = 4$, the required number of ¾-inch rivets.

This calculation shows that the rivets in Fig. 1 for fastening the column *c* and beam *b* are entirely too many.

PERSONALS

FRANK J. O'BRIEN, vice-president and general manager of the Globe Steel Tubes Company, Milwaukee, Wis., with headquarters at Milwaukee, Wis., has been elected president with the same headquarters,, to succeed Paul J. Kalman, who has been elected chairman of the board of directors. John W. Floto, general manager of sales, with headquarters at Chicago, has been promoted to vice-president and general manager of sales with the same headquarters. Mr. O'Brien entered the employ of the Pullman Company in 1894 as a clerk and until 1906 held the positions of chief clerk to the general manager and assistant to the sales manager. On the latter date he resigned to become assistant to the president of the Kirby Equipment Company, which position he held until June, 1910, when he entered the employ of the Globe Steel Tubes Company as sales manager with headquarters at Chicago. On April 6, 1917, he was promoted to works manager, with headquarters at Milwaukee, which position he held until June, 1918, when he was promoted to general manager, with the same headquarters. In February, 1920, he was promoted to vice-president and general manager with the same headquarters, which position he has held until his recent appointment.

Frank J. O'Brien

ROBERT W. WHITE, assistant general sales manager, of the Linde Air Products Company, manufacturers of oxygen for welding and cutting of metals, has been appointed general sales manager of the Carbide and Carbon Chemicals Corporation. L. M. Zimmer, Western sales manager of the former company, has been appointed assistant general sales manager to succeed Mr. White.

C. B. LINDSTROM, recently made works manager with the Cole-Duncan Boiler Works, Inc., Long Island City, N. Y., and who for a number of years has conducted the questions and answers department of THE BOILER MAKER, began his career in boiler making while he was attending the grade schools by serving during vacation periods in a boiler shop in the various capacities which a boy is capable of handling. He completed his high school course in 1898 and immediately volunteered for service in the Spanish-American War, where he served in the Porto Rican campaign. After the war, he went back to his work in the boiler shop, studying the various branches, especially laying out and methods of boiler design and construction. In 1907 he joined the text-book force of the International Correspondence School at Scranton, Pa., and assisted in the preparation of courses in sheet metal work, pattern drafting, laying out for boiler makers and also the course in boiler making. For several years he served as assistant principal of the School of Mechanical Drawing and as principal of the Schools of Sheet Metal Work and Boiler Making. In 1918 Mr. Lindstrom joined the forces of the Emergency Fleet Corporation as assistant production manager in the boiler division. This work involved the installation of methods for increasing boiler production in several plants. After the war, he returned to the shop in the service of the General Boilers Company at Waukegan, Ill., remaining with this company until 1921, when he went back to his work with the International Correspondence School to revise the courses in boiler making, sheet metal work and steam engineering. The first of this year he accepted the position as works manager with the Cole-Duncan Boiler Works, Inc.

C. B. Lindstrom

BUSINESS NOTES

The Chicago Pneumatic Tool Company, New York, announces the General Machinery Company of Spokane, Washington, as their agents in the eastern part of the state of Washington and northern part of Idaho.

The Cleveland branches of the Westinghouse Electric and Manufacturing Company and the Westinghouse Lamp Company have consolidated in one building their sales and service departments and their warehouses.

Frederick M. Becket, chief metallurgist of the Electro Metallurgical Company, and vice-president of the Union Carbide and Carbon Research Laboratories, Inc. (both subsidiaries of the Union Carbide and Carbon Corporation) was awarded the Perkin Medal of the Society of Chemical Industry, on January 11, 1924, for his achievements in the field of applied chemistry.

The Heine Boiler Company, St. Louis, Mo., has named the Tennant Company, with offices in the Union National Bank Building, Houston, Texas, to represent them in the entire southern half of the state of Texas.

Letters from Practical Boiler Makers

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

Gray Matter and Its Reward?

A CLOSE analysis of various methods of supervision among railroad men brings to light some rather interesting features; for example, their zealousness in putting forward new ideas is at times misunderstood by their superiors, due chiefly no doubt to a lack of understanding on the part of the executive department. Oftentimes, the result from a few experiences of this kind is that the supervisor loses his initiative which, if encouraged, holds great possibilities for the future development of that part of production coming under his charge.

Examples of this are evident in various shops at the present time. One case which I have in mind is that of a supervisor whose only aim is to increase the production of his shop and in the success of his road to make good his own ambition in the field of production. This supervisor believes fully in the training of the individual worker so that each one may gain a full knowledge of his trade and a thorough understanding of the principles on which the trade is based. This understanding is essential and brings out the capabilities of the individual. For this purpose he has analyzed the ability of the worker and has classified the efficiency of his men into various divisions so that in the assignment of work he is able to take the qualities of the men into account and put them on the jobs for which they are best fitted. This undoubtedly tends to improve their efficiency and enables them to meet the requirements of new developments in their trade which are constantly coming up.

After this idea has once been impressed on the minds of the various workers, there is a real incentive for them to develop more efficient methods of doing their work especially since they know that they will obtain satisfaction and recognition of their efforts from their supervisor who has played the part of instructor through their earlier days of employment. If the supervisor is given authcrity by his superiors to incorporate the new ideas and methods in doing the work, a source of encouragement for the display of energy and initiative is provided and the development takes on a constructive aspect. On the other hand, if the suggestions are ignored, the interest to improve their work is entirely lost and the tendency is for them to discontinue any sign of initiative. This is essentially true in the case of those who have attained a fair degree of ability and skill in their work.

Lack of appreciation of the efforts made by the men under him will almost invariably react on the standing of the supervisor. His best chance for success is to show these men that he personally appreciates their efforts and realizes that they have at heart only the promotion of greater production. Often the average worker likes to think that some day he may become an important factor in the development of his industry and, although this does not always work out, the idea of achieving his purpose will lead him farther on the road to success than he would have reached otherwise.

It is certain that the supervisory force should not be ignored by the management of any industry for, with the practical knowledge and experience at his command, the supervisor is often able to suggest ways and means for accomplishing greater production that have never been thought of by the executive department. A recognition of the supervisor would not only aid production and the industry as a whole but would provide a real incentive for the various workers connected with it.

Sedalia, Mo. JACK WITT.

Designing Flanged Mouthpiece Rings of Vulcanizers and Similar Pressure Vessels

BELOW is a letter from the Editor, William D. Halsey, of *The Locomotive*, published by The Hartford Steam Boiler Inspection and Insurance Company.

In an issue of *The Locomotive* published some time ago appeared a complete discussion of methods of designing mouthpiece rings of vulcanizers which is referred to in Mr. Halsey's letter, and which is published below:

To the Editor of THE BOILER MAKER:

We were very much interested in reading in the December issue of THE BOILER MAKER a discussion of the determination of proportions for cast steel rings.

In connection with this article we believe that you would be interested in reading the inclosed issue of *The Locomotive*, which deals with the strength of vulcanizer rings.

WILLIAM D. HALSEY,
Editor, *The Locomotive*.

The article in question follows, and we trust that those of our readers interested in this type of construction will find it of value to them in their work.

FLANGED MOUTHPIECE RINGS

In the course of certain manufacturing operations it is necessary to submit the articles manufactured, or the material of which they are made, to a definite temperature for a time; and if the required temperature is not too high, it may be most conveniently realized by means of saturated steam of a known pressure. In the operation of vulcanizing or devulcanizing rubber, for example, the articles to be vulcanized or devulcanized are usually enclosed in a cylindrical vessel, into which steam is passed at a pressure sufficient to give the temperature that is needed to effect the desired change in the material. The articles to be treated are commonly loaded on cars, which are run into the steam chamber on rails, the chamber itself being placed horizontally, with rails along its interior upon which the car can be run into place.

To facilitate the introduction and removal of the goods to be treated, it is usual to have one of the heads of the steam vessel mounted upon a hinge, so that it can be swung aside in such a way as to give an opening for the admission of the loaded car, equal to the entire diameter of the shell of the vessel. It is essential, of course, to provide means for closing the door tightly before the steam is turned on; and the fastenings by which it is secured must be sufficiently strong to resist the pressure of the steam safely, and they must also be of such a nature that the operation of closing or opening the door can be expeditiously performed. These conditions are most commonly realized by the use of swinging bolts that are secured to a flanged mouthpiece that is riveted to the shell, the bolts swinging into slots on a similar flanged ring that is secured to the cover, or door. The construction will be understood by reference to Fig. 1. The flanged ring that is riveted to the shell is slotted at the edge to a sufficient depth to admit of the "cover-bolts," or bolts by which the cover is held in place; and beneath the flange there are brackets with pivot-bolts between them, upon which the cover-bolts can turn. When the cover or door is to be opened, the nuts are slacked up (but not necessarily removed entirely), and the bolts are swung out of the slots in the flange of the cover-ring. In closing the door, this operation is reversed, and when the bolts have been swung into place, their nuts are set up just sufficiently to prevent leakage when the pressure is turned on.

In the present article we shall deal exclusively with the strength of the flanged ring which is riveted to the main shell of the vessel, and in fact, we shall give extended consideration to only one particular mode of failure of this ring. The shell-ring might conceivably fail by the shearing of the rivets, as suggested in Fig. 2, or by direct fracture across the net section of one of the rivet rows as in Fig. 3, or by fracture from the inner angle of the flange, as in Figs. 4 or 5. We shall not treat of these modes of failure in the present article, however, partly because they are not the commonest modes in which failure occurs, but mainly because there is no great difficulty in ensuring sufficient strength in any of these respects; the methods of computation to be adopted in each of these cases being already known. The mode of failure that we shall consider in this article is the one indicated in Fig. 6. In this mode of failure, which, in our experience, is the most common one, cracks start at the free edge of the hub of the shell-ring, and progress into the metal as indicated at *CCC*, sometimes passing into the rivet holes, and sometimes avoiding them. As will be understood from what follows, there is a circumferential tension in the hub of the shell-ring, which is greatest at the free edge of the hub; and it is this circumferential tension which gives rise to the cracks in question.

The books on machine design and kindred subjects do not appear to give any formula for computing this circumferential tension and it is our present purpose to suggest such a formula, and to indicate how it may be most conveniently applied in practical calculations. We desire to state, however, that we are well aware that the formula that we here submit gives values of the circumferential tension which sometimes appear to be excessive. For example, when it is applied to certain particular cases, the formula indicates the existence of a circumferential tension approaching the ultimate strength of the material, although we know positively that the vessels to which these apparently dangerous rings are attached have been operated for some years without giving any trouble. On the other hand, the formula successfully predicts failure when applied to certain other cases in which the shell-rings have actually failed in practice, by the development of cracks such as are shown in Fig. 6. We have thought best to publish the formula, in the hope that the future experience may throw light upon its deficiencies and its limitations, and perhaps lead to substantial improvement in its form. At all events, we feel assured that the formula will always err upon the right side, so that hub cracks need never be feared in any shell-ring whose circumferential tension it indicates to be within safe limits.

For the sake of simplicity in making references, we shall hereafter suppose that the shell has been turned up on end, so that the end to which the ring under discussion is attached is uppermost. We shall also adopt the terminology suggested in Fig. 7, for naming the parts of the ring; the part that is riveted directly to the shell being called the "hub," while the projecting flange will be called the "leaf" of the ring.

The internal stresses, within the material of the ring, are due, of course, to the external forces to which the ring is subjected. Firstly, the steam pressure, acting upon the interior of the vessel after the manner indicated in Fig. 8, produces a longitudinal tension, S, in the shell; and this tension is thrown upon the ring, through the rivets by which the shell is attached to the ring. The total pull of the shell upon the ring (which we shall denote by the letter L in the formula) is found by multiplying the area of the circle whose radius is R in Fig. 8, by the pressure of the steam within the vessel, as expressed in pounds per square inch. The pressure of the steam radially upon the upper part of the ring, where the ring is not covered by the shell, undoubtedly gives rise to a corresponding stress in the ring; but the stress due to this cause will be small, and we shall not take it into account. The radial pressure of the steam against that part of the shell which overlaps the ring is probably carried, for the most part at least, by the shell itself, without material direct influence upon the ring. The pressure of the steam upon the circular space on the top face of the ring, which lies just within the packing circle, likewise gives rise to a stress within the ring; but this also is small, and we need not take it into account, unless we do so in computing the total tensile stress that the cover-bolts must carry, in order to just sustain the steam load upon the cover.

In addition to the direct steam pressure that we have just considered, the ring is subject to two other sources of stress, which are indicated in Fig. 9 by the forces P and Q, P being the total tension upon one cover-bolt, and Q being the downward pressure of the cover upon as much of the packing circle as corresponds (measured around the circumference of this circle) to one of the cover-bolts.

Under the influence of these various forces, the ring becomes deformed in the manner indicated, on a grossly exaggerated scale, in Fig. 10. The actual deformation of the ring is of course very small indeed,—so small that it ought to be practically impossible to demonstrate any deformation at all, by direct observation of the ring itself;—yet, small as it is, it is undoubtedly as real as it would be if the ring were composed of rubber. In plastically elastic materials such as rubber, a large deformation is accompanied by the development of only a comparatively small amount of internal stress; but in a material such as iron or steel, the development of an exceedingly small deformation corresponds to the existence of internal stresses that are enormous when compared with those in the rubber. Hence the deformation of the ring we are considering is of the greatest importance, even though it is exceedingly small.

The deformation of the ring, as illustrated in Fig. 10, may be described as follows: The cover-bolt tensions, P, acting upon the leaf of the ring near its outer edge, tend to raise this outer edge; and the downward pressure on the packing circle tends to depress the inner edge, and so also does the longitudinal tension, S, upon the shell. The result is, that the ring tends to take such a form that the upper face of the leaf assumes a conically concave shape. The ring being supposed to be stiff enough so that it does not bend materially at the angle where the leaf and the hub join (this stiffness is pretty well assured in those forms of ring in which there are brackets beneath the leaf), the hub of the ring must be thrown outward at the same time that the leaf bends upward; and the shell, which is rigidly secured to the hub, will therefore be deformed as well as the ring. At its upper edge, the sheet may be slightly compressed; but as we pass downward and away from the edge, the compression, if it exists, diminishes and soon disappears, and below the point of its disappearance, the shell becomes subject to an increasing stretch, which reaches its maximum somewhere near the lower row of rivets. After we pass this region of maximum stretch, the shell quickly at-

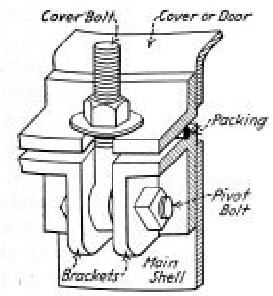
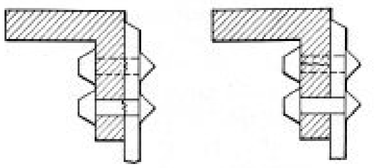
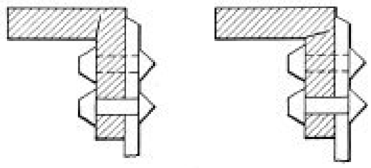


Fig. 1—Illustrating Details of Cover-Bolts


Figs. 2 and 3—Methods of Failure of Ring


Figs. 4 and 5—Methods of Failure of Ring

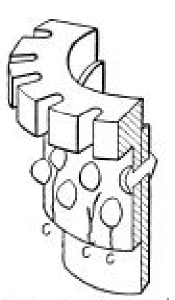


Fig. 6—Showing "Hub Cracks"

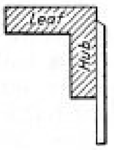


Fig. 7—Names of Ring Parts

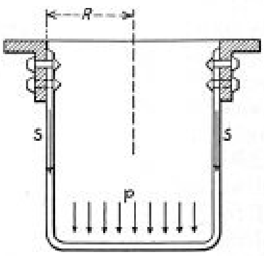


Fig. 8—Illustrating the "Total Steam Load"

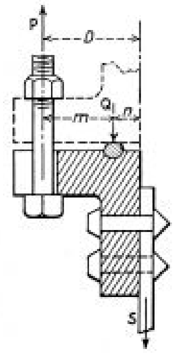


Fig. 9—Principal Vertical External Forces

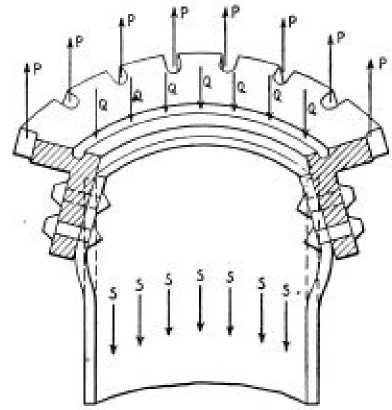


Fig. 10—Distortion of Ring (Greatly Exaggerated)

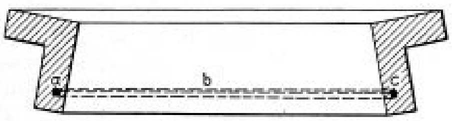


Fig. 11—Illustrating Circular Fiber of Ring

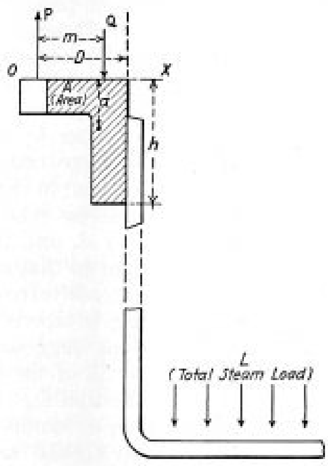


Fig. 12—Illustrating Meaning of Symbols

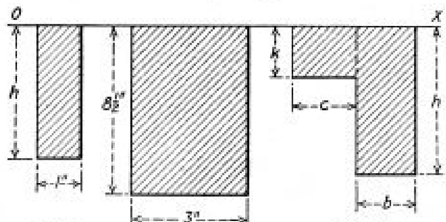


Fig. 13 Fig. 14 Fig. 15

Moments of Inertia

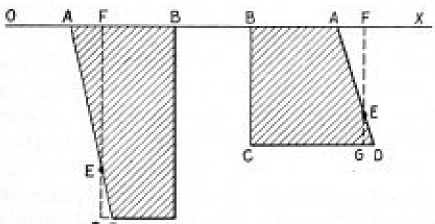


Fig. 16 Fig. 17

Moments of Inertia of Trapezoid

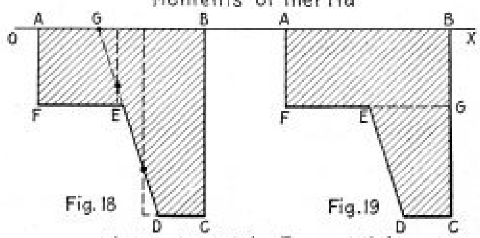


Fig. 18 Fig. 19

Finding I and A for Tapered Hub

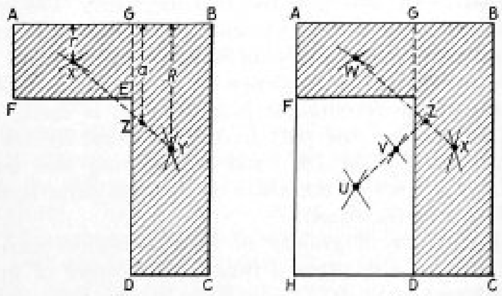


Fig. 20 Fig. 21

Center of Gravity of Ring-Section With Straight Hub

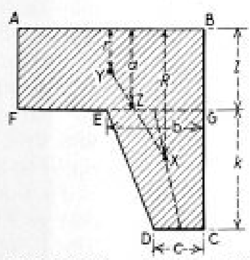


Fig. 22—Center of Gravity of Ring-Section With Tapered Hub

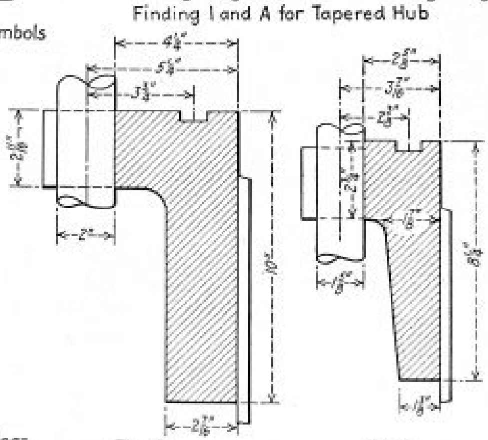


Fig. 23 Fig. 24

Cross-Sections of Actual Rings

Methods of Computing Stresses in Vulcanizer Mouthpiece Rings

tains the normal diameter that it would have if the ring were absent altogether. It will be apparent that the deformation of the shell, here explained and illustrated, must give rise to considerable tensions upon the rivets, which will tend to restore the ring to its original, undeformed state. The actual tensions upon the rivets are hard to compute, however, and we have therefore been forced to leave them out of consideration, and to treat the ring as though it were subject to no external force save the steam pressure, and the forces P and Q. No doubt this explains, in part, why the formula gives results that appear too large in some cases; but the omission of the rivet-tensions may be justified, perhaps, on the ground that the ring ought to be quite strong enough, in itself, to resist the forces to which it is exposed, without any help from the shell.

The way in which the deformation of the ring gives rise to circumferential tension in the hub will be understood by reference to Fig. 11, which shows a cross-section of the ring. If we consider any fiber of the material, such as *abc*, which runs around the ring circularly, it will be apparent that the deformation of the ring increases the length of this fiber, if the fiber is situated in the lower part of the hub, and so must necessarily throw it into a state of tension. If the fiber is situated in the upper part of the leaf of the ring, it will be shortened instead of stretched, and it will therefore be subject to compressive stress. The entire ring (except along a single imaginary horizontal surface which separates the parts in tension from those in compression, and which therefore corresponds to the "neutral surface" or "neutral axis" of a beam), will be, therefore, in a state of circumferential tension or compression; the lower part of the ring being in tension, and the upper part in compression. We might proceed at once to the mathematical analysis of this circumferential stress, and deduce a formula for finding its maximum value, for given values of the steam pressure and of the cover-bolt tensions. It has been thought best, however, to give this mathematical work in a separate article, which is printed elsewhere in this issue. In the present article we shall give only the formula which results from the analysis, together with explanations and a table, to make the application of the formula clear.

The formula for finding the maximum circumferential tension in the ring (this maximum tension coming at the bottom of the hub), is

$$F = \frac{(mNE + LD)(h - a)}{6.2832\ (I - a^2A)}.$$

The significance of most of the letters will be understood from Fig. 12. A is the area of the cross-section of the ring, in square inches; a is the distance, in inches, from the face of the leaf to the center of gravity of the cross-section; I is the "moment of inertia" of the cross-section, with respect to the line OX; h is the total length of the ring, in inches, from the face of the leaf to the extremity of the hub; D is the distance, in inches, from the inner face of the ring to the cover-bolt circle; L is the total steam load on the head of the vulcanizer, in pounds; N is the total number of the cover-bolts; m is the distance, in inches, from the middle of the packing to the cover-bolt circle; and E is the excess of the actual tension on each cover-bolt, over and above that which would be just sufficient to sustain the steam load on the head of the vulcanizer. A, a, and I are to be computed for the smallest cross-section;—namely, for one that passes through a bolt-slot.

The quantity I, which occurs in this formula, is difficult to explain to those who are not familiar with it in the theory of beams and other structures. It is found by dividing up the area of the cross-section into a great number of little parts, multiplying the area of each part by the square of its distance from the line OX, and then taking the sum of all the little products so obtained. This operation, which sounds rather formidable, is readily performed by the aid of the integral calculus. It will not be necessary for us to enter further into the details of the calculation of the quantity I, because for the purposes of practical calculation we may make use of the accompanying table, which enables us to obtain the numerical value of I in a very simple manner. The table gives the value of the moment of inertia (I) of a rectangle one inch wide and h inches long, about one of its ends. For example, Fig. 13 shows a rectangle that is h inches long and 1 inch wide; and from the table we can take, directly, the value of the moment of inertia of this rectangle with respect to the line OX. The moment of inertia of a rectangle having any other width than one inch is found by taking out the tabular value for a rectangle of the same length, and multiplying this tabular value by the actual width of the given rectangle, in inches. To find the moment of inertia of the rectangle shown in Fig. 14, for instance, we first look in the table for the value $h = 8\frac{1}{2}$ inches, and opposite this we find 204.71, which is the value of the moment of inertia of a rectangle having a length of $8\frac{1}{2}$ inches, and a width of one inch. The given rectangle being 3 inches wide, we have to multiply the tabular value by 3; and we find $204.71 \times 3 = 614.13$, as the concluded value of I for the proposed rectangle.

To find the value of I for a section of the shape shown in Fig. 15, we conceive the section to be divided into two rectangles as shown by the dotted line. We then find the moment of inertia of each of these rectangles separately, and add the two, and the sum is the moment of inertia of the whole.

To find the moment of inertia of a shape such as that shown at $ABCD$ in Fig. 16, where the sides AB and CD are parallel, and the side BC is perpendicular to AB, we take a point E, situated on the line DA and at a distance from D equal to one-fourth of DA, and through the point E we draw the line GF, so as to form a rectangle $CGFB$. The moment of inertia of the original given figure, $ABCD$, is then equal to that of the rectangle $CGFB$; and we can find the latter by means of the table, as already explained. If the large end of the original figure is *away* from the line OX, as in Fig. 17, the construction is precisely similar. Thus we take the point E, one-fourth of the distance from D to A, and the moment of inertia of the original figure is equal to that of the rectangle $BFGC$.

It not infrequently happens that the hub of the vulcanizer ring is tapered, so that the cross-section of the ring has the shape suggested in Fig. 18. In that event the moment of inertia of the section may be found most conveniently thus: The line DE is continued until it intersects AB at G. We then determine the moments of inertia of the parts $AGEF$ and $GDCB$ separately, according to the method just given, and the sum of the two is the moment of inertia of the cross-section as a whole.

To find the area of a cross-section of the form shown in Fig. 15, we have merely to find the areas of the constituent rectangles separately, and add the two together. The area of the cross-section of a ring in which the hub is tapered may be found most conveniently as follows: We divide the cross-section into two parts as shown by the line EG in Fig. 19. The area of the rectangular part, $AFGB$, is easily obtained; and the area of the part $EGCD$ is found by taking the half-sum of EG and DC, and multiplying this half-sum by CG. The sum of the areas of the two parts is then equal to the area of the whole.

To find the center of gravity of a cross-section such as that of Fig. 15, we may proceed thus: The center of gravity, X, of the rectangle $AGEF$, in Fig. 20, is at the center of the rectangle; and that of the rectangle $GDCB$ is at the center, Y, of $GDCB$. The center of gravity, Z, of the whole cross-section must lie on the line joining X and Y, and its distance from the line AB is found thus: Multiply the distance r by the area of $AGEF$, and the distance R by the area of $GDCB$, add the two products so obtained, and divide the sum by the area of the whole cross-section. The distance of Z from AB is the quantity denoted by a in the formula.

If it is desired to find the center of gravity of a cross-section of the form shown in Fig. 15 by means of drawing-board operations, we may conveniently proceed as indicated in Fig. 21. We here complete the big rectangle $ABCH$, and we draw DG, as before, cutting AB at G. Then X being the center of $GDCB$, W the center of AGF, U the center of FDH, and V the center of $ABCH$, we join U and V, and also W and X, and the intersection of the lines UV and WX is the desired center of gravity of the whole shaded cross-section.

When the hub of the ring is tapered, the problem of finding the center of gravity of the cross-section is a little more complicated. We begin by dividing the cross-section into two parts by means of the line EG in Fig. 22, just as we did in finding the area of a cross-section of this kind. The center of gravity of the part $EGCD$ lies upon the line joining the central points of EG and DC, and its distance from the line AB is found thus (the significance of the letters being given in the diagram): Multiply k by c, and divide the product by three times the sum of c and b. To the quotient add l, and add also one-third of k. The sum so obtained is the distance of the center of gravity of $EGCD$ from the line AB. The center of gravity of the rectangle $FGBA$ is at the center of that rectangle, Y. The center of gravity of the whole cross-section lies on the line joining X and Y, and its distance from the line AB (which is the quantity denoted by a in the formula) is found thus: Multiply R by the area of $EGCD$, and multiply r by the area of $FGBA$, and take the sum of the two products. Divide this sum by the area of the whole cross-section, and the quotient is the desired distance of the center of gravity of the whole cross-section from the line AB, and is the quantity to be used in the formula for a.

A drawing-board method for finding the center of gravity for a cross-section of this shape can easily be devised, but it does not appear to be of much practical value, the method given above being easier in its application.

The quantity E in the formula, which is described above as "the excess of the actual tension on each cover-bolt, over and above that which would be just sufficient to sustain the steam load on the head of the vulcanizer," is unfortunately quite uncertain in magnitude. The subject of the tension on cover-bolts is dealt with elsewhere in this issue. We can only say, in the present place, that the workman, if he chooses, can easily put an enormous tension upon each cover-bolt, so as to stress both the bolt and the mouth-piece ring to which it is connected, far more severely than is necessary. The ideal way to set up the nuts on the cover-bolts is to screw up each nut carefully, with an amount of force just sufficient to prevent leakage when the vessel is put under pressure. There is no use in trying to compute what the actual tension on the bolt may be, with careless handling of the wrench. As has been well said, all that any formula can aspire to is to give the stress on the bolt when a "reasonable amount of foolishness" has been exerted by the workman. Any attempt to estimate what he can do when he resorts to *unreasonable* foolishness is foredoomed to failure. Generally speaking, we may perhaps assume that in good practice the stress applied by the wrench to each bolt will not exceed by more than (say) 1,000 pounds the tension that would be required in order to keep the joint tight. Hence it will be fair, perhaps, to take 1,000 or (at most) 1,200 pounds as the value of E in the formula; provided the workman who tightens up the nuts on the cover-bolts does the job intelligently.

Let us now compute the maximum circumferential stresses in the hubs of two vulcanizers that have been observed for a considerable time in actual practice. For this purpose we shall select one that has a straight hub, and one in which the hub is tapered.

The dimensions of the selected ring with the straight hub are shown in Fig. 23. The radius of the vessel, in this case, is 30 inches, the maximum working pressure is 150 pounds per square inch, and the number of cover-bolts is 23. The total steam load on the lower head of the vessel is computed as follows: The diameter of the vessel being 60 inches, the area of the lower head is 2,827 square inches, as will be seen from a table of the areas of circles. Hence the total steam load on the lower head is $150 \times 2{,}827 = 424{,}050$ pounds. From these data, and from the data that are given in the engraving, it is apparent that the quantities that occur in the formula have the following values for this ring: $N = 23$; $R = 30$; $L = 424{,}050$; $m = 3\frac{3}{4}$ in.; $D = 5\frac{1}{4}$ in.; $h = 10$ inches. The values of a and A and I have yet to be computed. To find the area, A, of the cross-section, we proceed as indicated in Fig. 15. There is no difficulty in showing that in the present case the total area of the cross-section is 29.24 square inches; the area that is cut away to form the packing ring being neglected, and also the area added in forming the fillet. To find I for this ring-section, we proceed as indicated in Fig. 15. By the aid of the table we find that the moment of inertia of a rectangle 10

TABLE OF MOMENTS OF INERTIA OF RECTANGLES

h (Inches)	I	h (Inches)	I	h (Inches)	I
0	0.000	5	41.667	10	333.33
⅛	0.000	⅛	44.870	⅛	345.99
¼	0.005	¼	48.234	¼	358.96
⅜	0.018	⅜	51.762	⅜	372.26
½	0.042	½	55.458	½	385.88
⅝	0.082	⅝	59.326	⅝	399.82
¾	0.141	¾	63.370	¾	414.10
⅞	0.223	⅞	67.593	⅞	428.71
1	0.333	6	72.000	11	443.67
⅛	0.475	⅛	76.594	⅛	458.96
¼	0.651	¼	81.380	¼	474.61
⅜	0.867	⅜	86.361	⅜	490.61
½	1.125	½	91.541	½	506.96
⅝	1.430	⅝	96.925	⅝	523.67
¾	1.786	¾	102.516	¾	540.74
⅞	2.197	⅞	108.317	⅞	558.19
2	2.667	7	114.333	12	576.00
⅛	3.199	⅛	120.57	⅛	594.19
¼	3.797	¼	127.03	¼	612.76
⅜	4.465	⅜	133.71	⅜	631.71
½	5.208	½	140.62	½	651.04
⅝	6.029	⅝	147.77	⅝	670.77
¾	6.932	¾	155.16	¾	690.89
⅞	7.921	⅞	162.79	⅞	711.41
3	9.000	8	170.67	13	732.33
⅛	10.173	⅛	178.79	⅛	753.66
¼	11.443	¼	187.17	¼	775.40
⅜	12.814	⅜	195.81	⅜	797.55
½	14.292	½	204.71	½	820.13
⅝	15.878	⅝	213.87	⅝	843.12
¾	17.578	¾	223.31	¾	866.54
⅞	19.395	⅞	233.02	⅞	890.38
4	21.333	9	243.00	14	914.67
⅛	23.396	⅛	253.27	⅛	939.39
¼	25.589	¼	263.82	¼	964.55
⅜	27.913	⅜	274.66	⅜	990.15
½	30.375	½	285.79	½	1,016.21
⅝	32.977	⅝	297.22	⅝	1,042.72
¾	35.724	¾	308.95	¾	1,069.68
⅞	38.619	⅞	320.99	⅞	1,097.11
5	41.667	10	333.33	15	1,125.00

inches high and 1 inch wide is 333.33; and multiplying this by 2 7/16, we find that the moment of inertia of the right-hand rectangle in Fig. 15 is 812.49. Similarly, we find that the moment of inertia of the left-hand rectangle in Fig. 15, for this ring, is 11.74; so that the total moment of inertia of the entire cross-section is $812.49 + 11.74 = 824.23$. By the method shown in Fig. 20, we find that the value of a,—that is, the distance of the center of gravity of the cross-section from the face of the leaf of the ring,—is 4.392 inches. Hence we have $A = 29.24$ square inches; $I = 824.23$; and $a = 4.392$. With these values, the formula gives, as the value of the circumferential tension at the free edge of the hub (that is, its *maximum* value),

$$F = \frac{(3\tfrac{3}{4} \times 23E + 424{,}050 \times 5\tfrac{1}{4})\ (10 - 4.392)}{6.2832\ (824.23 - 4.392 \times 4.392 \times 29.24)}$$

or

$$F = \frac{483.69E + 12{,}485{,}000}{1{,}635}$$

If, as has been suggested above, we take $E = 1{,}200$ pounds, we have, as the maximum circumferential tension upon the ring (namely, the tension at the free edge of the hub),

$$F = 7{,}991 \text{ pounds per square inch.}$$

This ring is made of cast steel, with a conjectured tensile strength of about 55,000 pounds per square inch of sectional area. A pair of vulcanizers are run, side by side and under similar conditions, each having a ring of the dimensions here indicated. The ring of one of them shows "hub cracks" such as are indicated in Fig. 6, while the ring of the other does not show any signs of distress. The rivets, in these vulcanizer rings, come rather too near to the free edge of the hub, so that the circumferential stresses are too much concentrated in the vicinity of the edge of the hub. (See Fig. 27, in the mathematical sequel to this article.) We are of the opinion that in the case here cited, the formula gives a reasonable result for the maximum circumferential tension upon the ring.

Let us now consider the second illustrative example, in which the hub is tapered. The radius of the vessel is here 24⅜ inches, the number of cover-bolts is 16, and the maximum working pressure is 90 pounds per square inch. The other principal data are given in Fig. 24. The area of a circle of radius 24⅜ inches is (by the table already cited) 1,866 square inches; and hence the total steam load upon the head of the vessel is $1{,}866 \times 90 = 167{,}940$ pounds. The total area of the cross-section, as found by the method suggested in Fig. 19, is (omitting the fillet and the groove for the packing) 16.16 square inches. The moment of inertia of the cross-section is to be found as indicated in Fig. 18. The distance *BG* in that figure has the value, for the cross-section under consideration, of 2.125 inches, and the moment of inertia of the part *GDCB* is equal to that of a rectangle 8¼ inches high, and 1.562 inches wide. By the aid of the table, this moment is readily found to be equal to 292.36. Passing then to the consideration of the moment of inertia of the portion indicated by *AGEF* in Fig. 18, we similarly find this to be 4.77. Hence the total moment of inertia of the cross-section shown in Fig. 24 is $292.36 + 4.77 = 297.13$. It only remains to find the value of a, according to the method suggested in Fig. 22. The method having been fully described, it will not be necessary to give the details of the calculation. The general result is, that the center of gravity of the whole section lies at a distance of 3.58 inches from the upper surface of the leaf.

The data for computing the maximum circumferential tension, F, in the ring shown in Fig. 24, are therefore as follows: $R = 24\tfrac{3}{8}$ inches; $N = 16$; $L = 167{,}940$ pounds; $m = 2\tfrac{3}{8}$ inches; $D = 3\ 7/16$ inches; $h = 8\tfrac{1}{4}$ inches; $a = 3.58$ inches; $A = 16.16$ square inches; and $I = 297.13$. With these values, the formula gives

$$F = \frac{(2\tfrac{3}{8} \times 16E + 167{,}940 \times 3\ 7/16)\ (8.25 - 3.58)}{6.2832\ (297.13 - 3.58 \times 3.58 \times 16.16)}$$

or

$$F = \frac{177.46E + 2{,}695{,}963}{565.61}$$

If, as before, we take $E = 1{,}200$ pounds, we find, as the maximum value of the circumferential tension in this hub (this maximum value occurring, as it always does in these rings, at the free edge of the hub),

$$E = 5{,}143 \text{ pounds per square inch.}$$

The ring whose maximum circumferential tension we have just computed is made of an excellent quality of cast-iron, and it has been in service for a long time, without giving any trouble. If the computed tension as given by the formula is correct, we must admit that the factor of safety in this case is smaller than could be desired. It is not customary to take the tensile strength of cast-iron as much, if any, greater than 20,000 pounds per square inch. Thurston (*Materials of Engineering*, Part 2, edition of 1903, page 442), gives the following values of the tensile strengths that "should be given by the best sorts of cast-irons":

Good pig iron..........	20,000 lbs. per square inch.
Tough cast-iron	25,000 lbs. per square inch.
Hard cast-iron	30,000 lbs. per square inch.
Good tough gun iron....	30,000 lbs. per square inch.

These values appear to us to be somewhat high; but if they really represent practice faithfully, then provided we admit that the casting upon which we have just figured (and which is known to be of excellent quality) is equal to Thurston's "tough cast-iron," we see that it has a factor of safety of approximately 5, so far as the development of "hub-cracks" is concerned; the tension as computed by the formula being assumed to fairly represent that actually existing in the ring.

It will be seen, from these examples, that the term which depends upon the assumed value of E is much smaller than the one which does not depend upon E. Hence a considerable range of values might be given to E without affecting F to an extent that would be of serious import. We make this observation because if the fact itself were not noted, it might be supposed that the formula would yield seriously indeterminate values of F, on account of the arbitrary quantity, E, that it contains.

EDITOR'S NOTE:—If our readers are interested in studying the mathematical discussion of the stresses in mouthpiece rings, such a discussion will be published in a later issue of THE BOILER MAKER.

TRADE PUBLICATIONS

WELDING MACHINES.—The Wilson Welder & Metals Co., Inc., New York, has just issued a new catalogue illustrating and describing Wilson welding machines and Wilson colortipt welding metals, together with a number of attractive photographs of large electric welding repair jobs and steel tank work.

BOILER TUBE CLEANERS.—Lagonda tube cleaners for boilers and for special uses are described in a 44-page catalog, X-7, recently issued by the Lagonda Manufacturing Company, Springfield, Ohio.

HIGH SPEED STEEL FURNACES.—Steel heating furnaces for a great variety of steel heating, annealing, carburizing and heat treating purposes have been described in a bulletin sent out by the Chicago Flexible Shaft Company, Chicago, Ill.

"SHELBY" SEAMLESS STEEL TUBES.—A recent publication of the National Tube Company, Pittsburgh, Pa., gives a detailed description of the manufacture of Shelby seamless steel tubes and contains technical information of value to men engaged in machine design and various mechanical engineering vocations having tubular requirements.

TWIST DRILLS.—A complete self-indexing catalog has been published by the Cleveland Twist Drill Company, describing its products, including drills, reamers, sockets, counterbores, mills, screw extractors, arbors, mandrels and high-speed tools. A special section is devoted to the famous Cle-Forge high-speed drill.

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

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

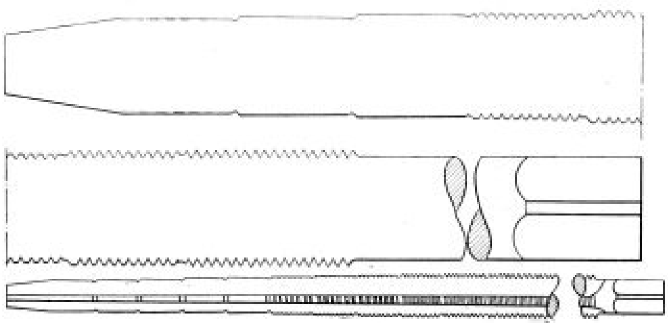
SELECTED BOILER PATENTS

Compiled by
GEORGE A. HUTCHINSON, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

1,478,414. STAYBOLT TAP. FRANK O. WELLS, OF GREENFIELD, MASSACHUSETTS.

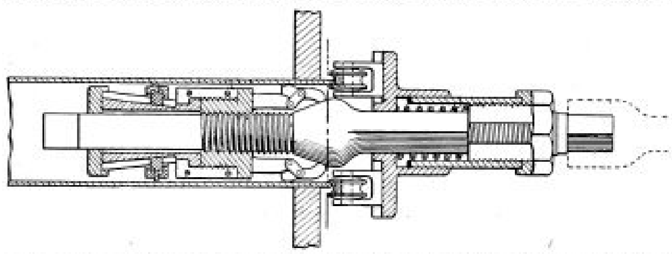
Claim.—A tap construction comprising a member having a series of rear-



wardly tapered reamer elements of different diameters and a series of thread forming elements of different diameters. Six claims.

1,478,692. COMBINATION TUBE EXPANDER, BEADER AND CUTTER. ANDRIAN J. BARANOFF, OF LOS ANGELES, CALIFORNIA.

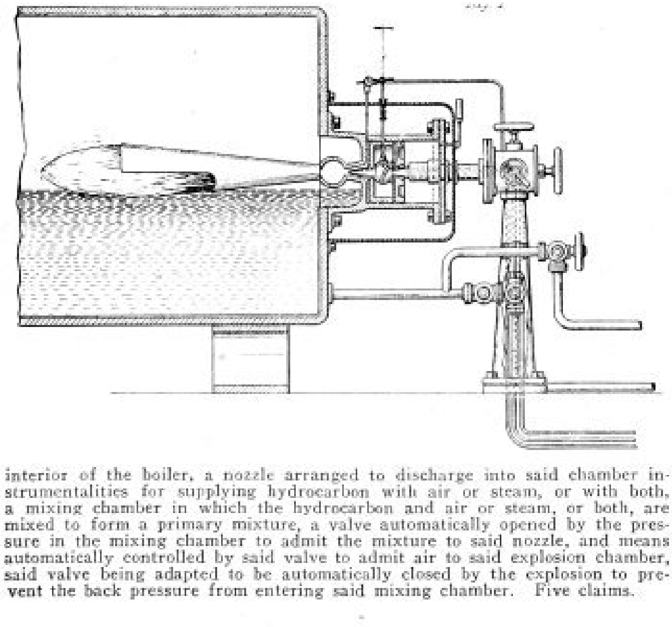
Claim.—In a device as disclosed, a spindle, an expander mounted on said spindle for expanding the tube when the spindle is rotated and forced into the tube, a beader on said spindle for beading said tube when it is expanded,



and a cutter including a cone mounted on said spindle to rotate therewith and to move upwardly thereon as the spindle is rotated and forced into the tube, and knives mounted on said cone to be forced outwardly and rotated by said cone when the cone is rotated and moved upwardly by the spindle. Two claims.

1,478,067. INTERNAL-COMBUSTION BOILER. ALEXANDER SEIDLER, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE, ASSIGNMENTS, TO F. C. AUSTIN MACHINERY COMPANY, A CORPORATION OF ILLINOIS.

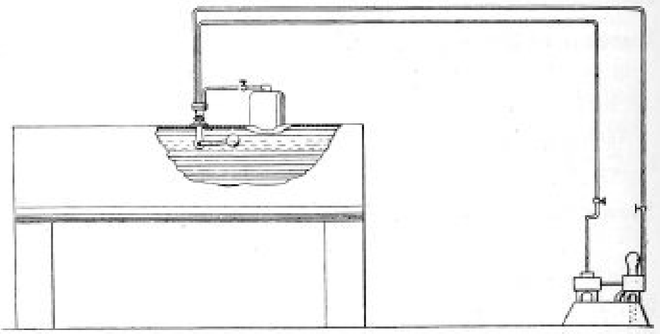
Claim.—The combination of a boiler for containing water to generate steam and means for causing combustion within the boiler so that the products of combustion serve to augment the pressure derived from the generation of steam, said means comprising an explosion chamber communicating with the



interior of the boiler, a nozzle arranged to discharge into said chamber instrumentalities for supplying hydrocarbon with air or steam, or with both, a mixing chamber in which the hydrocarbon and air or steam, or both, are mixed to form a primary mixture, a valve automatically opened by the pressure in the mixing chamber to admit the mixture to said nozzle, and means automatically controlled by said valve to admit air to said explosion chamber, said valve being adapted to be automatically closed by the explosion to prevent the back pressure from entering said mixing chamber. Five claims.

1,475,076. AUTOMATIC BOILER FEEDER. HERMAN E. MALAIER AND FRANK R. CLARK, JR., OF ROCK MART, GEORGIA.

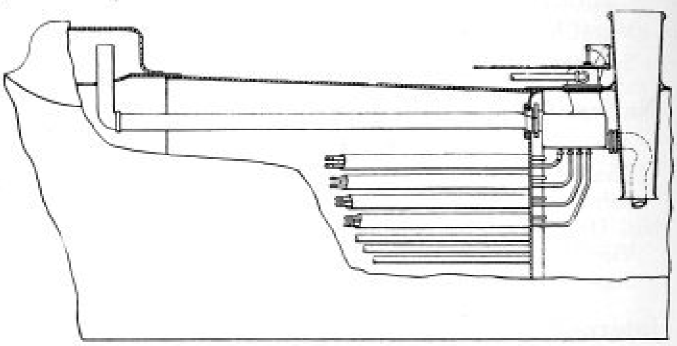
Claim.—A feed water apparatus for boilers having a three-way nozzle provided with a plurality of steam channels for respective connection with the



boiler steam dome and the steam chest of the feed water pump, and another channel in communication with the pump and provided with a water outlet at the inner end of the nozzle, and a float actuated valve for controlling said outlet and the communication between said steam channels. Two claims.

1,476,150. LOCOMOTIVE SUPERHEATER. MICHAEL M. CROWLEY, OF SIOUX CITY, IOWA.

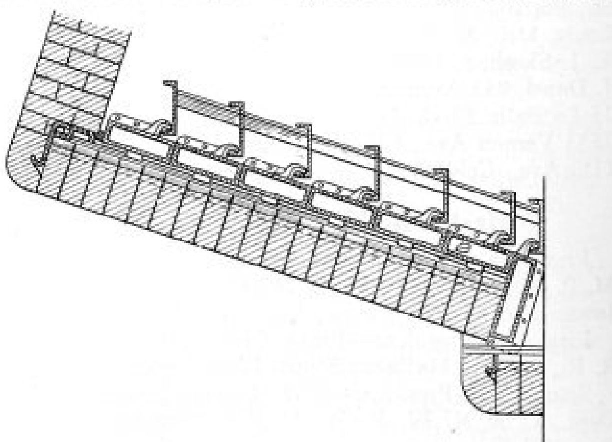
Claim.—In combination with a boiler of locomotive type, of a superheater header consisting of an integral casing supported within the smoke box and extending transversely across the same in its upper portion, said casing comprising a compartment disposed between the dry pipe of the boiler and the superheater units, a second compartment disposed upon the first compartment and receiving superheated steam from said superheater units, a third compartment disposed at the front of the other compartments and adapted to



conduct superheated steam to the engine cylinders, said second and third compartments having upwardly projecting tubular extensions open at their upper ends and tightly secured at such upper end to the smoke box top plate, said plate having a single opening therethrough extending over the open ends of said extensions, a dome tightly mounted on the outer face of said top plate and enclosing said opening and adapted to establish communication between the extensions of the second and third compartments, said dome further provided with outlets adapted for communication with other steam actuated auxiliaries whereby superheated steam may be delivered to such auxiliaries, and a throttle valve mounted in the upper end of the extension of the third compartment, said valve extending through said dome and manually operable from the locomotive cab. Four claims.

1,477,895. FIRE ARCH. HERMAN A. POPPENHUSEN, OF HAMMOND, INDIANA, ASSIGNOR TO GREEN ENGINEERING COMPANY, OF EAST CHICAGO, INDIANA, A CORPORATION OF ILLINOIS.

Claim.—In a fire-arch, a plurality of laterally spaced beams, a plurality of rows of tiles, one row in each of the spaces between said beams and sus-



pended therefrom, a plurality of conduits above said beams and adapted to have a cooling medium circulated therethrough, said conduits extending across said beams, and means carried by said conduits and engaging said beams for suspending the same from said conduits. Seven claims.

THE BOILER MAKER

MARCH, 1924

Fabricating Heavy Plate by Oxy-Acetylene Welding

Two 1,000-Barrel Oil Storage Tanks, 125-Foot Rotary Kiln and 50,000 Cubic Foot Gas Holder Successfully Welded

WITHIN the last year progress in applying oxy-acetylene welding and cutting to the fabrication of heavy steel plate has been marked by the completion of three notable jobs, namely, two 1,000 barrel oil storage tanks, a rotary kiln (the largest single piece of rotating equipment ever built by welding), and a 50,000 cubic foot gas holder. Each of these illustrates the fact that welding can be used in a particular field, as well as the fact that large scale oxy-acetylene welding operations can be carried on under field conditions. Basic engineering principles which have been proved to be correct when doing similar work on a smaller scale were adapted with a few modifications to the special needs and special conditions met with in these larger operations.

Welding Operations Planned in Advance

Most of the welding practice was considered and planned in advance. Some changes or modifications of the first plans, however, were reached after a careful consideration of all the factors involved. This slowed up the time of completion in each case, but since the engineers in charge "felt their way" and kept careful records as the jobs progressed, a considerable fund of valuable information was gained. This information is being made available in various ways to the welding industry and to executives in other lines who are interested either in the results obtained or in the methods utilized and will undoubtedly open up hitherto untried fields for the process.

Construction of 1,000 Barrel Oil Storage Tanks

The first of these three jobs, in point of time, was the construction of two 1,000-barrel oil storage tanks in Ohio for a pipe line company. The company felt that if it should be found practicable to build welded tanks for the storage of crude petroleum, savings would be made through the elimination of leakage and evaporation which always take place to a greater or less degree through riveted seams. Experience with smaller oil storage tanks and drums has shown that an oxy-acetylene welded joint has a high factor of safety and such a joint, when properly made, is not only leakproof but is permanently leakproof. Expansion and contraction caused by pressure and temperature do not affect properly welded seams after the tank has been placed in service.

As has been mentioned, it was not formerly considered practicable to weld a tank as large as 1,000 barrels capacity. However, the advantages to be derived from such construction were so attractive that an attempt was made to prove by building some of these tanks that, if the proper methods were pursued, welded construction could be successfully utilized in this work.

These two tanks are 20 feet in diameter and 18 feet high. It was necessary that they test "gas tight," and it was specified that the plates were to be of the best grade open hearth tank steel. The bottoms and shells are of 10.2-lb. plate throughout, the bottom angles 2½ inches by ½ inches by 5/16 inch and angle rafters were placed radially. Various pipe connections, manholes, valves and other fittings were welded in place and a welded stairway which was made of steel plate and odd lengths of piping was installed on each tank.

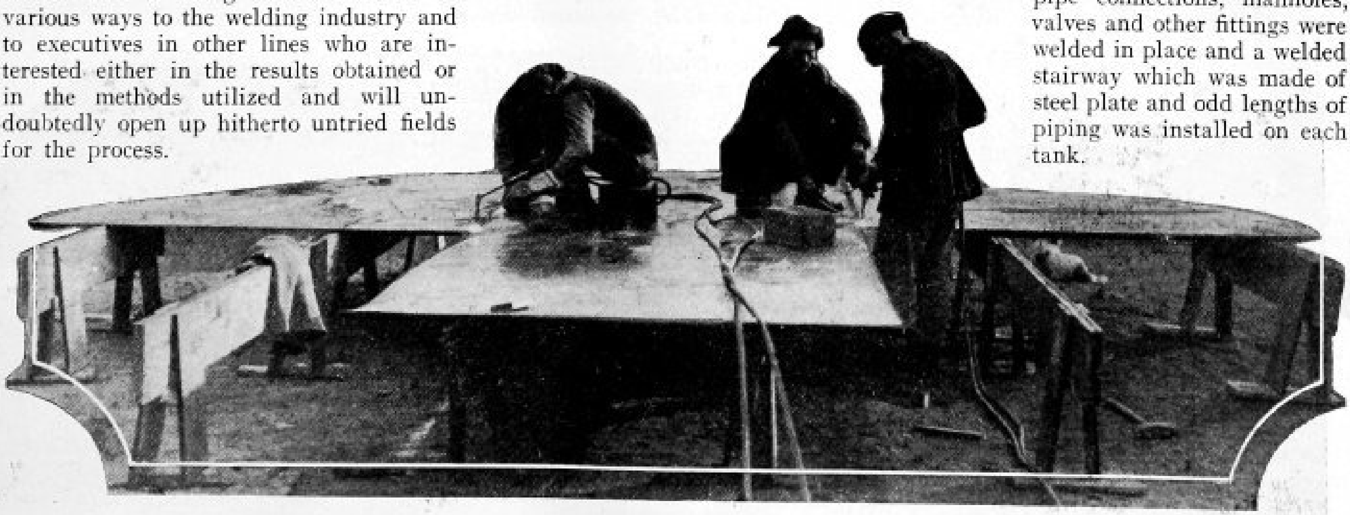


Fig. 1.—Welding Bottom Plates of Oil Storage Tank

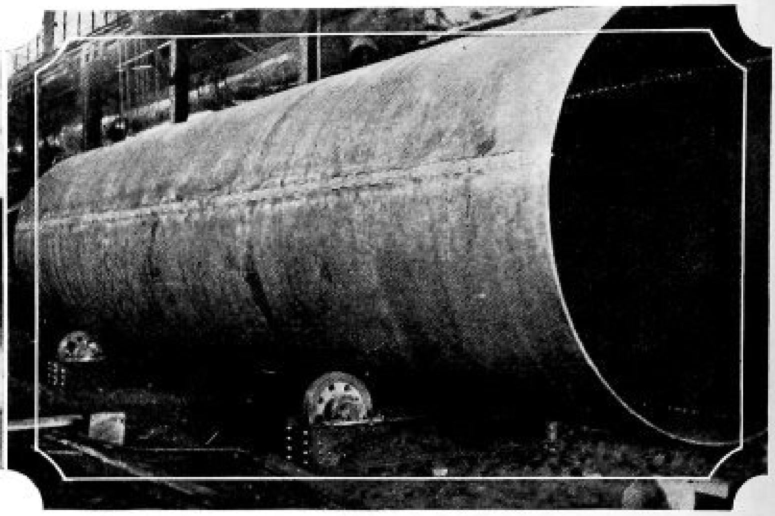


Fig. 2.—(Left) Welding a Longitudinal Seam of Rotary Kiln Section. (Right) End Section of Kiln with Welds Complete.

Before the work was actually begun the engineers who had charge of the welding operations were able to foresee a number of the obstacles which would be encountered and make a provision for them. One was the buckling which was expected in the plate. Arrangements were made to guide and control this in a manner that proved satisfactory with one or two exceptions. Some other minor emergencies which could not be provided for in advance were successfully met as the job progressed, none of these proving any more serious than the ordinary incidents expected by field men erecting tanks of riveted construction.

Sequence of Operations

Roughly, these tanks were built in the following order. The bottom plates were set up on wooden horses and matched. Handling this work off the ground made the welding operations easier and simplified the control of expansion and contraction in the plate. The plate had been delivered direct from the mill where it was beveled to a 45 degree angle.

The wooden horses supporting the bottom plates were set up so that these were parallel with the seams to be welded. After the plates were set in position they were welded. In the first of the tanks contraction was allowed for by spacing the plates apart. In the case of the second tank the plates were tack-welded at 12-inch intervals. Seams were then welded, a helper being utilized as an aid in spacing the sheet as the welding progressed. These helpers also handled a series of clamps which were required on all the long seams, and in some cases held the edges of the plate apart with a specially fashioned lever which worked very well.

A curb angle welded around the edge completed the construction of the tank bottoms. This curb was tack-welded at 8-inch intervals and then was welded solidly into place. The finished bottoms were tested with kerosene poured in to a depth of 1 inch, this test bringing to light two small defects in the welds of the first bottom. After these were re-welded a second test did not show a single defective place. The second bottom successfully passed the test to which it was subjected, without showing any defects. Individual sheets for the sides of the tank were lifted (with a derrick), properly spaced to allow for expansion and contraction and then welded into position. Clamps, and in some cases helpers with levers, served to force the plates into correct alinement when it became evident during the welding that movements were not being properly controlled.

As each of the three rings was completed it was submitted to a hammer test. The small number of defects which appeared were made tight by re-welding before the work proceeded to the next ring. In a number of places it was found that the plate, sheared and formed at the mill, did not fit as planned. Here the oxy-acetylene cutting blowpipe was utilized to excellent advantage in trimming the misfit section to the correct dimensions. The roof structure and plates were then welded and swung into place and the pipe connections and fittings attached.

Upon the completion of these two tanks they were completely filled with water and, while under this water pressure, the seams were severely hammered. A small number of pin

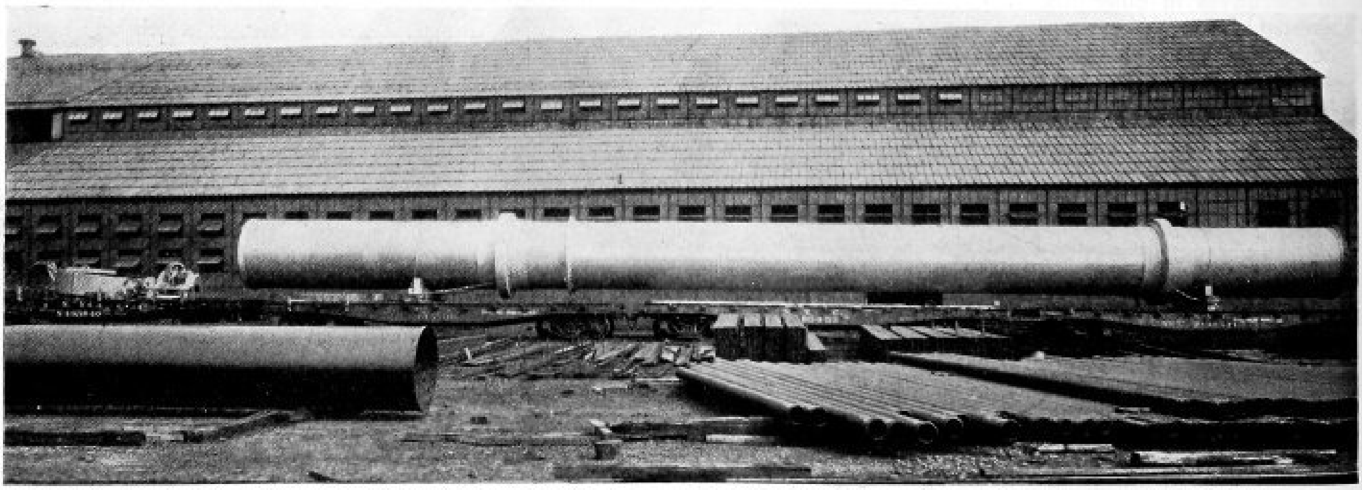


Fig. 3.—Drier Mounted on Cars for Shipment

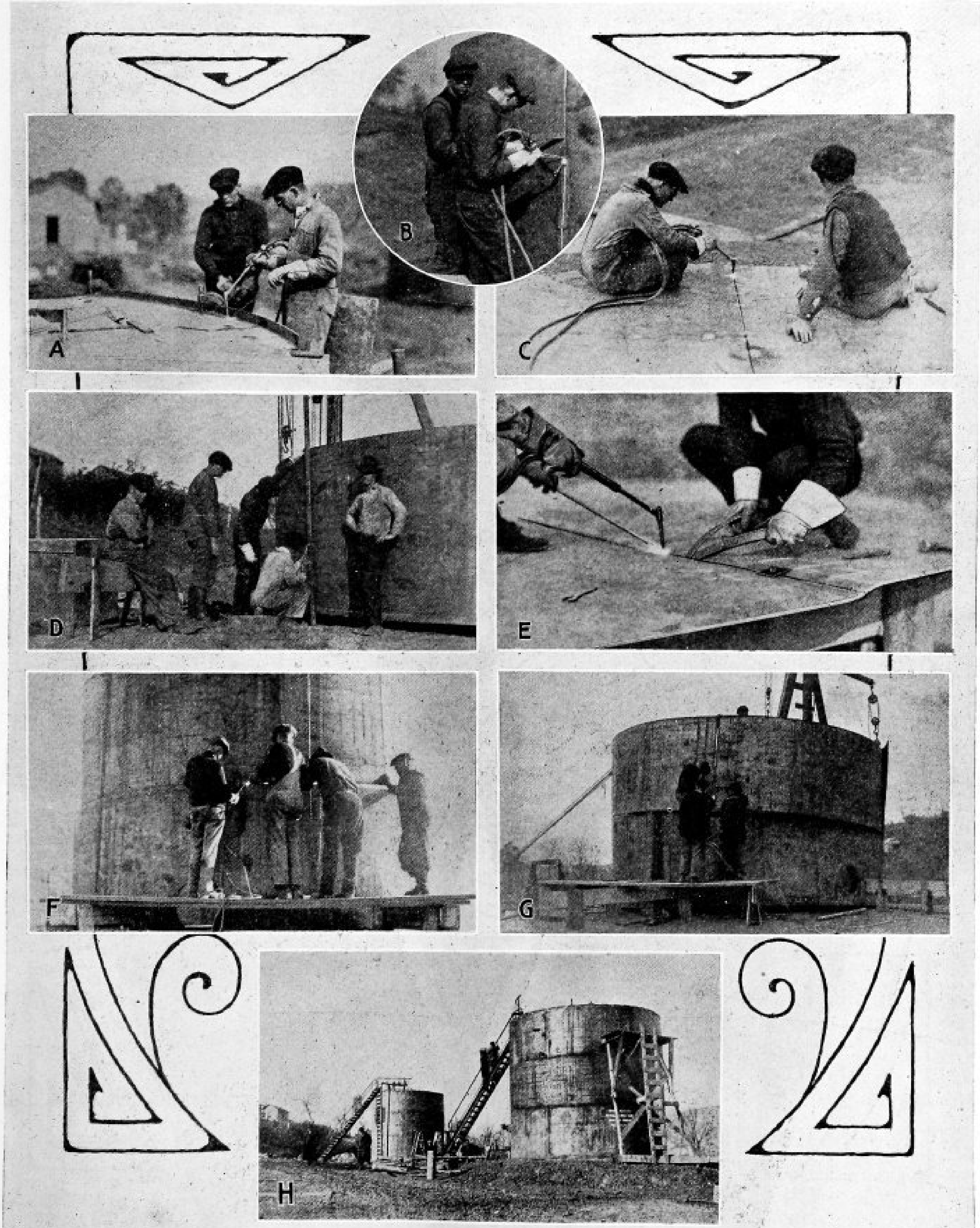


Fig. 4.—(A) Welding Curb Angle to Tank Bottom. (B) Welding a First Course Vertical Seam. (C) Tack Welding a Bottom Seam. (D) Lining Up the First Course Plates. (E) Nearing the End of a Seam. (F) Welding the First and Second Ring Seams. (G) Finishing the Second Ring. (H) The Completed Tanks.

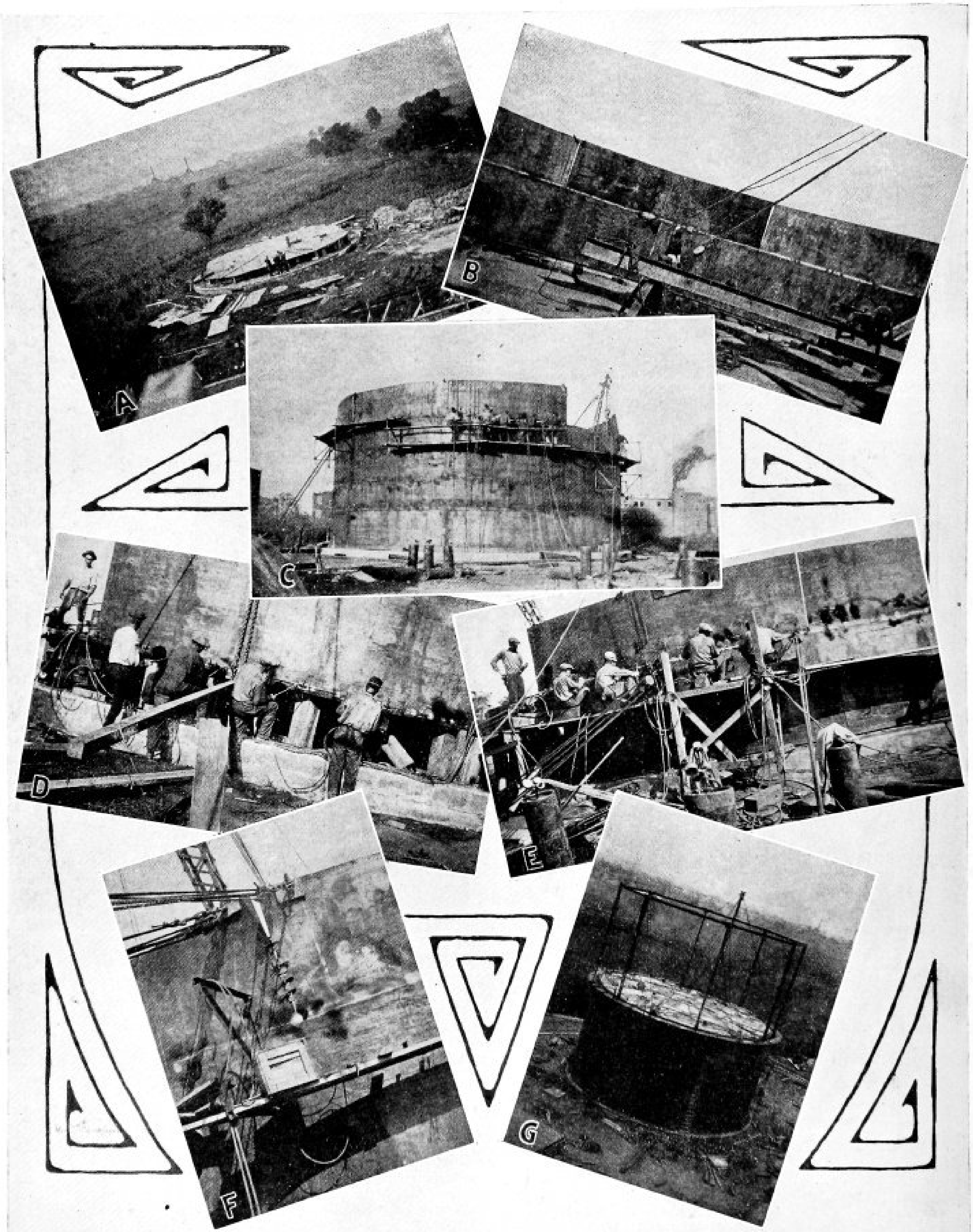


Fig. 5.—(A) Bottom Plates Ready for Welding. (B) Second Ring "Key" Plate Clamped in Position. (C) Welding One of the Upper Rings. (D) Welding the First Course. (E) At Work on the Second Ring. (F) Method of Controlling Expansion and Contraction in Plates. (G) All Welded Gasholder Completed.

hole leaks developed under this test, these being easily rewelded. These tanks have been in service now, for the company for which they were built for over a year and are reported to be entirely satisfactory.

ROTARY KILN NEXT BUILT

The second large job mentioned above is a large rotary kiln, 125 feet long and 8 feet in diameter. This type of equipment had always been riveted up to this time.

Such dryers and kilns are lined with firebrick when in use and their interior is heated to high temperatures, while the heavy material to be treated passes through from one end to the other. During this process the kiln is rotated on steel tires by suitable gearing attached near one end.

These severe conditions impose large stresses upon the plate from which the kiln is made and, of course, upon the joints between the plates. Five-eighths-inch steel plate was used on the large welded kiln and it was estimated that either a single or a double vee welded joint finished down close to the plate on both sides would give sufficient strength to resist twisting, bending and temperature stresses.

The kiln was built in ten sections, eight of these being 8 feet in diameter and 8 feet long, and two, 30 feet 6 inch in length and 8 feet in diameter. The former were made of a single piece of plate rolled into a ring and closed with one welded seam 8 feet long. The latter were fabricated by welding together three sections about 8 feet wide, bent the short way; thus there were three longitudinal seams in the 30-foot sections. Welding practices employed in this work were identical to those described on the tanks and contraction and expansion in the plate was controlled in the same way. That these practices were highly successful is evidenced by the fact that when this great steel tube was completed it was eccentric only ½ inch in diameter on one end and ⅜ inch on the other. These variations were well within the ⅝-inch tolerance allowed for eccentricity in riveted or other construction. Bolt holes for attaching the revolving gear, which were punched in the sheet before the sheet was rolled, matched up closely after completion of the welding, only a small amount of reaming being necessary.

FABRICATION OF 50,000-CUBIC FOOT GAS HOLDER

So successful were these two jobs that it was decided to undertake a still more complicated piece of plate fabrication. Plans were drawn to build entirely by oxy-acetylene welding a 50,000-cubic foot gas holder to be erected in Columbus, Ohio. The water tank of this gas holder was 53 feet 3 inches in diameter and 26 feet 6 inches high, having a storage capacity more than ten times as great as that of either of the two tanks described in the first part of this article.

To describe in detail the practices employed in this work would be to cover the same ground as the preceding paragraphs. The principal variations in practice were only those which were brought about by the difference in the size of the job in the field and carrying it through to completion as rapidly as consistent with good work.

Almost the same sequence of operations was followed as in the building of the two oil storage tanks. The plates constituting the bottom were first tack-welded into place, which operation was carried on with the plate supported on wooden horses, as in the former instance. A curb was tacked around the edge of the completed bottom and the first row of plates for the sides of the tank was built by welding individual plates to form a ring. Then the plates of the bottom were welded together, and the tank tested by filling with 12 inches of water and hammering the seams on the outside. Whatever small defects were found were readily corrected by re-welding.

After successfully passing the tests imposed, the bottom section was lowered on to the foundation. Then the second, third, fourth and fifth rings were welded, and the tank completed by welding the "walk-around" into place. Routine tests of the seams above the first ring generally consisted of throwing a stream of water from a fire hose against the inside of the seam and observing the outside for traces of moisture forced through. Finally, the completed tank was filled with water and the welded seams pounded. It was required that the bell in this tank be absolutely gas tight and upon its completion it successfully met this requirement. Since completion, another gas holder of about the same capacity has been erected by oxy-acetylene welding at Salt Lake City, Utah.

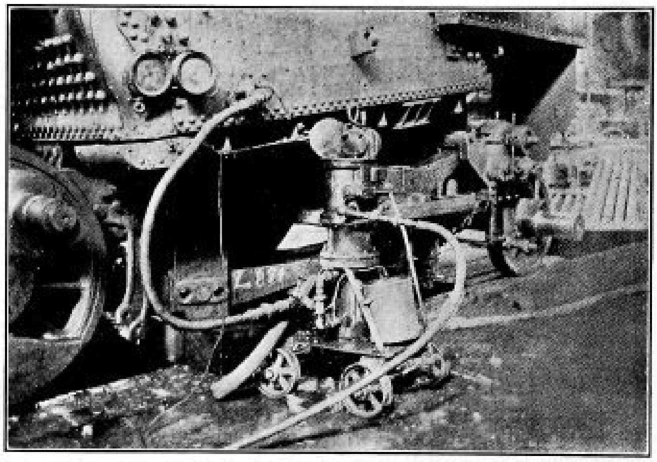
These three operations represented pioneering effort in three important phases of heavy plate fabrication. The fact that the equipment built has successfully met all the requirements indicates that such work is feasible by oxy-acetylene welding. The principles involved have been proved correct.

Air Pump Used for Hydrostatic Testing

By E. A. Murray

Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

THE illustration shows how a 9½-in. Westinghouse air pump can be used successfully for applying a hydrostatic test to locomotive boilers. The steam end of the air pump is connected directly to a water cylinder, which is 4 in. in diameter. The pump is operated from the air line and



Ingenious Arrangement for Giving Locomotive Boilers Hydrostatic Tests

forces the water into the boiler through a metal hose. This hose is equipped with an angle cock at the point where it is applied to the boiler and can be used to hold the pressure in the boiler in case the pump is shut off.

The pressure gages are located in view of the operator, which facilitates the work of carrying on the test. No trouble has ever been experienced where this apparatus has been used and pressure can be maintained easily on the largest boilers.

STATE OF WASHINGTON ADOPTS BOILER CODE.—The secretary of the American Uniform Boiler Law Society, Charles E. Gorton, 253 Broadway, New York, has sent out a notice of the incorporation of provisions covering boilers and pressure vessels in accordance with A. S. M. E. Boiler Code requirements in the new "Safety Standards" of the state of Washington, Department of Labor and Industries.

The section on "Boiler and Pressure vessels—Requirements and Inspection" reads as follows:

"The Boiler Codes (1918 Edition, and 1921 Edition for Locomotive Boilers) of the American Society of Mechanical Engineers are approved by this Department. Boiler Inspections made by inspectors employed by insurance companies licensed to write boiler insurance in this State, and also inspections made by city boiler inspectors or other boiler inspectors of equal competence will be accepted by the Department."

Adequate Training Needed for Welding Operators

Successful Flue Welding Can Be Accomplished by Using Good Material and Equipment and by Carefully Preparing Parts

By C. E. Lester

FUSION welding, familiarly called the autogenous process, has assumed such an importance in locomotive boiler work that without it the present records of repair and maintenance would not be possible. Out of the vast number of successful applications that have been made with the process, there have been a few cases, particularly the welding of flues, that have not been as good as they might be, due to a number of causes that were in no way a reflection on the process itself. However, certain mechanical men of unquestioned ability have looked with some disfavor on the use of the process where there is an element of uncertainty in the results to be expected.

The following paragraphs outline precautions and suggestions which, if carefully observed, should remove any question of the safety of welding such places as flue beads where some difficulty has existed in getting these tight especially in bad water districts.

Too little importance has been placed upon the proper training of operators. It is undoubtedly a fact that many welding outfits have been and are being placed in shops without any previous or current training of the supervisors and avoidable mistakes have been made in the process of the self education of those in charge of the work.

The period of experimentation in flue welding has extended over a term of ten or twelve years and may now be considered to have passed that stage and is, under favorable conditions, a successful operation, if proper preparations are made and the work skillfully done.

Making Tight Flue Welds

The principal drawbacks to the welding of flues seem to be porosity of the welds, overheating and split beads. The opposition to the adoption of the practice in bad water districts is probably due to these three causes with the more or less unknown contributory factors in the case of longitudinally split beads.

The porosity of the weld doubtless comes from the minute blow holes that form as the molten metal passes from a liquid to a solid form. Many of the small holes may be closed with a few light blows of a calking tool. Leakage from this cause can however be only a seepage and not in an amount that will cause failures.

Causes of Overheating

Overheating comes from lack of sufficient cooling area to counteract the impinging heat. This effect may be due to one or a combination of the following causes: Ferrules too long, bridges too narrow, infrequent expanding of flues with resultant accumulation of solids, lack of adequate means of washing between flues and reactions from uncertain combinations of metails, chemicals and heat. All these factors, save possibly the last, lead to accumulations of mud and scale and result in overheating and leakage.

Any heating surface unless kept clean of foreign matter loses its relative efficiency in proportion to the accumulation of insulating material, hence it would seem but logical in design, that cognizance should be taken of the fact that closely spaced flues are prone to accumulate insulating solids and that a sacrifice of some flue heating surface by increasing the width of the flue bridges would be compensated for, in service, by giving freer circulation with a consequent delay in accumulating solids and longer lived flues.

When flaring flues preparatory to forming beads, it is unquestionably a fact that microscopic cracks are started. This applies particularly to flues cut off by a beveled cutter and is reduced somewhat when flues are cut off by a hot saw. The conditions encountered are similar to the more pronounced cracks occasionally encountered in flanging boiler plate, when ragged edged plate is flanged without filing or chipping off.

When flues are not welded these cracks are, ordinarily, of little consequence as they are closed by the beading tool when the beads are first turned over. So long as the flue end is kept cool, as in good water districts, welded or not, there is no deleterious action. In bad water, where flues are not welded, the splitting tendency is counteracted by more or less frequent beading which keeps the cracks closed. With the flues welded, however, in bad water, the beads are held in position by the weld and the frequent expansive and contractive effects caused by unequal temperatures, coupled with over-heating due to dirty sheets cause these incipient cracks to open up and gradually increase in size as they cannot be beaded to close them due to the weld about them. This statement is proven by the fact that flues which are welded and later split may have the weld cut off, the flue expanded and rebeaded closing the cracks, be put in service *without* welding and give good service without again cracking for some time. It would therefore seem logical that by cutting safe ends off in a manner to minimize end fractures less tortuous methods of turning over flues and the reduction of accumulating solids next the sheet would lead to better service from welded flues in bad water.

There are several other conditions that effect serviceable welding that are purely matters for correction by the local management. For example; poor welds may be caused by any one or a combination of the following: poor welding wire, incompetent welders, dirty welding surfaces, improper amperage and voltage, copper ferrules in contact with the weld, irregular current, oily surfaces for the weld. The sum total represents a lack of skilled supervision.

No attempt should be made to weld where there is the slightest trace of mineral oil. The practice of sandblasting before welding seems almost a practical necessity. The firing of boilers before welding also seems good practice. However, the use of a vegetable oil—for lubricating flue tools will eliminate the necessity for firing up as the welds are not adversely affected by this oil.

Amount of Metal in Weld

In the welding of flues the main point for consideration is to actually make a bond between the flue bead and the sheet. It is not necessary to use a great amount of material—an amount of metal of approximately the same height and half the width of the bead or equal to one-half the cross sectional area of the bead being sufficient. The weld should be started a little to the left of the bottom of the bead, going up the right side a little past the top center. Then commence again at the bottom and come up the left side, slightly overlapping the top of the weld first made.

Due to the light weight of locomotive flues as compared with the sheet there is always danger of flowing away part of the bead in the "burning in" process and work of this description should be entrusted only to welders of known ability and long experience.

Whether or not flues should be welded, especially in bad water, is still a matter for debate, yet it is believed that the solution lies only in changes in present methods and practices.

In view of the rapid strides in autogenous welding since its invention barely two decades ago, I venture the prediction that the next few years will bring successful flue welding under all conditions of service.

"Cleanliness is next to godliness" in welding. It is most imperative that all parts to be welded be clean and smooth. I do not favor the use of the "roughing tool"—one reason being that it may cover up spongy spots left from other welds and is not conducive to good welds that will be free from pin holes. To "rough up" a spot for welding seems but an admission that other more necessary work has not been done.

Close observation of flue welding under various conditions of service leads the writer to express the opinion that the so-called failures of electric welds are the result of faulty application of the process.

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, C. W. Obert, 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, and then given publicity where it will reach the members of the industry who are interested.

CASE No. 423—*Inquiry*: If a horizontal return tubular boiler were supported by outside-suspension supports at the rear end, but at the front end the projecting smokebox section of the shell were supported by a structural steel cradle or framework, with ample bearing extending around the circumference to properly distribute the load, is it permissible, under Pars. 323 and 324 of the Boiler Code, to consider it as supported by the equivalent of the outside-suspension type of setting?

Reply: It is the opinion of the committee that while such construction does not conform to the requirements for the outside-suspension type of setting, the form of support above outlined may be considered the equivalent of suspensions sanctioned by the Code.

CASE No. 426—*Inquiry*: Is it permissible, in checking the safety valve capacity of a steam traction engine boiler, under Par. 275 of the Boiler Code, to deduct from the evaporative capacity of the boiler the amount of steam used in the stack steam jet for the forced draft, which jet must be used to develop the maximum evaporative capacity of the boiler and cannot be shut off under an accumulation test if the maximum evaporation is to be obtained?

Reply: The object of the accumulation test specified under Par. 275 is to make sure that there is ample safety valve capacity for any conditions that may exist in service. It is the opinion of the committee that the test should be made by forcing the fire and driving the engine at its maximum load and then shutting off the engine suddenly with the hottest fire that can be built up with the draft created by exhausting the steam from the engine into the stack; the pressure gage should be watched carefully after shutting down the engine, to note the maximum rise in pressure.

CASE No. 428—*Inquiry*: Is it permissible, under the requirements of the Boiler Code, to form a diagonal boiler brace from a single bar of rivet material with integral single rivet ends, that for the head connection being formed straight so as to project directly through the rivet hole, whereas the other being formed at right angles to the brace so as to permit of easy insertion to the hole in the shell after the head rivet end is inserted, and if so, how shall the brace be proportioned under the requirements of the Code?

Reply: It is the opinion of the committee that for such a design of diagonal brace with single projecting rivet ends, the requirements of Pars. 8, 223, sections 1, 2 and 8, apply. In the application of this form of diagonal brace, the method of calculation of the stayed surface will be found in Par. 203a, in which it is shown that 135 must be used as the value of C in the formula of Par. 199. In the application of diagonal brace of the form described, attention is called to the necessity of carefully insulating any portion of the head or shell that might be heated up if the projecting rivet end is heated in position before riveting.

CASE No. 432—*Inquiry*: Is it permissible, under the requirements of the Heating Boiler Section of the Code, for the fusible plug to be inserted in the front head of a firebox type of boiler with tubes in a two-pass arrangement so that the plug sets 1 inch above the upper row of tubes, which tubes are inclined upward toward the rear?

Reply: It is the opinion of the committee that in such a construction as you describe, the fusible plug may be placed in the front head, provided the requirements of Par. H-64 are met.

CASE No. 433—*Inquiry*: Why is Par. H-97, relating to water-relief valves in the Cast-Iron Section of the Heating Boiler Code, different from Par. H-44 of the Steel Plate Section, which also relates to water-relief valves?

Reply: There is a clerical error in Par. H-97, which should read the same as Par. H-44 to state that the valve shall be of the diaphragm-operating type without guide wings below the seat.

CASE No. 434—*Inquiry*: Will a steam stop valve, the outside screw of which is of the telescoping type, meet the requirements of Pars. 301 to 303 of the Boiler Code? It is pointed out that while the hand-wheel is stationary, the telescoping member rises and falls with the action of the valve and serves as an indicator as to the open or shut position of the valve.

Reply: It is the opinion of the Boiler Code Committee that the valve as described does not meet the requirements in the Code which specify an outside-screw-and-yoke type of valve in which the spindle projects through the hand wheel when the valve is open.

Bureau of Locomotive Inspection Makes Report for January

The Bureau of Locomotive Inspection during the month of January inspected 5,311 locomotives, of which 3,073 or 58 percent were found defective and 737 were ordered out of service. There were 85 accidents during the month caused by the failure of some part or appurtenance of the locomotive or tender, in which 6 were killed and 93 were injured.

Boiler Manufacturers Meet in Cleveland

Mid-Winter Meeting of American Boiler Manufacturers' Association Devoted to Discussion of Standard Practices for the Benefit of the Industry

ABOUT 40 members of the American Boiler Manufacturers' Association attended the mid-winter meeting of the association at the Hollenden Hotel in Cleveland, O., on February 12 to discuss standard practices. The meeting was opened at 9.45 A. M. with President E. R. Fish, of the Heine Boiler Company, in the chair.

Mr. Fish reminded the members that this was purely an association meeting for the purpose of discussing standard practices for the benefit of the industry.

Report of the Secretary

H. N. Covell, secretary of the association and chairman of the membership committee, reported that since the annual meeting in June two new members had joined the association and that the membership committee is conducting a vigorous campaign to increase the membership. Assurance was given that five additional boiler making concerns had already signified their intention to join the association. As there are from 30 to 40 other concerns that should become members the secretary urged the members to urge the men in their own towns to join the association.

The secretary-treasurer also reported that the financial condition of the association is in excellent shape with all bills paid and a good balance in the bank.

Code of Ethics

The question of a code of ethics for the association was briefly discussed. At first it was the intention of the committee on ethics to present the same report that was prepared for the last annual meeting but discussion brought out the opinion that the report could be improved upon by consulting the codes of other organizations and it was finally voted that the report be referred to the executive committee to cooperate with the ethics committee in preparing a report for presentation at the spring meeting.

Report of Commercial Committee

Thickness of Pressed Steel Manhole Plates for Various Working Pressures

In endeavoring to obtain information regarding the strength of pressed steel manhole plates to show what pressures they will stand the committee took the matter up with various manufacturers, one of which made tests with the following results:

Ten-inch by 15-inch manhole caps suffered no distortion at 600 pounds pressure but at 700 pounds showed a deflection and a permanent set.

Eleven-inch by 15-inch manhole caps withstood 1,000 pounds without showing any permanent set.

Twelve-inch by 16-inch manhole caps withstood 1,000 pounds pressure with no permanent set.

The 10-inch by 15-inch and the 11-inch by 15-inch manhole plates were of ½-inch steel and the 12-inch by 16-inch were of 9/16-inch steel.

Standard Form for Acceptance of Jobs on Boilers Where the Erection is Part of the Boiler Manufacturer's Contract

Acting upon the instructions of President Fish, your Commercial Committee wishes to report on the subject of standard form to be used by boiler manufacturers in having the work of erectors accepted by the purchaser.

Typical Acceptance Forms

We have asked the various members of our Association to send us copies of such forms as any of our members may use and wish to report we had a very good response, and those who had such forms furnished us with same.

The E. Keeler Company of Williamsport, Pa., report they use the following form and with very good results:

Release of Erecting Engineer

E. Keeler Company,
Williamsport, Pa.

The undersigned has examined the work of erecting equipment furnished under contract with you and finds his work complete as specified in the contract and satisfactory to us.

....

Dated ....

The Murray Iron Works state they do not have any standard form for release of boiler erectors, but do have such a form for use of their engine erectors, and their standard form is as follows:

Burlington, Iowa, ... 192..

....
....

This will introduce Mr. ...., one of our erecting engineers, who comes to superintend the erection of your .... at a charge of ten dollars ($10.00) per day and expenses, in accordance with the following schedule:

One dollar per hour including time traveling.

Living expenses from time of leaving until return, including such incidental expenses as are ordinarily met with in a journey.

Railroad, steamer, trolley and street car fares and transfer charges for baggage and tools.

Sleeping car expenses for night trips and long overland journeys. In a word, we are putting this man at your service, at your request, and we are most anxious to avoid any disputes over his time and expenses. We must maintain a larger force of traveling engineers that can be usually kept continuously employed because we almost never know when they are to be called for, and our margin of profit is so small that it cannot stand deductions.

But our men are expected to be square and honest in their charges and to serve the customer to the best of their abilities.

In putting Mr. .... at your service we wish it understood that we are not responsible for any accidents to life, limb or property, which may occur while he is at work on or about the premises. He is a careful and reliable man, and we are exercising all due care in sending him to you, but after he is on the job, he must be considered as your employee and you must accept responsibility for accidents.

Kindly so indicate youi understanding of this matter by signing the duplicate copy of this agreement that he will hand you, and very much oblige.

Yours truly,

Accepted — Murray Iron Works Co.
By ....

....

The American Hoist & Derrick Co., St. Paul, Minn., report that they have a standard form in connection with their machinery business and their form is as follows:

Dated at ....
....

American Hoist & Derrick Co.,
St. Paul, Minnesota,

Gentlemen: This is to certify that we have received in good condition .... specified in contract of .... and that Superintendent of Erection .... has satisfactorily supervised installation and has left same in perfect working condition.

Respectfully,

....
....

The Henry Vogt Machine Co., Louisville, Ky., have a standard form in connection with their ice machine and watertube boiler installations and their form is as follows:

Henry Vogt Machine Co.,
Louisville, Ky.

Gentlemen—This is to certify that your engineer, Mr. .... has completed in an entirely satisfactory manner all work under contract between .... and Henry Vogt Machine Co., said contract dated ....

We hereby accept this work and agree to make settlement in accordance with terms of said contract.

....
....

Dated at ....
.... 19..

Some of our members have felt that there might be difficulty in obtaining the signature of the customer to a standard form and have felt that it would be easier to get an acceptance from the customer drawn up in the customer's own way. However your Committee wish to report that we believe the form as outlined below might prove beneficial to the manufacturers of boilers who are called upon to erect boilers on the purchaser's foundations:

This is to certify that your Erecting Engineer Mr. .... has completed the installation of material covered by contract between .... and the .... Boiler Company, dated .... The undersigned has examined the work and equipment furnished under contract, and the workmanship is satisfactory and the material furnished as specified in contract and is hereby accepted.

....

....

Dated at ....

.... 19..

Discussion

E. C. Fisher, of the Wickes Boiler Company, stated that it was always assumed that manhole covers were manufactured of sufficient strength to equal the Code requirements. In view of the results of the tests, however, he believed that other manufacturers should test their manhole plates as it was very important that no weakness should develop in this part of the boiler.

F. G. Cox, of the Edge Moor Iron Company, described a test of a ½-inch manhole plate in the head of a drum 34 inches inside diameter. The drum was tested to 1,200 pounds pressure. While the plate withstood this pressure without distortion the turn-in edges of the manhole were distorted and the plate in the center moved in so that a ⅛-inch space was opened between the plate and the reinforcing ring around it.

E. R. Fish, of the Heine Boiler Company, president of the association, stated that the American Society of Mechanical Engineers does not specify anything as to manhole covers nor their strength. Reinforcement of the boiler plate at the manhole is covered and, with the increasing boiler pressures, he believed this matter becomes of great importance.

As to a standard form for acceptance of jobs on boilers where the erection is a part of the boiler manufacturer's contract, Mr. Fish expressed the opinion that if all manufacturers used the same form there would be less resistance from the customers.

E. G. Wein, of the E. Keeler Company, pointed out that the contract itself takes up all the details of the work and that the card referred to in the report simply signifies that the work has been done in accordance with the contract.

A. G. Pratt, of the Babcock & Wilcox Company, reiterated the statement that the signing of the card simply means that the job is finished and he believed it would be inadvisable for the association to adopt a specific form.

E. R. Fish, of the Heine Boiler Company, stated that his firm did not use any special form but the engineers were expected to get a statement from the firm stating that everything had been installed so that there will be no question of shortages.

It was voted to adopt the report of the committee for the information of the members of the association.

Cost Accounting

The cost accounting committee reported progress, F. G. Cox, its chairman, stating that the three members of the committee, each of whom is engaged in a different kind of work, will present a report at the spring meeting based on voluminous correspondence showing the cost accounting systems used by various members.

Report of Stoker-Boiler Committee

A. G. Pratt, chairman of the Stoker-Boiler Committee, advised the members that no meeting of the committee had been held since the spring meeting of the association, but that as there are several matters to be discussed the committee will report at the annual meeting in June. He suggested that the committee can help the members most, if the members will tell the committee what their difficulties are.

E. R. Fish, in referring to the value of the work of this committee in the past, urged the members to make the association a clearing house for solving their difficulties.

Mr. Fish also referred to a letter from the president of the Stoker Manufacturers Association suggesting the holding of a joint meeting of the boiler and stoker manufacturers associations. As this is a matter for executive committee action, no attempt was made to decide the matter although the opinions expressed indicated that only a few members of the boiler manufacturers association would be actively concerned in matters of common interest to both associations and that matters in which both are concerned can be handled more satisfactorily through the joint committee of both associations or their executive committees.

Report of Committee on Steel Heating Boilers

In submitting this report the committee pointed out that the response to the questionnaire sent out dealing with this question had not been very generous because the information either was not readily available or could not be secured which suggests the necessity for all to keep complete records of installations and performances.

The committee conclusions are submitted under three heads:

1. First Cost.
2. Efficiency.
3. Maintenance.

The choice of type must be left to the customer. Conditions surrounding the installation must necessarily affect the choice and it is often a choice between two evils. The committee refers especially to cast iron boilers of large sizes being installed where steel boilers may be used or the building planned so as to permit their use.

First Cost

Regarding the first cost, the f.o.b. price of a steel boiler at the factory may be somewhat higher but the boiler is usually in such shape that it may be easily and quickly installed or, if it is of another type which requires more erection work, the factory price is usually correspondingly lower.

On the other hand, the cast iron boiler in sections must be erected by experienced and high-priced men. The work must be done carefully or undue strains will be produced in the sections thereby aggravating the usual tendency of cast iron to crack.

It is believed that the overall cost of each type of boiler will not be very different.

Efficiency

While there is not much difference in efficiency as shown by laboratory tests, nevertheless the steel boiler shows better economy in actual service. This is due to several reasons such as the ability of the operator to keep the boiler clean because of openings advantageously placed and the smooth surface of steel making it possible to clean the boiler as compared with the uneven and inaccessible surfaces in the cast iron boiler.

Better combustion is possible with the steel boiler because of the better proportions of the furnaces. The furnace of the cast iron boiler with many sections is often badly proportioned.

According to information which the committee has been able to obtain so far, there is a saving in operating costs by the use of steel boilers of 30 percent or more and, in some cases, it may be nearly 50 percent.

Maintenance Cost of Cast Iron Boilers

Aside from the above, one of the great objections to cast iron boilers is the maintenance cost. The cracking of sections is a constant menace. The cause of this is fundamental as the cracking is characteristic of cast iron.

Cracking may be brought about by

(a) Sudden changes of temperature.

(b) Freezing.

(c) Unequal thickness of metal due to method of manufacture.

(d) Unequal initial strains due to improper assembling.

(e) Non-uniform structure of cast iron due to sand holes, blow holes and spongy formation which cannot be detected by external inspection.

Cost of Insurance

The cost of insurance should also be considered. For steel boilers the insurance is only about 20 percent as compared with that for cast iron. In certain cases, insurance cannot be secured against the cracking of sections because of the nature of the installation.

Accidents

Out of a total number of 976 accidents reported over a two-year period during the heating season, about 30 percent were due to cracking of from one to all of the sections of cast iron heating boilers. The report includes explosions, rupture of tubes, bursting of pipes, etc.; in fact all kinds of accidents to boilers or accessories and pressure vessels of all kinds. When it is considered that the difficulties and expense incident to these failures are a considerable item, it is possible to get some idea of the magnitude of the losses.

Repairs

Often repairs cannot be made immediately as sections are not available and must come from the factory which adds to the expense and inconvenience. On the other hand, repairs on steel boilers can usually be made in a few hours with a minimum of expense and indirect loss.

In conclusion, the committee emphasizes the fact that it does not wish to give the impression that there is no place for the cast iron boiler but rather that it should be used in smaller installations where conditions are favorable and that its use in larger heating plants is neither profitable nor good engineering.

Report of Committee on Standardized Setting Heights for Horizontal Return Tubular Boilers

The writer attended the annual convention of the Smoke Prevention Association in Minneapolis last summer and addressed the 75 smoke inspectors present asking them to appoint a committee to act jointly with the Boiler Manufacturers' committee with full power to work out all details necessary to bring about standardization wherever smoke departments are in force.

The committee was appointed and the joint committee of the two associations met in Chicago on December 11, 1923, with Mr. Chambers, secretary, and Mr. Behan and decided to confer with the A. S. M. E. committee, of which O. P. Hood of the Bureau of Mines, Washington, D. C., is chairman. Their setting heights are somewhat lower than those proposed by the American Boiler Manufacturers' Association but they are minimum heights.

G. W. BACH, Chairman.

Joint Smoke Prevention Committee Meeting

Mr. Bach suggested that a joint meeting of the committees from both associations be held to iron out the discrepancies.

W. A. Pittsford, of the Kewanee Boiler Works and vice-president of the National Smoke Prevention Association, reviewed briefly the work of the Smoke Prevention Association in arriving at a standard height of boiler settings and emphasized the advantages that will be gained by the adoption of this standard by the Boiler Manufacturers' Association.

F. A. Chambers, of Chicago, stated that the Smoke Prevention Association appointed a committee in 1910 to determine the standard height of return tubular boilers as well as of other types. The committee's report was presented in St. Louis and adopted and this standard has been adopted by the Bureau of Mines.

Mr. Chambers pointed out that in cities where smoke inspectors are changed, new men have different ideas as to proper heights of settings and the manufacturers are obliged to make changes. In Chicago, he stated, the Civil Service has reduced materially the changes in personnel. The matter has been taken up with the smoke inspectors of various cities and, while the majority conform, some call for exceptional heights. He believed that if a standard code should be adopted as a guide but not as part of the city ordinances a lot could be accomplished.

The association voted to refer the matter of setting heights to a committee with power to act, the report of the committee to be confirmed at the next annual meeting.

The members of the association were invited to attend the convention of the Smoke Prevention Association in Buffalo on June 3, 4, 5 and 6.

Report of Committee to Act With A. S. M. E. Code Committee

The A. S. M. E. Boiler Code Committee has continued its work through 1923, two days per month having been given to the work.

The work has been confined to a revision of the Code and preparation of an unfired pressure vessel code which will be completed during the year. The new revised Boiler Code, which will be published in a pamphlet 5¼ inches by 7¾ inches, will be designated "The A. S. M. E. Boiler Construction Code—Edition of 1924."

The revised Code paragraphs, prefaced by the letter P, indicate "Boiler Construction Code—Power Section," the material specifications being grouped by themselves and prefaced by the letter *S*. The letter *L* prefaces the paragraphs in the Locomotive Boiler Code, *M* in the Miniature Boiler Code and *U* in the Unfired Pressure Vessel Code. Old paragraph numbers have been adhered to in the revised Code.

A. S. M. E. Boiler Code Revised

In the revised edition, the rules respecting existing installations will be suggestions and are therefore placed in an appendix.

The specifications for materials have been enlarged to some extent and some changes have been made. For example: The elongation requirements for firebox steel have been slightly increased over that required for flanged steel.

There are two paragraphs to which your committee desires to draw attention: P—331, *b* and *c*, read as follows:

b. It is permissible to transfer, without imitation, the markings on the plate under authority of an authorized inspector in charge, said inspector to put his private mark after the transfer stamp.

c. If, during fabrication in the boiler shop, removal of both groups of the plate manufacturers' stamps cannot be avoided because of the cutting or punching of necessary holes in the plates, one group of such stamps may be transferred to a permanent position by re-stamping under the supervision of an authorized state, municipal or insurance company inspector. When stamps are transferred, the plate manufacturer's name shall not be imitated. The inspector shall put his private stamp beside the transferred group and a record of the transfer and the inspector's stamp shall be noted on the data sheet. A group of stamps consists of the manufacturer's name, manufacturer's test under identification number, grade and tensile strength.

P—*332* in part reads:

"Each boiler shall be stamped adjacent to the symbol, as shown in Fig. *P-22* with the following items with intervals of about ½-inch between the lines.

1. Registered number.
2. A. S. M. E. serial number which may be the manufacturer's serial number.
3. Name of manufacturer.
4. Maximum working pressure.
5. Water heating surface in square feet.
6. Year 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 the point of installation.

Manufacturers before using the A. S. M. E. symbol shall be given a registration number by the A. S. M. E. 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 ½-inch above the symbol and centering on it.

The Boiler Code Committee has stated to the A. S. M. E. council that in its opinion it is unnecessary and perhaps unwise to continue the holding of a hearing as often as once in four years. If this be concurred in by the council, revisions which may be desired and agreed upon will be made from time to time as necessity demands. It is hoped that the 1924 edition of the rules will not require a general revision for some time. If the addenda become such as to require a revision, the committee will confer with the council.

The committee recommends that members of the American Boiler Manufacturers' Association apply for copies of the 1924 revised edition of the Code and familiarize themselves with its contents. The committee also recommends that boiler manufacturers apply for registration numbers.

E. C. FISHER.

DISCUSSION

E. R. Fish warned that some manufacturers have not paid sufficient attention to the A. S. M. E. Code and, consequently, have got into trouble. He pointed out that it is impossible to sell boilers except in states where the Code is mandatory and, therefore, all should conform with the Code. The new revised Code with be available shortly and slight differences will be found in the requirements for firebox and flanged steel.

REPORT OF COMMITTEE ON BOLTS AND NUTS AND RIVET PROPORTIONS

F. G. Cox, chairman of the committee, stated that proposed standard proportions for rivets 7/16 inch diameter and under have been published in the Journal of the American Society of Mechanical Engineers and that rivets above that size have not been worked up as yet.

WORLD POWER CONFERENCE

J. E. Mason of *Power*, speaking for Fred Low, editor of *Power* and president of the American Society of Mechanical Engineers, who was unable to attend the meeting, outlined the scope of the World Power Conference to be held at Wembley, England, on June 30 to July 12 and explained the arrangements which are being made by engineers in this country to attend the conference.

In response to the invitation extended to the Boiler Manufacturers' Association to participate in this conference, the association voted to invite Mr. Low to act as its representative at the Conference.

AFTERNOON SESSION

At the opening of the afternoon session the special committee appointed at the Homestead convention and known as the "Hand Book Committee" presented its report through A. G. Pratt, chairman, which will be published in full in the April issue.

PROPOSED RULES FOR THE INSPECTION OF MATERIAL AND BOILERS

The report of the sub-committee of the A. S. M. E. Boiler Code Committee on Rules for the Inspection of Material and Boilers was presented by L. E. Connelly in the form in which it had been completed and approved by the sub-committee and printed in *Mechanical Engineering* for February, 1924. The report, which is intended to form a section of the A. S. M. E. Boiler Code, is divided into two parts, the first dealing with new boilers, and the second with installed boilers. Copies of the rules reprinted from *Mechanical Engineering* were distributed to the members, and, after some discussion as to the advisability of lowering the pressures specified in paragraph 1-16 on Bull-Driven Rivets, the rules were approved.

National Board of Boiler and Pressure Vessels

C. O. Myers, secretary of the National Board of Boiler and Pressure Vessels, told the association that the National Board is now self-supporting and hopes to hold a convention this spring. Seventy manufacturers are now using the National Board stamp, 1,000 boilers are being registered per month at 60 cents per boiler and 321 inspectors are at work. Still more is to be done, however, he stated, and every boiler manufacturer should be registered with the Board and all their boilers should be stamped.

One question is giving annoyance lately, he said, and that is the furnishing of data reports to manufacturers, owners and insurance companies. In his opinion, only the insurance companies should receive the reports.

American Uniform Boiler Law Society

Charles E. Gorton, chairman of the administrative council of the American Uniform Boiler Law Society, stated that this is an off year in the activities of enacting uniform boiler law legislation as only a few of the legislatures are meeting. In view of this, the Uniform Boiler Law Society is bending its efforts towards keeping the departments in line.

Bills are being introduced by members of departments who have hobbies to ride, he said, and these bills are inimical to the interests of the manufacturers and uniform laws. It is absolutely necessary to hold the departments in line so they will not break the uniformity.

Mr. Gorton announced that the State of Washington has just adopted the A. S. M. E. Boiler Code and also the Locomotive Code so that only A. S. M. E. boilers will be allowed in the State of Washington.

INTERSTATE BUSINESS

President Fish called attention to the fact that a number of members have asked for information regarding doing business in other states than their own and S. H. Barnum of the Bigelow Company suggested that each member write to the Corporation Trust Company, 37 Wall street, New York, for information bearing on this question and also suggested that the commercial committee investigate these conditions as there is a wide diversity of practice and legal requirements.

Secretary Covell announced that the Corporation Trust Company has expressed a willingness to have a representative at the annual meeting of the association to explain this matter.

Mr. Covell also called attention to a communication suggesting the advisability of adopting a standard temperature of water for hydrostatic tests. Mr. Fish advised that this matter is covered by the Inspection Code.

Attendance at Meeting

L. E. Armstrong, Bass Foundry & Machine Co.
Geo. W. Bach, Union Iron Works.
Starr H. Barnum, The Bigelow Co.
H. H. Brown, THE BOILER MAKER.
C. F. Carlson, Otis Steel Co. (Cleveland)
J. G. Carruthers, Otis Steel Co.
F. A. Chambers, Chicago.
D. J. Champion, The Champion Rivet Co.
Fred W. Chipman, International Engineering Works.
J. F. Coburn, Corlett & Co.
L. E. Connelly, D. Connelly Boiler Co.
W. C. Connelly, D. Connelly Boiler Co.
H. N. Covell, Lidgerwood Mfg. Co.
Frank G. Cox, Edge Moor Iron Co.
W. A. Drake, Brownell Co. (Dayton)
J. R. Edwards, Pittsburgh Steel Products Co.
E. R. Fish, Heine Boiler Co.
E. C. Fisher, The Wickes Boiler Co.
J. C. Gaskill, Ames Iron Works.
F. B. Godley, "Power" (Cleveland)
Chas. E. Gorton, American Uniform Boiler Law Society, New York.
L. T. Gregg, Hartford Steam Boiler Insp. & Insurance Co.
W. D. Johnson, Milwaukee Boiler Mfg. Co.
J. D. Kamerer, Erie City Iron Works, Erie, Pa.
A. H. Kempfer, The Gem City Boiler Co.
John Kirby, Wm. B. Pollock Co.
Mr. Levalle, The Superheater Co.
Harry Loeb, Lukens Steel Co.
W. S. McAleenan, The C. H. Dutton Co.
J. E. Mason, "Power."
F. B. Metcalf, The International Boiler Works.
C. O. Myers, National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio.
W. A. Pittsford, Kewanee Boiler Works.
A. G. Pratt, The Babcock & Wilcox Co.
Mr. Prentiss, "Iron Age."
Cliff M. Tudor, The Tudor Boiler Mfg. Co.
Wm. H. Walker, International Engineering Works.
E. G. Wein, E. Keeler Co.
C. F. Wolfe, Ames Iron Works.

Electro-Chemical Cleaning of Boilers

By Max A. R. Brünner

AN old proverb says: "Prevention is better than cure." The removing of fur (scale) from the inside of boilers is an endless source of expense and trouble. Extensive experiments have been made on how to prevent the formation of fur. The best present method is that of introducing a weak electric current which issues from a positive pole inside the boiler and passes through the walls. The walls act as the negative pole. Along the boiler walls hydrogen is gradually generated, which prevents formation of fur. It even destroys the sulphurous lime of the fur in a rather short time so thoroughly that only a harmless mud remains on the bottom which can be easily removed. This is the more advantageous as the dissolving of metal in the water is prevented. Persons with a sensitive tongue always know whether tea has been served in metal kettle or one of china.

This dissolving of metal accomplished by a weak electrical current may assume in the steam boiler such proportions that the walls become damaged. We know from the laws of galvanics that we can eliminate metals from a solution at the cathode (negative pole) by means of electricity. In boilers, metals which may be found in the form of dissolved salts in the water are deposited along the walls which serve as the cathode or in other words the feared dissolving of the shell does not take place. Of course the positive pole is affected which does not do serious damage since it can be replaced. Besides the consumption of metal is rather moderate.

One of the largest German electrical firms which has installed during the past few years a number of such electric equipments for boilers has discovered that the anodes made of gaspipes or iron plates have a life of d 4-6,000 working hours. The consumption of current is moderate and for a square meter boiler wall a current of 0.02 Ampère is mostly sufficient. Thus a current such as is used for an ordinary incandescent lamp, suffices for about the 30-40 squaremeter of boiler wall.

Note.—The practice outlined in this article is that carried out in Germany, but this method of scale prevention may offer suggestions that might well be incorporated in methods used in this country.—The Editors.

Cost Figures That Measure Efficiency

By William R. Basset*

STUDY of cost figures has made it possible for one medium sized concern to save more than $50,000 a year by improving its manufacturing methods. That a cost system can be made to point out possible betterments is just beginning to be realized by some manufacturers. As a matter of fact, if costs are used solely as a guide in setting selling prices, their greatest value is being wasted.

Merely to look at a workman or a machine is a mighty uncertain fashion in which to determine whether the work is being done in the best possible way. A properly designed cost system will however, give definite information as to whether the efficiency of any operation is what it should be.

To do this it is necessary to determine what should be the normal cost of labor, material and expense for each product. In fact a normal amount for each item of expense should be set up.

Then each month the executive will get a report showing whether the actual amount of labor, material and expense is greater or less than normal. The fluctuations may be divided to show whether they are caused by the plant operating at more or less than normal capacity, or whether they are due to extravagance or unusual care in the use of any of the elements of cost. If lack of orders causes the trouble, the selling needs attention.

Such a report for one department of a plant might look like this:

STATEMENT OF DEVIATIONS FROM NORMAL

	Gain	*Loss*	*Reason*
Material		$2,000	Defective material.
Labor	$700		Large production—long runs.
Overhead	$200		Large production—low non-productive labor.

These gains or losses are the deviations from the normal or budgeted amount for the department.

They show accurately what is wrong, and indicate the steps to be taken. In this case the management would undoubtedly get after the supplier who furnished defective raw material.

One concern cut its use of certain supplies $1,800 a month after it obtained reports showing how much more was being used than tests showed to be the normal consumption.

Properly devised cost figures are the surest guide to reduced costs.

*President of Miller, Franklin, Basset & Co., Inc.

Safety in Electric Welding and Cutting*

Methods of Protecting the Eyes and Bodies of Electric Arc Welding Operators—Safeguarding Apparatus

By D. H. Deyoe†

FOR the protection of the operator and of men working in the near vicinity of electric welding and cutting operations, it is necessary to take certain precautions. If these precautions are taken, arc welding becomes a perfectly safe occupation. There are, at present, some 60,000 welders using the arc. We have several welders at our plant who have worked steadily with the arc for six or seven years without any apparently bad effect. In ordinary arc welding, where currents ranging from 50 to 200 amperes only are used, simple precautions are necessary for the protection of the operator's eyes and the exposed portions of his body.

Protection of the Eyes and Body

The usual method of protecting eyes is the use of a face shield or head mask with glass window inserts, the glass of which is of such composition as to absorb the injurious ultra-violet and infra-red rays. When several welders are working in the same room, in addition to the use of face shields or head masks, colored glasses with side protection are worn to protect the eyes of each operator from the arcs of the others.

All exposed parts of the body are subject to a burning effect from the rays of the arc. This burning is similar to a sunburn and if the body is not protected by a covering of some kind it will cause the operator more or less discomfort or pain. The body is usually covered by ordinary close-woven clothing and the hands by leather gloves, not only to protect against the rays of the arc but against flying particles of hot metal. The gloves further protect him in handling hot parts. In heavy carbon arc welding and cutting, where currents from 200 to 1,000 amperes are used, it is necessary to protect the operator still further, as with these heavy currents the arc rays will penetrate the ordinary clothing and the flying particles of molten metal will burn through them. Usually, a large, well fitting leather or asbestos apron is used to protect as much of the body of the operator as possible.

For the protection of men working in the near vicinity of an arc welder opaque screens should be placed between the arc and the workers, or better still, a booth should be built around the operator, thereby shutting off the arc rays from the surrounding part of the factory.

Welding Booths

Care has to be taken regarding the painting of the interior of an arc welding booth. If a paint that reflects the rays of an arc is used the operator may be subjected to eye flashes from the side and back of his face shield, or to the burning on the back of his neck or ears. A paint should be used on the interior of a booth and on all machinery located within it that will absorb the dangerous rays. A simple satisfactory paint for this use is composed of zinc oxide and oil which may be given any desired tint with lamp black.

Where heavy welding or cutting is being done and where galvanized iron or steel or materials that are oily are being welded, it is very desirable in safeguarding the health of the operator to provide ventilation ducts or fans to carry away the smoke fumes from the vicinity of the work.

In metallic arc welding where direct current is used with an open circuit voltage or from 40 to 60 volts and a welding voltage of 20, it is not necessary to pay much attention to the protection of the operator from an electric shock. With alternating current welding this is a little more serious as the operating voltage ranges from 100 volts up as high as 175. If the operator is not careful while changing electrodes this is liable to give him quite a shock. There is really, however, no way to protect the operator against this voltage as he is in direct contact with one side of the circuit in handling his work and with the other side of the circuit in inserting his electrode material. He must, in turn, be careful not to get in contact with both at the same time. This same condition applies to resistance welders used for railway work where the trolley voltage is from 450 to 650 direct current. In this case it is necessary for the operator to be very careful to keep free from grounds while changing electrodes. Welding resistors for use in railway welding are sometimes provided with a push button station under the control of the welder for opening a contactor in the welding circuit while changing electrodes. However, many welders object to carrying around this push button station and would rather take the extra precaution when changing electrodes.

In many installations where a large number of small articles are welded, particularly with the automatic welder, instead of building a booth around the operator to protect outside workers and instead of providing the operator with a mask or face shield, an inclosed cabinet is built around the operation itself, inserting in this cabinet a colored glass protective window through which the operator can watch the progress of the welding.

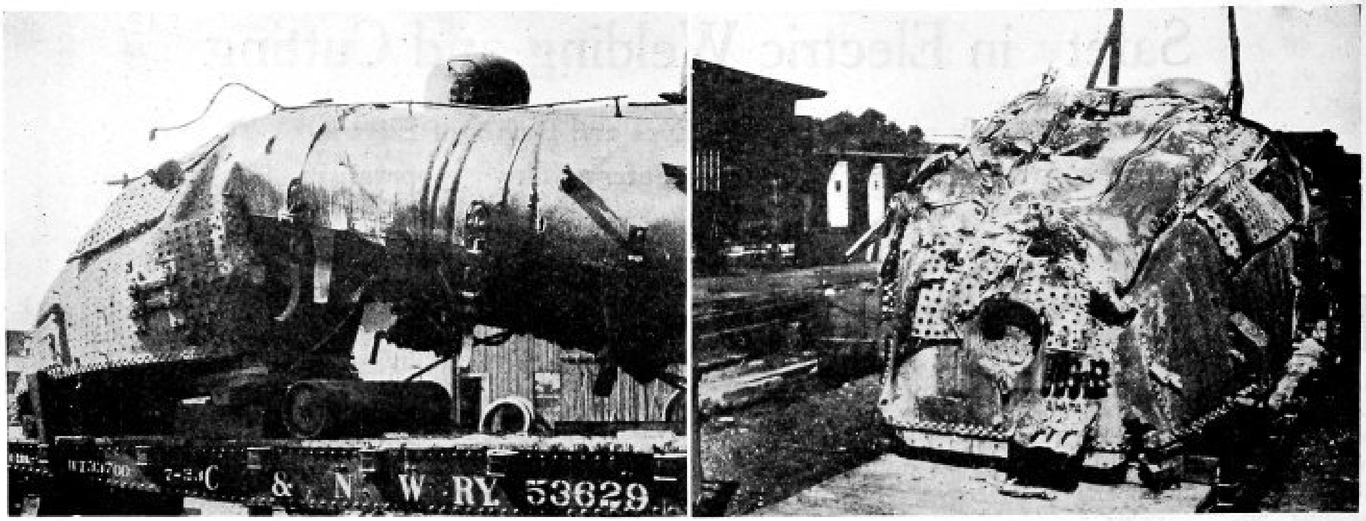
Where many welders are working on small work it is customary to build a series of small booths, the tops of which are open and extend above the operator's head, the front of the booths being supplied with the welding control apparatus and with a bench on which material to be welded is placed. The backs of the booths are protected with a series of curtains which are closed by the operators before starting to weld. This makes a very compact and satisfactory arrangement.

For the protection of welding apparatus, safeguards, as applied to apparatus of similar nature, are used, such as circuit breakers, contactors, fuses, enclosed switches, enclosing boxes for control apparatus, insulated couplings, gear cases, insulated holders, etc.

Conference on Storage Tanks.—Manufacturers of tanks, and manufacturers of equipment in which tanks are used, held a series of conferences under the auspices of the Division of Simplified Practice of the Department of Commerce on March 11, 12, 13 and 14 at Washington, looking to the elimination of seldom-used sizes and varieties of tanks. More than 150 manufacturing representatives from 24 states were invited to the meetings as well as delegates from the National Board of Fire Underwriters, American Institute of Architects, American Society of Sanitary Engineering and other technical groups and officials from many cities throughout the country. Distributors and consumers of tanks were also present.

* Paper read at the joint Safety Conference of the Engineering Section, National Safety Council, and American Society of Safety Engineers, New York, January 22.

† Power and Mining Engineering Department, General Electric Company, Schenectady, N. Y.



Side and End Views of Wrecked C. & N. W. Boiler Being Transported to Boone, Ia., for Examination

Boiler Explosion Caused by Failure of Crown Sheet

Locomotive Disaster Indicates Importance of Equipping Boilers with Water Columns to Check Water Level

LOW water and overheating of the firebox crown sheet with accompanying ruptures is responsible for the most serious of locomotive boiler disasters on railroads of the United States. This deplorable fact is again vividly brought home in the official report detailing the Chicago & North Western locomotive No. 2455 explosion at Belle Plaine, Iowa, which occurred last July. This report was prepared by A. G. Pack, chief inspector of the Bureau of Locomotive Inspection.

Some of our readers had the opportunity of inspecting the wreck at the time and have since requested that full details of the accident be published. The results of the investigation by government inspectors follow:

C. & N. W. locomotive No. 2455 left Boone, Iowa, at 7:45 a. m., July 14, 1923, with a train of 47 empty cars. It proceeded to Tama, Iowa, a distance of 70 miles, where 40 more empty cars were picked up, making a train of 87 cars with a tonnage of 2,122. The rating of this locomotive is 3,125 tons.

Water was taken at Tama; left Tama at 10:55 a. m. and proceeded to Belle Plaine, Iowa, west yard, a distance of 16 miles, arriving there at 11:30 a. m., where the train stopped at the interlocking signal, and after standing at this point 6 minutes the boiler exploded, resulting in the instant death of the engineer and fireman and injury to a brakeman, who was riding the first car in the train when the boiler exploded.

When the boiler exploded, it was torn loose from the frame and hurled directly forward a distance of about 150 feet, the wagon top struck the rails, rebounded and rolled over coming to rest in an upright position. Parts of the boiler were found hundreds of feet away from the explosion, the right injector being found a distance of 750 feet, where it was buried in the ground for a depth of 3 feet.

The engineer's body was found 240 feet back of the point of the explosion on the adjacent track. The fireman was crushed by the wreckage against the left tender bulkhead. The front brakeman, who was on the first car back of the engine when the explosion occurred, was found a distance of two car lengths back of the first car on which he had been riding.

After the accident, the boiler was loaded on a flat car and taken, with the running gear, to the Belle Plaine roundhouse, where it was held intact for government inspection.

Firebox Construction

Locomotive 2455 was a 2-8-2 type with extended wagon top boiler with a wide, radial stayed firebox. The side sheets and crown sheet were joined by autogenous welding, the welded seams being located 15¼ inches below the highest point of the crown sheet. The crown sheet was supported by 29 transverse and 20 longitudinal rows of radial stays, the first four transverse rows of stays, from the back flue sheet, were Tate flexible expansion bolts, body reduced to 15/16 inch with 1⅜ inch diameter heads with hammered heads. The fifth transverse row had 15/16 inch body at the reduced section and 1⅜ inch diameter head in the crown sheet, with hammered heads. The remaining stays in the three longitudinal rows each side of center line were 1⅛ inch where screwed into the sheet, with a taper of 1½ inch in 12-inch body reduced to 15/16 inch, all bolts having hammered heads. The remaining longitudinal rows, both sides of the taper bolts, were 15/16 inch diameter at the reduced section with 1⅛ inch diameter heads with hammered heads. The side sheets were supported by ⅞-inch staybolts. Radial stays and staybolts spaced 4 inches by 4 inches.

Thickness of firebox sheets:

Crown, side and door sheets ⅜ inch.

Back flue sheet ½ inch.

Slope of crown sheet, from flue sheet to door sheet, 4¾ inches.

(Taken from blue print.)

Small flues 2 inches in diameter; total number 259. Beaded.

Superheater flues, diameter front end 5½ inches, back end 4½ inches, beaded and welded to sheet.

Firebox equipped with brick arch supported by four 3-inch arch tubes.

Equipped with Franklin butterfly type fire door.
Not equipped with stoker.

EXAMINATION OF FIREBOX

The entire crown sheet with the top portion of the flue sheet and a small strip of the right side sheet was blown entirely out of the firebox coming to rest on the trailer frame, the back half of the crown sheet folding over the top of the front portion.

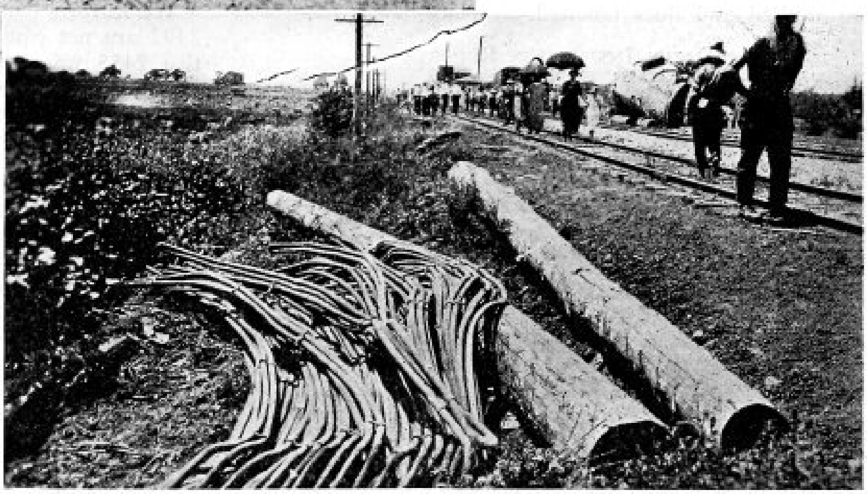
The crown sheet pulled away from 580 radial stays, the right side sheet was forced over 98 staybolts and partly pulled away from 7 more; the left side sheet was forced over 34 staybolts and partly pulled away from 2 more; the door sheet was forced over 125 staybolts.

As near as can be determined, the initial rupture started at a point about 4 inches from the back flue sheet in the first transverse row of radial stays 20 inches to the left of the center line of the crown sheet and on the edge of the overheated area. The rupture extended down to between the tenth and eleventh longitudinal rows of radial stays from the center of the crown sheet through the solid plate just back of the riveted seam of the flue sheet until it reached the left side sheet seam, which connects the crown and side sheets; this seam was autogenously welded. The tear then followed this seam the entire length of the left side sheet to the door sheet, then followed through the seam, which connected the door and crown sheets, shearing the rivets in this seam to the right side sheet-crown sheet seam.

The top portion of the door sheet folded down over itself for a distance of 25 inches, covering the fire door hole. From the right back corner of the right side sheet seam, which is autogenously welded, it tore through this seam along the right side to a point 36 inches from the back flue sheet. From this point, the tear followed two directions, first, downward through the solid plate of the right side sheet for a distance of 30 inches below the welded seam and then upward diagonally to the welded seam at a point 6 inches from the flue sheet; second, upward from the seam, the tear followed diagonally through the crown sheet to the flue sheet seam at a point 23 inches from the center of the crown sheet, then through the top row of flues in the flue sheet, joining with the side sheet rupture, tearing out pieces of the side and crown sheets and a small section of the flue sheet flange. From this point, the tear extended across the flue sheet through the bottom of the top row of superheated tubes, joining the rupture at the front corner of the left side sheet seam.

The crown sheet was overheated 20 inches each side of the center at the flue sheet, tapering back to nothing 56 inches from the flue sheet. As near as can be determined, the water was down 3¼ inches below the highest point of the crown sheet. (Measurement made on same class of locomotive No. 2454.) The overheated area showed a deep blue color, characteristic of overheating, the line of demarcation being clear; the ends of the radial stays in this area also show a deep blue color, indicating overheating.

Position of boiler and running gear after explosion



Superheater units were thrown one hundred and fifty feet from boiler

The crown sheet in the overheated area was pocketed between the stays from 1¼ inch to ½ inch. The threads on the radial stays and in the crown sheet were in good condition. The holes in the overheated area in the crown sheet were elongated to a maximum of 2 inches. The overheated area was ruptured in the center of the crown sheet at a point 20 inches from the back flue sheet for a distance of 12 inches; this rupture did not extend to other tears or ruptures in the crown sheet, and at this rupture the sheet was pulled to a knife edge.

A total of thirty-three 2-inch flues and nine superheater flues pulled through the back flue sheet. Both back mudring corners were broken; the throat sheet was badly bulged in and the right side of the firebox was bulged out 25½ inches. The entire boiler and firebox were badly bent and distorted, a large part of this damage undoubtedly being done when the boiler fell on the rails.

Water Glass and Connections

The boiler was equipped with a tubular glass located on the left side of the back head. The glass fittings were broken off the boiler at the time of the accident and considerably damaged. Both top and bottom cocks were found in open position with the opening to the boiler free from obstruction. The water-glass drain cock which was found closed was tested on locomotive 1435 under steam, and found to be in good condition. The openings to boiler of the water-glass cocks and gage-cocks were found to be unobstructed.

Both check valves were found clean and free from obstruction; angle valves, both sides, found in the open position; check valve lift, right side ¼ inch, left side 5/16 inch.

The tank was found clean, and the tank valve screens in position and clean. Both feed pipes were broken off at the time of the accident, permitting the water in the tender to escape, therefore, we are unable to determine the amount of water in the tank at the time of the accident.

All of the other appurtenances were so badly damaged at the time of the explosion that they could not be tested.

The last monthly inspection was made July 12, 1923, at East Clinton, Ill.

This locomotive received classified repairs in March, 1922, at which time both side sheets and back flue sheet were applied and flues renewed.

Daily Inspection Reports

Work reports were examined for all arrivals during the month of June and during July to date of accident, from Boone, Belle Plaine and East Clinton, Ill., and the following found reported:

Boone, Ia., July 3, 1923:

"Wash out boiler; if you cannot wash out boiler, change the water; cannot get this engine over the hills on account of engine foaming."

Report not noted, showing action taken.

East Clinton, Ill., July 2, 1923:

"Water very bad; wash out boiler."

Report noted: "Changed."

July 4, 1923:

"Wash out boiler."

Report not noted.

July 8, 1923:

"Wash out boiler."

Report noted: "Changed."

Belle Plaine, Ia., July 8, 1923:

"Wash out boiler."

Report noted: "Changed."

Evidence indicates that the water in the boiler was foaming badly during the trip on which the accident occurred, which may have contributed to the overheating of the crown sheet.

The Track Characteristics

Track was level for 6,900 feet back from point of accident, then an ascending grade of 0.06 of one percent for the next 100 feet, then 0.02 ascending grade for the next 100 feet; between this point and Tama the greatest ascending grade, going east towards the point at which the accident occurred, was 0.4 of one percent. The track for three miles preceding the point of accident was straight track followed by a curve of two degrees, then six miles more of straight track.

Estimated property damage $30,000.

We learned that locomotives beginning with No. 2301 to 2492 are not equipped with water columns; hence locomotive 2455 was not equipped with a water column. However, water columns are applied on locomotives of the same class beginning with 2493 to 2592.

Saving Time and Labor on Flue Jobs

Method of Making a Flue Swedging Machine and Bench and Front End Flue Cutters

By C. A. Chincholl

ONLY employes in direct charge of shops doing locomotive or stationary boiler flue work can appreciate the value of time and labor-saving devices, especially when such devices can be manufactured of material generally to be found at hand in any shop.

This article will describe the construction and usefulness of three devices necessary wherever boiler flues are replaced in boilers; namely, a flue swedging machine for 2-inch flues, a flue cutter for cutting flues to length and an attachment for an air motor to cut flues in the front end.

Flue Swedging Machine

In the first-named device an old 8-inch brake cylinder is used to drive the swedge block. The work is performed automatically. The flues are first heated to a red heat, then placed in the largest hole of the swedge block. As soon as the flue touches the bottom swedge block, it has moved the throttle down sufficiently to open the valve at the top of the cylinder and admits air into the cylinder, causing the piston to move down until it reaches the point below the 1¼-inch round openings in the side of the cylinder, shown in the accompanying sketch. These holes allow the air to escape and diminish the pressure in the upper part of the cylinder until the tension of the spring in the lower part of the cylinder drives the piston back up. This takes place very rapidly, causing the top swedge block to strike the stationary or lower swedge block as a trip hammer. While the top block is striking the flue, the flue should be kept turning; several strokes is all that is required. If the flue is not swedged sufficiently, move it over to the next hole and repeat the same operation and so on until the right size is obtained.

If the smallest size is desired on the flue, do not attempt to swedge that size but start with the larger hole and come down the block to the size desired, otherwise the flues might fold and would have to be cut off and swedged over again.

The three sizes generally chosen in swedge block are 1 13/16 inches, 1⅞ inches and 1 15/16 inches. Size 1 13/16 inches is used only on flues to be applied in boilers receiving new back flue sheets where holes are drilled 1 15/16 inches. This will provide for the heavy copper ferrule.

Referring to the sketch, you will notice a 3/8-inch pipe or hose connecting from the brake cylinder to a small manifold in the back of the bottom swedge block. This keeps the block clean of scale by blowing the scale clear during the swedging of the flue. This is necessary as the scale accumulates very rapidly due to oxidation of the heated end of flues.

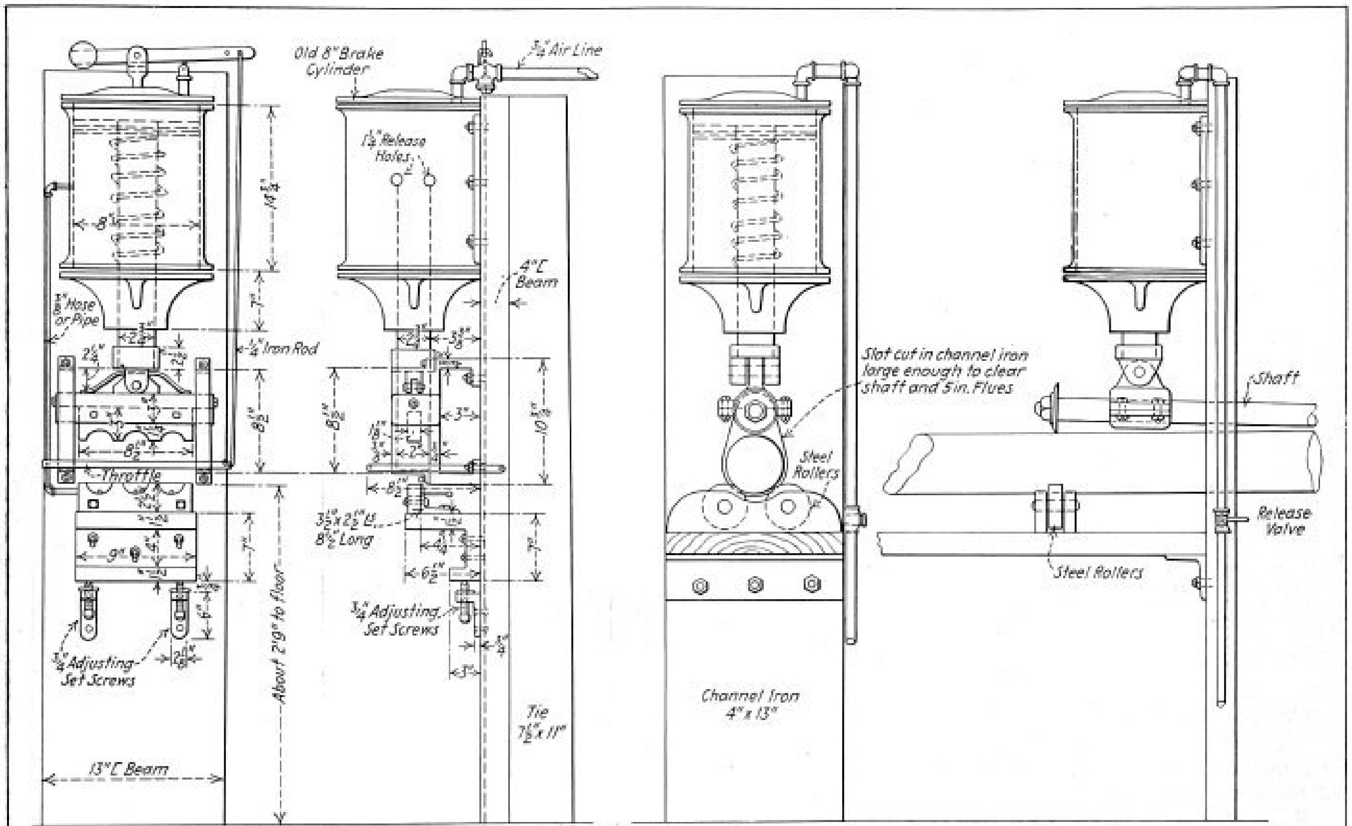
The flues can be swedged down to the different sizes desired very rapidly after a little practice.

Bench Flue Cutter

The bench flue cutter is very simple in construction and is as useful as it is simple, saving a great deal of time and worry in the cutting of the flues to length. It also employs the use of an 8-inch brake cylinder, but does not have the 1¼-inch release holes in the side of the cylinder, as in the case of the flue swedge cylinder. This cylinder must be absolutely air tight and is operated by a release valve placed in a convenient place.

When air is applied to the top of the piston it forces the flue cutter to engage with the flue, rotates it and cuts it in two rapidly. The valve is then turned back allowing air to escape from the cylinder through the valve. The tension in the spring in the bottom of the cylinder will then lift up the piston and cutter. The bearing of one end of the shaft

(Continued on page 91)



Three Shop Made Devices That Simplify Flue Work

Method of Finding the Sines of the Angles Formed by Crown Stays

By Edward Hall

SOME time ago in the Questions and Answers Department the question was asked as to the meaning of the expression $\xi \sin \alpha$.

The answer gave the proper meaning and examples of how it was used, but it did not give the method for finding the sines of the different angles which the crown stays make with the vertical axis of the boiler.

Meaning of Terms

The purpose of this article is to show how the sine of each of these angles may be found and how to use the value so found in the formula where the term $\xi \sin \alpha$ is used.

In order to better understand the following method, the meaning of the symbols ξ, α, and sin is given.

The symbol ξ is a Greek letter and stands for the words "the sum of."

The symbol α is a simple way of expressing an angle. Thus if we have angle ABC we may denote this angle by the letter B or by using the symbol α.

The sine of an angle is the quotient found by dividing the side opposite the angle by the hypotenuse of the right triangle; Sin is the common way of writing sine. Sine of angle α is written $\sin \alpha$.

Referring to the sketch, which is part of this article:

The line XY is the vertical axis of the boiler.

AB represents the length of one of the crown stays in any given transverse row.

BY represents the crown stays AB extended to intersect XY at Y forming the angle AYX which will be denoted by the symbol α.

Finding the Sine of an Angle

Our problem then is to find the sine of this angle:

We begin by selecting any crown stay in any transverse row at the wrapper sheet. In this case we select the point A of the crown stay AB.

From this point A extend a line to the outside door sheet, making sure the line is parallel with the horizontal axis of the boiler.

Next draw the line AC parallel to XY, the vertical axis of the boiler, and long enough to be below the crown sheet.

Next locate the point B where the crown stay AB is fitted to the crown sheet. This point must be transferred to the outside door sheet making sure that the point B as marked on the outside door sheet is in line with the crown sheet and the end B of the crown stay AB.

Draw ZC' perpendicular to XY and passing through point B as marked on the outside door sheet.

Connect the points A and B.

We now have constructed the right triangle $AC'B$ on the door sheet from which the sine of the angle α' may be found by measuring the length of AB and BC'. Then divide BC by AB.

This gives us the sine of the angle α'.

However, the angle α' equals the angle α because they are alternate interior angles between the parallel lines XY and AC which is cut by the transversal ABY.

The sines of the other angles formed by the remaining crown stays are found in the same manner.

If all the crown stays in one transverse row and on one side of the vertical axis of the boiler are parallel, they all make the same angle with the vertical axis, therefore these sines are all equal to one another.

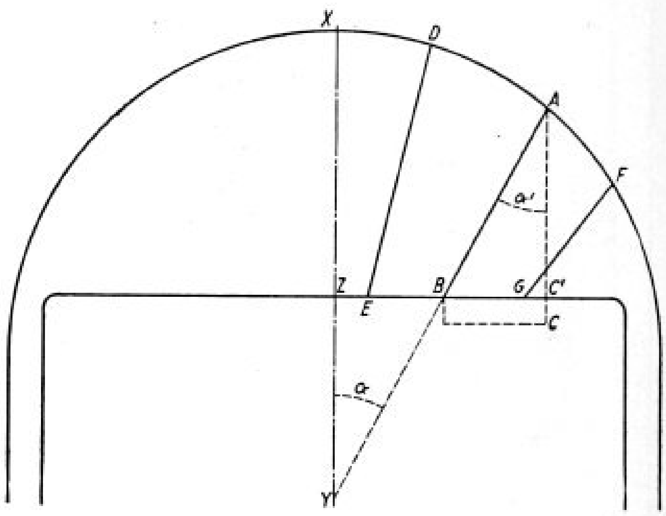
If the crown stays, to be considered, are all parallel with the vertical axis of the boiler, there will not be any angle formed. In this case the $\sin \alpha = 0$.

Safe Working Pressure on Wrapper Sheets

The expression that has just been demonstrated is used in the formula found in Par. 212 B of the A.S.M.E. Boiler Code and relates to the safe working pressure on the wrapper sheets of locomotive type boilers.

The formula is:

$$P = \frac{11{,}000\, t\, E}{R - s\, \xi \sin \alpha}$$



Applying Principles to Firebox Door Sheet

where; P = safe working pressure, pounds per square inch.
t = thickness of the wrapper sheet in inches.
E = efficiency of wrapper sheet through joints or staybolt holes expressed in percent of unit length.
R = radius of the wrapper sheet in inches.
s = transverse pitch of crown stays at the crown sheet, inches.
$\xi \sin \alpha$ = the sum of the sines of all the angles the crown stays make with the vertical axis of the boiler, considered on one side only, and in one transverse row.

As an example, consider the following, using the accompanying sketch for the notation:

$t = 5/16$ inch.
$E = 0.80$.
$R = 30$ inches.
$s = 5$ inches.

Sine of angle formed by crown stay $DE = 0.2419$.
Sine of angle formed by crown stay $AB = 0.4795$.
Sine of angle formed by crown stay $FG = 0.6088$

Therefore $\xi \sin \alpha =$ 1.3302

Substituting these values for their equals in the formula gives

$$P = \frac{11,000 \times 5/16 \times 0.80}{30 - 5 \times 1.3302} = 118 \text{ pounds.}$$

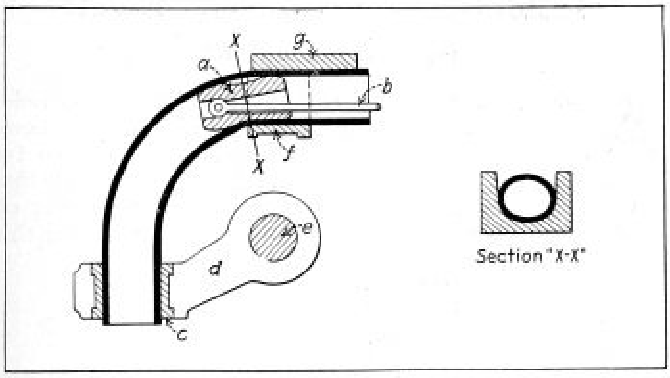
Of course the author of this article understands that, on account of the door sheet being flanged to come under the wrapper sheet, the line *AB* will be broken at the turn of the flange; however, if a straight edge is run from the selected crown stay parallel to the long axis of the boiler and this straight edge projects beyond the outside door sheet, a plumb line held over the straight edge and close against the outside door sheet will serve for the line *AC* in the sketch. If this method is used care must be taken to have the boiler level in order that the plumb line is parallel to the vertical axis of the boiler.

Pipe Bending

A Brief Review of the Bonn System Developed in England and Scope of Its Application

By Major Johnstone-Taylor

While the bending of steel pipes up to 1½-inch inside diameter presents no great difficulty, provided the usual precautions are taken, above this size the matter becomes increasingly difficult as the size increases. When pipe bends are made by the more common shop methods wrinkles are formed during the bending process especially if the radius is small and the wall of the tube on the outside of the bend is thinned. On this account the bent pipe cannot stand the pressure that the original pipe could, hence the gage of the bent portion, at least, must be increased, and as any portion of a pipe may require to be bent it is usually necessary to raise the gage all over. Besides this, the continued heating of the tube is detrimental to the metal especially at the welds.



Bonn System of Pipe Bending

Cold bending is highly desirable, and the machine bending system outlined herein is of interest in view of the fact that a machine-made cold bend can be produced in a few minutes with a uniform radius and great strength.

While the majority of machines introduced for cold bending are more or less adaptations of hand-bending systems, that used in the Bonn process employs a new method. It takes into account, firstly, that the bending cannot be restricted to one point, and, secondly, that the pipe, especially if of large bore and relatively thin, must not be held at full bore at the bending point.

The pipe must be allowed to flex as it approaches the point where it starts bending so that it may come up to the bending stress, and it must be allowed to flatten about the neutral axis to an extent that will properly distribute the stresses and prevent wrinkling.

Referring to the diagram, in the pipe is placed a specially shaped mandrel *a* having two heads held by rod *b*, which is articulated to the forward head as shown. The pipe is rigidly held by grip *c* fixed to arm *d*, which is attached to a roller bearing mounted on post *e*. At the commencement of the bending process the forward head of the mandrel lies within the grip *c*, and this effectively prevents any distortion of the pipe at that point. As the pipe is pushed forward it flexes imediately at the rear of the point of bending. After passing this point it commences to bend. Between the two heads of the mandrel the pipe continues bending, but the bending is delayed by the distortion of the pipe.

However, when it passes under the forward head of the mandrel all the bending has been completed and it is up to full bore again. By this time it has been stress hardened, and as it is now of full bore, whereas it was bent in a distorted condition, nothing further can happen to it save elastic flexure.

It will be observed that as the pipe passes over the mandrel and through the slipper *f* it takes various elliptical forms. To commence with, it has the elliptical form due to its flattening against rail *g*, then that due to the increasing stress as it approaches the point of bending, and finally that due to the distortion as it passes over the mandrel.

The stresses are so beautifully balanced that any undue friction will upset the perfection of the results obtained, in consequence the slipper and mandrel are shaped to conform with these elliptical sections so that the pipe might be considered as floating through the slipper when bending. The distortion of the mandrel increases as the radius of the bend decreases and is automatically corrected for the radius to which the pipe is bent in every case.

At the minimum radius in all cases the pipe wall on the inner side of the bend is effectively held over practically the whole length of the mandrel between the slipper surface and the mandrel surface, thus effectively preventing the formation of wrinkles in the case of very thin pipes. The distortion of the pipe on the mandrel varies with the thickness of the pipe for a given bore at a given radius and in this case is also automatically correct.

A condition which governs the bending of pipes by this method in common with other methods is that the pipe shall have sufficient ductility to bend to the radius required and be free from such imperfections as would cause it to split.

There is, however, no theoretical limit to either the size of the pipe which can be bent nor to the ratio of wall thickness to bore, but it is essential that the pipe shall be properly supported in the bending zone, that friction be eliminated and that the length behind the point of bending be short that it can act as a column without failure.

For specially thin pipes, however, different sets of slippers and mandrels are required to those used for ordinary working thicknesses, and owing to the special supporting arrangements necessary and other complications its use hardly seems justified under such conditions.

"In Full of All Claims"

Legal Phases of Settling Debts by Check

By Elton J. Buckley

I AM asked a great deal about the law which says what a check means when it is marked "in full of all claims." Business men seem to think there is a trick in the thing which, indeed, in some cases there is, the danger being that we may inadvertently accept a check marked "in full of all claims" when it really isn't all the debtor owes us.

The general law on the subject can be simply and briefly stated. If a creditor and a debtor agree that the debtor owes $200, and the debtor, trying to put something over, sends a check for $150 marked "in full of all claims," the creditor can accept the check and collect the remaining $50 without any difficulty.

But suppose, on the other hand, the debtor and the creditor have been arguing about what the debtor owes. They haven't been able to agree. The creditor says it is $200, the debtor says it is $150. Finally the debtor sends a check for $175 and with it a note saying: "The inclosed is sent as full payment of my account." The check is also marked "in full of all claims." If the creditor accepts this he is gone as to anything more, because the law says that the tender of such a sum in full, accepted by the creditor, constitutes what is called an "accord and satisfaction"; that is, a settlement of the debt.

The law won't allow a debtor to slip anything over on his creditor if it can help it, and always insists on full proof that the payment or settlement which the debtor is insisting was in full, wasn't a trick, but a real intended settlement on both sides.

A case just decided (81 Super, 124) is a good illustration. In this case a dealer in hides sold a batch to a customer for about $5,500. They were delivered and the buyer paid $2,000 on account. Later he sent a check for $2,542.27, and with it a letter stating "we herewith inclose you statement and check for the balance due you on your recent shipment of calfskins." The statement referred to was a statement of account showing the quantity, quality and price of the hides. What happened was that the buyer in reselling the hides allowed *his* customers some concessions—he said because of the poor quality of the skins—which he then deducted from his own debt to the original seller. This deduction amounted to very nearly $1,000.

The original seller accepted the check, but when he demanded the balance the buyer said, "Why, no; we tendered you the check for $2,542.27 in full of all claims, and your acceptance of that prevents you from getting any more." There was considerable plausibility to this, for the check was certainly sent as a full and final payment.

The parties were unable to get together, and finally the seller sued for the balance. In the lower court he got a verdict for the entire balance, which the Appeal Court affirmed. The court said the following interesting things about the principle I am discussing here:

> The case is distinctly limited to the inquiry whether the acceptance of the defendant's check in connection with their letter and statement had the effect to discharge them from further liability in the transaction. In asserting the accord and satisfaction, the effect of which would be to relieve them from the payment of the whole of the plaintiff's demand, the burden is on the defendant to prove such a state of facts as clearly produces that result. It is not sufficient that a creditor receives less than the amount which he claims with knowledge that the debtor denies all further liability. Where one seeks to establish accord and satisfaction payment should be tendered in full discharge of the demand and be accompanied by acts and declarations amounting to express notice that the payment is conditional, and if accepted must be received in satisfaction of the claim. Our cases are all to the effect that the debtor's intention to make the tender final and conclusive of the creditor's demand must be communicated by express notice or by the equivalent thereof, and also that the payment tendered is conditional on its acceptance according to that intention. There was no request that the check be returned if not satisfactory, or notice that the acceptance of it by the plaintiff would be treated as a satisfaction of any claim which he had growing out of the sale.

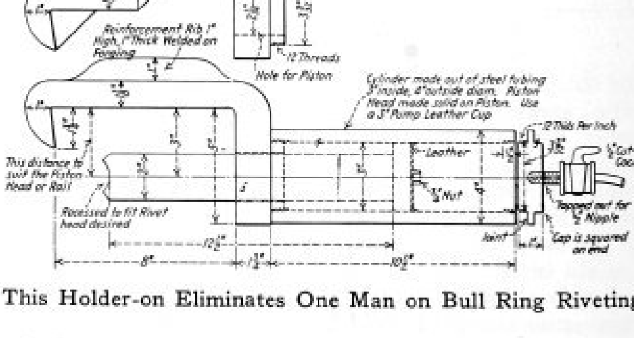
Here is the whole thing in a nutshell: When a debtor whose debt, according to the creditor, is $200, sends $150 to settle in full, he must tender that in a way that will say substantially to the creditor: "I'm offering this $150 in one way only—as a full payment of all I owe you; not on account. If you don't want to accept it in that way, please send check back." Unless he does something like that, the creditor can collect the balance, even though he accepts the check.

The subject isn't free from difficulty, and there are so many different phases of it that the average business man can't safely decide for himself whether he ought to accept a check with a string to it. My advice always is, when a check comes in that way, better get your attorney's advice right away, before accepting it. If you don't want to do that, send it back, if you aren't sure, provided the maker is financially responsible. If the maker isn't financially responsible, and you are afraid to send the check back, you will have to trust to luck—if you don't want to consult a lawyer—that it will turn out all right.

Holder-on for Bullring Rivets

By F. W. Lampton*

A HOLDER-ON for bullring rivets, also used for holding rivets used in making switches and frogs is shown in the accompany sketch. This tool was devised for holding on the rivets driven in our new type of bullrings as we had so many loose rivets by driving and holding on with a long stroke hammer and a dolly bar. By using this



This Holder-on Eliminates One Man on Bull Ring Riveting

tool and driving the rivet with a long stroke you can get a good tight job with less manual effort. This tool will take the place of one man.

This tool can be made at any shop as there is just one forging to be made. The cylinder is made out of tube stock. A reinforcement rib is welded on top of the forging so as to give it added strength. The piston is turned out of a piece of steel at one end and conforms with the shape of head desired on the rivet. The other end is turned to a working fit in the cylinder with a 3-inch pump leather studded on the end to make it air-tight. A removable cap is placed on one end of the cylinder so that repairs can be made and the tool inspected when needed. The other end of the cylinder is screwed on the forging proper. With 90 pounds of air on this piston you can be assured of a tight job on all rivets.

*General Foreman, St. Louis-San Francisco, Springfield, Mo.

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CONTENTS

A matter of utmost importance to boiler manufacturers was brought up at the mid-winter meeting of the American Boiler Manufacturers' Association in Cleveland last month and that was the question of when "doing business" is illegal. No attempt was made to discuss the ins and outs of this complex question but enough was said to indicate that serious pitfalls lie in the path of the unwary or uninformed manufacturer who fails to watch his step when doing business in states other than the one in which his boiler shop or home office is located.

The whole matter—and under certain circumstances it may easily become a serious one—hinges on the question of whether your company has business transactions outside the state in which it is incorporated, and, if so, if it is qualified, licensed, registered, or whatever the law requires, in the states in which such business transactions are carried on. According to the Supreme Court of the United States, a "foreign corporation" is a corporation in a state other than the state of its creation. Nearly every state in the Union has now enacted laws with reference to such "foreign corporations" requiring them to take out licenses in one form or another and making provisions for their taxation and the appointment of an agent in the state upon whom service of process may be made that will be binding upon the corporation. The dividing line between corporations lawfully subject to such statutes and those exempt therefrom turns upon whether the character of their business in the state constitutes "interstate commerce," the regulation of which is expressly reserved by the constitution to the Federal Government and cannot be interfered with by the states, or "intrastate or domestic commerce," that is business conducted wholly within the borders of one state, regardless of where the corporation conducting it may have its main office.

What makes the matter complex and the risk of financial losses serious is the fact that what actually constitutes "intrastate commerce" is determined separately and individually in each state by the definitions which each state has applied to such business and these definitions are generally contained in decisions and not in the statutes of the several states. While these decisions are fairly uniform on some subjects they are widely diverse, if not contradictory, in others, as the courts of the various states have to apply the particular statutes of their own state and these statutes are not entirely alike. Hence, due to the lack of uniformity in the state laws and their interpretation, a corporation manufacturing boilers or heavy sheet metal work in one state and "doing business" within the meaning of the law in another state without having first duly qualified itself in that state may run the serious risk of finding its contracts unenforceable, its debts uncollectible or itself liable to heavy fines.

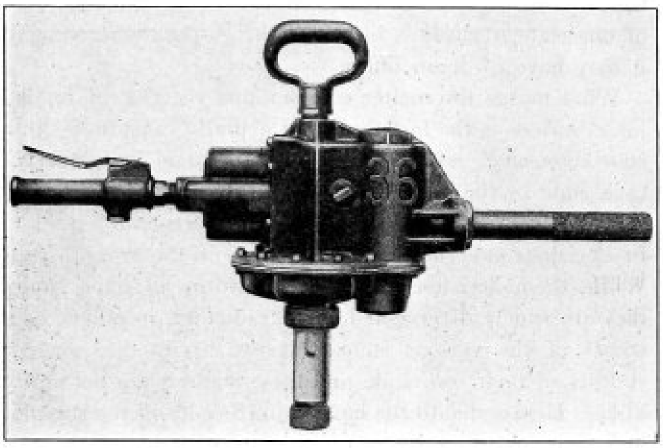
In the brief discussion of this matter at the Cleveland meeting it was apparent that not all of the members of the Boiler Manufacturers' Association were conversant with these conditions; in fact some boiler manufacturers know little or nothing about them. This lack of information is no excuse for faulty practice in the sight of the law and the fact that failure of a corporation about to contract for installation of boilers or other equipment in a foreign state to qualify in that state prior to closing the contract may result in total or partial loss of the contract price should be ample warning for boiler manufacturers to investigate this matter. As suggested by several members at the convention, valuable advice regarding this matter can be obtained from the Corporation Trust Company, 37 Wall street, New York. A more detailed explanation of the situation as it affects the boiler making industry will also be contributed to our next issue by a competent authority. In the meantime, discuss this matter with your attorney, if you have not already done so, and avoid the legal pitfalls that may stand in the way of your successful transaction of business in states other than the one in which your company is incorporated.

Engineering Specialties for Boiler Making

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

Portable Air Drill Adapted for Reaming Service

THE No. 36 Red Giant drill, made by the Chicago Pneumatic Tool Company, has been specially designed for use where piece work rates prevail and where the demands on portable air drills for reaming service require ability to handle a constantly fluctuating load. Generally speaking, reaming is an unknown quantity, for the work varies from single plates to a multiplicity of plates or forgings, gray iron or steel castings and the quantity of metal to be removed produces a constantly changing power factor which demands a type of drill other than that equipped with the usual high speed motor.



No. 36 Red Giant Drill

It is stated by the company that, while the design of the Red Giant drill is not revolutionary, it is nevertheless unique and possesses all the points of advantage incident to stability, reliability, low maintenance, ease of operation and adaptability for reaming or drilling purposes. These claims are based on extensive trials conducted in the plants of many large users of pneumatic equipment. The weight of the drill is 35 pounds and can be classed as a strictly one-man machine for down or side hole reaming.

This drill, which is of the piston type, has been balanced to a high degree and, because of this, is easy to handle and control. The spindle is of the extension type with a tang slot for the convenient ejection of the reamer or drill. The connecting rods are attached to the crosshead by means of standard design wrist pins, as in steam engine practice, obviating the use of a connecting rod toggle. Double acting type cylinders are used which are provided with a packing gland to prevent the leakage of air into the crank case with the attending difficulties.

The valves are of the balanced piston type, long wearing and leak proof and require no pressure to hold them to their seats. The valves are located between the cylinders with very short ports, thus providing air control as close to the cylinders as is possible and effecting the greatest economy in the use of air.

The crank shaft is forged from high grade nickel steel, heat treated to give high tensile strength in the throws and hardness at the wearing points. It differs slightly from the standard Little Giant design, having the eccentrics located between the throws and an integral part of the forging. The crank shaft is mounted on three ball bearings, the extra or third ball bearing insuring proper shaft support on both sides of the main drive gear and adding materially to the frictionless qualities desired for maximum power and efficiency.

The crank pinion and ball gear are of the stub-tooth type perfected by, and extensively used in the automotive industry as well as in most of the standard types of Little Giant drills. These gears have teeth thicker at the roots and shorter in length than the standard involute gear which makes them stronger and more compact and practically eliminates pinion or gear failures under severe service conditions. Splash lubrication is used throughout and, as there is no air to bleed from the crank chamber, there is no loss of lubrication through being carried out with the escaping air.

New Air Hoist Available in Wide Range of Capacities

THE Ingersoll-Rand Company, New York, is offering a line of new air motor hoists including five different sizes with capacities ranging from 500 pounds to 10,000 pounds, suited for a wide range of service where rapid and economical lifting and handling of loads is desired. These hoists contain many distinctive features and in addition possess all the essential features which two decades of familiarity with the field has shown the manufacturer to be necessary.

The 500 pound capacity hoist (size A) was put on the market a short time ago and now the company has developed four larger sizes of similar design so that the same type of hoist is available for heavier work. The four new sizes

New Ingersoll-Rand Air Hoists

embody all the features of the smaller hoist except for such variations, as in the gearing on the two heaviest sizes and similar details.

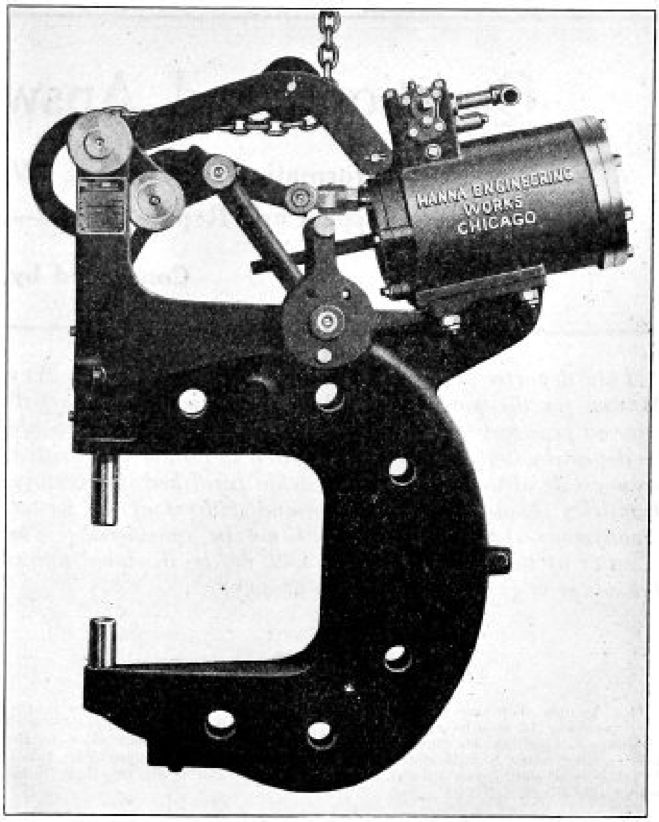
The outstanding characteristics of the new hoists are briefly as follows: Compactness of design resulting in low head room required; and relatively light weight; automatic brake which will hold the load under all circumstances—even if the air supply be disconnected or fail; and a graduated throttle which permits a close regulation of both the lifting and the lowering speeds.

A balanced three cylinder air motor is used which operates in either direction and without vibration at any speed or load within the rated capacity of the machine. The motor is of the same type such as has long been provided for Ingersoll-Rand hoists. Some of the advantages claimed for this motor are its freedom from vibration, the ready manner in which it can be throttled down slowly at all loads and the absence of lubricating troubles, even when subjected to considerable neglect.

The throttle graduation on the new hoists is very fine and this ensures instant and complete control of the hoist at any speed and contributes to the excellent operating performance. A safety stop lever is provided which closes the throttle and stops the motor whenever the load is by chance raised to the top of the hoist lift.

The automatic brake consists of a disk attached to the motor shaft, and of a brake plunger with a friction face, which is held in contact with the disk by springs whenever the hoist is not operating, *i.e.*, whenever the air supply to the motor is cut off either by throttling or otherwise.

A roller bearing mono-rail trolley or top hook mounting can be provided as desired.



Riveter Equipped with Plunger Suspension

Plunger Suspension for Hanna Riveting Machines

A NEW and desirable accessory to the pneumatic riveter, made by the Hanna Engineering Works, Chicago, is the plunger suspension arrangement, which is illustrated herewith. Riveters equipped with this mechanism are improved in their operating characteristics, in that the upper die is stationary and the lower die is movable when suspended in the position illustrated. This permits rivets to be stuck from the top and driven from the bottom. It results in a greater production from this machine for a given number of men in the operating crew. The rivets may be stuck far in advance of the riveter.

As the name of this rigging implies, the suspension is made from the plunger by means of a chain which passes over a sheave on the upper toggle pin and under a sheave so placed at the top of the machine that the chain leading therefrom to the suspension hook is directly above the center of gravity of the riveter when the die screw axis is exactly vertical. Operation of the mechanism to advance the plunger out of the frame barrel towards the lower die results in the entire frame being lifted, since the plunger cannot go down, with the result that the lower die rises, advancing upon the protrusion of rivet shank below the work and driving the rivet head from below. This suspension rigging is additional to and independent of the bale suspension and when furnished the riveter may be suspended by either method.

In the Hanna Riveter is incorporated the Hanna Mechanism that develops a predetermined pressure uniformly throughout the last half of piston stroke, or the last ½-inch of rivet die travel (on machines of over 80 tons, last 1-inch of die travel). This portion of die stroke that performs the final or critical setting of the rivet is, therefore, identical to the die stroke characteristics of a hydraulic riveter. Added to this, the early part of die stroke in which very little actual work is done upon the rivet (that portion of die stroke which can be considered merely as closing the gap necessary for clearance of die about obstructions and for insertion of rivet), is accomplished at an average leverage (piston to die) of 2 to 1, as compared to 12 to 1 for the uniform pressure of stroke. Thus, the clearance gap between dies is closed at relatively small power consumption while the heading of the rivet is performed under ideal or known conditions, regardless of considerable variation in length of stroke and without die screw adjustment.

Improved Methods of Rolling Hollow Staybolt Iron

THE Falls Hollow Staybolt Company, Cuyahoga Falls, O., realizing that the locomotive is being improved rapidly and that equipment and material must keep pace, has developed new methods in rolling hollow staybolt iron which will make a more uniform and round hole of full size to readily admit the entry of the Government inspector's 3/16-inch gage which will both accelerate the work of inspection and avoid the necessity of reaming out ill-formed holes, as well as cut down drill breakage and the like. The design of the rolls used has also been improved to avoid what, in rolling mill parlance, is termed "turn downs" or laps which become imbedded in the surface, causing real or imaginary surface defects and seams.

The heating furnaces used in the mill are equipped with improved high and low pressure air oil burners which makes possible the proper intense white heat necessary to insure a perfect weld and fiber cohesion such as is ordinarily obtained in the solid bar furnace. The company states that it is striving to do its utmost in cutting down locomotive repairs caused by staybolt troubles and thus promote safety for the traveling public.

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Tube Failure

Q.—Assume that you were inspecting a B. & W. boiler 160 pounds pressure, working 12 months a year and that you were on the row of tubes with a hammer weighing 16 ounces and that you struck the tubes close to the header, and after a half dozen blows you dented and flattened the tubes. What reason would you submit as to your conclusion regarding their thickness?—D. C. B.

A.—If the tubes are not struck too hard, and then fail, as you state, our conclusion is that the metal in the tube section has deteriorated. A combination of causes would produce this condition; corrosion, burned tubes, due to the collection of mud and scale and reduced thickness of the tube wall due to the eroding effect of the gases.

Effectiveness of Heating Surfaces of Locomotive Type Boilers

Q.—Have you any late data on the large up-to-date locomotive boiler pertaining to generation of steam, and what parts of firebox generate the most steam; the percentage of different parts compared with one and the other? As what percentage of steam does combustion chamber generate compared with flues, and crown sheet? What percentage of steam do side sheets generate as compared with crown sheet and flues? What percentage of steam does firedoor sheet generate? Any information on this line will be thankfully received. J. C.

A.—The heating surfaces of firebox boilers of the locomotive type are classified according to *direct* and *indirect heating surfaces.*

The firebox sheets such as the crown sides, door, flue sheets and arch tubes are exposed directly to the fire for this reason—these surfaces are known as direct heating surfaces.

The tubes and flues are exposed to the heat from the gases that pass through them but not directly to the fire. Their surfaces are considered as indirect heating surfaces in calculating the entire heating effect.

Tests have shown that a heating surface in a horizontal position is more efficient than an equal area of vertical heating surface; and that a heating surface in direct contact with the fire will evaporate water at a higher rate than an equal area subject to indirect heat.

The heating surfaces of the firebox of locomotive type boilers will evaporate about 55 pounds of water per square foot of heating surface per hour. The evaporation by the tubes and flues is estimated roughly about 10 pounds per square foot of outside surface per hour. The actual evaporation by tube and flue surface is variable, depending on their diameter, length and spacing.

Some of the values of water evaporated per square foot of outside heating surface per hour for some tube sizes and spacing are given in the following table. These data were compiled by the American Locomotive Company:

EVAPORATION FROM TUBES AND FLUES IN POUNDS OF STEAM PER HOUR PER SQUARE FOOT OUTSIDE SURFACE

Length in Feet	2-Inch Tubes			2¼-Inch Tubes			5⅜ and 5½-Inch Flues		
	Spacing*								
	⅝ in.	¾ in.	1 in.	⅝ in.	¾ in.	1 in.	⅝ in.	¾ in.	1 in.
15	9.44	9.97	10.82	10.02	10.51	11.29	11.53	11.65	11.90
15½	9.27	9.78	10.63	9.83	10.33	11.09	11.35	11.46	11.71
16	9.10	9.60	10.44	9.67	10.15	10.90	11.17	11.28	11.52
16½	8.94	9.42	10.25	9.50	9.97	10.71	10.99	11.11	11.34
17	8.78	9.27	10.07	9.34	9.80	10.53	10.82	10.94	11.16
17½	8.62	9.11	9.89	9.18	9.63	10.35	10.65	10.77	10.99
18	8.47	8.95	9.72	9.03	9.46	10.18	10.49	10.60	10.82
18½	8.32	8.79	9.55	8.88	9.29	10.01	10.33	10.44	10.66
19	8.18	8.63	9.38	8.73	9.12	9.84	10.17	10.29	10.51
19½	8.04	8.47	9.21	8.58	8.97	9.68	10.02	10.14	10.36
20	7.90	8.32	9.05	8.44	8.83	9.51	9.88	10.00	10.22
21	7.63	8.02	8.73	8.15	8.55	9.19	9.60	9.72	9.94
22	....	....	....	7.90	8.28	8.90	9.33	9.44	9.66
23	....	....	....	7.66	8.03	8.62	9.08	9.18	9.38
24	....	....	....	7.42	7.78	8.35	8.83	8.94	9.12
25	....	....	....	7.20	7.55	8.10	8.60	8.70	8.90

*By *spacing* is meant the distance between the tubes or flues, after they are installed in the boiler. This should not be confused with the spacing in the tube sheet between the holes known as the *bridge*. On account of the swedged ends the spacing between the tubes is different than the bridge distance.

Burning Wood Refuse

Q.—The accompanying sketch is of boiler setting as used by the firm I am employed with. We have reports of some of these installations not steaming well. I will be pleased if you will publish this in the columns of your paper and will be thankful to anyone who can offer a suggestion as to the cause of our trouble. The fuel used is green sawdust from short leaf pine, although at times there is oak and other hardwoods used.—C. G. T.

A.—We would like some of our subscribers who have had experience with designs and the operation of such plants to give us their opinions on this question.

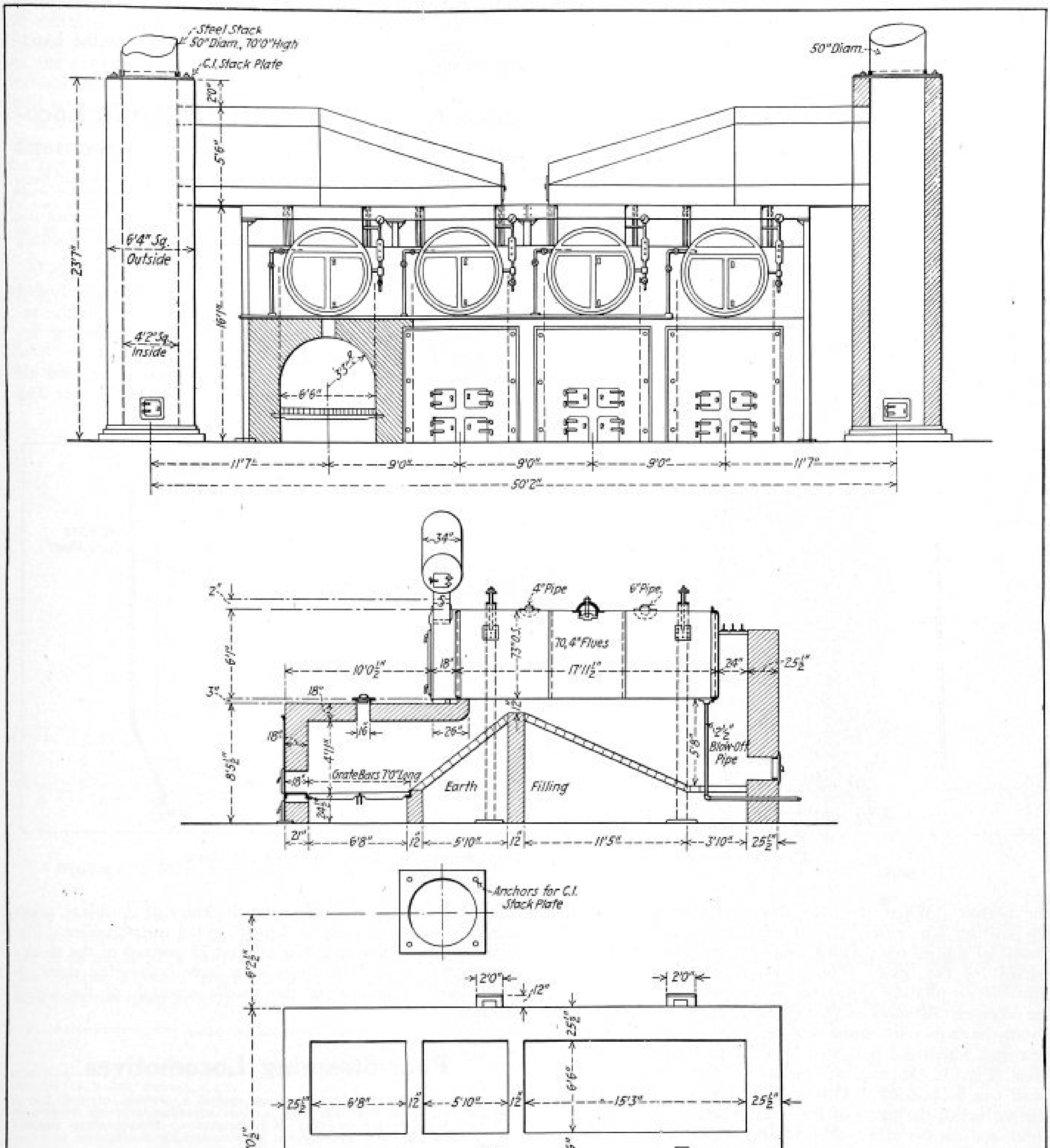
In burning wood such as shavings, sawdust and hogged waste, etc., it should not be discharged directly into the furnace from a blower pipe connection, as the high air velocity would cause trouble in burning the fuel, also quantities of the refuse would be carried into the boiler and block some of the tubes.

The waste should be discharged into a collector where the surplus air escapes and passes off at the top, the shavings and chips fall to the bottom of the collector and from there are fed by gravity into the top of the *dutch oven* or furnace.

With green wood piled on the grate, provision must be made for admission of air over the fuel bed. The fuel bed should be from 3 to 6 inches in depth. Where the fuel is fed at the top of the furnace the fuel piles up in the center, in the form of a cone, and, unless there is a sufficient depth of fuel around the edges, it burns away rapidly at this point, thus allowing surplus air to pass into the furnace and reduce the temperature.

A strong natural draft is recommended instead of forced draft for the reason that forced draft tends to pull the light fuel off of the grate. A high stack is therefore recommended, from 100 to 150 feet being generally used, depending on the size of the installation.

An area of 10 square inches per nominal rated horsepower at the point where the gases leave the boiler furnace to enter the heating surface will give good results.



Arrangement of Boiler Burning Sawdust for Fuel

Renewing Door and Firebox Tube Sheets of Locomotive Boilers

Q.—I have trouble in getting out the patterns for door and tube sheets of locomotive fireboxes. I get the holes cut or in too much. Nothing to go by, only the sheets when they are taken out. These sheets are usually burned out in 2 or 3 pieces. Kindly furnish me some definite method of laying out these sheets in a more accurate way.—J. F. D.

A.—To reproduce either a door sheet or firebox tube sheet from dimensions obtained from the old sheets, after their removal, requires careful attention in taking off the dimensions. Where the heads have been damaged to the extent that dimensions cannot be accurately determined the following plan is offered.

Fig. 1 shows an end view and a side view of one form of locomotive firebox. As the door sheet is inclined to the horizontal the end projection does not show the true size of the sheet. The true height and curvature of the sheet would be shown in a view at right angles to its position shown in the side view. The height can be measured from the side and the width dimensions taken from the end of the firebox. Where the door sheet is badly damaged from the cutting operations, the dimensions are taken from the inside of the firebox; which would be the dimensions to the outside of the head. The curvature of the head may be laid off by plotting the curve as follows: On the mudring set off equal distances as *g-1*, *1-2*, *2-3*, shown in the end view. From the inside dimensions as *g-g*, *1-1*, *2-2*, etc., of the firebox and which are indicated by their projections in the end view, Fig. 1, the required points on the curvature of the head can be laid off. This gives the points for drawing in the outline of the curve of the head, where it joins the crown sheet and as the other sides of the firebox are straight the shape of the head can be laid off directly from those of the firebox. All of the measurements found so far are for drawing up the head after it is flanged.

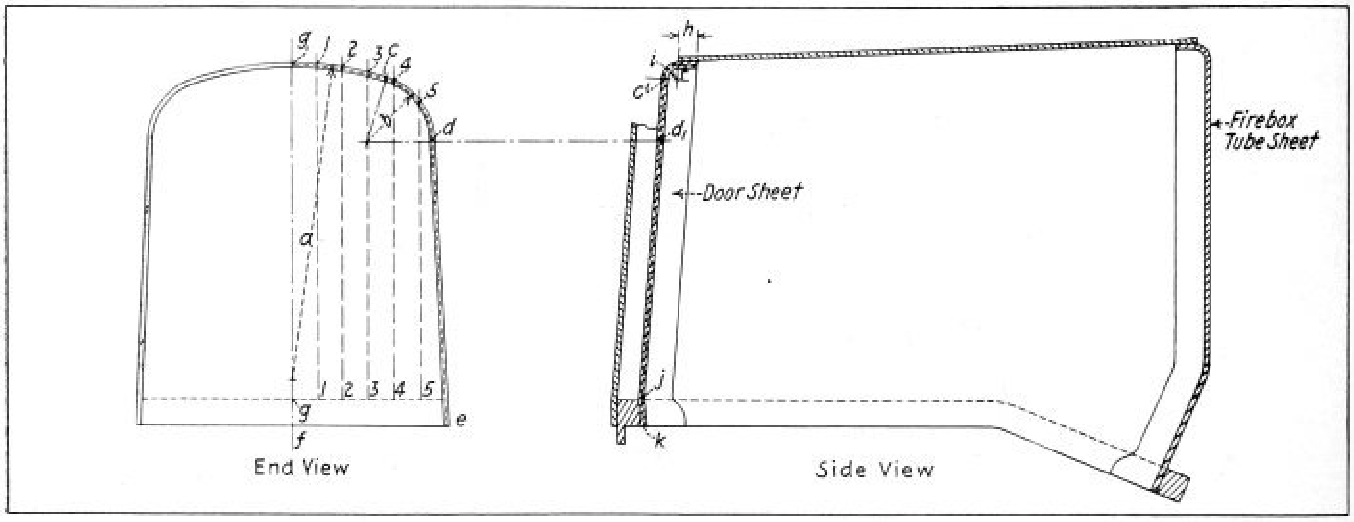


Fig. 1.—Method of Laying Out Door and Side Sheets on One Form of Firebox

Determining Flange Radius

The radius to which the flange is turned may be determined by measuring the inside radius of the flange of the head that was removed. One method is to cut and fit a piece of heavy paper or cardboard to the inside curvature of the flange. By trial locate the center of the arc on the paper template, from which the radius of the arc can be measured.

For the pattern of the door sheet or any other flanged head lay off the flange dimensions to the neutral line of the metal. When the head is flanged, locate several holes in the flange and bolt it in place. Mark off the rivet centers on the flange directly from the firebox sheet.

Our readers are invited to give their ideas on the handling of such repairs.

Rules Governing Size of Holes in Locomotive Boilers Requiring Reinforcement

Q.—Would like to be advised if there is any instruction out that limits the size of hole which shall be made in barrel of boiler for bracket studs of locomotives. I am under the impression that they are not to be over a given size, unless the hole is reinforced, but it is not clear in my mind just what the limit is, and would thank you to give me this information by return mail. I have made a search in the Interstate Commerce Commission circulars, but failed to locate any such information.

T. A. L.

A.—Rules pertaining to locomotive type boilers, adopted by the A. S. M. E. which are to be incorporated in the revised edition of the Boiler Code give the following requirement on holes that must be reinforced:

All holes in the boiler barrel, firebox, roof sheet, and all unstayed surfaces when the diameter of the hole is over 3¼ inches and exceeds 4½ times the thickness of the plate, must be reinforced by a liner or flange riveted to the boiler. The thickness of the lines must be at least 75 percent of the thickness of the plate. The rivets must have a shearing strength of at least 52 percent of the tensile strength of the metal removed.

Poor-Steaming Locomotives

Q.—I don't know whether I am up against a problem or not, but I would like to know what effect the various adjustments of the front end appliances have on the steaming of a locomotive. I have three engines that are hard steamers. Possibly you know something that is new to me.—H. T.

A.—Any of the following conditions will affect the operation of locomotive boilers:

Insufficient draft, which may be due to cinders in the tubes and smokebox; insufficient vacuum in the smokebox which reduces the draft through the boiler.

The vacuum may be sufficient, but the draft may be reduced by the deflector plates being set too near the tube sheet, or the diaphragm apron or damper may be set too low. When these appliances are so arranged the flow of the gases is reduced. These plates should be so adjusted that they do not hinder the flow of the gases other than what is needed to cause a uniform draft through all of the tubes.

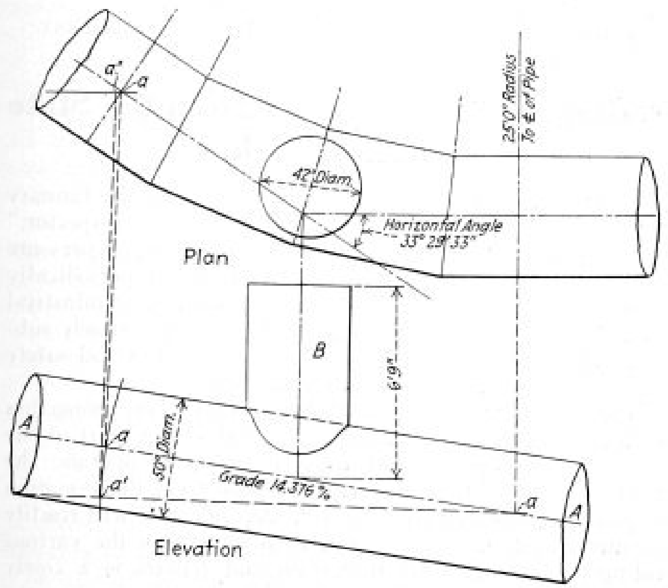
The conditions that reduce the vacuum in the smokebox are: Air leaks around the smokebox front end; steam leaks in steam pipe headers and superheater. The exhaust steam nozzle may be too large, which would reduce the velocity of the exhaust steam through the stack. The petticoat and exhaust nozzle should be in line, otherwise the exhaust steam will strike on one side of the stack and reduce the vacuum.

When the draft is too great cinders are drawn into the tubes and clog the wire netting. The tubes and front end should be kept free of such obstructions.

Elbow Construction

Q.—I am inclosing a sketch showing the plan and elevation of a 50-inch pipe line with a vertical 42-inch pipe intersecting it on the center of the elbow. Would you please show me how to lay out the plates for the elbow, the plate for the vertical pipe and the opening in the elbow?—S. R. B. C.

A.—This development can be made like the regular elbow construction, the only difference is that the layout is made at right angles to the inclination of the pipe, that is at right angles to the plane *A—A* shown in the sketch. In such a view the elbow sections are shown in their true size with the pipe *B* in an inclined position. Refer to September issue of THE BOILER MAKER, which contains two problems that involve the principles to be applied in this example.



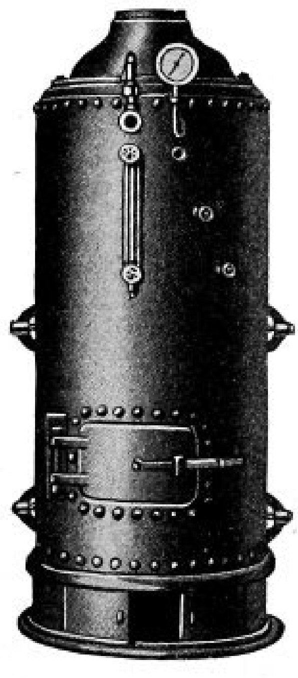
Problem in Plate Layout for Elbow Connections

Size and Capacity of Vertical Firetube Boilers

Q.—I am obliged to you for your letter of the 29 of October, and note what you have to say in answer to my question regarding steaming capacity of boilers.

I took up the query mentioned in the last paragraph of your enclosure, but my friends are unable to supply any further information. They simply state that they can only furnish particulars as regards the diameter of the boiler and number of tubes, but that they have no information regarding length of same nor other particulars such as grate area, combustion chamber, etc. They take it, however, that the boilers referred to would be of the *standard American type*, and therefore consider that the information given in the first place would suffice, and that the necessary information would be obtainable from one of the leading American boiler makers. Perhaps, therefore, you would be so kind as to look into this matter again and let me hear from you.—F. G. B.

A.—The following table gives the principal proportions of vertical firetube boilers from 1½ to 60 horsepower. These boilers are built to withstand 100 pounds working pressure, and are tested under hydrostatic pressure of 150 pounds per square inch. These data will be of assistance in determining the size and capacity of the boilers you refer to. Our readers may be able to suggest additional data.



Typical Vertical Firetube Boiler

SPECIFICATIONS FOR FULL-LENGTH TUBE BOILERS

Horse-power	1½	2	3	4	5	6	6	8	10	12	14	15
Diameter of boiler, inches	20	20	20	24	24	24	27	30	30	30	36	36
Height of boiler, feet	3	3½	4	4	5	6	5	5	6	7	6	6
Diameter of furnace, inches	16	16	16	19	19	19	21	24	24	24	30	30
Height of furnace, inches	18	18	18	23	23	23	26	26	26	26	26	26
Thickness of shell, inch	7/32	7/32	7/32	¼	¼	¼	¼	¼	¼	¼	¼	¼
Thickness of heads, inch	5/16	5/16	5/16	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
Thickness of furnace plate, inch	7/32	7/32	7/32	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Number of tubes (all 2 inches in diam.)	16	19	19	24	24	24	30	48	48	48	66	72
Length of tubes, inches	18	24	30	25	37	49	33	34	46	58	46	46
Square feet of heating surface	18	26	31	36	49	61	56	85	111	136	151	165
Diameter of stack, inches	8	8	8	8	8	8	10	12	12	12	15	15
Weight of bare boiler, about	350	425	475	770	870	950	980	1,185	1,395	1,600	1,800	1,900
Weight of complete boiler, about	580	650	700	1,070	1,170	1,250	1,330	1,685	1,895	2,100	2,475	2,575
Horse-power	16	18	20	22	25	27	30	35	40	45	50	60
Diameter of boiler, inches	36	36	36	42	42	42	42	42	48	48	48	54
Height of boiler, feet	7	7	8	7	7½	8	8½	9½	8½	9	10	9
Diameter of furnace, inches	30	30	30	36	36	36	36	36	42	42	42	48
Height of furnace, inches	26	26	26	30	30	30	30	30	30	30	30	30
Thickness of shell, inch	¼	¼	¼	5/16	5/16	5/16	5/16	5/16	11/32	11/32	11/32	⅜
Thickness of heads, inch	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	½
Thickness of furnace plate, inch	5/16	5/16	5/16	11/32	11/32	11/32	11/32	11/32	5/16	5/16	5/16	⅜
Number of tubes (all 2 inches in diam.)	66	72	72	92	92	92	92	92	130	130	130	172
Length of tubes, inches	58	58	68	56	61	68	74	85	74	80	90	77
Square feet of heating surface	186	201	232	252	272	299	324	368	453	486	543	639
Diameter of stack, inches	15	15	15	18	18	18	18	18	20	20	20	24
Weight of bare boiler, about	2,100	2,225	2,450	2,825	2,975	3,200	3,375	3,675	4,250	4,425	4,750	6,100
Weight of complete boiler, about	2,775	2,900	3,125	3,750	3,900	4,125	4,300	4,600	5,375	5,550	5,875	7,500

Letters from Practical Boiler Makers

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

How Much Does Boiler Scale Cost?

NEARLY everybody knows that scale in a boiler is expensive. Not enough of us realize, however, how expensive it really is per year.

The accompanying chart was developed with a view to emphasizing the importance of keeping boilers free from scale—in other words to drive home the fact that boilers should be kept *clean*.

The chart is very simple and easy to use. Merely connect the number of pounds of scale cleaned out of the boiler per month in the left hand column (column *A*) with the cost of the coal per ton (column *C*) and the intersection through column *B* gives the annual cost of the fuel per year.

For example, if you clean 1,000 pounds of scale out of your boiler, or boilers, per month and, if the cost of your

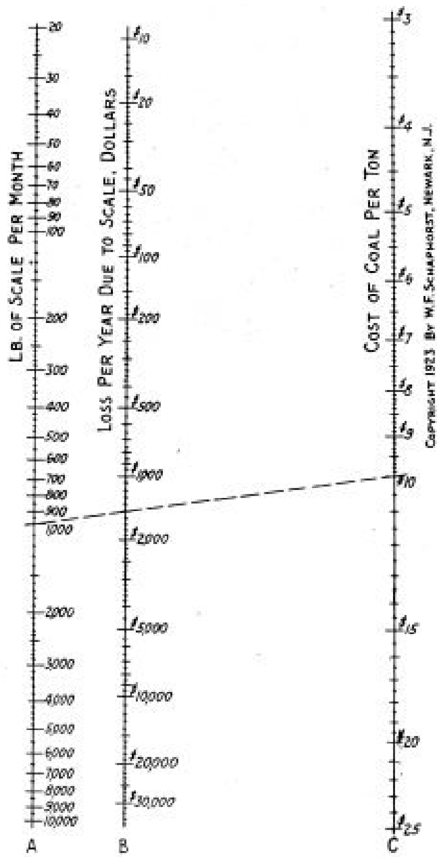


Chart for Computing Scale Losses

coal is $10.00 per ton, the dotted line drawn across the chart shows that the loss per year due to scale is $1,500.00. As will be noted the dotted line connects the 1,000 in column *A* with the $10.00 in column *C*, and the intersection through column *B* gives the answer as $1,500.

The range of the chart is great enough to take care of almost any boiler or battery of boilers ranging from 20 pounds of scale per month to 10,000 pounds per month, and including all varieties of coal from $3.00 per ton to $25.00 per ton. Between its extreme limits column *B* will give losses varying all the way from $10.00 per year to $30,000.00 per year.

The writer trusts that a study of this chart and its application to actual cases will have the desired effect, namely, that of keeping boilers clean and thereby saving much fuel and money. The present unnecessary annual losses due to scale are prodigious.

Newark, N. J. W. F. SCHAPHORST.

Stationary Boiler Inspection in the State of New York

THE communication appearing on page 26 of the January issue of THE BOILER MAKER, signed by "Inspector," inviting discussion on the laxity of steam pressure boiler owners and users in having their boilers periodically inspected and recorded in accordance with the Industrial Code of the New York Department of Labor, is a timely subject and one of great importance, since the interest and safety of the general public are vitally concerned.

The steam pressure boiler when operated in connection with any industry is generally considered as the heart of the mechanical equipment and when it ceases to operate, the works are idle. In considering the loss from the cessation of power upon which an industry is dependent, it will readily be understood that the practice of disregarding the various rulings governing boiler inspection and repairs is a costly one. The reason for the tendency to do this is that the average owner or user of pressure boilers lacks an understanding of the conditions which exist in a boiler under pressure and the consequences of negligence.

Decisive and definite enforcement of the law and all its rulings is the real way to educate the owners and operators of boilers to respect the provisions of the law, with heavy penalties when the requirements are not met.

Ignorance of the law can be no excuse to evade its provisions or penalties. As these provisions or rulings are embodied in the Industrial Code of the Department of Labor by which every industry of the state must be guided, no other course remains to those whose duty it is to enforce the law but to impose the stated penalties in proportion to the neglect of the boiler user in safeguarding the public.

In a number of states and cities ordinances are in force whereby employes operating such boilers are required to be licensed firemen and are subject to examination by a committee of the labor board to ascertain their qualification to perform such duties. They are also expected to be familiar with the laws governing the inspection and maintenance of such boilers. If the employes or license holders operating the boilers were required by law through some definite means to cooperate with the management or owners in reference to the boiler inspection provisions, I am sure a marked improvement would result in this respect. In any event, the law must be enforced.

Jersey City, N. J. T. P. TULIN.

Oil Country Boiler Explosions

ON the 19th day of December at 10 p.m. a locomotive wet bottom boiler as used in the oil country and manufactured by Selew and Popple exploded. We estimate that this boiler is somewhere between thirty and forty years of age as this firm has been out of business over thirty years.

The boiler was 36 inches in diameter by 14 feet 1¾ inches long overall. The front segment above the flues was 14 inches and provided with two diagonal braces. The plate was ¼ inch thick and the heads ⅜ inch thick. A single lap joint was used with hand driven rivets of 1⅞-inch pitch. The crown stays were ⅞ inch and pitched 5¼ inches by 6 inches. The side stays were ⅞ inch and pitched 6 inches by 5½ inches. The side of the firebox was 3 feet high, 4 feet 2 inches long and 3 feet 6 inches across. It had several patches on the left hand side of the firebox, and a large patch on the barrel; also three patches on the flange of the water bottom. The boiler was of iron construction.

At the time of the explosion the operators were carrying 90 pounds of steam. They had a very queer arrangement of safety valves which would certainly have been condemned by any inspector. It was only a miracle that no one was hurt for the tool dresser had put the injector to work and had left the boiler not a minute before it exploded. Strict and careful examination disclosed that the explosion was directly caused by low water and the initial rupture took place at the fusible plug hole.

The crown sheet tore through the second row of crown bolts from the back head down the sides, a distance of 13 inches and 22 inches, and threw the crown sheet into the water bottom, hurling the boiler a distance of about 60 feet. It also tore through the front row of crown bolts, a distance down the sides of 10 inches and 18 inches. The crown and staybolts were all in good condition prior to the explosion and the heads were stripped as the sheets went down.

Boiler Never Inspected

This boiler had never been inspected and was carrying a pressure greater than would really have been allowed. The efficiency of the longitudinal joint was 63 percent and, using a factor of safety of six for the age of 30 years, the allowable working pressure should be:

$$\frac{0.63 \times 0.25 \times 45{,}000}{18 \times 6} = \frac{7{,}087.5}{108} = 65.6 \text{ pounds pressure.}$$

Although the direct cause was overheating of the crown sheet caused by low water they were carrying about 25 pounds pressure more than safety would allow and, as the safety valve was a ball and lever type, there cannot be much dependence placed on its operation, nor had the steam gage been tested, so that its accuracy could not be relied on. The boiler was equipped with 3-gage cocks and no water glass. The gage cocks could not be found to see what condition they were in.

This boiler is located about 1,500 feet over the New York State line at Haymaker and is in Pennsylvania. I find by referring to the Pennsylvania Boiler Code and amendments whereby an amendment to Paragraph 380 gives an age limit of 30 years to horizontal return tubular, flue and cylindrical boilers carrying over 50 pounds and having longitudinal lap joints, why not locomotive types too?

Oil Field Boilers Exempt

The Pennsylvania Boiler Code under Section 5 (e) of the Rules and Regulations for the Administration of the Boiler Code, specifically exempts boilers used exclusively in connection with the operation of oil wells. Now I think this a grave mistake for these boilers are certainly just as dangerous, if not more so, than any other. They get very little care and a lot of rough usage and neglect. We know that there are not inspectors enough to cope with the situation at present and we who are interested in boiler practice safety should make a combined effort to enforce the laws more rigidly and to modify them to cover all boilers carrying over 15 pounds pressure. In New York State they already cover all boilers but do not have enough inspectors to cover the situation as thoroughly as we would like to. This boiler had the fusible plug removed and a solid plug inserted contrary to law.

In conclusion, I will say we should take these oil country boilers and give them our immediate attention before some one is killed and property destroyed.

Port Dickinson, N. Y. CHARLES W. CARTER, JR.

Locomotive Boiler Repair Records

IN the February number of THE BOILER MAKER (page 44) is published a boiler repair record made by the shops of the Southern Pacific Company at El Paso, Texas. On class two repairs, the master mechanic in charge claims that the work was completed in 72 working hours. If he had stated what work was done in the way of class two repairs we could then look up the records on some of our work to make a fair comparison.

For example; in making repairs of that class, an engine came into the shop September 25 just as she gave up the run at the round house. No stripping of any kind had been done. The boiler was removed from the frame, taken to the boiler shop for a new firebox, the frame was turned over to the machinist to work on, and all parts to be renewed were taken to the machines to be made new or repaired.

On such a boiler job it is necessary to remove the old firebox, the flues, staybolts, radials, and half radials and build a new firebox. When trying to establish a record the time taken must include laying out the plates, shearing, punching, rolling, flanging the flue and door sheet, drilling the flue holes, fitting up the firebox, driving the flue and door sheet, putting the firebox into the boiler, driving the mud ring rivets, tapping about 3,000 staybolts and 500 radials and half radials, putting them all in, burning off, driving them, putting in the flues.

Then the boiler must be put back on the frame so that the machinists can complete their work and get a test on the boiler. From my experience and that of others, I do not think that this can be done in 72 hours. I have outlined the boiler work necessary and I would like to have some master mechanic or shop superintendent discuss the machine work.

I am a master boiler maker with years of experience in different shops and about all of them work along much the same lines. I do not believe such record statements are altogether fair to other master mechanics, shop superintendents and foremen. To a man who understands conditions, such statements mean little or nothing, but to the public, the stockholders in the company, who do not know any better than to believe them, an entirely wrong impression is given.

A. WENDT.

Pittsburg, Kans.

Saving Time and Labor on Flue Jobs

(*Continued from page* 79)

is not shown in the sketch but should be at least 4½ feet from the center line of the piston.

Besides the drive pulley, there should also be an idler pulley at this point so that the belt may be shifted to the idler when the cutter is not in use. No dimension appears on this sketch as our purpose is only to convey the general idea and principles of its construction as it should be built to suit local conditions. This form of cutter will cut flues from 2 inches up to 6 inches if the shaft is made long enough, which will also enable the operator to cut off longer lengths.

FRONT END FLUE CUTTER

The flue cutter for cutting off flues in the front end of locomotives is simply an attachment for supporting the air motor and also to increase the power of the motor by the use of two heavy gears or, in other words, a low gear attachment.

In making and assembling this form of cutting attachment, the 20-inch or large gear was taken from a scrap hand car. The teeth of the pinion gear were cut out of a block of steel 2 inches by 4 inches in diameter, on a shaper, there being no milling machine in the shop at that time. The 2 inch by 5/8-inch bar iron shown in the sketch is bolted to the smoke arch ring by using the slots cut in each end making it possible to fit to almost any smoke arch regardless of the diameter.

After the attachment is bolted in place on the smoke arch ring, one man can easily cut all the flues in the boiler by the use of the extension bar shown in the sketch. A reversible air motor must be used in order to extract the cutter blade after the flue is cut in two. The cutter must be reversed a turn or two which will force the blade back into a small recess. It can then be removed from the flue and is ready to insert into the next flue to be cut.

Should any of the readers of THE BOILER MAKER be interested to the extent of making any of the aforementioned devices for his shop the writer will be glad to render any further assistance possible.

NEW BOOKS

SHAPE BOOK OF THE CARNEGIE STEEL COMPANY, 346 *pages, 5 inches by 7½ inches, illustrated. Flexible binding. Published by the Carnegie Steel Company, Pittsburgh, Pa.*

This volume is the ninth edition and is available to users of steel. The new edition is the result of a thorough check and revision of all the sections rolled by the Carnegie Steel Company on its shape, rail, bar and plate mills, and while no important changes have been made in the regular sizes of structural and bar mill sizes of beams, channels, angles, tees and zees, a number of changes have been made in the large number of special sections rolled by that company, such as concrete reinforcement bars, window and casement sections, automobile rim sections and other miscellaneous bar mill sections. Certain rails and splice bar sections, which have become obsolete since the issue of the preceding eighth edition, have been eliminated in the present issue.

PRACTICAL PERSPECTIVE. *By Frank Richards and Fred H. Colvin, with a chapter on true perspective by C. W. Reinhardt. Fifth edition. Size, 4½ by 7 inches. Pages, 69. Illustrated. Limp cloth binding. New York: 1923. Norman W. Henley Publishing Company.*

Practical perspective is a subject of interest to those dealing with mechanical drawing and to a lesser degree with laying out work. The treatise demonstrates the method of making mechanical drawings by means of perspective according to the so-called isometric system. Sketches and drawings made in this way are readily understood and can be correctly interpreted by the men carrying out the actual work. Time is saved in the drawing room by following the method and accuracy is promoted in the shop. Practical examples of various types of machine and construction work are given with suitable illustrations showing the use of isometric paper, methods of lettering and other applications of the method.

BUSINESS NOTES

The National Malleable Castings Company, Cleveland, Ohio, has changed its corporate name to the National Malleable and Steel Castings Company. There has been no change in management or personnel.

H. E. Hughes, vice-president of the Locomotive Crane Company of America, Champaign, Ill., has been elected president, succeeding Charles Bergan, resigned. He will be succeeded by John Brenza, a director.

Walter F. Delaney has been appointed representative of the Hanna Engineering Works, Chicago, manufacturers of Hanna riveting machines, air hoists, sand sifters and I-beam trolleys, with headquarters at 203 Mutual building, Richmond, Va.

Paul J. Kalman has been appointed chairman of the board of directors of the Globe Steel Tubes Company with headquarters at St. Paul, Minn. Frank J. O'Brien, vice-president and general manager has been elected president with the same headquarters to succeed Mr. Kalman. Mr. Kalman became president of the Globe Steel Tubes Company in August, 1922, at which time the company took over the business of the Globe Seamless Steel Tubes Company of Milwaukee, Wis.

Foundations have been laid for a new plant for the Dries & Krump Manufacturing Company now located at 2911 South Halsted street, Chicago. The company expects to occupy its new quarters about June 1. The new factory, which will be located in the block bounded by Seventy-fourth, Seventy-fifth, Loomis and Bishop streets, will be of reinforced concrete and steel construction, dimension for the main building being 200 by 260 feet, one story high in the center and two stories high on either side. An additional building, 30 by 60 feet, will contain the office and a garage.

TRADE PUBLICATIONS

SOOT BLOWERS.—A four-page illustrated folder, descriptive of the Bayer type S valve-in-head soot blower, has recently been issued by the Bayer Company, St. Louis, Mo.

AIR COMPRESSORS.—The Champion Pneumatic Machinery Company, Chicago, Ill., has recently issued a catalog describing the line of air compressors for industrial and automotive requirements produced by this company.

MOTOR-DRIVEN GRINDER.—A new wide swing floor stand grinder is described and illustrated in Bulletin No. 3016-S, recently issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio. The wheels of the grinder are of wide spacing (37 inches) to permit grinding of large, bulky castings and many other irregular shaped pieces.

WELDING AND CUTTING APPARATUS.—The Alexander Milburn Company, Baltimore, Md., has prepared two booklets covering first, welding and cutting apparatus and acetylene generators made by the company; and, second, a description of the Milburn light, which consists of a portable acetylene generator and various combinations of lights and reflectors.

ELECTRO ARC WELDING.—Bulletin 127 being sent out by the Burke Electric Company, Erie, Pa., illustrates and briefly describes variable voltage type equipment and portable equipment for welding, as well as gasoline engine-driven arc welding apparatus either for one or two operators. Various samples of parts repaired by welding, firebox welds and patches are included.

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—George Uhler, Washington, D. C.

Deputy Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law Society

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—John A. Stevens, Lowell, Mass.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 West 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—J. F. Scott, Trenton, N. J.

Secretary-Treasurer—C. O. Myers, State House, Columbus, Ohio.

Vice-Chairman—R. L. Hemingway, San Francisco, Cal.

Statistician—W. E. Murray, Seattle, Wash.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

J. A. Frank, International President, suite 522, Brotherhood Block, Kansas City, Kansas.

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, suite 524, Brotherhood Block, Kansas City, Kansas.

H. J. Norton, International Vice-President, Alcazar Hotel, San Francisco, Calif.

International Vice-Presidents—Thomas Nolan, 700 Court St., Portsmouth, Va.; John Coots, 344 North Spring St., St. Louis, Mo.; M. A. Maher, 2001-20th St., Portsmouth, Ohio; E. J. Sheehan, 7826 South Shore Drive, Chicago, Ill.; John J. Dowd, 953 Avenue C, Bayonne, N. J.; R. C. McCutcheon, 15 La Salle Block, Winnipeg, Man., Can.; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; John F. Schmitt, 605 East 11th Ave., Columbus, Ohio.

Master Boiler Makers' Association

President—E. W. Young, mechanical assistant to G. S. M. P., C. M. & St. P. R. R., 787 Caledonia Place, Dubuque, Iowa.

First Vice-President—Frank Gray, tank foreman, C. & A. R. R., 705 W. Mulberry Street, Bloomington, Ill.

Second Vice-President—T. F. Powers, System G. F. Boiler Dept., C. & N. W. R. R., 1129 S. Clarence Avenue, Oak Park, Ill.

Third Vice-President—J. F. Raps, G. B. I., I. C. R. R., 4041 Ellis Avenue, Chicago, Ill.

Fourth Vice-President—W. J. Murphy, G. F. B. M., Penn. R. R. Lines West, 3614 Mexico Street, N. S., Allegheny, Pa.

Fifth Vice-President—L. M. Stewart, G. B. I., At. Coast Lines, Box 660, Waycross, Ga.

Secretary—H. D. Vought, 26 Cortlandt Street, New York.

Treasurer—W. H. Laughridge, G. F. B. M., Hocking Valley R. R., 537 Linwood Avenue, Columbus, Ohio.

Executive Board—E. J. Reardon, Locomotive Firebox Company, 632 Marquette Building, Chicago, Ill., chairman; H. J. Raps, G. F. B. M., I. C. R. R., 7224 Woodlawn Avenue, Chicago, Ill., secretary.

Boiler Makers' Supply Men's Association

President—George R. Boyce, A. M. Castle Company, Chicago, Ill. Vice-President—J. P. Moses, Jos. T. Ryerson, Chicago, Ill. Secretary—W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

American Boiler Manufacturers' Association

President—E. R. Fish, Heine Boiler Company, St. Louis, Mo.

Vice-President—E. C. Fisher, The Wickes Boiler Company, Saginaw, Mich.

Secretary-Treasurer—H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

Executive Committee—George W. Bach, Union Iron Works, Erie, Pa.; G. S. Barnum, The Bigelow Company, New Haven, Conn.; F. G. Cox, Edge Moor Iron Company, Edge Moor, Del.; W. C. Connelly, D. Connelly Boiler Company, Cleveland, O.; W. A. Drake, The Brownell Company, Dayton, O.; A. R. Goldie, Goldie-McCulloch Company, Galt, Ont., Can.; J. F. Johnston, Johnston Brothers, Ferrysburg, Mich.; M. F. Moore, Kewanee Boiler Works, Kewanee, Ill., and A. G. Pratt, The Babcock & Wilcox Company, New York.

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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

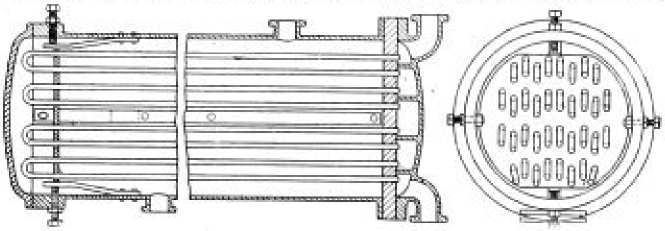
SELECTED BOILER PATENTS

Compiled by
GEORGE A. HUTCHINSON, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

1,478,855. BOILER-FEED WATER HEATER. WILHELM HILDEBRAND, OF BERLIN-LICHTENBERG, GERMANY, ASSIGNOR TO HANDEL MAATCHAPPIJ H. ALBERT DE BARY & CO., OF AMSTERDAM, NETHERLANDS, A DUTCH COMPANY.

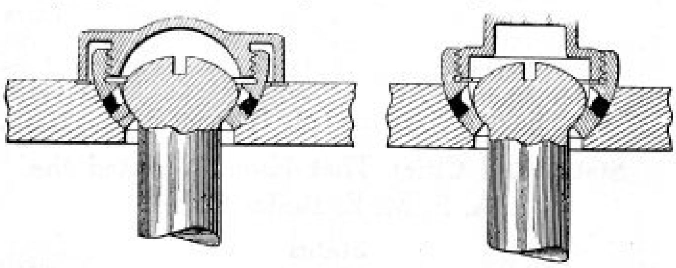
Claim.—In a feed water preheater, a shell, a tube plate within said shell, a plurality of water tubes penetrating said plate, said plate and tubes being



conjointly movable longitudinally in relation to said shell, and guide ribs secured to said shell longitudinally thereof, said guide ribs being adapted to maintain supporting contact with said plate during its longitudinal movement and in its operative position. Eight claims.

1,472,389. STAYBOLT STRUCTURE. JOHN ROGERS FLANNERY, OF PITTSBURGH, PENNSYLVANIA, AND ETHAN I. DODDS, OF CENTRAL VALLEY, NEW YORK, ASSIGNORS TO FLANNERY BOLT COMPANY, OF PITTSBURGH PENNSYLVANIA, A CORPORATION OF DELAWARE.

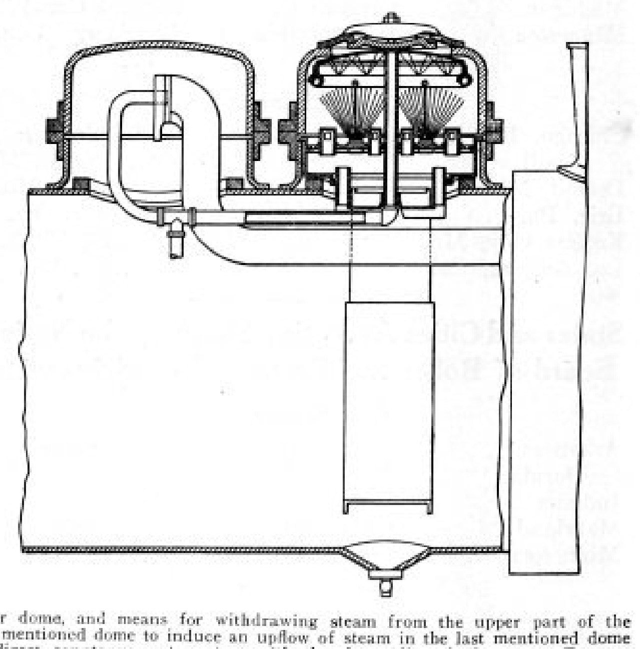
Claim.—In a staybolt structure, the combination of a boiler sheet having an opening therein and a bearing member for a staybolt head within said



opening, the said bearing member being provided with an opening in its side and welded to the sheet intermediate the inner and outer surfaces of the latter by welding material introduced into said opening. Four claims.

1,474,218. WATER-PURIFYING SYSTEM FOR LOCOMOTIVES. FRITZ WAGNER, OF BERLIN-LICHTERFELDE, GERMANY.

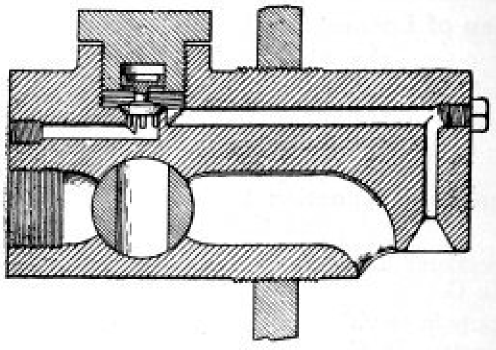
Claim.—A steam boiler having two steam domes one having the main steam outlet therefrom, means for delivering feed water to the upper part of the



other dome, and means for withdrawing steam from the upper part of the last mentioned dome to induce an upflow of steam in the last mentioned dome in direct countercurrent contact with the descending feed water. Twenty-two claims.

1,475,718. BLOW-OFF PLUG FOR BOILERS. SPENCER OILS AND WALTER A. GARDNER, OF CHICAGO, ILLINOIS.

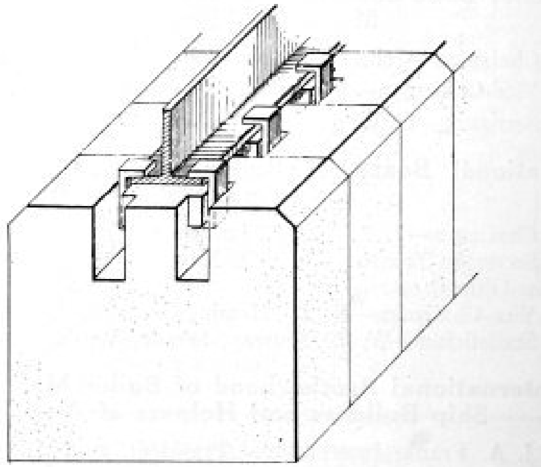
Claim.—A combined air blast and water blow-off plug for steam boilers having controlled passages for air and water therethrough, communicating



independently with the interior of the boiler and adapted respectively to deliver air thereto and withdraw water therefrom. Eight claims.

1,472,945. FURNACE ARCH. CLARENCE A. STRACHOTA, OF MINNEAPOLIS, MINNESOTA, ASSIGNOR TO LIPTAK FIRE-BRICK ARCH COMPANY, A CORPORATION OF MINNESOTA.

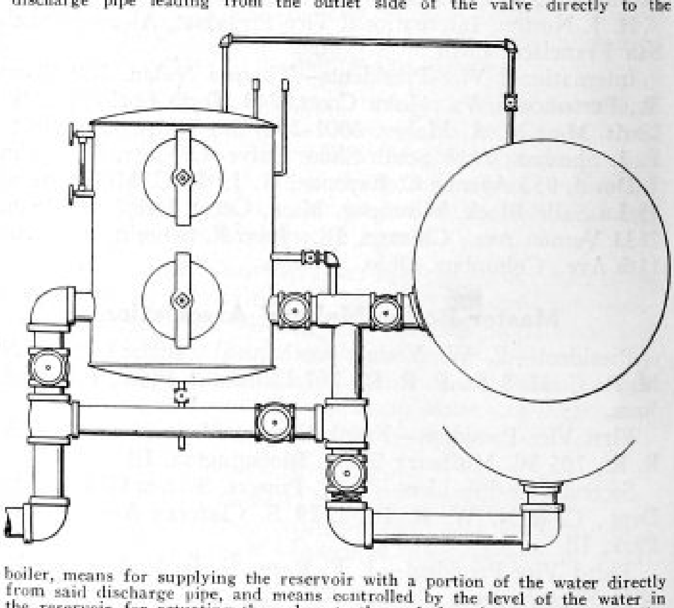
Claim.—The combination with a flanged beam and a block structure in which said blocks are formed with pockets having undercut ledges forming



contracted throats, of block hangers arranged in opposing pairs and having outer flanges slidable on the beam flange and having inner flanges slidable under the undercut ledges of the blocks. Six claims.

1,473,714. APPARATUS FOR CONTROLLING THE WATER LEVEL IN BOILERS. FRANK E. WEIDNER, OF MARYVILLE, MISSOURI.

Claim.—In combination with a boiler, a reservoir positioned to hold water on a level with that in the boiler, a valve located in said reservoir, a pipe leading from a source of water supply to the inlet side of said valve, a discharge pipe leading from the outlet side of the valve directly to the



boiler, means for supplying the reservoir with a portion of the water directly from said discharge pipe, and means controlled by the level of the water in the reservoir for actuating the valve, to the end that the water in the boiler and the reservoir may be maintained at, or approximately at, a predetermined level. Three claims.

THE BOILER MAKER

APRIL, 1924

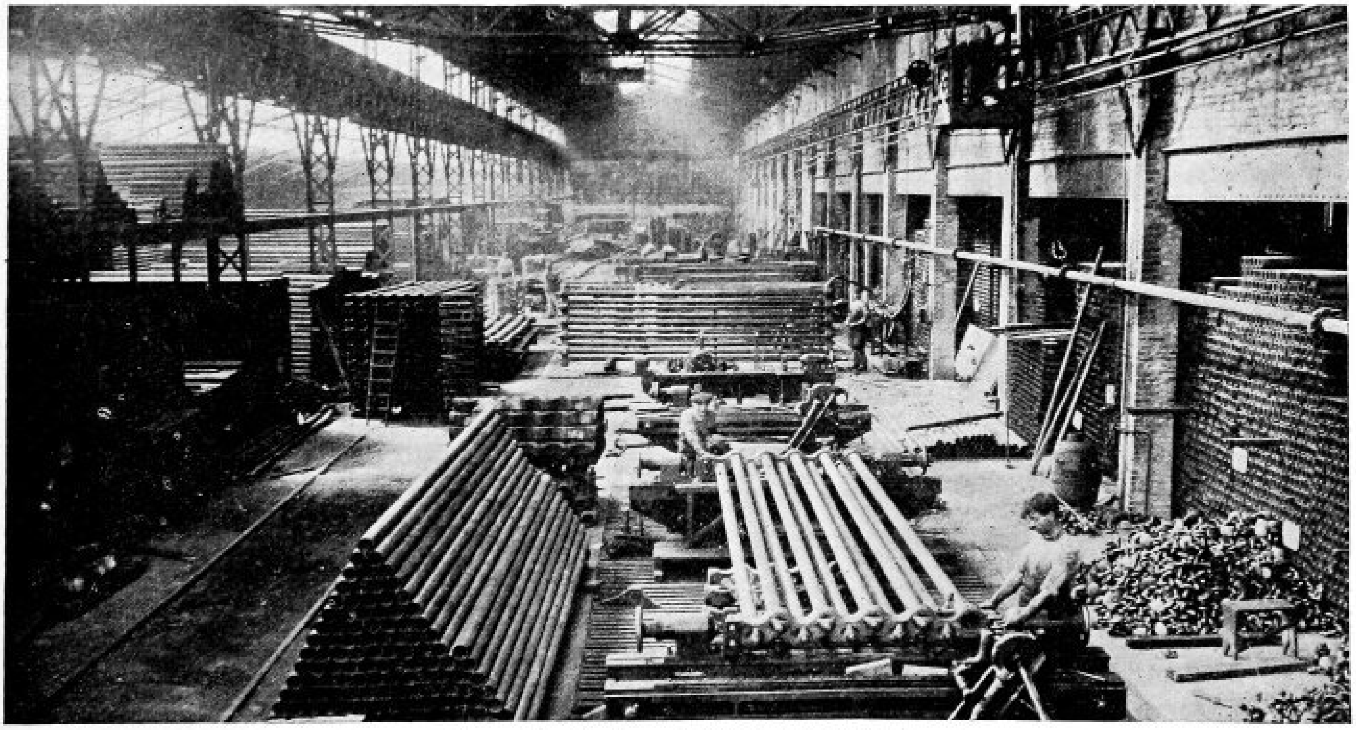
The French Babcock and Wilcox Boiler Works

This Plant Located at La Courneuve is One of the Three Most Active Boiler Shops in France

By Captain Godfrey L. Carden

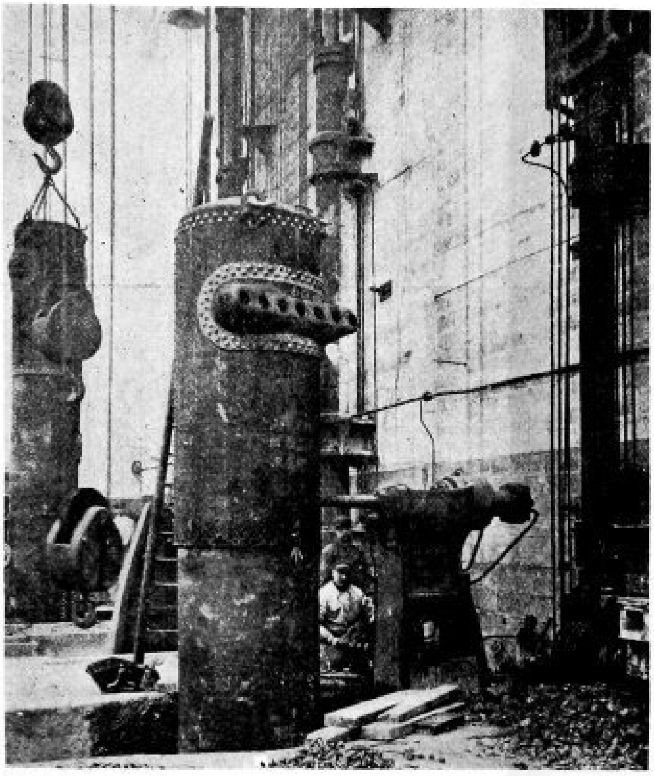
THE Babcock and Wilcox boiler works, located at La Courneuve on the northern outskirts of Paris, is undertaking important developments in the expansion of that plant. With the exception of the name, the works are essentially French, and French personnel only is in evidence. These works secured the American rights for France for the Babcock and Wilcox patents and all Babcock and Wilcox installations now being incorporated in the rehabilitation program in France are the outputs of the La Courneuve shops.

Prior to the advent of the Babcock and Wilcox plant, the major boiler work in France, especially for the marine was handled by Normand, Niclausse and Delauney-Belleville. Of late there has been little boiler demands for ship purposes and both Niclausse and Delauney-Belleville are building for land power installations. I should say that, today, the Babcock and Wilcox shops at La Courneuve, the Sterling boiler shops of the Company Fives-Lille and Niclausse are responsible for the majority of the important power plants recently built or in process of construction in France. The new Gennevilliers station near Paris, the most powerful power plant, I believe, on the continent of Europe is equipped with French made boilers of the Babcock and Wilcox and Sterling types.



Expanding Sections for Watertube Boilers

I recently visited La Courneuve and was received by Mr. Charles Roszak, director-general of the Babcock and Wilcox shops. In company with that gentleman I personally inspected the plant and took note of the building program in progress. The first impression conveyed indicated that the shops were busy, but the most important feature was the likeness in so many ways to American methods of doing things. Certainly there was noticeable a snap and vim that spelled for efficiency and which appeared unusual for a European shop.



Hydraulic Riveting Operation at the French B and W Shops

Arrangement of Plant and Buildings

In all, there are ten distinct shop buildings in the new La Courneuve layout, comprising the forge, foundry, drum, mechanical and tube shops, the erecting shops for boiler sections, and the modeling and tool shops. These are the essential production shops as distinct from the administrative buildings, the power station and store houses and the like.

The entire shop arrangement permits of automatic performance of work, and of a flow of material without retracing. The speed is regulated by the program department, in which department a record is kept of each detail as the work progresses. In the tool shop the methods in vogue are those familiar in all up-to-date American plants. No workman is permitted to rectify faults in his tool. The toolmaker attends to all necessary corrections, and in each shop there is an expert tool man who keeps watch on the tools in service. To guard against contingencies a small stock of tools is kept on hand sufficient in quantity to supply all shops for 15 days' calculated working time. This supervision over the tools would be taken as a matter of course in most American shops, but its existence in a French plant is noteworthy as indicative of the strides which the modern French shop is evidencing.

The American ability to undersell has generally, we believe, been due to mass production, made possible by a high shop efficiency. Where American products of a mechanical character have penetrated the foreign market at higher prices than competitors, it may be put down to superior technical design. Here at the Babcock and Wilcox works at La Courneuve one witnesses the American designed product coming through a French shop in a thoroughly American manner. Add to this the French tariff protection and there is little chance for competition to succeed from foreign makers. This fact seems to be so well recognized today that American firms wishing to do business in France on a manufacturing basis deem it necessary, as a rule, to incorporate as French companies. This necessitates the introduction of French interests.

Material Storage Facilities at La Courneuve

The central building in the Babcock and Wilcox plant is the general storehouse with approximately 5,000 different articles or items utilized in the boiler work in stock. The same building is a general depot for the issue of spare parts to users of Babcock and Wilcox boilers. The general storehouse covers an area of 2,100 square yards, and is served throughout by a 5-ton traveling crane.

In contra-distinction to the practice of making contact between shops through longitudinal ends, the Babcock and Wilcox management at La Courneuve has established contact broadside on. Wide openings in the wall afford passage from one building to another. Under this arrangement the fronts of all buildings face the park, or central enclosure. It is claimed that the system affords better heating conditions in winter and cooler shops in summer time. Furthermore, the Babcock and Wilcox engineers say there is a decreased travel of material from start to finish. Here one sees the forge men delivering baffle collectors to the section shop on its left and castings to the main boiler shop on the right. Another example is in the handling of plates and tubes, the large and small boiler shops being located, respectively, to right and left of the magazine for these items.

Area Covered by Plant

In all, Babcock and Wilcox shops cover 43,600 square yards of ground, but there is a total of 153,000 square yards available for future development. The outposts are confined strictly to boiler and mechanical grate building, but during the war the shops were utilized in addition for the production of projectiles. Power for the works is obtained from the outside, although there is a reserve engine installation which can be utilized if occasion demanded it. The policy of the Babcock and Wilcox works has been to patronize clients using their boilers for power development.

So far as I found, the Babcock and Wilcox boilers under construction do not undertake to give pressures, in service, beyond 25 kilograms (about 360 pounds). It is recognized, by French engineers that higher pressures are coming more into being but the advance in France, in this direction, has up to now been slow. The high pressures evidenced in some of the lately built American power stations, and in some of the Swedish stations, are unknown in France. As I mentioned in a previous report on French plants, the general tendency in France is to utilize relatively large boiler units and I find that the Babcock and Wilcox shops go in for units of 2,500 square meters (about 18,900 square feet) grate surface and down as low as 400 square meters (about 3,000 square feet) for the smaller boilers.

Installation at Gennevilliers

The Babcock and Wilcox boilers installed at the new Gennevilliers power station, numbering twenty in all, may be taken as a fair example of the types now being called for in French power plants. The Gennevilliers boilers operate at 25 kilograms (about 360 pounds) and have a tubular heating surface, per unit, of 1,330 square meters (about 10,000 square feet). The units are placed back to back in order to economize in auxiliary equipment. The superheating surface is 700 square meters (about 5,300 square feet). The volume of water at normal water-level measures 26,450 litres, (about 745,000 cubic feet) and the volume of steam at normal water level, 16,520 litres (about 461,000 cubic feet). Steam temperature measures 375 degrees C., and the steam generation, normal, per hour is 40,000 kilograms (about 18,100 pounds).

Steam generation, accelerated, per hour runs up to 53,000 kilograms (about 24,000 pounds). The boilers were guaranteed to Gennevilliers to yield 75 percent efficiency, provided coal of 7,000 calories per kilogram (about 15,420

General View of the Machine Shop

Looking Down the Main Bay of the Boiler Shop calories per pound) is employed with an 8 to 10 percent ash content, and a feed water temperature of 160 degrees C. at the boiler inlet.

The economizer sets of the Babcock and Wilcox boilers at Gennevilliers comprise a special feed water heater and sheet steel air pre-heater. The tubular heating surface measures 1,600 square meters (12,000 square feet) and the air pre-heating surface, 2,240 square meters (about 17,280 square feet). The guarantees under normal conditions of operation are:

Temperature of water at the inlet	90 degrees C.
Temperature of water at the outlet	150 degrees C.
Temperature of the air at the inlet	30 degrees C.
Temperature of the air at the outlet	90 degrees C.
Temperature of the gases at economizer inlet	340 degrees C.
Temperature of the gases at economizer outlet	220 degrees C.
Temperature of the gases at pre-heater outlet	150 degrees C.

At the Gennevilliers station the arrangement is two units back to back forming a double unit of 2,660 square meters (about 20,000 square feet) heating surface. While a pressure of 25 kilograms (about 360 pounds) was adopted, yet as a matter of fact the turbines are able to operate at Gennevilliers at full capacity with a pressure at the steam outlet of as low as 20 kilograms (about 285 pounds).

Shop Expansion at La Courneuve

As an example of the expansion of facilities take the boiler drum shop. Here is a building 425 feet in length by 95 feet in width in one bay and designed to turn out 17 standard size drums per week. This building is served by two 15-ton traveling cranes. All rivets are electrically heated, four at a time and three hydraulic riveters negotiate the riveting with the boiler suspended vertically. Oxy-acetylene gas is employed for the cutting of all drum openings and all important machine tools are driven by their own electric motors.

The mechanical stoker department building is but little smaller than the drum shop, the dimensions being 410 feet in length by 60 feet in width. The machine shop and tool department building has a length of 330 feet and a width of 65 feet. A 6-ton traveling crane is in operation. The foundry building measures 295 feet in length and 180 feet in width. It contains 4 cupolas, and is equipped with molding machinery. There are three 7.5-ton traveling cranes in this building, and one 5-ton crane. Castings up to 6-tons weight can be produced here.

The section building for expanding tubes into headers, when the sets are assembled, has a length of 330 feet and a width of 53 feet. All tubes utilized at the Babcock and Wilcox Works are of weldless steel and those used in the superheater are bent cold to shape.

Not the least important of the facilities at La Courneuve is the physical and chemical laboratory. It is regarded by the management as of utmost importance that the exact character of all metal entering into the boiler construction at their shops be known in a precise manner and the data on this subject are made a matter of record for use in the event of a future accident. In this connection, the experience of the general-director, M. Roszak, is valuable; for, besides being an active industrial director, that gentleman finds time to lecture before the Ecole Centrale, being in fact a professor of that distinguished institution of learning. This leaves the Babcock and Wilcox Shops at La Courneuve with a sense of conviction that the engineers there may be depended upon to keep abreast of French demands, and that the state of the output there may be taken as truly representative of French progress, that is in boiler construction as applied to the development of the American Babcock and Wilcox design.

Portable Oil Reservoir

By E. A. Miller

A PORTABLE oil reservoir that has proved its usefulness around railroad shops and terminals is shown in the drawing, Fig. 1. It consists essentially of a 14-inch by 33-inch reservoir for containing the oil, on top of which is mounted a separator through which the air is passed from an air line for the purpose of forcing the oil to the burners.

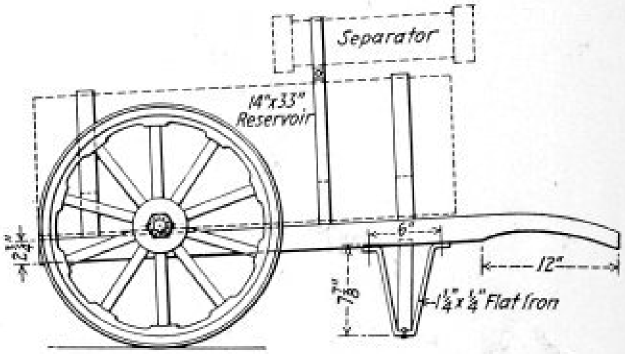


Fig. 1—Assembly Drawing of Reservoir and Truck

This device is mounted on a truck carried on two standard 21-inch baggage truck wheels, bored and faced to fit a 1½-inch by 3-inch axle. Air is passed into the separator at the air inlet, as shown in Fig. 2, from an air line, from whence it is carried through the piping, as shown in the end view of Fig. 2 to the oil reservoir.

The air enters the oil reservoir at the top through a ¾-inch globe valve. This pressure on the oil causes it to be

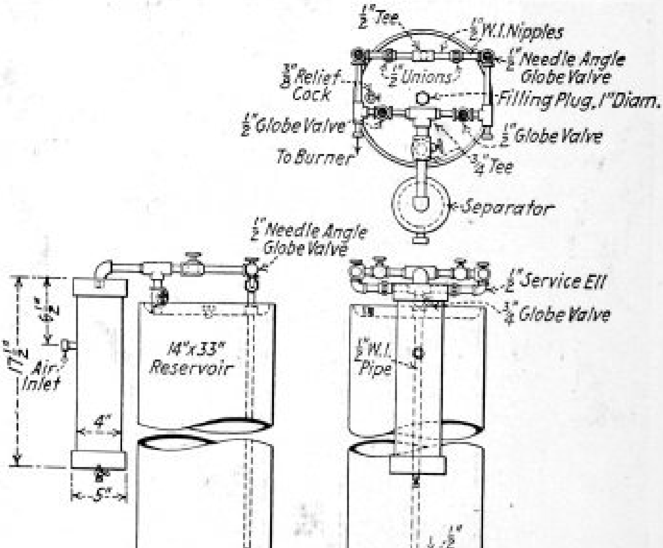


Fig. 2—General Arrangement of Reservoir and Piping

forced out through the 1½-inch wrought iron pipe which extends the entire length of the reservoir to within ½ inch of the extreme end. A ½-inch needle angle globe valve allows the oil to enter the burner through the burner connection. There is a ½-inch globe valve placed between the oil pipe and the air pipe, which can be adjusted for purposes of atomization.

This reservoir has been used successfully in providing oil for burners to thaw out ash pans, coal and sand pipes, as well as to operate car heating coils.

The Legal Problem of What Constitutes "Doing Business" in Foreign States as Applied to the Boiler Manufacturer

By John H. Sears*

When is Intrastate Business Illegal?

A QUESTION of vital importance to a corporation, engaged in the manufacture of machinery, tanks, boilers and other mechanical devices, carrying on transactions in states other than the state of incorporation is just how far it can go in the installation, or superintending the installation or erection of its product and still have the transaction considered interstate commerce by the courts. As long as the transaction remains interstate commerce—that is, between or among the different states of the union, the corporation can be subject to no regulations other than those imposed by the federal government. However, if it goes outside the state of its incorporation and in the installation or erection of its product, does a purely local intrastate business, within the confines of another state, it immediately becomes subject to the taxes, restrictions and conditions that it is within the power of that state to impose. *The Author*

A CORPORATION has no absolute right to exercise its powers except in the state of its incorporation. In the state of its organization a corporation is domestic, but as soon as it crosses the borders of that state into another state it becomes a foreign corporation as to the latter state; and if it proposes to carry on a purely local intrastate business in that state, it can do so only after it has done certain things which the state says it must do before it begins to transact business. So while under the principle of comity a foreign corporation can exercise the same powers in another state that it exercises in its domicile, as a general proposition it is permitted to do so locally only on the grace of the legislature and the legislature can impose conditions or restrictions without limit even to the point of total exclusion.

The power to regulate interstate commerce is given by the constitution to the federal government and no power of the national government is more jealously guarded by the United States Supreme Court than this sweeping power over interstate commerce; consequently any attempt by a state to encroach upon this power, any attempt by a state to burden or impede the free flow of commerce between the states is unconstitutional and wholly void. But as to local or domestic commerce, that is a matter for the states to regulate and the different legislatures have enacted laws with which a foreign corporation must comply if it wishes to do business within the state.

These statutes enacted by the different states generally provide that before a foreign corporation can do business within the state it must first qualify, that is, take out a license and pay the required taxes and fees for the privilege of "doing business" within the state. And they further provide that in the event a foreign corporation does not qualify it shall be liable to a fine and in some instances the imprisonment of its officers and agents. But what is vastly more important to the corporation is the fact that its failure to qualify prohibits it from bringing suit in the courts or from recovering on its contracts. It is denied absolutely the use of the courts, forfeits any corporate rights that it may have and may lose title to property that it has within the state.

It cannot be doubted that this is a very serious matter in so far as the foreign corporation is concerned. Let us suppose that a foreign corporation comes into a state and makes sales, but does not qualify. In the contract of sale it agrees to erect or install the article sold for the purchaser, that is, put the thing purchased in good order and start it to working properly. Then after the article has been delivered and the installation made, the customer either defaults or refuses payment on the contract and the corporation brings suit in the courts to collect. The customer certainly owes the money so he has no defense on the merits of the action. But he needs none. He simply raises the objection that the company was not qualified to do business in the state. The court looks at the transaction and decides that the corporation in making the installation was "doing business" in the state. That in making the installation it had employed local labor, used materials purchased in the state, competed locally with the citizens of the state and that the installation was not of such a delicate or complex nature as to require the services of an expert. In other words anyone could have done it. The result is, the corporation is out of court, and out of pocket by the amount which this customer owed.

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Concerns Should Comply with Requirements

This may seem harsh. It might be said that the state aids and abets its citizens in escaping their just debts. However the courts look at it differently. They say that the foreign corporation in transacting business outside of the state of its incorporation is exercising a valuable privilege for its own profit. It should therefore be considerate and careful enough to comply with the conditions which the state imposes as a price for exercising that privilege. The officers of a state, they reason, cannot be expected to assume the burden of pursuing foreign corporations to see that they have complied with the law. Let them fail to comply at their own peril; and the heavier the penalty for failure to comply the more likely it is that the corporation will comply in order to avoid the penalty. And it would also be extremely unfair to allow a foreign corporation to come into a state and compete with domestic corporations without first making it qualify. If this were possible it would be on a better footing than the domestic corporation.

What Constitutes Intrastate Business

It is hard to say just how a foreign corporation can determine whether or not it is doing a local or intrastate business when it erects or installs its product. The decisions of the courts on this point are many and varied. Some general rules have been worked out but it cannot be said that the courts have reached any formula which can be applied with certainty to all cases or to any considerable part of them. Each case seems to be decided on its own peculiar facts and the best that can be done is to observe the trend of the courts in a particular jurisdiction. It is not an easy matter to decide whether a contemplated transaction or series of transactions will constitute "doing business."

One rule that has been applied by the courts in determining whether or not the transaction constitutes "doing business," is, that if from the "intrinsic or peculiar quality or inherent complexity" of the product it is necessary for the manufacturer to agree to install in order to make sales, the foreign corporation is not "doing business" by making the installation. However, the product should be of such a nature that the ordinary workman cannot install it and that in order for it to function properly the installation required the services of an expert.

So a corporation cannot agree to the installation of its product, where the product is of such a nature that anyone can install it, merely for the sake of the additional revenue that would come from the installation, without competing locally and rendering itself liable for non-compliance with the statute.

However, as was said before, any rule that can be laid down would not apply to all cases or to any considerable part of them and the best way to attempt to reach a conclusion is to examine the holdings of the courts in the different states.

Typical Cases of Litigation

An excellent illustration is given of the difference in the opinion between courts of the various states, by two holdings, one in Texas and one in Wisconsin. (S. F. Bowser & Co. v. Savudusky, 154 Wis. 76 and Bryan v. S. F. Bowser & Co., 209 S. W. 189.) Both cases involved the installation of the same equipment, a gasoline tank and pump, by the same company and the installation, in each instance, was made in the same manner. The Texas court held that the company in making the installation was "doing business" within the state, as it was necessary to employ state labor, purchase some of the materials in the state and that the price agreed upon was not for the machinery alone or any part of it but was for the installation, including all material and labor. The Wisconsin court held that the installation was merely an incident of interstate commerce, in other words that the contract to install could not be separated from the contract of sale and that the company was not "doing business" within the state in making the installation.

In a case decided in Pennsylvania (Nickerson v. Warren City Tank and Boiler Co., 223 Fed. 841) a foreign corporation was in the business of constructing and erecting oil tanks, which when possible were constructed at its main factory in the state of its incorporation and shipped in charge of its employees, who erected it for the purchaser; the foreman in charge of the erection employed such local labor as was necessary. The court held that the corporation was doing a local business in the district where the tank was erected. While nothing was said regarding it, it would not seem that the erection of an oil tank is of such a nature as to require erection by the manufacturer in order to make sales. Or that it is so complex a prosposition as to require the services of an expert.

In another case (York v. Colley, 247 U. S. 21) a Pennsylvania corporation contracted to deliver and install in Texas a complete ice plant, consisting of gas compression pumps, a compressor, ammonia condensor, freezing tanks and cans, evaporating coils, a brine agitator and other necessary machinery and accessories. The work was to be in charge of an expert, furnished by the company but paid by the purchaser, the purchaser to furnish the expert any labor necessary to make the installation. The Texas court in holding the company to be "doing business" said that while the sale was interstate, the stipulation to install and furnish the expert was intrastate and separate from the contract of sale. However, the United States Supreme Court reversed this decision and said that the furnishing of the expert and the installation related inherently and intrinsically to the thing sold, could not be separated from it and was a part of the interstate commerce transaction.

In a case decided in Michigan (Power Specialty Co. v. Michigan Power Co., 190 Mich. 699) a New York corporation sold, delivered and installed six superheaters in a power plant at Lansing. The superheaters were installed in two new boilers as they were being erected. In other words they were installed before the boilers were bricked up. In order however, to install the superheaters in the old boilers, it was necessary to tear out the brick work in front, install the superheaters and brick the boiler up again. There was no evidence before the court as to whether this work could be done by the purchaser through local labor and the court in ordering a new trial said that the principal question in the case was whether the installing of the superheaters was such an essential requisite of the sale that if the superheaters had not been installed no sale could have been made. It would appear from this that, if it is shown at the new trial the purchaser could have made the installation through local workmen and the installation was not an essential requisite of the sale, the corporation was engaged in local business in making the installation of the superheaters.

A very important case regarding installations is that of Browning v. City of Waycross, Ga., 233 U. S. 16, decided by the United States Supreme Court. This case involved the sale and erection of lightning rods and it might be hard to see how the erection of lightning rods would apply to the installation and erection of tanks, boilers, machinery and other heavier mechanical devices. As was said by counsel in one case "it is a far cry from lightning rods to superheaters." However in the Browning case several important rules were laid down and have been followed by the courts in many jurisdictions where installation and erection were involved.

Browning was the agent of a St. Louis corporation, in whose behalf he solicited orders for the sale of lightning rods. The price paid for the rods included the duty to erect them without further charge. The rods were shipped from St. Louis to Browning and he erected them for the corporation. The court held this to be "doing business" in the state of Georgia, as the affixing of the lightning rods was merely the doing of a local act after interstate commerce had completely terminated and it was not within the power of the parties by the form of the contract to convert what was exclusively a local business, subject to state control into an interstate commerce business protected by the Commerce Clause of the United States Constitution. The Court intimated that an act is intrastate in character when it attempts to connect interstate commerce articles with or make them a part in the state of property which is not and cannot be the subject of interstate commerce and concludes by saying:

> "Of course we are not called upon here to consider how far interstate commerce might be held to apply to an article shipped from one state to another, after delivery, and up to and including the time when the article was put together and made operative in the place of destination, in a case where because of some intrinsic and peculiar quality or inherent complexity of the article the making of such agreement was essential to the accomplishment of the interstate transaction."

According to the last statement of the court it would seem that for the interstate commerce transaction to continue and cover the installation of the article it must be so thoroughly connected with the agreement to install that the two are inseparable.

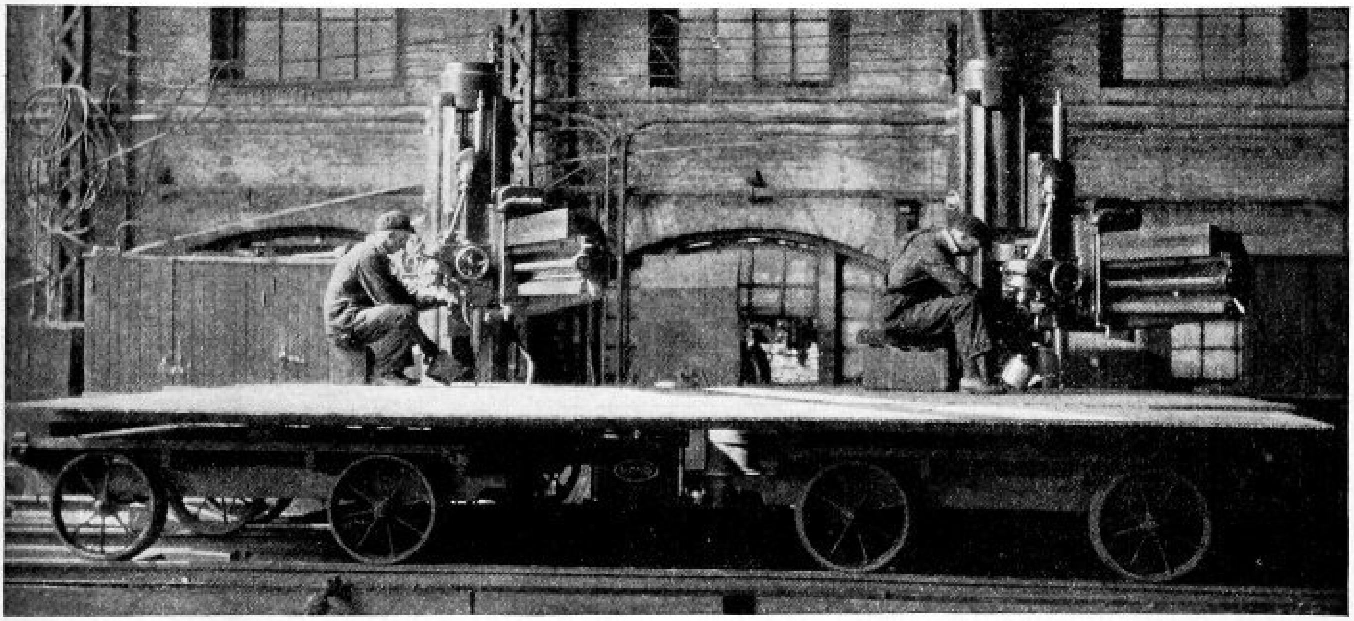
(Continued on page 123)

Making Four-piece Mallet Fireboxes

By John A. Doarnberger

The simplification of construction of Mallet fireboxes on the Norfolk & Western Lines had been thought advisable shortly after the introduction of the 2-6-6-2 heavy Mallets on this road in 1912 when 80 were put in service. The design of fireboxes for the second order of 110 Mallets incorporated certain simplifications that were carried to their ultimate conclusion in the four-piece firebox as now installed in these locomotives. Mr. J. A. Doarnberger, master boiler maker, who carried out the construction of these fireboxes, tells below how the work was done in this article which the Norfolk & Western Magazine has permitted us to publish.—THE EDITORS.

IN 1912, the Norfolk and Western placed an order for eighty 2-6-6-2 heavy Mallet locomotives for freight service. It was one of the largest orders for Mallet locomotives placed by a railroad up to that time. On account of the excellent service secured from these locomotives, orders were placed from time to time with the builders for additional locomotives until the Norfolk and Western now has 190 Mallet locomotives of the 2-6-6-2 type.



Special Arrangement of Trucks and Drills for Drilling Firebox Sheets

This first lot of eighty locomotives, numbers 1300 to 1379, inclusive, were received with what is known as the seven-piece firebox; *i. e.*, a firebox made of that number of sheets; flue sheet, bottom combustion chamber sheet, throat sheet, crown sheet, door sheet and two firebox side sheets—a design representing the best and approved practice. In this type of construction, the seams and laps are made between the crown and firebox side sheets, also between the crown and bottom of the combustion chamber.

Five-Piece Firebox Developed

After these eighty locomotives were received, and before orders were placed for additional engines of this type, it was decided to make some change in the design of the seven-piece firebox, and, if possible, eliminate some of the seams and laps. Finally firebox plates of sufficient size to permit a reduction in the number of seams appeared a possibility. The idea was to secure plates of sufficient size to make the combustion chamber in one piece, likewise the firebox and crown in another piece, thus reducing the number of sheets in the firebox from seven to five. This design was satisfactorily worked out, and the last one hundred and ten 2-6-6-2 Mallet locomotives put in service on the Norfolk and Western were equipped with fireboxes of this construction, which is known as the five-piece firebox.

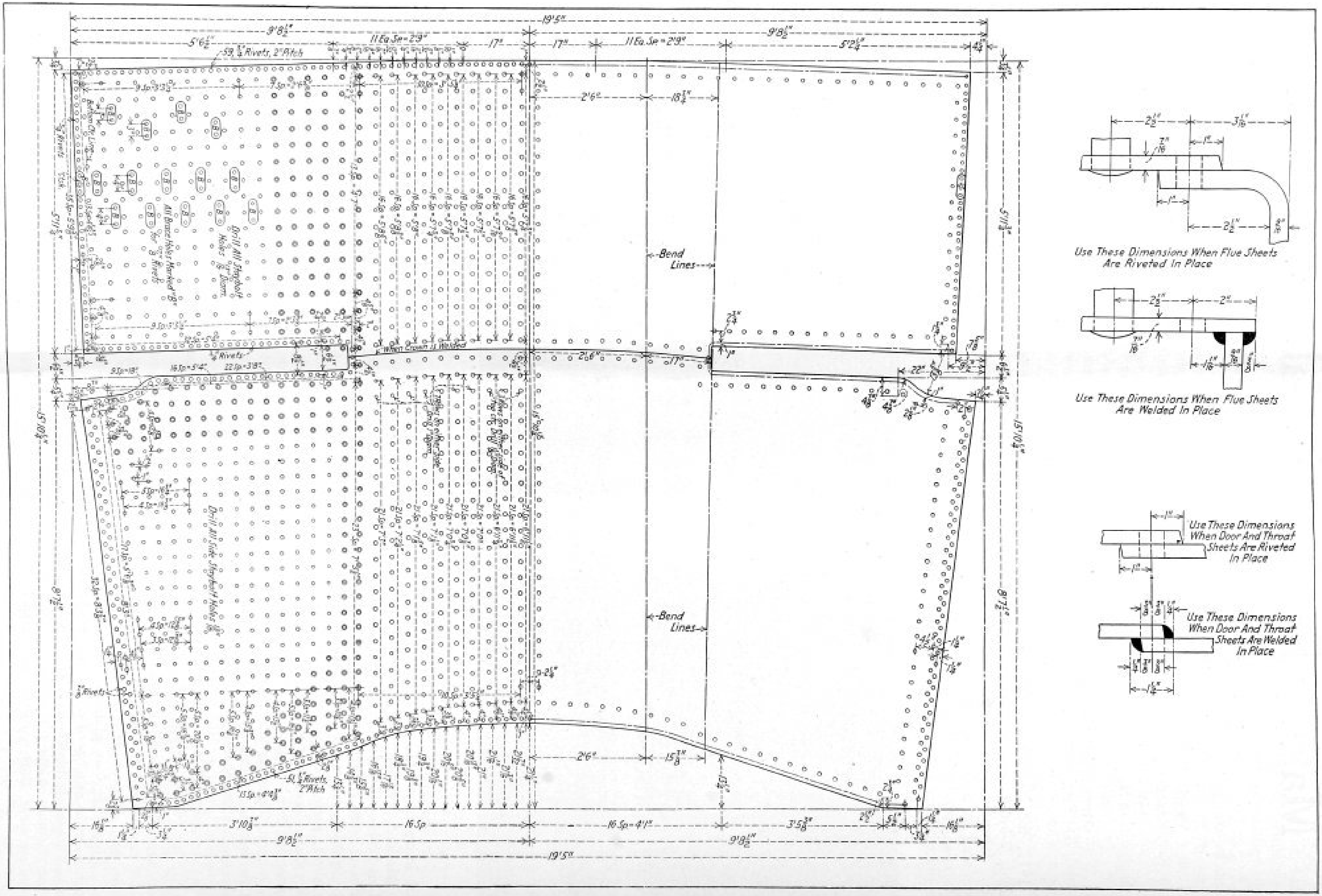
Aside from the junctions between the flue, throat and door sheets with the other sheets to which they join, there are in the design two seams, one a longitudinal seam in the bottom of the combustion chamber, and the other a transverse seam joining the combustion chamber and firebox proper. Both seams are electrically welded.

To construct a firebox without the transverse seam in the crown sheet then seemed desirable. A study of this led to the design of a firebox using but one sheet for the sides, crown and combustion chamber (formerly made up of four sheets), thus further reducing the number of sheets to a total of four for the entire firebox.

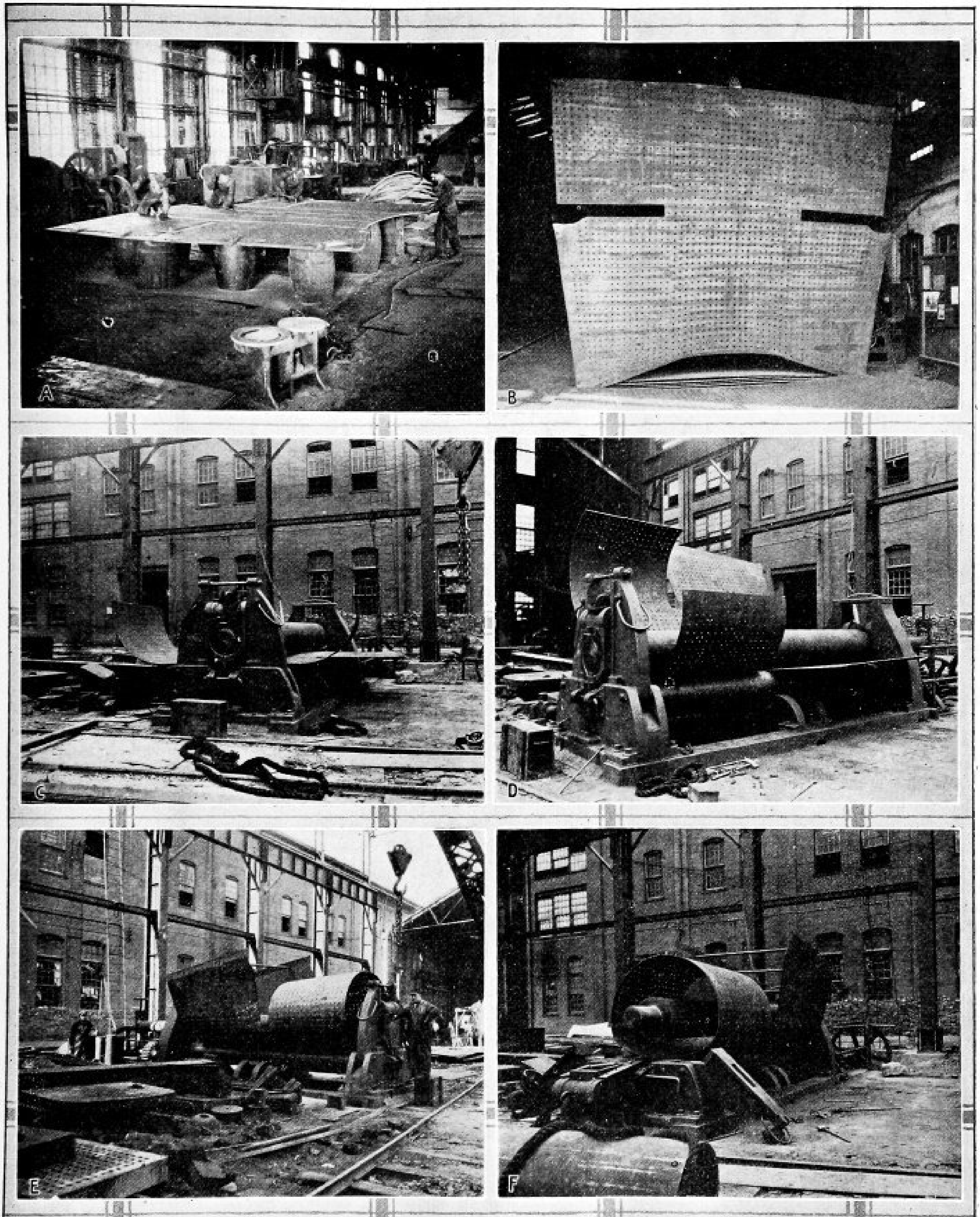
On May 11, 1922, an order was placed with the Lukens Steel Company for twelve firebox plates 193½ by 235 inches. The plates are not the longest nor the heaviest ever rolled, but they are the widest. After these plates reached the shop, the fun began. There seemed to be no way to roll them. But someone was on the job and a special mandrel was soon made as shown in the accompanying illustrations.

No Rivets Used

With the exception of the brace fastenings, there is not a rivet used in the entire firebox construction. The sheets are



Layout of Four Piece Mallet Firebox Sheet and Details of Connections



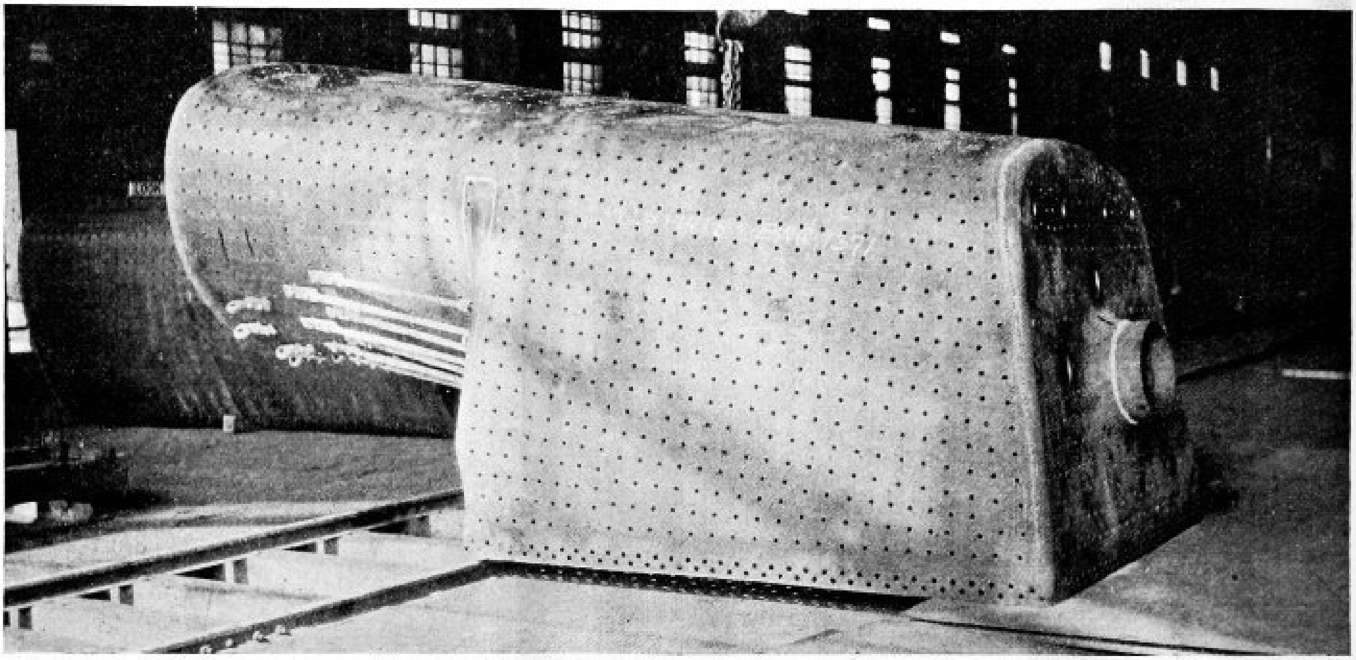
Method of Fabricating a Four Piece Firebox

A.—Firebox sheets were laid out with extreme accuracy and closely held within the allowed limits through the entire rolling operation. B.—The sheets used although not the longest nor heaviest ever rolled were the widest, measuring 193½ inches by 235 inches. C.—The sheets were rolled with the aid of a special mandrel. D.—The combustion chamber section was brought to the proper curvature first. E.—The rolled sheets as they looked when completed. F.—The end bearing of the mandrel was arranged so that it could be dropped to allow the removal of the firebox shell.

united by the use of the electric welding process, which is also an improvement over the former riveted, lapped and calked joints.

As the design was considered a step forward in locomotive firebox construction, subsequent orders were placed with the Lukens Steel Company until enough sheets were secured for a total of 112 firebox plates. At the same time arrangements were made to handle the work as systematically as possible, yet the rate of two a month was considered about the economic limit, considering the other repair work which had to be carried along currently.

Because so many engines of the same type had been purchased at the same time, they naturally became candidates for firebox renewal at approximately the same time, and in the early part of September, 1922, the group of Mallet engines referred to were rapidly becoming candidates for shopping. It was not a question of deferred maintenance, but of making regular firebox renewals after a full and customary life of satisfactory performance. There was some variation in the condition of the fireboxes; some showed their age more than others, due to slight differences in material and service such as might be expected. Therefore, these "older" fireboxes called for first attention.



Four Piece Mallet Firebox and Combustion Chamber Ready for Installation

Finding other railroads had taken up all the available space in the large locomotive works, there seemed to be no avenue for comfort in that direction. Therefore, a most critical and detailed inspection was made of the Mallet fireboxes in service with a view of finding out as definitely as possible the order in which they would have to be taken in for firebox renewals. Following this, a definite schedule was made providing for the handling of one Mallet engine per week at Roanoke Shops for a complete firebox of the four-sheet construction, and general overhauling, along with the regular repair work on other locomotives which could not be deferred.

Carrying Out the Schedule

This schedule was complete in all its details. Gangs were organized to handle materials; indeed, every detail of the various steps to be taken in the progress of the work from the time the engine reached the shop for stripping until it was completed and fired up for service had been worked out.

The schedule was so tight I thought it impossible of accomplishment. And I was not the only one that thought it almost an impossibility, even though it seemed to have been worked out very systematically. As soon as the word was given out, every supervising official became interested, took up the work with determination, and it was soon proven that the work could not only be satisfactorily accomplished, but the schedule was met from the time the first engines came in until some sixty-six engines were completely overhauled and turned out for service with new fireboxes. The workmanship was good, in fact, generally better than had been formerly secured, due principally to the specializing of forces.

Not only was a schedule of one locomotive per week accomplished, but for quite a period an output of one locomotive at intervals of five working days was maintained. The work was practically cleaned up in the latter part of September, 1923.

New Boiler Laws for New York State Proposed

A BILL amending section 204 of the labor law has been introduced in the New York State assembly by C. P. Miller. This law is intended to prescribe new conditions for the inspection of steam boilers. The principal differences in the proposed law from that in force at present are that at least once in each year the commissioner shall cause to be inspected all boilers used for generating steam which carry a steam pressure of more than 15 pounds to the square inch except where a report is filed with the commissioner within fourteen days from the date of inspection, by a fully authorized insurance company certifying that such inspection shows the boilers are in safe condition and conform to the provisions of the law and rules and regulations of the Board. Insurance companies duly authorized by law are required to report to the commissioner within the time limit prescribed in this section all boilers insured by them under the provisions of the section, including those rejected together with the reasons in writing for such rejection. No boiler required to be inspected by the provisions of this section is to be inspected unless it is done by a duly qualified boiler inspector who holds a certificate of competency issued

(*Continued on page* 123)

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

In the course of ten years' experience inspecting locomotives in the service of the New York State Transit Commission, the author of this series of questions and answers for boiler inspectors' examinations has had occasion to study closely the various requirements for inspectors both state and federal. Boiler makers, machinists, engineers and firemen are included in the list of those eligible to take the examinations necessary to an appointment as boiler inspector. These questions have been prepared with the view of indicating the scope of the experience and study required of those who desire to become inspectors. The Editors.

THE questions and answers given below indicate the type of questions on both boiler and mechanical work which are liable to occur and upon which those taking the examinations must be informed. The answers to questions as given must necessarily be brief and phases other than those outlined might to advantage be brought out in the answers. In general, however, the answers below, and those which will appear in future issues, should prove of benefit to all our readers and to those who may become readers while the series is in progress, who are studying to take such examinations. The author would like to have those interested in this subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.

1—Q. What is the purpose of the locomotive inspection law?

A. The purpose of the locomotive law is to promote the safety of the employees and travelers upon railroads.

2—Q. What governs the admission of steam to the cylinders?

A. The slide valve or piston valve.

3—Q. What are the principal parts of a locomotive boiler and the office of each part?

A. A locomotive boiler consists of the following essential parts: A firebox in which the combustion of the fuel takes place; a vessel to contain the water to be evaporated; a steam space to contain the generated steam, a heating surface to transmit the heat to the water.

4—Q. What are the functions of the slide or piston valve?

A. To admit steam to one end of the cylinder at a time, to cut off the supply at a certain point of the stroke, to allow the steam to escape from the cylinders through the exhaust cavity and ports.

5—Q. What is meant by cylinder clearance?

A. All the space between the piston when at the end of its stroke and the valve face.

6—Q. What is meant by wire drawing of steam?

A. A reduction of pressure caused by too narrow ports or insufficient port opening.

7—Q. What is a combustion chamber and what are its uses?

A. A compartment or space in a locomotive boiler to promote combustion and secure additional heat from the combustion gases before they enter the tubes.

8—Q. How does steam transmit power to a locomotive?

A. When steam pushes the piston through the cylinder its power is transmitted by the main rod to the main crank pin which causes the wheels to revolve.

9—Q. Why are arch tubes made thicker than boiler tubes?

A. Arch tubes are exposed to boiler pressure on the inside, in boiler tubes the pressure is on the outside.

10—Q. How is the pressure on the piston communicated to the wheels?

A. By the connecting rods and crank pins.

11—Q. How are sheets of a firebox supported?

A. They are supported by staybolts screwed through the inside sheets with their ends riveted over.

12—Q. Who is held responsible for the inspection and repair of locomotives and tenders?

A. The mechanical officer in charge at each point where repairs are made, will be held responsible for the inspection and repair of all parts of locomotives and tenders under his jurisdiction. He must know that inspections are made as required and that the defects are properly repaired before the locomotive is returned to service.

13—Q. What is the cause of strains on a staybolt?

A. The strain on a staybolt is caused by the expansion of the firebox sheets.

14—Q. What is the first duty of a locomotive inspector?

A. The first duty of a locomotive inspector is to learn the duties of his position.

15—Q. What is the general direction of cracks in the firebox sheets?

A. Generally vertical, radiating from the staybolts and from one bolt to another in the same vertical row.

16—Q. What is the purpose of the safety valves on a locomotive boiler, why is more than one used?

A. The purpose of the safety valve is to prevent the steam pressure from rising above a certain point. More than one safety valve is used as additional precaution against excessive pressure.

17—Q. On what part of the firebox sheets are found the greatest number of cracks and pitting?

A. On the lower part generally.

18—Q. What is meant by the area of a safety valve?

A. The area of a safety valve is the area of the opening of the valve or the area of that portion of the valve in contact with the steam when the valve is closed.

19—Q. What kind of a plate, a flat one or a curved one, makes the better kind of a heating surface over a fire?

A. A flat plate makes the better heating surface over a fire.

20—Q. What is meant by the effective area of the safety valve?

A. The effective area of the safety valve is the opening between the valve and the valve seat, when the valve is raised from its seat.

21—Q. How are domes fastened to the sheet of a locomotive boiler?

A. Domes are fastened by means of a steel collar fitted to the top of the boiler, to which the dome is fitted and fastened to by rivets.

22.—Q. How should a steam gage be connected to a boiler?

A. Steam gages should be connected to the boiler by means of a siphon pipe.

23—Q. Why are copper ferrules used in the back tube sheet of a locomotive boiler?

A. Copper ferrules are used to prevent leakage due to the expansion and contraction of the tube and tube sheet.

*Locomotive Inspector, New York State Transit Commission.

24—Q. How is the steam gage graduated to read?

A. Steam gages are graduated to read, pounds per square inch above the pressure of the atmosphere.

25—Q. What pressure is indicated by the steam gage?

A. The pressure per square inch inside the boiler.

26—Q. What shape is the tube in a Bourdon steam gage?

A. The tube is elliptical in section so that when the water is forced into it under pressure it will tend to become round and straighten out, thus moving the pointer to which it is attached.

27—Q. What qualities are determined in making a physical test of boiler steel?

A. In making a physical test of boiler steel, the qualities determined are the tensile strength, the elastic limit, the per cent of elongation, and the percent of reduction of area at the point of fracture.

28—Q. On what principle does a steam gage work?

A. The steam gage pointer is actuated by a flattened or bent round tube to straighten itself under the pressure of steam against the water inside the tube. The gage pointer receives movement from suitable mechanism connected with the tube.

29—Q. What properties are required of rivets, braces, stays and staybolts?

A. Material for rivets, braces, stays and staybolts should possess the same qualities that are required of boiler plates.

30—Q. For what purpose are check valves used?

A. The purpose of a check valve is to allow water to flow through it into the boiler and to prevent the water and steam flowing back into the injector.

31—Q. What is meant by the efficiency of the joint, and how is it expressed?

A. The ratio between the strength of the joint and the strength of the plate is called the efficiency of the joint and is expressed as a percentage of the strength of the solid plate.

32—Q. Why are boiler checks placed so far from the firebox.

A. To introduce the water into the boiler at as great a distance from the firebox as possible. This permits the water to become heated to a higher temperature before it comes in contact with the firebox sheets.

33—Q. How is the efficiency of the joint determined?

A. In order to determine the efficiency of the joint its resistance must be computed for each of the different ways in which it may fail. Then if 100 times the lowest resistance of the several parts of the joint be divided by the resistance of the solid plate the efficiency of the joint will be obtained.

34—Q. For what purpose are water gage glasses and gage cocks used?

A. To indicate the height of water in the boiler.

35—Q. What is the difference in the efficiency of a triple riveted lap joint and a double riveted butt joint with two cover plates?

A. Triple riveted lap joints and double riveted butt joints with two cover plates have about the same efficiencies.

36—Q. In locating water gage cocks in a locomotive boiler where should the lowest one be placed?

A. The lowest water gage cock in a locomotive boiler should be placed not less than 3 inches above the highest part of the crown sheet.

37—Q. How does the angle in a crowfoot stay affect the stress on the stay?

A. The angle of the crowfoot stay increases the stress on the stay.

38—Q. Why is the level of the water in a gage glass the same as the level of the water in the boiler?

A. Because the lower fitting is connected with the water space and the upper fitting with the steam space.

39—Q. Define the term pitch as applied to rivets.

A. The distance from the center of one rivet hole to the center of the next rivet hole is called the pitch.

40—Q. What is the difference between a lifting and a non-lifting injector?

A. A lifting injector will create sufficient vacuum to raise the water from the level of the tank. The non-lifting injector will not raise the water, but merely force it into the boiler. A non-lifting injector must be placed below the level of the tank so that the water will flow to it by gravity.

41—Q. Is it customary to have inside laps face upwards or downwards?

A. Inside laps should always face downwards.

42—Q. What is a lifting injector?

A. A lifting injector is one that will lift the water to the height of the combining tube from the source that is not under pressure.

43—Q. What arrangement is made to give warning when a screw staybolt breaks?

A. In order to give warning when a screw staybolt breaks, a hole 3/16 inch in diameter is drilled in the outer end, not less than 1½ inches deep.

44—Q. What are essential parts of an injector?

A. The nozzles which force the water into the boiler, the operating mechanism, such as the lifting, steam and water valve.

45—Q. Will an injector work with compressed air?

A. No, an injector depends on the condensation of steam for its successful operation.

46—Q. What is the cause of laminations in a boiler plate?

A. Laminations are due to slag or other impurities in the metal.

47—Q. Upon what principle does an injector work?

A. Steam entering the injector at a high velocity carries the air inside the injector with it and creates a partial vacuum, causing the water to flow into it. The steam then imparts enough velocity to the water to give it sufficient momentum to throw open the check valves and enter the boiler.

48—Q. What causes foaming in a boiler?

A. Oil, alkali, or other matter will cause the water to foam.

50A—Q. Trace the path of the gases from the fire.

A. The gases of combustion after leaving the fire pass over the brick arch and through the flues to the smokebox, under the table plate and adjustable diaphragm, then they are drawn up through the petticoat pipe by the exhaust and through the stack to the atmosphere.

51—Q. What are some of the defects that will cause an injector to fail?

A. A leak in the feed pipe or tank hose or any leak between the injector and tank, insufficient water supply due to the tank valve partly closed, strainer stopped up, or tank hose kinked.

52—Q. How should a rigid staybolt be tested?

A. Would tap each bolt on the firebox side and determine the broken bolts from the sound or the vibration of the sheet.

53—Q. What is the maximum temperature at which a lifting injector can deliver the water in a boiler?

A. About 160 degrees F. or 71 degrees C.

54—Q. How should flexible staybolts without caps be tested?

A. Flexible staybolts without caps shall be tested the same as rigid bolts. Whenever a hydrostatic test is applied the staybolts shall be tested while the boiler is under hydrostatic pressure not less than the allowed working pressure.

55—Q. What is meant by an engine out of tram?

A. When corresponding wheels on opposite sides of the engine are not spaced equally apart, where the axle of any wheel is not at a right angle to the center line from front to rear of the engine so they do not run square on the rails, or when the space between the axle centers on opposite sides is not equal.

(To be continued)

Standards Adopted By The American Boiler Manufacturers' Association*

THE American Boiler Manufacturers' Association has adopted various standards at different times, all of which may be found in the published proceedings of the Association. These proceedings are not indexed, making ready reference difficult. Standards have been adopted only after considerable discussion and in the past it has been necessary to read through the proceedings to determine just what standards were finally adopted. That which is presented here is the final result, the last official action taken on the particular subjects covered. The wording of the minutes has been edited for the sake of brevity and clearness and while the verbiage has been changed in some instances, the meaning and intent has not been modified. Past proceedings have been checked carefully and all standards adopted up to and including the Hot Springs Convention, June, 1923, have been included. The place and date of the meeting and the page of the proceedings at which each standard was adopted, is shown below each standard. This has been done in order that the reader may refer to the discussion if he desires to do so.

In addition to A. B. M. A. standards several matters of importance to the members and to which reference must frequently be made, have been included. It is impossible in a report of this character to include everything which the individual members might desire. The effort has been made to include all matters which it is believed will be of assistance to our members.

It is hoped that this report will be kept on the desks of the officials of the member companies, that the standards will be rigidly adhered to, and that the work will prove of sufficient assistance to the membership to warrant the continuance of a committee whose duty it shall be to keep the handbook up to date.

A. S. M. E. Boiler Code

The following states, counties and municipalities have adopted and have in effect the A. S. M. E. Boiler Code:

States

Arkansas	Oklahoma
California	Oregon
Delaware	Pennsylvania
Indiana	Rhode Island
Maryland	Utah
Michigan	Washington
Minnesota	Wisconsin
Missouri	District of Columbia
New Jersey	Panama Canal Zone
New York	Allegheny County, Pa.
Ohio	

Cities

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

It does not necessarily follow that the larger cities of a state that has adopted the Code are governed by the action of the state. Some cities, by special act of the legislature, were authorized to formulate rules and regulations before the state itself had adopted rules. Hence, the reason for listing the states and cities separately.

For information concerning boiler laws in other localities address:

Chas. E. Gorton,
Chairman, Administrative Council,
The American Uniform Boiler-Law Society,
253 Broadway, New York.

*Report presented at the mid-winter meeting of the American Boiler Manufacturers' Association held at the Hollenden Hotel, Cleveland, February 12. The complete proceedings of the meeting appear in the March issue of The Boiler Maker, beginning on page 70.

The National Board of Boiler and Pressure Vessel Inspectors

The National Board was formed to promote uniform boiler laws (the A. S. M. E. Code) and to register National Board boilers. National Board stamping and registration is now accepted in the following states and municipalities:

States

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

Cities

Chicago, Ill.	Parkersburg, W. Va.
Kansas City, Mo.	Seattle, Wash.
Nashville, Tenn.	St. Joseph, Mo.

Fees for registration:

From 1 to 5 horsepower	$0.25 per boiler
From 6 to 50 horsepower	.50 per boiler
From 51 to 200 horsepower	1.00 per boiler
From 201 to 500 horsepower	2.00 per boiler
From 501 horsepower up	3.00 per boiler

(Ten square feet of heating surface equals 1 horsepower.)

For particulars write:

C. O. Myers, Secretary-Treasurer,
502 Comstock Building,
Columbus, Ohio.

Materials

"Resolved, that this Association adopt as their standards for steel, the standards of quality as adopted by the American Society of Mechanical Engineers Boiler Code Committee and appearing in the A. S. M. E. Code report (1918 edition) on pages 11, 12, 13, 14 and 15, also any future revisions as to standard specifications as adopted by the A. S. M. E. Boiler Code Committee."

Buffalo, June, 1919, p. 53.

Standard Pressures

Watertube Boilers:

"Resolved, that the Association adopt 160, 180, 200, 225 and 300 pounds as standard pressures for water tube boilers."

Buffalo, June, 1919, p. 62.

Horizontal Return Tubular Boilers:

"Resolved, that this Association adopt the following pressures as their standard for HRT boilers: 100, 125 and 150 pounds."

Buffalo, June, 1919, p. 68.

Boiler and Stoker Definitions

For the purpose of the American Boiler Manufacturers' Association and the Stoker Manufacturers' Association the following definitions are adopted:

A Boiler is a metal vessel capable of withstanding pressure and serving the purpose of transmitting heat, usually produced by the combustion of fuel, to a liquid contained in the vessel.

In power plant practice, boilers are usually divided into two classes as follows:

(a) **A Fire Tube Boiler** is so constructed that the products of combustion pass within tubes or their equivalent, these being surrounded by the liquid to be heated.

(b) **A Water Tube Boiler** is so constructed that the liquid to be heated is contained within tubes or their equivalent, these being surrounded by the products of combustion.

A Boiler Baffle is a plate or partition placed in such relation to the tubes or their equivalent of a boiler as to cause the products of combustion to move in predetermined paths.

A Furnace is a partially enclosed space in which heat is produced by fuel combustion.

	Watertube										Repair Work	
Active Members	Horizontal	Inclined	Vertical	Marine	Scotch Marine	H. R. T.	Vertical Fire Tube	Locomotive	Stacks and Breechings	Heavy Plate and Tank Work	Our Product Only	On Boilers Any Make
American Hoist & Derrick Co.; Frederick Crosby, St. Paul, Minn.	..	..	..	..	..	..	X	..	..	..	..	..
American Locomotive Co.; Geo. M. Wilson, 30 Church St., N. Y. C.	..	..	..	..	..	..	..	X	..	..	..	..
Ames Iron Works, Oswego, N. Y.	..	..	..	..	X	X	X	X	X	X	X	..
Atlantic Works, The; J. M. Robinson, E. Boston, Mass.	..	..	..	..	X	..	..	..	..	..	..	..
Babcock-Wilcox Company; A. G. Pratt, 85 Liberty St., N. Y. C.	X	X	X	X	..	..	..	..	X	..	X	..
Babcock Wilcox and Goldie McCulloch, Limited; A. R. Goldie, v.-p., Galt, Ontario, Canada	X	X	..	X	..	X	X	..	X	X	X	..
Brass Foundry & Machine Co.; L. E. Armstrong, Ft. Wayne, Ind.	X	..	X	..	..	X	X	X	X	X	X	..
Bigelow Co., The; G. S. Barnum, New Haven, Conn.	..	X	X	..	..	X	X	..	X	X	..	X
Brennan & Co., John; Box 683, Detroit, Mich.	..	..	X	..	X	..	X	X	X	X	..	..
Broderick Co., The; M. H. Broderick, Muncie, Ind.	..	..	X	..	..	..	..	..	..	..	..	..
Brownell Co., The, Dayton, Ohio	..	..	..	..	X	X	X	X	X	X	..	X
Brunswick-Croeschell Co.; O. A. Recklitz, 460 W. Erie, Chicago	X	..	..	..	..	X	..	..	X	X	..	X
Casey-Heriges Co., The; F. C. Stimmel, Chattanooga, Tenn.	X	X	X	X	X	X	X	X	X	X	..	..
Coatesville Boiler Works; C. Wedgerton, 1421 Chestnut St., Philadelphia	..	..	..	..	..	X	X	..	X	X	..	X
Continental Iron Works; T. F. Royland, Jr., West St., Brooklyn	..	..	..	..	..	..	..	..	..	X	..	..
Cullen Company, The; J. T. Cullen, Clinton, Iowa	X	..	..	..	X	X	X	..	X	X	..	X
Connelly Boiler Co., D.; W. C. Connelly, Cleveland, Ohio	..	..	X	X	X	X	X	..	X	X	X	..
Cunningham Co., The C.; C. Cunningham, 427 Greenpoint Ave., Brooklyn	..	..	..	..	..	..	..	..	..	..	..	..
Dillon Steam Boiler Works, D. M., Fitchburg, Mass.	..	..	..	..	X	X	X	X	X	X	..	X
Dollinger, Inc., John Jr.; Ambrose Rouse, A. T. Beaumont, Texas	..	..	..	..	..	..	..	X	X	X	..	X
Dover Boiler Works; J. T. Loughlin, Dover, N. J.	..	..	..	..	X	X	X	X	X	X	..	X
Duluth Boiler Works; H. R. Nelson, Duluth, Minn.	..	..	..	..	..	X	X	..	X	X	..	X
Dutton Co., C. H., The; I. F. Plant, mgr., Kalamazoo, Mich.	..	..	..	..	X	X	X	..	..	..	..	..
Edge Moor Iron Co.; F. G. Cox, Edge Moor, Del.	X	..	..	..	..	..	..	..	..	..	X	..
Erie City Iron Works; F. C. Burton, Erie, Pa.	X	X	X	..	..	X	..	..	X	X	X	..
Farrar & Trefts; J. C. Trefts, Buffalo, N. Y.	..	..	..	..	X	X	X	X	X	X	..	X
Fitzgibbons Boiler Co., Inc., 47 W. 42nd St., New York City	..	..	..	..	..	..	..	..	..	..	..	..
Fletcher Co., W. & A.; H. G. Avery, Hoboken, N. J.	..	..	..	..	X	X	X	..	X	X	..	X
Fogarty, Inc., Michael, New York City	..	..	..	..	..	..	..	..	..	..	..	..
Frost Manufacturing Co., The; Galesburg, Ill.	..	X	X	X	X	X	X	X	X	X	X	..
Gem City Boiler Co., The; A. H. Kempfer, Dayton, Ohio	..	..	..	..	X	X	X	X	X	X	..	..
Hamburg Boiler Works, Inc.; H. A. Seiders, Hamburg, Berks Co., Pa.	..	..	..	..	..	..	X	..	..	..	..	..
Heine Boiler Co.; E. R. Fish, St. Louis, Mo.	X	X	..	..	..	..	..	..	..	..	X	..
Hodge Boiler Works, E. Boston, Mass.	..	..	..	..	X	X	X	X	X	X	..	X
Inglis Co., Ltd., John, Toronto, Canada	X	X	X	X	X	X	X	X	X	X	X	X
International Boiler Works; F. B. Metcalf, E. Stroudsburg, Pa.	..	..	..	..	X	X	X	X	X	X	..	X
International Engr. Works; F. W. Chipman, Framingham, Mass.	X	X	..	..	X	X	X	X	X	X	..	X
Johnston Bros.; J. F. Johnston, Ferrysburg, Mich.	..	..	..	..	..	..	X	X	..	..	..	..
Keeler Co., E.; E. G. Wein, Williamsport, Pa.	X	..	..	..	..	X	..	..	X	X	X	..
Kewanee Boiler Co.; M. F. Moore, Kewanee, Ill.	..	..	..	..	..	X	X	X	..	..	..	..
Kingsford Foundry & Machine Works, Oswego, N. Y.	X	..	..	X	X	..	..	X	X	X	X	..
Ladd Co., Geo. T., The, Pittsburgh, Pa.	..	X	X	..	..	..	..	..	X	..	X	..
Lidgerwood Mfg. Co.; H. N. Covell, Brooklyn, N. Y.	..	..	..	..	..	..	X	..	X	..	X	..
Marion Steam Shovel Co.; Ben Jakoby, Marion, Ohio	..	..	..	..	..	..	X	X	..	..	X	..
Milwaukee Boiler Mfg. Co.; W. D. Johnson, Milwaukee, Wis.	..	..	..	..	..	X	X	X	X	X	..	X
Murray Iron Works, Burlington, Iowa	X	..	..	..	X	X	X	..	X	X	X	..
Muskegon Boiler Works; R. Ashley, v.-p., Muskegon, Mich.	..	..	..	..	X	X	..	X	..	..	..	X
Mohr & Sons, John, S. Chicago, Ill.	..	..	..	..	X	X	X	X	X	X	..	X
McAleenan Bros. Co.; Geo. A. McAleenan, Pittsburgh, Pa. (Newark, N. J.)	X	X	X	X	X	X	X	X	X	X	..	X
McCabe Boiler Works; E. F. McCabe, pres., Newark, N. J.	..	..	..	..	..	X	X	..	X	X	..	X
McNeil Boiler Works, Akron, Ohio	..	..	..	..	..	..	..	..	X	X	..	X
National Tube Co.; Geo. N. Riley, Box 132, Pittsburgh	..	..	..	..	..	..	..	..	..	..	..	..
New England Iron Works Co.; Chas. F. Koopman, B and Fargot Sts., Boston	..	..	..	..	..	X	X	..	X	X	..	X
O'Brien Boiler Works, J.; J. A. McKeown, St. Louis, Mo.	X	X	X	..	..	X	X	..	X	X	..	X
Ohio Machine & Boiler Co.; Edw. H. Simon, Cleveland, Ohio	..	..	..	..	..	..	..	..	X	X	..	X
Oil City Boiler Works; Wm. Hagerty, Oil City, Pa.	X	X	X	X	..	X	X	X	X	X	X	..
Oldman Boiler Works, 32 Illinois St., Buffalo	..	..	..	..	..	..	..	..	X	X	..	X
Rees & Sons Co., James, Pittsburgh, Pa.	..	..	..	..	X	X	..	..	X	..	..	X
Scannell Boiler Works, Lowell, Mass.	..	..	..	..	..	X	X	X	X	X	..	X
Schofield Sons Co., J. S.; J. S. Schofield, Macon, Ga.	..	..	..	..	..	X	X	..	X	X	..	X
Southern Boiler Works; J. Iselhart, Belleville, Ill.	..	..	..	..	..	X	X	..	X	X	..	X
Springfield Boiler Co., Springfield, Ill.	X	..	..	..	..	..	..	..	X	..	X	..
Stewart Boiler Works, Worcester, Mass.	..	..	..	..	X	X	X	X	X	X	..	X
Topeca Steam Boiler Works; Walter Bromich, Topeka, Kans.	..	..	..	..	..	X	X	..	X	X	..	X
Tudor Boiler Works, Cincinnati, Ohio	..	..	..	..	..	X	..	..	..	X	..	X
Union Iron Works; Geo. W. Bach, Erie, Pa.	X	..	..	X	..	X	X	X	X	X	X	..
Voght Machine Co., Henry; J. G. Eury, Louisville, Ky.	X	X	..	..	..	X	..	..	X	X	X	..
Walsh & Weidner Boiler Co.; S. H. Daniels, v.-p., Chattanooga, Tenn.	X	X	X	..	X	X	X	X	X	X	..	X
Wholey Boiler Works, Providence, R. I.	..	..	..	..	..	X	X	..	X	X	..	X
Wickes Boiler Co.; E. C. Fisher, Saginaw, Mich.	X	..	X	X	..	X	..	..	X	X	X	..
Associate Members												
Ashton Valve Company; J. W. Metherwill, Boston, Mass.	..	..	..	..	..	..	..	..	..	..	..	..
Bateman, W. H. S., 822 Arcade Bldg., Philadelphia, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Boiler Maker; H. H. Brown, 30 Church St., New York City	..	..	..	..	..	..	..	..	..	..	..	..
Bethlehem Steel Co.; Alfred Howell, Bethlehem, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Boiler Tube Co. of America, Pittsburgh, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Champion Rivet Company; D. J. Champion, Cleveland, Ohio	..	..	..	..	..	..	..	..	..	..	..	..
Corlett & Co., J. F.; J. F. Coburn, 1322 Kirby Bldg., Cleveland, Ohio	..	..	..	..	..	..	..	..	..	..	..	..
Castle & Co., A. M.; A. C. Cox, Chicago, Ill.	..	..	..	..	..	..	..	..	..	..	..	..
Cleveland Pneumatic Tool Company; H. S. Covey, Cleveland, Ohio	..	..	..	..	..	..	..	..	..	..	..	..
Central Iron & Steel Company; R. H. Irons, pres., Harrisburg, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Diamond Power Specialty Co.; A. W. Honeywell, Jr., Detroit, Mich.	..	..	..	..	..	..	..	..	..	..	..	..
Glasgow Iron Company; Geo. D. Smith, Philadelphia, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Hartford Steam Boiler Inspection & Insurance Co.; S. F. Jeter, Hartford, Conn.	..	..	..	..	..	..	..	..	..	..	..	..
Lukens Steel Company, Coatesville, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
McCabe Manufacturing Co., 9 Water St., Lawrence, Mass.	..	..	..	..	..	..	..	..	..	..	..	..
Nutting, L. B., Power Specialty Co., 111 Broadway, N. Y. C.	..	..	..	..	..	..	..	..	..	..	..	..
Otis Steel Company, Cleveland, Ohio	..	..	..	..	..	..	..	..	..	..	..	..
Power; F. R. Low, 10th Ave. and 36th St.	..	..	..	..	..	..	..	..	..	..	..	..
Pittsburgh Steel Products Co.; J. R. Edwards, Pittsburgh, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Severance & Co., S.; F. W. Severance, Glassport, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Superheater Company; R. M. Gates, mgr., 19 E. 42nd St., New York City	..	..	..	..	..	..	..	..	..	..	..	..
Standard Seamless Tube Company; B. F. Bart, 295 Broadway, New York City	..	..	..	..	..	..	..	..	..	..	..	..
Townsend Company, New Brighton, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Vulcan Soot Cleaner Company; G. L. Simonds, Du Bois, Pa.	..	..	..	..	..	..	..	..	..	..	..	..
Honorary Member												
Schofield, A. D., Macon, Ga.	..	..	..	..	..	..	..	..	..	..	..	..

A Furnace Arch is made of refractory materials forming the roof of a furnace or so located within a furnace as to aid combustion.

A Grate is a metallic structure designed to support solid fuel and so made that air for combustion can pass through it to the fuel.

A Tuyere is a nozzle constructed to direct air under pressure into a fuel bed.

A Tuyere Block is a special form of grate containing a tuyere or tuyeres.

A Retort is a receptacle so constructed that solid fuel may pass through it and in which partial distillation of the fuel takes place.

A Dead Plate is an imperforate plate which supports fuel.

A Dump Plate is a movable plate, grate or combination of same for intermittently discharging refuse from a furnace.

A Mechanical Stoker is a device consisting of mechanically operated mechanism for feeding solid fuel into a furnace combined with means for supporting the fuel and supplying air to same during combustion and for directing the deposit of refuse in a location from which it can be readily removed from the furnace.

An Overfeed Stoker is a mechanical stoker where fuel is fed onto grates at one end of same. Overfeed stokers are usually divided into three classes as follows:

(a) **A Front Feed Inclined Grate Stoker** is an overfeed stoker where fuel is fed from the front onto grates inclined downwards towards the rear of the stoker.

(b) **A Double Inclined Side Feed Stoker** is an overfeed stoker where the fuel is fed from both sides onto grates inclined downwards towards the center line of the stoker.

(c) **A Chain or Traveling Grate Stoker** is an overfeed stoker where fuel is fed to the stoker from the front onto a moving grate forming an endless chain.

An Underfeed Stoker is a mechanical stoker having one or more retorts from which the fuel is fed from below the surface of the fuel bed.

Draft is a difference in pressure due to a difference in gas density which tends to cause a flow of gas from the region of higher pressure to that of lower pressure.

Natural Draft is a draft produced by a chimney.

Induced Draft is a draft produced by mechanical means located at some point between a furnace and the point where the products of combustion are discharged.

Forced Draft is a draft produced by mechanical means whereby pressure above atmospheric pressure is maintained under a grate.

French Lick, June, 1920, p. 60.

It was voted that firing tools if required be furnished by the stoker manufacturer.

It was agreed that combination drawings of boilers and stokers cannot be eliminated and that these, including foundation plan, should be prepared by the boiler manufacturer.

It was voted that the boiler and stoker companies interested in any contract exchange information sheets which will set forth contract conditions or details in which the other is interested, this in order that terminal points may be known and whether any items have been omitted by either contractor which are necessary in the combined unit.

It was voted that when stokers are installed under existing boiler installations that the stoker manufacturer furnish the boiler manufacturer with drawings of the stokers to be installed, for record purposes.

*It was voted that when I-beams or other supports are required to carry front boiler walls, either vertical or inclined, that these should be furnished by the boiler manufacturer, providing the vertical boiler supports are furnished by the boiler manufacturer.

*It was voted that stoker manufacturers should erect and connect all water backs, including blow off piping and the valves for water backs, regardless of by whom they are furnished.

It was voted that boiler and stoker manufacturers should standardize if possible on minimum setting heights for various types of boilers with the different types of stokers. Two heights were discussed. First—minimum, that is, absolute minimum; second—preferred minimum, that is, minimum height the committee would like to see installed. There was no discussion or thought of limiting maximum setting heights.

Definitions for "Setting Height" for the different types of boilers follow:

Watertube—Horizontal: floor line to bottom or header above stoker.

Watertube—Inclined; Horizontal Mud Drum: floor line to center of mud drum.

Vertical Mud Drum: floor line to top of mud drum.

Watertube—Vertical; Horizontal Mud Drum: floor line to center of mud drum.

Vertical Mud Drum: floor line to top of mud drum.

Horizontal Return Tubular—Floor line to under side of shell.

The following table shows Minimum and Preferred Minimum setting heights unanimously adopted by the Association.

	Taylor, Westinghouse, Riley, Jones A. C.		Type E		Jones Single Retort		Murphy Detroit		Roney		Chain Forced Draft		Grate Natural Draft	
	Min.	Pm.	Min.	Pm.	Min.	Pm.	Min.	Pm.	Min.	Pm.	Min.	Pm.	Min.	Pm.
Water tube, 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 (ver. 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 150 hp. (ver. m. d.)	4'6	5	4'6	5	4'6	5	3'3	..	3'6	4'6	4'1	4'7	5	5'6
Vertical 250 hp. (ver. m. d.)	5'6	6	5'6	6	5'6	6	3'3	..	3'6	4'6	4'1	4'7	5	5'6
Vertical 500 hp. (ver. m. d.)	6	6'6	6	6'6	6	6'6	3'3	..	3'6	4'6	4'1	4'7	6	6'6
H. R. T. 72"...............	8	10	8	10	7	10	7	8	6	8	7	8	8	10
84"...............	8	10	8	10	7	10	8	9	6	3	7	8	8	10

The Stoker Manufacturers' Association representatives agreed that stoker manufacturers will continue to make such evaporative and capacity guarantees as may be necessary, stipulating, however, that boiler manufacturers should on their part guarantee exit gas temperatures and draft losses through boilers with a given gas flow or at different ratings.

The motion was carried that to assist stoker manufacturers in making guarantees, boiler manufacturers would furnish stoker manufacturers direct with exit gas temperatures and draft losses through the boiler with given gas flow or at different boiler ratings for each type of boiler manufactured.

Bedford, June, 1921, p. 59

Setting Heights—Hand Fired HRT Boilers

The following *minimum* setting heights for Hand Fired HRT boilers were adopted:

	Diameter of Boiler					
	54"	60"	66"	72"	78"	84"
For bituminous coals containing more than 35% volatile matter...........	32"	36"	40"	44"	48"	52"
For bituminous coal containing from 18% to 35% volatile matter.......t.	30"	32"	36"	40"	44"	48"
For anthracite and semi-bituminous coal containing less than 18% vol. matter.	28"	28"	32"	36"	40"	44"

Note—Where the above dimensions are less than those required by existing local laws or regulations by smoke departments or others in power, such local laws or regulations should be followed.

Shawnee, June, 1922, p. 85.

Boiler and Stoker Fronts for Horizontal Return Tubular and Watertube Boilers

The Stoker Manufacturers' Association having agreed that its members would in all installations of multiple and single

*Modified as shown, Shawnee, June, 1922, p. 73.

(*Continued on page* 123)

Electric Welding for Safe-Ending Boiler Tubes

THE practice of using an electric butt welding machine for safe-ending locomotive boiler tubes is employed in several Union Pacific shops with results that show the practice to be thoroughly dependable and economical.

The machinery used consists of a Federal electric safe-end welder, an O'Neil roller, an old turret lathe and a shop

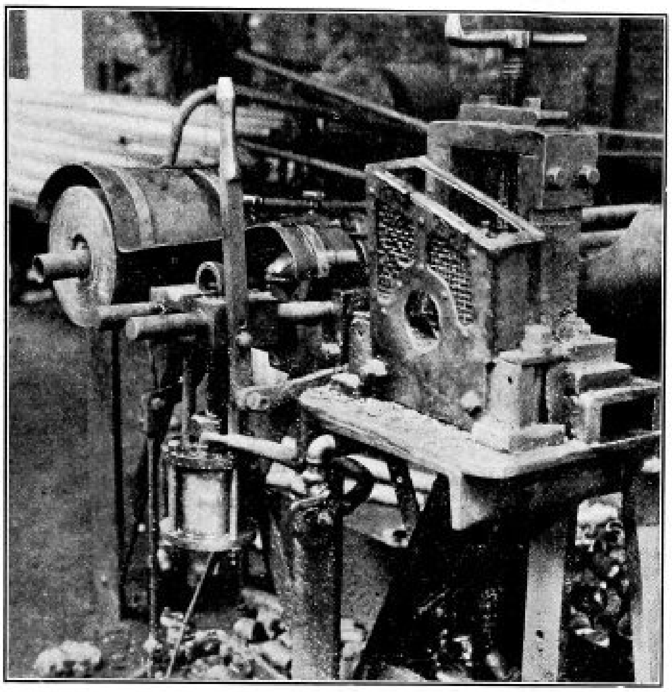


Fig. 1—Pipe Cutter, Reamer and Grinder Used to Prepare Boiler Tubes for Welding On Safe-Ends

made device which is combined cutter, reamer and grinder.

The combined cutter, reamer and grinder is shown in Fig. 1. The first operation is to cut off the ragged end of a tube which has been removed from a boiler and to which a safe end is to be welded. This is done in the cutter shown in the foreground in Fig. 1.

It has been found that tapered or beveled ends are more suitable for obtaining a good weld than ends cut off square and butted together and for this reason the reamer just back of the cutter is included. After the tube is cut off, the end is placed against the revolving reamer. The air cylinder is used to clamp it in the vise or clamp which slides on the two horizontal rods and the vertical lever is used to force the end of the tube against the reamer.

The welding is done by the resistance method and the welding electrodes must make good contact with the tube and with the safe end or the tube and safe end will heat where they are held by the electrodes instead of at the junction of the tube and the safe end. To insure this good contact the grinder shown at the rear in Fig. 1 is included. Inside of the rotating head are four blocks of emery which are thrown outward inside the head when the machine is running. The tube is inserted in the hole in the center of the head, the four blocks are pressed toward the center by a foot lever and are held there until the rust and dirt is removed from the outside of the tube at the point it is to be gripped by the electrode of the welding machine. In the illustration a safe end is shown protruding from the grinder. This is inserted simply to prevent the emery grinding blocks from falling out of the center hole when the machine is not in operation.

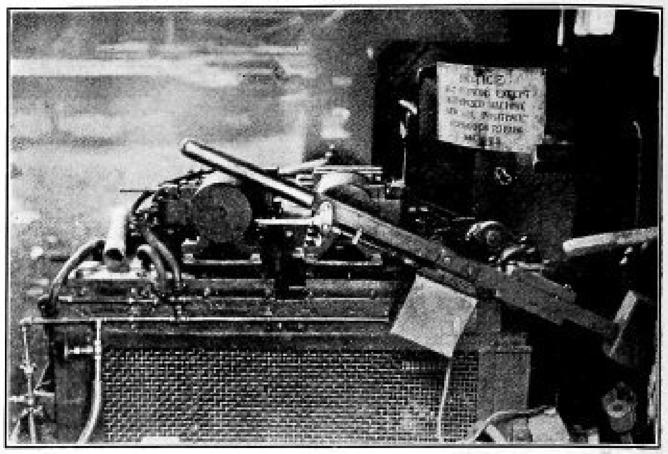


Fig. 2—Federal Electric Safe-End Welder

An old turret lathe has been fitted up for cutting safe ends. A piece of boiler tube which is to be cut up into safe ends is fed through the spindle of the lathe and is cut off by a tool on the cross side so that it has an external taper which will just fit the inside taper in the tube made by the reamer. A tool on the turret is then set forward into the end of the safe end to remove the wire edge produced by the cut-off tool. Another grinder, similar to the one shown in Fig. 1, is used to clean the outer surface of the safe ends.

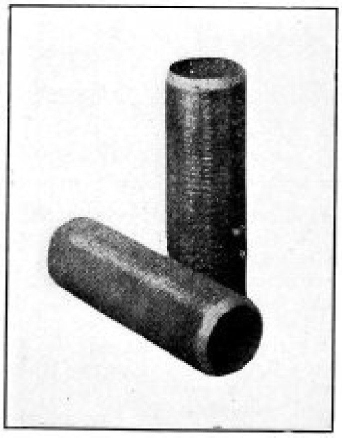


Fig. 3—Two Safe-Ends Ready for Welding

The welding machine is shown in Fig. 2. The tube and the safe end are clamped in the pneumatically operated, water cooled, copper electrode jaws of the welder and are forced together by the hand lever shown in the foreground. When the two ends are brought together the welding current flows through them between the two electrodes and the contact resistance and current are sufficient to bring the junction to a welding heat in about 45 seconds. A welding speed of 30 seconds is possible. The tube is then removed quickly and placed on the roller which finishes the weld by compressing and shaping it. Two safe-ends that have been made ready for the welder are shown in Fig. 3. After the weld is made it is hydraulically tested.

Riveting Pressures

TESTS of the effect of riveting made by Professor R. Baumann (*Zeitschrift des Vereines deutscher Ingenieure*) indicate that both the thermal stresses and the stresses caused by high riveting pressures have a tendency to open up cracks in the plates connected. To obtain an estimate of the thermal stresses, comparative tests were made with hot-driven iron rivets and with cold-driven lead rivets, which showed that the temperature stresses exceed the others. A high riveting pressure is likely to produce stresses in the plate exceeding the yield point. The plate reaches temperatures exceeding 500 degrees Centigrade during riveting, and large temperature stresses result from this heating. The most unfavorable stress conditions occur at the faying surfaces, between plates in contact, directly adjacent to the rivet hole.—*The Valve World.*

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, C. W. Obert, 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 simultaneously published.

Below are given the interpretation of the Committee in Case No. 411 (reopened), as formulated at the meeting of January 10, 1924, and approved by the Council. In accordance with the established practice of the Committee, the names of inquirers have been omitted.

Case No. 411 (Reopened). *Inquiry:* Par. 212*c*, which permitted increasing the pitch of staybolts on cylindrical surfaces over that required for flat plates, had, about two years ago, been held in abeyance pending the revision of the Boiler Code, but nothing has been left in its place. In view of this, what rules should be followed pending the publication of the revised Code?

Reply: It has been proposed to revise Par. 212*c* as follows, dividing it into items *c* and *d*, and the Committee recommends to the state inspectors that these rules be followed in place of the rules now given in Par. 212*c* of the Code:

c A furnace for a vertical fire-tube 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 in Par. 199.

The longitudinal pitch between the staybolts, or between the nearest row of staybolts and the row of rivets at the joints between the furnace sheet and the tube sheet or the furnace sheet and mud ring, shall not exceed that given by the following formula:

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

where;

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

except when this value is less than the circumferential pitch, in which case the longitudinal pitch may be as great as the allowable circumferential pitch.

The stress per square inch in the staybolts shall not exceed 7,500 pounds and shall be determined in the way specified in section *d*.

d In furnaces over 38 inches in outside diameter and combustion chambers not covered by special rules in this Code, which have curved sheets subject to external pressure, that is, pressure on the convex side, both the circumferential and longitudinal pitches of the staybolts shall not exceed 1.05 times that given by the formula in Par. 199.

The stress per square inch in staybolts shall not exceed 7,500 pounds, based on a total stress obtained by multiplying the product of the circumferential and longitudinal pitches by the maximum allowable working pressure.

Addenda to Code

The Boiler Code Committee has for several years had under consideration the formulation of rules to cover the strength of shells or drums pierced with any number of holes placed along a longitudinal line without reinforcement. As a result of its study the following rules are presented. Criticism and comment thereon from anyone interested in this subject are invited. Discussions should be mailed to C. W. Obert, Secretary of the Boiler Code Committee, 29 West 39th street, New York, N. Y., in order that they may be presented to the Boiler Code Committee for consideration. It is the purpose of the Committee to present the rules finally agreed on to the Council of the Society for approval as an addition to the Boiler Code. A set of curves for determining the strength of the diagonal ligaments similar to that given on the folder between pages 48 and 49 of the 1918 edition of the Code, but extending over a larger field, will be published with the rules.

Rules for Determining Efficiency of Drum Sheet for Any Series of Holes That May Be Placed Longitudinally Without Reinforcement

1. Where the tubes are arranged in groups along lines parallel to the axis and the same spacing is used for each group, and the length of each group does not exceed the outer diameter of the drum, the efficiency of the ligaments for one of the groups as computed by the rules shall not be less than the efficiency on which the maximum allowable working pressure is based. Where the groups of tubes are longer than the outer diameter of the drum, or where the tubes are unsymmetrically spaced, the average ligament efficiency for a length equal to the outer diameter of the drum for the position that gives the minimum efficiency shall not be less than the efficiency on which the maximum allowable working pressure is based.

2. The ligament efficiency computed between the centers of any two adjacent holes shall not be less than one-half the efficiency on which the maximum allowable working pressure is based.

3. Any holes shall be limited in diameter to such with which it would be possible to form recesses completely around the hole from both sides of the sheet and with a plane surface at the bottom of each recess provide thereby a tube seat ⅜ inch in width between the two planes which are perpendicular to the axis of the hole and which form the bottoms of the recesses.

4. For holes placed longitudinally along a drum but which do not come in a straight line the above rules shall hold, except that in the case of the diagonal ligaments the equivalent width of a ligament for equal strength if the holes were in the same straight longitudinal line shall be used. To obtain the equivalent width the longitudinal pitch of the two holes having a diagonal ligament shall be multiplied by the efficiency of the diagonal ligament.

Defective Locomotives in February.—The number of locomotives inspected by the Bureau of Locomotive Inspection of the Interstate Commerce Commission during February was 5,631. Of these 3,064 were found defective and 577 were ordered out of service. The number of accidents caused by the failure of some part of the locomotive or tender was 92, in which 11 were killed and 99 injured.

Rules for the Safe Handling of Gas Cylinders

THE following rules have been prepared by the Gas Products Association of Chicago to promote the safe handling of cylinders to prevent accidents among the users of oxygen, acetylene and hydrogen gases.

Oxygen

1. Compressed oxygen plus oil is explosive. Allow no oil or grease of any kind to come in contact with valve, regulator or any other portion of the cylinder or apparatus.

2. When shipping empty oxygen cylinders to manufacturer, lower portion of green tag attached to cylinders should be removed at the perforated line. Any green sticker label found pasted to the cylinder should be removed. Bill of lading should specify that the cylinders are empty and serial numbers of the cylinders should be noted thereon.

3. Cylinders of oxygen, except those in actual use and in excess of approximately one day's supply required in any one department or point about the shop, should be stored in a place where they will not be tampered with by unauthorized persons.

4. Oxygen cylinders should be stored in a safe, dry place, where they will not be exposed to the heat of stoves, radiators, furnaces, or in the direct rays of the sun. Heat will increase the pressure and it may cause the safety plug or disk to melt or blow, thus allowing oxygen to escape, resulting in waste. If the escaping oxygen comes in contact with even the smallest flame it has such a tremendous influence upon combustion that a quick raging fire is liable to result.

5. Cylinders of oxygen are never to be stored in the same room used for the storage of calcium carbide, cylinders of dissolved acetylene or other fuel gases, or with acetylene generators.

6. Open flames of any description shall not be employed in any building used for the storage of oxygen cylinders.

7. If cylinders are stored on the ground or open platforms, such locations should not be adjacent to points where there is a large amount of combustible material.

NOTE:—While oxygen itself will not burn, its effect in aiding combustion, once a blaze is started, makes it important that rules 4 to 7 inclusive be carefully observed.

Acetylene, Hydrogen, Etc.

1. When cylinders of dissolved acetylene, hydrogen, liquid fuel gases or vapors are not in use, outlet valves shall be kept tightly closed, even though cylinders may be considered empty and valve caps replaced.

2. Cylinders should be stored in a safe, dry, well-ventilated place where they will not be unduly exposed to the heat of stoves, radiators, furnaces, or the direct rays of the sun. Heat will increase the pressure, or it may melt the fusible safety plug with which most cylinders are provided and which melts at a temperature of approximately 212 degrees to 220 degrees F.

3. No open flame, grinding tools, or spark-emitting devices shall ever be used within the storage building or compartment, and all artificial lights shall be incandescent electric and shall be installed in accordance with the "National Electrical Code for Rooms in Which Inflammable Vapors May Exist."

Electric light switches, telephone and all other apparatus which may cause a spark must be located on the outside of building.

All lamps shall be enclosed in vapor-proof globes of the marine type.

4. Cylinders of dissolved acetylene shall always be stored standing upright with valve end up.

5. When shipping empty dissolved acetylene cylinders and other fuel gas cylinders to manufacturers, lower portion of red shipping tag attached to cylinders should be removed at the perforated line. Any red sticker label found pasted to cylinder wall should also be removed. Bill of lading should specify that the cylinders are empty, enumerating the type and individual numbers of such cylinders.

6. Under no circumstances attempt to transfer acetylene from one cylinder to another and never under any conditions attempt to compress acetylene into a cylinder. This work should only be performed by acetylene charging plants, and under conditions which comply with Interstate Commerce Commission regulations.

General

1. Oxygen cylinders and acetylene, hydrogen or other fuel gas cylinders shall not be transported or lifted by crane or derrick except when they are in a cradle or substantial stand, and cylinders shall never be handled with electro-magnets or with rope or chain slings.

2. Cylinders should be handled carefully, should never be dropped, antl should be placed so they will not fall nor be struck by other objects. Knocks, falls, or rough handling are liable to damage the cylinder, valve or fuse plugs, and cause leakage, and may even result in an explosion.

3. When exhausted cylinders shall be returned as rapidly as practicable to the storage building or place, and from there to the manufacturer. Empty cylinders should be marked "EMPTY" and stored apart from full cylinders to prevent confusion. Valve protection caps must be replaced.

Supply Men Completing Exhibit Plans for Master Boiler Makers' Convention

THE secretary of the Boiler Makers' Supply Men's Association has recently sent out to all members of this association details of the arrangements being made for exhibits at the Master Boiler Makers' Association convention, to be held at the Sherman Hotel, Chicago, May 20 to 23 inclusive.

In the past few years the conflict of this convention with that of the National Railway Fuel Association has prevented many companies from having as extensive exhibits of their products as would be possible if they were not required to carry a display at both conventions. Fortunately the conflict of dates will not occur this year due to the decision of committees representing the interested associations to hold the conventions at different times. Both conventions will be held at the Hotel Sherman, that of the Master Boiler Makers on the dates noted above and the National Railway Fuel Association on May 26 to 29 inclusive. This will make it possible for supply men who exhibit at both conventions to arrange one complete exhibit that will remain standing through the entire convention period since arrangements may be made to reserve the same space for both meetings.

The exhibits of the supply men will be shown on the mezzanine floor and the business meetings and entertainments will be held in the "Tiger Room."

Secretary Calls Attention to Necessity for Making Space Reservations

The secretary desires to call to the attention of the members who have not already reserved space, that little time remains to complete arrangements for the exhibits and other necessary details. Plans of the spaces available and rates for additional space, if required, as well as application data for new members will be sent to any of the members on request by the secretary, W. H. Dangel of the Lovejoy Tool Works, 316 West Ohio street, Chicago, Ill.

All indications point to one of the most successful and instructive conventions ever held by the Master Boiler Makers' Association.

The Boiler Maker

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CONTENTS

Unless all signs fail, the Master Boiler Makers' Association convention, to be held at the Hotel Sherman, Chicago, May 20 to 23, will be attended by practically the entire membership and will, from the standpoint of business sessions and instructive exhibits, be a great success.

The usual conflict between this convention and that of the National Railway Fuel Association has been avoided this year through the cooperation of the officers of both bodies. The National Railway Fuel Association will hold its meetings the week following the Master Boiler Makers' convention and has selected the same place for its sessions. This arrangement closely affects member companies of the Boiler Makers' Supply Men's Association who exhibit their products at both meetings since it will be possible for them to provide a single complete display that can be maintained through the entire convention period in the same exhibit space.

Due to the fact that formerly two distinct exhibits had to be given by many companies at different convention points, the display of equipment at the Master Boiler Makers' convention in a few cases left a great deal to be desired. The present opportunity for correcting this tendency by presenting for examination all manner of equipment that will be of interest to the master boiler makers is excellent. The Supply Men are apparently recognizing this fact and the exhibits will be of broader scope than have been presented for some years past.

At one time or another in his career the average boiler maker has aspirations of becoming a federal or state locomotive inspector and prepares himself by study and close application to his work to take the required examinations. A great many boiler makers together with the other eligible trades—machinists, engineers and firemen—take these examinations each year and those passing with the highest grades and offering the best qualifications are appointed to fill vacancies that exist in either the Bureau of Locomotive Inspection or state transit commission departments.

That information on these examinations, such as typical questions, and the like, is rather meager, is evidenced by the many letters received by THE BOILER MAKER requesting details of the requirements. To assist all those interested in preparing themselves for such inspectors' examinations and, as a matter of general interest to all who follow locomotive boiler work as a trade, a series of typical questions and their answers from examinations has been introduced as a feature of this issue of the magazine and will be continued for several months. The questions and answers were compiled by a locomotive inspector who has been connected with the New York State Transit Commission for ten years.

Since to qualify as an inspector an applicant must have a working knowledge of the mechanical details of a locomotive as well as of boiler work, our regular readers who are boiler makers will find the answers to mechanical questions contained in the article of special value. As noted in the introduction to the series, the author will be very glad to receive comments from our readers on the value of the material and to amplify the answers to any questions that may not be quite clear to those studying the subject, which might occur in the case of some of the mechanical problems.

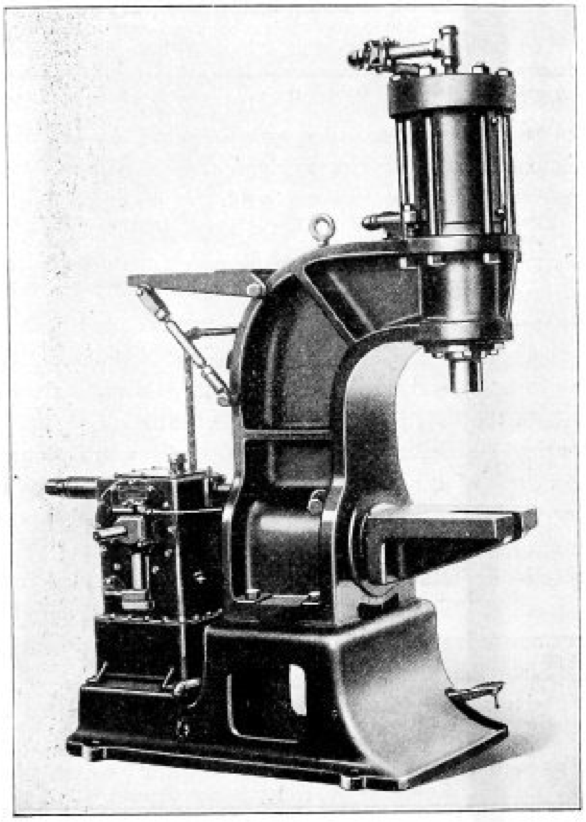
Members of the American Boiler Manufacturers' Association found the Homestead at Hot Springs, Va., so attractive as a meeting place last year that they have again selected it for their annual meeting this year. The period of June 9 to 11 has been chosen as the time of the meeting. An attractive program is being arranged by the officers of the association, details of which will be published in our May issue. As usual, a golf tournament will be a recreation feature of the program.

Engineering Specialties for Boiler Making

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

Hydraulic Riveter

A NEW riveter of the hydraulic type has recently been developed by The Oilgear Company of Milwaukee, Wis. This riveter, like Oilgear presses and broaching machines, is self-contained, easy to locate anywhere on the shop floor, and be driven from any constant-speed source of power. Equipped with a type W E Oilgear constant-pressure pump, there is no delay in waiting for pressure to build up, the pressure being available the instant resistance is met.



Self-Contained Oilgear Hydraulic Riveter

The pump furnishes oil to the cylinder under steady pressure, free from pulsations and with instantly variable delivery from zero to maximum, its displacement being positive against any resistance up to the maximum capacity of the machine.

Control by means of a foot treadle allows the operator the use of both hands for the work, the speed of the machine being limited only by the adeptness of the operator in placing rivets.

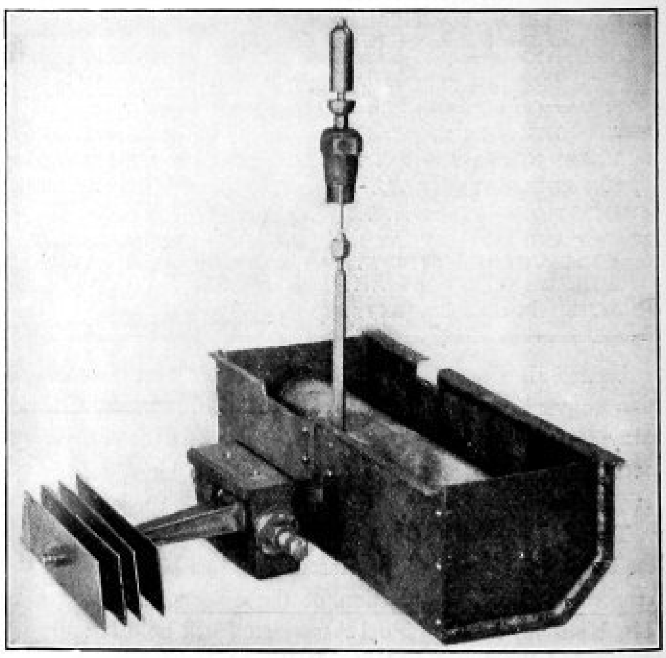
Setting rivets by this hydraulic method, subjecting each rivet to a quick squeeze, is claimed to be superior in that it allows the metal whether hot or cold to assume its new shape and make a uniform tight joint without undue stresses or fractures. The stroke is 4 inches and the design allows for so placing the work that the strokes can be limited so that they will just clear the work on the up stroke or on the return to the ram.

The horn shown in the accompanying illustration is of special design to accommodate an indexing fixture. Removable horns of any design can be used. Standard sizes of this riveter are 10 ton and 20 ton.

Low Water Alarm of the Float Type

A NEW low water alarm, differing in principle from other devices of this character, is being manufactured by the United States Metallic Packing Company, Philadelphia, Pa. This device, known as the Security low water alarm, employs no fusible plugs of any kind, but is actuated solely by the height of solid water over the crown sheet.

A cylindrical buoyant float is secured to the end of the rocker arm shown in the illustration. This rocker arm is pivoted in a bracket so that the float rises and falls with the variation of the water level in the locomotive boiler. The bracket which supports the rocker arm is located so that the center of the pivots is five inches above the crown sheet. When the water in the boiler is five inches above the crown sheet, the float causes the needle on the end of the vertical rod to seat in the whistle and the float can rise no higher above the crown sheet. When the water in the boiler is reduced to a height less than five inches above the crown sheet the float, now resting on the surface, will fall as the level of the water in the boiler becomes lower. The weight of the float pulls the needle valve away from the seat in the whistle



This Alarm Is Actuated Solely by the Height of the Water

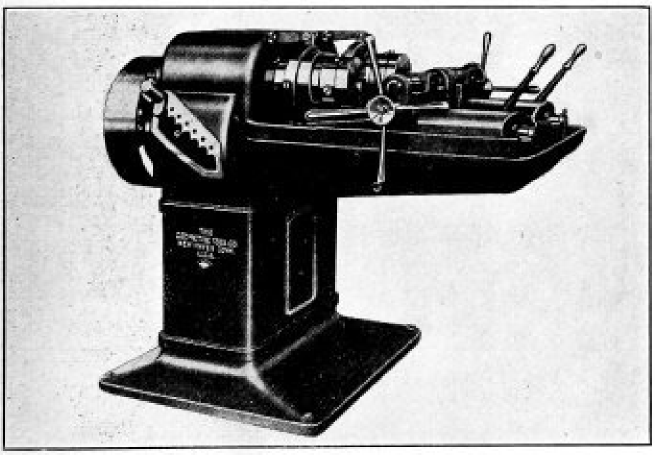
and this sounds a warning, calling the engineer's attention to the lower water condition.

The cylindrical float which controls the sounding of the whistle is encased in a sheet iron baffle box. The purpose of this baffle box is to break up any surging or pyramiding of the water so that the whistle will not sound unless there is an actual condition of low water. Secured to the balance lever on the opposite side from the cylindrical float is a series of plates. These plates present the same surface area for corrosion as is presented by the cylindrical float. Any corrosion or scale formation is thus equalized on both ends of the rocker arm.

Double Spindle Threading Machine

A MACHINE, designed primarily for threading work in which the threading time for both pieces is sufficient to allow the operator to check and start a second piece while the first is being completed, is now mnaufactured by the Geometric Tool Company, New Haven, Conn. A number of threading combinations are possible with this machine. Both spindles may be fitted with die heads for external threading only or with collapsing taps for internal threading, or one spindle may carry a die head and the other a tap for handling work which requires both an external and internal thread. The same combination may also be employed for separate external and internal threading whenever work of such character is required.

The bed of the machine consists of a casting, carrying the two spindles, which are mounted in large bronze bearings. The spindles are driven by a single pulley, located at the rear of the machine, but they can be driven independently by means of the change gear levers at either side of the machine. Each carriage is fitted with a two-jaw chuck. The chuck is operated by a hand wheel, and special bushings or holders can be furnished to suit various classes of work. An adjustable swinging gage on the side of the carriage provides an accurate means of setting the work for a predetermined length of thread. An adjustable stop on the trip rod ahead of the carriage governs the opening of the die head and the length of the thread to be cut. The adjustable stop back of the carriage controls the closing of the die head.



Geometric Machine With a Wide Range of Threading Combinations

Both spindles are operated and controlled in exactly the same manner. This facilitates the operation of the machine from the standpoint of production.

A single geared pump, driven from the main shaft by bevel gears and a flexible shaft, forces oil from the reservoir through the spindles and die heads against the work. When equipped with the collapsing tap or high speed tapping device, the oil is fed through pipes on the outside of the machine. The lubricating system may be easily removed for cleaning and inspection.

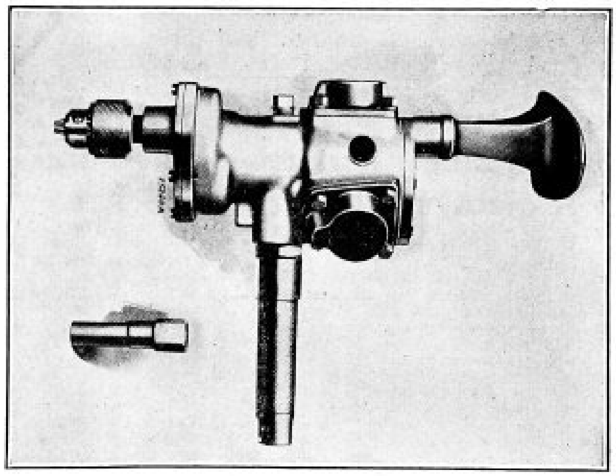
The change gear levers on the sides of the machine control the spindle speeds independently, and may be set to furnish the proper speeds for the threads being cut. The speed given will be found satisfactory for the average run of work, but may be varied to suit special conditions. A safe cutting speed for any diameter is one which will insure the maximum production without causing excessive wear on the chasers. If the speed for which the machine is designed is too fast to permit this, it should be run more slowly, regardless of the index.

This machine will cut threads of the following diameters: ¾, ⅞, 1, 1⅛, 1¼, 1⅜ and 1½ inch. The greatest cutting length at which the swinging gage can be set at one time is 9 inches. With resettings, a length of 14 inches may be obtained. The floor space required is 48 inches by 65 inches. The speed of the countershaft is 296 revolutions per minute, and the net weight of the machine, 2,165 pounds.

New Light Weight Pneumatic Drill

A NEW size lightweight non-reversible pneumatic drill has been brought out by the Ingersoll-Rand Company, No. 11 Broadway, New York. This new drill is known as size "D" and is suitable for light drilling up to 9/16-inch diameter holes, and reaming up to 5/16-inch diameter.

The drill may be fitted with either breast plate, feed screw or grip handle and so made adaptable for a wide variety of work. The construction of this machine is very similar to that of the No. 6 and 600 drills which this company brought out about two years ago and which were powered for drilling up to ⅜-inch diameter.



Size "D" Non-Reversible Ingersoll-Rand Drill

The features of this type of machine are briefly—lightweight aluminum case, with steel bushings cast in all the bearing holes and the throttle hole; cast iron cylinders which are renewable and interchangeable and a special three cylinder motor. The renewable cylinders are a valuable feature, as any cylinder after long service, may easily be replaced and the motor made as good as new at slight cost.

The three cylinder motor has the rotating parts all accurately balanced, eliminating vibration and reducing wear and tear on the machine. The drill is economical in air consumption and cost of maintenance, is high powered, and every part is readily accessible for inspection.

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Request for Back Numbers of The Boiler Maker

Q.—If you have any back number that shows any information on laying out firebox with combustion chamber, please send one, or wrapper sheet of any kind.—T. J. M.

A.—Back editions of THE BOILER MAKER are not available. It is advisable that you procure a copy of "Laying Out for Boiler Makers." This volume contains valuable information on the layouts that you desire—also other data on laying out problems of every description. A completely revised edition of this book with many new problems and a section on locomotive boiler laying out work as practised by one of the greatest locomotive building companies in the world will be available within a short time.

Use of Copper Ferrules—Locating Rivet Line on Elbow Patterns—Determining Points on a Long Radius Arc

Q. (1) Why is a copper ferrule used in a firetube boiler? Some boiler makers claim that a copper ferrule is for the purpose of preventing the tube sheet from being damaged by the chisel when the tube is being split or ripped for removal; others claim that the purpose of a copper ferrule is to be used for shimming purposes and again others claim that a better joint can be procured with the copper ferrule than without it. Now, if you please, I would like to know for what purpose the copper ferrule really is used?

(2) Which is the right method of spacing or locating rivet centers on the miter line of a sectional elbow when flat; suppose the diameter of an elbow to be 54 inches and to be made in five sections and the pitch of the rivets to be 2¼ inches?

Referring to page 227 of the August issue of THE BOILER MAKER, "A Long Radius Arc," supposing I am to layout sheets for a blast furnace, the furnace to be made up of 9 rings and 6 sheets, the rings to be 60 inches high. We assume the furnace to be 24 feet at the bottom and 18 feet at the top; again suppose the diameter difference between top and bottom is 14 inches; that is, 14 inches smaller in diameter at the top than at the bottom of the ring; how would you advise me to lay out the camber line on one sheet that would serve as a pattern for the other five sheets that are to form one ring?—M. M.

A.—In Fig. 1 is shown one way in which the tubes are installed in the back tube sheets of locomotive boilers. A copper ferrule *a* is inserted in the tube hole and the tube *b* is expanded and beaded in place. The ferrule is slightly longer than the thickness of the tube sheet. It is used to prevent leakage arising from the expansion and contraction of the tube sheet and tube. It is also used as a shim when a tube hole is too large in diameter and out of round from too much expanding and rolling.

LAYING OFF RIVET CENTERS

The method of laying off the rivet centers for elbow girth seams depends on the manner of fitting the elbow sections; thus if the segments are to be put together with one section inside and the next outside as shown in Fig. 2 the thickness of the sheet metal must be taken into account. In such cases determine the stretchout for the inside and outside sections from the neutral diameter *a* of each segment. In such a case the lap is bent at one end of each ring and in the pattern of each the rivet holes are laid off at a distance *x* measured from the bend to the center line of the rivet holes.

For light sheet metal elbows the ends taper, having the segments alternately inside and outside. The taper is produced by knocking the lap ends down or out as required for fitting the sections together.

FURNACE PROBLEM

The solution of the furnace problem involves trigonometrical calculations, and to illustrate the requirements Figs. 3, 4 and 5 are given with the following explanation:

Assume that the tank is built with the nine courses connected as shown in Fig. 3, in which the dotted lines represent the rivet lines. The respective diameters of the sections are indicated on the rivet lines, but in this example the plate thickness is not taken into account, which must be done in practice.

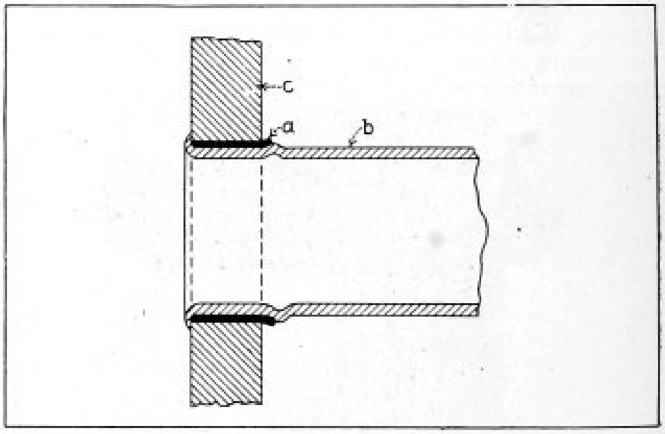


Fig. 1.—One Method of Tube Installation

The dimensions of section *A* are used for demonstrating the problem. First determine the slant length of the cone, Fig. 4, of which the frustum *A* is a part and as follows:

Reduce the diameters which are given in feet to inches; thus

$$18 \times 12 = 216 \text{ inches}$$
$$18\tfrac{2}{3} \times 12 = 224 \text{ inches.}$$

The difference in the diameters equals $224 - 216 = 8$ inches; and the distance *x*, Fig. 4, equals $8 \div 2 = 4$ inches.

With the respective dimensions of the frustum, the slant height *a-b* of the cone *a-b-c*, Fig. 4, may be found by proportion, which may be expressed as follows:

The slant height of the frustum is to the distance *x* as the

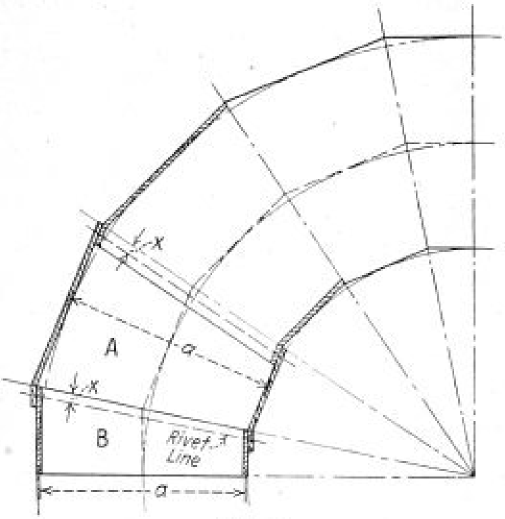


FIG. 2

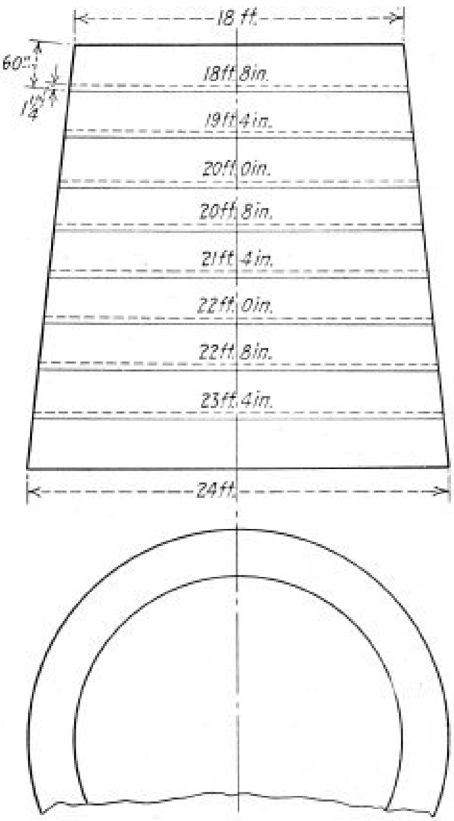


FIG. 3

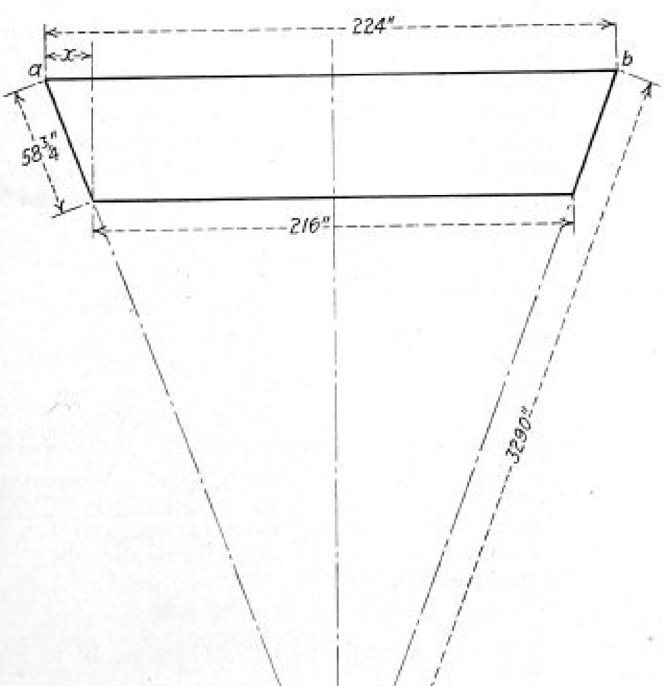


FIG. 4

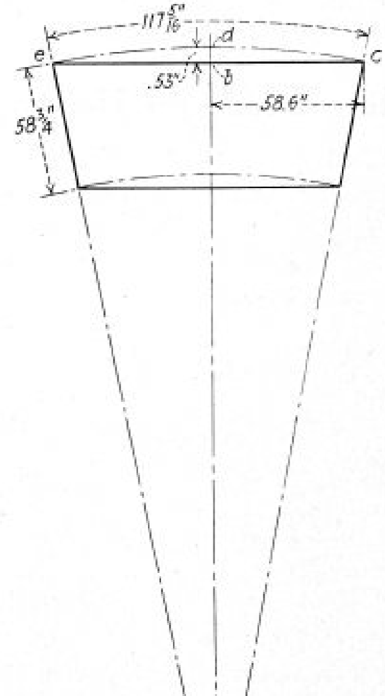


FIG. 5

Locating Rivet Centers in Elbow Layout and Furnace Problems

slant height of the cone is to the diameter of the base of the cone;

or, 58¾ : 4 :: 224 : x, then

$$\frac{58\frac{3}{4} \times 224}{4} = 3{,}290 \text{ inches, the slant height of the cone.}$$

In this problem each course is made of six plate sections, so the stretchout in each course is one-sixth of the circumference of the respective ends. The stretchout of the large base of frustum *A* equals

$$224 \times 3.1416 = 703.72 \text{ inches}$$

$703.72 \div 6 = 117\ 5/16$ inches, the stretchout of the base of the template.

The dimensions of the template are given in Fig. 5 in which *b-d* equals the versed sine. The angle between the extended edge lines of the template is 2 degrees 2½ minutes and the angle *c-b-a* is 1 degree 1¼ minutes. To determine the angle 2 degrees 2½ minutes, first find the circumference of the circle of which the arc *c-d-e* is a part. The diameter of the circle equals $3{,}290 \times 2 = 6{,}580$ inches. $3.1416 \times 6{,}580 = 20{,}671.73$ inches circumference. $20{,}671.73 \div 117\ 5/16 = 176.2$, the number of times the arc length 117 5/16 inches is contained in the circumference.

The angle *c-a-e* equals $360 \div 176.2 = 2$ degrees 2½ minutes.

One-half the angle *c-a-e* = 1 degree 1¼ minutes.

Sine of angle 1 degree 1¼ minutes = .0178125.

Cosine of angle 1 degree 1¼ minutes = .99984.

Then $bc = 3{,}290 \times .0178125 = 58.6$ inches.

$ab = 3{,}290 \times .99984 = 3{,}289.47$ inches.

$b—d = 3{,}290 — 3{,}289.47 = .53$ inch.

From the dimensions so found the outline of the template can be laid out, and the camber line drawn in at the top and bottom as explained in the solution given in the August issue of The Boiler Maker, page 227.

Calculating Loads on Hoisting Tackle

Q.—How much load is on *A* in Figs. 2 and 3 of the accompanying drawings shown below?—K. D.

A.—The greatest load on the lifting line arises when starting to raise the tank from a horizontal position. To determine the dead load *W* at the end of the line it is necessary to establish first the center of gravity of the tank. Thus in Fig. 4 assume that the center of gravity is at *a;* the total length of the tank is *L* and the distance *C* is between the center of gravity and the bottom of the tank.

The moment *M* about the point *d* equals

$$M = L \times C = W \times b$$

$$\text{or, } W = \frac{L \times C}{b}$$

The value of *L* is equal to the total weight of the tank.

The pull or tension in the rope may be found by laying off the diagonal line *e—f* for the rope, also the vertical line *f—g* to a scale representing the load *W*. From point *g* and perpendicular to *f—g* draw the line *g—h*. The length *h—f* on the diagonal should be measured to the scale at which the load *W* was drawn at, thus giving the stress in the rope. The calculations for the other positions of the tank are made in a similar manner; but as the greatest stress in the rope occurs at the start in raising the tank, these calculations are unnecessary.

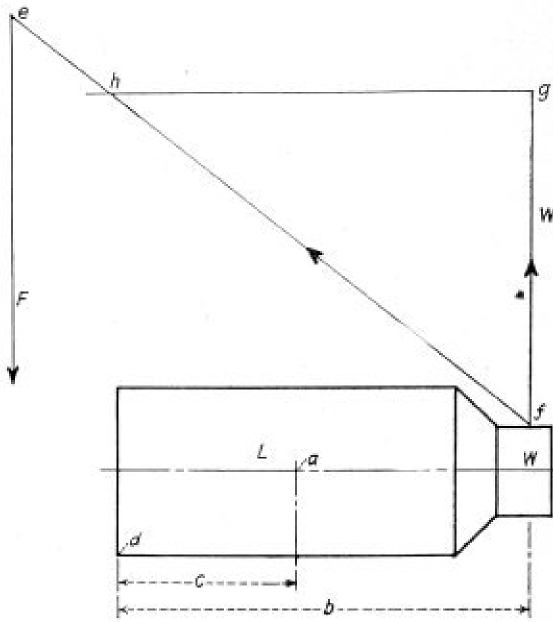
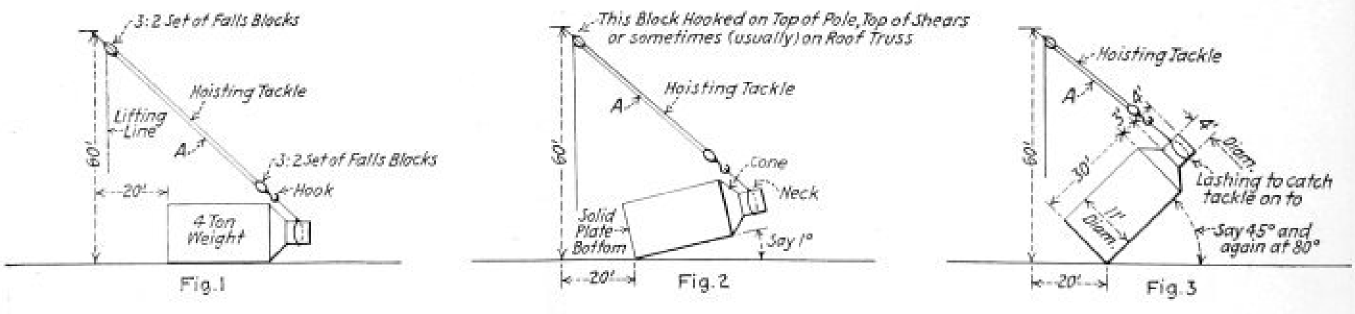


Fig. 4.—Diagram of Forces

The principle of the tackle-block, Fig. 4, is as follows:

The distance moved by *W* depends on the number of ropes *N* leaving the lower pulley. By the principle of work, $F \times$ its distance moved $= W \times$ its distance. If $N = 4$ ropes, then the weight *W* moves ¼ as far as *F* and would be 4 times as great as the pull *F*. Therefore $W = FN$ and

$$F = \frac{W}{N}.$$



Determining the Stresses on Pulleys and Tackle

One-Piece Firebox

Q.—Could you please give me information in regard to the one-piece firebox and combustion chamber? By whom was it patented, date and year? I think it was patented in 1920.—C. M.

A.—We do not have this information but possibly some of our readers can supply it.

Tank and Screw Calculations

Q.—(1) Will you please show me what will be the maximum working pressure of the water tank as shown below? Also, what will be the maximum deflection of the heads (and the maximum deflection allowed) under the working pressure so found above and how to figure it (deflection)? In calculating the working pressure and deflection only the heads have to be taken into account as the heads are without any stays for supporting them and have to be left unsupported. Give examples.

(2) What is the mean power in pulling and pushing? How can I work out the pressure exerted by the screws as shown; supposing that one man is pulling on the wrench (shown in full line) at 15-inch radius, also the same man with the double ended arm wrench (shown half dotted) at 30-inch radius? Give examples.—T. L.

A.—The pressure, in pounds per square inch on the ends or heads of the tank, due to the head of water, is equal to the product of the head in feet multiplied by 0.434.

In this case, the head equals 5 feet, then .5 × 0.434 = 2.17 pounds per square inch.

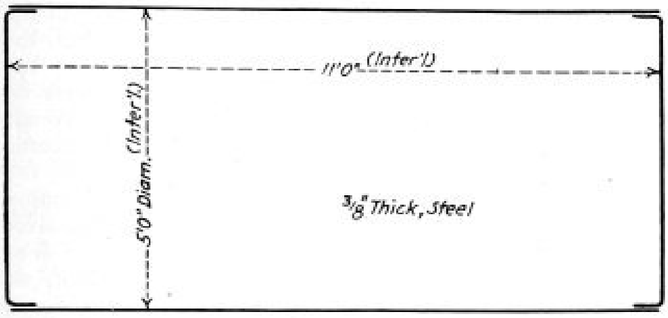


Fig. 1.—Finding the Working Pressure on a Water Tank

The deflection at the center of the head may be approximately figured from the following formula:

$$D = \frac{PR^4}{6Et^3}$$

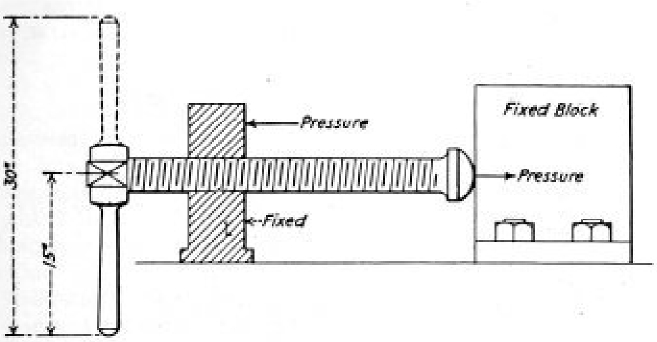


Fig. 2.—Screw and Lever Principles

in which D = deflection of head, inches.
P = pressure pounds per square inch.
R = radius of plate to supported edge, inches.
E = coefficient of elasticity, for steel equals 30,000,000.
t = plate thickness, inches.

Substitute the values given in the formula, then

$$D = \frac{2.17 \times 30^4}{6 \times 30{,}000{,}000 \times 375^3} = 0.184 \text{ inch.}$$

(2). The average pull that a man can make at the end of a lever is generally taken at 40 pounds.

The force that can be exerted by a screw by means of a lever and man power may be calculated from the formula:

$$W = \frac{PR\,6.2832}{p}$$

in which;

W = force produced by the screw, pounds.
P = power or force exerted at the end.
R = distance force is applied from the center of the screw to the end of the lever, inches.
p = pitch of thread of screw.

Assume that the screw, Fig. 2, has 4 threads per inch and that a force of 40 pounds is applied at the end of the 15-inch lever, as measured from the axis of the screw to the end of the lever. A screw having 4 threads per inch is a screw of ¼ pitch. In the formula given, substitute the values given, then

$$W = \frac{40 \times 15 \times 6.2832}{\frac{1}{4}} = 15{,}079 \text{ pounds.}$$

Development of Camber for Firebox Wrapper Sheet

Q.—Kindly tell me the simplest method for obtaining the true shearing lines of the wrapper sheet and firebox of a locomotive boiler.—W. D.

A.—The triangulation method of development is applied in problems of this kind. A number of firebox layouts have been given in preceding issues of THE BOILER MAKER. There are several layouts given in our treatise "Laying Out for Boiler Makers," new and up-to-date edition soon available. You should obtain a copy as, it covers fully the application of the different methods of laying out to practical examples.

Qualifications of a Boiler Inspector

Q.—Kindly tell me what qualifications are required to become a boiler inspector.—W. D.

A.—A boiler inspector should understand fully the requirements of boiler construction, the calculations for determining the strength of the different parts of a boiler, such as the joints, stays, braces, etc. He should also know the methods of testing old and new boilers, how repairs should be made, how to detect wasted plate and other materials.

To become an inspector of railroad locomotives the applicant must have a number of years' experience in the operation of the locomotive as a fireman or engineer.

Boiler Tests

Q.—Some time ago I received a letter from you stating that questions regarding boilers would be answered. I would thank you if you would give me advice as to what is the cause of boiler rupture while testing and is air more harmful than water or steam while filling the boiler with water creating air on top after applying pump for hydrostatic pressure. Will that compressed air be more harmful than ordinary water pressure, if so, to what degree?—R. J. M.

A.—It is customary in testing boilers to use water in preference to steam or air; for the reason that a greater pressure is required than that at which the boiler is to be operated. If the boiler should rupture under such a test no great damage will occur in the use of water, but if steam or air were used and rupture should occur serious results would happen.

If a boiler ruptures under test it may be due to faulty material, improper construction or the test pressure too great. The hydrostatic test pressure is usually one and one-half times the maximum allowable working pressure.

It is necessary in filling the boiler with water to allow the air to escape through a vent at the top. After the air is removed and the vessel completely filled with water, the pressure is gradually brought up; during the period of raising the pressure the vessel is inspected to observe if any deformations arise.

Letters from Practical Boiler Makers

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

More Care Required on the Part of Inspectors

IN the March number of THE BOILER MAKER, pages 76 to 78 inclusive, was published a report of a boiler explosion which caused the death of three men. The locomotive, No. 2455, was a 2-8-2 type owned by the C. N. W. Railway Company. The government report shows that the explosion was caused by the failure of the crown sheet.

I believe that it would be a good idea if the railway companies were compelled to employ a capable man to make the inspection of the boilers. The man so employed should be a first class boilermaker and have the same authority as the inspectors employed by the government.

I know of men who are inspecting boilers who never saw a boiler until the strike. Some of these men cannot even read the laws governing inspections.

Why do not the railroad companies try to help the Federal inspectors as much as they can instead of fighting them as so many of the shop foremen and superintendents do?

There are many locomotives today in operation that ought to be tied up. This is not the fault of the government inspectors but of the men in charge of the shops and roundhouses.

I am a master boilermaker and was discharged once by a shop superintendent because I would not violate the Federal laws. At that time the superintendent wanted me to put flues into a boiler without first scaling and inspecting the interior of the boiler; he also did not want me to remove all of the flexible staybolt caps.

Think of it! A shop superintendent wanted the inspector to hold up his right hand and take an oath that an internal inspection of the boiler had been made and that all braces were thoroughly inspected and found in good condition and that all of the flexible staybolt caps had been removed—which was all false.

Pittsburg, Kansas. A. WENDT.

Statements Concerning Repair Records

A WORD of commendation is due to Mr. A. Wendt for his remarks pertaining to locomotive repair records as given in the March issue of THE BOILER MAKER. Without question it is the purpose of the editor to give us all the information he can possibly gather regarding the boiler industry, leaving it to us as readers and boiler makers to form our own opinions and to compare the given information with what we know to be possible from our own actual experience.

We are told that "comparisons are odious"; they certainly can be, in many cases, manifestly unfair. Some years ago while employed on one of the large eastern trunk lines, which edited and distributed to all employees a monthly magazine devoted to the happenings in general on that road, a great amount of space was given to the telling of a repair record made on one particular engine in one of its large shops. Repairs included renewal of all flues, new ash pan applied, all grates and bearing bars removed for repairs to mud-ring corners, removal of drivers to lathe for turning up of tires, all broken and defective staybolts renewed, in fact all repairs that would be covered by a Class 4 repair. From the commencement of repair operations until the engine was fired up and on the turntable ready to take out its train the time was given as a few minutes over 13 hours.

As you may imagine, there was a great patting of backs and a regular chorus of "I told you so's" and the fellows in the other shops were made to feel like back-numbers. But, the writer who happened to be at that particular shop at that time, on special assignment and a few others who were on the inside, could tell a different story and, as Mr. Wendt says, to those who understand, such statements as to records mean nothing.

When statements are made as to rapidity in performing different operations, we must, in order to satisfy ourselves as to their accuracy, analyze such statements. If we wish to know what a certain fluid or substance is composed of, we don't go to a peddler or an umbrella-mender for an analysis, we would go to a chemist or one well versed in operations necessary to determine the component parts of such a fluid or substance. In doing this they have recourse to certain factors with which there can be no compromise. Therefore, we must refer to the two great factors in locomotive repair work, time and conditions, or, as it might be better expressed, time and facilities. Reduce all operations to terms, say of minutes, yes, even seconds, it's an interesting study and most of the conclusions you will arrive at will compel you to give the laugh to the majority of such statements.

Lorain, Ohio. JOSEPH SMITH.

Giving the Boiler a Rest

A FEW years ago I overheard a conversation between the station agent of a small western town and an "engineering expert" with reference to a boiler that had been held in the station for a considerable period of time. The railroad company was holding it because of an unpaid freight charge and the owner complained that the boiler was being ruined because of its exposure to the atmosphere. The agent said to the "expert," "Now, you are an engineer, Jim, and you ought to know. Is that boiler being ruined in the least because it isn't being used?" To which Jim replied, without a second's hesitation, "It isn't bein' hurt a bit." That was the very answer the agent wanted, being loyal to the company by which he was employed, and with a wave of finality, said, "That settles it."

However, in spite of this engineer's verdict an idle boiler is liable to be *ruined more quickly* than is one that is in daily use, especially if it has not been "laid up" properly. This deterioration itself may not seem to be serious, but corrosion in the atmosphere due to alternate wetting and drying is most rapid and in parts of the boiler will eat its way into the inner fibers to such an extent that when put back in use the deep corrosion will cause weakness and perhaps trouble.

LAYING UP BOILERS PROPERLY

When laying up a boiler for several months' time the interior should first be thoroughly cleaned. It should be scaled, washed, scraped, wire-brushed and cleaned to perfection. It pays to spend considerable time at this work to do it properly, even though it may seem to cost more than an average cleaning. The cost will be more than returned with the increased life of the boiler. And after the boiler is thoroughly cleaned it must be thoroughly dried. This drying may be done in various ways, but about the easiest way is to heat the boiler carefully by means of an external fire just sufficiently to drive off all of the water or moisture in the form of steam and vapor. Then close all valves and small openings tightly so that no air can get in and before closing the manhole place several trays of unslacked lime in various parts of the shell.

Unslacked lime has *a powerful affinity* for moisture and should any happen to leak through the valves or other chance openings it would be absorbed by the lime before it would attack the metal of the shell. Lastly, close the manhole tightly and you can rest assured that there will be little danger of corrosion on the interior of the boiler for a good many months. Should the boiler be laid up for over six months it is well to examine the interior at the end of that time and if there is evidence of moisture by the lime having slacked either wholly or partially renew the lime, and if deemed wise give the exterior of the boiler another heating.

As for the outside of the boiler, that should also be treated with care, especially those parts that are liable to be attacked by moisture. It is easier to treat the outside with a protective paint or graphite mixture than to clean and dry the inside, therefore the outside is not so liable to suffer. We can always see the outside whereas the inside is hard to get at and is too often neglected.

The outside, therefore, should be protected with a paint or grease in order to keep the air off of the metal. Those parts that cannot be reached by a brush can very likely be reached by means of a spray or fine flushing stream of the treatment. If given proper care boilers are longer-lived than is generally supposed.

At the same time that the boiler is being laid up it is a good plan to treat the working parts of all valves connected with the boiler with a graphite or other greasy solution in order that corrosion will not set in and in order that the valves will operate easily when the time comes to put the boiler back into service. It does not take long to treat a valve with graphite, but it does take a long time to put a bad valve back into a good working condition.

Newark, N. J. W. F. Schaphorst.

Why Are Copper Ferrules Used in Boiler Tubes?

SOME few days ago while discussing the case of a stationary boiler, the flues of which had been giving considerable trouble through leaking, the writer made the statement that conditions would not have been so bad had copper ferrules been applied with the flues, which was met with the remark that copper ferrules made no difference one way or another that they were used primarily as a protection to the flue in rolling.

Copper, as is well known, has a higher range of ductility than any other metal used in mechanical lines and in tenacity is exceeded only by the better grades of iron. In sheet form it gives a more equal distribution of contraction and expansion stresses than any other metal. Leaky flues are caused mainly by too sudden changes of temperature in the firebox induced by the too powerful and too frequent use of the blower at the ashpit and in the roundhouse.

Under these conditions, the copper ferrule comes into its own. We confess it does not entirely eliminate trouble, but it surely stands in the position of a shock absorber or as we might say an equalizer, for then its natural properties are set in motion and a more even contraction is brought about, so that the trouble is not so great as it would be without ferrules.

We are told that flues in marine boilers are applied without ferrules and do not leak. I haven't any experience in marine work, so cannot verify that statement, but, if such is the case, where could we find a more ideal location for a boiler than in the hold of a vessel as far as temperature conditions are concerned?

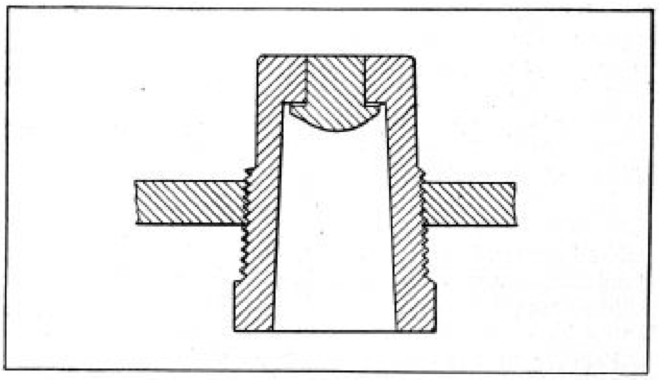
It is the writer's contention that, given a greater circulation area around each and every flue (flues are spaced too close in most boilers), and ferrules applied without being rolled to death (they should be applied with straight expanders), then flues swaged to fit the copper easily, the careful use of the prosser expander in setting the flue, and a light rolling after beading, this with proper handling of the boiler will go far toward eliminating some of our flue trouble.

Jersey City, N. J. Leonard Stanley.

The Operation of Fusible Plugs in Locomotive Boilers

I AM prompted to write this article from a safety first standpoint after reading the twelfth annual report of the chief inspector of the Bureau of Locomotive Inspection to the Interstate Commerce Commission.

During the past fiscal year there were fifty-seven boiler explosions which resulted in the death of forty-one persons and the serious injury of eighty-eight others—an increase of seventy-five percent in the number of such explosions, eighty-six percent in the number of persons killed and ninety-three percent in the number injured as compared with the preceding year. Most of these explosions were caused by the crown sheet having become overheated due to low water in the boiler.



Special Fusible Plug to Prevent Crown Sheet Failures

This does not look very good to the average boiler foreman or the supervisors who have charge of these locomotives. Something should and must be done to prevent these disastrous boiler failures.

In this connection, I wish to relate some of my experiences with low water and the operation of fusible plugs in locomotive fireboxes. On this division, which is the longest and steepest of any railroad in the United States, there are 61 heavy Mallet type locomotives in operation, 16 Mikado type, 2-8-2's, in passenger service with numerous other small engines of Consolidation type, etc.

The following paragraphs describe the fusible plug used in the fireboxes of all the locomotives on this division and the standard for the Southern Pacific Company in all the locomotives on their lines.

Description of Plug

In the accompanying drawing is a vertical central section through the plug as fixed in operative position in the crown sheet of a steam boiler.

This provides a collapsible plug comprising:

First, a hollow or tubular body, which is open at its lower end and closed at its upper end, except as to a central opening, and is provided with an external screw thread throughout a portion of its length, by which it is connected to a corresponding internal screw thread, tapped in a hole which is drilled in the crown sheet, of a locomotive or other steam boiler, to receive the plug.

Second, a disk or plate, usually made of brass, which is of less diameter than the bore of the body, and is located therein adjacent to its top. The disk closes the opening in the top of the body, and is provided with a central boss or projection, on its top, fitting neatly in the opening and extending a sufficient distance to be substantially flush with the upper surface of the top of the body, so as to prevent the opening from becoming choked by deposits of scale.

Third, a seal, of tin or other metal, fusible at a comparatively low temperature, which is interposed between the inner surface of the top of the body and the top of the disk, and serves to connect the parts by being fused thereto. The seal, being entirely separated from the space above the crown sheet, is exempt from liability to become corroded and is also protected from the direct action of the heat in the firebox, without which protection the fusing properties of the plug would be so impaired as to destroy its reliability in time of need.

The fusible metal forming the seal between the plug and the button is composed of 8 parts of lead to 1 part of tin. Hole in plug and sides of button are first tinned with pure tin, before the button is put in the plug. The above composition, 8 of lead and 1 of tin, melts or fuses at approximately 525 degrees F.

This fusible plug has prevented many accidents and serious boiler failures. In the past seven years there has never been an overheated crown sheet on this division due to low water as this fusible plug puts out the fire before overheating occurs. The fusible plug is located in the crown sheet directly over the burner. When the water gets down to the plug, the button blows out and steam and water strike the burner, putting the fire out. The engine dies very shortly. The engineer has to answer for bad engine failure instead of answering to someone above.

Disasters Avoided by Use of Plug

Not long ago two Mikado type engines were taking a heavy standard through-passenger train over the mountain. When within about twelve miles of the summit, the fusible plug button blew out due to low water. One engine died. The first engine put the dead engine on the siding; a light engine at the station was coupled in with but twenty minutes' delay. The dead engine was pulled into the terminal, inspection made of the boiler and it was found that the crown sheet had not been scorched. The fusible plug was renewed and the brick work repaired in the bottom of the fire pan where the steam and water out of the fusible plug had made a hole in the brick. The engine was back on the regular run the next day and was ready for service four hours after arriving in the roundhouse.

Compare the above case of low water with plates one, two and three on pages 96 and 97 of the Twelfth Annual Report of the Chief Inspector, Bureau of Locomotive Inspection, Mr. A. G. Pack.

Another Example

On this division it requires two heavy Mallet type engines to move forty-five cars of fruit over the summit. These engines are taken out of the roundhouse by the hostler and the engine crews receive the engines at the house track. While looking around one of these Mallet engines, I noticed that the engine had a heavy fire and blower on rather strong but did not pay much attention as this is common when short of power during a busy season. I walked toward the roundhouse and, when about 60 feet from the engine, the fusible plug button blew out. This gave me a chance to make a personal observation of a case of low water. The fire was put out immediately and the water and steam was coming out of the front end of the fire pan.

It was impossible to get into the cab for some time on account of the steam coming out of the fire door. I could not learn how much steam the boiler had when the plug let go. The noise that the fusible plug made with the steam and water escaping could not but impress the practical man as to what a great safety device this fusible plug is. This engine was returned to the roundhouse, inspected and returned to service in five hours.

I have talked fusible plugs to quite a number of well posted men. Some think a fusible plug in a combustion chamber with the boiler equipped with brick arch using coal for fuel and stoker fired, would be of very little use because the exhaust is so strong that it would carry the steam and water from the fusible plug out through the flues and the fire door being closed the enginemen could not hear the plug when it let go.

I would suggest that the fusible plug be placed in the combustion chamber, one back of the brick arch and, if necessary, one in the back end of the firebox. If one of these plugs let go, no matter how hard the engine is being worked, the engine crew will soon know it, as no engine could live very long with two of them gone as the water, steam and soot would clog up the flues, the engine would smoke badly, would not steam and the engine crew would know something was wrong long before the crown sheet could get hot enough to let go.

Any safety device will be worthy of a trial after reading the Twelfth Annual Report.* One of these reports should reach every locomotive boiler foreman and he in turn should see that his assistants and boiler inspectors are made to realize that all federal boiler inspection rules are strictly lived up to in view of decreasing the number of failures.

One of the reasons why the Southern Pacific Company is so fortunate in not having any serious boiler failures for some time can be attributed to the use of this fusible plug herein described.

Roseville, Cal. H. A. Patrick.

*Sections of the Twelfth Annual Report of the Bureau of Locomotive Inspection, dealing with the boiler and appurtenances appear on page 7 and succeeding pages of the January issue of The Boiler Maker.

NEW BOOKS

Chemical Resistance of Engineering Materials. *By Marston Lovell Hamlin and Francis Mills Turner, Jr. Size, 6½ by 9¼ inches. Pages, 267. Illustrations, 21. Cloth binding. New York, 1923. The Chemical Catalog Company, Inc.*

During the years 1915 to 1918 when, under the stress of war conditions, engineers with no previous chemical experience were called upon to build chemical plants, they were greatly handicapped by the lack of necessary information in a readily accessible form. To correct this lack in the future, the authors have prepared this book with a three-fold object in view; to present the results of experiment and of general knowledge in a full but not exhaustive way and wherever possible to give quantitative data; to serve as a bibliography of the subject by referring specifically to all the sources of information utilized; to stimulate further research and study along this line by showing what parts of the field are incompletely covered and by suggesting ways of making results more generally comprehensible and hence more practically useful. Realizing the difficulties of covering as exhaustive a field of knowledge as this one, the authors have endeavored to make this volume representative rather than exhaustive and to outline methods of systematizing research along chemical lines. The contents covers a general plan of work, classes of materials and destructive reactions and analysis of the value of experimental results, the influence of agitation and electrolytic action, sulphuric acid and metals, other acids and metals, acids and non-metallic materials, bases and alkaline salts, neutral substances, selection of material for specific construction, concrete in chemical construction and an appendix containing tables of useful data.

A Century of Locomotive Building by Robert Stephenson & Company, 1823-1923. *By J. G. H. Warren. Published by Andrew Reid & Co., Ltd., Akenside Hill, New-Castle-upon-Tyne, England. 461 pages with over 300 illustrations from original portraits, documents, drawings, engravings, letters, etc., and several plates; size 8 inches by 11 inches. Bound in Cloth.*

Invariably the history of a great industry is the biography of great men. For this reason it is not strange that an account of a hundred years' growth and achievement in locomotive building by Robert Stephenson & Company should be principally an account of the life of George Stephenson and his son, Robert. Twenty-two of the thirty chapters are concerned with the development of the locomotive during the classical period, which may be said to have terminated at the death of Robert Stephenson.

The author has told the story in a commendable manner. Based on original documents still in the possession of the descendants of the two original partners, Edward Pease and George Stephenson, and illustrated with numerous reproductions in fac-simile of original manuscripts, he has produced a book that is intensely interesting. These have been supplemented by contemporary documents and drawings from English, French, German, Russian and American sources. Some of the most important are published in this book for the first time.

The greater part of the book deals with the evolution of the locomotive in its early stages. It brings out in a striking manner the influence that the roadway and track had on the mechanical development. The fact that the elder Stephenson made a remarkable record as a civil engineer and devoted a large part of his time to such work as the construction of the Liverpool and Manchester and various other lines, was given careful consideration by the author in showing the effect this training had on the early growth of the locomotive. It was George Stephenson who advocated the wrought iron rail in preference to cast iron in order to carry a heavier locomotive. The development of the "Rocket" and its success at the Rainhill trials is told in an interesting and instructive manner. That the work of the Stephensons was not without its trials and tribulations is well brought out in the account of the various controversies as to the relative merits of the different methods of locomotion advocated at that time.

The victory of the "Rocket" at these trials was a fortunate event, for it permitted further experimentation along the lines established by the winning locomotive. As it so happened, Robert Stephenson & Company was enabled to go ahead with considerable experimental work in which it tried out both the four- and six-wheel types and also conducted various performance tests to determine the drawbar pull and the cost of operation.

It is interesting to read of the period of separation of the American from the English design. A number of locomotives were shipped by Robert Stephenson & Company to America, the types following closely those that were being developed in England at that time. It was the result of a careful study of one of the first engines of the "Planet" type sent to America that Matthias W. Baldwin built the locomotive known as "Old Ironside." The unfavorable conditions under which locomotives were required to operate in this country soon led to the development of the engine truck and cow catcher. Cast iron wheels were substituted for the wooden ones and cast iron crank axles were found to give excellent service. Regulator and steam pipes were fitted outside the boiler and a bell was also added to the equipment.

The book contains a wealth of information not only to the general reader and student of railway history, but also to the designer of locomotives, who may learn many things from the original working drawings that are reproduced.

New Boiler Laws for New York State

(Continued from page 104)

by the Industrial Commissioner. Internal inspection fees are raised from $5 to $6 and the amount for which each boiler may be liable, for a year from $7 to $8. Every insurance company making an inspection of a steam boiler as required by this section is required to forward together with the report of inspection a fee of one dollar for each boiler inspected to compensate for the certificate of boiler inspection which shall be issued by the commissioner. A fee of $10 is to be charged by the commissioner for each boiler completely inspected by the department during the course of construction when such boilers are manufactured within the state of New York. The boiler owner or lessee allowing, permitting or suffering its use when in an unsafe or dangerous condition shall be subject to a fine of $50 for each day on which it is used after receipt of the notice.

The provisions of this section do not apply to cities where inspectors operate under the authority of local laws and the like.

The Legal Problem of What Constitutes "Doing Business"

(Continued from page 100)

The Attorney-General of North Carolina in his biennial report for 1915 says:

> "A corporation manufacturing towers, tanks and other goods outside of the state and which, in addition to selling such goods in the state undertakes the work of erecting them or superintending their erection is 'doing business' so as to require compliance with the statute."

In conclusion it might be said that in many contracts or agreements involving installations, it is possible to separate the interstate commerce transaction, that is, the part covering the shipment and delivery to the purchaser, from the part of the contract involving the installation. In other words the one is not dependent on the other. Where this can be done the corporation is "doing business" in the state by making the installation. But if from the very nature of the article the installation is an essential requisite to the sale, that is—the sale could not have been made without it, or the installation is of such delicate or complex nature that it requires expert service from the seller, the corporation is not "doing business" in the state by making the installation.

Standards Adopted by American Boiler Manufacturers' Association

(Continued from page 109)

retort underfeed stokers come to a point 6 feet above the boiler room floor line (regardless of whether stokers are set on or below the boiler room floor line), the American Boiler Manufacturers Association voted to carry their boiler fronts down to a point 6 feet above the boiler room floor line. When stoker fronts of side feed and chain grate stokers come higher than 6 feet above the floor line, boiler manufacturers will bring boiler fronts down to meet the stoker fronts.

Draft Over Fire

It was voted that the draft over the fire should be taken as follows: On horizontal watertube boilers, midway between the heating surface of the boiler and the grate surface of the stoker. On vertical and semi-vertical water tube boilers, at a point midway between the inside face of the front wall and the front face of the bridge wall on a line with the top of the bridge wall. And that the draft at this point is to be not less than .15 in. suction.

Hot Springs, June, 1923, p. 46.

Heating Surface and Horse Power Ratings of Boilers

Voted that all specifications and other data pertaining to the surface of "boiler horsepower" be specified both on a square-feet-of-heating-surface basis and also on a horsepower basis, and that preference be given to the square-feet-of-heating-surface basis if any preference be given.

Voted that for all types of boilers, ten (10) square feet of heating surface constitute a horsepower.

Voted that heating surface shall be calculated in the manner outlined in the A. S. M. E. Power Test Code, which reads as follows:

"Heating surface for boilers comprises the total area of surface in actual contact with hot gas and below the normal water level of the boiler, provided the heating surface comprises a part of the circulation system of the boiler proper. If any such surface is not in the boiler circulation system and is not connected to the steam space of the boiler, it is to be considered as preheater or integral economizer surface, and not as boiler heating surface. Superheater surface is the total area of all surface in contact with the hot gases. Superheater boiler and preheater surfaces should be separately stated. Since the gas side of the surface offers the controlling resistance to heat transmission, the surface will be figured on the outside diameter of the tubes for watertube boilers, and on the inside diameter for fire tube boilers."

The committee brought out that the A. S. M. E. Power Test Code specifically states that superheating surface, boiler heating surface and pre-heating surface should be separately stated, and it was voted that in all specifications this rule be followed.

Attention was called to the fact that in calculating heating the surface of water tube boilers, the outside diameter of the tubes should be used, and for fire tube boilers the inside diameter of the tubes.

Voted that for plain vertical fire tube boilers, the rule be adopted that in calculating the heating surface of same, the normal water line or center of the gauge glass be taken as the top point of the heating surface, and that only such surface of the shell and tubes as is below the center line of the water glass be calculated as heating surface.

Voted that in calculating the heating surface of return tubular boilers, only one-half the circumference of the shell be calculated as heating surface on account of the brick walls closing in on the boiler at a point about half-way up on the shell. It was stated that some boiler builders calculate two-thirds of the shell as heating surface.

Hot Springs, June, 1923, p. 41

BUSINESS NOTES

Frederic E. Wright has joined the sales department of the International Oxygen Company, Newark, N. J.

Leroy Beardsley, treasurer of the Chicago Pneumatic Tool Company from 1898 to 1918, died on March 5, at Riverside, Ill.

The Cleveland office of the Simmons-Boardman Publishing Company, publishers of The Boiler Maker and other railroad and marine papers, has been moved from 4300 Euclid avenue to new quarters at 6007 Euclid avenue.

The Pittsburgh, Pa., office of the Niles-Bement-Pond Company has been removed from 425 Seventh avenue to 503 Liberty avenue.

The Chicago Pneumatic Tool Company will construct a three-story, 45 feet by 126 feet extension to its plant at Cleveland, Ohio.

A. F. Stiglmeier has resigned his position as general boiler foreman of the B. & O., Mt. Clair shops, to accept a like position with the New York Central R. R. at West Albany, N. Y.

The Galt Machine & Screw Co., Limited, Galt, Ontario, Canada, has been recapitalized under dominion charter for $500,000 and has taken over and will continue to operate on a much larger scale the business formerly carried on by the Galt Machine & Screw Co., Limited.

TRADE PUBLICATIONS

Wires and Cables.—Both railroad and power installations of Okonite wires and cables are shown in an illustrated booklet recently issued by the Okonite Company, Passaic, N. J.

Industrial Furnaces.—Stewart furnaces, capable of handling any class of work in heat treating, are described in an illustrated folder recently issued by the Chicago Flexible Shaft Company, Chicago.

Grinding Machines.—A general description of the Gisholt internal and link grinder for railroad work, also a description of the link grinding attachment, is contained in a four-page folder issued by the Gisholt Machine Company, Madison, Wis.

Flexible Metal Hose.—The American Metal Hose Company, Waterbury, Conn., has issued a 24-page brochure descriptive of its flexible metal hose, which is especially adapted for conveying steam and oils and for numerous other special purposes.

Bent-Tube Boilers.—The Heine Boiler Company, St. Louis, Mo., has issued an attractive bulletin describing the Heine V-type Bent-Tube Boiler. The general design, circulation characteristics, detail of construction, supports, trimmings, etc., of this boiler are outlined and illustrated. Details of several installations are also given.

Standardization.—The American Engineering Standards Committee, New York, has just issued an interesting booklet entitled, "Standardization—what it is doing for industry." This describes how standardization is being carried on; first, in the individual plant; second, in industry as a whole; third, nationally on an inter-industrial basis, and, fourth, internationally.

Power Pipe Machine.—The "Willie Williams," a new portable pipe threading, cutting-off and reaming machine, is fully described and illustrated in a catalogue recently prepared by the Williams Tool Corporation, Erie, Pa. The machine is demountable, has a wide threading, cutting-off and reaming capacity, and has a handy self-contained grinder and three drives—motor, belt and hand.

Specifications for Lubricants. — Technical Paper 323-A, "United States Government specification for lubricants and liquid fuels and methods for testing," has just been issued by the Department of the Interior, through the Bureau of Mines, Washington, D. C. This specification, known as standard specification No. 2c, is a revision of the specification officially adopted by the Federal Specifications Board on February 3, 1922, for the use of the departments and independent establishments of the government in the purchase of materials covered by it.

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—George Uhler, Washington, D. C.

Deputy Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law Society

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—John A. Stevens, Lowell, Mass.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 West 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—J. F. Scott, Trenton, N. J.

Secretary-Treasurer—C. O. Myers, State House, Columbus, Ohio.

Vice-Chairman—R. L. Hemingway, San Francisco, Cal.

Statistician—W. E. Murray, Seattle, Wash.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

J. A. Frank, International President, suite 522, Brotherhood Block, Kansas City, Kansas.

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, suite 524, Brotherhood Block, Kansas City, Kansas.

H. J. Norton, International Vice-President, Alcazar Hotel, San Francisco, Calif.

International Vice-Presidents—Thomas Nolan, 700 Court St., Portsmouth, Va.; John Coots, 344 North Spring St., St. Louis, Mo.; M. A. Maher, 2001-20th St., Portsmouth, Ohio; E. J. Sheehan, 7826 South Shore Drive, Chicago, Ill.; John J. Dowd, 953 Avenue C, Bayonne, N. J.; R. C. McCutcheon, 15 La Salle Block, Winnipeg, Man., Can.; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; John F. Schmitt, 605 East 11th Ave., Columbus, Ohio.

Master Boiler Makers' Association

President—E. W. Young, mechanical assistant to G. S. M. P., C. M. & St. P. R. R., 787 Caledonia Place, Dubuque, Iowa.

First Vice-President—Frank Gray, tank foreman, C. & A. R. R., 705 W. Mulberry Street, Bloomington, Ill.

Second Vice-President—T. F. Powers, System G. F. Boiler Dept., C. & N. W. R. R., 1129 S. Clarence Avenue, Oak Park, Ill.

Third Vice-President—J. F. Raps, G. B. I., I. C. R. R., 4041 Ellis Avenue, Chicago, Ill.

Fourth Vice-President—W. J. Murphy, G. F. B. M., Penn. R. R. Lines West, 3614 Mexico Street, N. S., Allegheny, Pa.

Fifth Vice-President—L. M. Stewart, G. B. I., At. Coast Lines, Box 660, Waycross, Ga.

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Treasurer—W. H. Laughridge, G. F. B. M., Hocking Valley R. R., 537 Linwood Avenue, Columbus, Ohio.

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Boiler Makers' Supply Men's Association

President—George R. Boyce, A. M. Castle Company, Chicago, Ill. Vice-President—J. P. Moses, Jos. T. Ryerson, Chicago, Ill. Secretary—W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

American Boiler Manufacturers' Association

President—E. R. Fish, Heine Boiler Company, St. Louis, Mo.

Vice-President—E. C. Fisher, The Wickes Boiler Company, Saginaw, Mich.

Secretary-Treasurer—H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

Executive Committee—George W. Bach, Union Iron Works, Erie, Pa.; G. S. Barnum, The Bigelow Company, New Haven, Conn.; F. G. Cox, Edge Moor Iron Company, Edge Moor, Del.; W. C. Connelly, D. Connelly Boiler Company, Cleveland, O.; W. A. Drake, The Brownell Company, Dayton, O.; A. R. Goldie, Goldie-McCulloch Company, Galt, Ont., Can.; J. F. Johnston, Johnston Brothers, Ferrysburg, Mich.; M. F. Moore, Kewanee Boiler Works, Kewanee, Ill., and A. G. Pratt, The Babcock & Wilcox Company, New York.

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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

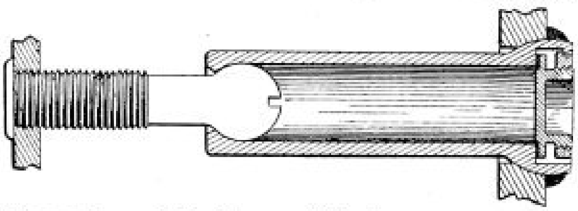
SELECTED BOILER PATENTS

Compiled by
GEORGE A. HUTCHINSON, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

1,475,474. STAYBOLT STRUCTURE. ETHAN I. DODDS, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PENNSYLVANIA.

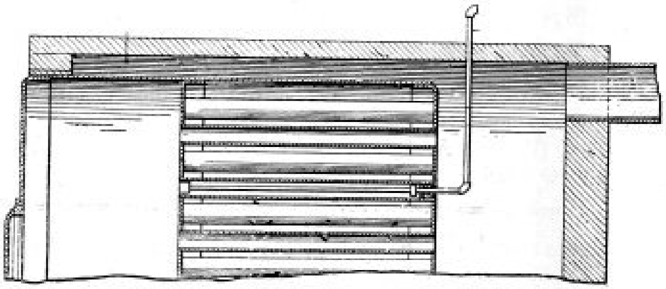
Claim.—In a staybolt structure, the combination of a staybolt comprising a tubular member open at one end and having a rounded head at its open



end and a member provided with a rounded head at one end mounted in one end of said tubular member and having a threaded portion at its other end, and removable closure means for the outer end of the tubular bolt member. Four claims.

1,475,599. FUEL-SAVING DEVICE FOR FURNACES. NELSON J. RUSSELL, OF CHICAGO, ILLINOIS.

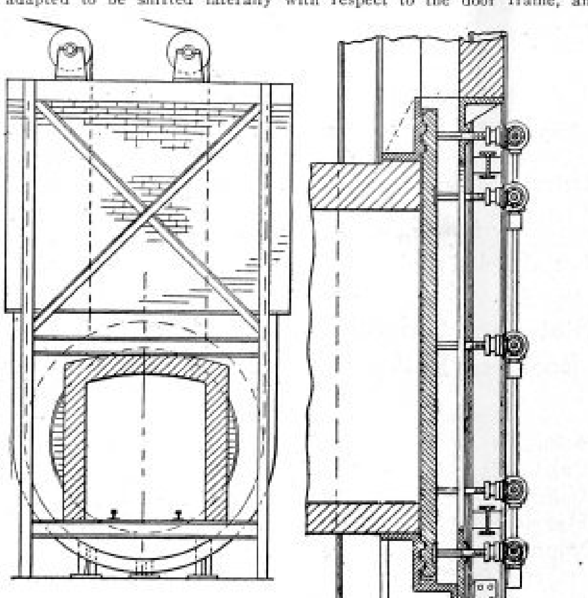
Claim.—In a device of the class described, the combination with a furnace having a firebox, of a conduit having one of its ends open and its other end closed, the open end of said conduit being adjacent the firebox, an air



intake pipe communicating at one of its ends with the conduit near its closed end and having its other end disposed for the intake of air, an apertured casing located in the conduit near its closed end in communication with said pipe, another casing located in the open end of the conduit and having means for discharging air forwardly therefrom, and a pipe connecting the said casings. Five claims.

1,475,731. DOOR AND DOOR-OPERATING MECHANISM FOR FURNACES AND THE LIKE. VICTOR WINDETT, OF CLEVELAND, OHIO, ASSIGNOR TO THE WELLMAN-SEAVER-MORGAN COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

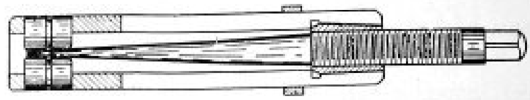
Claim.—The combination with a door frame of a furnace or the like, of a door adapted to be shifted laterally with respect to the door frame, and



a plurality of circumferentially spaced axially movable members engageable with the door for pressing the door against the frame, or for releasing the same. Ten claims.

1,473,884. EXPANDING DEVICE FOR BOILER TUBES AND THE LIKE. PAUL SLESAZECK, OF BERLIN-REINICKENDORF, GERMANY.

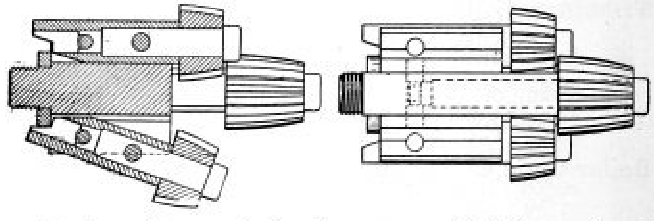
Claim.—A device for expanding heating tubes in boiler walls, comprising in combination a casing resiliently split in its longitudinal direction, rollers



mounted in said casing so as to be radially movable and adapted to be pressed against the tube wall in order to expand the same, a conically-shaped mandrel adapted to engage between said rollers and having external screw threads and a nut engaging with said screw threads and being frictionally surrounded by said casing. Four claims.

1,472,255. CUTTER HEAD FOR TUBE CLEANERS. HARRISON L. STALEY, OF MARTINSVILLE, INDIANA, ASSIGNOR TO THE ROTO COMPANY OF HARTFORD, CONNECTICUT, A CORPORATION OF CONNECTICUT.

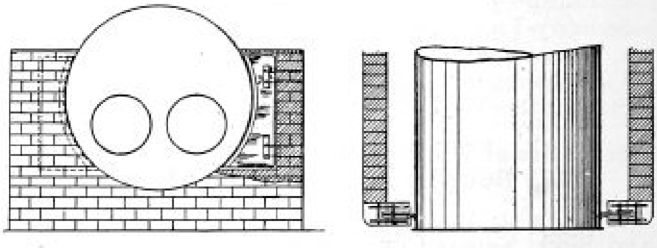
Claim.—A tube cleaner cutter head comprising a body having longitudinally extending grooves, arms pivotally held in said grooves, cutter bolts



extending into said arms and adapted to engage and hold the arm pivots in position, pins extending through the arms and bolts for holding the latter in position, and adjustable means on the head for engaging and preventing the arms from swinging out sufficiently far to carry the bolt pins beyond the walls of the grooves supporting the arms. Five claims.

1,476,236. SETTING OF STEAM BOILERS. GEORGE HARLAND BOWDEN, OF WESTMINSTER, LONDON, ENGLAND.

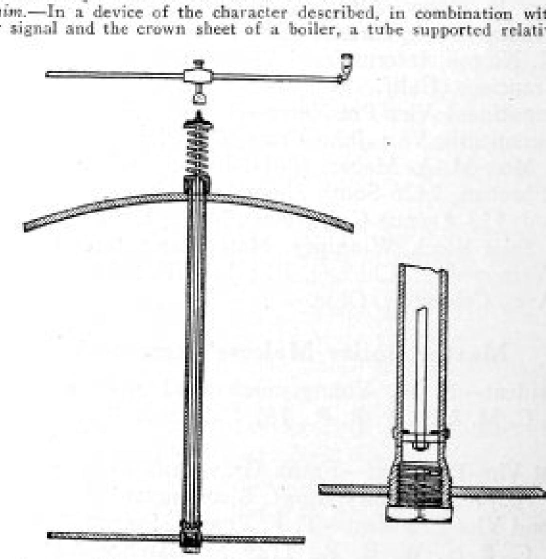
Claim.—In an expansion joint for a steam boiler the combination with a plate affixed to the boiler of supporting brickwork a groove formed therein,



longitudinal reinforcing members disposed at either side of the groove, transverse reinforcing members disposed behind the groove and transverse reinforcing members passing through the groove and through apertures in the plate.

1,471,564. LOW WATER ALARM FOR STEAM BOILERS. WILLIAM A. McKEOWN, OF COLUMBUS, OHIO.

Claim.—In a device of the character described, in combination with a low-water signal and the crown sheet of a boiler, a tube supported relative to the



crown sheet, a shaft supported in said tube and operably connected to the signal, means to operate said shaft, a fusible element secured to the shaft, a stop secured in the tube adjacent the fusible element and normally co-operating therewith to prevent operation of said shaft, said fusible element having clearance providing for movement of said shaft relative to the stop in one direction and portions adapted to engage the stop to prevent movement of the shaft in the opposite direction.

THE BOILER MAKER

MAY, 1924

Building the Longest Locomotive Boilers in the World

C. and O. Simple Mallet Locomotives Built by Alco Works at Schenectady Have Boilers 57 Feet in Length

NEW and heavier motive power demands special features of design and construction, as evidenced in the case of the boilers recently built by the American Locomotive Company for an order of 25 simple 2-8-8-2 Mallet locomotives for the Chesapeake and Ohio Railroad. This company has for a number of years operated 235 Alco built 2-6-6-2 type Mallets, so that when the need for heavier power arose on the Alleghany section of the road for handling heavy freight over the mountains, it was decided to adopt a simple Mallet of a heavier type which would conform to the clearance limits of the tunnels in that region. In meeting the limitations imposed, the American Locomotive Company has produced a single expansion articulated type locomotive that, from the standpoint of boiler features, is unique both in size and in the number of methods that were developed during the process of construction to bring the finished locomotive up to the requirements and still produce the power demanded.

General information concerning the locomotive and tender is given in tabulated form in a later section of this article.

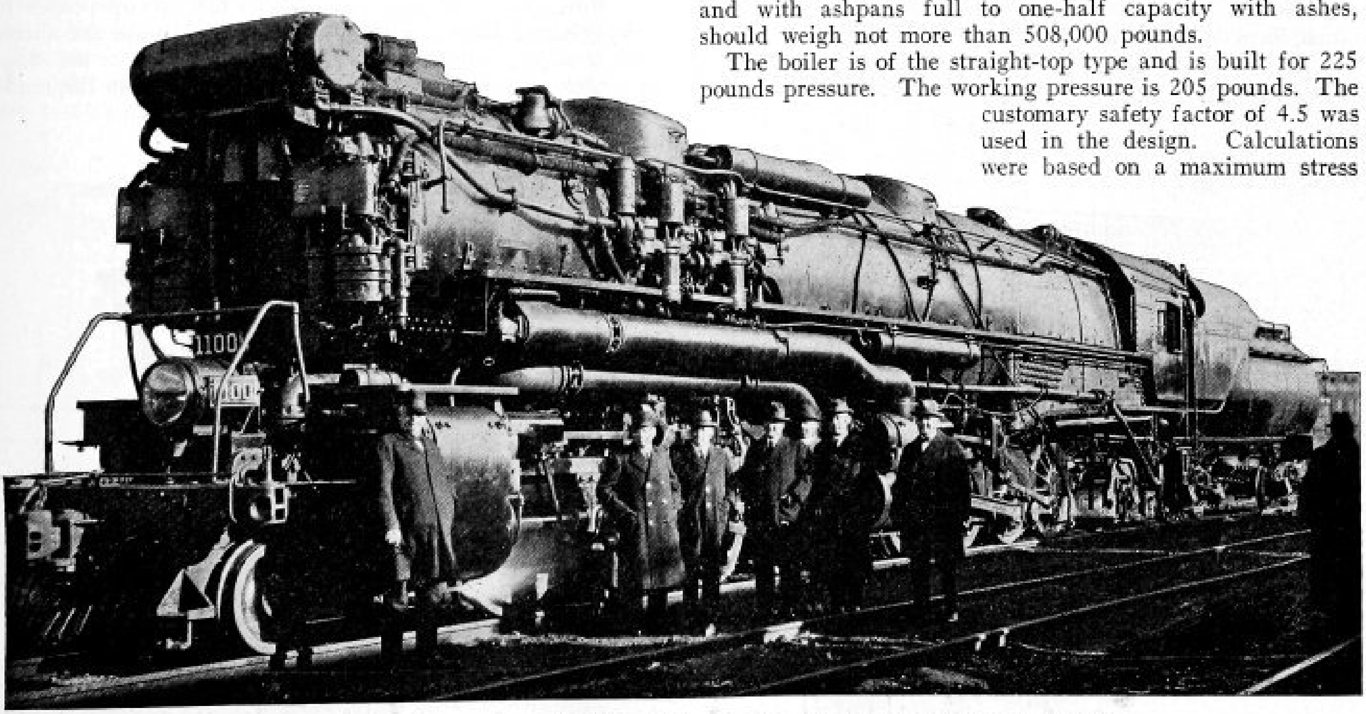
Before going into the specific features of the construction of this boiler some of the quantities of material that entered its fabrication and the size and weight of parts will be of interest.

The boiler has a length overall of 56 feet 11⅛ inches and is made in five courses and a smokebox. The firebox proper is 248⅛ inches by 96¼ inches and a combustion chamber 69 inches long. The mudring, which is 18 feet long, is one of the largest ever installed in a locomotive boiler.

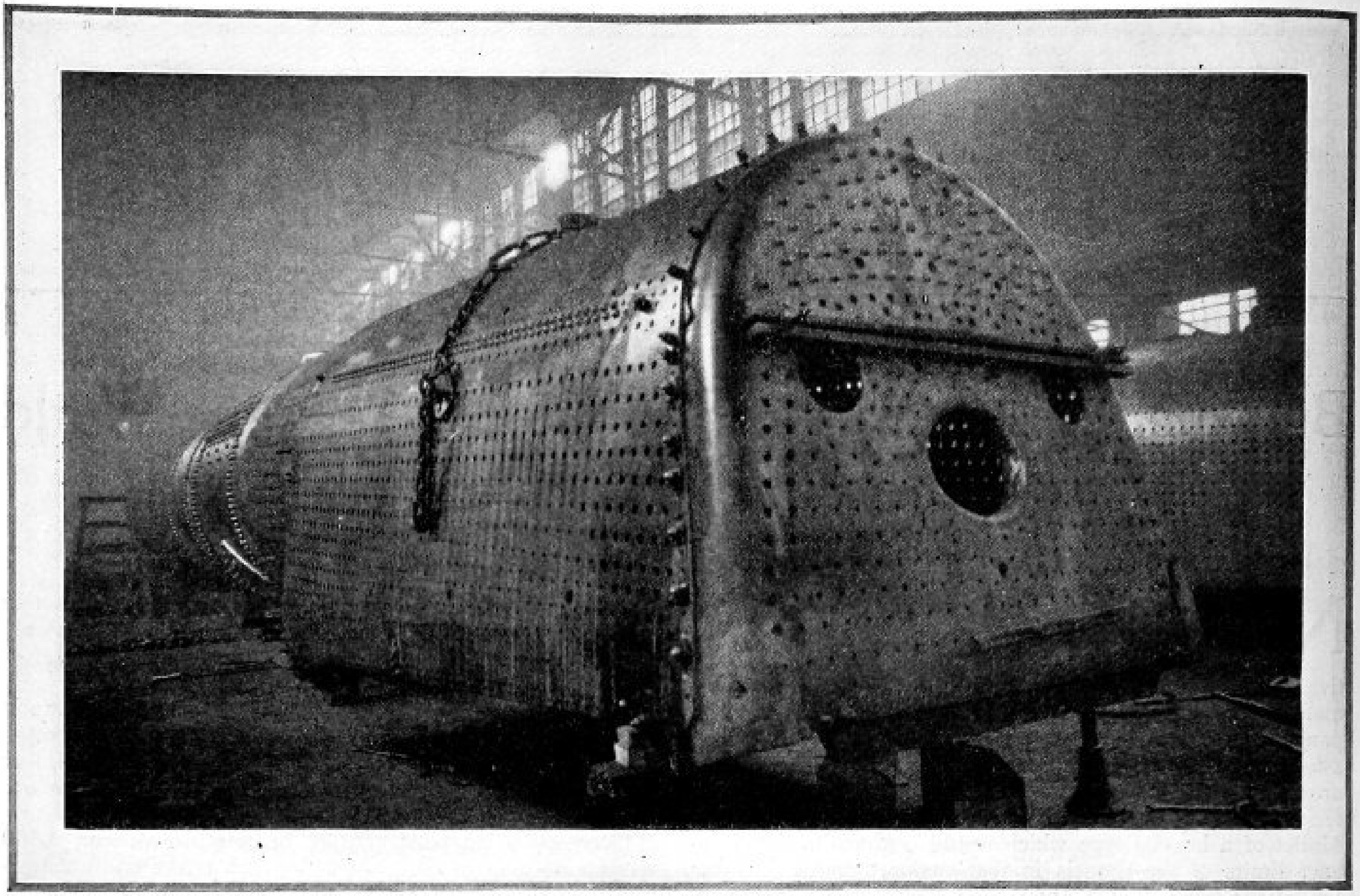
Over 4,000 staybolts, 17,000 flexible sleeves and 3,500 rivets were used in the construction. A rather odd arrangement is the dome which is only 5½ inches high, being limited to this dimension because of the tunnel clearance requirements.

Without flues, or tubes, the boiler weighs 98,000 pounds and with these installed, 129,000 pounds. When ready for the riveting tower without the backhead firebox or bracing, it weighed 67,000 pounds. The weight requirements of the railroad company governing the order were that the engine in working order with three gages of water in the boiler, a full fire on the grates, sand boxes filled, complete equipment and with ashpans full to one-half capacity with ashes, should weigh not more than 508,000 pounds.

The boiler is of the straight-top type and is built for 225 pounds pressure. The working pressure is 205 pounds. The customary safety factor of 4.5 was used in the design. Calculations were based on a maximum stress



Officials of the Chesapeake and Ohio Railroad Inspecting One of the New Mallets



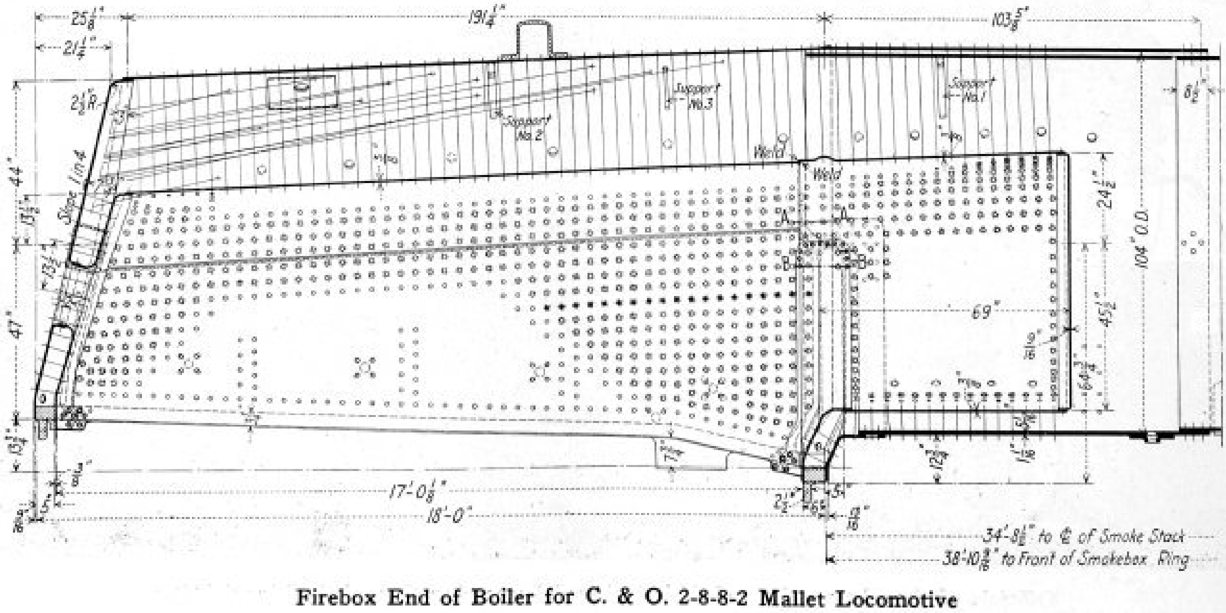
Fitting Up the Door Sheet

on stays of 7,500 pounds and 9,000 pounds on braces, using a steam pressure of 225 pounds. At the throat the outside diameter is 104 inches and at the smokebox 93⅞ inches.

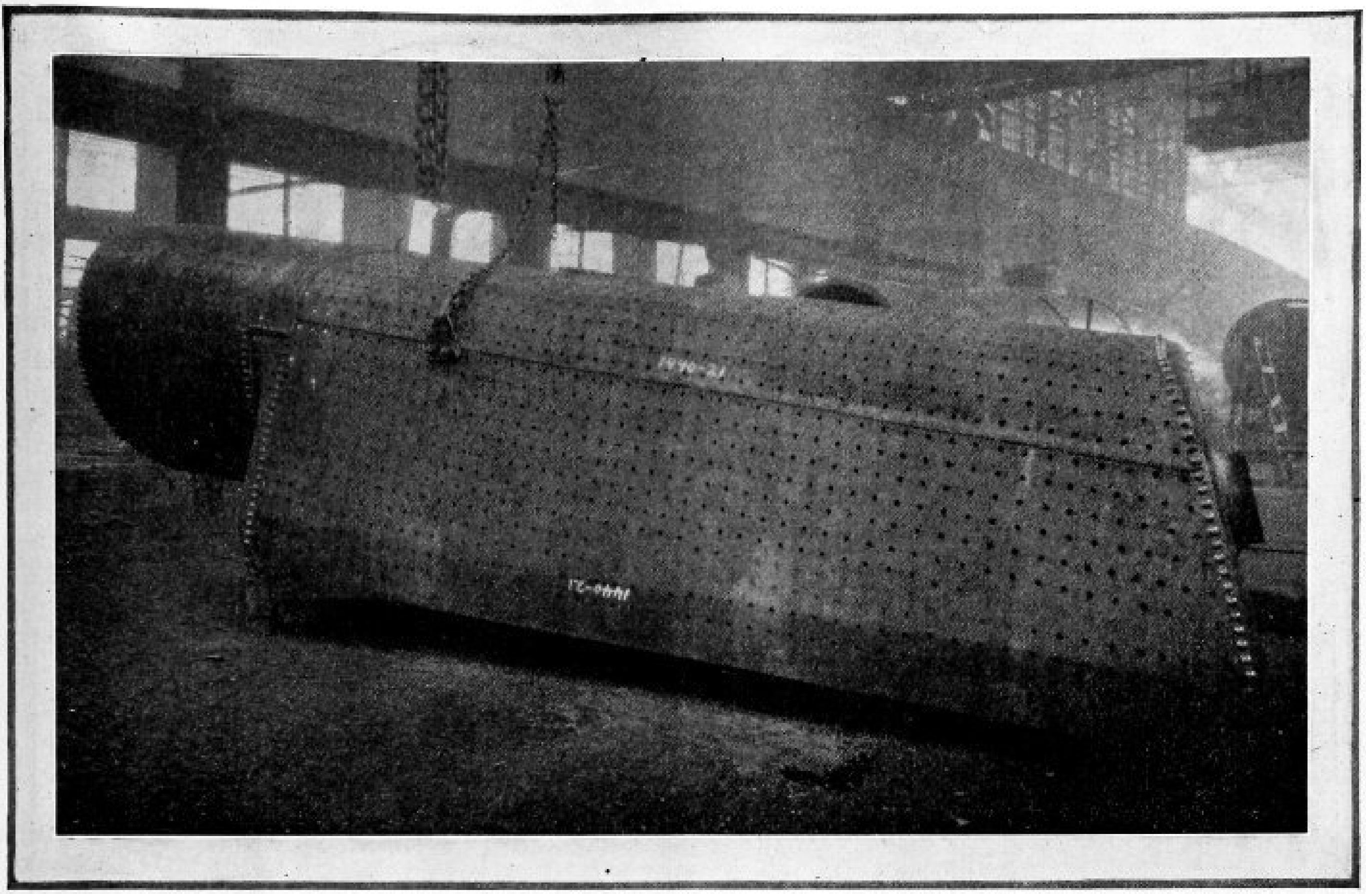
The sheets making up the shell, the firebox and heads vary in thickness; the front tube sheet, for example, being ¾ inch, the first and second courses 15/16 inch, the third and fourth 1 inch and the fifth 1 1/16 inches, the roof ¾ inch, the sides 9/16 inch, the throat 13/16 inch and the back head 9/16 inch. The roof and sides are in three pieces. All horizontal seams in the shell are joined with inside and outside welt straps multiple riveted. The circumferential seams of the barrel and throat are double riveted lap joints.

Firebox Construction

The firebox in this boiler is of special interest because of its size and the great amount of electric welding used in its fabrication. As previously noted, the firebox proper is 204⅛ inches long and 96¼ inches wide inside the sheets with a water space at the front of 6 inches and at the sides and back of 5 inches. This width increases from the mud-



Firebox End of Boiler for C. & O. 2-8-8-2 Mallet Locomotive



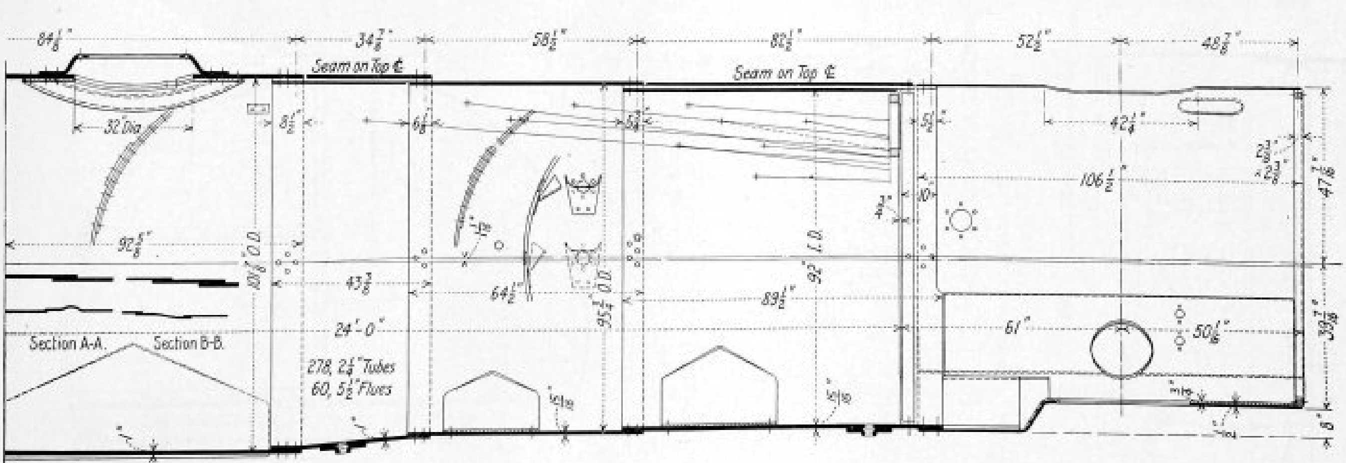
The Welded Seams Are Here Shown to Advantage

ring up to secure good circulation and to permit the installation of long staybolts. The crown sheet, side sheets and back sheet are all of ⅜-inch steel while the tube sheet is 9/16-inch the inside throat ½-inch and combustion chamber ⅜-inch thick. The combustion chamber, 69 inches long, is in one piece.

On account of the extreme length of the firebox, a stiffener in the form of a corrugated plate is applied at the top of the inside throat sheet to assist in caring for expansion and contraction stresses. The corrugated portion of the plate is supported by a row of stays at its center. The edge of this plate is lapped over the firebox sheet and welded at the top and down the sides as far as the throat connection.

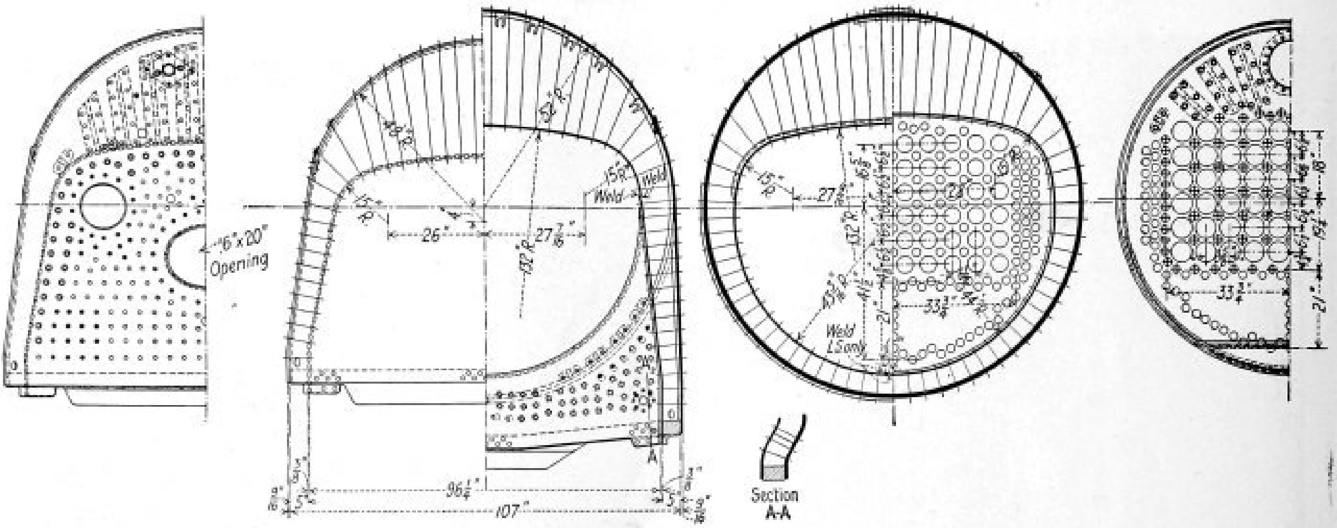
The horizontal seams where the firebox crown and side sheets meet are ½-inch lap joints electrically welded both on the fire and water sides, the sheets being beveled ⅛ inch before welding to conform to the C. and O. standard. All rivet holes in flanges and firebox sheets were drilled or punched ¼-inch small and reamed out to size. Firebox and tube sheet rivets are crown countersunk. The rivet holes in the firebox were half countersunk on the fire side only and the rivets driven from the inside.

In the case of this boiler, the oval fire hole, measuring 16 inches by 20 inches, has a riveted lap seam instead of a welded connection. The braces used in the boiler are of the Alco weldless type. The inside throat sheet is scarfed at the top and the riveted seam is sealed by means of electric welding both inside and out.

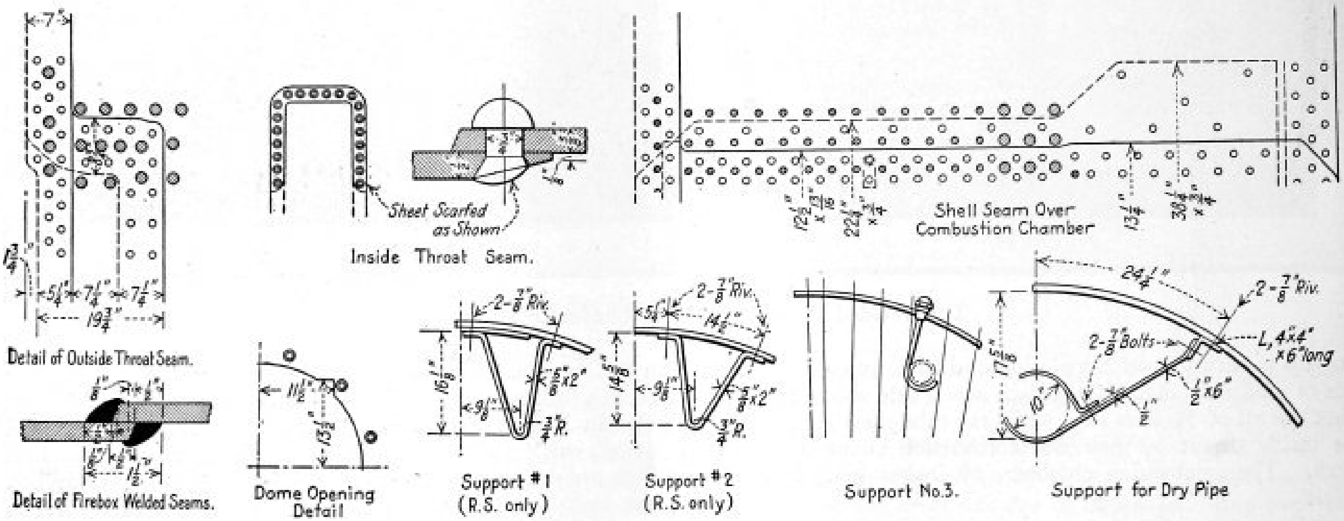


Front End of Boiler for C. & O. 2-8-8-2 Mallet Locomotive

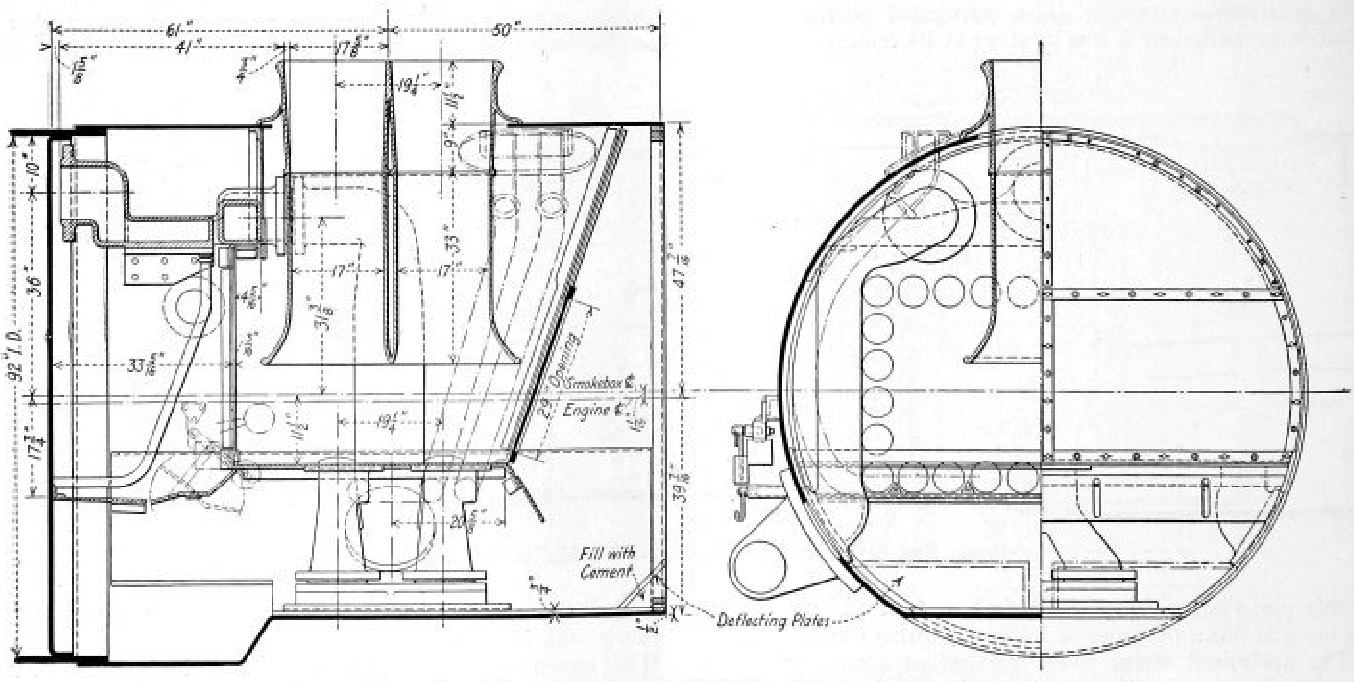
The crown sheet is supported by radial stays screwed through the crown and shell, the 10 central rows having a



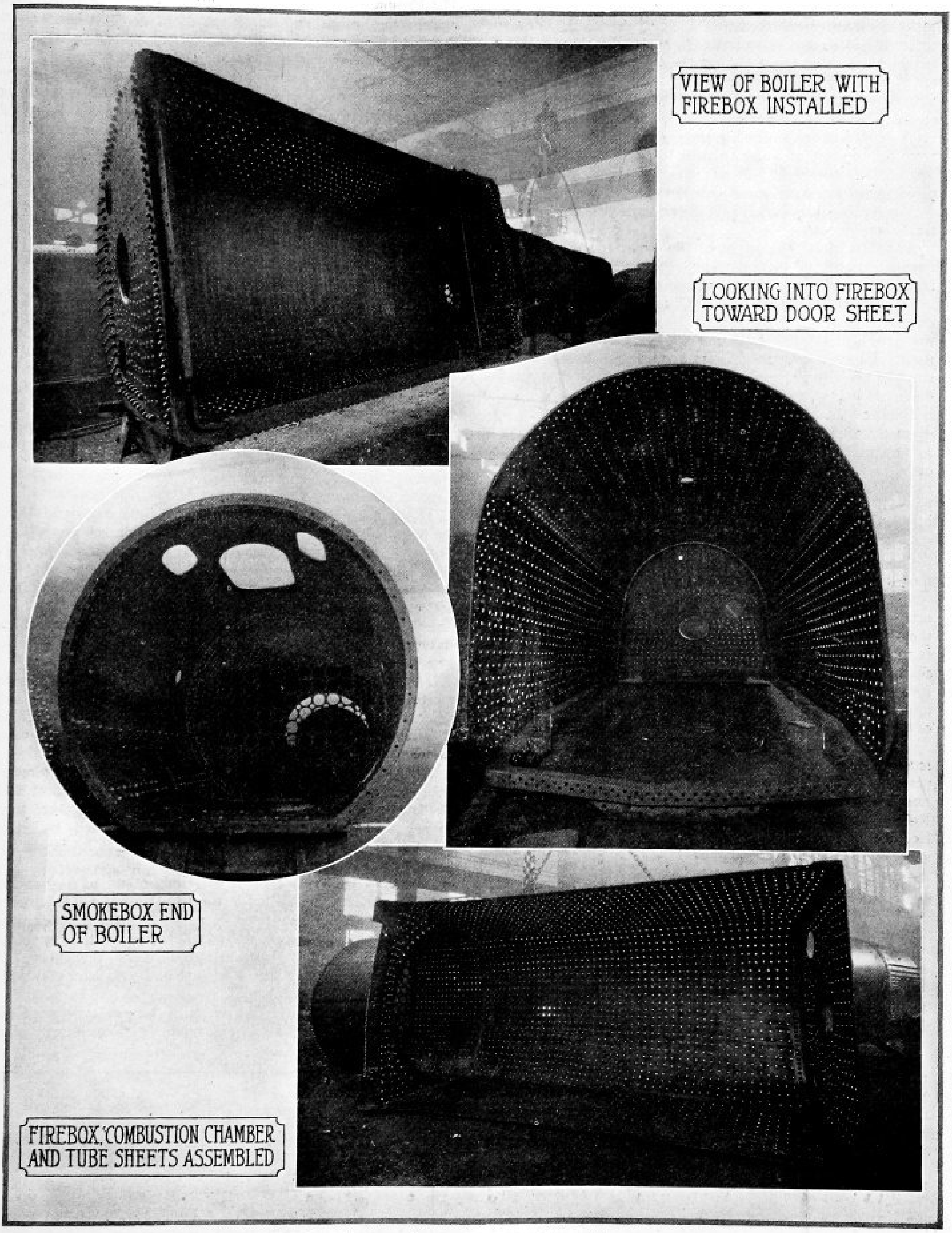
Back Head and Cross-Sections of the C. & O. Mallet Boiler



Boiler Details



Smoke Box Construction Showing Design of Double Stack, One for Each Engine Unit



These Views Taken at Various Stages of the Construction Indicate the Great Size of the Boilers and the Amount of Work Involved in Building Them

2-inch taper in 12 inches, the body of the bolt being 13/16 inch in diameter enlarged to 1 inch at the shell. The first three rows of crown stays from the back tube sheet are of the flexible expansion type of Alco design, 15/16 inch in diameter expanded to 1 inch at the shell. All flat sheets are stayed with 1 inch rigid staybolts spaced 4 inches on centers. The staybolt holes are all reamed to size. Nineteen flush flexible staybolt sleeves are applied in the eighth horizontal row down from the top row of water space bolts at the front of the firebox on both the right and left sides. Flexible stays are applied in the breaking zones as follows:

A complete installation in the combustion chamber, except the 9 bottom rows.

Approximately 50 percent of the water space stays in the firebox located in the breaking zone, except the expansion stays. The number of these was limited to 1,750.

In spite of the fact that the C. and O. railroad specified extensive welding in the construction of the firebox, there is not a welded sleeve in the boilers—only screw sleeves being used. However, where a full thread was not insured for a staybolt because of the slope of the sheets bosses were welded, 46 in all being fitted.

Back of the expansion row, the radial stays have a body diameter of 13/16 inch with straight ends, top and bottom, 1 inch in diameter. Crown stays are riveted over at both ends. C. and O. standard requirements for telltale holes are that all rigid staybolts less than 8 inches in length must have 7/32 inch holes drilled in the outer end at least 1¼-inch deep. In cases where the thickness of the material through which the outer end of the bolt passes exceeds ⅞-inch, the depth of the hole is increased to at least ⅜ inch more than the thickness of the plate.

Since these boilers are at present equipped with the Gaines arch—with the intention of sometime in the future equipping them with arch tubes, a full installation of hollow staybolts is made behind the brick arches and grate side bars so that the monthly staybolt inspection might be facilitated. Hollow bolts are also applied behind the grate shaker fulcrums and the stoker distributors as well as in the 9 bottom rows of the combustion chamber.

The materials used in the boiler include boiler steel and smokebox furnished by the Lukens Steel Company; firebox plates, Otis acid steel; cold drawn seamless steel tubes, Pittsburgh Steel Products Company; rigid water space stays, Rome Iron; flexible water space stays, made by the American Locomotive Company of Rome Iron; hollow staybolts, Ryerson; rigid crown stays, Rome Iron; flexible crown stays, American Locomotive Company of Rome Iron; braces, Logan Iron; throat sheet staybolts, Rome Iron. Victor rivets were also used.

Expansion plates are fitted at the front end of the firebox, at the rear and under the arch support.

Bronze wearing plates are secured to the boiler bearing sliding plates by patch bolts.

Grates

The grate is 168 inches by 96½ inches with an area of 112.29 square feet. The side grate bearing is fitted tight against the firebox end, to prevent shifting, lugs are cast on the grate side bars which fit over special supports. In order to permit the removal of stays, the tops of the grate bars have been kept below the bottom line of staybolts. The ends of the side frames are cut away to facilitate calking the mudring corners. Wherever possible the grate rigging pins are applied from the inside so that the pin keys are visible for inspection.

Arrangement of Saddle Liner

A 1-inch saddle liner is fitted to the third course to provide a reinforcement for the high pressure cylinder saddle. This liner is fastened to the boiler with 1¼-inch rivets. To insure tightness and provide accessibility for mounting the saddle, the work has to be done before the tubes are installed. Taper fit bolts are used to bolt the saddle to the boiler.

It might be well to mention at this point that in order to insure the correct length of tubes being fitted where there might be a slight variation in distance between the front and back tube sheets, top and bottom, the tubes were all cut to length and fitted in the boiler before it was sent to the erecting shop. The tube sheets were divided into four sections and marked, the tubes for each section then being cut and marked to correspond with that section. When finally assembled in the boiler, the tubes were placed in the same section they were originally cut for.

Tube Specifications

The standard flue practice of the Chesapeake and Ohio Railroad was followed on this order. The tubes are of cold drawn seamless steel. Two hundred and seventy-eight 2¼-inch outside diameter tubes 0.125-inch thick and 24 feet long over sheets being applied with a spacing of ¾-inch between flues.

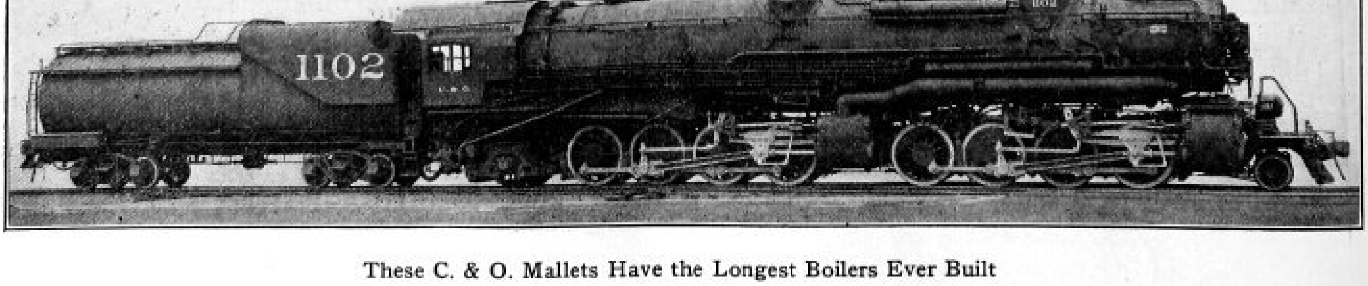
For superheater flues, 60 cold drawn seamless steel tubes having an outside diameter of 5½ inches, 0.150-inch thick, were installed.

The tubes were swedged at the firebox end to 2⅛ inches, to receive seamless drawn copper ferrules 0.065-inch thick and ⅝-inch wide, these ferrules of course only being applied to the back sheet and rolled in place before the tubes were inserted.

Holes in the flue sheet were punched to 1-inch diameter and pin drilled to 2¼ inches in the firebox flue sheet and 2 5/16 inches in the front tube sheet. The tubes were then forced tight against the firebox tube sheet, rolled, belled to 45 degrees, prossered and beaded. All tubes were electrically welded at the firebox end.

The flues were swedged at the firebox end to 4½ inches outside diameter and belled at the front end to 5 9/16 inches diameter. Seamless copper ferrules 1/16-inch thick and ⅝-inch wide were applied and the same rolling, beading, swedging and welding process used as on the tubes. A standard tube beading tool was used and a 4½-inch by 5½-inch superheater beading tool.

The ashpan is of the self-cleaning hopper type with the slide of cast steel. The pan is made of ¼-inch tank steel



These C. & O. Mallets Have the Longest Boilers Ever Built plates, well braced to the frame. The air space is equal to 90 percent of the flue and tube area. Provision has been made in the construction and location of the pan to dismantle it without removing the trailer wheels. It is also equipped with a sprinkler for washing down the sides when the engine is in motion.

The smokebox is of the flat bottom type with a double stack, one for each engine unit. The smokebox front is equipped with Okadee front end hinges and arranged to carry two 8½-inch cross compound air compressors. This front is in three sections, the top portion being bolted solidly to the smokebox to allow for the application of the feed-water heater. A long vertical opening between the air pumps is left for access to the front end.

Accessories and Fittings

All engines are equipped with Elseco feed water heaters. Hancock "K" type non-lifting injectors, having a capacity of 9,000 gallons per hour, are also fitted. The superheater is of the Superheater Company's type "A" with a superheating surface of 1,885 square feet which is sufficient to give about 200 degrees F. superheat when the boiler is working at 205 pounds pressure.

In addition to the usual washout plug installation, arrangement has been made for three washout plugs in the bottom of the first course, third course and fifth course. In the combustion chamber, two plugs of the railroad company's standard are fitted right and left about 29 inches off center. These plugs are staggered. Still another standard plug is placed in the backhead below the fire door hole. Plugs are fitted in the sides of the firebox right and left near the mud-ring, which is back of the vertical combustion chamber wall.

A C. and O. standard brass water column is installed on the right side of the backhead with the low connection direct to the boiler. The top connection of the column is through a ½-inch copper pipe direct to the steam space.

Two water gages are fitted in the right side of the cab and one on the left. These are applied to register the same level as the gage cocks under the same operating conditions. Three gage cocks are arranged with cast iron drip pans and a 1-inch waste pipe. Two blow-off cocks are located in the throat sheet far enough from the center line so that they can be operated from the running board.

Testing the Boiler

Special care was taken in cleaning the boiler so that no chips or dirt remained in it when ready for service. It would seem to be self evident that this was necessary in the case of all boilers when ready to leave the shop, but experience has shown that careless inspectors will sometimes let an engine go out of the shop with all sorts of waste matter on top of the firebox and rather serious results have sometimes occurred from no other cause than this.

The water test was made with warm water at a pressure one-third in excess of the working pressure to insure tightness of all seams.

The steam pressure test given was 20 percent in excess of the working pressure. In raising the steam to this pressure, the boilers were given 2½ hours to heat, any calking necessary being done during this time. After reaching the maximum, the pressure was reduced to 50 percent of the working pressure and then again raised 20 percent in excess to insure tightness under the most severe temperature changes.

These locomotives since they have been on the road have given consistently good service and completely satisfied the officials of the C. and O. For really fine workmanship in every detail it would be difficult to find their superior in the line of boiler work. One particularly important feature is the entire interchangeability of parts—even to complete fireboxes. This will make the carrying of stock repair parts for this type an unusually simple matter and reduce the maintenance costs considerably.

General Details of Locomotives

Railroad	C. & O.
Builder	Amer. Loco. Co.
Type of locomotive	2-8-8-2 Simple
Service	Freight
4 Cylinders, diameter and stroke	23 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	12 in.
Weights in working order:	
On drivers	491,000 lb.
On front truck	32,000 lb.
On trailing truck	42,000 lb.
Total engine	565,000 lb.
Tender	210,000 lb.
Boiler:	
Type	Straight top
Steam pressure	205 lb.
Fuel	Bituminous coal
Diameter, first ring, inside	92 in.
Firebox, length and width	204⅛ in. by 96¼ in.
Height mud ring to crown sheet, back	60½ in.
Height mud ring to crown sheet, front	89¼ in.
Combustion chamber length	69 in.
Tubes, number and diameter	278—2¼ in.
Flues, number and diameter	60–5½ in.
Length over tube sheets	24 ft.
Grate area 169 in. by 96¼ in.	112.9 sq. ft.
Heating surfaces:	
Firebox and comb. chamber	467 sq. ft.
Tubes	3,912 sq. ft.
Flues	2,064 sq. ft.
Total evaporative	6,443 sq. ft.
Superheating	1,885 sq. ft.
Comb. evaporative and superheating	8,328 sq. ft.
Tender:	
Style	Cylindrical
Water capacity	12,000 gal.
Coal capacity	15 tons
Trucks	Four-wheel
General data estimated:	
Rated tractive force, 85 per cent	103,500 lb.
Cylinder horsepower (Cole)	3,902 hp.
Boiler horsepower (Cole) (est.)	3,677 hp.
Speed at 1,000 ft. piston speed	31.8 m.p.h.
Steam required per hour	81,162 lb.
Boiler evaporative capacity per hour	76,472 lb.
Coal required per hour, total	12,682 lb.
Coal rate per sq. ft. grate per hour	112.9 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	86.9
Weight on drivers ÷ tractive force	4.91
Total weight engine ÷ cylinder hp	147.1
Total weight engine ÷ boiler hp	156.1
Total weight engine ÷ comb. heat. surface	67.9
Boiler proportions:	
Boiler hp. ÷ cylinder hp., per cent	94.2
Comb. heat surface ÷ cylinder hp	2.13
Tractive force ÷ comb. heat. surface	12.42
Tractive force × dia. drivers ÷ comb. heat. surface	708
Cylinder hp. ÷ grate area	34.5
Firebox heat. surface ÷ grate area	4.40
Firebox heat. surface, per cent of evap. heat. surface	7.72
Superheat surface, per cent of evap. heat. surface	29.25

Use of Lap Welded or Seamless Flues in Marine Boilers

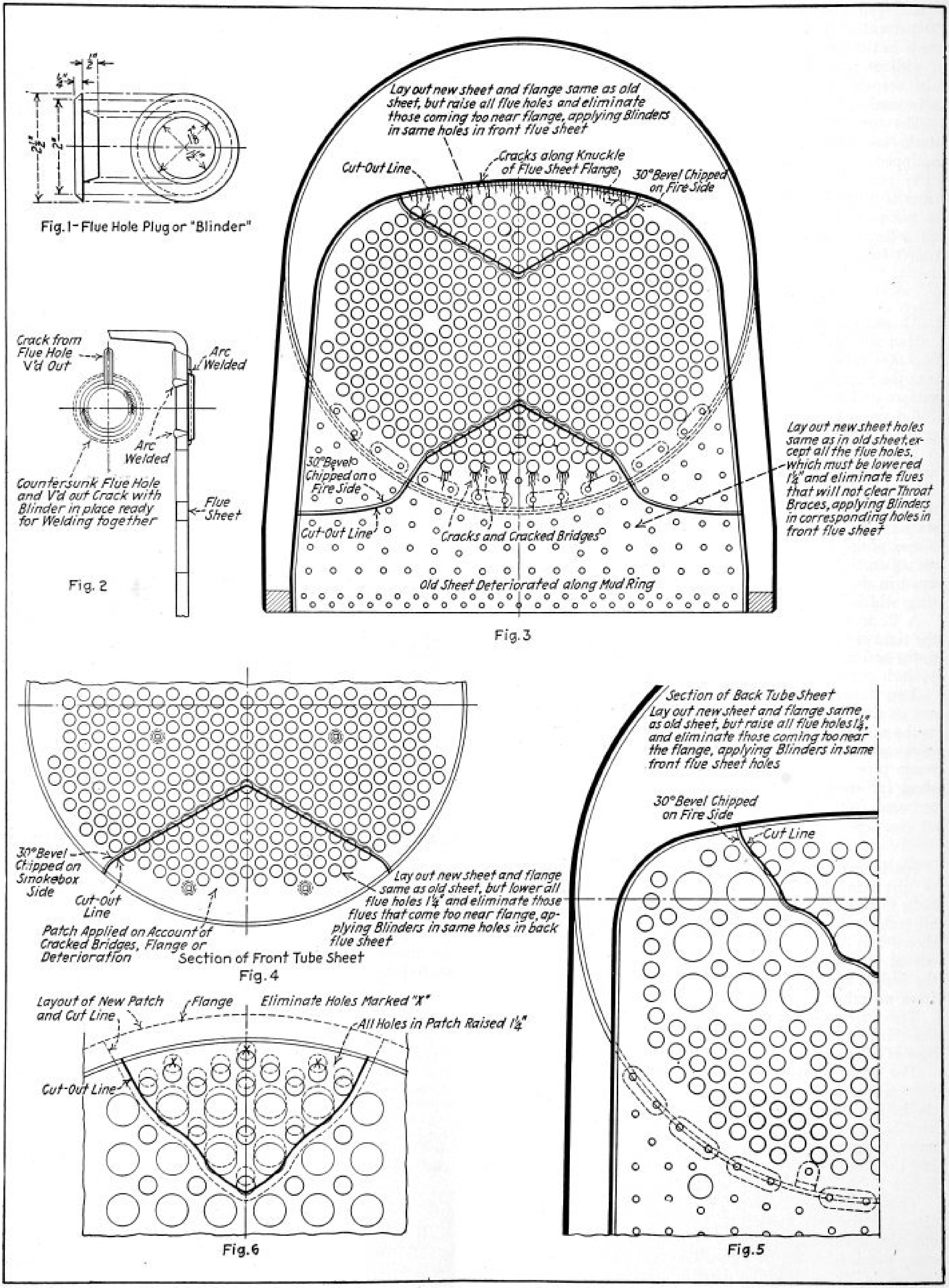
THE thirty-fourth supplement to the General Rules and Regulations of the United States Department of Commerce, Steamboat Inspection Service, contains an amendment to Rule II dealing with boilers and attachments as follows:

Rule II.—Boilers and Attachments

Lapwelded or seamless flues in externally fired boilers

The next to the last paragraph of section 14, Rule II, all classes of the rules, was amended as follows:

When lapwelded or seamless flues over 5 inches in diameter are used in externally fired boilers over 20 feet in length, they may be allowed to be made in two pieces (1) joined together by a standard screw-pipe coupling or sleeve, or (2) *by swelling the end of one section of the flue sufficiently to permit it to lap over the other section not less than 4 inches and be double riveted, or* (3) *by butting the two sections of the flue together and fitting a band or butt strap not less than 8 inches in length equally divided over the joint of the two sections, and of a thickness not less than the thickness of the flue, and double riveted to each section.* When *any of the above methods are* used on more than one flue in the boiler, the couplings or sleeves shall not be allowed to come opposite, and the distance measured between any such flues and between any such flues and the shell shall be made by measuring between the plates in the flues and the plates in the shell. It shall be the duty of the inspectors to see that the flues are well screwed into the couplings or sleeves so as to have the ends of flues as near together as is practicable.



Flue "Blinders" or Plugs and Methods of Welding Patches to Tube Sheets

Flue Holes and Patches

Methods of Installing Flue "Blinders" with the Welding Process and Flue Sheet Patches

By T. P. Tulin

THERE are a number of railroads in this country that follow the practice of applying flue pockets, "blind flues," in their boilers when necessity arises to cut out the regular flue and in a number of instances where no such necessity exists.

This practice has been serving its purpose with more or less efficient results, but now is gradually becoming obsolete due to several methods of substituting autogenous welding, which are promising to be more successful and safe.

It is but several months ago that an accident occurred in the state of Oklahoma on one of our largest railroads due to a flue pocket blowing out of its hole while making the first regular trip after receiving class 3 general overhauling repairs.

To overcome any such further dangers, a simple method is outlined which provides a clear-cut job and leaves no doubt in the mind of the foreman as to its safety.

As nearly 95 percent of the shops are equipped with autogenous welding apparatus by means of which this device is applied, it is the belief of the writer that most of the roads will consider the adoption of this method as standard practice. In its favor are simplicity in production, application and no maintenance cost.

How to Make the Flue Plug

Fig. 1 illustrates the flue hole plug or "blinder" as I would call it, which is turned out on a machine lathe in quantity numbers from soft steel, round bar material. It can also be turned from scrap shearings of ¾-inch thick flange steel, but this method is not as productive as the former.

Cracks that develop from the flue holes towards the knuckle of the flue sheet flange are V'd out on the firebox side of the sheet and the flue hole countersunk, the scale removed from around the hole and the crack on the water side of the sheet to receive the seat of the blinder, and to afford a good contact for the arc in the welding. The blinder is then set in place from the water side, as shown, and tack welded in several places. Weld the crack and blinder fast in the firebox; also a single ring of weld around the blinder on the water side, and at the same time cover the crack weld with one layer to insure a tight job. The same should be done with the flue hole in the opposite flue sheet unless the flue hole is redrilled in the blinder and the flue applied.

Type Patches to Use

When these blinder applications reach the number allowed in any locality beyond the limit of the safe stress of that unsupported area, a patch as illustrated in Figs. 3, 4 and 6 shows the modern practice application with good results. The application of this patch can be made for other defects such as enlarged flue holes, numerous cracks at the knuckle of the flange, shortage of calking edge, etc.

When the cracks develop at the bottom flue holes, either in the front or back flue sheets, the procedure should be followed as outlined in Fig. 2. If the application of these blinders becomes too numerous and the holes are not redrilled for reapplication of the flues to support the excessive unsupported area, patches should be applied as shown in Figs. 3 and 4.

If a crack develops leading from any flue hole and gives trouble to the extent that it needs repairs and has to be carried out in the roundhouse as an emergency job, the same manner of application will govern as outlined in Fig. 2, with the exception of the water side detail. Here the blinder edges have to be cut off on two sides for entry into the flue hole from the firebox or smokebox side (whichever the case may be).

For the upper portion of the back flue sheets the patch flange and cut line are laid out the same as the piece that is removed, allowing for edge trimming during the fitting process, *but all the flue holes are raised 1¼ inches* and the holes that would come too near to the knuckle of the flange are eliminated and blinders applied correspondingly in flue holes in the front flue sheet.

Renewing Bottom Half of Flue Sheet

When the bottom half of the back flue sheet needs renewal the layout is the same as the piece that is removed, *but the flue holes dropped 1¼ inches,* and those holes eliminated that would not give flue clearance due to a throat brace obstruction, in which case, blinders are applied correspondingly in the flue holes in the front flue sheet.

The feature of this method of patching the flue sheets prevents the necessity of cutting the flue holes in the line of the patch weld. This would weaken the weld by expanding and working the flues, thereby tending to part the bridges, all of which are left after the flue holes are cut in.

These methods are also applicable to the flue sheets that have superheater flue holes by following the same procedure as outlined, with the cut-out patch line made as shown in Figs. 5 and 6.

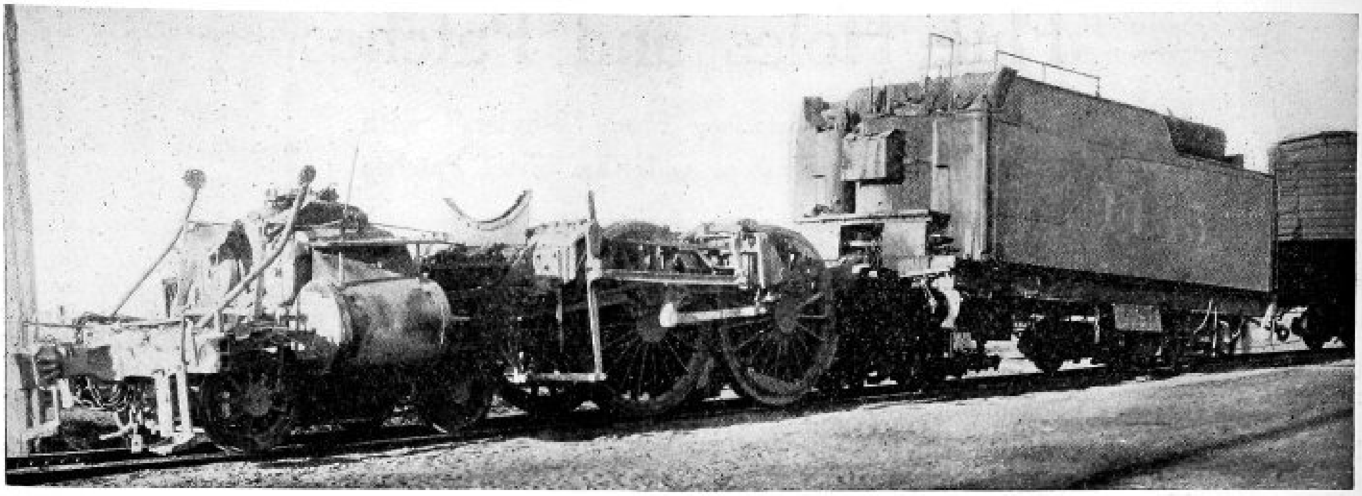
After the patch is cut out of the flue sheets, the remaining edges of the bridges and the flue holes that were cut through are chipped to a 30-degree angle ready for receiving the new patch, which should be chipped to the same angle allowing about ⅛-inch opening for welding. The patch should be welded up to the knuckle of the flange first and then the welding finished after the flange is laid up and the rivets driven, giving one layer of weld on the water side if possible. While calking the rivets and seams the welding should be lightly bobbed.

A permanent job is also secured where two blinders are applied to two adjacent flue holes between which a cracked bridge is V'd out and arc welded together, then the flue holes are redrilled and the flues reapplied.

Locomotive Shipments in March

The Department of Commerce has prepared the following table of shipments of locomotives in March.

Locomotives	Shipments			Unfilled orders		
Year and month	Total	Domestic	Foreign	Total	Domestic	Foreign
1923						
January	229	217	12	1,788	1,699	89
February	207	196	11	2,220	2,141	79
March	282	269	13	2,316	2,214	102
April	217	201	16	2,204	2,111	93
May	238	228	10	2,150	2,045	105
June	232	221	11	1,958	1,854	104
July	239	211	28	1,738	1,652	86
August	272	259	13	1,497	1,406	91
September	335	313	22	1,178	1,102	76
October	310	295	15	977	915	62
November	299	270	29	691	656	35
December	329	305	24	387	365	22
1924						
January	151	147	4	376	344	32
February	99	92	7	499	466	33
March	132	128	4	534	494	40



Appearance of Trucks and Tender After Explosion

Low Water Causes Fatal Crown Sheet Explosion

Report of Bureau of Locomotive Inspection Investigation of A. T. and S. F. Locomotive 1455 Disaster in Which the Engineer and Fireman Were Killed

ON February 13 at 8:33 A.M. the crown sheet failed on A. T. and S. F. Locomotive 1455 while the engine was pulling westbound train No. 91. The accident which occurred near Lariat, Texas, resulted in the deaths of the engineer and fireman. At the official investigation which followed the disaster a great many officials of the road were present, including the general boiler inspector of the Santa Fe Lines, the general inspectors and assistants of the various divisions, master mechanics, division engineers and others. The federal inspector, who arrived about three hours after the explosion occurred, carried through a most complete investigation of this explosion, which was submitted to A. G. Pack, chief inspector of the Bureau of Locomotive Inspection. The most important sections of this official report are given below.

The explosion occurred at mile post 660:496 of the first district of the Slaton Division on a ten-foot fill at which point the track is tangent 0.4 of one percent grade ascending westbound. The force of the explosion tore the boiler from cylinders and frames, hurling it end over end through the air. The boiler first struck the ground, landing on the boiler head 371 feet forward and 21 feet to the left of the track, rebounded and made almost another complete turn before again striking the ground 79 feet beyond, landing on the wagon top and steam dome 447 feet forward.

The brakes applied in emergency at the time of the explosion due to the breaking of the train line. The head end of the train came to a stop 554 feet ahead of the point of explosion, so that the center of smoker car 873, the second car in the train, stood opposite the boiler.

The fireman was found dead 35 feet north and 27 feet to the right of the point of explosion. The engineer was found unconscious 93.5 feet west and 28 feet to the right. He died a few minutes later without regaining consciousness. The deaths of both were apparently due to the effects of the explosion.

Construction of Firebox

According to specifications the length of this firebox is 107 15/16 inches and width 66 inches, heating surface 190 square feet. Four arch tubes 3 inches in diameter are used. The height of the boiler head is 91⅜ inches and slopes forward 26½ inches. The crown sheet slopes so that the front center is two inches higher than the back center and is supported by forty 1 3/16-inch crownbolts and 248 radials pitched 4 inches by 4 inches and arranged in 24 transverse and 12 longitudinal rows. The crownbolts are located at the front end and are supported by two crown bars which in turn are suspended from Tee bars riveted to the roof sheet by four sling stays each. The radials are 1 3/16-inch diameter at the heads and reduced to 1 inch in center, threaded with Whitworth threads, 12 threads to the inch and tapered 1½ inches to the foot. The distance from the center line of the crown sheet to the center line of the roof sheet at the back end is 23⅝ inches, and at front end 21⅝ inches.

This firebox was originally of three-piece construction the crown and side sheets being of one-piece ⅜-inch steel, the door sheet of ⅜-inch steel and the flue sheet of ½-inch steel. With the exception of being patched as follows this was the original firebox that came with the locomotive: A patch thirty inches wide extended across the front part of the crown sheet and down the side sheets approximately 12 inches below the highest part of the crown sheet. The seam joining this patch to the crown and side sheets was electrically welded. The carrier records indicate that this crown sheet patch (No. 10744-24917-1) was applied at Clovis, N. Mex., December 21, 1921. A three-quarter firebox flue sheet was applied at Clovis, N. Mex., December 28, 1923, the lower seams of the flue sheet being electrically welded and the side sheet and crown sheet seams riveted. A patch approximately 20 inches wide and 26 inches long was electrically welded in at the bottom center of the right side sheet at the mud ring. Both front corners of the mud ring were patched. The seam joining the door sheet and crown sheet had the rivets removed at some time and was electrically welded.

Description of the Firebox After Explosion

The crown sheet tore along the calking edge of the riveted flue sheet seam shearing two rivets out of the flange of the flue sheet on the left side and one rivet out of the right side. The tear followed the calking edge of the flue sheet down into the side sheets across the lower welded seams of the crown sheet patch, from which point the sheets ripped diagonally downward and backward to the bottom rows of staybolts above the mud ring. As this rupture took place, the crown sheet together with the side sheets and the upper portion of the door sheet were practically inverted and folded back against the door sheet.

The crown sheet pulled away from 40 crownbolts and 247 radials, the left side sheet pulled away from 286 staybolts, the right side sheet pulled away from 268 staybolts and the top portion of the door sheet pulled away from 39 staybolts, the threads being stripped on all these bolts. The 11th radial from the flue sheet in the 6th row, right side of the center together with the adjacent short radial in the same transverse row were broken and remained in the firebox sheets. The ends were scaled over indicating that these bolts were broken prior to the explosion. In the left side sheet the 18th and 19th staybolts in the 3rd row from the top were fractured. These broke off and pulled with the sheet. The threads on the radials and staybolts also the threads in the firebox sheets were apparently in good condition prior to the explosion.

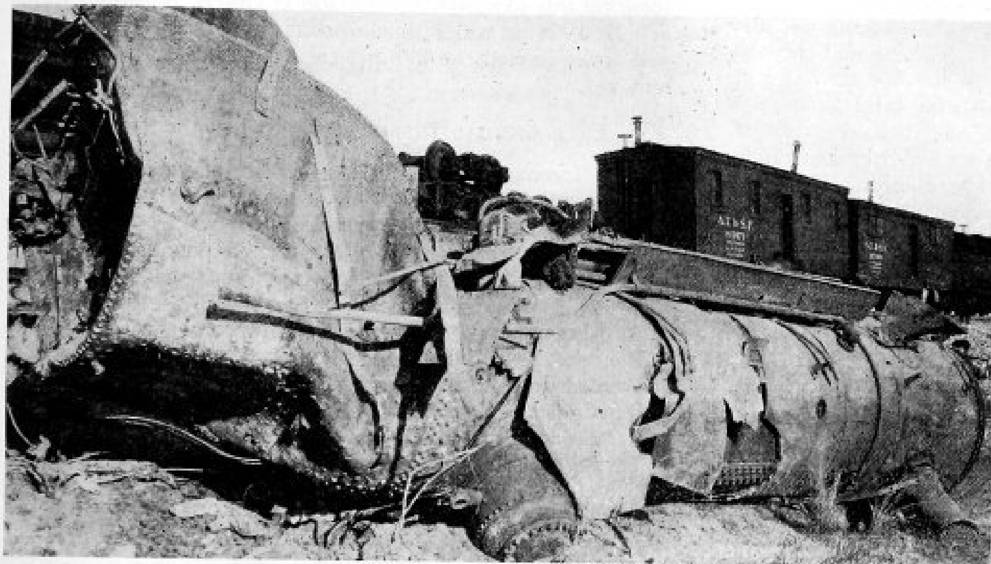
The entire front portion of the crown sheet extending down to the first short radial in the right side sheet and reaching back to the 23rd transverse row of radials converging to a width of only four longitudinal rows, taking in an area supported by 40 crownbolts and 150 radials the crown sheet was a strong blue color and showed every indication of having been overheated. The bolt holes in the overheated section were stretched approximately 1/16 inch larger than the original sizes. The heads on the radials corresponding with the overheated area were a strong blue color and were cupped. The back flue sheet top knuckle showed indications of overheating down to the top row of flues and the flue sheet knuckle had folded downward pulling away from the five flues in the top row and eight flues in the second row from the top.

The transverse welded seam of the crown sheet patch extending through the overheated section of the crown sheet held but through the short radius of the left side sheet this weld failed for a distance of 18 inches.

The weld seam between the door sheet and crown sheet held but the door sheet ripped open for a distance of 40 inches along the edge of the crown sheet lap due to corrosion on the water side of the sheet. Estimating from the specifications of this firebox with due allowances for the increased slope of the crown sheet due to this locomotive being on a 0.4 of 1 percent ascending grade would indicate that the back portion of the crown sheet together with the knuckle of the door sheet were above the waterline as measured on the front portion of the crown sheet, yet these parts showed no indications of overheating. This was apparently due to these parts being protected by the bank of water existing at the backhead and flowing over the back portion of the crown sheet caused by the rapid circulation of water upward along the sloping door sheet while generating steam under operating conditions.

The mudring was forced outward at the sides and was broken at the left front and right back corners. The wagon top was driven in about 26 inches and the backhead was driven in about 24 inches. This damage no doubt resulted from the boiler striking the ground after being blown from the frames and running gear.

There was one water glass tubular type located on left



The boiler as it landed 447 feet from point of explosion

The boiler was beyond all hope of reclamation side of boiler head. Both top and bottom water glass cock fittings were screwed in the backhead sheet, the bottom cock fitting being screwed in the backhead sheet approximately 14 inches above left No. 2 arch tube and about 9½ inches to the left of the center line. The top water glass cock was screwed into the backhead sheet 15½ inches above the bottom cock fitting and 9½ inches to the left of the center line and located 6¼ inches from the backhead knuckle.

The bottom water glass cock fitting was broken off flush with the outside of the backhead sheet. This fitting had an opening into the boiler ½ inch in diameter which was encircled with a coating of scale about 1/32 inch in thickness. Following the explosion only two small pieces of the bottom water glass cock could be found. The spindle and bonnet were found near the boiler in a badly distorted condition, the spindle being bent over at both ends. This was put in a vise and the spindle straightened in order to be taken apart. Examination of the threads disclosed that this valve was within a few threads of being wide open. The packing nut fitting, together with the packing nut in which was found the bottom end of the water glass together with the bottom water glass gasket proved to be open and upon being taken apart, it was found that the gasket was in place and in good condition.

The top water glass cock fitting was also broken off flush with the outside surface of the backhead sheet. The opening into the boiler was found to be clean and measured ½ inch in diameter. The top water glass cock together with the fitting was found upon the embankment about 36 feet beyond the point where the boiler first struck the ground. This cock was found in open position and the passages to the boiler unobstructed.

The water glass drain valve was found in a car of scrap at Clovis, February 18, having been loaded at the wreck. This was found to be in closed position and examination of the seat indicated that it had been tight.

The specifications of the 1452 class locomotive indicate that the lowest reading of the water glass is 4½ inches above the highest part of the crown sheet. Due to the distorted condition of the boiler and firebox this could not be verified.

Gage Cocks

Three gage cocks were used, the fittings of which were screwed directly into the backhead sheet on the right side adjacent to the knuckle. All three gage cock fittings were broken off flush with the outside surface of the sheet. The openings in the fittings were 3/16 inch in diameter and were found free from obstruction. All gage cocks were found in closed position and when opened it was found that the passages were free from obstruction and were apparently in good working order. These gage cocks were pitched in a diagonal line 4½ inches apart or vertically 3 inches apart.

The specifications of the 1452 class locomotive indicate that the lowest reading of the bottom gage cock is 4½ inches above the highest part of the crown sheet. This, however, could not be verified due to the distorted condition of the firebox and boiler.

Data on the safety valves, steam gage, blow-off cocks, injectors, boiler checks, etc., are inserted in the official report, which will be omitted here.

Washout and Water Changes

The carrier's records indicate that this boiler was washed at Clovis, N. Mex., on dates January 13, 15, 17, 19, 21, 23, 25, 27, 29, February 1, 3, 5, 7, 9, and 11. Receiving a water change at Sweetwater on dates January 12, 14, 16, 18, 20, 22, 24, 26, 28, 31, February 2, 4, 6, 8, 10 and 12.

Daily Locomotive Inspection Reports

All daily inspection reports as required by Rule 104 were accounted for from which the following extracts under dates mentioned were taken:

Clovis, N. Mex., Jan. 27, 1924, Time 9:30 A. M.

"Examine front end and make some changes, engine not steaming. Raise burner a little." Reported by engr. Report approved. Proper repairs made.

Clovis, N. Mex., February 5, 1924, Time 9:30 A. M.

"Examine front and see if petticoat pipe is in line with stack. Engine is not steaming." Reported by engr.

This report was approved without any explanation of this work not being done indicating proper repairs made.

All of the daily inspection reports indicated that the injectors and gage cocks were in good condition and the safety valves opened at 220 pounds and closed at 218 pounds, except the report at Clovis, N. M., under date of January 25, in which the heading was left blank and report at Clovis under date January 27 indicating pops closing at 217 pounds.

Last Monthly Locomotive Inspection

Last monthly locomotive inspection and repair report covering this locomotive was made at Clovis, N. Mex., January 27, 1924, at which time all conditions were reported good and one broken and nineteen fractured staybolts were removed.

Last Annual Inspection and Repair Report

This locomotive received last hydrostatic test at Clovis, N. Mex., December 28, 1923, at which time the following work was done on this locomotive:

Applied hydrostatic test pressure 275 pounds.
Applied ¾ back flue sheet.
Reset 273 2¼-inch flues.
Applied patch on both front mudring corners.
Renewed 4 radials and 3 staybolts.
Welded doorsheet seam.
Repaired braces and splash plates in water tank.
Repaired ashpan and applied four 3-inch arch tubes.
Testing of steam gage and setting of safety valve.

Contributory Defects Found

Boiler appurtenances so badly damaged that nothing definite could be determined about their condition prior to the explosion. The locomotive was apparently in good condition prior to the explosion. The cause of the accident is given as crown sheet failure due to overheating caused by low water.

Our Business Grows—

If we take it seriously when it is small.

More because of merit than because of luck.

When we satisfy a real need in a masterly way.

Faster through honest workmanship than through clever advertising.

When we develop a fine respect for trifles.

If we quit wishing and begin working.

When a customer's patronage is considered a personal trust.

The Other Man's Experience—

Will often save us a lot of expensive experiments.

Is what we get out of a trade paper.

Added to our own, means progress.

Often sounds much better when he tells it.

Is worth nothing to the man who knew it all to begin with.

Never helps the man who is satisfied with second-rate results.

Is worth most when it teaches us to study more.

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

THIS is the second instalment of a series of questions on both mechanical and boiler subjects which are liable to occur in state or federal examination papers for boiler inspectors. The first set of questions with their answers appeared on page 105 of the April issue of THE BOILER MAKER. *The material should prove of benefit to all those who contemplate taking the examinations. The author would like to have those interested in the subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.*

56—Q. How should a crack in the barrel of a locomotive be examined and why?

A. The barrel of the boiler should be thoroughly cleaned of scale and a careful examination made to determine the extent of the crack. The whole interior of the boiler should be given careful inspection at the same time to see that no other defects exist.

57—Q. What is meant by an engine out of quarter?

A. When the crank pins on opposite sides are not at right angles to each other.

58—Q. What is autogenous welding and how many kinds are at present in use?

A. Autogenous welding is the process of uniting metals by heat, without the use of either flux or compression. Two kinds of autogenous welding are at present in use, oxy-acetylene and the electric.

59. Q. What is meant by an engine out of square?

A. When the valves do not make an equal distribution of steam to each end of the cylinders.

60—Q. What is the purpose of the hydrostatic test?

A. The purpose of the hydrostatic test is to determine the ability of the boiler to withstand a prescribed pressure, and to show the leaks.

61—Q. What are some of the pounds in a locomotive and the reason?

A. Wedges not properly adjusted, loose or worn driving box brasses, rod brasses not properly keyed or brasses worn larger than pin, loose side rod bushings or side rod connections, worn crossheads, wrist pins, broken frame, loose cylinder key, piston loose on rod, or piston rod loose in crosshead, loose follower bolts or obstruction in the cylinder.

62—Q. Where should fusible plugs be placed in a locomotive boiler?

A. Fusible plugs should be placed in the highest part of the crown sheet.

63—Q. What is the reason that a loose brass or bushing will cause heating as well as a tight one?

A. Because of the pounding action.

64—Q. What is combustion?

A. Combustion is the chemical combination of oxygen with carbon or hydrogen or both.

65—Q. What tests are required to be made on locomotives before each trip.

A. It must be known before each trip that the brakes on locomotive and tender are in a safe and suitable condition for service; that the compressor or compressors are in condition to provide an ample supply of air for the service in which the locomotive is put; that the devices for regulating all pressures are properly performing their functions; that the brake valve works properly in all positions; and that the water has been drained from the air brake system. Injectors should be tested before each trip. The train signal system when used, shall be tested and known to be in safe and suitable condition for service. Sanding apparatus shall be maintained in safe and suitable condition for service, and tested before each trip.

66—Q. At given pressures, what are the temperatures of steam in degrees Fahrenheit and Centigrade?

A. The temperatures are as follows:

Steam Pressure Pounds	Temperature of Steam degrees Fahrenheit	Temperature of Steam degrees Centigrade
75	307.5	153
90	320.2	160
100	327.9	164
115	338	170
125	342.2	173
140	352.9	178
150	358.3	181
165	366	186
175	370.8	188
190	377.5	192
200	381.7	194

67—Rule for reducing Fahrenheit to Centigrade degrees. Subtract 32 and take 5/9 of the remainder.

Example:

$$212 \text{ degrees F.} = (212-32) \times \frac{5}{9} = 100 \text{ degrees C.}$$

Rule for reducing Centigrade degrees to Fahrenheit. Take 9/5 of the sum and add 32. Example:

$$180 \text{ degrees C.} = (180 \times 9/5) + 32 = 356 \text{ degrees F.}$$

68—Q. (a) What is the temperature of water at 200 pounds steam pressure?

(b) What is the temperature of water at 170 pounds steam pressure?

A. (a) 381.7 degrees F.; 194 degrees C.

(b) 375.1 degrees F. 187 degrees C.

69—Q. (a) What is the boiling point of water F?

(b) What is the boiling point of water C.?

A. (a) 212 degrees F.; (b) 100 degrees C.

70—Q. Name the essential parts of the air brake and the duties of each part.

A. The air pumps, pump governor, engineer's brake valve, triple valve, auxiliary reservoir, brake cylinders, main reservoir, air gages, angle cocks cut-out and the necessary piping. The duty of the pump governor, is to regulate the steam supply to the air pump. It is the duty of the air pump to furnish the compressed air used in the operation of the brake and all other air operated appliances on both locomotive and cars. The purpose of the engineer's brake valve is to regulate the flow of air from the main reservoir into the train pipe and to the atmosphere for putting on the brakes. The triple valve has three duties to perform; to charge the auxiliary reservoir; to apply the brakes; and to release the brakes. It is in the auxiliary reservoir that the air is stored that is admitted to the brake cylinder when the brake is applied. In the brake cylinder is where the power of the compressed air is converted into work by forcing the brake piston out, moving the levers, rods and brake beams, forcing the brake shoes against the wheels, and applying the brakes. The purpose of the main reservoir is for storing a large volume of air for the purpose of promptly charging and recharging the brakes. When the engine is equipped with either the E. T. or L. T. type of brakes, air from the main

*Locomotive Inspector, New York State Transit Commission.

reservoir is used to supply air to the brake cylinders on the locomotive. Air from the main reservoir is also used in the operation of the sand blower, bell ringer, water scoop, air signal whistle, fire door, water sprinkler and other devices. The duty of the air gages is to indicate the pressures in the main reservoir, brake cylinders, equalizing reservoir and the brake pipe. The purpose of the angle cocks is to open and close the ends of the brake pipe. Cut-out cocks are used to cut out any brake that is not in operating condition. It is through the brake pipe that air flows from the main reservoir to the triple valves and auxiliary reservoirs on the different cars, and through the brake pipe that the brakes in the train are placed in communication with the locomotive.

Correction.—In the answer to Q. 43 which appeared on page 106 of the April issue the figures 1¼ inches should be substituted for 1½ inches.

(To be continued)

Page from an Inspector's Note Book

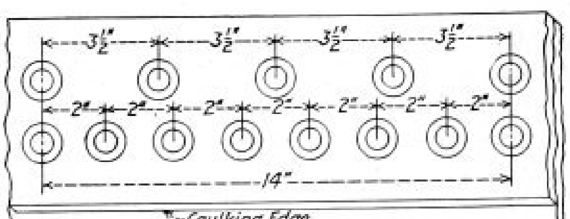
Mongrel Lap Joint

By W. F. Odenheimer

Occasionally an inspector or boiler maker will come across an old boiler having a longitudinal lap joint, double riveted, with the pitch of the rivets in one row different from the pitch in the other row. The following shows the method of figuring the efficiency of this type of joint:

$P = 14$ inches = unit length of joint
$p = 3\frac{1}{2}$ inches = pitch of inner row
$P' = 2$ inches = pitch of outer row
$d = 11/16$ inch = diameter of rivet holes
$a = 0.37122$ square inch = area of rivet holes
$t = \frac{1}{4}$ inch = thickness of plate
$T.S. = 55{,}000$ pounds = tensile strength of plates per square inch of section
$n = 11$ = total number of rivets in unit length of joint
$S = 42{,}000$ pounds = shearing strength of rivets per square inch in single shear.

Unit length of joint is a common pitch into which the joint



Method of Finding the Common Pitch

pitches can be divided without a remainder, as shown by 14 inches in the sketch. This is found as follows: Convert both into simple fractions, thus:

$3\frac{1}{2}$, $2/1$, $2 = 7/2$. Now find the least common multiple of 7 and 2, thus:

$2 \times 7 = 14$ = unit length of joint of common pitch.

Strength of solid plate in unit length of joint is 192,500 pounds.

$t \times P \times TS = \frac{1}{4} \times 14 \times 55{,}000 = 192{,}500$ pounds.

Total shearing strength of rivets in unit length of joint is 171,503 pounds.

$a \times n \times S = 0.37122 \times 11 \times 42{,}000 = 171{,}503$ pounds.

Percentage of strength (shearing) of rivets as compared with the strength of the solid plate is 89 percent.

$171{,}503 \div 192{,}500 = 89$

Percentage of strength of the rivet section of the inner row of rivet holes as compared with solid plate is 80.3 percent.

$$\frac{P - d}{p} = \frac{3\frac{1}{2} - 11/16}{3\frac{1}{2}} = 0.803$$

Percentage of strength of the net section of the outer row of rivet holes as compared with solid plate is 65.6 percent.

$$\frac{P' - d}{P'} = \frac{2 - 11/16}{2} = 0.656.$$ Hence 65.6 percent = efficiency of joint.

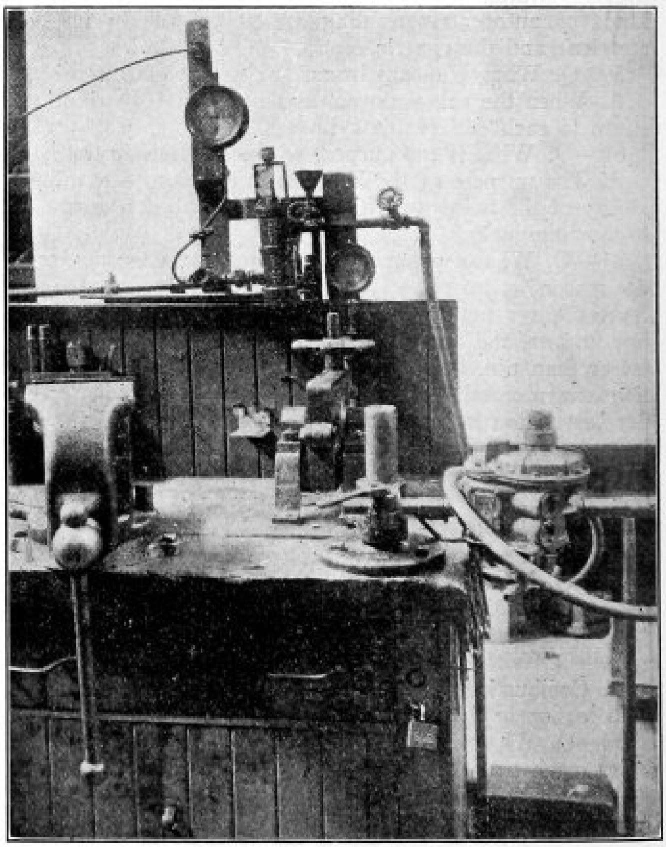
Use 44,000-pound single shear of rivets under A.S.M.E. Code.

Device for Testing Pneumatic Motors

By E. A. Murray*

It is essential that pneumatic motors be kept in first class condition in order to get effective performance. To determine the condition of such tools, this shop has put in a testing device that has worked very well. The illustration and drawing show the arrangement used.

This device operates in the following manner: Air is con-

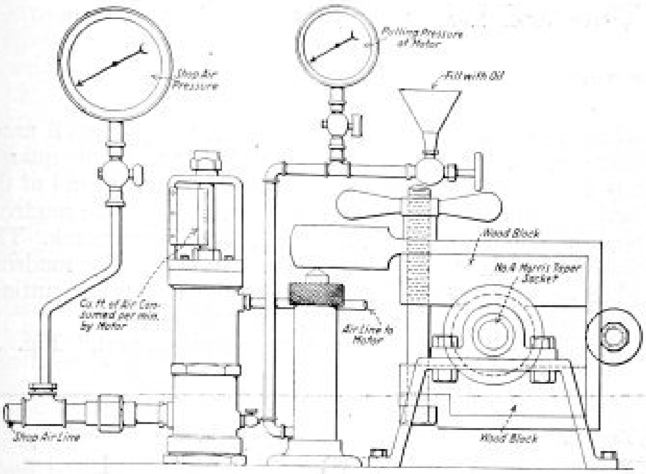


Apparatus for Determining Pneumatic Motor Performance

ducted to the "toolometer" from a full, free air pipe. This "toolometer" is for a ¾-inch standard pipe and registers the amount of free air that passes through it. This is necessary as the manufacturers usually give the free air con-

*Shop Superintendent, Chesapeake & Ohio, Huntington, W. Va.

sumption in connection with the rating of different air motors. A standard air gage is attached to the pipe just before it enters the "toolometer" to give the correct air pressure in the shop lines. An air hose is connected to the air pipe after it has traveled through the "toolometer" and the



Arrangement of Apparatus for Testing Pneumatic Motors

open end of the hose is then connected with the air motor to be tested. The spindles are arranged for Morse taper shanks. An arbor is made with the Morse taper shank on both ends, one to fit an air motor and the other a Prony brake. The spindle is also arranged to fit a Morse taper up to No. 4 size.

The Prony brake is arranged with a roller between the bearings and wood clamps. The roller is attached by means of a screw passing through straps that encase the wood. The end of upper strap projects out far enough to have a bearing on the plunger, which is 1½ inch diameter and has a lift of 3 inches. The bearing is made after the order of scale points in order to reduce the friction as much as possible. Some good oil is run into the cavity after the plunger has been lifted to its highest point. This oil is obtained from a reservoir on the top, where a small funnel is attached with a valve under it to close the pipe that leads to the plunger.

The motor attached to the Prony brake is started and after full speed is attained, the hand wheel which closes the wood clamps on the roller, is screwed down. The friction between the wood clamps and the roller causes the straps to bear down on the plunger and this brings a pressure on the small air gage attached to the plunger. Pressure on the brake is increased until the air motor is finally stalled under full air pressure. Records are made from the gages as soon as this occurs; first the air pressure in the shop line; second, the number of feet of free air passing through the "toolometer," and third, the number of pounds pull are registered on the gage connected with the plunger.

This test is made on each new air motor, according to the classification, as it is placed in commission. If these motors or any others come in for repairs or complaint concerning the power developed, they are placed on the test rack to get a record showing what this class of motor should do.

As a last resort, the motor is placed under a steel yoke attached to the work bench and a practical test is run to determine just what size hole the motor will drill. Consideration is given for any depreciation in speed or in the diameter of the drill used when the motor is new and first tested.

This device has proven very effective in checking up air motors against the ratings given by the manufacturers.

A Totally Unnecessary Loss of $1000*

By Elton J. Buckley†

A CASE has just been decided which illustrates how careful business people who buy and sell merchandise should be to get a real contract. I don't suppose it will be believed, but my sober judgment is that at least half of all the agreements made to buy and sell goods would fail if either party raised any question about them. The only reason they go through is either that the market doesn't change, or if it does change, the parties are too honest to change with it. If I were to wager to drive a horse and cart through 50 percent of all buying and selling transactions, I feel I couldn't lose.

Now just listen to the narrow line which the court in the case just decided held divided a contract from no contract. A line so narrow that had I been consulted I should have unhesitatingly advised that the contract was good. A New York buyer placed an order with a Pennsylvania seller for several cars of merchandise. The order specified kind and grades of merchandise, price, time and terms of delivery, and all other conditions. The seller was willing to accept, but didn't quite understand the terms, so he wrote back and said: "This being the first business I have ever had from you, it is but proper for us to have an understanding as to terms." Then followed what the seller thought the terms ought to be, and finally these words: "The above conditions being satisfactory, we will be glad to begin shipping as rapidly as we can secure cars. Please let us hear from you on the subject." The buyer replied: "We have for acknowledgment yours of the 9th inst., regarding shipment of the eight cars ordered by us for delivery to Forty-eighth Street Station, Bush Terminal, all of which is in order." The seller answered: "Again with reference to the eight cars, we have now written you twice on the subject of terms and the manner in which we wished the stock to be paid for, and not hearing from you in reply to either of our letters, we take for granted that you do not wish the material and are therefore cancelling the order." The buyer refused to accept the cancellation and wrote: "Would refer you to our letter in which we advise that the terms, etc., as given in your letter were all in order." The seller, however, stood on his cancellation and finally wrote that he had sold the goods elsewhere (at a higher price) and couldn't fill the order. The buyer then went into the market, bought eight cars of the goods from somebody else, also at a higher price, and then sued the original seller for the difference. That is the way the case got into court.

The issue was whether the buyer's statement "all of which (meaning terms) is in order," amounted to an acceptance of those terms. The buyer said he meant it to be, and that as a matter of fact and law, it was. The seller said it was not, and that he had showed the buyer he didn't think it was by writing him several letters demanding specific acceptance. To which the buyer retorted: "I had given you one acceptance, I didn't need to give you another."

Now probably every business man asked what he thought "all of which is in order" meant in the above correspondence, would have said it meant an acceptance of the terms. And I

(*Continued on page 144*)

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†Attorney, Philadelphia, Pa.

Kinks for the Boiler Maker

Four Simple Devices Developed in the Shop to Save Time and Labor

C. E. Lester

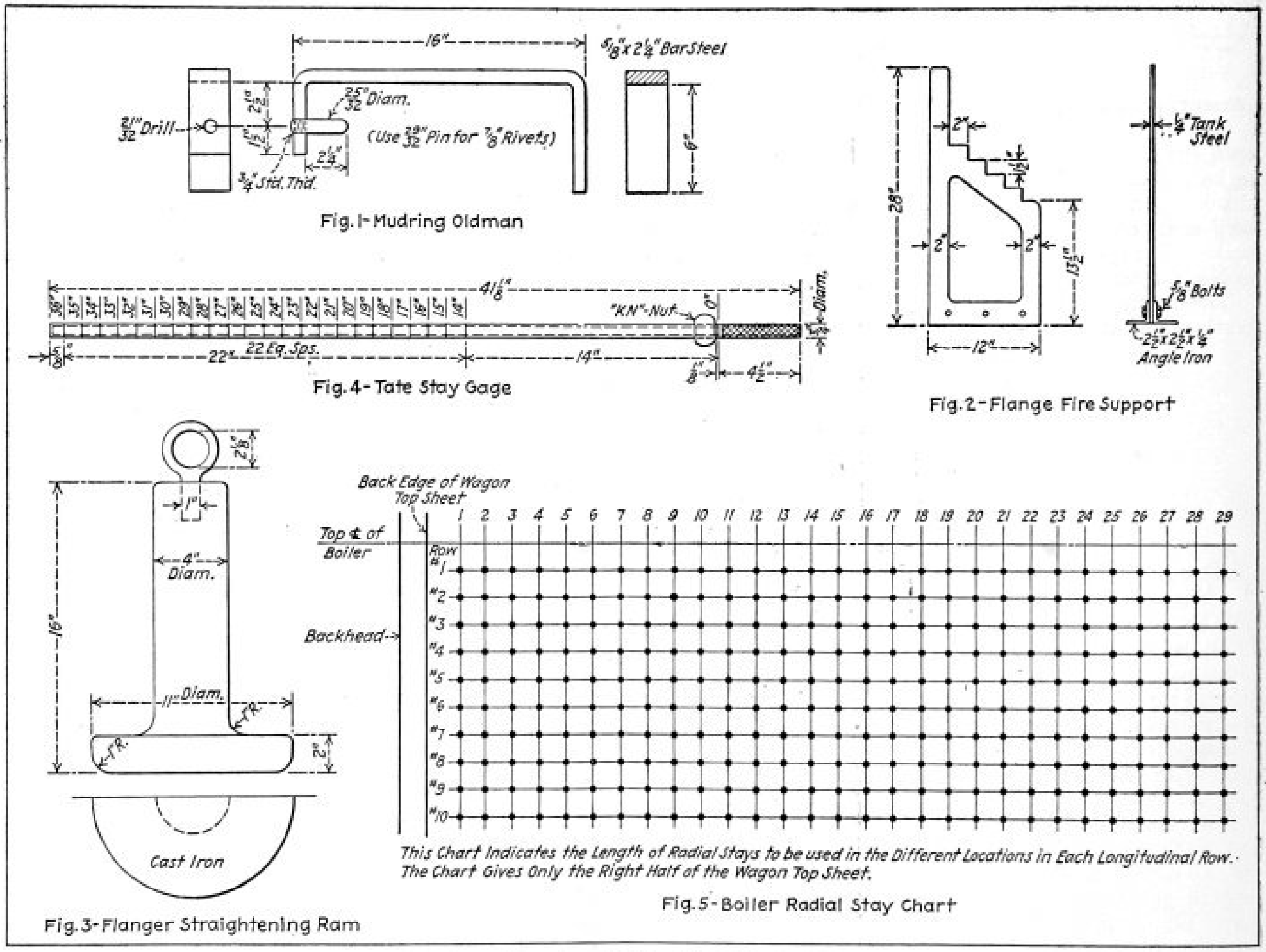
THERE are frequently found in various shops some ingenious labor saving devices that are not generally used. In other words, the device has been developed locally and, in common with many such things, is never used outside the shop where it originated simply because no one ever sees it who might be interested in it, other than the crew of the local shop.

It is a fact to be deplored that the majority of our better foremen never get into print and were it not for the fact that outsiders sometimes get into their shops—many of the best unpatented devices would remain unknown outside their place of origin.

The writer, however, claims no originality in the submission of the following kinks, and although they are most simple, they serve excellently the purpose for which intended and are valuable in their simplicity and inexpensiveness and well worth adoption by any one who follows work for which they are adapted.

The first device is a "one man old man," Fig. 1. The writer uses countersunk rivets exclusively inside in all mudring corners. This device is used to hold up a close quarter motor to countersink the holes. To use it, the stud end of the device is stuck in a rivet hole on the outside of the mudring opposite the end of the hole desired to be countersunk. The device automatically clamps itself securely to the mudring when the feed screw of the air motor is fed out for cutting, thus countersinking the hole on the inside.

Another simple device is a "flangers support," Fig. 2, which is merely a piece of ¼-inch tank steel with a series of steps graduated in 1½-inch heights and supported by two pieces of 2-inch angle iron as illustrated.



Details of Devices Easily Made in the Shop

This is used to support sheets while flanging that are required to be set at different heights as the work progresses. It does away with the old method of building up with blocks, boxes, and various temporary expedients and gives the flange fire permanent fixtures that are always available and in good order.

The "straightening ram" illustrated in Fig. 3 was developed for the purpose of protecting the flanging gang from the great heat of the furnace while straightening large sheets. The usual method of using sledges and mauls at close quarters makes the heat most intense. With this block swung on a 20-foot flue and handled by four men all the large high spots and lumps can be knocked down quickly without overheating the men. The finishing touches can be put on at higher temperatures and consequently with greater ease and accuracy.

Fig. 4 illustrates a gage developed by the writer to more accurately determine the correct length of flexible crown stays of the type using sleeves with a ball joint. It has been found that in order to secure a good job the bolts should be accurate in length to within about a quarter of an inch. With the ordinary methods of measuring this is not always accomplished. The writer took a K-N nut and secured it to a piece of ¾-inch steel tubing, calibrating the tubing as illustrated. The method of using the gage is by inserting it through the wagon top sleeves, taking the finished lengths on the inside and jotting them down on a chart as illustrated in Fig. 5. No trouble whatsoever is experienced in getting bolts to proper length and putting them in the proper hole. The chart is used to give the bolt cutter the correct number and length of bolts and for the staybolters to apply them in the proper holes. It will be noted that ⅛ inch is allowed above the K-N nut. This gives a little to hammer over to hold the nut in place.

Program of the Master Boiler Makers' Association Convention

THE secretary of the Master Boiler Makers' Association, Harry D. Vought, has issued the official program of the convention which is to be held at the Hotel Sherman, Chicago, May 20 to 23 inclusive. The meetings will be held as follows:

FIRST DAY

Tuesday, May 20, 1924.

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

10:00 A. M.—Convention called to order.

Invocation—Past President John H. Smythe, Official Chaplain.

Addresses— Hon. William E. Dever, Mayor of Chicago; H. T. Bentley, General S. M. P., C. & N. W. Ry., Chicago.

Responses—P. J. Conrath, Past President; Frank Gray, First Vice-President.

Annual Address—Edward W. Young, President of the Association.

Routine Business—Annual report of the Secretary, Harry D. Vought.

Annual report of the Treasurer, W. H. Laughridge.

Miscellaneous Business—

- Unfinished business.
- New business.
- Appointment of special committees to serve during convention.
  - Resolutions.
  - Memorials.
- Announcements.
- Adjournment.

SECOND DAY

Wednesday, May 21, 1924.

9:00 A. M.—Convention called to order.

Addresses: J. E. Bjorkholm, Asst. S. M. P., C. M. & St. P. Ry.; Frank McManamy, Interstate Commerce Commission.

Responses: Thomas F. Powers, Second Vice-President; John F. Raps, Third Vice-President.

Committee Reports:

9:30 to 10 A. M.—"The Training and Developing of Apprentices." George B. Usherwood, Chairman; W. J. Murphy, John Harthill, John F. Raps.

10:00 to 10:30 A. M.—"Shop Kinks." Thomas F. Powers, Chairman; E. W. Rogers, Otto C. Voss, C. E. Elkins.

10:30 to 11:30 A. M.—"Does the Application of Thermic Syphons Increase the Life of Firebox Sheets and Flues?" A. F. Stiglmeier, Chairman; Henry J. Raps, John J. Keogh, H. J. Wandberg, A. C. Dittrich.

11:30 to 12 M.—"Autogenous Welding in General. Its Uses, Development and Advancement." Mr. H. H. Service, Chairman; R. W. Clark, Isaac J. Pool, George M. Wilson, John L. Welk.

Announcements.

Adjournment.

THIRD DAY

Thursday, May 22, 1924.

9:00 A. M.—Convention called to order.

Addresses: John Purcell, Asst. V. P., in Charge of Operations, A. T. & S. F. R. R.; A. G. Pack, Chief Inspector, I. C. C., Bureau of Locomotive Inspection.

Responses: W. J. Murphy, Fourth Vice-President; L. M. Stewart, Fifth Vice-President.

Committee Reports:

10:00 to 11:00 A. M.—"Most Economical Method of Removing Firebox Sheets for Renewal. Describing Method. Is It More Economical to Renew Firebox Without Removing Boiler from the Frame?" Thomas Lewis, Chairman; Andrew S. Greene, James T. Johnston, Thomas W. Lowe.

11:00 to 11:30 A. M.—"The Causes and Prevention of Boiler Pitting and Grooving." Lewis Nicholas, Chairman; Harry V. West, Frederick J. Howe.

11:30 A. M. to 12 M.—"Washing Boilers and Tools for Same." Franklin T. Litz, Chairman; L. E. Hart, Harry V. West.

12 M. to 12:15 P. M.—Topics for 1925 Convention: P. J. Conrath, Chairman; Harry V. West, Stephen E. Westover.

Announcements.

Adjournment.

FOURTH DAY

Friday, May 23, 1924.

9:00 A. M.—Convention called to order.

Address: W. J. Tollerton, General S. M. P., C. R. I. & P. R. R.

Response: Thomas Lewis, Past President.

10:00 to 10:30 A. M.—Report of Executive Board, E. J. Reardon, Chairman.

Committee Reports:

10:30 to 10:45 A. M.—Report of Committee on Law. George W. Bennett, Chairman; Thomas F. Powers, P. J. Conrath.

10:45 to 10:50 A. M.—"Most Economical Method of Cutting Off and Removing Mud Ring Rivets." C. F. Patrick, Chairman; J. P. Malley, M. J. Guiry.

"The Proper Staying of Crown Sheets." (No report filed.)

"Proper Method of Applying Arch Tubes and Tools Used for Same and Proper Thickness of Such Tubes." (No report filed.)

Report of Committee on Rules for Recommended Practice and Standards. (No report filed.)

Special Committee to Interview General Managers' Association, Superintendents of Motive Power and Other Railroad Officials with Reference to Having All Their Foremen and Inspectors Attend the 1924 Convention. (No report filed.)

Report on A. S. M. E. Standards. (No report filed.)

Unfinished Business:

10:50 to 11:00 A. M.—Report of Committee on Resolutions.

11:00 to 11:15 A. M.—Report of Committee on Memorials.

11:15 to 11:45 A. M.—Election of Officers.

Adjournment.

LOCAL CONVENTION COMMITTEE OF ARRANGEMENTS:

P. J. Conrath, Chairman

E. J. Reardon **Thomas F. Powers** **John F. Raps**

The Women's Auxiliary

Annual meeting will be held at 10 A. M. at the Hotel Sherman, Wednesday, May 21, 1924.

OFFICERS

Honorary President—Mrs. John McKeown, Galion, O.

President—Mrs. James E. Cooke, Greenville, Pa.

VICE-PRESIDENTS

First—Mrs. C. F. Petzinger, Macon, Ga.

Second—Mrs. Charles Hempel, Omaha, Neb.

Third—Mrs. M. J. Fennelly, Jersey City, N. J.

Fourth—Mrs. C. H. Browning, Battle Creek, Mich.

Secretary-Treasurer—Mrs. W. H. Laughridge, Columbus, Ohio.

Meeting of the National Board of Boiler and Pressure Vessel Inspectors

ARRANGEMENTS have been made to hold a meeting of the National Board of Pressure Vessel Inspectors at the Hotel Cleveland, Cleveland, O., May 27-29, coincident with the spring meeting of the American Society of Mechanical Engineers.

This meeting is not only important for the members of the board but also for every inspector and individual interested in making the interpretation and application of the American Society of Mechanical Engineers' Boiler Code standards uniform throughout the states and cities in which the Code is enforced.

The secretary of the board, C. O. Myers, has sent out the following program:

MONDAY

Registration of members and guests.

2:30 O'clock

Visit to Nela Park with departmental trips, sporting events, lunches and entertainments. (As guests of the American Society of Mechanical Engineers.)

Return to Cleveland 9:30 P. M.

TUESDAY—10:00 O'clock

The Boiler Code Committee of the American Society of Mechanical Engineers will hold a meeting at Hotel Cleveland.

The members of The National Board are members of the Conference Committee of The Boiler Code Committee, and are invited to participate in the meeting.

WEDNESDAY MORNING—10:00 O'clock

Meeting called to order by Joseph F. Scott, chairman.

Reading of minutes of last meeting.

Report of C. O. Myers, secretary-treasurer.

Address—Jos. F. Scott, chairman, Engineers License and Steam Boiler Inspection Bureau, State of New Jersey.

Address—Fred R. Low, president of American Society of Mechanical Engineers, "The Necessity of Uniform Enforcement of the Boiler Code and Interpretations."

Address—John A. Stevens, chairman, Boiler Code Committee, American Society of Mechanical Engineers.

WEDNESDAY AFTERNOON—1:30 O'clock

Address—Dr. D. S. Jacobus, member of Boiler Code Committee, "Advisability of Conference Committee Making Careful Study of Interpretations and Revisions While in the Making."

Address—E. R. Fish, president, American Boiler Manufacturers' Association.

Address—Wm. H. Furman, chief inspector of boilers, New York State, "The Advantages of Interchange of Inspectors and Uniform Stamping to a State Department."

Address—Chas. E. Gorton, chairman, American Uniform Boiler Law Society, "Uniform Boiler Laws and the Necessity of Uniform Application."

General discussion.

THURSDAY MORNING—10:00 O'clock

Business session.

A Loss of $1,000

(*Continued from page* 141)

think most lawyers would have thought the same; I have already said I would. But the court split the hair and the seller got away with it. The decision was that "all of which is in order" did not constitute a specific acceptance, and was obviously not so considered by the seller. This is from the decision:

> The seller was of course entitled to insist on an acceptance which it in fact understood, or by the custom of its trade, was required to understand to be an acceptance. We do not consider the words "all of which is in order" to be such an acceptance, and it is not without significance in ascertaining what the buyer meant by those words, that when the seller's letter of the 15th asked for specific acceptance, the former words were merely repeated when the words "We accept" would have removed all possible doubt. As the letters show the seller never accepted the order, but specified terms and conditions upon which it would be accepted and requested an acceptance of those terms and conditions, and as the letters show the buyer did not accept the terms there was nothing to submit to the jury on the subject.

Personally and professionally, I very much dislike courts to make decisions like this, for they always help to destroy confidence in judicial institutions. They don't seem sensible, or right, or just. And therefore I am glad that in this case one judge filed a dissenting opinion, in which he said: "I think that with the words 'all of which is in order,' the contract was complete. This was a sufficient acceptance of all the terms stated in the seller's letter of the 9th. That they did not so understand it, as appears by statements in their subsequent letters, cannot relieve them from the plain effect of the letter. They were not entitled to insist on an acceptance which they in fact understood. All they were entitled to was an acceptance stated in terms which were reasonably clear and sufficiently plain to be understood by a person of ordinary intelligence. I cannot bring myself to the conclusion that there is any doubt whatever as to the meaning of that letter and the words 'all of which is in order.' The seller says that these words are not technical terms. It follows that they must be taken in their natural and obvious sense, which is that the buyer agreed to the stipulations exactly as set forth by the seller in the letter being answered." This dissenting opinion is 100 percent right, in my judgment, but of course since the majority of the court ruled the other way, the buyer loses his case and his contract.

Now, the moral of this case is clear. The buyer here, although he had what I believe to have been a legal contract, was in the first place to blame because he did use somewhat ambiguous language. Ambiguous language is the curse of business transactions and gives more work to the courts than anything else. He could have just as easily have said: "which we herewith accept." The moral, therefore, while we have sellers unscrupulous enough to crawl out of contracts on technicalities, and courts that can bring themselves to split hairs, is not only to get everything in the written contract, but to get it in in the simplest and most understandable words.

The buyer's totally unnecessary loss in the above case was nearly a thousand dollars.

A. S. M. E. Spring Meeting in Cleveland

THE A.S.M.E. spring meeting will be held in Cleveland, Ohio, from May 26 through May 29. The program contains matter of interest to all mechanical engineers and the largest spring meeting attendance is expected.

The high lights of the technical program include the presentation by W. L. R. Emmet of a paper on the Mercury-Vapor Process and a session in which the American Society for Testing Materials is co-operating on the Properties of Materials at High Temperatures. There will be a joint session with the American Society of Refrigerating engineers who are also having their meeting in Cleveland at that time.

Headquarters have been set up at the Hotel Cleveland and those who plan to attend are encouraged to make their hotel reservations as early as possible.

The Boiler Maker

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CONTENTS

After a lapse of two years the National Board of Boiler and Pressure Vessel Inspectors will hold a meeting in Cleveland at the Hotel Cleveland, May 27 to 29. This meeting is being held coincident with the spring meeting of the American Society of Mechanical Engineers and will afford an opportunity for a joint session of the Boiler Code Committee and the members of the National Board, who are also members of the Conference Committee of the former.

The entire opening session on Tuesday, May 27, will be devoted to a Boiler Code Committee meeting and an excellent opportunity is thus available for the discussion of the practical and uniform application of the Code where it is in force. As the whole work of the National Board is based on the rulings of the Code, it is of vital importance that individual opinions as to the application of such requirements be reduced to a common understanding. Undoubtedly every member of the National Board will be present throughout the entire meeting, and in addition every boiler inspector or individual interested in the application of Boiler Code requirements should make an effort to attend. Arrangements have been made for all guests and visitors to be permitted at all sessions of the meeting.

The second day of the meeting will be devoted to addresses by individuals prominent in the formulation, interpretation and application of the Boiler Code and all phases of the work will be presented. The final day will be given over to business sessions.

The features planned for the Master Boiler Makers' Association convention at the Hotel Sherman, Chicago, May 20 to 23, include addresses by H. T. Bentley, general superintendent of motive power, Chicago and North Western Railway; J. E. Bjorkholm, assistant superintendent of motive power, Chicago, Milwaukee & St. Paul Railway; Frank McManamy, member of the Interstate Commerce Commission; John Purcell, assistant vice-president in charge of operations, Atchison, Topeka & Santa Fe Railroad; A. G. Pack, chief inspector of the Bureau of Locomotive Inspection; W. J. Tollerton, general superintendent of motive power, Chicago, Rock Island & Pacific Railway.

The matters which these men will discuss, dealing, as they will, with all phases of locomotive boiler construction, maintenance and inspection, combined with the papers to be brought out by members of the association, should make it imperative that every member be present at all sessions of the convention.

For the benefit of all our readers a complete record of the proceedings of the convention will appear in the June issue.

At the time of going to press, the official program of the American Boiler Manufacturers' Association annual meeting had not been issued. This meeting will be held at the Homestead, Hot Springs, Va., June 9 to 11, and as interesting business and recreational sessions are promised as those of last year. All members of the association who were at the Homestead for the 1923 meeting will be certain to attend the present one, and those who were not there last year should make every effort to be in attendance at the present meeting.

On April 1 the hearing on House of Representatives' Bill 5836, amending the Federal Boiler Inspection Act, was concluded. This bill is designed to materially increase the salaries of the chief inspector, assistant chief inspectors and district inspectors. The feature of the bill of greatest interest to our readers is that an additional number of inspectors are provided for. The bill will undoubtedly be passed without opposition.

Engineering Specialties for Boiler Making

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

Combination Multiple Punch, Gate Shear and Gap Forming Press

THE Cleveland Punch and Shear Works Company, Cleveland, O., has recently developed a combination punch, gate shear and gap forming press which measures 12 feet 2 inches between housings, has a 15-inch horizontal gap and weighs 40 tons.

The machine, arranged as a multiple punch, is shown in the accompanying illustration. The features stressed by the company are the automatic stripper, a positive jaw clutch for the regular run of punching operations, an adjustment to slide, a friction clutch for forming, patented single-bolt gagged adjustable punching attachments, an interchangeable plate shearing attachment and safety counterweights for balancing the sliding head. All gearing is of steel with cut teeth.

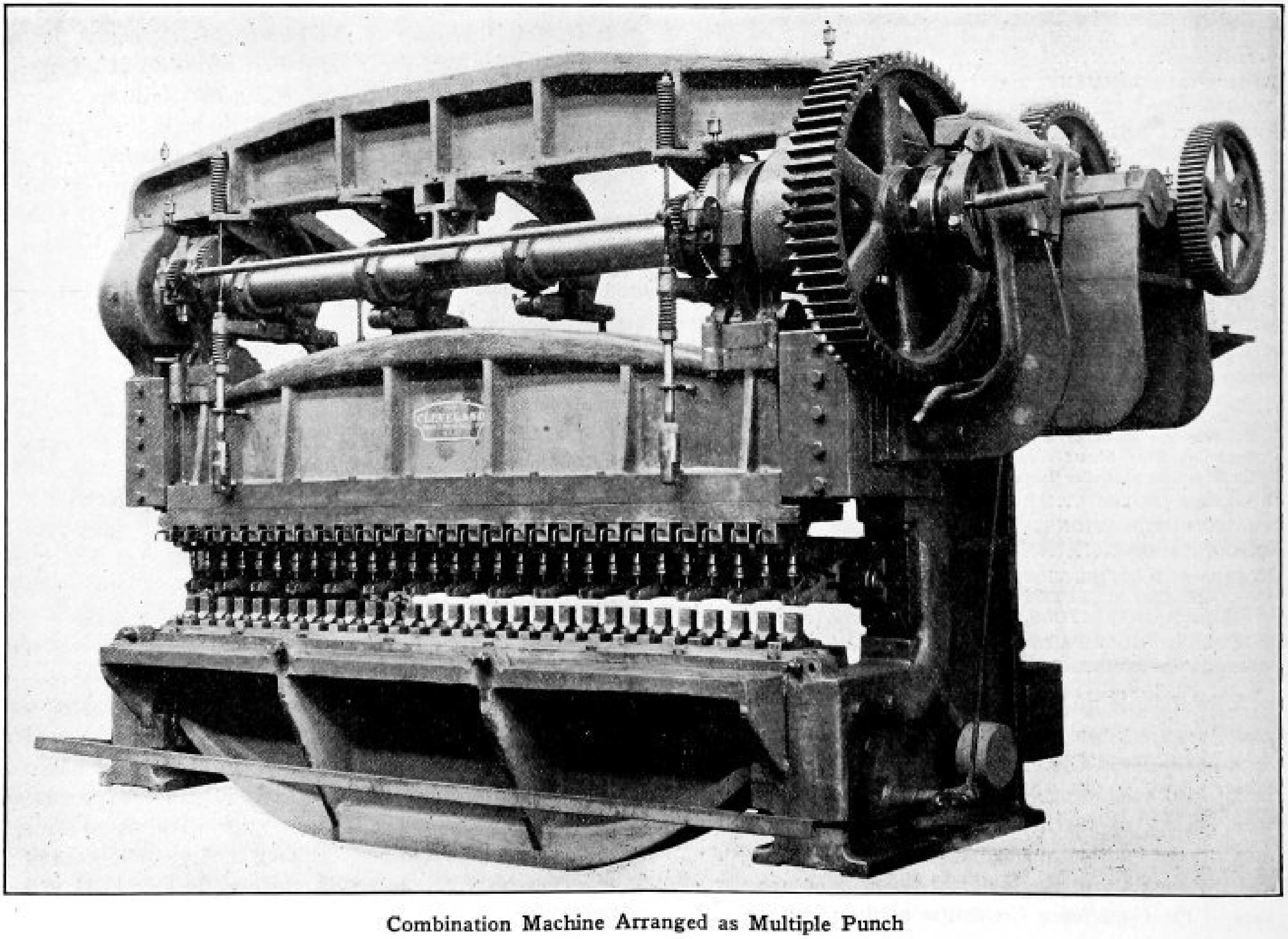
The automatic stripper is designed with adjustable trunnions, so that the flat finished face of the stripper fingers will always strike material of minimum and maximum thickness squarely and not in a "cocked" position. This arrangement materially reduces the breaking of punches due to stripping.

The patented single-bolt adjustment reduces the setting up time for multiple punching. It is stated that one man can do this work without trouble. The steel casting adjustable cup strippers are in an accessible position and may be adjusted or removed from the front of the machine with great facility.

Super-Mixing Tip for Cutting Torches

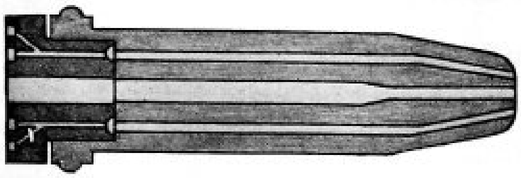
THE Alexander Milburn Company, Baltimore, Md., has recently perfected a new type mixing tip for metal cutting torches.

The features of this tip are a method of super-mixing the gases and preheating the cutting oxygen as well as giving added velocity and penetration to the pre-heating and cutting jets. A further feature is that the tip is provided with a renewable seat at a fraction of the cost of a complete tip, rendering it unnecessary to re-machine or discard the used tips. This renewable seat facilitates the cleaning and maintenance of the tip. In the standard tip the seat could be refaced by taking a thin cut off of it in a high speed lathe, but



Combination Machine Arranged as Multiple Punch if the lathe is not available the seat cannot as readily be refaced.

The new tip retains all the advantages claimed for the tip which has been standard on Milburn torches for a number of years, with the added advantages noted above. The mixture of the preheating gases takes place in multiple passages in the renewable seat. These gases then pass into an



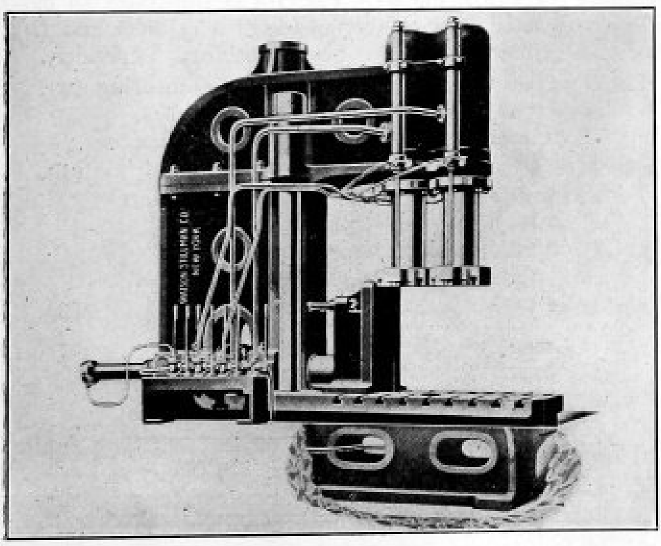
New Tip for Metal Cutting Torches

annular passages where they are given a swirling motion and an additional mixing. The gases are again separated and expanded into enlarged multiple passages leading to the orifices in the tip proper. Here the preheating flames are projected with an increased velocity inclined toward the high pressure oxygen jet resulting in a speedier cut, a narrower kerf and a material saving in gases.

Flanging Press of Built-Up Type

A LINE of hydraulic plate-flanging presses of the built-up type, the main frame being made up of sections securely bolted together, has been placed on the market by the Watson-Stillman Co., New York. The machine is available in four sizes, with total pressures on the vertical cylinders of 150, 200 and 300 tons.

Standard practice heretofore has been to make the main frame in one single casting, a design said to have inherent faults, many of which are overcome in the built-up type of frame. It is emphasized that since the casting is only exposed to compressive stresses it can be made in lighter sections. The tension strains are taken up by two heavy



Sectional Construction of Press Makes Replacements Easy

columns or bolts which secure the two parts of the main frame together and the spring is in this way reduced to a minimum.

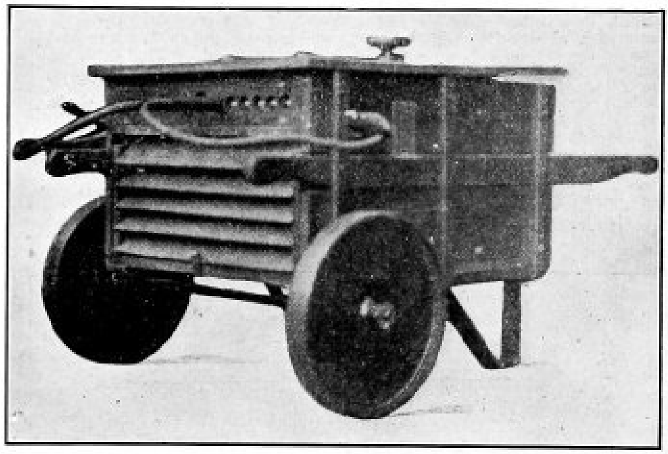
A feature of the design illustrated is that in case repairs are necessary or replacement is required of the main cylinders, it is only necessary to renew that section. Another feature is that the return stroke of the main rams is effected by draw back cylinders below the top of the frame, which reduces the overall height of the press making it possible to install it in restricted quarters, and permitting the mounting of a swing crane on the top of the press to facilitate the handling of materials.

The presses are usually fitted with two vertical upper rams, one lower vertical ram and one horizontal ram. The main cylinders are connected through special filling valves to the main pressure line, an arrangement intended to increase the speed of the rams and at the same time reduce the consumption of pressure water.

A One-Man Portable Universal Welder

A NEW type of welding transformer has been developed by the Electric Arc Cutting & Welding Company, Newark, N. J. It is called universal because it can be operated from almost any shop supply circuit whether it is alternating or direct current and the manufacturers offer it for doing all kinds of arc welding and also for nickel spotting, lead burning and spot-tack welding.

Previous designs of welding transformers made by this company could be used on alternating current voltages such as 220-440 or 110-220. This unit which is no larger than the regular size can be used on the 110, 220 or 400 volts



Barrow-Type Universal Arc Welding Machine

alternating current by means of multiple, series-multiple and series combinations of the coils of the primary winding. To make the same machine operate on 25 and 40 cycles, taps and adapter windings are used to obtain the proper electrical characteristics. Operation of the blower and automatic switch are not interfered with by any of these circuit combinations. In addition to this, the apparatus can also be operated on 110 and 220 volts direct current by means of a resistor-reactor combination inserted in the circuit with the secondary winding.

The core of the transformer is made of silicon steel. The windings are of double asbestos magnet wire each layer of winding separated from the next by pure mica. The primary is separated from the secondary by four layers of mica and ¼-inch asbestos spacers. The machine has all welded joints so that there is nothing in its construction which will melt or char.

Previous designs of these welders, which weigh about 200 lb. were carried by two men. The machine has now been made more easily portable by one man by the addition of wheels at one end and an extension of the side handles at the other so that it can be moved about like a wheel barrow. The machine is furnished either with or without the wheeling arrangement.

Questions and Answers for Boiler Makers

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

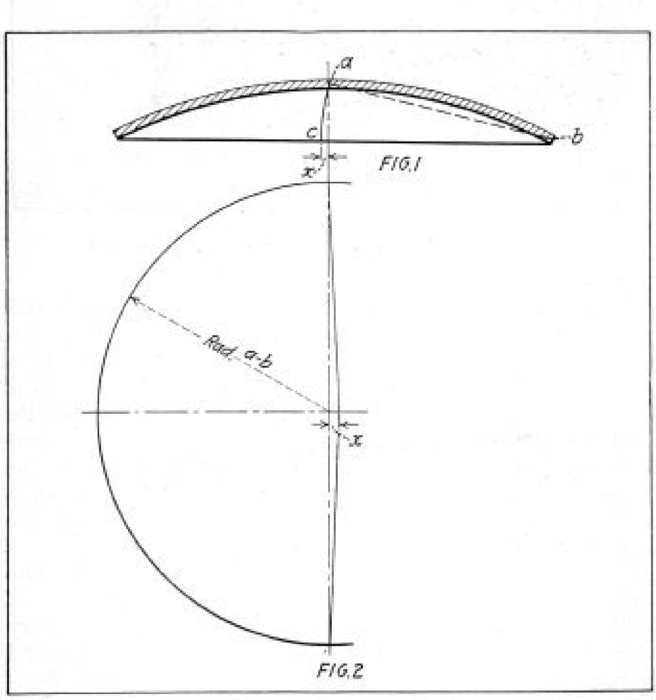
Conducted by C. B. Lindstrom

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.*

Spherical Head Calculations

Q.—Some time ago I bought the 3rd edition of your practical treatise on the layout of boilers, stacks, tanks, pipes, etc., and I find your system simple and easily understood as far as I have gone over the work. There is one problem that is bothering me and I hope you will place this letter in the hands of your engineer who I know will clear me up on it. The problem is on pages 261 to 265 inclusive—"Layout of a Large Water Tank with a Hemispherical Bottom." The bottom only is bothering me. You give the tangent of the different angles as the radius for developing the width of plates 3 and 4 and the diameter of the first or extreme line of holes in plate 1. Ten feet 9 inches is given as ample for the diameter of plate 1. The tangent or radius governing this plate is given as 5 feet 4⅞ inches. I will appreciate your assistance in clearing me up on the tangent of plate No. 1 and on plates Nos. 2 and 3 if the same conditions exist.—J. J. C.

A.—The tangent lengths 30 feet 11 7/16 inches and 5 feet 4⅞ inches are the required radii for drawing the large and



Method of Laying Out Head

small arcs for the plate section marked *z*. The tangent 5 feet 4⅞ inches is not used in the development of the dished head sections. The dished head is made in two sections and riveted together by means of a butt strap. The overall diameter of the head measures 10 feet 9 inches.

The radius for drawing the disk as required in the flat before dishing is equal to the diagonal *a-b*, Fig. 1. An allowance in each half section must be made along the butt line, for if this section is cut straight the dishing of the head sections will pull the plate in and leave a gap along the butt line or edge. The required allowance at the center of the head is approximated by revolving the diagonal *a-b*, Fig. 1 to the horizontal axis as at *a-c*. The chamber in each half of the head is then laid off as indicated in Fig. 2.

To determine the tangent lengths shown in Fig. 4, page 263, "Laying Out for Boiler Makers," determine the tangent of the angle 51 degrees 4 minutes 36 seconds which equals 1.238 nearly. Then multiply the radius 25 feet by this tangent, or $25 \times 1.238 = 30.95$ feet.

The tangent of angle 12 degrees 9 minutes 12 seconds is approximately 0.2156 then 24 feet 11¼ inches × 0.2156 = 5 feet 4⅞ inches.

Calculations of Stock Lengths for Inside and Outside Angle Iron Rings

Q.—Will you please mail me a sketch or publish the same in regard to the easiest and fastest method to layout different size angle bar rings with heels rolled in and also heels rolled out. For instance, 3-inch by 3-inch by ¼-inch angles laid out when straight with 13/16-inch holes on both flanges to be rolled to a 10-inch diameter heel to heel with heel rolled in. How much do I allow on this bar when straight to make this bend? Will the method you give me apply to any size angle—to heel in or out?—W. J. R.

A.—The length of angle in the straight to form a ring is determined in a manner similar to the calculations employed for plate rings or cylinders. Fig. 1 (a) illustrates an *outside ring* that is fitted on the outside of a cylinder and (b) shows an inside ring that fits on the inside of a cylinder.

Let D = the required inside diameter of the ring (a).
c = thickness at root of the angle, inches.
L = length of angle iron required, inches.

Then $L = (D + 2c) \times 3.1416$. (1).

For an inside ring, let
L' = length of bar required, inches.
D' = external diameter of ring, inches.
c' = thickness at root of angle bar, inches.

Then $L' = (D' - 2c') \times 3.1416$. (2).

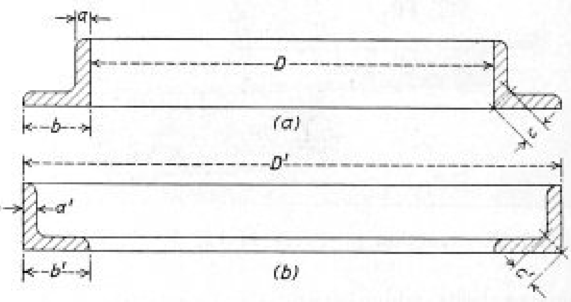


Fig. 1.—Outside and Inside Angle Iron Rings

The formulas given are for butt joints and if the rings are to be lapped and welded allow from ¾ to 1 inch additional length. These rules are approximately correct and are close enough for practical purposes.

For angles having unequal legs or if the thickness a is very great then the following formulas are applicable:

For outside rings:

$$L = (D + a + \frac{b}{3} \times 3.1416.$$

For inside rings:

$$L' = (D - a - \frac{b}{3} \times 3.1416.$$

Transition Piece Intersecting a Frustum of a Cone

Q.—Please show a method of laying out an intersection of a frustum of a cone and transition piece.—A. P.

A.—In the development, Fig. 1, the intersection of the transition connection and the frustum of the cone is produced, by first finding a true section of the transition piece in a plane as *x—x* in the elevation. The profile of this section is shown at (*a*), the upper part of the profile above the line 1′—1′ is elliptical and the lower part is semi-circular. The combination of these two sections produces an egg-shaped oval. The ellipse is developed by spacing off the semi-circle into a number of equal parts and the quadrant into one-half as many parts. The intersection of the lines drawn from the arcs establishes points 2′, 3′, etc., through which the curves of the ellipse are drawn.

To produce the miter lines, consider horizontal planes to pass through the frustum of the cone. The location of these planes is determined by drawing projectors from the profile (*a*) to intersect the outer element of the cone at *r*, *s*, *t*, *u* and *v*. The positions of these points are also located on the horizontal projection of the element of the cone as shown at *r*, *s*, *t*, etc., in the plan. With *o* as a center in the plan and *o-r*, *o-s*, *o-t*, etc., as radii, draw arcs, which are a part of the sections of the cone, as produced by passing the horizontal planes through it as explained.

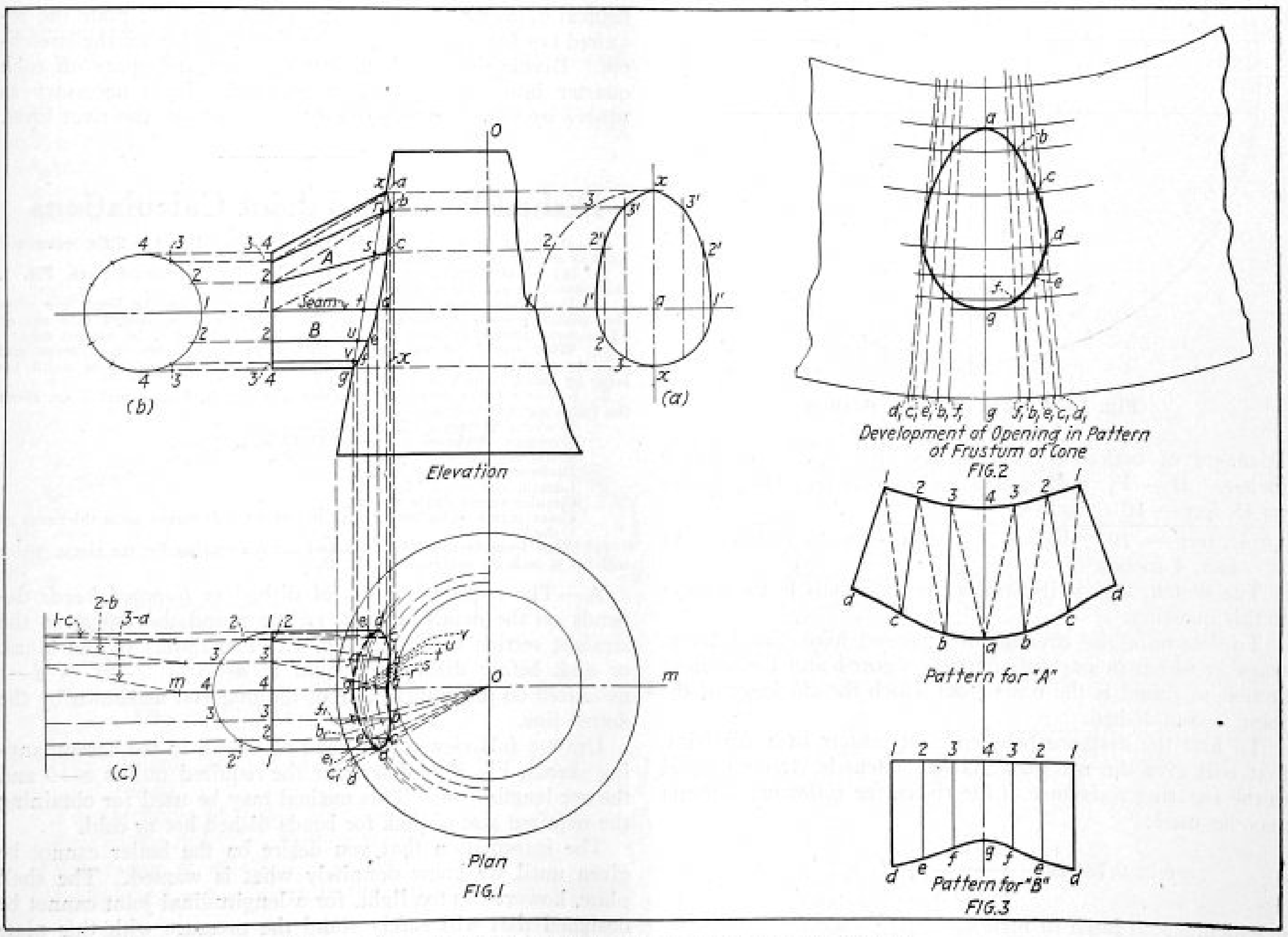
Locate in the plan the position of the transition piece and draw a semi-circle for the small end as shown. The semi-circle is divided into the same number of parts as in the one shown in profile (*a*). The intersection of the lines drawn through the points 1, 2, 3 and 4 of the profile with the arcs of the cone as at *a*, *b*, *c* and *d* are the required points on the miter line.

Figs. 2, 3 and 4 illustrate the pattern developments. As all reference lines are marked to correspond with those of Fig. 1, the developments should be readily understood.

Tire or Measuring Wheels

Q.—On page 7, chapter I, third edition, of "Laying Out for Boiler Makers," published by your company, is an illustration of a measuring wheel for the measuring of irregular curves. Will you kindly inform me where one of them can be bought? It would help me greatly in my work and I am unable to obtain one.—C. G.

A.—Circular measuring wheels graduated in inches and fractions of an inch are referred to as tire wheels. Dealers in blacksmith and boiler maker's tools have such instruments. You can procure them from Montgomery and Company, 64 Reade street, New York, N. Y.



Layout of Transition Connection to Frustum of Cone

Tank Bottom Calculation, Strength of Riveted Joints and Camber Layout

Q.—In your February issue of THE BOILER MAKER would you kindly explain how you obtain the proportion in a rectangular plate tank layout by R. L. Phelps, the formula:

$\sqrt{9 \text{ feet } 10\frac{1}{2} \text{ inches} \times 39 \text{ feet } 10\frac{1}{2} \text{ inches}} = 13$ feet 4 inches, etc.

I cannot see where the 9 feet 10½ inches or 39 feet 10½ inches comes from. The rest of the problem is very clear.

(2) Have you a good formula to determine the strength of the net section of plate to equal the strength of the rivet in the riveted joints?

(3) Have you a good formula to find the camber of a tapered course or cone?—C. H. H.

A.—The dimensions given for finding the length of $a - V_1$ should according to our understanding of the problem equal respectively the following:

$$v - V_1 = 3 \text{ feet } 10\tfrac{1}{2} \text{ inches}$$
$$M - V_1 = 45 \text{ feet } 10\tfrac{1}{2} \text{ inches.}$$

In the one-half section of the bottom there are three rows of sheets, each of which is 72 inches wide between rivet lines. Their combined width equals $72 \times 3 = 216$ inches. To this amount add the width of ½ sheet or 36 inches, or $216 + 36 = 252$ inches. The radius of the bottom equals 24 feet 10½ inches or 298½ inches. The width $v - V_1 = 298\frac{1}{2} - 252 = 46\frac{1}{2}$ inches or 3 feet 10½ inches.

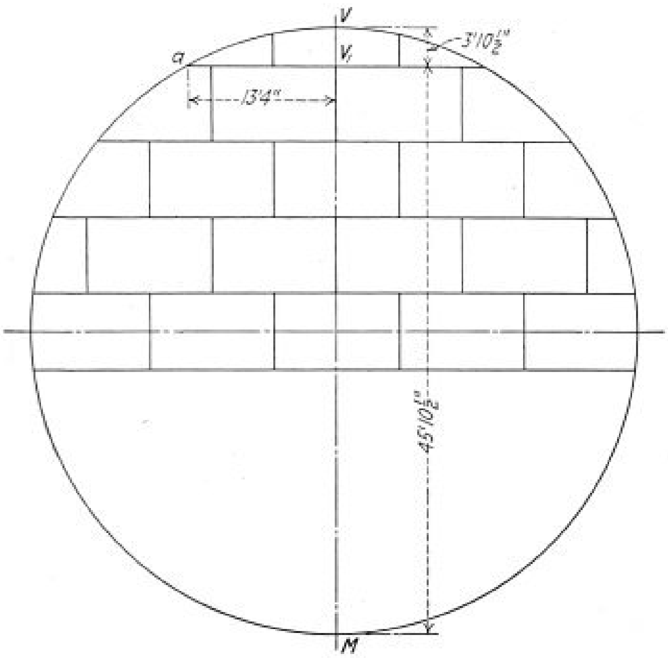


Fig. 1.—Layout of Tank Bottom

Diameter of bottom equals 24 feet $10\frac{1}{2} \times 2 = 49$ feet 9 inches. $M - V_1 = 49$ feet 9 inches $-$ 3 feet 10½ inches $=$ 45 feet — 10½ inches.

$\sqrt{45 \text{ feet} - 10\frac{1}{2} \text{ inches} \times 3 \text{ feet} - 10\frac{1}{2} \text{ inches}} = 13$ feet, 4 inches.

The sketch, Fig. 1, illustrates the conditions in the answer to this question.

To determine the strength of a riveted joint, the different ways in which it may fail must be figured and the weakest section so found is the basis from which the efficiency of the joint is established.

To find the distance between rivet centers in a lap joint, that will give the net plate section a tensile strength equal to the shearing resistance of the rivets, the following formula may be used:

$$p = 0.7854d^2 \frac{S}{t \times TS} + d$$

in which, p = pitch in inches
d = diameter of rivet, inches (driven size)
S = shearing strength of rivet material, pounds per square inch
t = plate thickness, inches
TS = tensile strength of plate, pounds per square inch.

We would advise you to procure a treatise on riveted joint design and strength of materials.

In the August issue, year 1923, of THE BOILER MAKER is given two methods of determining the camber of cones and conical sections.

Examination Questions

Q.—I have a copy of a number of questions that were asked at a recent boiler examination and I do not feel that I can answer some of them as completely as I would like to. Will you please answer the following: At a shop inspection, what would cause you to reject a piece of flanged steel and in the process of being flanged in the dies what would you particularly look for? What is necessary to secure the uniform spacing of circumferential seams? Explain how you would mark off rivet holes to be evenly spaced.—*Engineer.*

A.—In the inspection of boiler materials observe if the plate is stamped in accordance with the requirements of the rules under which the boiler is to be operated. Examine the plate, for defects such as laminations, and micrometer the plate for thickness.

Plates undergoing flanging operations may crack or tear in the flange. Small cracks may occur in the knuckle of the flange, especially in cases where the flange is marked or centered too heavily. Plates should not be flanged, at what is called a *blue heat,* that is, below a temperature, at which the metal should be heated in order for it to readily flow during the flanging operations.

To lay off rivet centers in circumferential seams, calculate the stretchout for each adjoining ring or course from the neutral diameter of each ring. Locate on each plate the required lap for seams, and on the rivet lines lay off the stretchout. Divide the stretchout into quarters and space off each quarter into equal parts, as required. It is necessary to *square up* the plate preparatory to laying out the rivet lines.

Dished Head and Joint Calculations

Q.—It would be a great help to me if you could find a little space and time to answer the following questions:

1. (a) What formula is there for finding the diameter of plate, Fig. 1, that should be cut for a standard dished head, Fig. 3?

(b) How much should the circumference measure on the bend line after the dishing process is finished, Fig. 2, but before it is flanged into shape? (This measurement to be on inside of plate.) Heads are to be worked cold.

(c) What would be the sizes if they were worked hot in a press and flanging machine? I cut plate 41 inches, but that seemed to be a bit too large by about ⅝-inch in diameter.

2. I have a boiler to make something like sketch, Fig. 4, and I am given the following information:

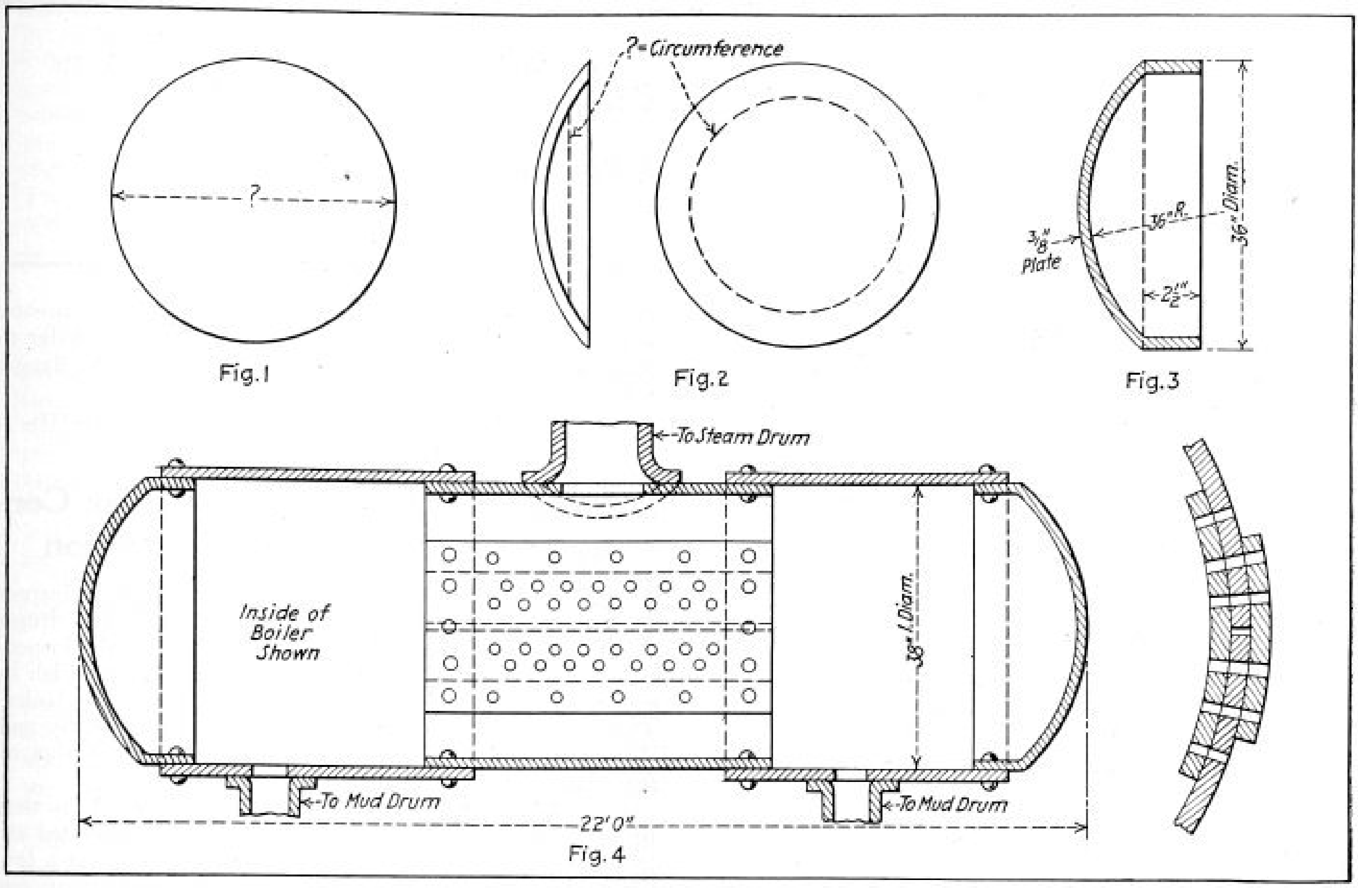
Working pressure, 225 pounds.
Minimum thickness of plates, 11/32 inch.
Minimum tensile strength, 63,000 lbs.
Diameter, inside, 38 inches.
Length, over all, 22 feet.
Circular seams single riveted.
Cross seams to be butted with in-and-out butt straps same thickness as shell.

(a) What formula could I use to find out the spacing for the rivets, which will be ⅜-inch on centers?—R. E. D.

A.—The required radius of dished or *bumped heads* depends on the depth of dish, radius r and the flange in the straight section shown in Fig. 1. The radius of the blank or disk before dishing is equal to $a—b + c—b + d—c$ measured on the neutral line of the material as shown by the dotted line.

Draw a full view of the head as shown in the accompanying sketch, Fig 5, to determine the required radius $a—b$ and the arc length $c—b$. This method may be used for obtaining the required size of disk for heads dished hot or cold.

The information that you desire on the boiler cannot be given until we know definitely what is wanted. The shell plate, however, is too light, for a longitudinal joint cannot be designed that will safely stand the pressure with this plate thickness. For a triple riveted butt joint, shell plate 11/32



Calculations on Dished Heads and Seam Design

inch in thickness has a maximum efficiency of 87½ percent and a quadruple riveted butt joint an efficiency of 93.8 percent.

Assume that the shell is made of solid plate with no longitudinal seam, in such a case the allowable pressure may be found from the formula:

$$P = \frac{TS \times t}{R \times FS}$$

in which,

P = allowable pressure, pounds per square inches.

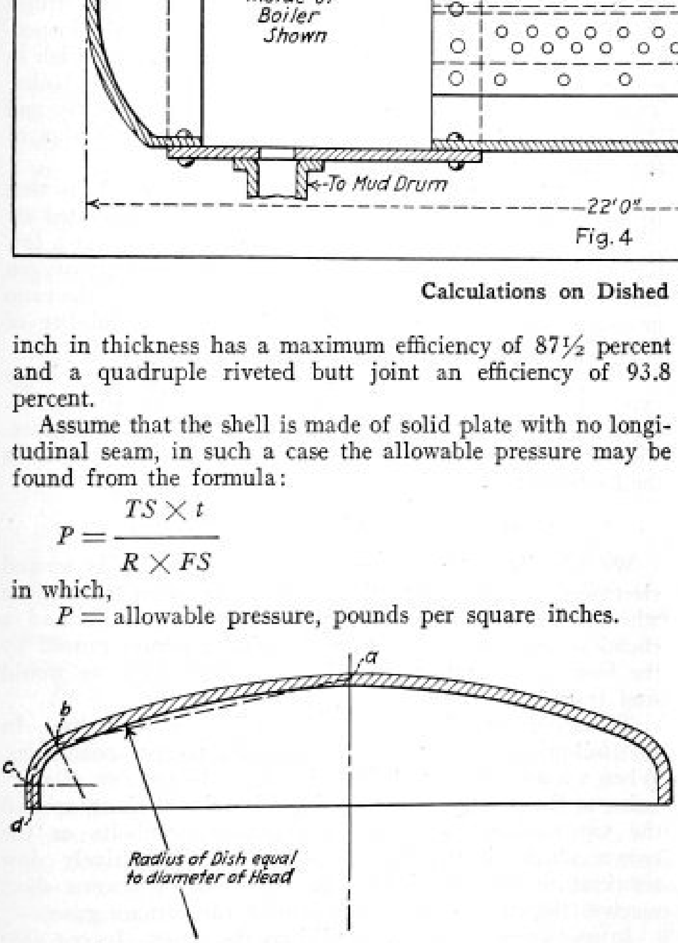


Fig. 5.—Finding the Radius of Head

TS = ultimate tensil strength of plate, pounds per square inch.

t = thickness of plate, inches

R = inside radius of weakest course, inches.

FS = factor of safety = 5 for new constructions.

Substitute the values given in the problem in the formula, then

$$P = \frac{63{,}000 \times 11/32}{19 \times 5} = 227.96 \text{ pounds per square inch.}$$

This calculation shows that a longitudinal joint would have to be nearly equal in strength to the solid plate section, which is not possible.

To determine the maximum allowable working pressure when the joint efficiency is known use the formula:

$$P = \frac{TS \times t \times E}{R \times FS_1}$$

in which E equals the efficiency of the longitudinal joint in percentage. The efficiency of a riveted joint depends on the plate thickness, thickness of butt straps, size and arrangement of rivets. The joint must be figured for the different ways it may fail and the strength of the weakest section divided by the ultimate strength of the solid plate section for the unit of length considered is the efficiency. Refer to the A.S.M.E. code on rivet calculations.

Forming Spiral Flights

Q.—Could you inform me of the method employed by the builders of spiral conveyors to form the spiral flights? We have had to beat ours out by hand; that is, in the case of flights of 18-inch pitch. It seems to me that they are twisted in some manner. We have twisted small ones with a long pitch, but these flights are made out of 3/16-inch plate. Any information you could give me would be very welcome. Thanking you for past favors.—H. M. K.

A.—In plants where a large number of spiral conveyors are built, the spiral sections are "raised" or bent to the required curvature by formers. Either air or hydraulic pressure may be used, depending on the plate thickness.

The Interstate Commerce Commission's report to Congress for March on the condition of railway equipment shows that during the month 5,083 locomotives were inspected; that 2,674 were found defective and 468 were ordered out of service.

Letters from Practical Boiler Makers

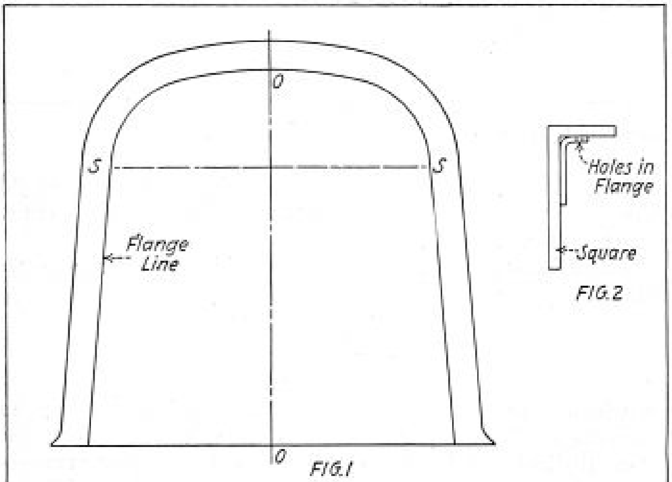
This Department Is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

Renewing Flue and Door Sheets

In answer to Mr. Lindstrom's request for additional information on renewing flue and door sheet per "I.F.D.'s" inquiry in the March issue of The Boiler Maker the following is submitted:

We assume that these sheets are taken out in such a manner as to make it difficult to use them for a pattern. First, get inside width at mud-ring, this will give us outside width of flue sheet at mud-ring, set off width as shown by Fig. 1, erect center line and on this line set off distance from the bottom of the mud-ring to the under side of the crown sheet at the center. Mark this distance 0-0 as shown.

Now, as the boiler has probably seen much service, the curvature of the crown sheet has become somewhat irregular, so that it will be almost impossible to plot off a regular radius for the top flange of the flue sheet. Then we will take a sheet



Laying Out a New Door Sheet

of light iron, jacket iron will do, wide enough for the top of the firebox and deep enough to extend below the end of the curve S-S. Set this up against the edge of the crown sheet and side sheet and mark off the outline on the under side; also mark the center of the crown sheet and at the points where the curve ends draw in a horizontal line, get the center of this and square up to the center line of the crown sheet. Cut out the template to the lines marked and set on the center line of the plate, bringing the center line of the template to correspond. Mark off and at the points S-S draw the lines down to X-X. This gives us the pattern of the sheet to the flange line. Allow flange as shown.

To locate the holes in the flange, take the square and set it on the old sheet, as shown in Fig. 2 (a small section of the sheet will answer), and mark off the distance of the hole from the back of the flange, as shown. Transfer this distance to the new sheet when flanged. This will give us the line for the location of the rivet line. To save the trouble of putting in the sheet to mark off the holes, if the sheet has been flanged to correctly correspond with the template, take a narrow strip of thin iron or tin, set to the center hole in the crown sheet and extend down on one side of the firebox at the rivet holes; mark off the holes on this and transfer to the flange, commencing at the top of the center of the flange. With care, this should give good holes.

Lorain, Ohio. Joseph Smith.

Determining the Causes of Boiler Corrosion and Methods of Prevention

Having had an opportunity a short time ago to inspect a watertube boiler consisting of three horizontal drums below and three above, I found, in making the inspection that the feedwater entered the rear lower drum which in this case was assumed to be the coolest part of the boiler. This shell or drum was pitted and corroded very badly and the other five drums were in good shape and not a sign of pitting or corrosion.

I took the matter up with a chemist interested in that line and he informs me that it was the effect of liberated air in the water caused by oxygen and was most active at a low temperature. Air, we know, is composed of one part oxygen and four parts nitrogen but when dissolved in water, the ratio or percentage is about one-half owing to the solubility of oxygen being greater.

When the air in the water is liberated by boiling, a large excess of oxygen is formed and is very active chemically, thereby allowing corrosion, known as pitting, to take place. Pitting or corrosion is also caused by free acids present in the feedwater.

Still Other Causes of Corrosion

We still find another cause for pitting which is termed electrolysis or galvanic action, which very often takes place when feedwater passes through brass pipes. If we had a chemical analysis made where the pitting occurs caused by the feedwater having passed through brass pipes, we would find traces of copper.

This offers one theory as to why pitting is so active. In the following cases we have just the reverse conditions. When a locomotive type boiler pits along the top row of staybolts, at the wrapper sheet, at the sides, throat sheet, around the top row of staybolts, around the crownbolts or the crown sheet, it cannot be said a comparatively low temperature or poor circulation exists for the crown sheet receives the full benefit of the heat of the furnace gases.

In no two cases are the conditions the same. In one case the crown sheet and crown bolts pit and corrode, while in a boiler of the same type and used in the same locality, the pitting and corrosion is more active at the top row of staybolts of the side wrapper sheets or along the bottom of the barrel of the boiler.

A case came to my notice in the past few weeks of a horizontal tubular boiler of the economic type, wherein the barrel sheet directly over the fire was pitted and corroded very badly, also the bottom of the shell which was not exposed to the products of combustion. Here we have a case where both poor and good circulation takes place, also a low temperature and a high one, yet the theory is held that corrosion is more active at low temperatures when caused by oxygen liberated in the water.

My opinion is that most pitting we have is caused by acids such as tannic, nitric and sulphuric present in the feedwater entering the boiler. Of these, sulphuric acid is considered the most dangerous and attacking the metal of the flues or shell from which the boiler is made corrodes it very rapidly. The other acids are not considered so damaging in their action but are dangerous and water containing them should be neutralized when used.

Corrosion in Marine Boilers

Another case of corrosion that came to my notice was one wherein a Scotch marine boiler was set on concrete blocks instead of brackets built for that purpose. At the time of inspection signs of moisture and corrosion were noticed where the shell set on the concrete blocks. Taking the hammer and cleaning away the scale and corrosion, I was able to puncture a hole through the shell with apparent ease. This was what is termed an external corrosion and could have been prevented by keeping the boiler set up on brackets and the boiler shell free from moisture or leakage.

Having explained some cases of pitting or corrosion, we will take up a short sketch on some remedies or preventives.

Preventing Corrosion

On the first appearance of pitting, thoroughly clean the boiler surfaces, if possible, and apply a good coat of red lead and boiled linseed oil mixed into a paint. This operation should be done from time to time to insure the metal surfaces being protected.

The corrosive acids may be neutralized by soda or alkali. Corrosion caused by fresh water may be prevented by a treatment of red lead and boiled linseed oil applied to plates and surfaces.

The water may be chemically treated preferably before entering the boiler as it gives better results than waiting until after the feedwater entered the boiler. Feedwater heaters are also very helpful.

Port Dickinson, N. Y. Charles W. Carter, Jr.,
State Boiler Inspector.

Economy and Efficiency

It is claimed by some "hard-shell" lovers of argument that such an expression as "economical efficiency" is ridiculous and superfluous—that efficiency naturally includes economy. The writer, however, claims that there are four ways of looking at it and that all four may be correct.

First, there is;

Economy Alone

Economy alone involves a great many points in its definition. In general though, economy means "making a dollar do as much as possible" regardless of conservation of natural resources, regardless of refinement of machinery, and regardless of life of machinery. A machine does not necessarily have to be efficient in order to be economical. Thus the thermal efficiency of a steam engine may be 10 percent and the thermal efficiency of a gasoline engine may be 20 percent. Yet it is possible for the steam engine to be more economical because of the cheapness of coal as compared with gasoline. This should surely be clear to any man who has ever had experience with the two types of engines.

Second, there is;

Efficiency Alone

This expression has a great variety of meanings. Thus an engineer who is constantly on the alert may be called an "efficient" engineer because of his vigilance. A machine is called efficient when it does almost as much as it can possibly do under ideal conditions. An efficient electric generator, for instance, is one that transforms most of the mechanical energy into electrical energy. Efficiency is generally measured by dividing the output of energy by the input of energy. Efficiency during the war applied to practically everything—governments, soldiers, ships, men, aeroplanes, machines, etc. All of these things may be efficient, yet they may not be economical. For example, if you have an electric generator whose efficiency is 95 percent you can call it "efficient," but if you would have it running all night lighting an empty unused building that wouldn't be economy. It might be better economy to use a few storage batteries for keeping a stray light a-going here and there in strategic positions.

Third, we have;

Economical Efficiency

This may mean that a machine, say, is both efficient and economical. Or, it is economical in spite of its efficiency. If a thing is economically efficient it may be considered as being at its best. For example, it may be possible to utilize 25 per cent of the heat in coal by the use of machinery whose first cost would be $1,000,000 per horsepower. Such a steam engine would be an "efficient" machine, but it would not be economically efficient. In the whole cycle of first costs and operations there is just one combination that represents the height of economical efficiency. The only way in which that point can be determined is by endless experimentation and computation. It is quite probable that it will never be accurately determined in the case of the steam engine or any other engine.

Lastly, we have;

Efficient Economy

Which means that a machine needn't necessarily be efficient, but it must be economical and this economy must be cared for in an efficient manner. Otherwise, it may be translated to mean as much as the reversed expression "economical efficiency."

The writer has written this explanation or discussion at some length in order to clearly differentiate between the four expressions and show that each expression has a meaning very much its own. Economy and efficiency as applied to engineering practice are often very, very far apart.

Newark, N. J. N. G. Near.

Replacing Flue and Door Sheets

I have observed in the March issue of The Boiler Maker an inquiry regarding replacement of flue and door sheets in locomotive fireboxes. Having had some little experience with work of this nature I venture to offer a suggestion concerning it.

I have found it a good practise in making such replacements not to rely altogether on the original firebox for the layout. The sheets may have been carelessly laid out to start with or the box may not have been properly lined up to give the same water space on each side or it often happens that a door sheet ready to be replaced has already had a fire-door collar or other patch applied.

The staybolt holes in such patches are in nine cases out of ten located by guesswork and the safest way of insuring fair holes is to use the outer or backhead for the staybolt layout of the new door sheet. A sketch of half the layout may be made in a very short time, working from the vertical centerline of the backhead and the bottom row of staybolts.

A Simple Method of Laying Out the Flange Line

Probably the simplest way of laying out the flange line is to remove the old door sheet complete in one piece and lay it, flange toeing down, on the new plate to be used and mark around it with soapstone. Transfer the vertical center line and the bottom line of staybolts from the old sheet to the new and complete the layout from the sketch made as described. Straight flue sheets may be replaced in much the same way by making a sketch of the tube hole layout and checking the staybolt holes from the throat sheet. In the case of a flue sheet which bends and slopes toward the rear just below the belly-braces, it will be necessary to make a template of the bend and a little ingenuity must be exercised in checking the holes.

I have seen more than one railroad shop, when renewal of side-sheet, crown sheets or boiler courses or partial courses became necessary where the practise was to cut out the old sheet, straighten it (sometimes at considerable expense) and mark off the new plate from it. Besides involving much unnecessary labor this method usually causes a large percentage of bad rivet holes and should be avoided.

BOILERS SELDOM CHECK WITH PRINTS

It happens that I have in the past laid out fireboxes of various types for several different railroads. In most cases drawings printed from the manufacturer's tracing were furnished; but rarely have I found a boiler to check up accurately with the drawing. Sometimes I have found it desirable to throw away the blueprint and work directly from the outer wrapper of the boiler for the firebox layout.

I have often wondered why railroads do not exercise a little more foresight and in ordering new engines specify that all firebox door sheets, wrappers and flue sheets shall be marked from sheet iron templates; these templates to become the property of the purchaser when locomotives are delivered. The cost of a few sheets of light gage iron is trivial and the saving in labor when firebox replacement becomes necessary would be considerable, and assuming the original construction to be done in a workmanlike manner the possibility of bad holes as a result of replacement, is eliminated.

Houston, Texas. R. L. PHELPS.

Qualifications of Boiler Inspectors

THE statement of requirements for boiler inspectors, which appeared on page 119 of the April issue of THE BOILER MAKER in answer to W. D.'s question on the subject, has led me to give the requirements as they appear on the Civil Service papers announcing examinations for the important post of a federal boiler inspector.

"It must be shown in connection with his application that each applicant is a person (a) of good moral character and habits, active, intelligent and discreet; (b) of good speech and manners qualified to address and confer with railroad officials as occasion may require and that (c) he has had not less than three years' railroad experience in the capacity of master mechanic, road foreman of engines, locomotive boiler maker, locomotive boiler inspector, roundhouse foreman, shop foreman, locomotive machinist or locomotive engineer; or, not less than five years as a locomotive inspector or locomotive fireman and that he has within the three years next preceding the date of his application been in active service in any such capacity or in the capacity of inspector of locomotive equipment in the service of the government of the United States or any state or territory."

New York, N. Y. A. J. O'NEIL.

BUSINESS NOTES

A branch sales office of the Burke Electric Company, Erie, Pa., has been established in Chicago at 310 South Michigan avenue. This office is in charge of Miles E. Standish.

On May 1 the Wilson Welder and Metals Company moved the plant and general offices to the Wilson building, Hoboken Factory Terminal, Hoboken, N. J. This company has recently appointed the Mills and Lupton Supply Company of Chattanooga, Tenn., exclusive distributors for Wilson welding machines and "Color Tipt" welding wire in Tennessee and Kentucky.

Announcement has been made by the Oilgear Company, Milwaukee, Wis., manufacturers of variable speed hydraulic power transmissions, hydraulic broaching machines, presses, riveters, etc., of the appointment of Henry Prentiss and Company as its exclusive agent in the New England states, New York city, northern New Jersey and northeastern Pennsylvania. The main office of Henry Prentiss and Company is located at 149 Broadway, New York city, with branch offices in Boston, Buffalo, Hartford, Rochester and Syracuse.

The Smith-Heylandt Company, with offices at 2633 Fourth street, S. E., Minneapolis, Minn., has been incorporated to take over the patents, importation, sale and distribution of Heylandt apparatus for the manufacture of oxygen and other gases by the liquefaction process. Elmer H. Smith, president of Smith's Inventions, Inc., and of the Commercial Gas Company, heads the new organization as president. John R. R. Miles will be secretary and Herman G. Amling, former representative of the Heylandt Company, will cooperate with the new organization.

TRADE PUBLICATIONS

GAGE MAKING.—A new gage catalogue has been issued by the Greenfield Tap and Die Corporation, Greenfield, Mass. All of the latest advances in the art of gage making are shown in this catalogue.

OILGEAR PRODUCTS.—Four bulletins, Nos. 30, 31, 32 and 33, descriptive of broaching and assembling presses, the Type W variable delivery pump, the Oilgear hydraulic riveter and the Oilgear bench press, have been issued by the Oilgear Company, Milwaukee, Wis.

RESPONSIBILITY OF BANK DIRECTORS.—Recent banking tragedies that are avoidable by the application of modern accounting methods are outlined in a booklet issued by Ernst and Ernst, New York. The eleven points emphasized by the comptroller of the currency for bank directors' special attention, with timely suggestions, are also given.

THE AUTOMATIC FIRE DOOR.—The present position in the field of locomotive operation of the automatic fire door, particularly as relates to the Shoemaker radial fire door, is clearly outlined in a four-page circular recently issued by the National Railway Devices Company, Chicago. The construction of the Shoemaker radial type door is clearly shown and red arrows pointing to various parts of the door emphasize its operating advantages. The fourth page of the circular is devoted to a diagram which shows the clearance lay-out of the Shoemaker radial fire door with a commonly applied mechanical stoker.

TREATMENT OF BOILER WATER.—One of the recent publications of value is a pamphlet entitled "Treatment of Boiler Water" published by the Babcock & Wilcox Company, describing a new boiler water testing apparatus designed by that company and containing a short but comprehensive treatise on the use of soda in combating corrosion and scale in marine boilers. The new testing apparatus is an enlargement of the well-known Babcock & Wilcox silver nitrate testing outfit which for years has been a standard among the marine men, the addition to the original apparatus being a simple, quickly made and accurate alkalinity test. The information on the treatment of boiler water is of decided interest to the engineer and equally valuable to the owner who pays the repair bills consequent upon damages due to corrosion.

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—George Uhler, Washington, D. C.

Deputy Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

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Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—John A. Stevens, Lowell, Mass.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 West 39th Street, New York.

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Chairman—J. F. Scott, Trenton, N. J.

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Vice-Chairman—R. L. Hemingway, San Francisco, Cal.

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International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

J. A. Frank, International President, suite 522, Brotherhood Block, Kansas City, Kansas.

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, suite 524, Brotherhood Block, Kansas City, Kansas.

H. J. Norton, International Vice-President, Alcazar Hotel, San Francisco, Calif.

International Vice-Presidents—Thomas Nolan, 700 Court St., Portsmouth, Va.; John Coots, 344 North Spring St., St. Louis, Mo.; M. A. Maher, 2001-20th St., Portsmouth, Ohio; E. J. Sheehan, 7826 South Shore Drive, Chicago, Ill.; John J. Dowd, 953 Avenue C, Bayonne, N. J.; R. C. McCutcheon, 15 La Salle Block, Winnipeg, Man., Can.; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; John F. Schmitt, 605 East 11th Ave., Columbus, Ohio.

Master Boiler Makers' Association

President—E. W. Young, mechanical assistant to G. S. M. P., C. M. & St. P. R. R., 787 Caledonia Place, Dubuque, Iowa.

First Vice-President—Frank Gray, tank foreman, C. & A. R. R., 705 W. Mulberry Street, Bloomington, Ill.

Second Vice-President—T. F. Powers, System G. F. Boiler Dept., C. & N. W. R. R., 1129 S. Clarence Avenue, Oak Park, Ill.

Third Vice-President—J. F. Raps, G. B. I., I. C. R. R., 4041 Ellis Avenue, Chicago, Ill.

Fourth Vice-President—W. J. Murphy, G. F. B. M., Penn. R. R. Lines West, 3614 Mexico Street, N. S., Allegheny, Pa.

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Secretary-Treasurer—H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

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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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

SELECTED BOILER PATENTS

Compiled by
GEORGE A. HUTCHINSON, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

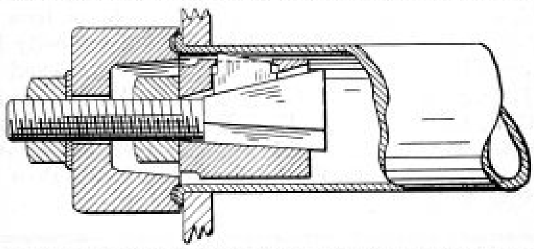
1,473,467. PNEUMATIC DEVICE FOR CLEANING BOILER TUBES. CHARLES LOUIS CORNE, OF BROUSSARD, LOUISIANA.

Claim.—A pneumatic gun for cleaning out tubes of boilers, comprising a cylindrical barrel with means for supplying compressed air to same, a head mounted in one end of said barrel and provided with a nozzle, a second head closing the opposite end of said barrel and provided with a packing

gland, a stock connected to said second head, a valve rod passing through said barrel and said gland, a valve mounted on said rod near one end thereof and adapted to close said nozzle, a yoke having a cross bar slidably mounted on said rod near the other end thereof, a notched sear block journalled in said stock and pivotally connected to the arms of said yoke, a trigger pivoted to said stock and normally engaging said sear block to hold the valve rod in the retracted position, and a safety spring normally pressing said valve rod rearward in said yoke to keep the valve closed, but yielding to open said valve when the pressure in the barrel becomes excessive. Eight claims.

1,459,542. BOILER-TUBE REPAIR PLUG. HENRY N. McCATHRON, OF BRIDGEPORT, CONNECTICUT.

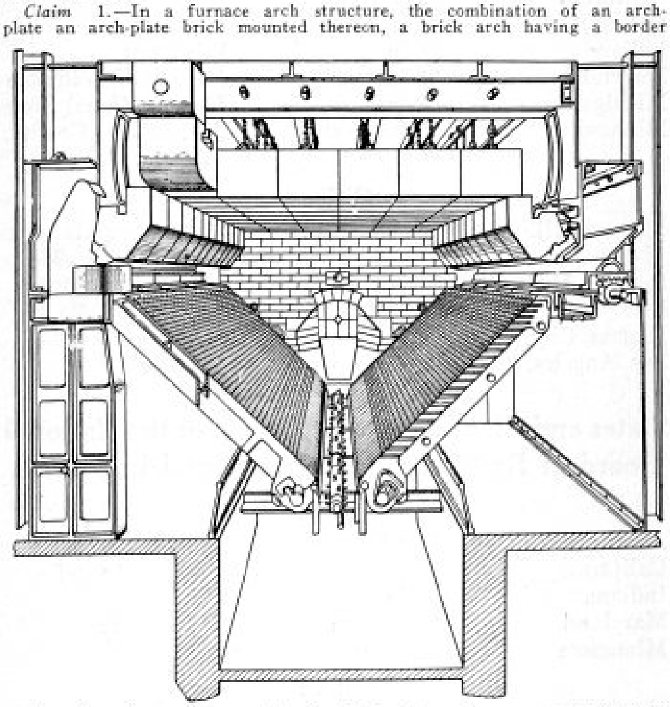
Claim 1.—In a device for sealing the end of a conduit, a body portion adapted to be slid in said conduit, lugs contained within the body portion and projecting outwardly therefrom, a bolt provided with an enlarged end, a nut engag-



ing the body portion and bolt to draw the enlarged end thereof against said lugs and press the same outwardly for engagement with the inner walls of said conduit, a closure member provided with a packing ring and adapted to be clamped against the end of said conduit, and a nut in co-operation with said member and bolt to retain the closure member in position and seal the conduit. Four claims.

1,488,660. ARCH CONSTRUCTION FOR FURNACES. FRANK B. BIGELOW, OF DETROIT, MICHIGAN, ASSIGNOR TO MURPHY IRON WORKS, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

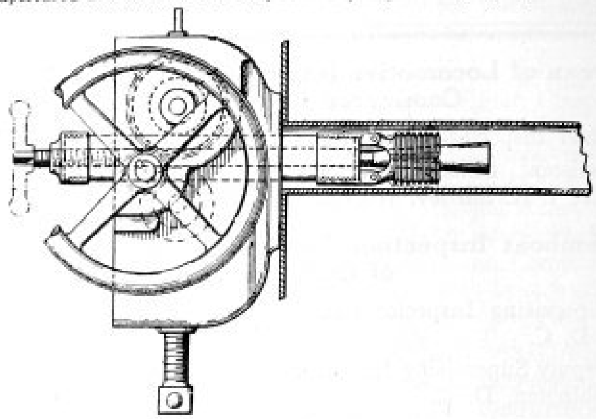
Claim 1.—In a furnace arch structure, the combination of an arch-plate an arch-plate brick mounted thereon, a brick arch having a border



brick at least in part over said arch-plate brick, and means supporting said border brick from above and capable of permitting variation in the contactual relation of such arch-plate and border bricks. Five claims.

1,486,637. APPARATUS FOR DRAWING BOILER TUBES. PETER COVAL, OF PITTSBURGH, PENNSYLVANIA.

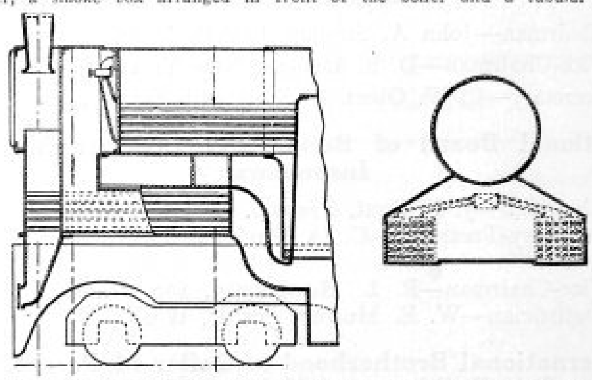
Claim 1.—In a device of the character described, a casing formed with an apertured abutment at one end, relatively adjustable gripping rolls within



said casing, a bracket fixed to one side of said casing, gearing mounted in said bracket for rotating said rolls, and exterior means for operating said gearing. Four claims.

1,477,968 LOCOMOTIVE PROVIDED WITH TUBULAR AIR PREHEATERS. FREDRIK LJUNGSTROM, OF LIDINGO-BREVIK, SWEDEN, ASSIGNOR TO AKTIEBOLAGET LJUNGSTROMS ANGTURBIN, OF STOCKHOLM, SWEDEN, A CORPORATION.

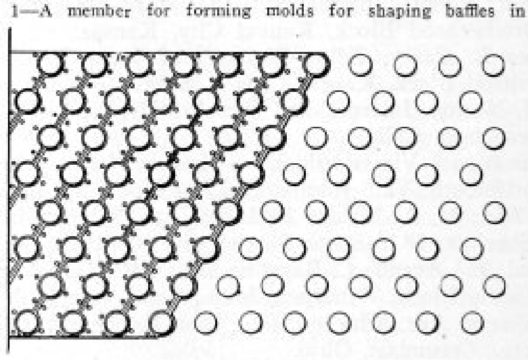
Claim.—In locomotives and similar carriages the combination with a steam boiler, a smoke box arranged in front of the boiler and a tubular air-

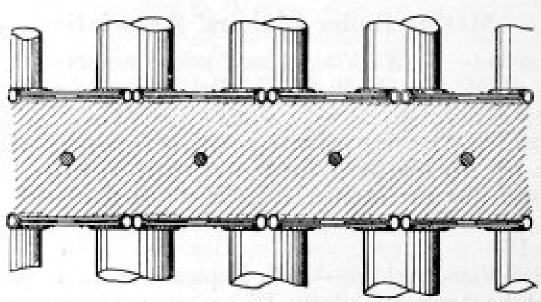


preheater, the tubes of which are situated in the longitudinal direction of the boiler, said air-preheater being arranged beneath the smoke box as well as beneath the boiler of a channel conducting waste gases from the boiler, the one end of said channel communicating with the smoke box, whereas the other end thereof communicates with that end of the air-preheater which is situated beneath the boiler. Four claims.

1,489,249. WALL SECTION FOR FORMING BAFFLES IN BOILERS. JOHN M. HOPWOOD, OF PITTSBURGH, PENNSYLVANIA.

Claim 1—A member for forming molds for shaping baffles in boilers





having in combination a body portion and yielding edge portions and means for changing the transverse dimensions of one of said parts. Four claims.

THE BOILER MAKER

JUNE, 1924

Repairing Locomotive Boilers at Bischheim, France*

Special Equipment Developed at New Alsace and Lorraine Railways' Boiler Shop to Speed Up Production

THE Alsace and Lorraine Railways operate four main locomotive repair shops located at Bischheim, Montigny, Mulhouse and Basse-Yutz. Until recently these shops, although rather well equipped with pits and material handling facilities, were not particularly adapted for boiler repair work with the exception of the one at Montigny.

This lack of boiler repair facilities was particularly serious immediately following the war when over 40 percent of the equipment of this system was in need of repairs, especially the boilers. About seven hundred and fifty of the locomotives of this road were fitted with steel fireboxes made of rather poor quality plates and had during the war received little attention. Steps had to be taken by the new management to correct the lack of facilities so that the repair of these boilers might be made with a greatly decreased number of workmen than were available before the war.

Having this object in view, it was decided to enlarge the Montigny boiler shop, which was quite small, and to build an entirely new shop at Bischheim. The principal work to be undertaken at Bischheim was the replacement of complete fireboxes by the shop force. In some cases it was necessary to strip the old fireboxes and ship the boilers to outside firms to have them fitted with new copper fireboxes which is more or less standard practice on European roads.

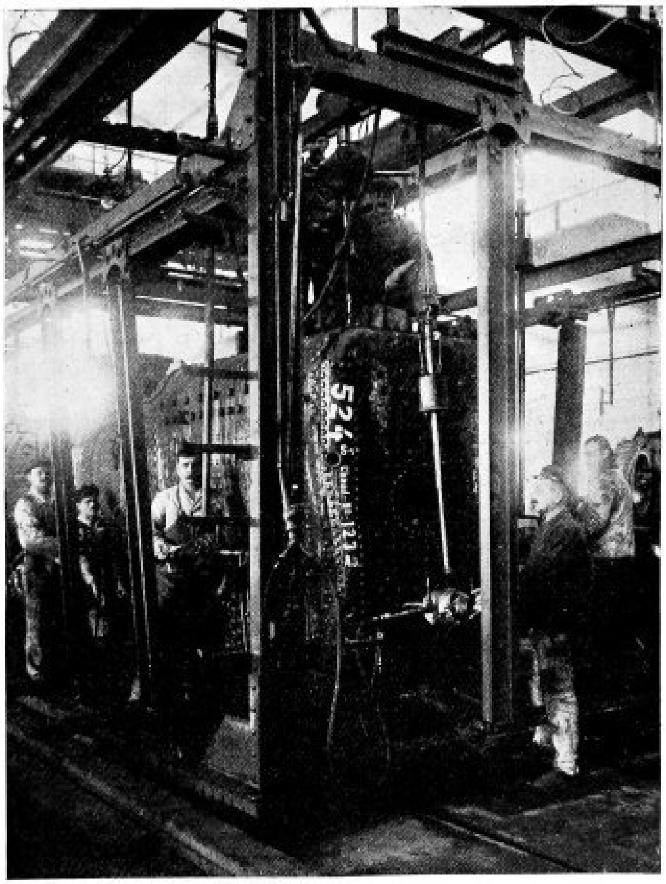


Fig. 1.—Standard Used in Removing Firebox Stays

Beginning thus with new equipment it was possible for the management to apply modern shop methods and equipment to provide for the stripping of boilers and the fitting up of new boilers. Special structures and jigs, which will be later described, were provided so that the tools and facilities best suited for the special work required might be at hand at all times.

The structures mentioned, although particularly developed for the replacement of fireboxes, are equally satisfactory in making ordinary repairs and quite adaptable to the requirements of a building shop.

The Bischheim boiler shop, built of reinforced concrete, consists of a central bay 492 feet long, 66 feet wide, which is served by two traveling cranes of 30 and 5 tons' capacity respectively and two side bays 492 feet long, 26 feet wide, each one being served by one crane of 3 tons' capacity.

In general the central bay is used for actual repair work, the stripping of defective parts, the installation of new parts, electric welding repairs, boiler tests and for the repair of steel plate work. A 600-ton flanging press served by an oil furnace is located in the plate section of this bay, to take care of both boiler and tank flanging.

The side bays are reserved for the repair of complete fireboxes and spare parts such as mudrings, half and three-quarter side sheets, boiler plates, light sheet metal work, safe-ending of tubes and superheater flues, repairing and grinding of the cocks and valves. Casing work is done in the erecting shop.

Schedule of Boiler Work

Boiler repair work is divided as follows, a separate location being reserved for each operation listed:

1. Stripping of boiler and locomotive from frame.
2. Drilling out stays and tie rods for dismantling of firebox; cutting out rivets.

*Translation of an article by M. Oudet, which appeared in *Revue Générale des Chemins de Fer et des Tramways*.

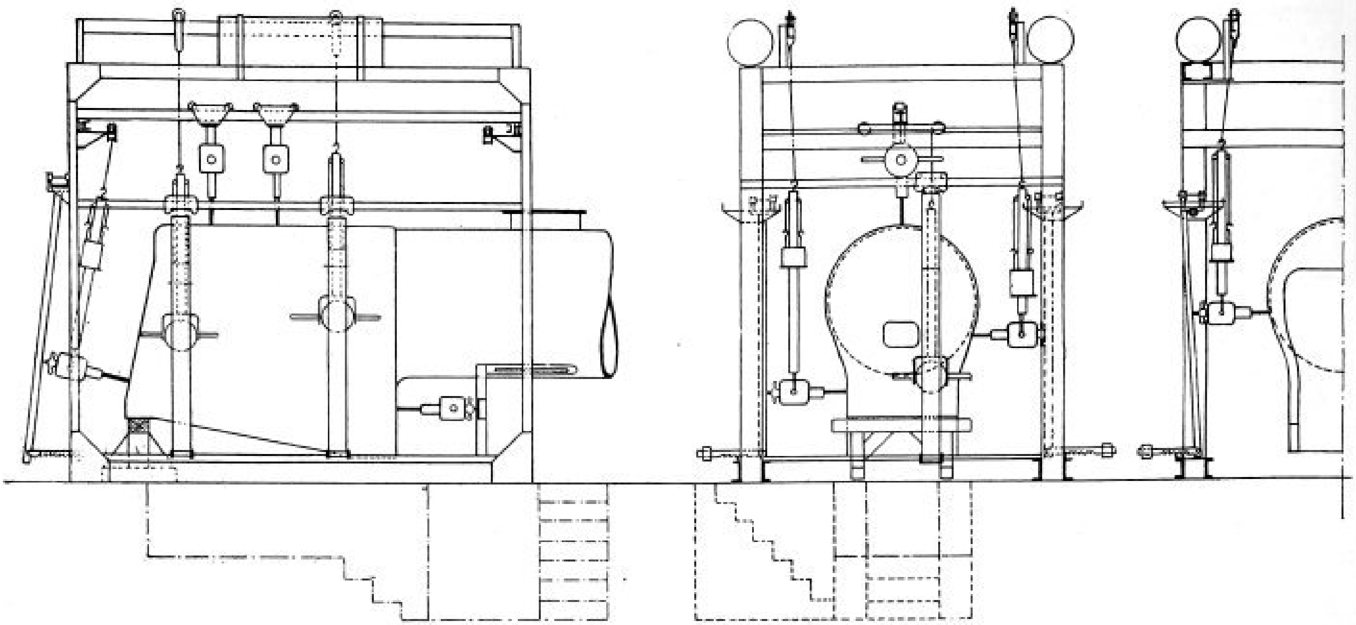


Fig. 2.—Schematic Arrangement of Framework in Stay Drilling Operation

3. Cutting off stays and rivets and sections of firebox to be replaced.
4. Cutting off sections of stays and tie rods which remained attached to the shell of the firebox in operation 3.
5. Cleaning of the boiler.
6. General repair of the boiler, replacing parts, reclaiming corroded plates by means of electric arc welding, etc.
7. Putting firebox in place.
8. Riveting of the firebox to the mudring and door sheet.
9. Drilling and tapping stay holes.
10. Screwing in the stays.
11. Riveting the stays.
12. Installing tie rods, setting in place of the cocks and valves and installing tubes.
13. Testing the boiler.

The practice is to remove the tubes before the boiler is taken into the shop. The locomotive is then hauled into the shop by means of a windlass and placed in a standard provided with winches electrically controlled which are used to lift the boiler off the frames and place it on a truck on which it is taken to the boiler shop.

Here it is placed on a special truck in readiness for operation 2. The boiler remains on this truck until it is time for operation 5. While on this truck it passes first under a drilling standard, then is removed to the location reserved for operation No. 3, moved through operation 4 and finally through operation 5, cleaning, which takes places on the same truck in a special building located outside of the shop. The boiler is then brought back on the same truck into the boiler shop and placed in the center bay on a stationary block on which the repairs to the barrel of the boiler and firebox are made. With these repairs made, the boiler is ready to receive the firebox which is placed on a truck at location 7 with the mudring up. The firebox is then set in place. The boiler is then taken to the locations used for operations 8 to 12. After operation 12, the boiler is picked up by the shop crane and placed on the test pit. From this point it is taken on a truck back to standard No. 1 which is used for placing the boiler back on to the frames as well as the original operation of removing the boiler.

The Principles Underlying Shop Methods Used

In studying the shop methods outlined above, two principles have been applied which will bear further explanation. First, in each operation the maximum number of men possible without interfering with each other are put at work, as is also the case with tool equipment. Second, the most advantageous methods have been developed so far as safety and decreasing physical effort are concerned. The latter result has been accomplished by having the men work in the most comfortable manner possible and by decreasing the physical labor by means of suitable rests and supports for the various portable tools.

Operation 2—drilling of the stays before taking down the firebox.—It has been found in this shop that the work can be

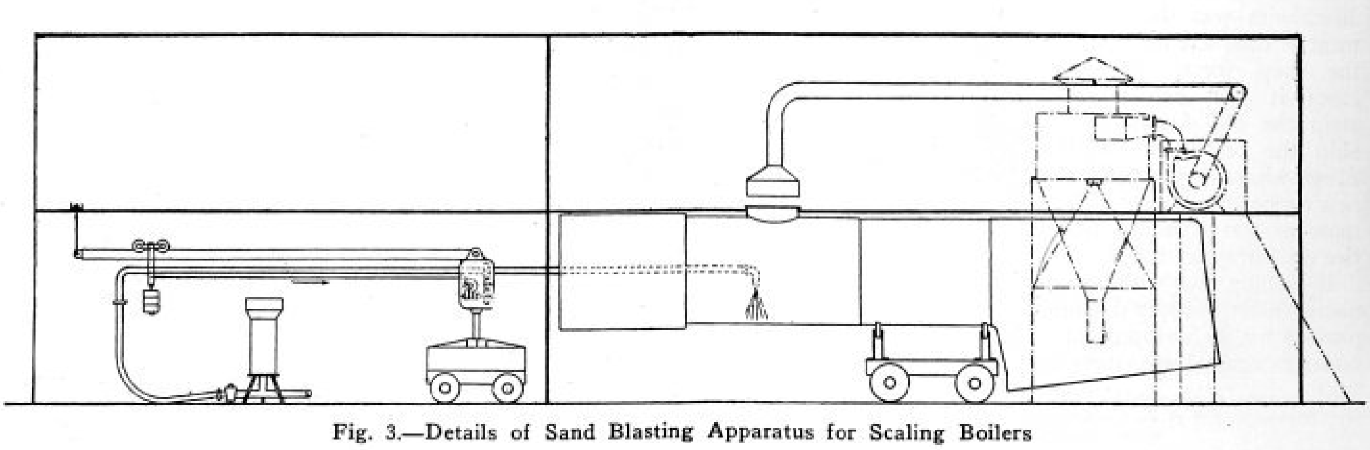


Fig. 3.—Details of Sand Blasting Apparatus for Scaling Boilers

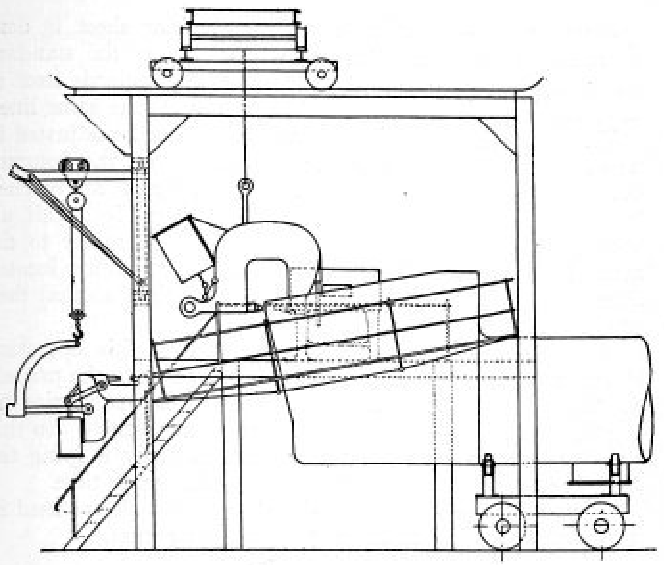


Fig. 4.—Arrangement of Equipment for Riveting Up Mudring

most satisfactorily done by drilling the stays on the side of the firebox shell, the depth of this hole being about equal to the thickness of the shell plate. The stay is then cut off by means of a pneumatic hammer of the type used for cutting rivets. The standard shown in Figs. 1 and 2 enables this work of drilling to be done very rapidly. This standard is in effect a metal frame which fits around the firebox completely. The lateral and back sides are provided with vertical bars which slide along the boiler and which can be spread out at will. These bars are used as rests for the electric or pneumatic tools. A stop which can be adjusted forward is also used as a rest for the drills required for the holes in the firebox tube sheet. The upper part of the standard also carries a rest for two drills which are used for vertical stay holes.

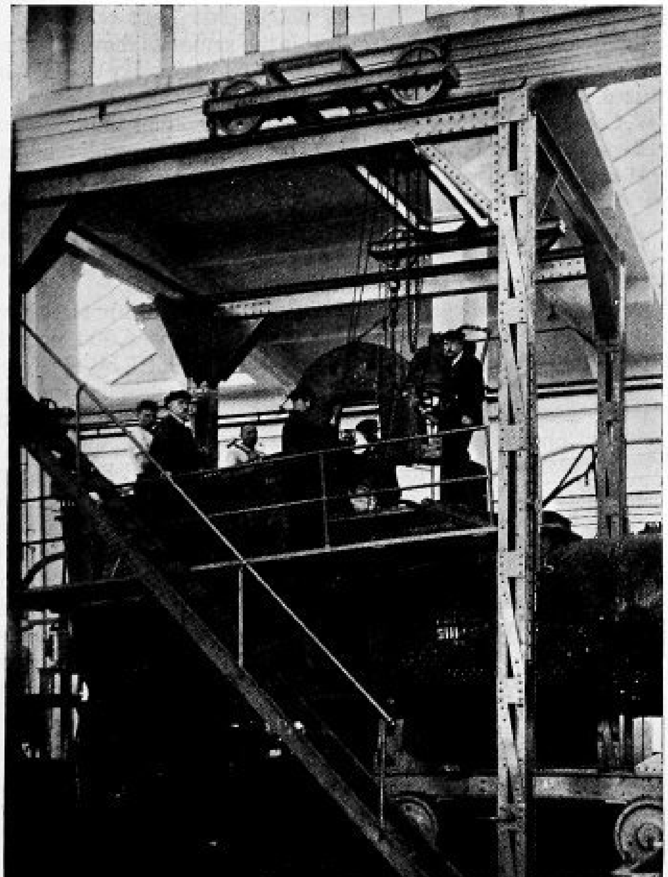


Fig. 5.—Rapid Work Is a Feature of the System of Production Equipment at Bischheim

The drills which are used for holes in the side sheets and the back tube sheet are secured on special rests which not only equalize the weight of the drill but also prevent it from turning, thus relieving the operator from practically all effort except the control. An air piston fitted to the drill applies pressure to the drill bit, further relieving the operator. This device is also used on machines for drilling holes in the stays.

Due to these various devices and to the fact that 8 men can carry out the drilling operations at the same time, the drilling is done very rapidly. The time taken for the drilling operation is about six hours for a boiler fitted with 1,200 stays and 190 firebox crown stays.

A pit located under the standard and provided with oxygen and acetylene connections allows two men to cut the rivets

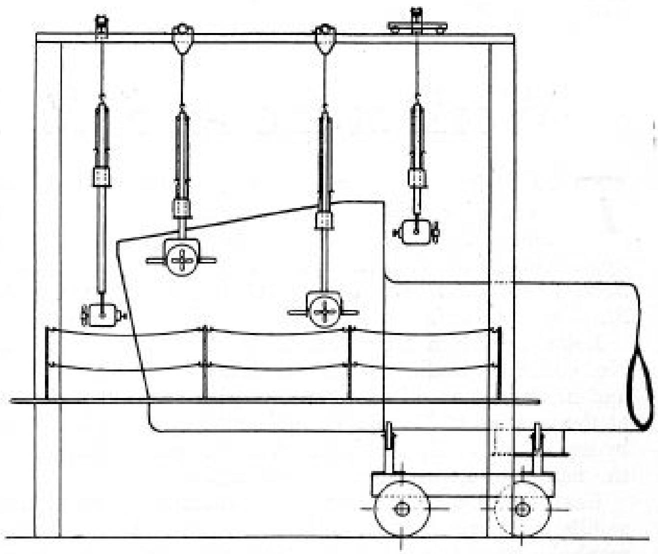


Fig. 6.—Standards for Suspending Stay Hole Drills and Taps

from the mudrings and from the side sheets and to take off the latter with the cutting torch at the same time that the drilling takes place.

Operation 3, cutting off stays.—There is little to say in connection with this work which is done quite rapidly. If care has been taken to drill only to the inside face of the side sheet, two or three hammer blows are sufficient to break off the stay.

Operation 4.—The work at this point consists of taking off the threaded part of the stay which adheres to the firebox plate and is either done by means of a pneumatic chisel or by hand.

Operation 5.—The scaling of the boiler is done entirely by means of a sand blasting apparatus which is shown schematically by Fig. 3. As is usual in this country in such operations, the sand is projected on the inner walls of the boiler barrel and the firebox by means of a nozzle at the end of an iron tube which is introduced through one of the holes in the front tube sheet. This tube is actuated with a helical motion along its axis in such a manner that the sand sweeps all sides of the boiler. An exhauster is used to evacuate the rather abundant dust set up by the operation into a separator. If large grain silica sand is used, the cleaning process is done very rapidly, leaving the plates perfectly free from scale and facilitating the inspection and work of filling in corroded spots by the torch.

Operation 6.—In this operation rings are applied to the stay holes to bring them back to the normal diameter. For this purpose steel bars of suitable diameter are tapped for lengths of 18 inches to 3 feet and then cut to thicknesses slightly larger than the thickness of the sheet in which they are to be inserted. These rings are then drilled with a ⅞-inch hole and screwed into holes tapped in advance in the sheets and expanded by means of a taper punch driven by a pneumatic hammer. No other calking or drifting is necessary to keep these rings tight in the sheet. Other general repair work is done at this point, new heads and tube sheets are laid out, flanged, etc.

Operation 7.—Another location is used for placing the firebox in the boiler which is done before the holes in the outside sheet are marked off. A strong flooring at a convenient height is arranged at this point for the men to work with comfort. When it comes to drilling the wrapper sheet, once the holes have been marked to correspond with those in the firebox, the work is done under a standard similar to that which is used in taking down a firebox to be replaced. This operation does not require more than four or five hours.

Operation 8.—Mudring riveting and door sheet is done by means of pneumatic machines held up by the standard shown in Figs. 4 and 5. This and other standards used in the following operations are built along much the same lines.

The platforms on which the men work can be adjusted in height by means of small winches carried on the columns and not shown in the illustration. The platforms are reached by means of stationary side steps and there is a rail all around so that work can be carried on with safety to the men. The rivets are heated in oil furnaces which are located alongside the standard and at a suitable height so that they can be passed direct to the riveters.

Operation 9.—The standard under which this operation is performed is shown in Fig. 6, and is similar to the preceding one. The drilling and tapping machines are carried by balanced rests similar to those previously mentioned. In this arrangement, six men can work simultaneously tapping the sides and the front and back sheets at the same time.

Operation 10.—The standards and rests which are used in this operation are similar to the foregoing ones.

(*To be concluded*)

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. Anyone desiring information as to the application of the Code is requested to communicate with the Secretary of the Committee, Mr. C. W. Obert, 29 West 39th St., New York, N. Y.

Below are given interpretations of the Committee in Case No. 436, as formulated at the meeting of February 7, 1924, and in Cases Nos. 437, 438 and 439, inclusive, as formulated at the meeting of March 14, 1924, all having been approved by the Council. In accordance with the established practice, the names of inquirers have been omitted.

CASE NO. 436. *Inquiry:* What thickness is required for saddles or frames to be fitted inside of dished heads, when the manholes are 11 by 15 inches, and the frames are designed for two rows of ⅞-inch rivets, for a working pressure of 250 pounds, used in dished heads of dimensions varying from 45/64 to 55/64 inch thick, and 36 by 48 inches radius of dish?

Reply: It is the opinion of the Committee that the thickness of the plate for the saddle or frame shall at least be that called for by Par. 195 of the Code for a dished head with a manhole opening. The saddle or frame shall be attached to the dished head in accordance with the rules under Pars. 259 and 260.

CASE NO. 437. *Inquiry:* What maximum allowable working pressure is permitted under the Heating Boiler Section of the Code for copper tubing to be inserted in the form of coils or loops in the fireboxes of steel heating boilers for the heating surface? It is pointed out that there is no reference in the Heating Boiler Section of the Code to pipe or tubing material of copper.

Reply: In Par. H-14 of the Heating Boiler Section of the Code specifying minimum thicknesses for tubes for use in watertube and firetube boilers, only tubes made of steel or iron were considered. Where heating boilers are to be constructed using copper tubes, either straight, bent or coiled, it is the recommendation of the Committee that the following minimum thicknesses should govern:

In water boilers where working pressures of over 30 pounds and not to exceed 160 pounds per square inch may be used:

$$t = \frac{D}{30} + 0.03$$

where t = thickness of tube wall in inches.

D = outside diameter of tube in inches.

For steam boilers to be used at pressures not exceeding 15 pounds per square inch, and water boilers where the maximum allowable working pressure does not exceed 30 pounds per square inch:

$$t = \frac{D}{45} + 0.03$$

the definitions of the letters being the same as above. In no case shall a tube thinner than No. 16 gage (B. W. G.) be used.

CASE NO. 438. *Inquiry:* Are the Recommendations for Repairs by Welding, which appear in the Appendix of the 1918 Edition of the Boiler Code, optional or mandatory?

Reply: It has been the idea of the Boiler Code Committee from the beginning that the Appendix is explanatory of the Code and contains matter which is not mandatory, unless specifically referred to in the Rules of the Code.

CASE NO. 439. *Inquiry:* Is it intended that only steel having a range of tensile strength of 45,000 to 55,000 pounds per square inch shall be used for joints welded by the forging process? If it is permissible to use a steel having another range of tensile strength, can the working stress of 28,500 pounds per square inch be used?

Reply: Par. 186 requires that all joints welded by the forging process, if to be allowed the ultimate strength specified of 28,500 pounds per square inch, must be made with steel plates having a range in tensile strength of 45,000 to 55,000 pounds per square inch. Attention is called, however, to the fact that in the recent revisions of the A. S. M. E. Boiler Code it has been proposed to increase the ultimate strength allowance for forge-welded joints from 28,500 pounds per square inch to 35,000 pounds per square inch. This paragraph as it has been proposed for revision will read as follows:

> "*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."

E. W. Young,
Retiring President

Frank Gray,
President

Thomas F. Powers,
First Vice-President

Master Boiler Makers Hold Successful Convention

Reports Presented Include One on Recommended Locomotive Boiler Welding Practice to be Discussed and Adopted at Next Annual Convention

THE fifteenth annual convention of the Master Boiler Makers' Association was held at the Hotel Sherman, Chicago, on May 20 to 23. As usual with conventions conducted in this city the attendance was excellent—nearly 300 members of the association being registered. The total registration of members, supply men, ladies and guests was nearly 750. Exhibits of boiler making equipment and tools were shown on the mezzanine floor of the hotel by 57 different companies constituting the membership of the Boiler Makers' Supply Men's Association.

E. W. Young, assistant to the general superintendent of motive power, Chicago, Milwaukee & St. Paul Railroad, president of the association, called the meeting to order on Tuesday, May 20 at 10 A. M. The invocation by past-president John H. Smythe, official chaplain and an address of welcome to the city by Frank M. Padden, assistant corporation council of Chicago, acting as the representative of the Hon. William H. Dever, mayor of Chicago, followed. H. T. Bentley, general superintendent of motive power, Chicago & North Western Railway, addressed the convention.

Abstract of Mr. Bentley's Address

Having been in the mechanical departments of railroads all my working life, I am, or ought to be, fairly familiar with the various trades that go to make up a successful department and the kind of men that should have charge of the various crafts. It is a source of satisfaction to know that we have men in this country who are willing to go through the laborious but healthy work as an apprentice and journeyman, and finally, through study and attention to business, qualify as foremen and leaders of men. We have a number of such men on the Chicago & North Western Railway. I am proud of those in charge of the boiler department and feel sure that others in positions similar to mine on other roads can speak equally well of their own boiler foremen.

Now to get down to business—since the last meeting what have you done to qualify yourself for a better position?

Have you made short cuts in the way of doing work so as to justify the expense of your attending these conventions?

Do you check up the work to see that it has been done properly?

Are you careful to see that front ends and ashpans are maintained so that danger from fires will be reduced to the minimum?

Do you know that boilers are properly washed out?

What can you do to improve the quality of the work done?

What have you done to reduce the expense of doing work?

Have you kept track of the various jobs to see if you are increasing output and reducing costs?

If the boiler of your locomotive is in good condition, flues and grates clean, free from leaks and no air being drawn in through the front end, you can invariably depend upon a successful trip being made.

We must not forget that railroading is like any other business. Men who cannot get good results have to be dropped and others who can do so, are put in our places. The pitting and corrosion of boiler shells and tubes is still a serious matter for many of us. With all of the wonderful talent stored up in this country, it does seem strange that no one has yet evolved a practical way of overcoming this trouble.

The question of training apprentices is an important one and special effort must be made to give these younger men the help and information that will enable them to master their business and prepare themselves for promotion. It is not wise to build only for the present; we must look ahead and have in training men who will be able to carry on the work properly when we are ready to retire.

The Federal Inspection Department has been of great assistance in standardizing practices and bringing about improvements in the general condition of the power. The study made by Mr. Pack and his assistants on the subject of "action of water in boilers and use of the water column to overcome irregularities in water readings" has been very helpful and the use of the water column is gradually being adopted as standard practice.

On several occasions I have spoken to you about the benefit derived from the use of good water for locomotive and other boiler purposes and many people seem to think that I am somewhat of a crank on this subject. It is a good subject to be a crank on and after having personally observed the benefits to be derived from good boiler water, I know it to be a business proposition and one that should not be overlooked in our efforts to reduce expenses. I have in mind one division in particular where engine failures were of daily occurrence and flues and firebox sheets had to be replaced once a year and in some cases more often. After considerable effort on the part of all concerned, larger locomotive tenders were furnished and other changes made, which enabled us to get past the bad water stations. Now we run for three or four months without a failure from boiler leakages. Our people are continuing the installation of water purifying or treating plants in bad water territory, and improvement in service, decreased cost of maintenance, etc., will prove conclusively the wisdom of this expenditure.

The cold flanging of firebox and flue sheets has made great progress during the past few years and an extension of this practice, in line with our efforts to economize, should be made.

Am glad to know that you are holding your convention in Chicago, the best city in the United States for conventions and accommodations. Railroad conventions that are worth while, when held in Chicago, always have a larger attendance than in any other city. Next week the International Railway Fuel Association holds its annual meeting in this same hotel and am sure its members appreciate the fact that you men can and will help them in the splendid work they are doing to conserve this country's fuel resources.

At the conclusion of Mr. Bentley's address, President Young spoke to the convention according to the usual custom.

Abstract of President's Address

It was in 1902 that the old Master Steam Boilers' Association met here in Chicago for the first time. Since then, 22 years have rolled around. Some who attended that first meeting have departed from this world and have gone to the great beyond. Others have, through the ravages of time, become too feeble to attend a gathering of this kind.

Our meetings here are of a two-fold character—the social side and the purely technical side. The line of demarcation of the two is not nearly as well defined, as upon first thought we might suppose. While our gatherings in this hall are purely for the purpose of talking shop, we are also touching elbows with the men who have the same troubles to contend with that we have been trying to overcome. We are brought together with those who have solved the same problems that we have met with and who, from experience, know what has caused us sleepless nights and days of worry. It is not only the reading and discussing of technical papers, but it is the intermingling here of men of the same frame of mind, of the same training and like tastes and inclinations, brought on by many years of hard work along similar lines of human endeavor. Our meetings in this hall stimulate us. While we are all striving in the same direction, our roads are not the same to reach the common goal. Some have discovered shorter cuts and others have found more durable ways, even if they are longer. By telling our experiences, our failures and successes, we make the paths smoother and easier. From the experience of others we learn what can be done and what should be avoided, where to start and where to go, how to overcome and how to avoid difficulties, and what is being done outside of our own shop and local environment.

John F. Raps,
Second Vice-President

W. J. Murphy
Third Vice-President

L. M. Stewart
Fourth Vice-President

Reports of Secretary and Treasurer

Secretary H. D. Vought reported upon the financial condition of the association and also upon the condition of membership, both of which are excellent, a number of new members having been proposed and few resignations having been received. He discussed the matter of delinquent members and requested that all those in position to do so assist in bringing delinquent members back into the association. His report was followed by that of the treasurer, W. H. Laughridge.

A communication from the Hon. Herbert Hoover, secretary of the Department of Commerce, was read by the secretary, asking for the cooperation of the association in improving the movement of coal during the summer and early fall months of the year. A memorandum, promising the cooperation requested to the best of the ability of the members in their activities in the maintenance of motive power of the country is to be prepared and forwarded to Mr. Hoover as soon as possible.

An invitation to send a representative to sit with the advisory council of the Federated American Engineering Societies is being acted on by the executive board of the association.

Wednesday Morning Session

This session was opened by President Young at 9:15. J. E. Bjorkholm, assistant superintendent of motive power of the Chicago, Milwaukee & St. Paul Railway, addressed the association at this time.

Abstract of Address by Mr. Bjorkholm

It is a tribute to the pioneer locomotive builders that while engine has greatly increased in size and certain refinements of its appurtenances, its fundamental principles remain the same. As a power plant on wheels, subjected to a greater variety of abuses than that accorded any other machinery, the satisfactory manner in which it is functioning is a wonderful tribute to those whose work is responsible for the building and the maintenance of the energy-generating unit—the boiler makers.

As railroad men we have a responsibility not only to our employers, but also to the great American public, and still I often wonder if every man connected with a railroad in a supervisory capacity fully appreciates this responsibility and appreciates the far-reaching consequences connected with delays when for some reason the transportation machine fails to function properly. To us closely associated with the transportation problem and the proper functioning of the motive power it is acknowledged that the greatest agent in disorganizing transportation is engine failures, because they are responsible for throwing all calculations and schedules into discard, causing delays and congestion, general disruption of traffic, inconvenience and annoyance to passengers, and adverse advertisement for the road.

Towards these engine failures the boiler frequently contributes its full share and sometimes more, although I am happy to say that through improved methods and the splendid efforts put forth by those having the proper performance of the boiler and its appurtenances in their charge engine failures caused by defective boilers are rapidly being reduced, and if you will pardon me for referring to the road with which I am associated, almost unheard of, and I wish to take this opportunity of voicing my sincere opinion that the greatest percentage of all boiler failures is entirely uncalled for and something which sound and efficient maintenance practice should prevent. I am making this statement from personal observations during a number of years in territories classed as exceptionally bad water districts in Minnesota and the Dakotas and where engines are being operated under every imaginable condition known.

Perhaps it would be of some interest should I say that last year we operated some 1,500 locomotives on the lines east, these engines making something like 46,000,000 engine miles, with only 15 failures due to leaky boilers, and I wish to state further that in considering these 15 failures, please do not get the impression that they were total failures. Instead they have been compiled from failures causing a delay of more than two minutes to a passenger train or more than five minutes to a freight train. It is true we had some additional boiler failures, although their number was very small, these failures being due largely to pitted flues and some occasional flue breaking in the weld, and an occasional crack in a firebox sheet. These are failures difficult to entirely guard against, although by proper practice they can be reduced to a very reasonable minimum, and in this connection, I might mention that we have found a very effective way of discovering pitted flues by not closing the front end door after the boiler has been washed until after the boiler is filled. You will understand that we are using the front end system of washing.

The washing of a boiler, as we all know, constitutes one of the most important roundhouse operations, an operation which deserves more consideration than it receives in certain places. It is an operation deserving careful and exact attention and I want to take this opportunity to pay my tribute to the boiler washer, a worker not always appreciated for what he is worth, but one whom I have learned to appreciate as one of the most important assets in a roundhouse organization. To wash a boiler does not only mean to remove the washout plugs and permit a stream of water to run from one end of the boiler to the other. It requires much more than that. It requires properly designed nozzles, washout plugs properly located, proper pressure, and the proper manipulation of the nozzles in order that all the precipitation be washed out instead of only loosened and banked up against some sheet or in some corner, creating a condition making it impossible to guard against boiler failures. I have often heard the remark made that it is impossible to keep the boilers clean on account of bad water condition. I believe you will agree with me that this is an excuse that no longer should be tolerated on a well-regulated railroad and I wish to take the opportunity to make the broad statement that there is no water so bad that the boilers cannot be kept clean, providing there is a will, and when I say "clean" I mean everything that that word implies, spelled in capital letters. It may be necessary to use certain compounds or chemicals to accomplish the result, but no excuse should be accepted for a crown sheet where the bare iron is not visible everywhere and where the bolts are not clean and free from fillets, the same being true of the water leg and the flues.

One of the common mistakes made in many roundhouses is to depend on the boiler washing and flue boring forces to substitute when other sundry workmen fail to report for work, for instance: If the fire builder fails to report it is sometimes the practice to resort to the boiler washer to do his work and thus it frequently happens that an engine is fired up and

J. M. Carroll,
Fifth Vice-President

W. H. Laughridge
Treasurer

Harry D. Vought,
Secretary

E. J. Reardon,
Chairman Executive Committee

sent out on the road to fail because it was not washed. So it would have been much better had the engine never been sent out. It would have saved a lot of trouble for the train dispatcher, the company would have saved a lot of money and the motive power department would have had one less engine failure to explain.

Now, someone may feel that I am exaggerating matters, but I am not, as I have found that while it is an easy matter to fool yourself, it is not so easy to fool the boiler, and when the day comes when the average roundhouse foreman appreciates the necessity and the full value of boiler washing, forgetting everything about that "one more trip," the boiler maker will have less trouble with his boilers, the roads a better locomotive performance, and everybody a better reputation. If we add to proper boiler washing the regular and thorough blowing of flues, proper cleaning of crown sheets, arch bricks and firebox sheets, the rest is an easy matter and if you remove leaky boilers and hard steaming engines from a boiler maker's troubles you have rendered him real service, but without removing these the most enthusiastic boiler maker will work in vain.

To expect to live to see the day when there shall be no disruption of traffic due to engine failures is a dream beyond the limits of possibilities, as anything mechanical and built by human hands is liable to fail sometime. It is our job, however, to take care that failures do not occur too frequently and be prevented as far as possible within human limitations. One of the greatest faults is to take anything for granted and as supervisors and chiefs of departments you are frequently called upon to investigate cases of failures of boilers or their appurtenances and I wish to admonish you never to take a boiler failure for granted as something that must happen once in a while, feeling satisfied that it was not worse. If you do, you will soon find that your troubles will multiply and the reputation of your road will climb in the same direction that mercury does on a cold winter day. Even though you are satisfied beforehand that the failure which caused inconvenience to the public was a legitimate one, investigate just the same, as we all have the peculiar faculties that we relax if not constantly reminded of the necessity that nothing less than at least 99.44 percent will be accepted. To learn when and where the failure occurred is of the least importance; the "why" is the vital question and never give up before that "why" has been satisfactorily explained. After you have satisfied yourself on that point, proceed to make corrections so that it does not occur again. You may have to start with the mechanical engineer to ascertain whether the design is correct. You may have to see the purchasing agent about better material. The man at the flue fire may be at fault, or the dies in the threading machine, or the taps or the expanders, or whatever the case may be. But whatever it is, find it and then apply corrective measures.

And so it comes that you gentlemen, leaders in your particular branch of work, have a very important part in the task of making America's railroads popular and dependable.

As leaders of men, you have a task before you to be a true leader, a man loved and respected by your subordinates, firm but fair in your dealings with your workmen, recognizing no personal favorites and tolerating no gossipers, only recognizing every man for his own worth and demanding a good day's work for a good day's pay. The good morale in any organization is its greatest asset and that morale you can make or break. It is easy to destroy, while sometimes a hard and difficult task to build, and while we always will be confronted with forces eager and always ready to destroy, the better element will always stand forth ready to help guard against destruction, providing you do your part.

The American railroads are fortunate indeed in counting among its leaders of men the members of the Master Boiler Makers' Association, an association which has contributed in large and unstinted measures towards the wonderful achievements of industry in general and the railroads in particular, an organization we all respect and honor and of which every member should feel justly proud.

Following this address, the remainder of the session was occupied with the reading of committee reports and their discussion.

The first paper taken up was "Training and Developing Apprentices." The report was prepared by a committee composed of G. B. Usherwood, chairman; W. J. Murphy, John Harthill and J. F. Raps. The paper and discussion will appear in a later issue.

A report entitled "Shop Kinks" was read by the secretary. This report was prepared by a committee consisting of Thomas F. Powers, chairman; E. W. Rogers, Otto C. Voss and C. E. Elkins.

Discussion on the report "Does the Application of Thermic Syphons Increase the Life of Firebox Sheets and Flues?" prepared by a committee consisting of A. F. Stiglmeier, chairman; H. J. Raps, J. J. Keogh, H. J. Wandberg, A. C. Dittrich, completed the morning session.

Both of the above reports with their discussions will appear in an early issue of the magazine.

Wednesday Afternoon Session

Wednesday afternoon the meeting was called to order at 2 o'clock and the subject "Autogenous Welding" introduced.

Autogenous Welding in General—Its Uses, Development and Advancement

AUTOGENOUS welding is used in boiler, blacksmith and machine shops, ship yards, factories; also by sheet metal workers and pipe fitters for new work and repair work in various branches of the metal trades. Each finds the oxy-acetylene and electric arc process for welding and cutting indispensable for quick, efficient and economical results. Their value for cutting and welding is so well known to all users that comments on its use for this purpose are unnecessary at this time.

Autogenous welding during the past 20 years has been known to the industrial world as a very valuable process, in which two similar parts of metals are heated and united while in a plastic or molten state, without the aid of hammering or compression. This process was not generally used until about 1910, at which time its advantages in the repairing of fireboxes of locomotives were very noticeable and attracted the attention of some of the greatest welding engineers of the country.

The process has been somewhat retarded until operators could familiarize themselves with its application. For example, the chairman of your committee recalls that in the year of 1910, he witnessed the welding of a patch in a side sheet of a Prairie type locomotive. This was being welded by the most proficient operator then available. However, from a service standpoint this weld was a failure for it remained in service only some two months, when it became necessary to do this work over again and during this time the weld failed several times.

During the period between 1910 and 1915 the process developed to such an extent that many operators became more proficient in manipulating and controlling the metals while in a molten condition.

Nevertheless, there were a great many welds that failed, these being termed welding failures. Upon thorough investigation, it was found in many cases they were not all weld failures, but construction failures; that is the sheets were improperly prepared, and that the construction of welding blow pipes in use at the time were improperly designed and that the method of counteracting contraction was not properly understood. This, combined with the inexperience of the operator, brought about numerous failures, and considering the small amount of welded seams in fireboxes at the time, the percentage of failures was exceptionally high.

In May, 1916, the Santa Fe Railway issued a welding folio with a set of rules which were followed as closely as possible. But, from time to time it became necessary to change the design of many of the patches, because of their failures.

During the year 1918, the designs of the various patches (quoted in 1922 Proceedings of the 13th Annual Convention of the Master Boilermakers' Association) were found to give the best results, and are now used as standard.

From the above it is quite evident that the use of oxy-acetylene or electric arc processes for boiler welding and cutting, to which this report principally pertains, is by no means new. During recent years many and improved devices have been placed on the market, which enables the work to be done with greater efficiency. New alloys have been developed for welding rods and electrodes, which enable the operators to perform autogenous welding with greater efficiency. But we must not lose sight of the fact that before a welder may perform autogenous welding in fireboxes, he, like other mechanics, must have a knowledge of the tools he uses and must also learn to properly heat and make perfect fusion of metals continuously by his control and manipulating of the welding blow pipes, filling rods and electrodes, used for the purpose: he should be required to make a test weld of at least 75 percent efficiency from the original stock of steel used in fireboxes. He should be required to make at least one welded specimen monthly. By so doing, the master boilermakers and the railroad companies may know the efficiency of the welder performing the work, and the man having the highest efficiency is undoubtedly the man whose work will show the best results.

The success of a welding job depends a great deal on how it is prepared, and for this reason the autogenous welder and boilermaker should see that the plates are properly bevelled and edges thoroughly cleaned from dirt, scale and grease. Plates should be secured in position with suitable strut belts, clamps or wedges, with the proper opening to enable the autogenous welder to perform the welding all the way through the plate and make the weld solid.

Autogenous welding is now used in many ways to advantage for the following reasons:

Its application is better known and becoming more efficient.

The cost of application in many instances is less.

In many cases the use of the process reduces the cost of maintenance to the locomotive firebox and other mechanical parts.

There is also a percentage of saving in the operation of the locomotive.

When the flues are welded in back flue sheets, there are less leaks, therefore, a better steaming boiler. When there is a good steaming boiler, there is a fuel saving locomotive. When there are less leaks, there are not as many locomotive failures, therefore, less delays and a reduction in operating costs.

For further advancement of the processes, it is essential that all operations be given careful consideration and study, which is so necessary for the further development and advancement of the autogenous welding processes.

This report was prepared by a committee composed of H. H. Service, chairman; R. W. Clark, Isaac J. Pool, G. M. Wilson and J. L. Wells.

Discussion

Robert Service, Santa Fe: You will note in the report read it is mentioned that the welder should make a test weld of at least 75 percent efficiency from the original stock of steel used in fireboxes. We are going a bit further than this; we are going to test the welds after they have been in service, that is after a firebox comes in for test. We are going to find out how the welds are in the firebox. Occasionally we have surprise tests. As an illustration, we place a patch inside the sheet and the superintendent of motive power, the assistant superintendent or myself go along and ask that that patch be removed and set back for test purposes. Those things make welders more efficient.

I have here a standard report which is gotten up by the Santa Fe, with the percentage of the operators' work. One which I have special reference to is that out of 21 welders sending in their monthly report, 14 were over 100 percent. That same shop had two men put in for welding, we asked the men to work on a job of autogenous welding and their efficiency was 30 percent. They did not get the job of welding, which was given to the better men, so you see those things go a long way to make better welding and firebox conditions.

T. F. Powers, C. & N. W.: What do you do when they don't come up to the required amount of efficiency?

Robert Service, Santa Fe: I will read this report of Mr. Smith's. We want to find out what is being put into the firebox. The average efficiency for a welder is 88 percent, below that there is Interstate ruling. In the specific case mentioned, the operator is only a fair welder because he is below 75 percent.

Some welds made that test as high as 98 percent are open to criticism because of bubbles. When an operator gets such a weld, after the test report he will guard against bubbles and watch his electrode. These specimens are returned, as it states, for inspection, to the point from which they come. The man in charge keeps this record, it goes to the operators and in some shops they pass them on so that it can be seen what is going on. The original report is sent to the superintendent of motive power, or vice-president, all the way down to the gang foreman and then, perhaps, to the different operators.

Chairman Young: Who is next? Have you anything to say Mr. Pack?

A. G. Pack, Bu. Loco. Insp.: I have not heard the discussion.

Chairman Young: Was it your intention to cover that tomorrow? Mr. Gray called on me to ask you to give us some information on this.

A. G. Pack: My views are pretty well known on autogenous welding. We keep our records in such shape that we know what the effect is from day to day. As for any information, I could give you that individually. I have a little memorandum here, but I did not expect to say anything publicly on this subject.

Abstract of Mr. Pack's Remarks on Welding

I recognize that autogenous or fusion welding is among the most valuable modern discoveries when used with good judgment and discretion, however, it has not yet advanced to a stage where it can be considered "a cure-all."

I do not believe that it should be used on any part of the locomotive boiler where the strain to which the structure is subjected is not fully carried by other construction, which meets with the requirements of the Locomotive Inspection Law and Rules, which are based on recognized standard practices of the best authorities, nor on any other part of the locomotive which is subjected to severe strains and shocks where through failure, accident and injury might result. This will be my position until its reliability has been established beyond a reasonable doubt, or until some means is discovered whereby the value of the weld can be established before failure occurs.

It is too well recognized that the value of welding varies with the different welding operators, and even with the same operator, to give it a definite value.

It is further established that autogenous welding changes the structure of the material to which it is applied to such an extent that the material cannot be depended upon as retaining its original physical properties. The welding of seams or cracks in the boiler backhead, where men are constantly employed in close proximity, should never be permitted except where the welding is covered with a patch secured by patch bolts, studs, or rivets. Some of the most serious accidents have been investigated by the Bureau of Locomotive Inspection where welded seams in boiler backheads failed, which has led me to this final conclusion.

Our records, as kept by years, show for the period July 1, 1915, to April 30, 1924, the relative effect of crown sheet failures in which the sheets pocketed or bagged as compared with those in which the sheets tore. The term "involved," as used in our study, refers to seams that were included in the pocketed, bagged or ruptured area.

During the period July 1, 1915, to April 30, 1924, inclusive, there were 495 accidents due to firebox crown sheet failures which resulted in the death of 326 persons and the serious injury of 761 others, or an average of 0.66 killed and 1.54 seriously injured per accident.

In 286 of the 495 failures the sheets bagged or pocketed, but did not tear, as a result of which 48 persons were killed and 474 others were seriously injured, or an average of 0.17 killed and 1.66 seriously injured per accident.

In 209 of the failures the sheets tore causing the death of 281 persons and the serious injury of 336 others, or an average of 1.35 killed and 1.61 seriously injured per accident.

It will be seen from this comparison that the fatalities where sheets tore have been eight times as great as where they did not tear. From the viewpoint of safety to persons, this very clearly illustrates the necessity for constructing firebox sheet seams in the strongest practical manner, especially so in the "so-called low water zone," or such seams as may be within 15 inches of the highest part of the crown sheet, measured vertically, the purpose being to keep the welded seams, 78 percent of which have failed when undue strain was thrown upon them, below that part of the firebox which pulls away from the stays causing pockets or bulges of various depths in cases of low water.

Of the 495 crown sheet failures referred to there were 277 cases where the riveted seams were involved, where 44 or 15.9 percent of the seams failed, while in 234 or 84.1 percent of the total riveted seams did not fail.

In the total of 495 crown sheet failures there were 132 cases in which the autogenously welded seams were involved, of which 103 or 78 percent failed, while 22 percent did not fail.

During the period July 1, 1915, to April 30, 1924, autogenously welded seams were involved in 26.7 percent of the total crown sheet failures, while 50.7 percent of the total fatalities occurred in such accidents where the autogenously welded seams were involved.

It will be seen from this that 15.9 percent of the riveted seams failed, while 78 percent of the autogenously welded seams failed under exactly the same conditions. The average number of persons killed per accident in which the riveted seams were involved was 0.76 as compared with an average of 1.17 killed per accident where the autogenously welded seams were involved.

It may be said that a large percentage of the crown sheet failures involved in this discussion were caused by overheating due to low water, therefore, the primary causes of such failures were overheated crown sheets, and that nothing can prevent a crown sheet from coming down when allowed to become extremely overheated, with which I agree. But when a stronger construction of the firebox seams will reduce the number of fatalities and the damage to property, I feel that there can be no excuse to offer for not employing the strongest and best practical methods.

I do not desire to be understood as knocking or opposing autogenous welding when properly and discreetly used, and believe that it has a very wide and useful field. If we are to profit by the experiences of others, we must give careful consideration to the result of all practices and methods. The extreme to which autogenous welding has been carried is what I have taken exception to. It is not "a cure-all," nor can it be used indiscriminately with safety, nor even economy.

THOMAS LEWIS, Lehigh Valley: Autogenous welding in general is used too freely. We receive reports from Mr. Pack relative to boiler accidents of all kinds. It is surprising to us to learn of some of the autogenous welding that is going on. We all know the rules as put out by the Interstate Commerce Commission; where we can do welding and where we cannot do welding. A great many reports put out by Mr. Pack indicate that welding is used in absolute violation of these rules. It is surprising what limit some roads and shops will go to. We will all agree that autogenous welding has been of great benefit to us all, and if it is going to be of greatest benefit in the future it seems to me we should take care of it. As for welding mudrings, cracks, etc., we have made a practice to weld about eight inches on each side. This is done under the hydrostatic test, which saves a good deal of time.

We have been welding flues immediately after the hydrostatic test. A few years ago we thought we had to put a fire in the engine and run it for a time. We do not now find it necessary.

MR. FENNEKER: We do quite a good deal of welding on the Southern Pacific, along the Texas and Louisiana lines, and on our flues we started in to weld the whole side and we found out that the small flues had cracked, on the inside sheet, so we stopped welding the small flues and welded the superheaters and the small flues in between. We get more service out of one division than on the others because of the water conditions on the Texas and Louisiana division. Without welding I get 275,000 miles out of a set of flues on our run between New Orleans and Houston, ten to fifteen thousand miles a month. After welding, we have one now still in service and she has gotten a little over 300,000 miles and from the condition of the firebox I have her lined up for service until March, 1925. I expect her to run that long.

On the Houston division and the H. & T. C. division we get from 100,000 to 150,000 miles. We have practically doubled the life of the flues on this division by the welding of the superheaters, but we renew the small flue in about half the time. We found it is cheaper to renew the small flues on account of the saving in fuel because of scale accumulation. On the El Paso division, about six months was as much as we could get out of a set of flues. They make between eight and ten thousand miles. That division is a 450-mile division. We have been running them on that division for the last three years. We are figuring on running them from El Paso to Houston. The Southern Pacific is running them from Los Angeles to Houston.

The firebox work on our system is handled in the following way: Where a crack develops between the staybolts we don't weld the cracks, we cut that piece out if it takes in two staybolts or three and we make a piece to set around that. Our method of welding flues, they are either fired up or make one trip and we go over them after they make the trip, send the flues to the shop and roll the sheet. Roll the bead and put as little metal as possible in welding. Mr. Pack spoke about welding back heads; we weld them but we always put a patch over them. My idea is if you don't weld the crack it will break.

A. F. STIGLMEIER, N. Y. C.; I want to say something in regard to this violating of the law. Mr. Pack recommends welding fifteen inches below the crown sheet. Your committee speaks of welding in the crown sheet. Why doesn't this convention go on record and back up Mr. Pack? Mr. Pack has written papers and recommends fifteen inches below the crown sheet, ask the members to stand back of this. A gentleman will get up and say we are violating the law, when your own committees recommend things, and Mr. Pack recommends them. I want them to say they recommend fifteen inches below the top of the crown sheet.

Additional Subjects Discussed

No report was filed on "The Proper Staying of Crown Sheets" but the following discussion took place on this subject:

Chairman Young: The next topic will be "The Proper Staying of Crown Sheets." There was no report filed. Mr. Stewart tells me he provided one for the convention.

L. M. Stewart, Atlantic Coast Lines: I was on this committee. In January I mailed a report, but I noticed when I came here there was no report filed. I don't recall what I had to say, but to get it before the convention, I will try to give you my opinion in regard to the staying of crown sheets.

I am, personally, in favor of tapered radials. It is cheaper in your shop and cheaper in your application. The lower water is something you must consider. In using the radials you don't have these questions coming up around the roundhouse. Many of the boiler makers don't know how to handle the crown sheet, therefore the taper radial is best. Personally, I don't think we should go beyond 1½ inches taper.

We had an engine which had a firebox about a year old. We installed the taper radial on the crown which had pushed itself down about 14 inches. After making the inspection I asked the federal inspector there what would happen if this sheet had been set with button head stays; he said, "The button head would have held so long that it would have run all the way down." That is one of the reasons the taper radial is the proper stay for the crown sheet.

J. F. Raps, I. C. R. R.: On the Illinois Central we are using the button head stay for the crown in order to make a safety zone in case of low water. I have had several cases of low water on other railroads where they used a taper crown bolt and in one I inspected, a firebox had been turned inside out. We have had cases of low water on the Illinois Central, fourteen inches off the sheet, and there was another case, two cases in fact, where we had to have a government inspector on our road on account of low water; one case was a roundhouse job and the other was where a man jumped down, but we have never had one turn inside out like you will have with the taper bolt.

Mr. Fenneker: I have had a great deal of experience with all kinds of bolts. We might not have had any trouble with some. I did not know about the button head until we ran into oil. We have had a great many radial staybolts, but have adopted a common staybolt, as we had so much trouble with the taper, particularly on the El Paso division. I have seen the taper bead out so all you have to do is pull them out. Now, there are arguments about that, in the first place your bolt is too large in the fire sheet. If you use a taper head bolt you have to have a hole large enough for it to push through. We had some spaces 1¼ inches on the crown sheet, we then had to make it 1 5/16 and the next time 1⅜. There are some 1⅝; they have to be removed so many times that my idea about the bolt is the size. That is one point. When the water goes down you can stick the point of your knife in there long before they crack through.

Another thing, and that is, if you fire an engine up too fast it will cause the crown bolts to leak. Several years ago we decided to change back to the staybolts. In 1919 we started to build twelve Mikado engines at Houston. We put in all staybolts, two were put in service in 1920. We stopped building the other for a year, although on these two engines we have never had to renew a crown bolt on account of leaking, never had any trouble with them. On the El Paso division, where we had twelve men out there renewing bolts, all of them are back in the shops.

In the case of the subject "Proper Method of Applying Arch Tubes" no formal report was presented but the subject was thrown open to the house for the discussion which follows:

Chairman Young: We will close this discussion and pass on to the next topic, "The Proper Method of Applying Arch Tubes and the Proper Thickness." There was no committee report on this subject.

W. J. Murphy, Penn. R. R.: I think the application of arch tubes is a very important subject, and I think we should open it for discussion.

We have the arch tubes set to the flue point and allow ⅜ inch on each end. We turn them over and we don't use any beading, when it is properly turned over and reset we don't have any trouble.

J. B. Reese, C. M. & St. P.: The Milwaukee and St. Paul has issued a circular letter which is placed in every roundhouse for the purpose of proper placing of the arch tube. It also has a chart showing how they should be. They should be arched and properly beaded. We allow 1/16 inch and in this way there is no tension and they wont pull out. With this method of placing and by the proper placing of the arch tubes we have had no trouble. Of course, you must keep the scale out of the arch tubes.

S. A. Fegan, Grand Trunk: We had two applications of arch tubes to deal with on the Grand Trunk Line. We discovered in tests that the belling of the tube was the stronger, that the beading caused a fracture, and, therefore, we adopted the tube without the copper and it is very satisfactory.

P. J. Conrath: We tested some that were belled and we also tested some that were beaded, and the beaded stood five to eight thousand pounds more pull than the belled. The bells were perhaps a little too long—if the bell were shorter it might be better. The trouble is you say bell them to 45 degrees—what looks like 45 degrees to this man is a little bit less to the other man. Unless you have some set rule to go by it will not work. Be sure you bell them the same.

Edward Hunt, Illinois Central: The plan on the Illinois Central is very simple and very easy. We apply the arch tube by placing the tube in the sheet and letting it lay so as to expand far enough so that the rolls will go in hard and draw it back to the sheet. It gives you a bell on the end of your arch sheet. The beading back is detrimental to the arch tubes for the pressure will force the tube up to the sheet, and is apt to cause a check. I am not in favor of the bead unless it is kept far away to give it a chance to yield.

A. G. Pack, Bu. Loco. Insp.: In thirteen years' experience as locomotive inspectors we have never investigated an accident due to arch tubes burning out the sheet. We have had instances where the pieces were cut too short—it is not a question of strength, it is a question of length. We have found trouble with tubes being cut too short on roads where they bead and on roads where they bell. You must be more careful to get the proper length. If you will bell or bead properly the tube will never pull out.

Chairman Young: We have heard all about the application, but you have not said anything about the thickness.

Mr. Bennett: After considerable experience, I think three-sixteenths is the proper thickness.

Delegate: Number seven gage?

Mr. Bennett: Yes, that is about the average thickness.

The remainder of this session was occupied with the reading of a report on "Rules for Recommended Practices and Standards—Autogenous Welding" which was prepared by a committee consisting of L. C. Ruber, chairman; E. W. Rogers, A. S. Greene, J. W. Kelly and G. B. Usherwood.

This report will be published in full in an early issue of The Boiler Maker so that all members of the association may be able to study its provisions carefully and be prepared to discuss them thoroughly at the 1925 convention at which time the report will be adopted either in full or in revised form.

Thursday Morning Session

Two important addresses were presented at the Thursday morning session which opened at 9:15 A. M. The first was given by John Purcell, assistant to the vice-president in charge of operations of the Atchison, Topeka & Santa Fe Railroad. An abstract of his remarks follows:

Abstract of Address by Mr. Purcell

During my entire mechanical career the construction, inspection and maintenance of the locomotive boiler has impressed me as being more important than the machinery parts. A good efficient boiler is the life of the machine. Locomotive boiler construction, which, of course, includes design, has made rapid progress toward larger boilers during the past 20 years. Economic conditions have and still are forcing the railroads towards larger units of power, and with the larger units, the larger boiler brings with it greater care in design and construction to provide relief from the increased stresses which accompany the increase in size.

As we all know, expansion and contraction forces cannot be held, we can only provide for their free movement by giving them all the flexibility of staying and bracing it is practical to allow. Movement of certain parts occurs simultaneously with lighting the fire in a cold boiler, and just as soon as the flame comes in contact with any part of a firebox sheet it begins to heat and expand, and the expansion is opposed by the inertia of the cooler parts of the same sheets as well as of the outside sheets which get the heat after it passes through the firebox sheets and is conveyed to them by the water or by the generation of steam. These differences are unavoidable when firing and steaming up boilers from a cold water temperature. We also get differences in temperature when cooling hot boilers or washing hot boilers with water of low temperature, and these differences of temperature of parts of the boiler, set up stresses which tend to distort the boiler and produce tension or compression strains which cause staybolt and radial stay breakage and eventually develop defects in boiler and firebox sheets.

It is important to maintain as nearly as practical, equal temperatures of all parts of a boiler at all times. Whether it be during roundhouse handling or while on the road, we cannot entirely prevent these undesirable conditions, but we can expect that by education and perhaps improved processes or appliances, or making the best use of those we have, to restrict or confine these inequalities of temperature to a minimum, which is of vital importance from the fact that if we can reduce the amplitude of the stresses, the boiler can stand many more of them without injury.

All of our boilers built at the locomotive works, are under Santa Fe inspection while being constructed and until final test is completed. Therefore, we believe we have as good a locomotive boiler as is built and it is then up to our boiler department forces to maintain them in good condition to get the best service from them.

Our boiler department consists of one general boiler inspector and several assistant general boiler inspectors. The general inspector reports to my office, while the assistant general boiler inspectors report to the mechanical superintendent of the grand division or district to which they are assigned and to the general inspector.

All hydrostatic tests, staybolt tests and inspections are reported to the general inspector, and copies of all diagrams showing staybolts removed, defects which may have developed, or repairs which have been made, which includes arch tubes, staybolts or radials or new fireboxes, or parts of sheets of firebox or boilers which have been renewed, are sent to his office.

The duties of the assistant general boiler inspector are to see that boilers are properly washed, inspected and repaired, and that staybolt testers are competent to test staybolts and render correct reports of all inspections and tests. The assistant general inspectors not only make competitive tests with the local inspectors but check up the local inspectors' work by making test at any convenient occasion, of a set of bolts which he knows has been recently tested. In this way we keep in touch with the quality of staybolt testing and inspection we are getting, and instruct our inspectors in the best inspection methods. The assistant general inspectors also look after the condition of boiler washing pumps and appliances, also the quality of boiler washing we are getting, also the hot water boiler washing plants as to temperature and pressure of washing and filling water.

A few words about the duties and qualifications of the local boiler inspectors, will no doubt, be permissible at this time. Usually roundhouse boiler inspectors are selected because of their proficiency in locating fractured or broken staybolts which is, of course, an essential qualification. We expect our inspectors to supervise the inspection of all parts of the locomotives or tender, the maintenance of which is assigned to the boiler forces.

While in our larger roundhouses, front end, grate and ash pan inspectors are regularly assigned, the boiler inspectors are required to know that those inspections are properly made and that appliances are in good condition according to our rules. They are also instructed to watch closely the performance of firebox sheets, staybolts, flues, arch tubes and other parts. For example, if a group of staybolts or flues starts leaking or arch tubes or firebox sheets begin to show evidence of scale formation, the inspector investigates and if possible, determines the cause. It may be scale forming on the water side; it may be uneven distribution of draft. Whatever the cause of the leakage or defect, it is the duty of the boiler inspector to correct the condition which is causing the damage and report it to his foreman.

If scale is found to be accumulating of troublesome hardness or thickness, if the fire seems to be concentrated at some part of the box, it should be reported. In fact, any adverse condition which is or may cause injury to the firebox or boiler should excite the apprehension of the inspector that something is wrong and his investigation may locate and correct it, before damage has occurred, and locomotive must be held out of service for repairs.

Boiler inspectors have the very best opportunity to cultivate and develop their powers of observation and judgment in their work, each case investigated broadens his experience and strengthens the judgment which fits him for further responsibility. In other words, by constant practice in locating defects and carefully looking for the cause, and way to correct them, he soon qualifies himself as an authority on such matters and as a first class inspector and increases his value to his employers and himself.

Any young man who desires to qualify for higher position and greater responsibility, must study and prepare himself for them. It is just as essential for a boiler maker who is ambitious for advancement, to familiarize himself with the machinery as it is for the machinist to know the boiler. The door to advancement is always open to the competent man, which should be the incentive to those who aspire to improve their condition.

A few words on autogenous welding. The introduction of the blow pipe for cutting, also the use of the autogenous welding system to weld in the new parts instead of the old system of riveting, patch-bolting or plugging them together, has greatly expedited the work of applying patches and parts of sheets to fireboxes, and increased the efficiency of that class of repairs. Not only has the autogenous weld given us a better job, but it is more economical and gives us better service in every way than the old style of riveted, patch-bolted or plugged seam.

In order that we may be sure of making solid welds it is necessary to have an experienced operator with the proper tools in good order and welding material suitable for the work that is to be done and the plates which are to be welded must be properly fitted. Provision must also be made to take care of contraction. If it is found there is trouble in making a good weld we do not allow our people to proceed with it until all adverse conditions which may be bothering the welder have been corrected. Welds made under these conditions are good and prove it by the service they give.

The welding of flues in back flue sheets has also been a great improvement. Its introduction on our line has practically eliminated engine failures due to flue leakages in back flue sheet, which, of course, is economical from every standpoint, especially from the fuel economy side.

We introduced autogenous welding, in a small way, in one of our principal shops in 1908, and did considerable experimental work. In 1916 we formulated a set of rules and instructions describing the methods of making repairs by the use of autogenous process. These instructions go into minute detail as to just how flues, patches and seams are to be welded. These instructions, which are incorporated in what we call our welding folio, are in the hands of all supervising officers on the railroad, as well as the men who actually do this work, and those who fit up jobs for welding. The boiler foreman in charge of the work sees that it is performed strictly in accordance with the rules governing same. Like the boiler inspection department, we have an organization to look after the autogenous welding work in conjunction with the boiler foremen, holding one man responsible for it, his duties being to go over the line and see that the work is done in accordance with our folio instructions.

I feel that all roads that use the autogenous welding should have a full set of rules governing the work, defining what should be welded and what should not be welded. It is also our practice to have each welder at the different shops weld a specimen once each month. This specimen is marked with his number and is sent to our testing laboratory at Topeka in order to determine the efficiency of the weld. After the specimens have been tested report is made of the results obtained from the specimen and it is forwarded to the officer in charge, as well as the test piece that was welded. The welders are shown results obtained from their welds. The man in charge of the welders gives special attention to the individual whose test specimen did not show that he made a strong and solid weld. We do not assign any of our welders to firebox or steam tight work until they have demonstrated that they are capable of making good, solid welds.

The subject of construction, inspection and repairs of locomotive boilers is one that could be discussed for an indefinite period of time. However, it has been my experience that good inspection, good workmanship, treated water, hot water washing facilities and good, thorough boiler washing, are the best friends the boiler has.

A. G. Pack, chief inspector of the Bureau of Locomotive Boiler Inspection, was then introduced as an old member and staunch supporter of the association. His address will appear in the July issue.

Reading of Committee Reports

The first report introduced for discussion at this time was that on "Washing Boilers and Tools for This Work" prepared by a committee consisting of F. T. Litz, chairman; L. E. Hart and H. V. West.

The report, "Most Economical Method of Removing Firebox Sheets for Renewal," next came up for consideration. This report was prepared by a committee composed of Thomas Lewis, chairman; A. S. Greene, J. T. Johnston and T. W. Lowe.

The reports and discussions not published at this time will appear in full in later issues of the magazine.

Thursday Afternoon Session

The entire afternoon session Thursday was occupied with completing the discussion of committee reports. The first subject before the meeting was "The Most Economical Method of Cutting Off and Removing Mudring Rivets and Cost." The committee on this subject consisted of C. P. Patrick, chairman; J. P. Malley and M. G. Guiry. This paper and its discussion will appear later.

Charles P. Patrick reported that so far no matter had come up in connection with the meetings of the Bolt, Nut and Rivet Standards sub-committee of the American Society of Mechanical Engineers Standards Committee that in any way affected the association. Within a short time, however, he expected this committee to take up the subject of rivets and bolts in sizes that would apply to boiler work. Mr. Patrick was retained to continue representing the association at the American Society of Mechanical Engineers' Standards Committee.

A complete discussion of the subject "The Causes and Prevention of Boiler Pitting and Grooving" prepared by a committee composed of Lewis Nicholas, chairman; H. V. West and F. J. Howe, took place at this time. The report and the discussion of this subject will appear in a later issue.

The report on "Topics for the 1925 Convention" was read by the secretary. The committee which prepared the report consisted of P. J. Conrath, chairman; H. V. West and S. E. Westover. Several of the subjects were revised at the meeting and the complete list will be published later.

Friday Morning Session

The Friday morning session opened with a most interesting and instructive talk by W. J. Tollerton, general superintendent of motive power, Chicago, Rock Island & Pacific Railroad.

Abstract of Mr. Tollerton's Address

In speaking to the Master Boiler Makers' Association, I feel that I am talking to the most important mechanical officers on the railroads of today. The locomotive boiler is called on for a constant increase in requirements, and you men are constantly called on to provide that. We have men in this room who can recall the time when the locomotive boiler was required only to furnish steam to the cylinders and probably the air pump. What is the locomotive boiler called on to do today? It is called on to provide everything from the head light to the stokers, not only furnishing steam for two cylinders but three, four and six. Therefore, the requirements of the modern locomotive depend wholly on the efficiency of the boiler.

Now, how was it possible to create a locomotive boiler that would fulfill all of the gigantic requirements that it is now called upon to fill? We are always limited in widths and heights in designing locomotives; we are always controlled by weights, the greatest part of the weight is in the locomotive boiler, therefore, you have to study your boiler requirements to give you an efficient boiler to provide maximum steam capacity for the cylinder requirements and the other essentials that have been put on the locomotive to conserve steam and to decrease the labor of the engine crew. Certainly that could not be brought about by the locomotive boiler as we knew it twenty or thirty years ago.

Mechanical ingenuity came forward and created various devices that have been added to the locomotive boiler to improve its working efficiency. One of the important devices that have come out in recent years—and I feel it is the most important—is the locomotive syphon. It has greatly increased firebox heating surface, which is the most important heating surface in the locomotive boiler. It has improved circulation which, in turn, has greatly benefited flue performance. In a boiler today equipped with syphons, you never hear of a flue failure. The answer to that is that the circulation is so perfect that in bad water territories, there is scarcely any scale forming against the back flue sheet.

Not only do we have these benefits which I speak of, but the locomotive syphon is almost a perfect non-explosive device. You cannot blow up a locomotive boiler that is equipped with syphons. The answer to that is that when the water does drop below the crown sheet, there is enough circulation coming up there through the syphon to retain a wet surface on the crown sheet.

We speak from experience, we do not speak from guess work. The Rock Island Railroad has probably more locomotives equipped with syphons than all of the other railroads, well, I wont say that, but more than any other railroad in the country. We have about 225 locomotives which have been so equipped since 1917.

It is all right to create a boiler, but if it is not properly maintained, it would not be an efficient boiler, and on you gentlemen falls the responsibility of this maintenance. We all know that if superheater tubes are not kept clean, firebox plates, flues not kept clean the boiler is inefficient in its performance. It is quite possible to get over the road with a locomotive that may have some defect in some other part of it, but it is a very difficult matter to get over the road if you are trading water for steam. I think anyone who has had engine experience will agree with that.

Now, before closing, I want to take this opportunity of saying a word on the Federal Boiler Inspection Law: In 1911, by an Act of Congress, a law was passed which provided for the inspection of locomotive boilers. This law was broadened out in 1915 to include all of the engine. I feel that law is the greatest piece of constructive and protective legislation that has ever been passed. Since 1911, we have been building up new boilers along general constructive lines. The past few years, we have been maintaining our boilers. I believe that the Federal Boiler Inspection Department in Washington is the most conservative and instructive body of men that we have today on our railroads. All of the inspectors are practical shop or engine men, their ideas are constructive. The chief inspector has always taken the position to help, never to criticize, and I believe with the constant inspection and education that we are getting all the time from the boiler inspection law, that it has brought about a vastly improved boiler condition, which brings about a condition of safety.

The remainder of this final session of the 1924 convention was occupied with the election of officers.

Officers of the Association for the Coming Year

President—Frank Gray, tank foreman, C. & A. R. R., Bloomington, Ill.; First Vice-President—Thomas F. Powers, assistant general foreman, boiler department, C. & N. W. R. R., Oak Park, Ill.; Second Vice-President—John F. Raps, general boiler inspector, I. C. R. R., Chicago, Ill.; Third Vice-President—W. J. Murphy, general foreman boiler maker, Penn System, Fort Wayne Shops, Allegheny, Pa.; Fourth Vice-President—L. M. Stewart, general boiler inspector, Atlantic Coast Lines, Waycross, Ga.; Fifth Vice-President—S. M. Carroll, general master boiler maker, C. & O. R. R., Richmond, Va.; Secretary—H. D. Vought, 26 Cortlandt street, New York; Treasurer—W. H. Laughridge, general foreman boiler maker, Hocking Valley R. R., Columbus, Ohio.

Executive Board—(Three years) C. H. Browning, foreman boiler maker, Grand Trunk Railway, Battle Creek, Mich.; Louis R. Porter, foreman boiler maker, Soo Line, Minneapolis, Minn.; Albert F. Stiglmeier, general boiler shop foreman, N. Y. C. R. R., Albany, N. Y. (Two years) John Harthill, general foreman boiler maker, N. Y. C. R. R., Cleveland, O.; Henry J. Raps, general boiler foreman, I. C. R. R., Chicago, Ill.; Kearn E. Fogerty, general boiler inspector, C. B. & G. R. R., Lincoln, Neb. (One year) Edward J. Reardon, Locomotive Firebox Company, Chicago, Ill.; Lewis E. Nicholas, general boiler foreman, C. I. & L. R. R., Lafayette, Ind.; George G. Fisher, foreman boiler maker, Belt R. R., Chicago, Ill.; chairman of the executive board, E. J. Reardon; secretary, H. J. Raps.

Supply Men Elect Officers

At the annual business meeting of the Boiler Makers' Supply Men's Association, held during the convention, the following officers were elected for the coming year:

President, J. P. Moses, Jos. T. Ryerson & Son, Chicago, Ill.; Vice-President, F. H. McCabe, McCabe Manufacturing Co., Lawrence, Mass.; Treasurer, S. F. Sullivan, Ewald Iron Company, Chicago, Ill.; Secretary, W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

Executive Committee (one year)—Frank J. O'Brien, Globe Steel Tubes Company, Milwaukee, Wis.; J. W. Kelly, National Tube Company, Pittsburgh, Pa. Two years—A. W. Clokey, American Arch Company, Chicago, Ill.; W. M. Wilson, Flannery Bolt Company, Pittsburgh, Pa. Three years—Geo. R. Boyce, A. M. Castle & Company, Chicago, Ill.; Geo. P. Robinson, American Locomotive Company, New York.

List of Exhibitors and Supply Men at Master Boiler Makers' Convention

The following members of the Boiler Makers' Supply Men's Association were represented at the Master Boiler Makers' convention and held exhibits of equipment and supplies which proved of great interest to the members:

Air Reduction Sales Company, New York.—Represented by E. M. Sexton, B. N. Law, W. H. Ludington, R. T. Peabody, George Calmbach, F. W. Graneman, G. E. Phelps, L. W. Hughes. The exhibit included Airco-Davis-Bournonville welding and cutting apparatus and accessories; cylinders of Airco quality oxygen and Airco acetylene; Airco-Davis-Bournonville radiagraph with samples of work.

American Arch Company, New York.—Represented by W. L. Allison, R. J. Himmelright, J. P. Neff, J. T. Anthony, A. W. Clokey, G. M. Bean, T. M. Ferguson, W. Haag, T. F. Kilcoyne, R. Malone, E. T. Mulcahy, A. M. Sucese, George Wagstaff. The exhibit included a model firebox equipped with arch tubes and arch.

American Bolt Corporation (Boss Nut Division), Chicago, Ill.—Represented by J. A. MacLean, J. W. Fogg. The exhibit included bolts, rivets and boss lock nuts.

American Locomotive Company, New York.—Represented by G. P. Robinson an C. O. Rogers. The exhibit included staybolts.

American Railway Appliances Company, New York.—Represented by Lloyd D. Brown. The exhibit included Superior locomotive flue blower.

Baldwin Locomotive Works, Philadelphia, Pa.—Represented by C. H. Gaskill, F. A. Neely, R. J. Schlacks.

Bethlehem Steel Company, Bethlehem, Pa.—Represented by George H. Raab. The exhibit included charcoal iron tubes, Bethlehem special staybolt iron.

The Bird-Archer Company, New York.—Represented by Major L. F. Wilson. The exhibit included literature and other information relative to various types of water treatment compound furnished by this company.

The Boiler Maker, New York.—Represented by George Slate, G. W. Beattie and L. S. Blodgett.

Brown & Company, Inc., Pittsburgh, Pa.—Represented by L. E. Hassman and J. B. Armstrong.

The Burden Iron Company, Troy, N. Y.—Represented by John C. Kuhns. The exhibit included staybolt iron, engine bolt iron, hollow drilled staybolts and iron boiler rivets.

A. M. Castle & Company, Chicago, Ill.—Represented by George R. Boyce and L. J. Quetsch. The exhibit included a series of photographs and literature.

The Central Steel Company, Massillon, Ohio—Represented by Irving H. Jones.

The Champion Rivet Company, Cleveland, O.—Represented by T. P. Champion and T. J. Lawless. The exhibit included a display of hot and cold made boiler rivets.

Chicago Engineer Supply Company, Chicago, Ill.—Represented by W. M. Burns and W. J. Selbie. The exhibit included Cesco air and water driven tube cleaners.

Chicago Pneumatic Tool Company, New York.—Represented by H. G. Barbee, J. L. Rowe, E. K. Lynch, C. W. Campbell, D. E. Cooke, G. Grant Porter.

The Cleveland Pneumatic Tool Company, Cleveland, O.—Represented by H. S. Covey and C. J. Albert. The exhibit included a line of railroad tools in the way of Cleco ball bearing air drills, Cleco ball bearing air grinders, Cleveland pocket-in-head riveting hammers, Cleveland chipping and calking hammers, together with a complete line of Cleco pressure-seated air valves and Bowes air hose couplings.

Dearborn Chemical Company, Chicago, Ill.—Represented by George R. Carr, J. D. Purcell, C. M. Hoffman, L. P. Bowen, O. H. Rehmeyer, N. F. Dunn, I. H. Bowen. The exhibit included Dearborn water treating preparations and NO-OX-ID rust preventive.

Detroit Seamless Steel Tubes Company, Detroit, Mich.—Represented by C. H. Hobbs, L. R. Phillips, C. C. Rosser. The exhibit included locomotive flues, arch tubes, large superheater tubes, stationary boiler tubes.

Elliott Company, Jeannette, Pa.—Represented by H. A. Pastre. The exhibit included a line of boiler tube cleaners and cleaners for locomotive arch tubes manufactured by the Liberty Manufacturing Company and the Lagonda Manufacturing Company.

Everlasting Valve Company, Jersey City, N. J.—Represented by the Scully Steel & Iron Company. The exhibit included Everlasting valves.

Ewald Iron Company, Louisville, Ky.—Represented by S. F. Sullivan and R. F. Kilpatrick. The exhibit included staybolt iron, both solid and hollow.

The J. Faessler Manufacturing Company, Moberly, Mo.—Represented by G. R. Maupin. The exhibit included the Faessler line of boiler makers tools together with some special tools which the company has recently developed for removing scale from welded tubes.

Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio.—Represented by G. H. Mansfield and C. M. Seymour.

Flannery Bolt Company, Pittsburgh, Pa.—Represented by J. Rogers Flannery, Wm. M. Wilson, John H. Murrian, E. S. Fitz-Simmons, George E. Howard, B. C. Hooper, E. G. Flannery, James A. Murrian, Dr. G. R. Greenslade. The exhibit included models of the Tate flexible staybolt, the F B C universal welded flexible staybolt, the F B C staybolt tester, model of boiler showing the working of the telltale flexible staybolts.

Forster Paint and Manufacturing Company, Winona, Minn.—Represented by O. T. Caswell. The exhibit included literature on paint, etc.

Gary Screw and Bolt Company, Chicago, Ill.—Represented by Philip Robinson, Gerald J. Garvey, Robert W. Dierker. The exhibit included rivets and bolts.

Garratt-Callahan Company, Chicago, Ill.—Represented by A. H. Hawkinson, W. F. Caspers, J. G. Barclay, T. H. Stevens.

Globe Steel Tubes Company, Milwaukee, Wis.—Represented by J. W. Floto, T. F. Clifford, R. R. Lally, J. S. Bradshaw, F. J. O'Brien. The exhibit included samples of cold drawn and hot rolled seamless steel boiler tubes, arch tubes, superheater pipes and bushings.

Huron Manufacturing Company, Detroit, Mich.—Represented by E. H. Willard, E. C. Rodie, Jr., H. N. Reynolds. The exhibit included the Huron arch tube and washout plugs.

Independent Pneumatic Tool Company, Chicago, Ill.—Represented by Henri Nelson, I. T. Cruice, G. H. DuSell, J. G. Cowell, O. H. Dallman. The exhibit included Thor pneumatic tools and electric drills.

Ingersoll-Rand Company, New York.—Represented by Walter A. Johnson and L. W. Schnitzer.

William H. Keller, Inc., Grand Haven, Mich.—Represented by Daniel Woodhead, E. J. Biederman and J. V. Conway. The exhibit included a complete line of pneumatic tools and pneumatic tool parts.

King Pneumatic Tool Company, Chicago, Ill.—Represented by E. N. Hurley, Jr., H. A. Lorsen, W. M. Hankey. The exhibit included pneumatic riveting and chipping hammers, arch tube cleaner, rivet cutter, rivet sets, rivet set retainer spring, ball type steam control throttle valve, sleeve type main valve.

Liberty Manufacturing Company, Pittsburgh, Pa.—Represented by H. A. Pastre, E. L. Davis, C. F. Harms. The exhibit included the Liberty and Lagonda types of arch tube cleaners.

Locomotive Firebox Company, Chicago, Ill.—Represented by John L. Nicholson, A. A. Taylor, L. R. Pyle, C. M. Rogers, E. J. Reardon, John Baker. The exhibit included a locomotive boiler model, using gas burning grate to demonstrate effect of thermic syphons on boiler water circulation.

Lovejoy Tool Works, Chicago, Ill.—Represented by W. H. Dangel. The exhibit included roller tube expanders, sectional spring tube expanders, superheater tube expanders, railroad flue cutters, staybolt sets, Mack two-piece rivet sets, Mack re-cupping tool for rivet sets; Lovejoy improved sectional expander for preliminary setting of tubes; Dixon multiple roller expanders; Kelly flaring tools; Lovejoy cloverleaf staybolt set; beading tools.

Lukens Steel Company, Coatesville, Pa.—Represented by Harry Loeb. The exhibit included test pieces of steel and literature.

McCabe Manufacturing Company, Lawrence, Mass.—Represented by F. H. McCabe and H. E. McCabe. The exhibit included a model of the latest flanging machine equipped with all the new attachments.

National Tube Company, Pittsburgh, Pa.—Represented by G. N. Riley, P. J. Conrath and J. W. Kelly.

The Ohio Injector Company, Chicago, Ill.—Represented by N. M. Barker. The exhibit included the Ohio low water alarm, Chicago injectors, lubricators, flange oilers, and boiler attachments.

The Otis Steel Company, Cleveland, Ohio.—Represented by George E. Sevey. The exhibit included a number of samples of various qualities of plate together with sample tests.

The Oxweld Railroad Service Company, Chicago, Ill.—Represented by A. N. Lucas, H. W. Schulze, W. A. Hogan, W. A. Champieux, H. V. Gigandet, J. W. O'Neill, Hugh Reeder, C. E. Allen, O. F. Ladtkow, G. V. Rainey, L. H. Gill, F. H. Frye, H. R. McRae, J. D. Hester. The exhibit included sample parts of welding and Oxweld welding apparatus.

The Parkesburg Iron Company, Parkesburg, Pa.—Represented by W. H. S. Bateman, J. R. Wetherald, L. P. Mercer, J. F. Wiese, R. Porteous. The exhibit included samples of genuine charcoal iron boiler tubes, arch pipe and flues for marine, locomotive and stationary boilers.

Penn Iron and Steel Company, Creighton, Pa.—Represented by W. A. Hicks, W. H. S. Bateman, H. F. Gilg. The exhibit included a complete line of all high grade double refined iron showing what iron can do by way of tests.

Pittsburgh Steel Products Company, Pittsburgh, Pa.—Represented by C. F. Palmer, J. D. Brandon, C. H. VanAllen. The exhibit included sample ends of seamless steel boiler tubes.

Pratt & Whitney Company, Chicago, Ill.—Represented by P. C. Renno and F. A. Armstrong. The exhibit included staybolt taps, punches and other miscellaneous small tools used in the manufacture and repair of boilers.

Premier Staybolt Company, Pittsburgh, Pa.—Represented by W. F. Heacock, H. G. Doran, J. C. Little, L. W. Widmeier, C. A. Seley. The exhibit included staybolts.

The Prime Manufacturing Company, Milwaukee, Wis.—Represented by Fred J. Prout and D. A. Lucas. The exhibit included Prime composite washout plugs.

Rome Iron Mills, Inc., Rome, N. Y.—Represented by C. C. Osterhout. The exhibit included samples of staybolt iron.

Joseph T. Ryerson & Son, Inc., Chicago, Ill.—Represented by Messrs. Pike, Willcuts, Moses and Hiner. The exhibit included samples of Lewis special staybolt iron.

Scully Steel & Iron Company, Chicago, Ill.—Represented by J. W. Patterson, C. E. Lingenfelter and J. J. Becker. The exhibit included a display of tube expanders, tube cutters, staybolt chucks, flue hole cutters, flaring tools, also other tools used by boiler makers and the Campbell nibbling machine.

S. Severance Manufacturing Company, Glassport, Pa.—Represented by F. G. Pfahl and T. S. Reynolds. The exhibit included rivets of various styles, specifications, etc.; rivet sets, punches, dies and chisel blanks of both alloy and carbon steel; and the Severance low pressure oil and gas burners for furnace work.

The Superheater Company, New York.—Represented by R. M. Osterman, R. R. Porterfield and Bard Browne.

The Talmadge Manufacturing Company, Cleveland, Ohio.—Represented by Frank M. Roby and H. B. Thurston. The exhibit included Talmadge system steam chest and cylinder lubricating drifting valves; Talmadge blow-off valve; Cleveland low water alarm; Talmadge system boiler cleaner; ash pan and ash pan cleaner.

Thomson Electric Welding Company, Lynn, Mass.—Represented by F. H. Leslie. The exhibit included literature in the form of an eight-page bulletin on the subject of "Electric Flue Welding," giving tabulated costs, illustrations of shop layouts, methods of welding, etc.

Torchweld Equipment Company, Chicago, Ill.—Represented by W. A. Slack, C. F. Egbert, J. M. Cameron, J. Jensen and R. M. Smith. The exhibit included gas welding torches, gas cutting torches, lead welding and brazing torches, improved gas pressure regulators for oxygen, acetylene, hydrogen and other gases, acetylene generators.

Tyler Tube & Pipe Company, Washington, Pa.—Represented by E. Tyler Davis,, A. M. Castle & Company, G. R. Boyce, L. J. Quetsch. The exhibit included charcoal iron boiler tubes.

Ulster Iron Works, Dover, N. J.—Represented by H. A. Gray, E. W. Kavanagh and C. F. Barton. The exhibit included a number of samples of Ulster special staybolt iron and Ulster special hollow drilled staybolt iron.

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Becker, Mrs. W. C., 415 N. 21st St., E. St. Louis, Ill.
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Bennett, Mrs. G. W., 15 Kent St., Albany, N. Y.
Berrey, Mrs. Frank E., 5315 Julia Ave., Cleveland, O.
Besant, Mrs. W. F., 1426 E. 65th St., Chicago, Ill.
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Davey, Mrs. J. J., St. Paul, Minn.
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Farrell, Mrs. E. G., 574 33rd St., Milwaukee, Wis.
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Fischer, Mrs. F. J., 109 14th St., N. W., Mason City, Ia.
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(*Continued on page 184*)

Boiler Manufacturers Discuss Business Affairs

Thirty-Sixth Annual Convention of American Boiler Manufacturers' Association at Hot Springs, Va., Given Over Largely to Discussion of Commercial Aspects of the Industry

FIFTY members and guests of the American Boiler Manufacturers' Association assembled at The Homestead, Hot Springs, Va., on June 9 for the thirty-sixth annual convention of the association. E. R. Fish, of the Heine Boiler Company, St. Louis, Mo., president of the association, presided at the meetings and opened the convention by reading his annual address.

Abstract of President's Address

Modern conditions seem to make for the multiplication of associations in great variety, but among these, the true trade associations come first. So far as the art of boiler building is concerned the need of a trade association to discuss technical questions is now largely non-existent, except in rather minor details, for that has been taken care of by a larger and more inclusive organization. Our field now lies more especially in the non-technical and commercial lines, and it is to these that we have, for several years past, given more prominent attention and with very gratifying results.

Association Work Beneficial

There are other organizations, however, that are worthy of recognition, and should be supported by all who are engaged in industrial activities, and which, while they may not contribute very directly to one's own well being, do help to keep the nation on an even keel and so react for the general good. Among such organizations are the League for Industrial Rights, National Metal Trades Association, United States Chamber of Commerce, National Industrial Conference Board. Doubtless each of you have some local organization whose activities are confined to your state and city which merit support just as they do in my state and city. Each must determine for himself to which of these he will lend his support, but he should, beyond doubt, be willing to contribute his share to the efforts to promote the general welfare and not merely be content to drift along without contributing either money or personal effort, and yet benefit by the expenditures of others. Much may be learned by attending meetings of various associations. It is largely by contact with others that new ideas are gained that will tend to increase the efficiency of one's own organization.

One of the interesting developments at the recent annual meeting of the National Metal Trades Association was the extent to which the health of employees is being looked after by many companies, and astonishing results of the effect on the individual workers were brought out. While many such measures may savor of paternalism, the effect is two-fold in that the individual as a human being is benefited, and his efficiency increased with the resulting benefit to the business.

Growth of Radical Tendencies

I have watched with considerable interest during the past few years, and particularly within the past year or two, the growth of radical, socialistic and communistic tendencies. One should not be stampeded into a belief that such tendencies are going to overrule the country, but I do believe the situation is sufficiently serious to warrant thoughtful consideration by every one who believes in the established order and the bringing about of changes through gradual and orderly evolution rather than chaos producing revolutionary measures, great or small.

I am very strongly of the opinion that relatively few of us realize the extent and persistence of the activities of the radical element, but I have heard and seen enough to believe that a serious situation exists to a far greater extent than any of us are aware. That this tendency is world-wide is evidenced by recent events in France, Germany, England and even Argentine not forgetting the most spectacular of all, Russia, about whom the real truth unquestionably is unknown.

Do you think it significant that our legislative halls have recently been invaded by a large number of radicals who must perforce have been elected by co-believers in their theories? While I do not believe that these sort are going to rule, it does seem to me that the seriousness of the situation is going to continue to increase to the point where it wakes up thoughtful people to the end that more organized counter-propaganda is put out and more interest taken in voting both at primary and secondary elections than in the past.

Do you approve of the recent bonus, tax and immigration legislation? I realize that about this there may be some considerable differences of opinion, but it does emphasize the necessity of electing to Congress thoughtful men who have at heart the good of the country, rather than their own political aspirations.

Statistical Organizations a Guide Only

In the past few years there have grown up a number of statistical organizations which, by constant study of conditions, offer advice as to the conduct of one's business. Such organizations should be regarded as of value, but only as a general guide. One's own conditions must be studied and his course steered accordingly. No two of our businesses are alike and while possibly the same general conditions may exist in any one industry, the way in which those conditions act and the effects which they are likely to produce are for each individual to determine for himself. We all realize that in our own field, conditions have changed tremendously in the last five years and are yet exceedingly unstable. It is a perplexing question to know to just what extent to go in preparing for extreme developments. Mass production is practically impossible with most of us, although a few are fortunate in being able to operate in this way. Such production for most of us lies in those details of construction which consist of repetitive operations, and for which adequate preparation should be made to keep down costs.

One of the governmental activities that should interest us in this connection is that of simplification to which unfortunately our product does not readily lend itself. There are, however, opportunities which are being seized and which conform to Secretary Hoover's plea for elimination of unnecessary effort.

Industrial Preparedness

Among other governmental activities is that of industrial preparedness. There is no doubt but that complete and adequate preparation for war is at present the best assurance of peace. One of the essential factors in being fully prepared is the ability to begin the manufacture on a day's notice, virtually if not literally, of all the thousands of items that make up the military and naval equipment of a modern army and navy. The War Department has at present well under way plans for completely organizing all the industries of the country to this end, and doubtless each of you will in due time be approached as to your part in this plan and no one of us should fail to cooperate with the governmental authorities.

The state of business is always an interesting topic and the answer to the query "How do you find business?" will be about the same by all engaged in the same line of endeavor. The amount of business is governed by the immutable laws of supply and demand and I believe it to be entirely futile to attempt to impose artificial conditions by legislative acts. Not only is this question of supply and demand a national one, but it is also very largely international. It can, to some extent, be influenced by protective tariffs as regards other countries, but this is not a complete answer.

In conclusion I may say that I have not attempted to confine my remarks to purely association matters, but I have chosen rather to emphasize our obligations as good American citizens. As representatives of a relatively small, but not unimportant, specialized industry of the country we should do our part both selfishly and unselfishly for our own individual welfare as well as for that of our country by cooperating with those agencies that stand for law, order and the kind of progress for which our governmental institutions fully provide.

At the conclusion of his annual address President Fish appointed the auditing and nominating committees to serve at the convention and called for the annual report of the secretary and treasurer.

Report of the Secretary

H. N. Covell, of the Lidgerwood Manufacturing Company, Brooklyn, N. Y., secretary and treasurer of the association, expressed his appreciation of the cooperation of the members of the association in getting new members, resulting in the addition of three new members, the reinstatement of one other and the addition of four new associate members during the year. The treasury showed a satisfactory balance for the year.

A. B. M. A. Takes Over Activities of Return Tubular Boiler Manufacturers

President Fish called attention to the fact that the manufacturers of horizontal return tubular boilers have been meeting recently to discuss matters relating to this branch of the industry and expressed the opinion that it would be better to have this work a function of the American Boiler Manufacturers' Association.

G. W. Bach, of the Union Iron Works, Erie, Pa., explained briefly the character of the work which the H. R. T. boiler manufacturers had carried on at a meeting in Chicago on May 20, dealing with the simplification and standardization of their product, and expressed their willingness to have this work carried on by the A. B. M. A.

A. G. Pratt, of the Babcock & Wilcox Company, New York, moved that a committee be appointed to further the interests of the H. R. T. boiler manufacturers of this association, the duties of the committee to be left to the direction of the president in consultation with the executive committee.

The motion was unanimously carried.

Following a report of the entertainment committee President Fish introduced Mr. Merle Thorpe, editor of *The Nation's Business,* who spoke on the topic "Business is Business."

"Business Is Business"

Mr. Thorpe pointed out that today Washington has become the economical as well as the political capital of the world and that the tremendous economic calendar which now faces Congress and the Chief Executive has a far-reaching effect on the welfare of the business man. To cope with this situation Congress is not composed of supermen but average men who when they come to Washington are swamped with thousands of bills and documents concerning matters regarding which they are supposed to know all and to legislate wisely.

Meanwhile industry is going on at a tremendous rate and as in the public mind "big business" looks sinister and should be watched, the people are turning to the Government for the regulation of business. Lacking set rules for business Congress provided the Federal Trade Commission. The idea was good but taking its cue from the popular idea of "business is business" the commission is now doing what its sponsor said it should not do—spying on business and acting as both prosecutor and judge. Secretary Hoover is now asking the business men to regulate business themselves, pointing out that if they don't the Government will and business will be further encumbered with laws and commissions involving the resulting evils of politics and authority in incompetent hands.

Mr. Thorpe strongly urged business men to take a greater interest in selecting their representatives in Washington and in regulating business themselves. In view of the fact that 90 percent of business is conducted on credit, which is an expression of confidence in one another, the need for such quickening of interest in national affairs is imperative. Mr. Thorpe pointed out the important influence of romance in business and stated that the business man has the same right and privilege to serve the public as the professional man.

Safety

By H. N. Covell

"Safety first" is the slogan heard on all sides. It is a good one and should be heeded and taken very much to heart.

Thirty years ago it was unknown. Accidents were expected to happen and were considered a necessary evil. Machinery was poorly guarded, few first aid kits or appliances were to be found and a daub of shellack or a chew of tobacco were considered good enough for any cut or wound. A bottle of whiskey (always kept under lock and key) and possibly some aromatic spirits of ammonia with some cholera medicine were panaceas for all other ills. Law suits for damages were prevalent and the ambulance chaser flourished. When an accident case was settled, it was hard to know whether the employee or his lawyer had been hurt; the lawyer usually got the most money.

Modern Safety Measures

Today things are different. Most of the states have adopted compensation laws which are compulsory in form or fact, and law suits are eliminated. Machinery and appliances are guarded, in many instances to a ridiculous extent, being required by state labor bureaus or recommended by insurance carriers; and here let me say that the only safe machine is one inclosed in glass and not used. Well selected first aid kits and appliances are common even in the smallest shops, while large organizations as well as some small ones, maintain a fully equipped hospital with doctors and nurses in constant attendance.

From every point of view these changes are good. From an humanitarian standpoint alone, there has been an awakening. From an economical side it pays and from reduced rates granted by insurance carriers for improved physical conditions and improved experience the financial benefits are apparent.

Costs Steadily Increasing

But there is another viewpoint, and that is the increasing cost, due to a variety of causes, not the least of which is malingering. The knowledge that two-thirds pay is coming to an injured man is a deterrent to a more speedy return to work than in the days before compensation. To make things worse in New York state, after January 1, 1925, compensation will have to be paid after the first week instead of after the second week, which will not only increase the cost but will surely increase the time lost from work. On July 1 of this year several other amendments to the act giving more compensation for dismemberment and permanent cases and increasing the maximum in all cases become effective, and I am reliably informed that the combined effect of these changes in the law alone will add nearly 10 percent to our compensation rates in New York state within the next six or eight months. Medical costs for accident cases have been going up all over the country, which have increased from 50 to 100 percent within a comparatively few years. It is easy enough for a physician to charge for double the number of visits made, or to make a number of unnecessary visits for the sole purpose of running up the bills. Doctors, hospitals and even druggists all charge the employer more than they would the employee, and it seems to be a race between them to see who can reach the limit first.

In the past 5 years my company reported 219 cases in our works, exclusive of foundry, of which 3 or 0.014 percent were traceable to our fault, 32 or 14 percent were accidents on guarded tools, 50 or 23 percent were eye cases and 134 or 61 percent were mostly attributable to carelessness and in the majority of cases to dropping objects on various parts of the person or by contributory negligence on the part of fellow employees.

Our compensation insurance costs are high. The tax on our business is oppressive. What is the solution?

Proposed Remedies

Some years ago I became a director of a mutual insurance company that has carried our liability and compensation insurance for the past 30 years. It is the largest mutual institution of its kind in this country and probably in the world. Last year out of about $10,000,000 in premiums, over 80 percent went directly back to the policy holders in the form of losses and dividends. The insurance rates will always be a reflection of costs, and it is up to us to find out what these costs are and how they can be controlled. If the insurance company is wasting too much of our premium for unnecessary expenses, let us find some company which is more economical. If the cost to us is the cost to them, on a fair basis, let us turn in and help them to cut the costs, or at least keep them within bounds. This we all can do, and I think that most of us are trying to do, by cooperating with the insurance engineers in guarding our plants and educating our employees to avoid accidents. Let us cooperate with them to prevent malingering and fraud, to prevent doctors, hospitals and druggists from overcharging. Let us make their interests ours, because that is what it amounts to in the final analysis.

There are other things that we can do for ourselves. We can appear before the legislatures, through our various trade associations or in person and protest against adding unreasonably to our burdens at every session. We can impress upon our senators and representatives that we have rights that must be guarded. The labor unions are on the job all the time and they are so noisy in their never ending demands, and we are so listless in opposing them, that it seems as if they had all the votes and all the justice on their side. This is the reason they get about everything they ask the legislatures for. It has got to stop some time, or break the country's back, and the sooner we step in and do some effective work to slow it down to a reasonable pace, the better.

Another thing we must do is to make our influence felt in demanding more even-handed justice by industrial commissions which have all the power of courts in deciding disputed compensation cases. We demand that they give injured employees all they are entitled to under the law; but we also demand that they weigh the evidence and apply the rules of law and common sense. Their decisions should be rendered as judges and not as partisans or politicians or philanthropists.

We all hope for the time when manufacturing can be carried on without accidents. Until that time arrives, we expect to pay the price for having such accidents as we cannot prevent. In the meantime it is our duty to protect the public, as far as we can, against any unreasonable cost, all of which must be added to the price of our product.

Discussion

A. G. Pratt stated that each applicant for work with the Babcock & Wilcox Company is given a physical examination so that those physically unfit are eliminated. This, he said, had materially reduced the number of accidents in the shop.

A. R. Goldie, Babcock-Wilcox and Goldie-McCullock, Ltd., Galt, Canada, explained briefly the safety measures in force in the province of Ontario where all workmen's compensation is made compulsory by the government. In the administration of this a commission of three men has the entire say. No appeal can be made from its decision, consequently legal expenses are eliminated and 96 percent of the money paid into the commission actually reaches the injured workmen. In the case of disability, below 7 days no compensation is paid; over 7 days the compensation is two-thirds the wage. In the case of death, the family is taken care of to a fairly generous extent. In the matter of assessments the whole industry is divided into classes and different groups receive different rates. The assessments for the last 4 years, as applied to his company, Mr. Goldie said were as follows: Four years ago, $1.30 per $100 wages; 3 years ago, $1.10; 2 years ago $0.90 and a year ago, $0.80, which was less, he believed, than is paid by manufacturers in the United States. Auxiliary to the commission there is an industrial association which educates both employers and employees to prevent accidents. The system in Ontario has worked out splendidly. The manufacturers are in favor of it. It has proved both efficient and economical.

Several other members, including W. A. Drake of the Brownell Company, Dayton, Ohio; N. L. Snow of the Diamond Power Specialty Corporation, Detroit, Mich.; C. W. Edgerton, Coatesville Boiler Works, Coatesville, Pa.; E. E. Baker of the Kewanee Boiler Company, Kewanee, Ill.; G. W. Bach of the Union Iron Works, Erie, Pa.; F. G. Cox of the Edge Moor Iron Company, Wilmington, Del., and E. C. Fisher of Wickes Bros., Saginaw, Mich., outlined briefly the methods used for promoting safety in their shops and the Government regulations in force in their states regarding safety appliances and compensation for accidents. In general, the evidence shows that at the present time the number of accidents is being materially reduced, accidents involving injury to the eyes being the most prevalent. Most of the speakers were agreed on the necessity for immediate attention to trivial injuries and emphasized the importance of compelling the men to go immediately for treatment to the nurse or doctor or first-aid expert which is available in practically all of the shops at all times.

W. C. Connelly of the Connelly Boiler Company, Cleveland, O., called attention to special safety devices such as the sounding of a gong on an overhead crane when a load is being hoisted or lowered and also to the fact that his company had given up the use of chain hoists or slings, substituting for them steel cables.

Further discussion brought out the fact that this practice has been adopted by others, although some claim equal safety with the use of chains provided they are annealed once or twice a year.

MONDAY EVENING SESSION

At the evening session two speakers addressed the convention followed by an informal round table discussion of the subjects of their addresses.

The first address was delivered by Mr. Carroll C. Robertson, Pittsburgh, secretary of the Corporation Trust Company, who spoke on "What Constitutes Doing Business in Foreign States." This address will be published in full in a later issue.

The second speaker of the evening was Mr. Fred R. Marvin, editor of the searchlight department of the *New York Commercial*, who spoke on "Radicalism," warning his hearers to recognize the sinister influence and danger of the Communist development in this country. He outlined in detail the history of Bolshevism and described the lengths to which socialism is being introduced in this country. The Communist Internationale, he said, is responsible for most of the unrest and the trouble among the people and he urged his hearers to use their efforts to turn the country back from the path of socialism.

TUESDAY MORNING SESSION

The Tuesday morning session was opened at 10 o'clock with an address by R. M. Hudson, assistant chief of the Division of Simplified Practice, Department of Commerce, Washington, D. C., on "Simplified Practice—Industry's New Source of Profit." This address will be published in a later issue.

DISCUSSION

C. V. Kellogg, of the Kellogg-Mackay Company, Chicago, outlined briefly what had been done regarding the simplification and standardization of horizontal return tubular boilers at a group meeting of return tubular boiler manufacturers held in Chicago on May 20 at the suggestion of Mr. Hudson.

Seventeen manufacturers attended the meeting. Suggestions, covering 28 separate items, were discussed regarding the simplification of boiler sizes.

Mr. Fisher's report on standard stacks, read at the last annual A. B. M. A. meeting, was adopted, the stack plate opening to be standardized 25 percent in excess of tube area.

The standard distance from floor to dead plate was fixed at 24 inches, except for special cases.

Other standards discussed included: Standard grate areas for various size boilers, standardizing two- or three-course boilers for various diameters and lengths, standardizing plate thickness for a given diameter and pressure, standard number of braces and through rods below the tubes, minimum diameter of boiler set with suspension, smokebox extension bolted or extended shell, rear combustion chamber depth and smokebox depth.

In the matter of standardized sizes, the following were tentatively agreed upon for boilers carrying 100 pounds pressure: 25-40-50-60-80-100-125-150 horsepower.

Boilers carrying 125 pounds were eliminated, except in the 78- and 84-inch sizes.

The following sizes were adopted for boilers carrying 150 pounds pressure: 50-60-80-100-125-150-180 (78-inch by 18-foot)-200-225-250 horsepower.

It was decided that the 100-pound boiler is best suited for heating purposes and the 150-pound boiler for power. The reason for making 78- and 84-inch boilers in the 125-pound size was to suit the plate thickness and avoid planing for the girth seam.

An exception was made in the above sizes for a special oil country boiler extensively used in California, which is built in either 54-inch by 16-foot or 60-inch by 14-foot sizes (rated at 70 horsepower) for 150 pounds pressure.

The following number of tubes were accepted for standard 4-inch tubes:

Diameter of boiler, inches....	54	60	66	72	78	84
Number of tubes	36	44	54	70	88	108

The following number of 3-inch tubes were accepted as standard:

Diameter of boiler, inches....	44	48	54	66	72	78	84
Number of tubes	36	48	60	88	110	130	162

The A. S. M. E. Code definition of heating surface for firetube boilers was adopted, figuring tubes on the inside diameter and the parts of the boiler exposed to the fire and hot gases as heating surface, only such surface as in contact with water on one side and fire on the other side to be considered heating surface, 10 square feet of heating surface to be considered 1 commercial horsepower for all boilers, including Scotch boilers, which had formerly been accepted at a somewhat less rating.

The standard setting heights adopted by the Smoke Prevention Association were adopted.

A. S. M. E. Boiler Code

By E. C. Fisher

The A. S. M. E. Boiler Construction Code, Edition of 1924, has been very much improved in the revision. Quite a number of changes have been made, and in consequence your committee recommends that the members of this association procure and distribute as many copies of the revised code as possible, so as to educate the public to the standard to which we are working. We also urge members of this association to apply to the A. S. M. E. Boiler Code Committee for their registration numbers at once.

The following are some of the principal changes which have been made in the 1918 code:

The specifications for material have been added to some extent, and some changes have been made. Orders for new material should conform to the new code so that stocks may be up to date.

The elongation requirements for firebox steel have been slightly increased.

The revised Code paragraphs will be prefaced by the letter P to indicate the Power Code, the material specifications being grouped by themselves and prefaced by the letter S. Paragraphs in the Locomotive Boiler Code are prefaced by the letter L, in the Miniature Boiler Code by the letter M and in the Unfired Pressure Vessel Code by the letter U. The old paragraphs have been adhered to in the revised Code insofar as possible.

P-12 has been revised to make it clear and distinct that cast iron shall not be used for nozzles or flanges attached directly to the boiler for any pressure or temperature.

Tables P-2 and P-3 cover tubes or nipples for watertube boilers. There is one table for steel tubes and one table for wrought iron tubes. In the old Code one table covered both makes of tubes.

P-23, P-24 and P-25 are new paragraphs which cover thickness of steam, feedwater and blow-off piping.

P-184d specifies the minimum distance from the center of rivet hole of circumferential joints to the edges of the plate to be not less than 1¼ times the diameter of the rivet hole.

P-185 has been revised so that plates over ⅝ inch in thickness in horizontal return tubular boilers, instead of 9/16 inch, shall be planed or milled down to a thickness of not over 9/16 inch at the circumferential joint in place of ½ inch in the old Code, a change discussed at our Pittsburgh, February 13, 1922, meeting at some length and which will be welcomed by all.

P-194. The diameter of the dome on a locomotive or horizontal return tubular boiler shall not exceed 0.6 the diameter of the shell of the boiler.

Table P-7 has been revised so as to clear up some confusion as to what constitutes a stay, a brace or a staybolt.

P-248 has been revised so that cutting of plates may be done by machinery, punching, shearing or by means of an electric arc or gas process, providing enough metal is left so that the edges may be finished in accordance with paragraphs P-249, P-253 and P-257.

P-253 requires that all holes in braces, lugs and sheets shall not be punched in material that exceeds 5/8 inch in thickness.

P-260 has added a cut, showing more clearly the allowance in figuring manhole reinforcing rings.

P-276 is an important change. It provides that when two or more safety valves are used on a boiler the valves shall be made of equal size, if possible; and in any event, if not of the same size, the smaller of the two valves shall have a relieving capacity of at least 50 percent that of the larger valve.

P-278 requires on firetube boilers that the opening for safety valves shall be not less than in Table P-11. Table P-11 is the same as the intermediate lift of Table 15 in the old Code.

P-308 specifies the maximum size of blow-off opening 2½ inches, but the Boiler Code now permits the use of return connections of larger size to which the blow-off may be connected. It requires, however, that the blow-off must be so located on the return that the connection may be completely drained.

P-323 and P-324. These paragraphs have been clarified by using the terms "lugs and *hangers*" in place of the terms "lugs and *brackets*," hangers referring to the type of support used when the boilers are to be hung from gallows frames.

P-331. Stamps on boiler plates may be transferred when necessary, under the supervision and authority of an authorized state, municipal or insurance inspector. The mill stamps must not be imitated in this transfer.

P-332. The form of stamp on a boiler has been much simplified. A register number for each boiler manufacturer has been added, while the "States number," and the "State in which the boiler is to be used" is omitted. Each manufacturer must secure his register number from the A. S. M. E. Boiler Code Committee.

This paragraph provides, in cases where boilers cannot be completed and hydraulically tested before shipment, that the proper stamps shall be applied at the shop, and two data sheets signed by the same or different inspectors, covering the portions of the inspections made at the shop and in the field, the data sheets to be sent to the proper destination.

The Manufacturers Data Report has been revised and changed to better suit all of the different interests who have to do with it. It is believed that this report will be found easier to work and will give to the inspectors the data required in a form permitting of quicker calculation.

Report of Stoker Committee

A. G. Pratt, chairman of the Stoker Committee, declared that the committee had no formal report to offer but that they were hoping that members of both associations would advise the committee of questions on which they might act.

Handbook Committee

Mr. Pratt, chairman of the Handbook Committee, reported that the loose-leaf handbook, containing the various standards adopted by the association, had been printed and is being delivered to the members of the association.

National Board of Boiler and Pressure Vessel Inspectors

J. F. Scott, president of the National Board of Boiler and Pressure Vessel Inspectors, and C. O. Myers, secretary of the National Board, outlined the progress of the work of the Board.

Mr. Myers read a brief report of the meeting of the National Board of Boiler and Pressure Vessel Inspectors held in Cleveland on May 26 to 29 in conjunction with the spring meeting of the American Society of Mechanical Engineers, a full report of which is printed elsewhere in this issue. Mr. Myers referred especially to the resolution adopted by the inspectors at this meeting requesting all boiler manufacturers to stamp their boilers upon completion with either a State stamp or the National Board stamp. He stated that at present approximately 20,000 boilers are in the field bearing the National Board stamp, 338 inspectors hold National Board commissions and 75 boiler manufacturers are using the National Board stamp.

H. N. Covell offered the following resolution, which was unanimously adopted:

COVELL RESOLUTION

Resolved that the American Boiler Manufacturers Association in convention assembled hereby recommend that all boiler manufacturers endorse, use and stamp all boilers built under and in conformance to the A. S. M. E. Boiler Code, with the stamp of the National Board of Boiler and Pressure Vessel Inspectors.

Report of Committee on "Rules for Boiler Inspection and Construction Tolerances"

Your committee appointed to act with the sub-committee of the A. S. M. E. Boiler Code Committee is pleased to report that the work has been approved by the Council of the American Society of Mechanical Engineers, and the Rules for Inspection are now a part of the 1924 edition of the A. S. M. E. Boiler Code. The new book has been ready for distribution since May 1 of this year. L. E. Connelly, F. G. Cox and Starr H. Barnum.

Commercial Committee

W. C. Connelly, chairman of the Commercial Committee, read a letter requesting the association to formulate a standard radiation capacity for horizontal return tubular boilers for heating purposes. It was decided that this question should be referred to the Heating and Ventilating Engineers' Association for further report and consideration.

Uniform Boiler Law Society

C. E. Gorton, chairman of the Administrative Council of the American Uniform Boiler Law Society, gave a brief report on the progress of the adoption of the A. S. M. E. Boiler Code. During the past year only four legislatures met and two states, Connecticut and Washington, have adopted the Code. Efforts have been made not only to secure legislation for the adoption of the Code but, more important still, to see that no legislation is introduced to destroy the uniformity of the boiler laws. Legislation was introduced in Kentucky and received the unqualified support of the boiler manufacturers in that state but the bill was eventually defeated by one vote. In Virginia, legislation was drafted but not introduced as, on account of other legislation under consideration, it did not seem feasible to push the boiler law.

Smoke Prevention Meeting

G. W. Bach reported that he had attended the convention of the Smoke Prevention Association in Buffalo, the previous week, and that the standard heights of boiler settings adopted at the winter meeting of the American Boiler Manufacturers' Association were adopted by the Smoke Prevention Association.

WEDNESDAY MORNING SESSION

The Wednesday morning session was given over principally to the discussion of a lengthy report by the committee on Cost Accounting comprised of F. G. Cox, Edge Moor Iron Company, Edge Moor, Del.; C. W. Edgerton, Coatesville Boiler Works Company, Coatesville, Pa.; and F. B. Metcalf, International Boiler Works Company, East Stroudsburg, Pa. The committee's report consisted of separate papers prepared by each member of the committee describing in detail the methods of cost accounting in his own plant.

Election of Officers

The present officers and members of the executive committee were reelected for another term as follows:

President—E. R. Fish, The Heine Boiler Company, St. Louis, Mo.

Vice-President—E. C. Fisher, Wickes Boiler Company, Saginaw, Mich.

Secretary and Treasurer—H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

Executive Board—George W. Bach, G. S. Barnum, F. G. Cox, W. C. Connelly, W. A. Drake, A. R. Goldie, J. F. Johnson, M. F. Moore, A. G. Pratt.

E. C. Fisher of the Wickes Boiler Company represents the A. B. M. A. in the A. S. M. E. Code Committee.

Entertainment Features

The principal entertainment features consisted of golf tournaments on Monday and Tuesday afternoon and an informal banquet in the main dining room of The Homestead on Tuesday evening when the golf prizes were awarded.

Registration

The following members and guests of the association attended the convention:

G. W. Bach, Union Works, Erie, Pa.
E. E. Baker, Kewanee Boiler Company, Kewanee, Ill.
Starr H. Barnum, The Bigelow Company, New Haven, Conn.
B. F. Bart, Standard Seamless Tube Company, New York.
C. L. Bauer, Erie City Iron Works, Erie, Pa.
B. R. Bristol, The Superheater Company, New York.
J. H. Broderick, The Broderick Company, Muncie, Ind.
M. H. Broderick, The Broderick Company, Muncie, Ind.
H. H. Brown, THE BOILER MAKER, New York.
W. L. Cameron, The Frost Manufacturing Company, Galesburg, Ill.
D. J. Champion, Champion Rivet Company, Cleveland, Ohio.
T. P. Champion, Champion Rivet Company, Cleveland, Ohio.
J. B. Collins, Henry Vogt Machine Company, Louisville, Ky.
W. C. Connelly, Connelly Boiler Company, Cleveland, Ohio.
H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.
F. G. Cox, Edge Moor Iron Company, Wilmington, Del.
S. H. Daniels, Walsh and Weidner Boiler Company, Chattanooga, Tenn.
J. F. Dickson, Kewanee Boiler Company, Kewanee, Ill.
W. A. Drake, The Brownell Company, Dayton, Ohio.
C. W. Edgerton, Coatesville Boiler Works, Coatesville, Pa.
J. R. Edwards, Pittsburgh Steel Products Company, Pittsburgh, Pa.
J. G. Eury, Henry Vogt Machine Company, Louisville, Ky.
E. R. Fish, Heine Boiler Company, St. Louis, Mo.
E. C. Fisher, Wickes Boiler Company, Saginaw, Mich.
Jos. Gaskell, Ames Iron Works, Oswego, N. Y.
R. M. Gates, The Superheater Company, New York.
A. R. Goldie, Babcock-Wilcox and Goldie-McCulloch, Ltd., Galt, Canada.
C. E. Gorton, American Uniform Boiler Law Society, New York.
R. M. Hudson, Department of Commerce, Washington, D. C.
J. F. Johnston, Johnston Brothers, Inc., Ferrysburg, Mich.
C. V. Kellogg, Chicago, Ill.
T. L. Kirk, Standard Seamless Tube Company, Pittsburgh, Pa.
Harry Loeb, Luckens Steel Company, Philadelphia, Pa.
F. R. Low, *Power*, New York.
F. R. Marvin, *New York Commercial*, New York.
J. E. Mason, *Power*, New York.
James J. Mays, Oil City Boiler Works, Oil City, Pa.
J. A. McKeown, John O'Brien Boiler Works Company, St. Louis, Mo.
F. B. Metcalf, International Boiler Works Company, East Stroudsburg, Pa.
M. F. Moore, Kewanee Boiler Company, Kewanee, Ill.
C. O. Myers, secretary, National Board of Boiler and Pressure Vessel Inspectors, Columbus, Ohio.
C. W. Obert, Lebanon Boiler Works, New York.
James O'Connor, Oil City Boiler Works, Oil City, Pa.
A. G. Pratt, The Babcock and Wilcox Company, New York.
Carroll C. Robertson, The Corporation Trust Company, Pittsburgh, Pa.
J. F. Scott president, National Board of Boiler and Pressure Vessel Inspectors, Trenton, N. J.
Norman L. Snow, Diamond Power Specialty Corporation, Detroit, Mich.
Cliff M. Tudor, The Tudor Boiler Manufacturing Company, Cincinnati, Ohio.
A. C. Weigel, Walsh and Weidner Boiler Company, Chattanooga, Tenn.
E. G. Wein, E. Keeler Company, Williamsport, Pa.

An Educational Program for Welders

THE oxy-acetylene welding trade is so young and has grown so fast that it has not been able to compete successfully with other metal working trades in the supply of trained operators. During the past fifteen years there have been developments in both the application and the technique of the process, but there has been little time to develop systematic methods of training men in the correct principles of welding. There are scores of trade schools teaching this craft, but in most cases the instructors have been left to their own devices with little assistance except what could be had from reading text books on the subject.

During the past year the Gas Products Association of Chicago has been working through its educational committee to improve the present situation. This committee is composed of some of the foremost authorities on gas welding in this country. Just as soon as it was organized communications were sent to all the trade schools in the country where welding was being taught, offering full cooperation in the establishment of systematic training in oxy-acetylene welding. The committee has prepared a complete outline of instruction covering twenty-four lessons and twenty-four shop exercises, furnishing lecture topics, suggestions for shop work and examination questions. Schools using the equivalent of this course are placed on the "accredited list" of the Gas Products Association, and are given special cooperation by representatives of the association who are located in practically every large center in the metal working trades. Students are secured for the schools and jobs are secured for the students. In addition to this, the services of a large group of welding experts are put at the disposal of instructors.

The Gas Products Association recently announced that copies of the course of instruction recommended for "accredited schools" could be obtained by individual firms who wish to train their own welders in a systematic way. The services of the educational committee are also at the disposal of the supervisors of such welding departments. This committee can render valuable assistance in developing a system of apprentice training for the welding department. It has also been suggested that in cases where individual firms do not employ a sufficient number of welders to justify class work, several firms in a particular city can arrange to have training furnished in a local trade school, and it has been indicated that if the employers of welders in a community will help a welding school to the extent of employing graduates, it will be possible for the educational committee of the Gas Products Association to work jointly with such employers in establishing a satisfactory school.

Although the educational committee of the Gas Products Association has been organized for less than a year, it has already been of considerable service to welders and their employers by carefully investigating all schools where welding is being taught and assisting many of them to improve their present plan of instruction. The schools themselves have been very glad to receive the cooperation of the committee because it furnishes them with an excellent means of doing well what has previously been done in a rather haphazard manner. There is an increasing demand for good welders and also an increasing demand for good welding instruction.

It Looks Like Good Sense—

To omit no detail that contributes to perfection.
To imitate the virtues and avoid the mistakes of our competitors.
To listen to a man who seems to have a new idea.
To put the honor of our business above its dividends.
To expect the men in the shop to reflect the spirit of the management.
To treat the public as if it was honest.

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

THIS is the third instalment of a series of questions on both mechanical and boiler subjects which are liable to occur in state or federal examination papers for boiler inspectors. The earlier instalments appeared on page 105 of the April and page 139 of the May issue of THE BOILER MAKER. *The material should prove of benefit to all those who contemplate taking the examinations. The author would like to have those interested in the subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.*

71—Q. What is superheated steam?

A. That which has been heated when not in contact with water.

72—Q. What effect will scale have on side sheets, crown sheets, arch tubes, flues and staybolts?

A. The effect of scale on the crown sheet, firebox sheets, flue sheet, flues and arch bar tubes, and the methods of combating and preventing the formation of scale on the various plates and tubes in the boiler.

The chief source of trouble in locomotive boiler operation is incrustation. All natural waters contain some impurities which when introduced into a boiler appear as solids, the incrusting solids being precipitated by evaporation. In a short time rosettes of scale are formed around the crown stays where they screw into the crown sheet. As this scale is a non-conductor of heat this produces overheating of the crown sheet and the threads around the crown stays burn out rapidly, the plate around the holes corrode, crack and cushion, the sheet pulls away from the crown stays and a disastrous explosion is liable to occur and probable injury to employees if the boiler is continued in service in this condition.

The scale forms stockings around the flues and the throat stays where they tap into the throat sheet in the form of a hard crust. The flues pit and burst, cracks start in the flue sheet extending across the unions between the flue sheet. The threads on the throat sheet braces burn off and leaks start around the bolts where they screw into the throat sheet as a result of this condition.

The scale prevents the carrying away of the heat and the flue sheet becomes mud burned and bulges out and in some cases pulls the flues out of the front flue sheet.

The scale collects around the staybolt and fills up the space between several rows of stays and prevents the water from coming in contact with the plates and staybolts, as a result of this condition. The plates become mud burned and pull away from the bolts. Scale will also collect around the rivets and sheets where the flue sheet and door sheet are joined to the side sheets of the firebox, overheating takes place and fire cracks start at the rivet holes extending to the edge of flue and door sheets. Frequently these cracks are chipped out in the form of a "V" and welded by the oxy-acetylene or the electric welding process. Unless the scale is removed this method of repairing seldom proves successful as the sheets will crack at other rivet holes due to the overheating of the plates.

Scale in the arch tubes will prevent the circulation of water through the tube. As a result of this condition the tube becomes overheated and bags where the scale has collected, and the tube either pulls out of the holes where it is fastened in the door sheet and flue sheet—in some cases the tube bursts and the result is serious injury to employees.

*Locomotive Inspector, New York State Transit Commission.

To prevent the formation of scale some form of treatment must be provided. So many factors enter into the treatment of boiler feed-water that it is evident that the subject is one that requires considerable study. Two methods for treating boiler feed water are:

(1) By chemical means.

(2) The means of heat.

Either of these may be used. In some cases frequent blowing off by means of a surface blow-off cock will carry the impurities in suspension out of the boiler. A great many substances are put into boilers to prevent the formation of scale, some are of no use whatever and a number are dangerous, such as fats and oils.

The use of oil should be prohibited as it generally starts corrosion or will cause the crown sheet to become overheated and the result may be disastrous.

The only safe methods for preventing the formation of scale are:

(1) By filtering.

(2) By using pure water.

(3) By frequent washing out.

(4) In a great many cases the water can be treated by chemicals and scale formation may be prevented.

73—Q. How should a flexible staybolt with caps over the outer end be tested?

A. Flexible staybolts with caps over the outer end should be tested the same as rigid bolts and each time the boiler is given a hydrostatic test the flexible staybolts shall be tested while the boiler is under hydrostatic test pressure not less than the allowed working pressure.

74—Q. What is an air brake?

A. A brake operated by compressed air.

75—Q. What is the minimum brake piston travel on a locomotive?

A. The minimum brake piston travel shall be sufficient to provide proper brake shoe clearance when the brakes are released.

76—Q. Describe the function of the triple valve.

(a) The slide valve.

(b) The graduating valve.

(c) The triple piston.

A. The triple valve has three duties to perform; to charge the auxiliary reservoir, to apply the brakes and to release the brakes.

(a) The slide valve controls the connections between the brake cylinder and the atmosphere, between the auxiliary reservoir and the brake cylinder and between the auxiliary reservoir and the chamber above the emergency piston.

(b) The duty of the graduating valve is to control the air flowing from the auxiliary reservoir through the slide valve ports.

(c) The duty of the triple piston is to open and close the feed groove and to control the slide and graduating valve.

77—Q. What does the red hand on each of the air gages indicate?

A. The red hand on the large gage indicates main reservoir pressure; on the small gage, brake cylinder pressure.

78—Q. How are patches in a firebox applied?

A. Firebox patches are applied by welding them in place or by riveting the patch to the sheets. When a patch is applied to a firebox sheet, the defective portion of the sheet should be cut away, in order to allow the water to come in direct contact with the patch.

(To be continued)

Boiler Inspectors Meet at Cleveland

Reports of National Board of Boiler and Pressure Vessel Inspectors Show That the Board Has Gained Widespread Recognition

AFTER a lapse of nearly three years in which they have not met the members of the National Board of Boiler and Pressure Vessel Inspectors held a three-day meeting at the Hotel Cleveland, Cleveland, Ohio, on May 27 to 29. This meeting was held in conjunction with the spring meeting of the American Society of Mechanical Engineers. Because of the fact that the inspectors were able to enter into many of the activities of this society and the interest shown by its members the value of the meeting was greatly enhanced.

As is more or less well known by our readers, the National Board is composed of the chief inspector or official charged with the enforcement of inspection regulations in the states or political sub-divisions of the United States that have adopted any of the Codes of the American Society of Mechanical Engineers.

Members of the Board are also members of the Conference Committee of the Boiler Code Committee and so the opening session of the meeting on Tuesday, May 27, was a particularly interesting one as it was devoted to attendance at the regular May meeting of the Boiler Code Committee on interpretations of the Code.

John A. Stevens, chairman of the Boiler Code Committee, presided at this session which proved to be one of the largest in the matter of attendance ever held. About 100 inspectors, members of the Code Committee and individuals interested in the work of the Boiler Code were present. The interpretations considered at this session will appear in a later issue of the magazine as they have not yet been approved by the Council of the Society.

The members of the Boiler Code Committee continued to take part in all later sessions of the National Board.

Addresses Given at Wednesday Sessions

On Wednesday, Chairman Joseph F. Scott, chief boiler inspector of the state of New Jersey, opened the meeting at 10 o'clock and requested C. O. Myers, chief inspector of the Ohio Boiler Inspection Board, to read the minutes of the last general meeting, as well as his report on the financial standing of the board. The organization is proving to be self-supporting in every particular from the fees charged for stamping new boilers with the National Board stamp. The fees are adjusted so that only the expense of running the organization and its meetings is insured.

Abstract of C. O. Myers' Report

The National Board of Boiler and Pressure Vessel Inspectors was organized December, 1919, to promote uniform boiler laws and rules throughout the jurisdiction of its members, to secure uniform approval of specific designs of boilers and other pressure vessels, as well as appurtenances and devices used in connection with their safe operation, and to promote one uniform code of rules, one standard stamp, and one standard of inspection and examination of inspectors.

Stamping of Boilers. Since the first meeting of the Board in Detroit, February, 1921, the work has progressed slowly but steadily, and the greater portion of our time has been given to the solution of the stamping problem.

We are in a position to report at this time that we have worked out a practical system of registering and recording A. S. M. E. Boilers, and commissioning inspectors, so that no state need have fear of a counterfeit Code boiler, if it bears the National Board stamp.

We have at this time approximately 20,000 boilers in the field bearing the National Board stamp. There are 338 inspectors holding National Board Commissions and 75 boiler manufacturers using the National Board stamp.

Prior to the organization of the National Board it was necessary for the boiler manufacturers building boilers for stock to secure some means of stamping their boilers other than placing all of the state stamps upon them where the boilers might go, and some of the manufacturers as a makeshift, or until something better presented itself, marked their boilers with the A. S. M. E. Code symbol, and a shop number, and when it was sold to a certain state that state's stamp was placed upon it. This method has proven to be a very loose arrangement, and it has been abused in some cases by the manufacturer willingly and in others without their knowledge. Since the organization of the National Board this system is no longer needed and there is no reason now why all the manufacturers cannot stamp all of their boilers upon completion and register them with the National Board, then it makes no difference when or where they are sold.

Data Reports. The question of furnishing copies of data reports to the inspectors, the owners and the insurance companies has been giving considerable annoyance recently. In certain cases, copies of these reports should be furnished by someone, and it stands to reason that the National Board should take care of this, but we have not encouraged it as our income was not sufficient to take care of the extra help necessary.

We do not believe that the inspector in the field should have a copy of the manufacturer's data report, inasmuch as it is part of his duty to get the dimensions and fill out a separate report, which can be checked by the state department with the manufacturers' report, and any errors existing either on the manufacturers' or inspectors' reports can be noted.

We have in numerous cases detected serious errors in this manner, and we do not believe that it is good policy that the field inspector have a copy of the manufacturer's data. On the other hand, we believe that the insurance company carrying the insurance should have a certified copy of the manufacturers' data in their office, but we do not believe that it is necessary for the owner of the boiler to have a copy, as the National Board stamp indicates that the boiler is a standard boiler, and is all that is necessary to satisfy the owner. A copy of the data in no case can be of any value to him.

Chairman Scott then addressed the meeting in part as follows:

We want to express our deep appreciation towards the whole-hearted support that the Boiler Code Committee of the A. S. M. E., the Uniform Boiler Law Society and the American Boiler Manufacturing Association have given to the National Board since its inception, which is another demonstration to my thought of the necessity of some kind of an organization to create uniformity, throughout the country, pertaining to our activities in the steam boiler field and which will work in co-ordinance with the Code, as adopted by the American Society of Mechanical Engineers.

As the National Board of Boiler and Pressure Vessel Inspectors, in accordance with its preamble, consists of the heads of the inspection bureaus, throughout the states and cities of the United States, it is essential that we should avoid adopting any regulations that would be in conflict with the uniform purposes for which the National Board was adopted.

It has been my experience that when a state or city adopts a law, covering the construction and inspection of boilers, there is usually a board appointed which consists of men, recognized in this particular field as very good men and there is a tendency for this board to sit and confer in accordance with the provisions of the law, to formulate their own regulations, thinking in their own minds that they are going to, or can formulate a better set of regulations than ever originated previously, in any state or municipality. This thought and practice is wrong, when you stop to consider the calibre of the men who constitute the Boiler Code Committee of the A. S. M. E. and the men who have been in such work throughout the United States in the various states or municipalities. You can readily see how ridiculous it is for any new board to entertain the thought that they could possibly improve on the results formulated by men with years of experience, backed up in a great many instances by an intensive engineering education, re-inforced by good sound practical experience.

The National Board of Boiler and Pressure Vessel Inspector officers are not above criticism and suggestions and welcome same, and the above remarks emanate primarily from the thought that where a new boiler board is about to be inaugurated in any part of this country, whether state, county or municipality, the resources of this National Board of Boiler and Pressure Vessel Inspectors are at their command. We desire their co-operation and I know every member and associate member is ready to serve or assist. I know I am also expressing the sentiment of the members of the Boiler Code Committee of the A. S. M. E.

I would like to suggest to the members of the National Board, who formulate the questions, that more attention should be given to the practical field and shop experience of candidates as boiler inspectors, instead of the large number of technical questions that are included in an examination of this character.

Relative to the inspection of steam boilers, it has occurred to me that the National Board members should take seriously under consideration the inspection of boilers and the fees levied and consider the different classes or types of boilers that come under our supervision. Laws are made, throughout the country, in states and municipalities covering the inspection of boilers, and in numerous instances, inspection of cast iron heating boilers is compulsory, whether the system is of the water or steam type. Also it is compulsory to inspect miniature boilers that are used in tailoring establishments, etc., and it has occured to me, through the experience of the New Jersey Board that I might respectfully suggest that consideration be given where fees are collectable, that such fees be regulated in accordance with good, sound, common, engineering sense.

I believe you will agree that all laws, pertaining to the inspection of boilers, were primarily instituted with the thought that they would cover steam generating plants that develop power for factory or other uses and, therefore, if this National Board is to work out as primarily conceived it is its duty to go into these matters in a way that will be of benefit to the states and cities that are operating in conformance to its provisions.

The later papers that will be presented to you, will cover fully the field, setting forth the purpose of the National Board of Boiler and Pressure Vessel Inspectors. The very fact that we are meeting here, in conjunction with the A. S. M. E. is a demonstration of the popular favor of our Board and it behooves every member to try and continue along the lines that we have heretofore followed out, and retain the popular favor and commendation that has been existing since its organization.

Fred R. Low, president of the American Society of Mechanical Engineers and editor of "Power" who has exerted every effort in support of the National Board gave the following address:

Uniform Enforcement of the Boiler Code

By Fred R. Low

I was very much interested when the formation of this Board was proposed and considered it a privilege to take part in its organization, and an honor to be conferred a complimentary membership in it. I have watched its progress with increasing regard, and it is very gratifying to see the manifestation of interest that this abundant attendance and character of this assemblage manifests, and your success in getting to be a going concern.

The United States has always led the world in the number of accidents—boiler explosions particularly. If you have read the early history of the art, you will find that this country has been one of the foremost in increasing the pressures of boilers above the atmospheric pressure. From time to time it was realized that the installation of any kind of a boiler in a plant, with unqualified operators, was an economic crime, but the effort to impose the same sort of inspection and supervision which in other countries had kept the number of boiler explosions down was always opposed by the "let us alone" element.

After a number of disastrous explosions some of the states did adopt such laws, and as the number of states increased a complicated condition with regard to the requirements developed so that it was impossible for a boiler maker to make a boiler unless he knew just where it was going and just what the requirements of that particular locality would be He had to run the chance of changing laws and changing views with regard to individual inspectors. He had to run the chance of a possible slip up on the part of his own men with regard to conforming with some unimportant requirement of a local inspector and the holding up of an important job. And so the American Society of Mechanical Engineers thinking that it could perform a useful service, by defining a safe boiler, appointed the Boiler Code Committee.

When a state has adopted a law and a board has been appointed to administer it, the first question that comes before the board is, "What kind of a boiler are we going to allow?" Our hope is that the work of the Boiler Code Committee has been such as to be amenable to these boards.

The thing that is safe for a boiler in one state is safe for a boiler in another state and there is no reason why the requirements should not be uniform. In the administration of the law, the local inspector has a great chance, either to incite opposition and dissatisfaction, or to be a real help and to be welcome. If he adopts the "thou shalt not" attitude—the police attitude—he will get into trouble. No man wants to live in the presence of danger nor does he want his property or the lives of his employees and perhaps his own life to be in danger. If you, as experts, can go to that man and show him in a good natured and convincing way that the boiler that has been in for twelve years is in danger of getting into trouble unless he does so and so and explain it to him so that he can understand it; he will thank you for putting him right in the matter.

I see great opportunities for a Board of this kind. In the first place, I would like to see it take over the mandatory features of the Code. The Code largely grew out of the practice in Massachusetts and was based upon a legal document. Unfortunately it has preserved many of those legal characteristics. For instance, you will notice that in the revised copy of the Code, the following phrase has been omitted, "This Code does not apply to boilers on locomotives subject to federal inspection." This Code applies to any kind of a boiler. This Code is directed towards making a safe boiler and it applies to a locomotive boiler that is federal inspected as well as one that is not. It is for your inspectors to say to what class of boilers the Code applies and what class of boilers are exempt from your inspection.

There is another requirement, that every manufacturer of a Code boiler shall stamp it with a stamp containing the A. S. M. E. Code symbol. If I were a builder of boilers, I should consider myself in accord with the Code and yet I would stamp a boiler with anything I wanted to unless one of you inspectors said that if I wanted to run the boiler in his town I would have to put the stamp on it. The Boiler Code Committee should only furnish the stamp for your convenience and give you the permission to use it. I can see where a Board of this kind, with annual sessions, growing in personnel, and its personnel growing in experience, can evolve a boiler practice which will be invaluable.

In the first place, there are a lot of legal phases which can be compared and discussed in your meetings. Then you can discuss the accidents that you have investigated and the causes that have brought them about. What are the most prolific causes of accidents or of threatening accidents? In what respects do boilers most need attention in order that their safety may be enhanced? A discussion by men who are dealing with these matters every day is invaluable. It seems to me that in pointing out the direction in which the Boiler Code Committee should work and in which you should strive to control this class of industrial disaster, in a continued program carried out year after year that a class of men comparable with Strohmeyer and others whose names are known and famous all over the world as authorities in boiler construction and installation and superintendence should be developed.

Another good friend of the board, John A. Stevens, chairman of the Boiler Code Committee, also spoke to the meeting. An abstract of his remarks follows:

Abstract of Mr. Stevens' Remarks

Your Board is the National Board of Boiler and Pressure Vessel Inspectors. Now the pressure vessel end of this business is tremendously interesting to me in its possibilities.

I have heard of many cases of dangerous pressure vessels. In all of the foreign countries, particularly in France, all pressure vessels are stamped with a tag of inspection and their allowances are the same as boilers. They are designed under the same regulations as boilers.

In the formation of boiler Code standards, from Joseph H. McNeill's time, we have depended in all of the work in the Massachusetts Board of Boiler Rules and later on in the A. S. M. E., on the men who live with the boilers and the pressure vessels for our ground work. Technique is all right, but there are pretty good structures built with the technique following afterwards. We have not passed any regulations or any suggestions or any rules until we have had them checked by the men in the field.

I venture to state, that through the service of the Board and your men, you can absolutely and actually double the life of boilers and pressure vessels, because the boiler maker's responsibility ceases when he has delivered the boiler to the plant. Your service will therefore appeal to the man who pays the bills. When you go into a plant and find dirty boilers, you know that it cost money to support them and you are in a position to prolong their life and increase the usefulness of your organization.

Then there is one other thought, and that is of the younger men. Have a kindly feeling for the young fellows because they will later take our places.

I predict a great future for you and I think you men, who have done so much in helping along this great work with the proper spirit and manner, will go down in engineering history.

Dr. D. S. Jacobus, member of the Boiler Code Committee, was scheduled to deliver an address before the meeting but was unavoidably prevented from attending. The paper which he had prepared was read by Charles E. Gorton and appears below in abstract form.

Advisability of the Conference Committee Making a Careful Study of Interpretations

By D. S. Jacobus

POSSIBLY the title of this paper is misleading, as it might seem that the members of the Conference Committee do not make a careful study of the interpretations and revisions. As all of you who are members of the National Board of Boiler and Pressure Vessel Inspectors know, through also being members of the Conference Committee of the Boiler Code Committee, a most careful study is actually made of matters of the sort and each and every member of the Conference Committee is given an opportunity to submit his views to the Boiler Code Committee.

It is often well to make a study of what is being done and to emphasize the importance of certain methods of procedure, and it is with this in mind, and not to infer that there has been any lack of interest and attention on the part of anyone that this is presented.

The Code is the American Society of Mechanical Engineers' Code and the Boiler Code Committee is governed in all of its actions by the Council of that Society. The states and municipalities that have adopted the Code have done so knowing that it has the endorsement of a powerful engineering society and a stability corresponding thereto. This is not all that has led to the success of the Code, as it is only through all of us working together that we have made it what it is to today and it is only through contining to work together that we can maintain its prestige.

Let us review the character of the work and the way in which it has been done. First of all there was the work of preparing the Code, which required three and a half years from the time the Committee was appointed to the acceptance on February 13, 1915, of the first Code for publication by the Society. There were times when it seemed that the efforts of the Committee were doomed to failure and that the time was not ripe for the preparation of a Code of the sort. After the publication of several preliminary reports it became plain that the only possible way of securing a working Code would be through everyone affected taking part in its formulation. Finally the principle of unanimous action was adopted and nothing was incorporated other than that approved by every member of the Boiler Code Committee and of the Advisory Committee that had been appointed to represent the industries affected.

After the acceptance of the Code by the Society the Boiler Code Committee was re-organized to include the Advisory Committee and the new Committee volunteered to submit its recommendations to the Council on questions that might come up respecting the meaning of parts of the Code and the handling of constructions not fully covered by the Code. This was the beginning of the so-called interpretations which now form an important part of the work.

The Conference Committee was formed at the time of the re-organization of the Boiler Code Committee and is, as you all know, made up of representatives from each state and municipality that has adopted the Code. The Conference Committee has assisted in a most helpful way in the formulation of the interpretations and in the making of revisions and additions to the Code and throughout all of the work the custom of securing unanimous actions has prevailed.

A review of the history of the Code makes it evident that its great strength has come through the securing of unanimous action; let us hope it may be possible to continue this custom and preserve a degree of security that can be obtained in no other way.

The method of handling inquiries and issuing interpretations is outlined in the preamble to the Code.

It may seem that this rule of unanimous action would, in some cases, lead to undue delay. It has led to delays and in some cases to long delays, but it should be remembered that an interpretation of the Boiler Code Committee when finally approved by the Council and issued is followed in the enforcement of the law, and has in many cases all the weight of law. When considered on this basis the interpretations cannot be criticized.

There has been trouble in some cases through replies being received from members of the Committee or the Conference Committee after the matter has been approved by the Council and in view of this, an action was taken by the Boiler Code Committee to the effect that ten days after the receipt of a communication shall be allowed for making replies and if no reply is received within that time it shall be assumed that the party has no objection to the interpretation. This necessitates that those receiving the proposed interpretations should act promptly. They should, however, make a most careful study of each and every case as misunderstandings through failure to do this have in certain instances led to needless delays.

No matter foreign to a case should be injected into the reply. Should a case bring to mind any other feature that should be brought out, this should form the basis of a separate case.

The adoption of a uniform Code is not all that is necessary to obtain uniformity. This led to the organization of the National Board of Boiler and Pressure Vessel Inspectors that you are here to represent. The idea of your Board is to secure concerted actions between the states and municipalities that have adopted the Code and to obtain uniformity in its enforcement. Your work is co-ordinated with that of the Boiler Code Committee by the election of one of your members to represent it on the Boiler Code Committee. Your Board has done good work and is continuing to grow in its usefulness and is thereby becoming more and more firmly established as time goes on. Through having the enforcement of the Code in your charge you have much to do with its success. Irrespective of how good a code may be it is of no value unless it is enforced. Again, it is most important that a code of the sort be uniformily enforced as this makes it possible to adopt uniform practice in manufacture. You are, therefore, just as much of a factor in maintaining the success of the Code as any other agency.

Let me again emphasize the importance of all of those interested in the Code working together in preparing the interpretations and revisions. This means that each and everyone of us must do his share when the work is under way and if anything seems wrong immediately get in touch with the Chairman of the Boiler Code Committee or Secretary Obert. By doing this there can be no question respecting the unanimous approval of the finished product.

During the remainder of the Wednesday sessions E. R. Fish, president of the American Boiler Manufacturers' Association, William H. Furman, chief inspector of boilers, New York State, and Charles E. Gorton, chairman of the American Uniform Boiler Law Society, spoke to the inspectors on various phases of the duties of the board and its possibilities for the future. These talks were followed by a general discussion on the work of boiler inspection and the problems that confront the inspectors in connection with the enforcement of the A. S. M. E. Boiler Construction Code. The papers which do not appear in this issue, as well as the complete discussion, will appear in the magazine later.

Officers Elected

The Thursday session was devoted entirely to business matters pertaining to the administration of the board and to the election of officers.

Joseph F. Scott of the State of New Jersey was unanimously re-elected chairman of the board; R. L. Hemingway, State of California, vice-chairman; C. O. Myers, State of Ohio, secretary-treasurer, and E. W. Farmer, State of Rhode Island, statistician. These officers also constitute the executive committee.

The inspectors in attendance at the meeting were: Joseph F. Scott, New Jersey; C. O. Myers, Ohio; William P. Eales, Pennsylvania; J. D. Newcomb, Jr., Arkansas; B. W. Bissell, Indiana; George Wilcox, Minnesota; Wm. H. Furman, New York; L. R. Land, Oklahoma; C. D. Thomas, Oregon; E. W. Farmer, Rhode Island; M. A. Edgar, Wisconsin; Gerald Gearon, Chicago, Illinois. James E. Speed, Erie, Pa.; John M. Lukens, Philadelphia, Pa.; Robert D. Ridley, St. Louis, Mo.; John Forgeng, Scranton, Pa.; L. M. Barringer, Seattle, Wash.; A. L. Daniels, Parkersburg, W. Va.

Registration of Ladies' Auxiliary of Master Boiler Makers' Association

(Continued from page 173)

Moore, Mrs. Wm. N., Miss Bessie, Allan & Thelma, 411 North Ave., Grand Rapids, Mich.
Murphy, Mrs. W. J., 3614 Mexico St., N. S. Pittsburgh, Pa.
Murphy, Miss Catherine, 1005 Regina Ave., Price Hill, Cincinnati, O.
Nelson, Mrs. Jos. J., 306 N. Mantua St., Kent, O.
Novak, Mrs. Albert W., 4449 Xerxes Ave., Minneapolis, Minn.
Oliver, Mrs. Jos. V., 213 Seymour St., Auburn, N. Y.
Ollis, Mrs. Luke S., 104 Pearl St., Keene, N. H.
Orr, Mrs. John J., 322 Taylor Ave., Scranton, Pa.
Osborn, Mrs. J. D., 650 "F" St., San Bernardino, Cal.
Lable, Mrs. Charles, 988 Oakland Ave., Milwaukee, Wis.
Phelps, Miss Bertha, Holmesville, Miss.
Pool, Mrs. I., 353 College Ave., Valparaiso, Ind.
Pool, Mrs. I. J. 2616 Kate Ave., Baltimore, Md.
Porter, Mrs. Louis R., 2723 Ulysses St., N. E., Minneapolis, Minn.
Powers, Mrs. John P., 1140 Union St., Boone, Ia.
Powers, Mrs. Thos. F., 1129 S. Clarence Ave., Oak Park, Ill.
Probert, Mrs. Frank E., 33 E. 100th St., Chicago, Ill.
Raps, Mrs. Henry J., 7224 Woodlawn Ave., Chicago, Ill.
Raps, Mrs. John F., 4041 Ellis Ave., Chicago, Ill.
Reardon, Mrs. Edward I., 7112 Euclid Ave., Chicago, Ill.
Redmond, Miss Lillian, 9412 119th St., Richmond Hill, L. I., N. Y.
Riley, Mrs. George N., 7225 Mead St., Pittsburgh, Pa.
Ritter, Mrs. Edward H., 562 E. Main St., Newark, O.
Robertson, Mrs. G. S., P. O. Box 192, Childress, Tex.
Rogers, Mrs. E. W., and Mrs. Lee Rogers, 18 Ardsley Rd., Schenectady, N. Y.
Rushton, Mrs. H. H., 10 Wilson Ave., St. Thomas, Ont.
Russell, Mrs. Robert, 9 Irving St., Battle Creek, Mich.
Saunders, Mrs. D. W., Chicago, Ill.
Schmidlin, Mrs. Joseph B., 76 Langmeyer Ave., Buffalo, N. Y.
Service, Mrs. H. H., 308 Jefferson St., Topeka, Kan.
Shea, Mrs. J. F., 814 W. 5th St., Sedalia, Mo.
Shoemaker, Miss Mina A., 7138 Constance Ave., Chicago, Ill.
Sholl, Mrs. H. I., 5535 Nicollet Ave., Minneapolis, Minn.
Smythe, Mrs. H. H., 505 S. Vail, Bloomington, Ill.
Smythe, Mrs. J. H., Cornwells Heights, Pa.
Sorgen, Mrs. Paul, Carbondale, Ill.
Stapleton, Mrs. T. J., 113 N. Monroe St., Baltimore, Md.
Steeves, Mrs. L. W., 312 E. Locust, Bloomington, Ill.
Stevens, Mrs. Henry V., 122 Elmwood Ave., Topeka, Kan.
Stuebben, Miss Uella, 1701 E. Houston Ave., Marshall, Tex.
Sullivan, Mrs. F. J., 537 E. Empire St., Freeport, Ill.
Sweeley, Mrs. Edw. H., Richmond Hill, L. I., N. Y.
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Thomsen, Mrs. Delbert A., 19 37th St., Milwaukee, Wis.
Thorwarth, Mrs. N., 523 S. Montgomery St., Sherman, Tex.
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Umlauf, Mrs. E. C., 209 Erie Ave., Susquehanna, Pa.
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Voss, Mrs. Otto C., Miss Grace and Dolly, 900 Scott St., Milwaukee, Wis.
Wagstaff, Mrs. George, 11 Monitor Place, West New York, N. J.
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Walla, Mrs. Frank, and Byron, 1405 Prairie St., Sioux City, Ia.
Wandberg, Mrs. H. J., 3033 Bloomington Ave., Minneapolis, Minn.
Washburn, Mrs. Leon, 215 Willow Ave., Susquehanna, Pa.
Whitman, Mrs. C. L., 611 52nd St., Milwaukee, Wis.
Whitsel, Mrs. N. B. and daughter, 51st and Stewart, Chicago, Ill.
Wiles, Mrs. John, Misses Mary and Elizabeth, Borden Rd., Forks, N. Y.
Yochem, Mrs. F., 324 S. Jackson Ave., Kansas City, Mo.
Yost, Mrs. C. F., 3932 S. Union Ave., Chicago, Ill.
Young, Mrs. E. W., 787 Caledonia Place, Dubuque, Ia.
Young, Mrs. M. J., Miss Jessie May, 1000 Hemphill St., Ft. Worth, Tex.
Ziegenbein, Mrs. Emil F., 121 Gilbert St., Jackson, Mich.

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And you will discover why your competitor succeeds when you fail.
And the leaks will be turned in profits.
And you will find the men have a lot of good ideas.
And emergencies will hold no terrors for you.
And it will grow as fast as you do.
And liabilities will be converted into opportunities.
And you won't be without your trade paper.

The Boiler Maker

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CONTENTS

In many ways the Master Boiler Makers' Association convention, held in Chicago last month, was successful, not the least contributing factor being the attendance. About 750 members, supply men and guests were present, and of these nearly 300 were association members. The exhibits were a real feature of the meeting this year. A great deal of benefit is bound to be felt in the shops from the knowledge gained by the men in their study of new tools and equipment.

At this convention, the work begun two years ago in establishing suitable standards of boiler practice bore its first fruit in the report "Proposed Practice of Locomotive Boiler Welding." Before taking action on this or on any proposed boiler standards that may be considered in the future, the association should bear in mind the recommendations once made by Frank McManamy, Interstate Commerce Commissioner, and reiterated at this convention, that careful and deliberate thought should be given to every phase of such matters in their relation to other standards.

When such study has been made and the subject matter debated at length on the floor of the convention by all interested individuals, then the association can feel satisfied that it is safe to go on record with its recommendations for standardization. Such changes as may be necessary to provide for advances in method may later be adopted.

In the case of "Proposed Welding Practice" the report will be published in complete form in the official proceedings of the association and in THE BOILER MAKER within a short time, so that every member interested can study its provisions and be prepared to discuss them at the next convention, when the report will be brought forward for action.

That the National Board of Boiler and Pressure Vessel Inspectors has become firmly established in its work of promoting uniformity in the application of the A. S. M. E. Boiler Code was definitely brought out at the meeting held in Cleveland in conjunction with the spring meeting of the American Society of Mechanical Engineers. A measure of the importance of this organization in its relation to the Boiler Code Committee was shown by the inclusion in the program of a special Code Committee meeting for the discussion of interpretations of the Code. As it is not possible for the greater number of members of the National Board who are also on the Conference Committee of the Code Committee to be present at regular meetings, the present session was of great value and proved to be a feature of the meeting.

A number of matters that occurred in the discussion following the presentation of the addresses which appear elsewhere in this issue, will later be commented upon.

One matter of importance to the National Board that was favorably discussed at the annual meeting of the American Boiler Manufacturers' Association at Hot Springs, Va., was the excellent work of the secretary of the National Board of Boiler and Pressure Vessel Inspectors. It would seem that in recognition of the painstaking effort and great amount of detail office work necessary in the conduct of the affairs of the Board, the secretary should receive some remuneration for his work. It is felt by many members of the Board, and other organizations interested in its work, that this matter should be adjusted at the earliest possible opportunity.

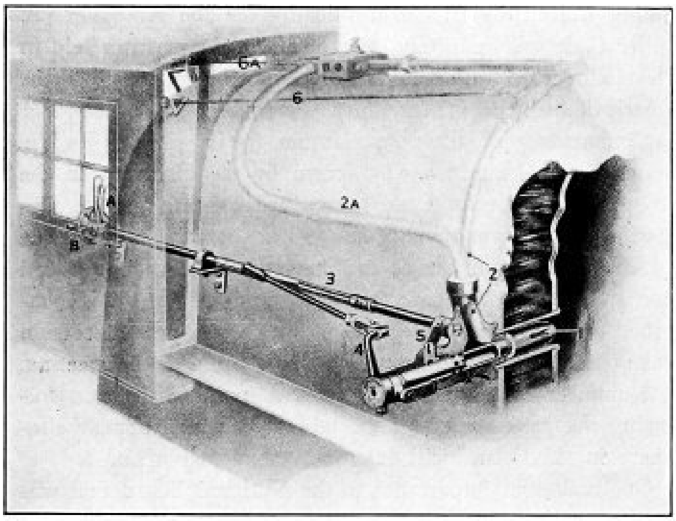
Much trouble and expense in communicating with members can be saved by the secretary's office of the Master Boiler Makers' Association if the executive board is able to determine the time and place of the next convention before the final proceedings are published. Some members have expressed the thought that if the 1924 convention can be held in some city in the east, possibly Buffalo, which is conveniently located and has much to offer in the way of hotel facilities, plants of interest to visit, and the like, many of the delinquent eastern members would renew their interest in the association. The executive board would like to receive suggestion in the matter from members. Communications may be sent to the chairman of the executive board, or to the secretary's office from which they will be forwarded.

Engineering Specialties for Boiler Making

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

Flue Blower for Cleaning Locomotive Boiler Tubes

IN the booth of the American Railway Appliances Company, Inc., New York, at the Master Boiler Makers' Association convention a sectional model of a locomotive boiler equipped with the Superior locomotive flue blower was demonstrated. This device consists primarily of two nozzles so mounted on sliding and oscillating sleeves as to provide



Phantom View of Flue Blower Installation

means of directing a steam jet over all parts of a locomotive flue sheet. The nozzles are withdrawn into a tube in the waterleg when not in use thus preventing their being burned. The sleeves are carried in body castings which are mounted on the outside of the boiler one on each side approximately 36 inches back of the flue sheet. Steam is piped from the steam direct to these castings and carried through ports in the movable sleeves to the nozzles. This steam supply is controlled by operating valves located within easy reach of the crew and so arranged as to operate one nozzle at a time.

Means are provided in the cab for projecting and withdrawing each of the nozzles and for oscillating the jet while either nozzle is in the firebox.

The nozzle directs a wide flat powerful jet of dry steam with uniform intensity into the flues. This band or jet of steam is slightly wider than one-half the width of the flue sheet and from 8 to 12 inches in height.

Details of Blower Installation

In the phantom view shown herewith (1) is the steam outlet in the oscillating nozzle, the nozzle being shown in its normal position in the tube through the waterleg where it rests protected from the fire; (2) is the steam supply pipe and steam passage through the blower; (2*A*) an alternate method of piping; (3) is the shaft mechanism connecting the blower with hand controls *A* and *B* in the cab; (4) indicates the lever for oscillating the nozzle so as to play the steam jet up and down over the flue area; (5) are the levers and links connecting shaft 3 with the nozzle tube and used to project the nozzle into the firebox when lever *A* is thrown downwards; (6) and (6*A*) are the cab controls for the steam supply.

In applying the blower to the boiler a short length of arch tube is inserted through each side of the waterleg of the firebox; this provides means for introducing the nozzle into the firebox at the proper position and also for housing and protecting the nozzle when it is withdrawn into this tube.

The body castings carrying the nozzles are secured to the side sheets by studs.

Steam is piped from the steam turret to the valves (controlled from the cab) and then to the body castings on either side of the firebox.

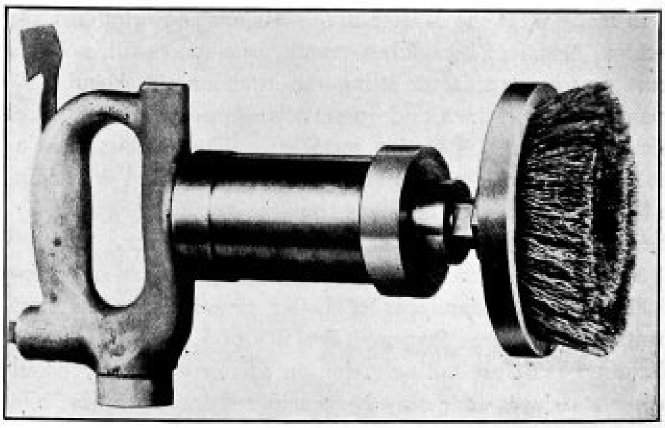
The operating mechanisms extend into the cab one on each side of the boiler where they are attached to the boiler by small brackets and are connected to the nozzle mechanism by suitable operating rods.

All operating controls are located convenient to the engine crew.

Pneumatic Surface Cleaner for Steel Plates

A PNEUMATIC surface cleaner has been developed by the Liberty Manufacturing Company, Pittsburgh, Pa., in response to the demand for an air-operated tool to remove rust, paint and scale from steel plates and flat surfaces. The machine is adapted to any service requiring the rotary motion of a steel brush.

The equipment consists of an air-operated motor, with an aluminum valve handle and a steel wire brush. A sight feed lubricator for distributing oil to the motor and a connection for the operating hose are also furnished. The motor is simple and rugged in construction. Air pressure acts behind a pair of semi-balanced blades which are inserted in a long, hardened steel shaft mounted eccentrically in the cylinder.



The Liberty Surface Cleaner with a Steel Wire Brush to Clean Flat Surfaces

An air pressure of 50 to 75 lb. is recommended for operating the cleaner.

A 5-inch steel wire brush, having a large working surface, is used. In operation the brush is held flat against the surface to be cleaned; it is not necessary to tilt the cleaner at an angle. The design of the brush is such that it will not lose its bristles, but after the bristles have been worn down, they can be replaced.

The complete outfit weighs about nine pounds, and has an approximate overall length of one foot. The valve arrangement at the rear makes the cleaner easy and convenient to control. This device was exhibited at the Master Boiler Makers' convention.

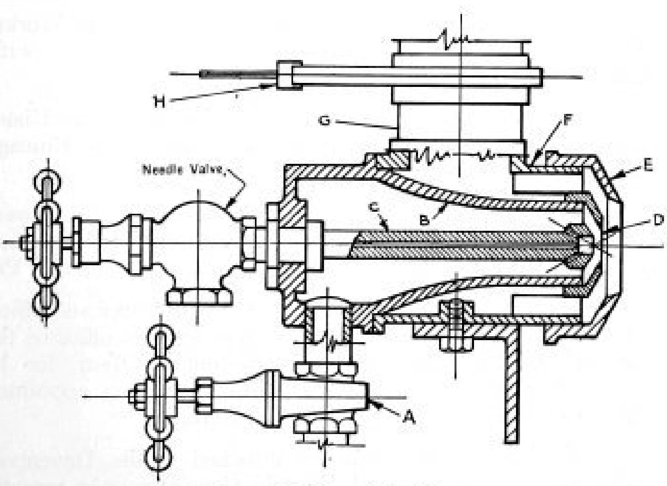
Oil and Gas Burner for Heating Furnaces

A BURNER for either gas or oil, made to operate on air pressures of 1 to 1½ pounds, was specially featured at the Master Boiler Makers' Association convention by the S. Severance Manufacturing Company, Glassport, Pa. In detail, the burner functions somewhat as follows:

The oil spray issuing from the inner nozzle is met by the main air supply which is introduced through the main nozzle *e* on the burner body *f*. This air supply is delivered to the burner through the blast pipe *g* and is controlled by the blast gate *h*. The main nozzle *e* is made adjustable to permit the full velocity of the blast to be obtained when the burner is operating at its maximum desired capacity for two reasons: (a) to secure the best possible atomization; (b) to prevent waste of blast power and fuel.

The converging form of the main nozzle causes the blast to surround the oil spray and, on account of its different velocity and the whirling motion which is imparted by vanes in the burner body, an efficient mixing action is secured.

It is stated by the company that the burners are designed for simplicity and flexibility and will operate at all temperatures required from the maximum to the minimum on oil or gas without wastage of the fuel especially at low temperatures. The temperature can be either increased or decreased at will by simply adjusting the supply of fuel or air. The burner may be instantly changed from one fuel to another by manipulating ordinary standard valves with which it is controlled. No change in the parts of the burner is required for either fuel. Three different sizes of main nozzles are supplied with the burner which are interchangeable allowing its range to be readily changed at any time in the field and at slight expense.



Section of Oil or Gas Burner

Nibbling Machine Cuts Sheet Metal Rapidly

THE Campbell nibbling machine, which was demonstrated at the Master Boiler Makers' Association convention in Chicago, by the Scully Steel and Iron Company, Chicago, is designed to facilitate the rapid cutting of sheet metal to various outlines or to the outline of a superimposed template when the quantity required is not sufficient to justify the making of press blanking tools.

Machine will cut metal up to 3/16 inch in any shape

The machine consists of an overhanging arm carrying a rapidly reciprocating punch of small size which works above a female die carried by the bed. The feeder is governed by a small stop pin on the extreme end of the punch. The metal is fed against this pin allowing a small portion of stock to be removed with each stroke of the punch. The arrangement permits the cut to be made from any direction. The value of this feature may be readily recognized. The machine is simple but strong in construction and it is stated that good work can always be produced providing adjustments are made in accordance with instructions.

Special cutting tools are easily and quickly inserted or removed, the punches being correctly formed from a special alloyed steel correctly tempered and ground to size, insuring uniformity and long life. These tools are double ended and may be inverted in the ram when the cutting edge of one end becomes worn, minimizing tools costs.

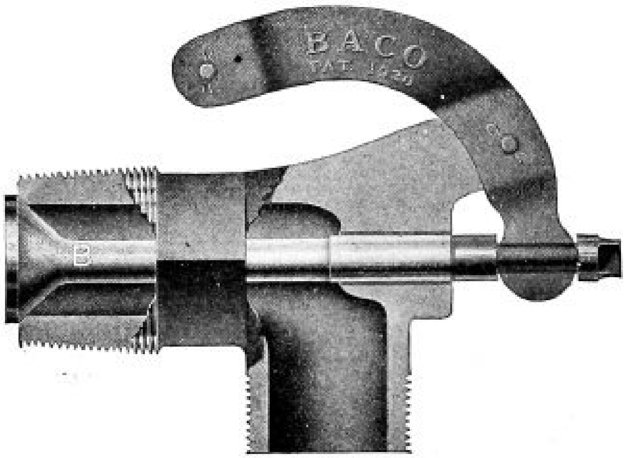
It is stated by the company that the nibbling machine will readily cut to any design all kinds of sheet metal up to and including 3/16 inch. The cut is made at an average speed of 18 inches per minute. Circles may be cut up to 28 inches in diameter by means of a special attachment. Adjustments are provided to fit different gages of metal.

The Bird-Archer Blow-Off Cock

THE Bird-Archer Company, New York, demonstrated a new blow-off cock at the convention of the Master Boiler Makers' Association, recently held in Chicago. As shown in the illustration, this cock is arranged with a threaded boiler connection but it is also made with flanged connections for those railroads which prefer this type. It is also made with a 45-degree delivery in both threaded and flanged types in sizes of 2 inches and 1½ inches.

Safety is secured in this type of blow-off cock by the arrangement which provides that the boiler pressure is exerted directly against the valve opening to maintain it in a closed position. This means that the body of the cock could be knocked off the locomotive in side-swiping while the valve would still close the hole in the boiler.

A special feature of the design emphasized by the company is the arrangement for grinding it under pressure. Should a particle of scale get between the valve and the seat, a few

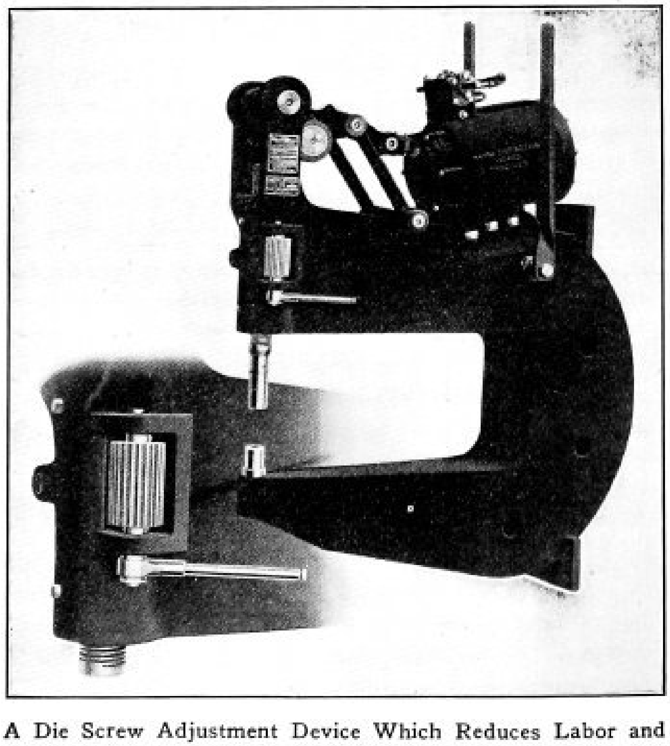


Blow-off Cock with Special Safety Features

turns of the extended valve stem would serve to grind the valve tight. As the body of the Bird-Archer cock is empty while the valve is closed, and since the valve is in the boiler, it cannot freeze in cold weather. Accidental opening is prevented by the arrangement for opening the valve which makes necessary a strong pull on the lever to open it against boiler pressure.

Die Screw Adjustment for the Hanna Riveting Machine

AN accessory for use in connection with its pneumatic riveter, has recently been developed by the Hanna Engineering Works, Chicago, Ill., the use of which makes possible exceptionally rapid die screw adjustment. The mechanism allows the riveting machine to be employed on



A Die Screw Adjustment Device Which Reduces Labor and Time to a Minimum

work of varied plate thickness, with very little loss of time in adjusting the dies at each new grip. With ordinary variations in thickness of plates on the Hanna pneumatic riveter it is not necessary to readjust the die screw. This is provided for in the riveter by a patented mechanism that develops a predetermined pressure uniformly throughout the last half of the piston stroke, or the last ½ inch (1 inch in machines of 100 tons and over) of rivet die travel. The motion is a combination of toggles merging into a lever action. It automatically applies sufficient pressure and follows up the shrink of the rivet under full tonnage until it is cool enough to have taken its set.

In large variations in thickness of plate the new die screw adjusting device reduces the labor and time to a minimum. A few pulls on the ratchet handle advances the die screw the desired amount in an exceedingly short time, thereby avoiding the interruption of the continuous operation of the riveter. If no adjusting device is provided and the die screw adjustment is necessary, it must be made with a pair of tongs, as the screw itself naturally becomes too hot to turn by hand.

The actual details and working mechanism of this die screw adjusting feature are clearly shown in the illustration. The rotation of the ratchet handle causes the large ratchet gear to rotate. Motion is transferred through an idler gear to the vertical gear, which is attached rigidly to a vertical gear shaft. This shaft is securely fastened by a pin to the upper end of the die screw, which it rotates. The vertical gear, the idler, the plunger, and the die screw form a single unit, which reciprocates with the mechanism. The ratchet gear is of such length that the idler can slide on it for the full stroke and remain enmeshed at all times. This mechanism is an addition to the standard riveting machine built by this company.

BUSINESS NOTES

L. A. MARSHALL, service manager of the Industrial Works, Bay City, Mich., has been appointed sales engineer, with headquarters at Chicago.

JOHN C. CAMPBELL has become associated with the Ulster Iron Works at Dover, N. J., with headquarters at the Chicago office in the Peoples Gas Building.

JOSEPH T. RYERSON & SON, INC., Chicago, has taken over the exclusive distribution of Lewis special staybolt iron manufactured by the Penn Iron & Steel Company, Creighton, Pa.

S. A. GATES, for 14 years in charge of the Spokane office, has been appointed manager of the Los Angeles office of the General Electric Company. Mr. Bernhard Olsen, for 12 years employed in the Spokane office, has been appointed manager of that office succeeding Mr. Gates.

K. A. HILLS, since January attached to the Davenport sales office of the General Electric Company, was recently made manager of that office, covering a territory including a large part of the state of Iowa. Mr. Hills has been an employee of the General Electric Company since May, 1910.

THE ULSTER IRON WORKS, with principal office at Dover, N. J., will hereafter conduct the sales of the products of its mill, which, for many years, have been known as Ulster Special staybolt iron, Ulster Special seamless hollow staybolt iron and Ulster engine bolt iron. Howard A. Gray has been appointed general manager of sales, with headquarters at the Chicago branch office, Peoples Gas building, and Henry T. Bradley, eastern sales manager, with headquarters at New York City. E. W. Kavanagh, C. F. Barton and John H. Craigie will also represent the Ulster Iron Works.

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Riveted Joint Calculations

Q.—Would like very much if you would help me out with the following: Find the least percentage joint strength and the working pressure of a boiler with the following dimensions: Plate, 7/16 inch thick; diameter, 72 inches; pitch of rivets, 6¼ inches; diameter of rivets, 7/8 inch; number of rivets in pitch, 5, four in double shear, one in single shear; constant, 8; strength of plate, 60,000 pounds; factor of safety, 4.5. What I would like to know is how to get the joint percentage?—J. C. W.

A.—To answer your question it is essential to know under what rules, the joint calculations are to be made. You have given a constant 8, and I do not know under what rules this constant applies.

Building Up Corroded Plate Sections

Q.—We have at one of our company plants a return tubular boiler that has some bad spots of pitting in shell plates; one in the girth seam lap being the worst, from 3/32 inch to 1/8 inch deep and 1 inch to 1¼ inches in diameter. Is there any good reason why these defects cannot be built up with the electric or other welding machines?—T. S. W.

A.—Corroded plate sections, if not damaged too much can be rebuilt by welding; especially in such cases as you describe. Where the parent metal has wasted away considerably it can be built up also, but the strength in the weld in such cases is not figured equal to that of the original metal.

Jib Crane Calculations

Q.—Being a subscriber to your valuable magazine, I should like to ask you if you could enlighten me on the calculation of the jib crane in the February issue of this year. In the formula for finding the bending stress in the beam (b), I don't understand how 4 is substituted for *A*. Also, in the formula for finding the permissible unit stress of the beam (b), I fail to see how 70 is substituted. Is it a constant?—F. S.

A. To determine the bending moment in a beam loaded at its center, the formula, $\frac{W \times L}{4}$ is used; in which

W = the load in pounds on the beam

L = length of beam in inches.

The use of the letter *A* in the formula was a misprint.

In determining the safe stress in columns or posts, factors known as radius of gyration and the ratio of the length to the least radius of gyration are used. For I-beams or channels used as columns, described in the question referred to, the ratio of the length to the radius of gyration should not exceed 120 times the least radius of gyration. The value 70 is a constant used in the formula for finding the safe unit stress in the beam which is also considered as a column due to the compression load.

Corrosion

Q.—I have just completed repairs on a Heine watertube boiler, one of a battery of three. One of these boilers I found wasted and pitted; in fact, quite a bit thinned. This all appears in one plate a little above the waterline in the steam drum. The rust picks off easily and drops at a touch. Can you give me a reason for this wasting away? Only a part of the plate shows this condition.—J. H. G.

A.—Corrosion is caused by a number of conditions—oxygen, grease from condensed water, and by acids or organic matter contained in the feedwater. Above the waterline it is due to oxygen given off when the water is generated into steam. To offset such troubles, an open feedwater heater is recommended. Internal corrosion occurs in several forms, known as *pitting, grooving, honeycombing* and *uniform corrosion.* When uniform corrosion appears in a large area of the plate, it is generally due to some defect of the material, making it readily susceptible to the elements of corrosion.

Blowing Down and Purpose of Sloping Crown Sheet

Q.—Would you please explain in THE BOILER MAKER why it is that the front part of a crown sheet is higher than the back? Explain it thoroughly, and if there is a difference in different class engines please give table of same. Also tell me if it will damage a boiler to let it empty itself quickly while under high steam pressure; that is, to blow down from both blow-off cocks without stopping until it is empty.—J. L. B.

A.—By the use of the sloping crown sheet a larger volume of water above the firebox is obtained. The crown sheet is also covered with water when the engine descends grades, provided the proper water level is maintained; thereby preventing the sheet from burning. We do not have the dimension data for the different types of locomotive boilers.

A boiler should not be blown down and emptied quickly under high pressure, for damage to the boiler materials would result. It should be blown down gradually and allowed to cool slowly. To empty a boiler rapidly without damage, feedwater is injected to the required level as the boiler is blown down, thus reducing the pressure or temperature gradually.

Error in Staybolt Formula

Q.—As I am shop foreman of a plant constructing vertical tubular boilers I am greatly interested in all matters pertaining to same. Hence when I tried out the formula given in the April issue of THE BOILER MAKER (page 111) I saw there must be some mistake, probably a misprint. Trying around I found that, omitting the power sign outside of the brackets, in the top line gave 4.4 inches for ½-inch plate in a 36-inch diameter firebox which I consider is right. However, as I have seen numerous instances of 5.5 inches in about the same size of boiler, I wanted to make sure if 4.4 inches was right. In other words, had I got the formula right. Hoping you will oblige with an answer and thanking you in anticipation.—J. W.

A.—There is an error in the formula you refer to. The power sign outside the brackets is a misprint.

Correction

In the furnace problem on page 116 of the April issue of THE BOILER MAKER the slant height as given at the bottom of the page and the top of page 118 should have read "The slant height of the frustrum is to the distance x as the slant height of the cone is to the radius of the base of the cone or, $\frac{58\frac{3}{4} \times 112}{4} = 1{,}645$ inches.

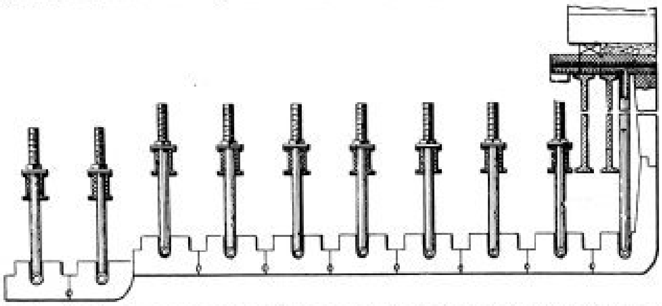
SELECTED BOILER PATENTS

Compiled by
GEORGE A. HUTCHINSON, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

1,488,576. FURNACE ARCH. FRANK H. WAITE, OF LONG ISLAND CITY, NEW YORK.

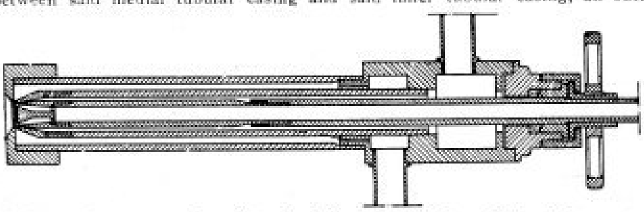
Claim 1.—In a furnace, a plurality of spaced pairs of channel beams, an arch disposed inwardly of the channel beams including a plurality of



blocks, hollow hangers connected to each end of each block and extending between the pairs of beams, means adjustably connecting the hollow hangers with the beams, certain of the hangers terminating inwardly of certain other hangers, as and for the purpose specified. Seven claims.

1,481,419. OIL-FUEL BURNER FOR USE IN FURNACES, BOILERS, AND THE LIKE. JOHN DAVIES, OF DARLINGTON, ENGLAND, ASSIGNOR TO THE DAVIES FUEL BURNERS LIMITED, OF STOCKTON-ON-TEES, DURHAM, ENGLAND.

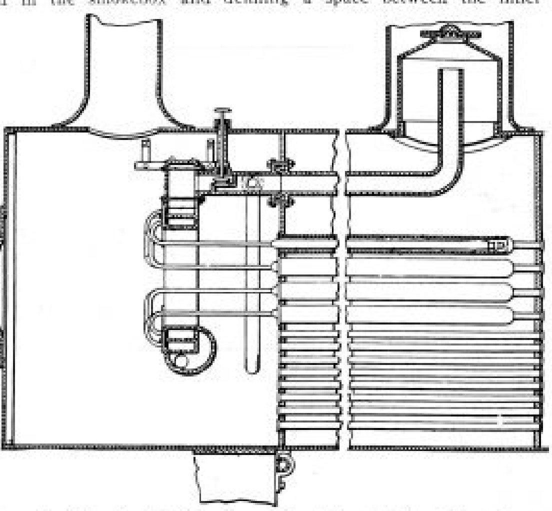
Claim.—Improved oil fuel burner for furnaces of various kinds utilizing liquid fuel comprising a medial tubular casing with a nozzle projecting an annular jet of fuel, an inner tubular casing concentric thereto, a passage between said medial tubular casing and said inner tubular casing, an outer



tubular casing concentric with the before-mentioned medial tubular casing and a passage between said outer tubular casing and said medial tubular casing and means for supplying compressed air to a passage between the said inner tubular casing and said medial tubular casing and means for ensuring that the air, steam in the passage between the medial tubular casing and the inner tubing casing issues at the nozzle in an annular jet at an angle inclined from the axis of the said tabular casing to meet the outer jet of air at an obtuse angle. Two claims.

1,489,660. SUPERHEATER FOR BOILERS. GEORGE COOK, OF BUFFALO, NEW YORK.

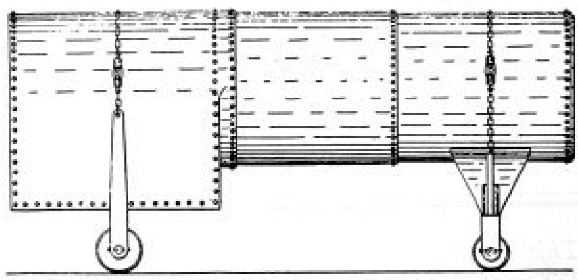
Claim 1.—In a superheater for firetube boilers having a smokebox, a continuous rectangular header divided into a pair of adjacent continuous compartments, one compartment surrounding the other, said header being arranged in the smokebox and defining a space between the inner walls



thereof, a plurality of relatively large fire tubes in the boiler, the axes of which pass through said space within the header, superheater elements removably mounted in the enlarged fire tubes, pipes connecting each of said elements with both of said compartments, said pipes extending through the space defined by said header and having return bends in front of said header and connected to the front side thereof. Four claims.

1,479,351. COMBINATION TRANSPORTING MEANS FOR BOILERS. RALPH F. WINTERBOTTOM, OF WATERLOO, IOWA.

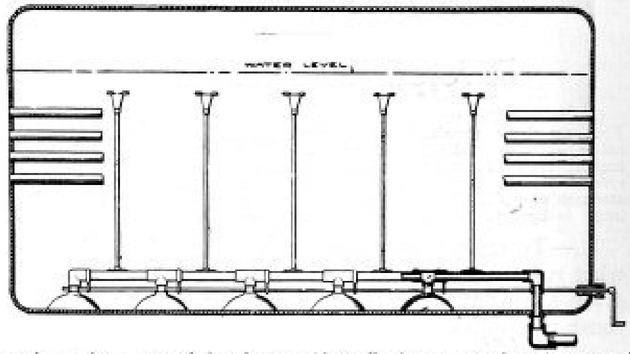
Claim.—Combination transporting means for boilers, comprising a caster-wheel, a frame in which said caster-wheel is rotatably mounted, a saddle on which said frame is pivotally mounted and removable supporting one end of a horizontal boiler which has a fire-box at its opposite end, chain sections



passed around the boiler and end-connected to opposite ends of said saddle, an adjustable separable linking-connection between the chain sections, screws mounted on opposite ends of said saddle to engage the boiler adjustingly, independent clips mounted under and fitting depending opposite sides of the fire-box, carrying wheels mounted on the clips and means for securing said clips in place releasably. Two claims.

1,484,832 BOILER CLEANER. PERCIVAL H. KAUFFMAN, OF NEW ORLEANS, LOUISIANA.

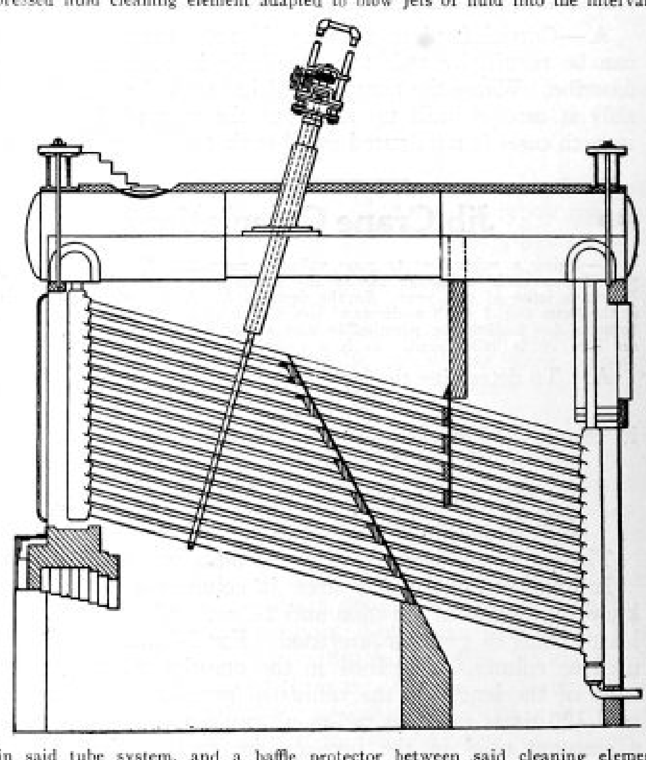
Claim.—In a boiler cleaning device, the combination of a series of inverted cup members adapted to rest on the bottom of the boiler, and having angular



flanged openings near their edges, a blow-off pipe, connections between the blow-off pipe and the cup members, a valve associated with each cup member, an operating arm for each valve, and rotatable rod lying adjacent said cup members and having cam projections to engage said operating arms and open said valves in sequence. Five claims.

1,483,460. COMBINED TUBE SYSTEM AND CLEANER. FREDERICK W. LINAKER AND THEODORE M. BRUBACK, DUBOIS, PA.

Claim.—In combination, a tube system having a baffle therein, a compressed fluid cleaning element adapted to blow jets of fluid into the intervals



in said tube system, and a baffle protector between said cleaning element and said baffle, said cleaner element being rotary, said protector being adapted to receive the impingement of the jets in that part of the movement of the element where they blow. Three claims.

THE BOILER MAKER

JULY, 1924

Side Lights on Boiler Work at Glenwood Shops

Special Shop Made Equipment Aids in Repairing the Many Different Classes of Locomotives Coming to This Shop

THE Baltimore & Ohio cooperative plan in operation between the men and the management has resulted in many time and labor saving methods throughout the shops of the system. Some of the methods developed for boiler work at the Glenwood shops, many of which are due to the suggestions of the men and their foremen, are given below.

Since all major operations must be done along more or less well defined lines, the efficiency of a boiler shop, or of any shop, in fact, must be measured by the manner in which the men carry out their work and by the many special pieces of equipment, usually shop made, that have been designed to supplement the regular machine equipment of the plant. Glenwood is exceptionally well fixed for such labor savers.

Practically the entire locomotive repair plant is housed in one building at Glenwood, the boiler shop with its machinery occupying the center section of one of the side bays. As the plant is but five years old, its layout and equipment are well designed to take care of the repair requirements at this point on the B. & O. system. Engines are stripped in the center bay and parts are scheduled to the various sections of the floor for repair or replacement. Ample crane facilities are available for handling material up to complete boilers to any point of the plant without interference with other work.

Personnel of Boiler Shop

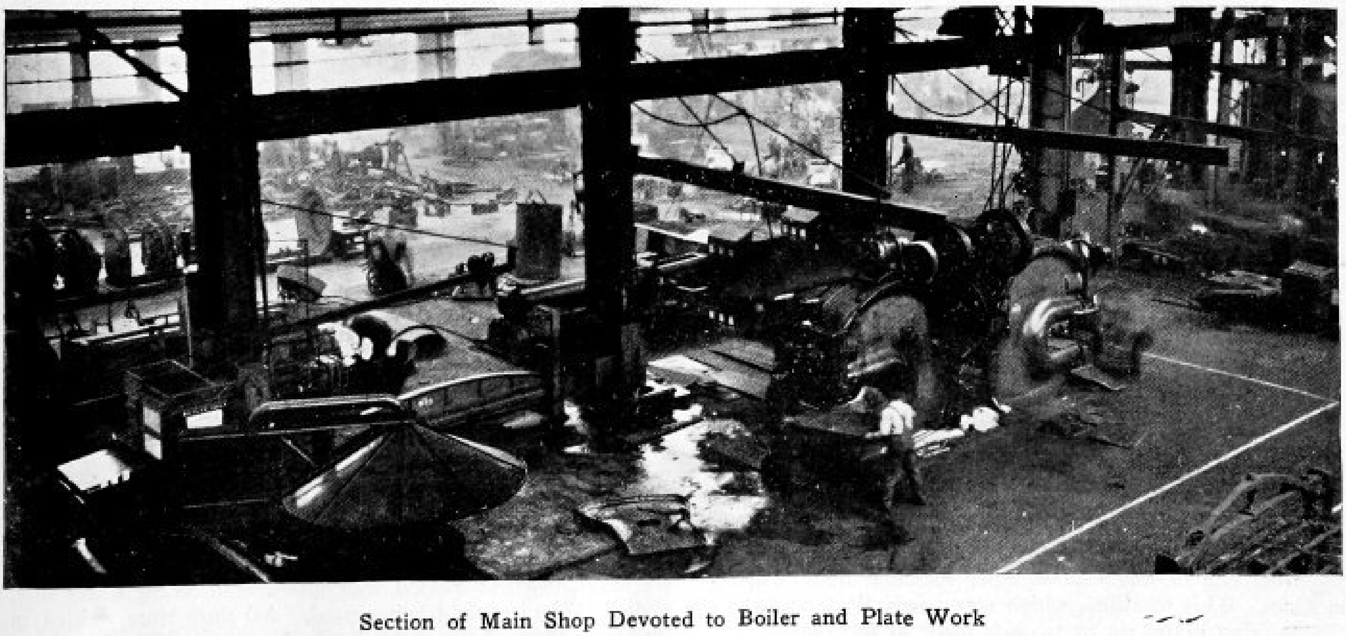
One hundred and seven men were employed in the boiler shop at the time of the writer's visit. Of this number, there were 1 general boiler foreman, 5 assistant boiler foremen, 2 boiler inspectors, 1 layerout, 9 welders and cutters, 1 flange turner, 54 boiler makers and 34 helpers.

The shop has been carrying out heavy repairs, that is, new fireboxes, and the like, since December, 1923. As it operates now, the shop does on the average of four class-2 repairs with new fireboxes and new courses to the boiler barrel; one class-1; ten class-4; ten class-5 and as many running repairs as are necessary in the course of a month.

A typical schedule for boiler work as arranged on the shop schedule board is about as follows:

First day, smokebox stripped.

Third day, flues out, delivered to flue department, cleaned, cut and safe ended.



Section of Main Shop Devoted to Boiler and Plate Work

Fourth day, flue lengths given to smith shop.

Tenth day, flues back in boiler.

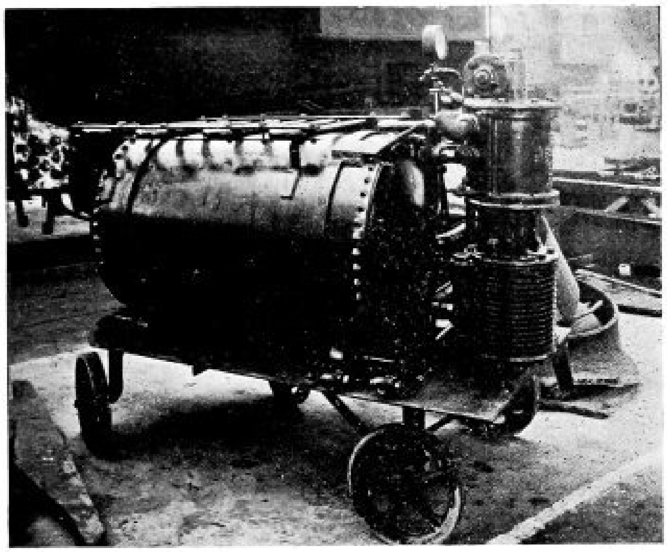
Twelfth day, ashpans and grates installed.

Fourteenth day, smokebox complete—boiler O.K. for test.

The greatest variety of boiler work comes to this shop—in fact to a greater extent than any other shop on the B. & O. system. Out of a possible 180 types of locomotives, 167 different classes of engines have been repaired at Glenwood. This, as may well be realized, involves a flexibility of both equipment and methods that is more or less unusual in a railroad repair shop.

Special Air Booster Built

When the shop was first built it was not intended that heavy repairs be carried out, so the equipment does not include a bull riveter. This necessitates the use of a 9-inch pneumatic riveting hammer for driving shell and other heavy rivets 1 inch and over in diameter. An air pressure of from 130 to 140 pounds is required for operating this size hammer and so a portable air pump has been developed and built in the



Portable Machine for Supplying Air to Heavy Riveting Hammers

shop to boost the regular air line pressure from 90 to 145 pounds. This equipment consists of a compressor and storage tank mounted on a special truck with a manifold for serving four lines of air hose. With two lines working, the pressure is maintained at 145 pounds; with four lines in operation the pressure drops to 133 pounds. The accompanying illustration of the booster indicates the arrangement of the pump and tank.

Another tool developed for overhead riveting, and especially useful in the tank department, is shown as the initial cut at the beginning of this article. It is an air hammer extension which, bearing on the shop floor, takes the weight of the hammer and bucks up the rivet as it is driven in the tank bottom. It consists of an extension rod attached to a 6-inch pneumatic hammer and is controlled by one man, eliminating another man on the job and, at the same time, allowing rivets to be driven rapidly and easily without tiring the operator.

Methods of Flanging

The flanging work done at this shop deserves special comment for it is accomplished in a clean-cut manner and rapidly with one of the earlier type, McCabe light flanging machines. This machine, which was originally intended for cold flanging plates up to ½-inch thick at the normal shop pressure of 90 pounds, has been equipped with an air booster which provides a pressure of 133 pounds, making possible the flanging of plates up to ¾ inch.

As stated by the foreman, the short time required for some of the flanging jobs done with the aid of this machine seems remarkable, although there are undoubtedly shops where it is done as rapidly or even more so with the newer types of McCabe flangers. For example, a door sheet is flanged in 1¼ hours and flue sheets require about the same length of time. The time taken for flanging the top section of a back flue sheet is given as 15 minutes with ½-inch metal and two men on the job. In the case of a back head of ⅜-inch metal on locomotive 2,530 and a flue sheet of ½-inch plate for the same job, two men did the flanging on both sheets in 1½ hours. To do the work by hand, four men would have required 10 or 11 hours. One other flanging job was mentioned by the foreman, that of a front flue sheet of ⅝-inch plate made in one hour and forty minutes. Four men doing the flanging by hand would have required eleven hours to complete the sheet satisfactorily. On the flanging machine, one flanger and helper handled the work.

In flanging the door hole, the sheet is placed in the flange fire and three men with 12-pound sledges complete the operation in about 25 minutes, the flanging block is of course eliminated. If the flanging is done on the block the job requires about three hours. It was stated that this practice of flanging the door hole in the fire gave a better radius and smoother work than on the block and saved considerable time.

Templates are made for every flange on flue sheets or heads, throat sheets, etc., that come to the shop so that in the future whenever it is necessary to lay out the sheets again the work can be accomplished very easily.

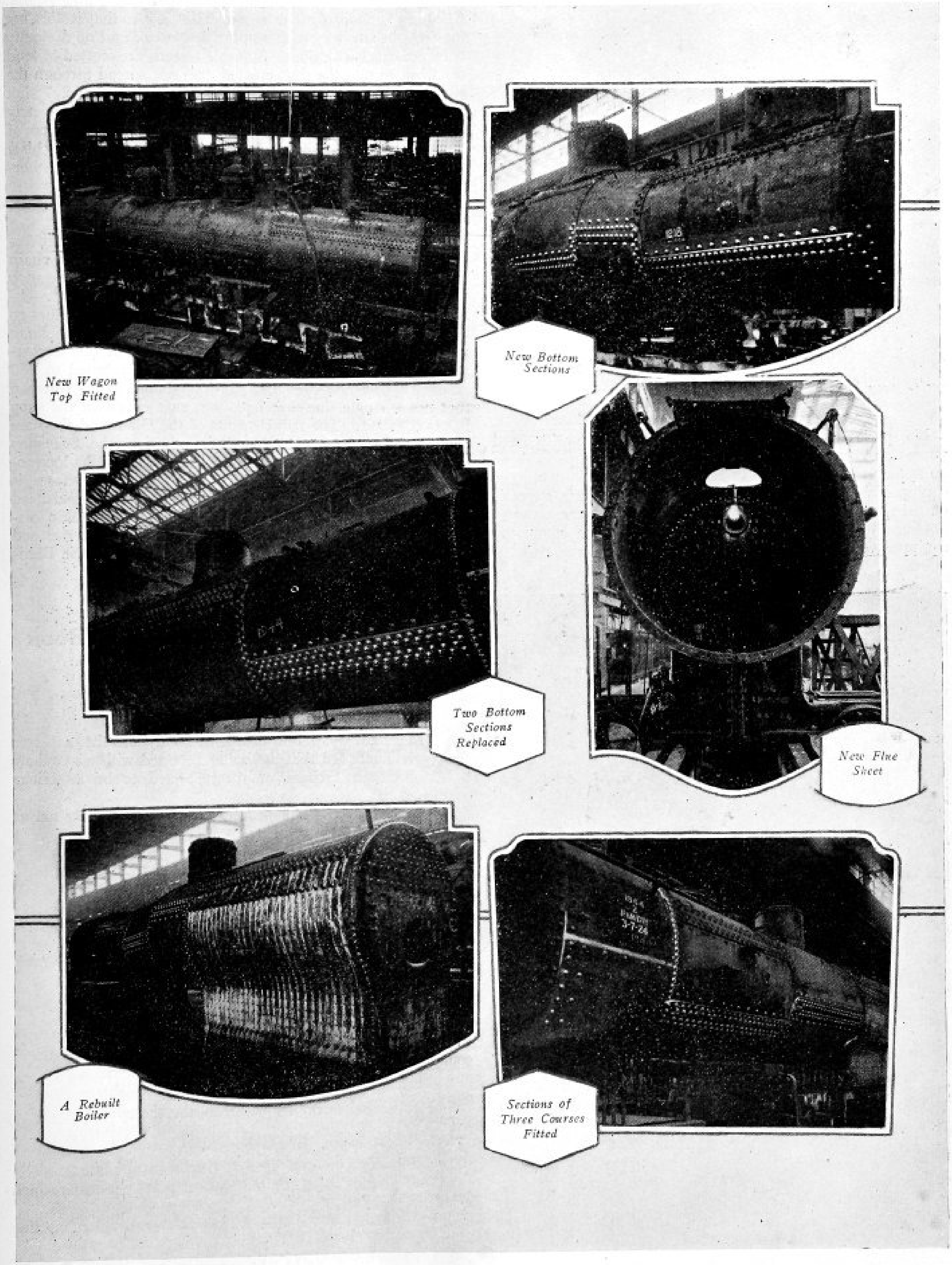
Back Head Repairs

The practice in making back head repairs at this shop is to cut out the old head with the oxy-acetylene torch up to the line of T-irons and to lay out the new section from the old head, bolt it up and rivet it in place. It is estimated that about $300 is saved on a back head job where the work can be done without removing the T-irons, braces and the like.

No regular stripping gangs exist in the shop, each foreman having charge of the stripping of locomotives on which he is to work. When a locomotive comes into the shop, the boiler foreman and machinist foreman not busy at the time on other work assemble their crews and carry out the stripping operations and later the erecting as well. This practice tends to broaden the men in experience with all classes of engines and makes better boiler makers than the system of specialization and individual operations that exist in many shops.

The firebox gang, handling six pits, consists of about 28 men, 14 of whom are boiler makers and the remainder helpers. This gang does on the average of four new firebox jobs a month, in addition to all heavy shell work, patches, new barrel courses, and the like.

Some typical heavy boiler jobs that were in the shop at the time of the writer's visit are shown in the accompanying illustrations. For example, locomotive 1410, in the railroad company's designation, M-60-68 type, had one new course applied. No. 1943, and E-21 type, Ogee firebox job, had one-half a new back head, two heavy hip patches, a new firebox, two-thirds of the first course, two-thirds of the second course, a new front flue sheet and half a new smokebox applied. In the case of No. 1668, a new firebox was fitted as well as half of the back head, half of the outside left and right side sheets and half of the first course; the firebox and outside sheets were welded with the exception of the back head throat connection and longitudinal seam. The outside wrapper sheet was welded both outside and on the water side, a double V-type weld being used. All flues were welded in the back flue sheet with the boiler empty. Incidentally,



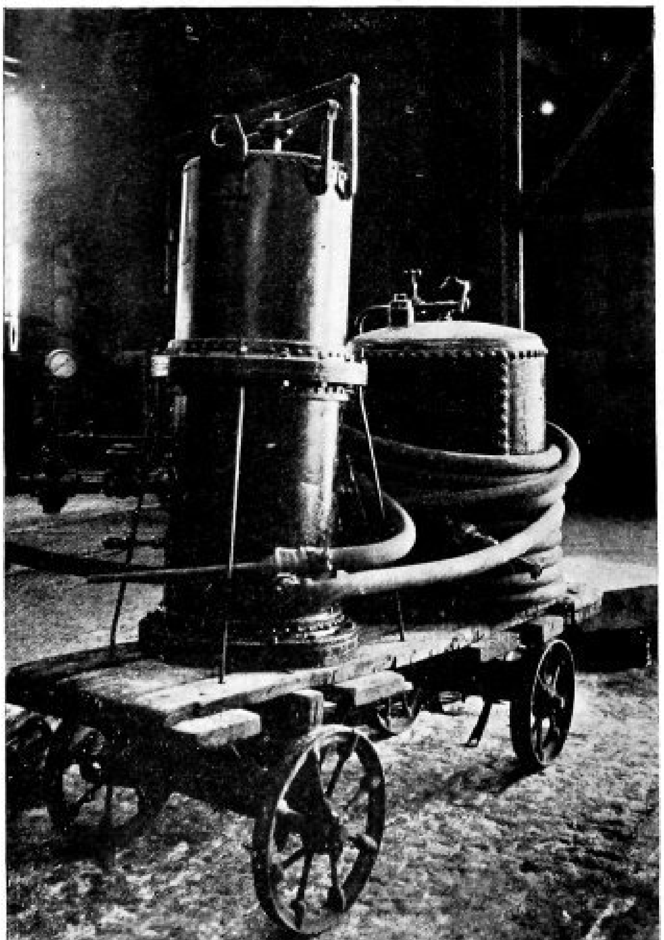
Examples of Boiler Repair Work at Glenwood

Portable Hydrostatic Pump for Boiler Testing

welding is applied on all jobs where it can be done with safety and consistent with federal requirements.

Portable Hydrostatic Test Pump

No special testing pit is provided in the shop with fixed pumps and drains so a portable hydrostatic pump has been built for use at all parts of the erecting floor. This unit is equipped with a 9½-inch air-driven pump which operates on the shop line pressure of 90 pounds and delivers a water pressure of 300 pounds. This pump, shown above, is equipped with four check valves; two inlet and two outlet.



Boiler Scaling Is Done with the Sand Blast

All boiler scaling is done with a portable sand blasting outfit supplied by the Filthman Company of Philadelphia. Cleaning is done at night by a special crew so that it does not interfere in any way with regular shop work and no difficulty is experienced with dust. Suitable screens are erected around the work so that the dust created does not spread through the shop. The best success has been obtained with No. 7 shot sand. The operation requires about 3 hours to completely scale the boiler and tubes. Depending on the condition of the scale, the old method of scaling with a hammer and chisel required between 20 and 30 hours at this shop to do a thorough job.

Flue Work

The flues are removed from the locomotives in the yard before going into the shops. Here they are bundled in chain slings, dropped on special flue trucks and hauled into the shop where they are cleaned. The flue rattler is of the wet submerged type constructed at Glenwood. The tubes and flues go through the regular operations of safe ending on machines mostly the product of the shop. The work in this department is carried on by 7 men. All flues are tested to 350 pounds hydrostatic pressure. It was stated by the foreman that not a single flue that had been safe ended in the shop has ever failed. The requirements of the Glenwood shop are about 9,000 flues a month and, in addition, the flue shop turns out 6,000 or so for outside points. Besides the locomotive boiler work done at Glenwood, the back shop force is required to maintain all stationary, vertical submerged head boilers for the West Virginia, Pennsylvania and Ohio districts. Also all shop order work for car yard material and boiler material for the lines west of Pittsburgh on the Baltimore & Ohio Railroad.

Page from an Inspector's Note Book

Internal Pitting of Boiler Shell

By W. F. Odenheimer

A BOILER was found pitted internally and the inspector recommended that the boiler be fitted with a new half sheet, on account of what seemed to be a serious condition.

An analysis of the case proved that conditions were not as bad as they seemed.

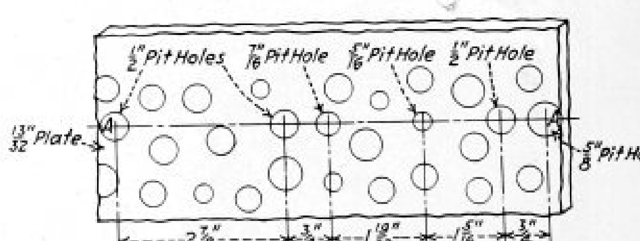


Fig. 1.—Section of Pitted Side Sheet

The following examples illustrate the theory:

Example No. 1

13/32 inch = 0.40625 inch = thickness of plate

55,000 pounds = tensile strength of plate per square inch of section

7 9/32 inches = 7.28125 inches = overall pitch on line *A-A*

2 5/16 inches = 2.3125 inches = sum of diameters of all pit holes on line *A-A* in a pitch of 7 9/32 inches.

A — Assuming that pit holes extend through the entire thickness of the plate, then:

Strength of solid plate on line *A-A* is 162,690 pounds
7.28125 × 0.40625 × 55,000 = 162,690 pounds.

Strength of net section on line *A-A* is 111,020 pounds
(7.28125 — 2.3125) × 0.40625 × 55,000 = 111,020 pounds.

Percentage of strength of net section as compared with solid plate is 68.2 percent.
111,020 ÷ 162,690 = 0.682

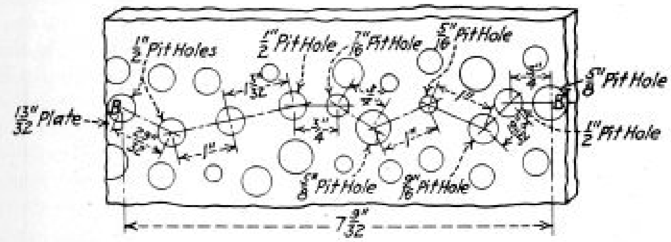


Fig. 2.—Method of Finding Strength of Pitted Plate

B—Assuming that pit holes extend to a depth of ⅛ inch, then:

Strength of plate *lost* by pit holes is 15,898 pounds
2.3125 × 0.125 × 55,000 = 15,898 pounds.

Strength of plate on line *A-A* after pitting action has taken place is 146,792
162,690 — 15,898 = 146,792 pounds.

Percentage of strength of pitted plate as compared with solid plate is 90.2 percent.
146,792 ÷ 162,690 = 0.902.

EXAMPLE NO. 2

13/32 inch = 0.40625 inch = thickness of plate
55,000 pounds = tensile strength of plate per square inch of section
7 9/32 inches = 7.28125 overall pitch
7 27/32 inches = 7.84375 = developed length of zig-zag line *B-B*
4½ inches = 4.5 inches = sum of diameters of all pit holes on zig-zag line *B-B* in pitch of 7 9/32 inches.

A—Assuming that the pit holes extend through the entire thickness of the plate, then:

Strength of solid plate in 7 9/32 inches is 162,690 pounds
7.28125 × 0.40625 × 55,000 = 162,690 pounds.

Strength of net section on zig-zag line *B-B* is 74,711 pounds
(7.84352 — 4.5) × 0.40625 × 55,000 = 74,711 pounds.

Percentage of strength of net section on zig-zag line *B-B* as compared with solid plate is 45.9 percent
74,711 ÷ 162,690 = 0.459.

B—Assuming that pit holes extend to a depth of ⅛ inch, then:

Strength of plate at pit holes plus strength of net section on zig-zag line *B-B* is 144,320 pounds
[(0.40625 — 0.125) × 4.5 × 55,000] + 74,711 = 144,320 pounds.

Percentage of strength of net section on zig-zag line *B-B* as compared with solid plate is 88.7 percent
144,320 ÷ 162,690 = 0.887.

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, C. W. Obert, 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 interpretations of the Committee in Cases Nos. 435, 440, 441, 442 and 443, as formulated at the meeting of April 25, 1924, all having been approved by the Council. In accordance with established practice, names of inquirers have been omitted.

CASE NO. 435—*Inquiry:* Will a nozzle mounted on a pipe shell or drum, which is attached thereto by bands formed of extensions on the side walls of the nozzle pipe material, wrapped around the pipe shell or drum and hammer-welded together at their ends, be considered as meeting the requirements of Par. 186, if autogenous welding is used merely for sealing and steamtightness? Ribs or gusset braces are welded in on four sides of the nozzle of this construction, but they are not relied upon to carry the stress due to steam pressure on the nozzle, the extended bands cut from the side wall of the pipe nozzle being calculated to withstand the stress due to the steam pressure.

Reply: The Boiler Code states that 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. If the construction is such that it will withstand the pressure with a proper factor of safety without depending on the additional strength secured by the autogenous welding, it will meet the requirements of the Code. The Committee does not pass on specific structures and therefore has not checked up the figures given for strength in the particular case. If a sample specimen can be constructed for testing the structure in such a way that the strength of the autogenous welding is not utilized for holding the parts together, the results of such a test could be used for establishing the working pressure in accordance with Par. 247 of the Code.

CASE NO. 440—*Inquiry:* Would a pipe plug that is used in a washout opening in a firebox boiler be considered as the equivalent of a fitting under the requirement of Par. 300 which stipulates that a pipe or fitting shall screw into a tap hole a minimum number of threads to correspond with the requirements of Table 8?

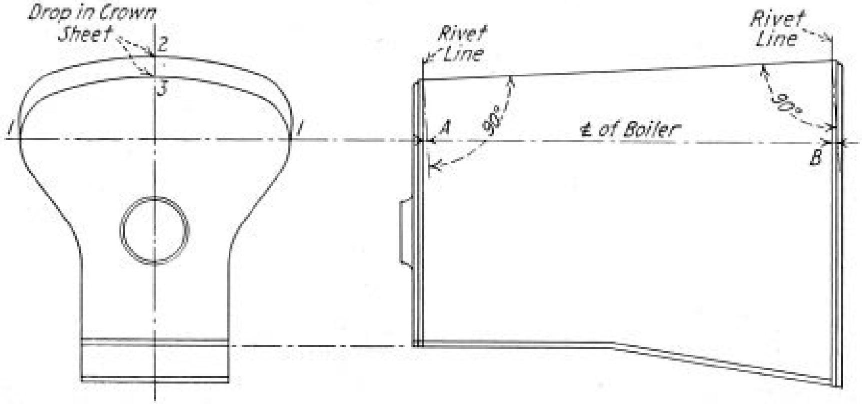
Reply: It is the opinion of the Committee that in the use of the terms "pipe or fittings" in Par. 300, it was intended to include pipe plugs.

CASE NO. 441—(In the hands of the Committee.)

CASE NO. 442—*Inquiry:* Is it permissible, under the rules of the Boiler Code, to form a nozzle not exceeding 8 inches pipe size, on a horizontal return tubular boiler shell or on a boiler drum, integral with the shell plate by forming a hot-pressed projecting neck from the metal of the plate and

(*Continued on page 210*)

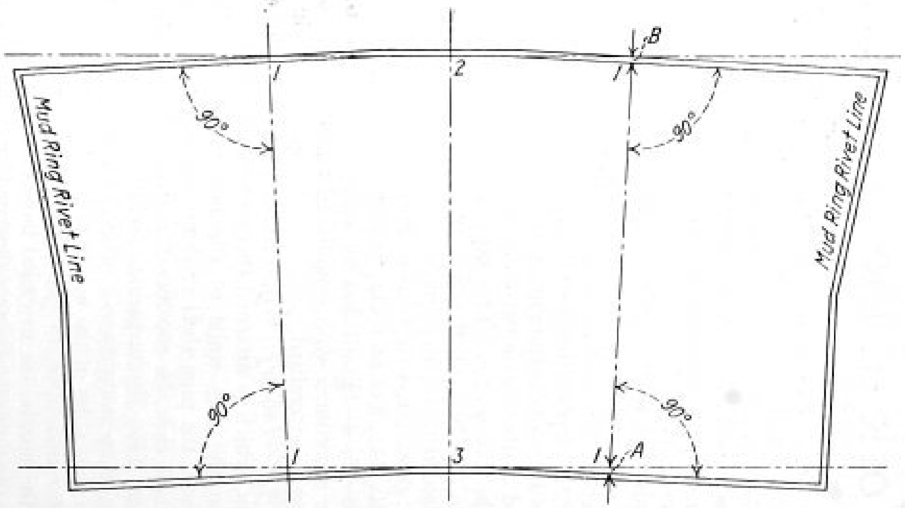
LAYOUT OF NARROW TYPE FIREBOX



End View of Heads

Side View of Firebox

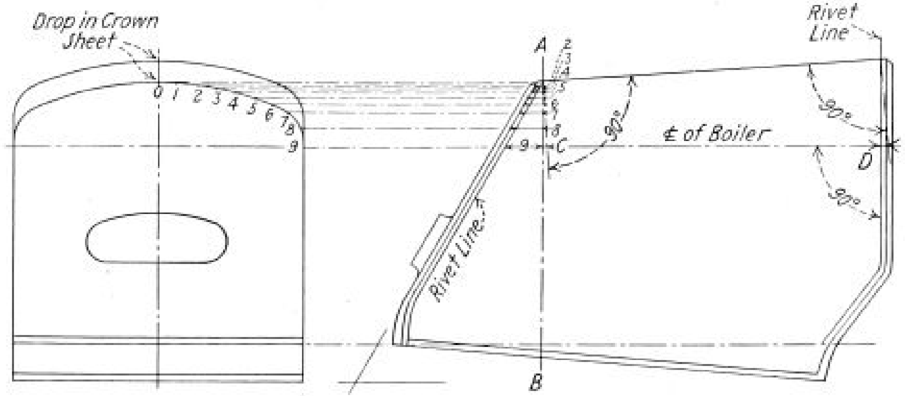
FIG. 1



Layout of Wrapper Sheet

FIG. 2

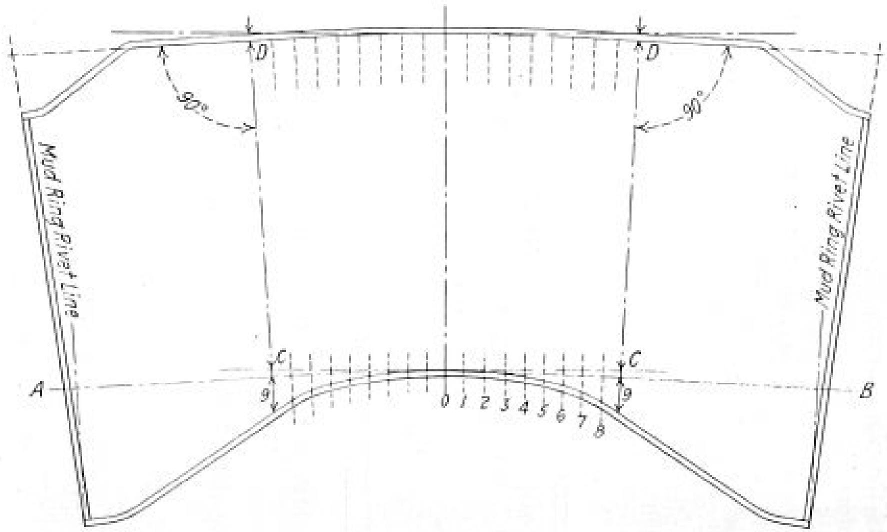
LAYOUT OF WIDE TYPE FIREBOX



End View of Heads

Side View of Firebox

FIG. 3



Layout of Wrapper Sheet

FIG. 4

Saving Time in Laying Out Locomotive Boilers

Simplified Methods of Developing Wrapper Sheets and Heads for Narrow and Wide Type Locomotive Fireboxes

By C. A. Chincholl

AT the present time when efficiency is the slogan of every shop, the laying out of the different plates for the boiler, is a factor not to be lost sight of. As it is generally agreed by all in the trade, this branch of boiler making cannot be rushed through. Following the age-old adage, "haste makes waste," in this department accuracy displaces haste. This does not mean that all ways are closed to speeding up the work of laying out. One sure time saver is for the layer out to thoroughly familiarize himself with the various shortcuts which are known to be practicable. These short methods do not come from technical or mechanical trade schools, but are originated by the practical tradesman and are generally guarded by him as personal property, and for this reason are little known by the average journeyman and apprentice.

It is hereby suggested, for the betterment of the trade and as a help to all the journeymen who care to avail themselves of the opportunity, that an exchange of these secrets of the trade be started in the columns of THE BOILER MAKER by men who having been employed in boiler shops for years and who, through years of practical experience and study are able to contribute such articles. Such articles contributed by those of our own fraternity are most highly appreciated because they are generally to the point, written in plain language and are practicable. With the idea of getting this movement started, two articles dealing with laying-out problems have been prepared by the writer, the first giving a short method of laying out fireboxes. The second article which will appear in a later edition of THE BOILER MAKER will contain a short method of laying out regular and irregular cones, otherwise the gusset sheet of the boiler.

The method of laying out fireboxes herein explained, has been used by the writer for years and found to be the most practical, when speed and accuracy are considered. As an example, let us consider the time required to lay out the rivet lines of a firebox by two methods. Four to six hours is a fair estimate of the time it will take a good layer-out using triangulation methods to prepare all necessary angles and transfer lines and lay out the rivet lines on the wrapper sheet. Using the other method, herein described, two hours is ample time for a layerout thoroughly familiar with the method, to lay out all rivet lines on the wrapper sheet.

This method applies to laying out fireboxes where crown sheets have a drop of five inches, as well as those having only a two inch drop.

In getting the camber for the wrapper sheet by this method, the first step is to outline the flue sheet and door sheet as in the end view of heads, see page 196. If the box has a straight mudring, see that mudring rivet lines on both heads are even; if the mudring has a drop of six inches, see that mudring rivet line of flue sheet is six inches lower than mudring rivet line of door sheet in your outline. It is not necessary to outline completely around the heads. The object is to get the distance from the crown sheet to a point on the intersection as *3* to line 1-1, for the door sheet and 2 to line 1-1 for the flue sheet. Next draw a side view of the firebox; place a square on the crown sheet line, square a line from point of rivet line to intersect line 1-1 as at *A*. The distance between arrow heads at *A* is the amount of variance in camber, for the door sheet rivet line.

Repeat this operation at the front of the firebox and obtain the distance between the arrow heads at *B* which is the amount of variance in camber for the flue sheet rivet line. We are now ready to lay out the wrapper sheet. Square your sheet, lay out a line 1⅛ inches from the edge of the sheet; this will be rivet line for the front end of the firebox. Parallel with the flue sheet rivet line lay off the door sheet rivet line; obtain the distance between these two rivet lines by measuring length of crown sheet, see side view in sketch.

With a two foot measuring wheel obtain the distance between 2 and 1 from the outline of the firebox heads, see sketch. Lay off this distance both ways from the center on the flue sheet rivet line previously prepared on the wrapper sheet. Take the distance obtained at *B*, which is the amount of camber for the flue sheet; set in from rivet line at 1-*B*. This gives us three points on camber 1-2-1. Take a stick which can be bent to touch these three points, draw a line connecting the three points 1, 2 and 1 and we have completed the camber for the front end of the box. Again take the two foot measuring wheel and travel the outline of the firebox head and find distance 3 to 1 from the door sheet. Set this distance both ways from the center on the door sheet rivet line already prepared on the wrapper sheet. Secure the amount of camber as at *A*. Set this distance out towards the edge of the plate as at *A*-1, see wrapper sheet. Draw a line connecting the three points 1-3-1, using the stick as in drawing the camber of the flue sheet, and we have the camber completed for the door sheet. Draw a line across the wrapper sheet from 1-*A* to 1-*B*. Right and left side of sheet, square your rivet lines both flue and door sheet from line 1-*A* to 1-*B*, shown as 90 degrees on sketch. Secure distance to mudring, lay off mudring rivet line, and you are ready to space off your staybolt and rivet holes which will complete the lay out of the narrow type firebox.

WIDE TYPE FIREBOX

In laying out the wide type firebox wrapper sheet the same method is used as in laying out the narrow type wrapper sheet, only we have the sloping door sheet to take care of, which we get in the following manner: The distance *O* to 9 on the end view of the head is divided into equal spaces, in this case we have this space divided into sections. Project to the side view of the firebox as indicated by arrow heads in sketch. By following the method used in laying out the narrow type wrapper sheet, we have completed the wide type layout up to line *A*-*B*, see side view of wide type box. This line we find by referring to layout of wrapper sheet is the camber line for the door sheet. Step off the nine spaces from door sheet outline to camber line on wrapper sheet, extend lines out towards edge of sheet from each pitch, number these starting at *O* or center line of crown sheet up to nine. Obtain distances between arrow heads from side view of box and set these distances out from camber line corresponding with their numbers 1-2-3, etc. Connecting these points 1 to 9 with a line gives us the rivet line for the door sheet 9 to 9. Draw lines *D*-*C*-9 across the wrapper sheet right and left side. Remainder of layout is taken from the side view of the firebox as this remaining part of the wrapper sheet is straight, down to the mudring it is simply a matter of transferring same to wrapper sheet. To completely layout, add lap for all rivet lines, space the rivet holes and lay out staybolt holes.

Repairing Locomotive Boilers at Bischheim, France*

Special Equipment Used for Erecting and Testing Locomotive Boilers and in Flue Reclaiming Department

THE standard used in operation 11, which is shown in Figs. 7 and 8, is similar to the one given in Fig. 6 (appearing on page 159 of the June issue), so far as the arrangement of the movable platform is concerned. However, it differs somewhat in the method used to suspend the pneumatic hammers. The riveting is done exclusively by means of pneumatic tools which rivet both heads of each stay simultaneously.

Hammers are suspended in pairs from beams which are themselves carried by counterweighted levers. This arrangement relieves the worker of the weight of the hammer and decreases the risk of bad workmanship.

The advantages of this system have been made complete by the addition of a small pneumatic block which is either attached to one of the firebox sides or is in the form of a lateral rest carried by the movable platform, adjacent to each hammer. Nine-tenths of the work is saved by means of these blocks and fatigue to the operator caused by the vibration of the hammer is practically eliminated. This device, which is not shown in the illustration, improves the work in a marked manner, and especially the appearance of the stay heads.

Operation 12.—The boiler, which so far has rested on the trucks with the mudring in the air, is now turned over 90 degrees to permit the tapping of the tie rods, which work, as well as the installation of the rods, is done on a special platform located adjacent to the tapping machine.

During the course of this operation, the tubes, cocks and valves are set in place. The tube reclamation outfit, the principal features of which will be given later, as well as the lathes used in repairing and grinding the cocks and valves, have been so placed near the point of installation that they are available at the time wanted without having to be sent through the shop.

Operation 13.—Boiler tests are made on a special pit, which is so built as to allow easy access about the firebox, the smoke being ejected through a chimney stack topped by a Chanard type exhauster.

The objection may be raised that, although this system can be efficiently operated when construction or repairs are being carried out on a large series of boilers of the same type, it does not lend itself as readily to the varied work of repairing boilers which include either the entire replacement of the firebox or, in many cases, the installation of half side sheets and the like. In work of this nature, it is many times impossible to route boilers in the same progressive manner and so that every part of the work requires the same amount of time as the operation which precedes and the one which follows.

In actual practice, owing to the diversity of types, it frequently happens that one portion of the work is complete before the gang which follows is ready to take charge of the boiler and the foreman is required to look for other jobs for his men. In addition, the locations used for certain operations, such as that for riveting mudrings and door sheets, cannot be used continuously owing to the large production of the various sections of the plant, but this inconvenience is largely compensated for by a more efficient use of the workers who always find on the spot the tools required for a given job. So far as safety and facility of work are concerned, the men are infinitely better off than trying to carry out the operations with makeshift equipment.

Results Satisfactory

Although this system has been in operation only a few months it has given thoroughly satisfactory results. For example, it has been possible to repair a G-8-1 locomotive boiler in 15 working days of 8 hours a day, the repair consisting of renewing the firebox, several courses of the barrel and considerable reclamation of corroded parts with the torch. It is hoped to reduce this time still more.

This use of standards or special frames in a shop which is served by traveling cranes which do not permit the suspension of any fixed equipment in the shop offers two additional benefits. Air piping is carried along the columns of the standards and does away with all piping from the mains along the shop floors. These standards also facilitate the use of individual electric lights and eliminate wires running along the ground or in special conduits.

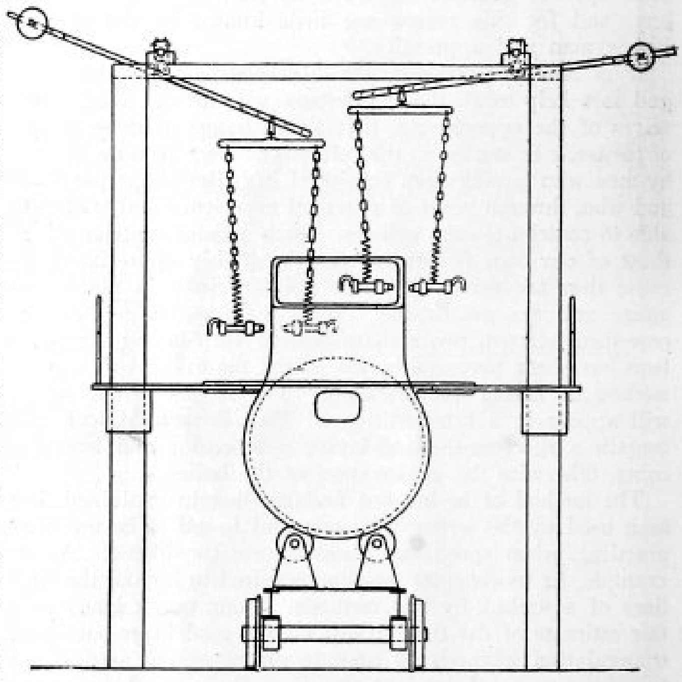


Fig. 7.—Frame for Stay Head Riveting

Repairing Tubes and Flues

The shop organized to reclaim tubes and flues has demonstrated several special features which we believe worth while describing briefly owing to the elimination of a great deal of handling and the saving in labor which the system has made possible. In the safe ending of tubes the use of electric welding is very similar to the methods employed in this country.

1. Cleaning.
2. Inspection and straightening.
3. Cutting off one end.
4. Grinding to insure contact of the welding machine jaws
5. Welding.
6. Grinding off the burr left by the welding.

* This is the concluding section of an article translated from one by Mons. J. Oudet which appeared in *Révue Générale des Chemins de Fer et des Tramways*. The first instalment of the article appeared on page 157 of the June issue of The Boiler Maker.

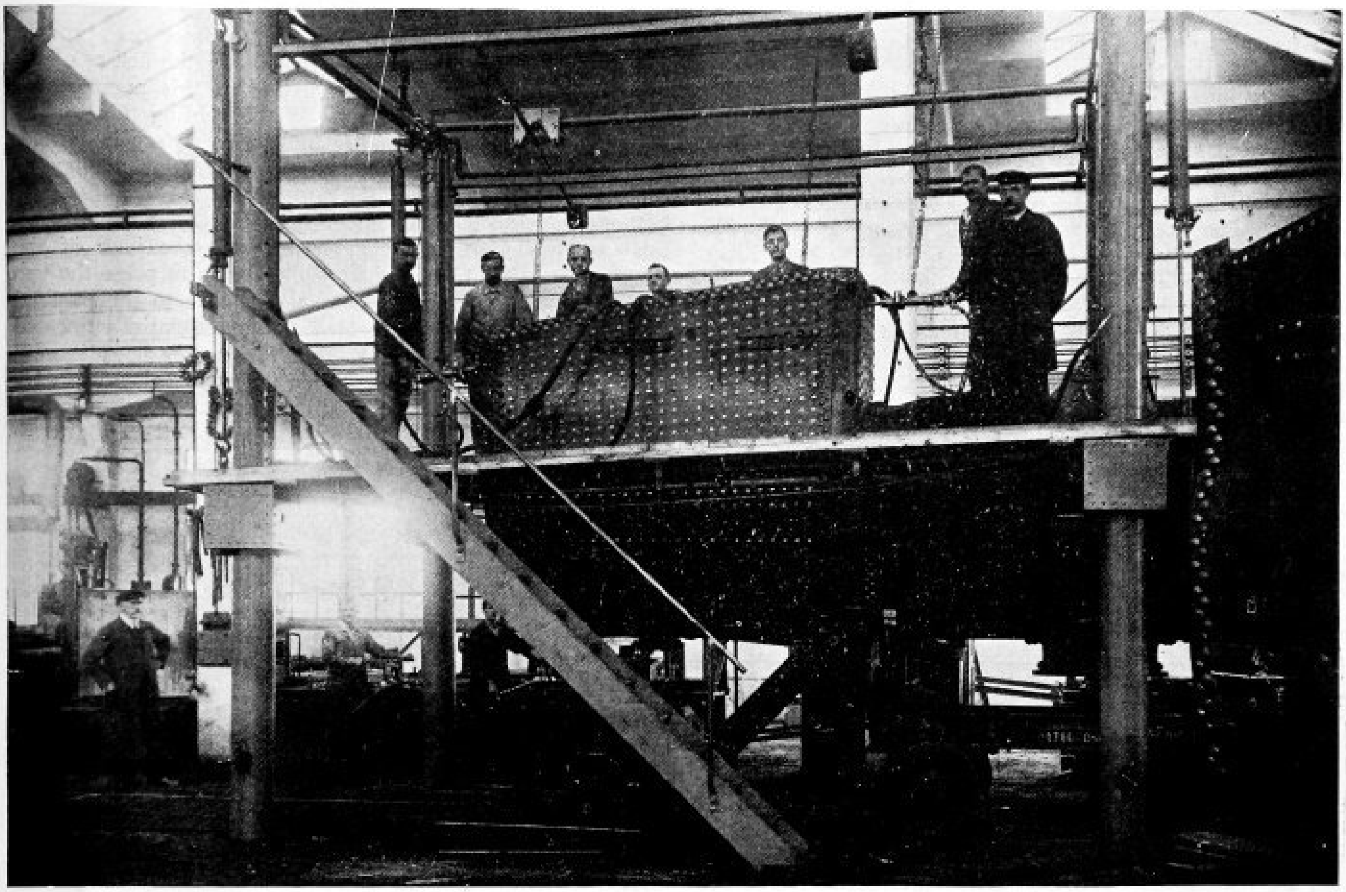


Fig. 8—Time and Labor Saved by Arrangement of Hammers for Riveting Stay Heads

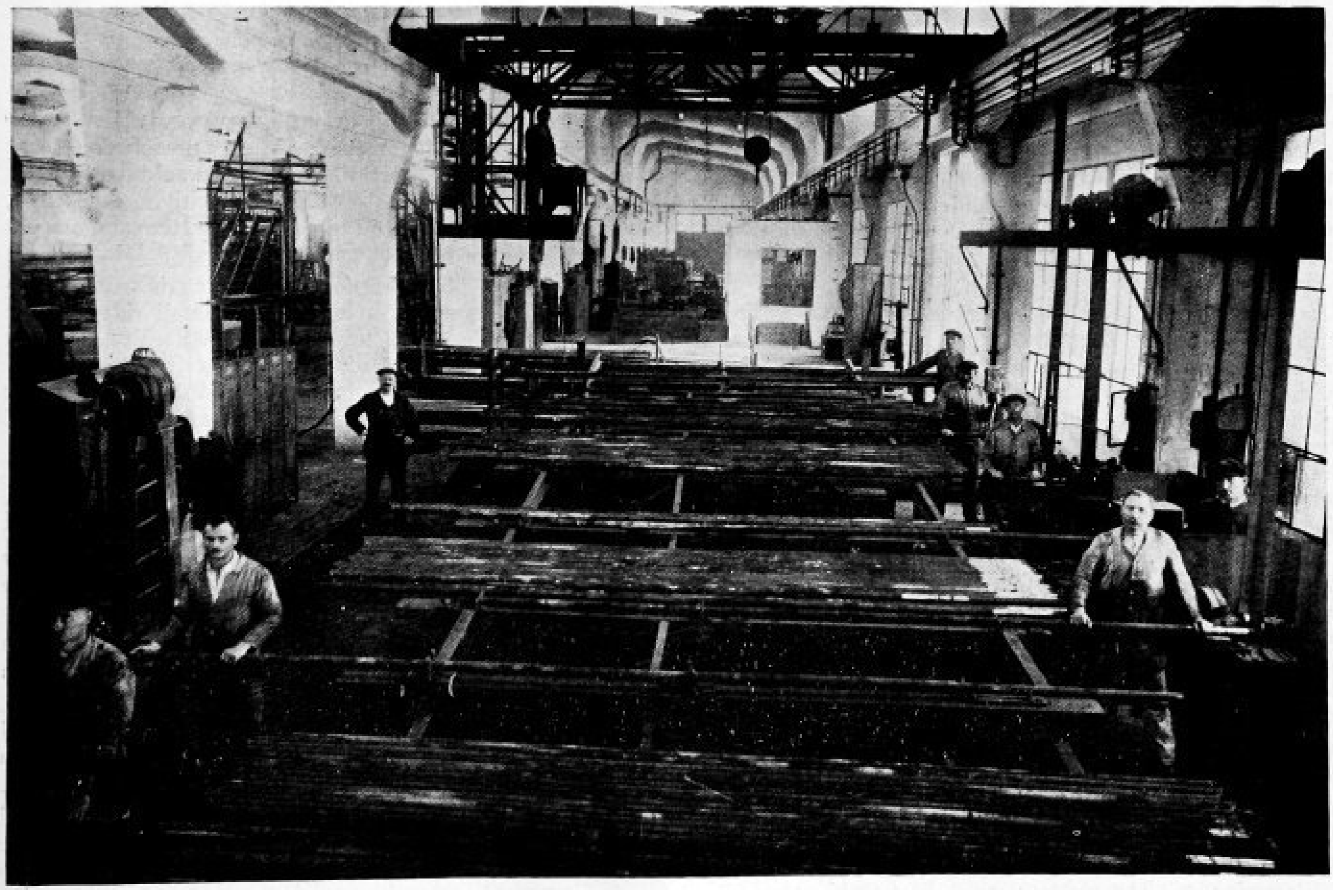


Fig. 9.—Location of Machines and Gravity Racks in Flue Department Speeds Up Flue Work

7. Cutting off the untrimmed end.
8. Hydrostatic test.
9. Expanding the smokebox end of tubes.
10. Expanding the firebox end of tube.

The round shape of the tube has been preserved through the first eight operations so that they will roll on gravity racks from one machine to another. The various machines used in this process are located close to each other in the direct line of progression of operations, Fig. 9, all machines being connected, as stated above, by inclined rollers along which tubes roll automatically. An ejector, worked by compressed air and foot control, takes hold of the tube at the bottom of the inclined plane and causes it to roll in a trough which is located at the exact distance it is to be cut, ground, welded, etc. All that the operator then has to do in the way of handling is to guide the tube along the rollers located in the bottom of the trough until it has reached the exact position where it is to be worked. When the operation is finished he guides the tube back to the ejector, presses another compressed air foot control and the tube is expelled from the trough and thrown on to the following gravity racks. As in the case of the boiler repair work, the equipment used in the operations of safe ending are briefly reviewed below:

Operation 1.—The tube cleaners used in this work are somewhat different from those usually found in French railway shops. They open by taking down part of the cylindrical walls which enables the placing and removing of the tubes in one operation by means of the cranes. The cleaners are of the submerged type and when in operation are closed by a cover in the floor which to a great extent cuts down the noise caused by the machine when in operation and thus permits their location inside the shop.

Operation 2.—The tubes leave the cleaner in bundles of 100 to 120. The small tubes are placed on the first inclined rack at the end of which they are inspected. Those unfit for use are discarded while those that can again be used are placed in the second gravity rack which carries them into position for operation 3.

Operation 3.—The cutting off is done by means of a tooth tube cutter which requires no special description.

Operation 4.—This operation of grinding the tube is necessary in order to get a proper contact between the jaws of the welding machine and the tube. It is done on an ordinary grinder.

Operation 5.—The welding might be termed arc welding rather than resistance welding. In explanation of this, when welding by resistance the parts in contact are brought together progressively as they soften under the action of the heat generated by the current. It is in this manner that small sized chains are welded. When welding tubes, however, they are brought together until a small arc is started. This arc, being accompanied by an abundant display of sparks, soon encompasses the tube to be welded and it is brought to white heat in about 12 seconds for small sized tubes. The current is then cut off and the jaws of the machine are quickly brought together so as to press the two ends of the tubes against each other. Due to this method of handling, the heat generated is almost entirely located in the parts to be welded so that the energy used is very low. For the small diameter tubes the power absorbed during the welding is not more than 8 kilowatts during the 14 seconds that the heating lasts. If, however, the ends to be welded are brought together too closely before the current is turned off, although this does not have any effect on the quality of the weld, the amount of energy used rises at once to 20 kilowatts and over, which figure would be reached were the welding done by resistance only. Altogether, obtaining a production of 60 tubes per hour, the total amount of energy consumed is not much more than 3 kilowatts.

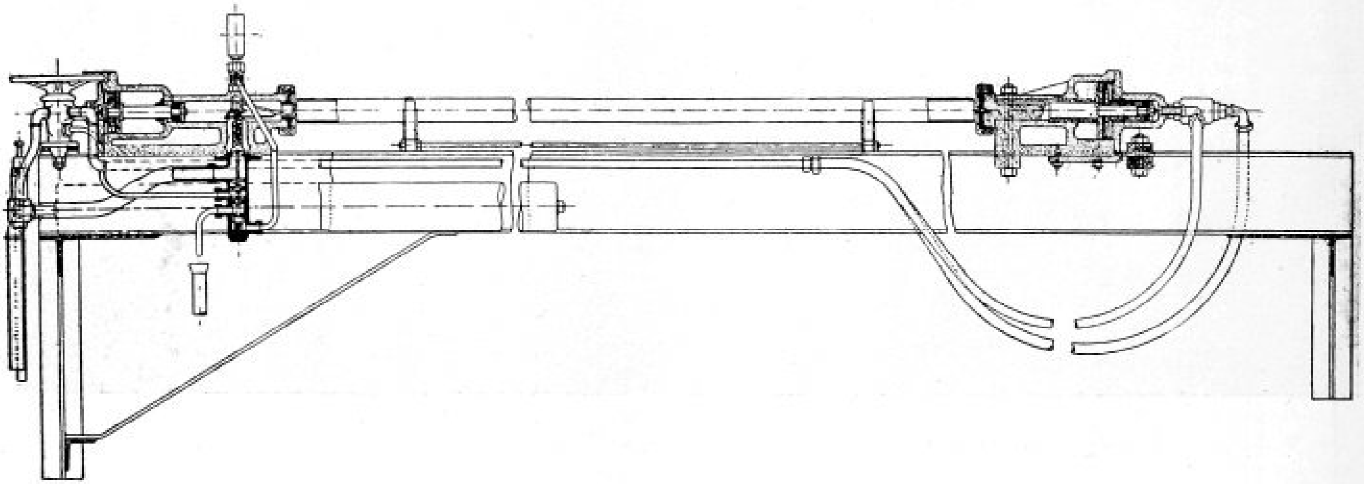


Fig. 10.—Machine Used for Testing Safe Ended Tubes and Flues

Operation 6.—The operation of grinding is made necessary by the fact that the welding leaves small ridges inside as well as outside of the tube. This small ridge does not seem to affect the inside of the tube, as it is burned off rapidly enough in service, but it is essential to remove it from the outside in order that the tube may be inserted through the front tube sheet.

Operation 7.—The second cutting off operation is the same as operation 3. It could be accomplished on the same machine but, in this case, the tubes would have to retrace their movement and be turned over, requiring another handling which can be avoided by using a special machine for cutting each end.

Operation 8.—The machine for testing tubes, which is shown in Fig. 10, has several interesting features which are enumerated below:

(1) A differential piston makes it possible to obtain 427 pounds per square inch pressure for testing although using only 85 pounds pressure from the shop air lines.

(2) A device which automatically closes the sliding head at the start of the test applies a moderate pressure on the tube while it is filling. This pressure is increased under the final test to 427 pounds pressure.

(*Continued on page* 219)

Committee Reports Presented and Discussed at Master Boiler Makers' Convention

BELOW are given a number of papers with their discussions which were presented at the recent Master Boiler Makers' Association convention and for which space was not available in the June issue containing the account of the proceedings. Several papers yet remain to be published and these will appear in an early issue. The address given by A. G. Pack, chief inspector of the Bureau of Locomotive Inspection, also appears below.

Work of Bureau of Locomotive Inspection

The responsibility resting upon members of this association is today greater than ever before, both from the viewpoint of safety and economy, and will continue to grow greater as time passes because locomotive boilers and their appliances are growing in size and complexity as a mushroom—rapidly.

During the past 20 years the number of locomotives in use in the United States has increased by 50 percent, while the total tractive effort has increased about 160 percent. To obtain this increased tractive effort, it has been necessary to increase the size and dimension of the boiler and to add many new and complicated appliances, all of which tend to increase your responsibility and require greater skill and ability on your part.

Since the Locomotive Boiler Inspection Law became effective in 1911, or 13 years ago, the number of locomotives in use has increased about 12 percent, while the tractive effort has increased about 58 percent, or nearly five times in proportion to the number of locomotives, and during the past five years the number of locomotives in service has increased about two percent, while the tractive effort has increased approximately 12 percent, six times more than the number of locomotives.

There are at this time coming within the jurisdiction of the law 70,670 locomotive boilers, of which number approximately 5,000 have been built within the past 15 months; 10,095 during the past five years; 20,880 within the past 10 years; 46,840 or 66 percent of the total number within the last 20 years; and, about 61,400 or 87 percent of the total number in use have been built within the past 25 years. This gives you some idea of the progress that has been made, as well as the life of the boilers in use.

About 58 percent of the boilers now in use are equipped with arch tubes and over 34,000 are equipped with superheaters.

The present day operation and maintenance of locomotives require greater skill and ability in construction, maintenance and operation than did those of days gone by. Accidents due to the failure of locomotive boilers are also becoming more disastrous as time passes.

The disastrous effect of a boiler explosion is in direct proportion to the size and suddenness of the initial rupture, which causes the explosion, and the temperature and volume of the water in the boiler at the time of the accident. The volume of water increases with the size of the boiler, and the temperature of the water in the boiler increases as the steam pressure increases, consequently, the failure of the present day boiler is very much more serious and disastrous in effect than formerly.

To illustrate this it is pertinent to know that during the first six years that the Locomotive Boiler Inspection Law was in effect, the average number of persons killed per 100 crown sheet failures was 51, while during the last six years the average persons killed has been 71 an increase of about 40 percent in the number of fatalities per accident of this kind. The year referred to by our records means the fiscal year beginning July 1 and ending June 30.

During the year 1912 there were 856 accidents, resulting in the death of 91 persons and the serious injury of 1,005 others, caused by the failure of some part or appliance of the locomotive boiler.

During the year 1915 the number of accidents had been reduced to 424, the number killed to 13 and the number seriously injured to 467, or 50 percent in the number of accidents, 86 percent in the number killed, and 53 percent in the number injured.

This reduction seems almost phenomenal and surpassed the most sanguine expectations of the most ardent advocates of the Locomotive Boiler Inspection Law, and shows what can be accomplished when a proper and united effort is exerted.

During 1916 there were 352 accidents, resulting in the death of 29 persons and the serious injury of 407 others.

During 1918 there were 398 accidents, resulting in the death of 36 persons and the serious injury of 510 others. It will be seen from this that while the number of accidents continued to decrease the number of fatalities increased.

During 1920 the number of accidents increased to 439, the number killed to 48, and the number injured to 503. This increase in the number of accidents may well be accounted for by the deterioration in the condition of motive power at that time, which was well recognized as being brought about by the chaotic conditions which prevailed not only in this country but throughout the civilized world, brought on by the great war, when many of the railroad companies' most skilled and valuable employes were engaged in other pursuits and in the war, which deprived the companies of their services and whose places were filled with inexperienced and less reliable men in many instances.

During 1922 there were 273 accidents, resulting in the death of 25 persons and the serious injury of 318 others, which again shows a very material decline in the number of accidents, killed and injured; in fact, the lowest number of accidents and injured since the law became effective, and the lowest number killed since the law became effective, except the years 1914 and 1915.

This decrease in the number of accidents is well accounted for because it is generally recognized that the physical condition of locomotive boilers and their appurtenances during 1922, was at the highest standard that had been attained for a number of years and probably ever before reached.

During 1923 the number of accidents increased to 509, the number of persons killed to 47 and the number seriously injured to 594, an increase of 87 percent in the number of accidents, 88 percent in the number killed, and 87 percent in the number injured.

During the first nine months of the current year there have been 316 accidents, resulting in the death of 49 persons and the serious injury of 355 others.

Crown sheet or firebox failures are the most prolific sources of serious and fatal accidents which can be caused by boiler failures, therefore, let us consider this feature for a few moments.

During the year 1912, the first year that the Locomotive Boiler Inspection Law was in effect, there occurred 94 firebox accidents, resulting in the death of 54 persons and the serious injury of 168 others.

During 1915 there were 25 accidents of this kind, resulting in the death of 10 persons and the serious injury of 35 others, a reduction of 73 percent in the number of accidents, 81 percent in the number killed and 79 percent in the number injured from this cause alone, which again illustrates what can be accomplished by better inspections and better repairs even beyond the most sanguine expectations of those who urged the necessity for the law.

It will be recalled that the Locomotive Boiler Inspection Law was amended and became effective in 1915, which more than doubled the duties and responsibilities of the Bureau of Locomotive Inspection, and which necessarily reduced the number of locomotives which might be inspected by the same number of Federal inspectors.

During 1918 the number of accidents had increased to 90, with 32 persons killed and 149 others injured, an increase over 1915 of 260 percent in the number of accidents, 220 percent in the number killed and 326 percent in the number injured. The same reasons assigned for the increase in the number of accidents, killed and injured due to boiler and boiler appurtenance failures are again applicable.

During 1922 the number of accidents had been reduced to 32, which resulted in the death of 22 persons and the serious injury of 55 others, or a decrease of 65 percent in the number of accidents, 31 percent in the number killed, and 63 percent in the number injured as compared with 1918. This reduction in the number of accidents shows without question the result of better inspection and better repair of fireboxes, feed-water appliances and water indicating appliances, as well as the locomotive in general.

It is generally well recognized that locomotives and locomotive boilers with their appurtenances, which contribute to the cause of these accidents, were maintained during 1922 at a higher standard than had obtained for a number of years and probably better than ever before. This reduction in the number of accidents was brought about notwithstanding an approximate increase in the number of locomotives in use by about 11 percent and the fact that locomotives had grown in size and complexity to such an enormous extent during recent years.

During 1923 the number of accidents from this cause increased to 53, nearly 100 percent, resulting in the death of 39 persons and the serious injury of 83 others.

During the first nine months of the current year there have been 46 accidents with 32 persons killed and the serious injury of 73 others.

BOILER AND APPURTENANCE FAILURES

	Accidents	Killed	Injured
1912	856	91	1005
1915	424	13	467
1922	273	25	318
1923	509	47	594

FIREBOX FAILURES ONLY

	Accidents	Killed	Injured
1912	94	54	168
1915	25	10	35
1922	32	22	55
1923	57	41	88

Notwithstanding the conditions which have so generally prevailed in the mechanical departments throughout the United States since July 1, 1922, the records for the fiscal year 1923, show a decrease of 39 percent in the number of crown sheet or firebox failures, 24 percent in the number of persons killed, and 48 percent in the number of persons injured as compared with the year 1912.

The responsibility which rests upon you and those called upon to administer the Locomotive Inspection Law are synonymous, therefore, our aims and purposes should be the same, and I am going to say that it is through cooperation that we are able to produce a record which is creditable to the Master Boiler Makers and to the Bureau of Locomotive Inspection alike.

Little is accomplished by issuing instructions or rules and regulations unless they are diligently followed up in such a way as to know that they are being complied with. It is too often found that the inspector does not test all of the staybolts in the firebox, as required by the law, assuming that those which he does not test are all right. Broken bolts are too often found among those the condition of which is assumed to be good, with the result that men are killed and injured.

Much has been said at these conventions regarding broken staybolts in the combustion chamber, and the liability of breakage in this location is recognized, notwithstanding one of the most violent explosions which we have been called upon to investigate in recent years resulted because of 19 bolts being broken and 33 others badly fractured in this location, which explosion cost the lives of two men, and destroyed the happiness of two homes.

Perhaps the importance of no single feature of boiler construction is more universally recognized than belling or beading arch tubes to secure them in place, yet it is found in case after case that arch tubes are applied too short to permit either belling or beading, with the result that they pull out, causing serious and fatal injuries to persons on the locomotives.

Every man who applies or properly inspects an arch tube knows whether it is belled or beaded, and it seems inconceivable that anyone would permit such a defective condition to exist if he knew that such condition would cause a serious and fatal accident, but chances are taken and the question then again arises—do we truly profit by the experiences of others?

Most of the railroads have issued instructions which prohibit the attempt to tighten washout plugs while under pressure. Notwithstanding these instructions, during the past 10 years there have been 179 washout plug accidents, which resulted in the death of 11 persons and the serious injury of 233 others, and in a large majority of these cases instructions were being violated at the sanction and approval of the foreman boiler maker in charge. The question again arises—are you truly profiting by the experiences of others? When these conditions exist, there can be but one answer. Money cannot compensate the loss of life and limb.

It is distressing when one, day after day, reads and studies the accident investigation reports covering the entire country as I do and to think of the distressing results that follow and are handed down to posterity. A specific instance will illustrate my thoughts in this matter. A short time ago a washout plug in the backhead which had been applied cross-threaded because of poor threads in the sheet was found leaking after the locomotive had been set out ready for service. Several officials were notified and the boiler foreman undertook to tighten the plug under pressure, when it blew out and this foreman was so seriously scalded that he died a few days later; notwithstanding that company had issued the most rigid instructions prohibiting the tightening of washout plugs under pressure. Many of you will no doubt say that he should have known better, but he took the chance. No one questions his motive and everybody realizes that it was his desire to avoid an engine delay that prompted him in taking the chance.

Do you ever stop to seriously consider what would be the result if you were to be killed or seriously injured? Have you thought about the men with whom you are associated and stopped to analyze the probable results from the death of any of you, which so often means the breaking up of a happy home and leaves those dependent upon your earnings in a most helpless condition.

We are very fortunate in being permitted to attend these conventions. Many do not enjoy this privilege and I sincerely hope that when you return to your homes and your respective stations in life you will carry with you a new determination to do and assist others in doing the work that comes to your hands in the most effective way. Let us strive to improve society and use our best endeavors to make life safer and more enjoyable for those with whom we come in contact and to those who are dependent upon us in no small degree.

Training and Developing of Apprentices

THE great need of this country today is a revival of respect for genuine old time skilled craftsmanship. There is a growing conviction among thoughtful men that a grave mistake has been made in making apprentice restrictions too drastic. It requires youth and vitality to make anything a success these days, and the skilled trades are no exception to the rule.

The quota of apprentices allowed should be kept filled at all times. The advantages of apprenticeship should be impressed on all employes to convince them that the railroad service offers good opportunities for advancement for their sons and is also pleasant and profitable employment.

It is also a patriotic and social duty for all good citizens to encourage the proper training of American youths to enable them to take their proper places in the industrial organization. They will respond to the pride of association on the job and off, and in fellowship with others having similar interests. There is a mutual benefit feature in developing young men through specialized training in an apprenticeship system which is conducted by carefully selected supervisors, and made a part of the local shop arrangements, and under their control.

It is recognized that the best results in apprenticeship can only be accomplished by educational facilities on the shop property during working hours with the apprentice under pay, combined with shop instruction, conforming to a regular schedule of advancement.

Never was there so great a need for skilled mechanics as there is today, but we cannot develop real mechanics unless a definite and adequate plan of training is adopted and rigidly adhered to. A thorough course training for each trade must be laid out and some one must be responsible for seeing that each boy is carefully conducted through the course. There must be a definite amount of school instructions in order that the boy may be given a thorough understanding of the underlying principles of the job. Means must be provided to insure thorough training of the apprentice in the shop work, by the use of shop instructors who devote their entire time to the instruction of the apprentices, directly on the work in which they are engaged in the shop. The department foreman cannot spare the time for detailed instruction of apprentices as he is fully employed in the duties of administration of his department. It has been demonstrated that the use of a shop instructor as indicated, results in a material increase in output, and is therefore immediately profitable to the railroad company, as well as ultimately beneficial in providing a group of well trained and well intentioned graduates to fill the places made vacant by promotion or other causes.

The best method of handling work to increase the efficiency of individuals and of machine tools should be made a subject of frequent consultation between the instructor and the foreman. This should be done in a manner to impress the foreman with the value of the service of the instructor in helping him to increase the output and quality of the work of his department.

It has been found that the best results in apprenticeship training are accomplished by a plan embodying instruction in the standard practices of the railroad company and all lesson papers and shop instructions should be arranged with that object in view in order to thoroughly drill the apprentice in the company standard practices, at the same time he is being taught drawing, mathematics, and shop methods.

Your committee is familiar with the development of apprenticeship in the mechanical department of railroads in the United States. Several of the prominent railroads have established comprehensive apprenticeship systems which are working out as a mutual benefit plan, profitable to the company and beneficial to the apprentice.

A number of railroad companies have a very complete apprenticeship system extending over the entire railroad and in successful operation for a number of years. Usually there are three groups of apprentices, as follows:

The Regular Apprentice: Boys 16 to 21 years of age, having a high school education or equivalent, and in good health. Schools be maintained at the shops, four to six mornings per week. Attendance be compulsory and under pay, but the minimum requirements not severe. Each apprentice be given instructions in mechanical drawing, shop mathematics, physics and related subjects during two periods of two hours each per week. It will be realized that many boys who have not had much early education, still have good intentions and respond to a genuine opportunity to improve their condition by attending the schools. The course in each of the mechanical trades is for four years in school and shop. The shop to have an instructor to supervise the movements of the apprentices in the shops, give them instructions in the proper methods to follow and arrange for them to be moved in accordance with the schedule established for each trade. The shop instructors should not assign work, but instruct the apprentices in the work which the department foreman has assigned to them.

The lesson papers, drawings, problem sheets, tee squares, angles, pencils, paper, and everything except the set of drawing instruments should be furnished by the company. The instruments can be purchased by the instructor for the apprentice at a reduced rate made with the manufacturers.

The Helper Apprentice: Young men 21 to 30 years of age, in good health, who have had two or more years' continuous experience as helpers in the shop from which application is made, should be given one year allowed time and serve a three year apprenticeship course. Attendance at the school could be optional for helper apprentices. The shop instructors also should look after the progress of the helper apprentice.

The Special Apprentice: Young men 18 to 26 years of age, who are graduates of a mechanical engineering course in college and have good health. They can be placed on the regular work in the shops and assigned to special work on tests and selected duties as required. These men need not attend the shop schools.

In making a selection of apprentices, the sons of employes should be given preference although others can also be taken in.

Many men now occupying good positions in railroad service are graduate apprentices of different railroads, it may be said that the railroad service offers as good opportunity for the future as any other line of work. It should be pointed out that ability to acquire knowledge is not alone sufficient to insure advancement in the service; some other desirable characteristics such as executive ability, initiative and common sense are necessary, and are sometimes unexpectedly developed after a period of experience. Many of these men have been advanced to good positions. This plan, we believe, will help materially, to increase the bond of mutual interest between the company and the employes.

Honesty and loyalty should be most commendable of human attributes. These qualifications can be developed by a good training and recruiting system administered by the railroad company and under its control.

The plan of apprenticeship should include the boilermaker's trade with others, in the manner described. This trade should be more attractive to young men than heretofore on account of the introduction of labor saving tools and appliances and improved methods. There is an excellent opportunity for young men who are thoroughly qualified to advance beyond the position of workman. We know of a number of cases of boilermaker apprentices who have been advanced to the position of foreman, general foreman, and in several cases master mechanics.

As stated previously the establishing of an apprenticeship system should include an arrangement of lesson papers in training methods which have to do with the methods of the particular road on which they are to be used, in order to get the best results.

This report was prepared by a committee composed of G. B. Usherwood, chairman; W. J. Murphy, John Harthill and J. F. Raps.

DISCUSSION

MR. LEWIS, Santa Fe: The apprentice system on the Santa Fe is our hobby. In the report it says that the department foreman has not the time to put in with the apprentice. We teach these boys to ask questions. In order to do this you have to ask them questions. I make it a habit when the boys come in to ask them little details of their job, for example, I ask about staybolts—the kind and number of threads. If the boy falls down I check him up and also get right after the instructor. If we find a boy who has failed to give the proper attention to his work we must see that he gets additional training. At the present time I have an apprentice boy for every job in the shop. We also put the apprentice boy with the inspector to give the boys confidence.

It used to be that the boiler shop was the last place a boy wanted to go. If he had any inclination toward the work at all he wanted to be a machinist. We must get after these boys and try to get them in the boiler business—make it attractive for them. When it comes down to figures, I think it requires a little more figuring in the boiler business than in the machinist's. In order to make our apprentice system attractive, we have arranged different sports; baseball and football and send the boys out over the line to compete with each other. The apprentice clubs have been very popular throughout the country, and they have been very beneficial to one another, that is, in getting the different superintendents in to talk to the boys. Sometimes I believe we are a little too strict in our requirements. Possibly half of us did not get through common school when we started in the shop. At the present time it seems, at all of our apprentice schools, they expect a boy to graduate from the eighth grade. He is also required to pass a physical examination. I am sometimes inclined to feel that the requirements are too rigid and that we are letting some good material get away from us.

On the Santa Fe, the boiler maker apprentices have to finish so many problems each week. They go to school two hours a week, and get paid every day. We also have the different mechanical managers keep them in touch with conditions in their departments. On the Santa Fe, I believe we have kept 90 percent of our graduates. Two of these graduates are master mechanics, there are also several of them boiler inspectors. Most of our instructors at the present time are graduates.

At the end of the apprentice course the boys are given $75. In case they stay six months longer they are given $75 more. For the information of those present, the Federal Board of Education has published a pamphlet entitled "An Analysis of the Railroad Boiler Makers' Trade." This is a very fine little pamphlet and will be very beneficial for those who have not had much experience. It covers everything very well. First, what class of work to give the boy when he comes in. What he learns on the first job will help him on the second. What he learns on the second will help him with the next. The best part of the analysis is that it does not tell you how—it would not be practical because there are so many ways to do the work. It tells you what class of work is recommended by the Federal Board on certain boilers. I believe that this subject should be continued at the next convention and that the Association should arrange with the Federal Board to furnish enough copies of the analysis for the members. (EDITOR'S NOTE: It is hoped that Mr. Lewis will arrange a complete article on the subject, which will appear in an early issue of the magazine.)

MR. KRITE: It would be a good thing to have the members come up front.

CHAIRMAN YOUNG: Is there anybody else?

MR. SERVICE, Santa Fe: In the report I note it was said that the school should be open in the morning. It may not be possible in all cases to handle it in this manner. For the benefit of those who have not this system, I might state that we have our apprentice school open from five until seven for the boys who live a distance, so they can attend before going home. Some come back at seven and work until nine. In that way they get every attention, and it does not conflict with their other work. In our shop any man can get this attention. In many instances we send a boy on a dead track to examine the boiler before it comes to the shop and see what it needs. We put them on their own responsibility, but check up their findings later.

THOMAS LEWIS, Lehigh Valley: I have always been interested in the boys. We are organizing a new apprentice system. We have today, working in our shop, men ranging from 25 to 30 years of age. They are the best boiler makers we have in the shop. They went to an apprentice school when they were serving their time. We have one who is a first class man, acting as a boiler inspector in the shop. We have another one working as a piece work inspector—though we have not yet gotten back to the piece work system. There is nothing like this system to relieve you of the many troubles the boiler makers have.

I can recall years ago when I was an apprentice how hard it was to find a boiler maker working with me to give me any information. They tried to hide it, it was hard work to learn anything until you became a man. We took our place side by side with men much older and I think there is nothing today that is going to help you like giving these boys your ideas. I can take any boy in the shop today and put him on any class of work. The first thing I did with the apprentices was to send them out with the other men, and there is nothing we hide from them, and they are giving first class satisfaction. I wish to heartily support the suggestion and recommendation made that everyone who can possibly do so have an apprenticeship school. I am sure that your company or your executive office will stand behind you, and these boys will stand behind you.

FRANK GRAY, C. & A.: I notice in the second to last paragraph the committee has referred to the fact that some boiler makers have become master mechanics. Indeed, they have not gone far enough, I know a number who have been advanced to superintendents of motive power.

A. G. PACK, Bu. Loco. Insp.: I know some of the best superintendents of motive power in the United States who started out as boiler makers. You spoke of men between 25 and 30 being first class mechanics. I want to know how long it took to train them.

THOMAS LEWIS, Lehigh Valley: I thought I made myself clear. These men came into our shop around about 1910.

A. G. PACK: My thought is I don't believe it is possible to make boiler makers or any other first class mechanics unless they are properly trained, they cannot be made over night.

Most Economical Method of Removing Firebox Sheets for Renewal

THE most up-to-date method of removing firebox sheets from a locomotive firebox is by the use of the oxy-acetylene torch and air ram. Rivets also are burned out with electric process in the flange of back flue sheet or door sheets. Cone head rivets can be burned off in mud ring with either electric or acetylene torch and air ram used to punch rivets out of ring.

Rigid staybolts that are riveted over at both ends can be drilled on the outer end of bolt or burned out. However, when the acetylene torch is used on this work great care must be taken by the operator to see that no damage is done to the outside boiler sheet.

When fireboxes have a full or partial installation of flexible staybolts and are equipped with caps and sleeves on the outside sheets, these bolts can be burned on the firebox side and driven out entirely free from the sheet. The same methods can be used when removing back flue sheets or door sheets only or applying new side sheets.

The cost of removing fireboxes is very largely dependent on the character of the shop doing the work. One shop may be up-to-date with all the latest appliances while another may be behind in this feature and therefore unable to compete with the up-to-date shop in matters of cost. However, the advantage in cost is in the matter of methods between the use of electric or acetylene torch as compared with the former method of drilling staybolts and the use of sledge hammers and chisel bars is in favor of the torch, because it is more economical as well as effecting a great saving of time, which is equivalent to money. It assists in keeping to schedule time which is a saving in overhead expense.

Taking up the question, "Is it more economical to renew fireboxes without removing boiler from engine frame." Having had experience in both ways of applying new fireboxes with boiler removed from the frames and applying new fireboxes without removing boiler from engine frames, two of us are in favor of removing the boiler from the frames whenever there is a new firebox to be applied, notwithstanding there appears to be an added cost on account of having to remove the cylinder saddle bolts and a few pipes. We believe this cost is offset by the easier way in which the boiler maker can handle the work. The old firebox can be removed in a shorter time. The new firebox can be assembled and fitted together better than it can be when assembled in pieces in the boiler. Also, it does not matter whether the firebox is riveted together or welded together. The matter of cost cannot be entertained when applying new fireboxes to locomotive boilers; the best workmanship is what we want and we don't always know we get that when new fireboxes are applied to boilers that are not removed from the frames. When a new firebox is completed on the shop floor the boiler foreman knows almost to a certainty that a good job is done.

To give an estimated cost of applying new fireboxes to locomotive boilers for all railroad shops it appears to two of us that it cannot be done without doing an injustice to some shops that are not thoroughly equipped for handling the work as are some of their neighbors. Two of the committee state it is more economical to renew fireboxes without removing the boiler from the frames. The firebox in their case is fitted together on the floor and assembled in the boiler by bolting the plates separately in place in the following order: Crown sheet, side sheets, then door sheet and tube sheet. The door sheet flange is provided with a shorter flange than when riveted and is welded entirely above the foundation ring. The tube sheet flange is treated similarly except where it is riveted in the ordinary way to the crown sheet. The crown sheet is welded to the side sheets. The joint of same is kept about 14 inches below the highest part of crown sheet. A patent welding method is used throughout, which has been employed for over three years, and it has given entire satisfaction without attention or failure. At the least, the cost of removing and replacing the boiler on the frames is saved by this method. One member of this committee quotes a cost of 21 cents per pound for labor and material charges between the incoming test of the boiler and its completed test, figured from the 1923 schedule of rates and material. This includes the store material and overhead, but excludes the shop overhead expense. He also favors a comparison of costs where shops are equally equipped for the performance of the work and claims a longer life for side sheets when the heavier crown sheet does not extend to include the side sheets. One member of committee suggests that it would be better to drive mud ring rivets with air hammer and air jam than to double gun them in order to be better able to remove them when necessary.

This report was prepared by a committee composed of Thomas Lewis, chairman; A. S. Greene, J. T. Johnston, T. W. Lowe.

DISCUSSION

THOMAS LEWIS, Lehigh Valley: In this report, you will notice, the committee was equally divided and I have the authority of one of the committee to give his name in order that he may speak for himself and fortify his position in the work he is doing. Two of the committee favor removing the boiler off the engine frame whenever the boiler requires a new firebox. The other two favor the other process, and claim that the job can be done equally as well and probably at less cost, by not removing the boiler from the frame.

T. W. LOWE, Canadian Pacific: In defense of the question of not removing the boiler from the frame, I think that deals with the new methods which are being introduced from time to time. However, whatever you do, don't take a chance. Mr. Pack pointed out how we should put our veto on that. His idea is certainly a good one. There is not a superintendent of motive power in the United States or Canada who will not support you, you can depend on his support if you proceed in the right way.

The price question is one of the most important parts of our work. Cost in any line is important. You don't know what mine are, but I want to know what yours are. I am not afraid of anybody hurting me. If I am behind in my shop I will be glad to acknowledge it.

H. J. RAPS, Illinois Central: There is one point in the report where the firebox is installed without removing from the frame and where it is mentioned that the best workmanship is what is wanted and they do not always know they get that when new fireboxes are applied to boilers that are not removed from the frames.

Over in our shop on the Illinois Central, where we cannot remove the boiler, from the frame we have a firebox constructed; slip the sheet over the frame, raise it up and afterwards rivet up the flue sheet. We are doing very good work on them. When we are putting in a box of this kind it is more economical than removing the boiler from the frame. In big shops where we have crane facilities we take the boilers off the frames, but we cannot do this in the smaller shops.

T. F. POWERS, C. & N. W.: From previous remarks it would seem a little discouraging to the officers to equip the shops with the necessary equipment. We have the cranes and we find we can do better work. It is my belief that we should take them off the frames where we have the equipment to do so.

T. W. LOWE, Canadian Pacific: Do you believe that the welded and riveted firebox are equally as efficient? It is not so much the cost, but does the association find firebox welding efficient?

THOMAS LEWIS, Lehigh Valley: I am glad we are getting some remarks in regard to efficiency for after all that is the big point. I have never heard anything about a new firebox as to the efficiency of the work. I believe just as Mr. Lowe says the efficiency of the work is everything and that is one of the principal reasons why I think the work should be done on the floor before it is put into the boiler.

Where a weld is being done on one side and reinforced on the other side it carries a larger efficiency than the weld only on one side. If we put in a firebox in sections—all of ours are made in three pieces—except the combustion chamber boilers which have fireboxes made of four and some of five pieces. I am very much interested in this welding, but I am suspicious of the weld that is only done on one side.

The Causes and Prevention of Boiler Pitting and Grooving

IN some districts in the United States and Canada, it has been found that corrosion, as evidenced in the pitting of flues, and the grooving of fireboxes, is a serious embarrassment in the maintenance of locomotive boilers.

The writer has had some experience of a general nature in these matters and has taken advantage of the opportunity of consulting with those who have had much to do with them.

Boiler metal corrosion is merely oxidation of the iron or its solution in water. Pure water will dissolve iron to some extent. That is the reason that absolutely pure water is not best boiler water. The presence of a little lime, in otherwise pure water, is frequently found to be a safeguard against this action and is, therefore, desirable.

The fact that this corrosion is evidenced in pits, or grooves, is due to lack of homogeneity in the metal of the parts affected. In other words, the boiler metal is not just alike in its qualities throughout its area. No commercially used iron can be pure, and steel is adulterated iron. If the other chemical elements used are not evenly distributed, we have metal of different tendencies at different points.

If absolute homogeneity were possible and were secured there would still be corrosion, under some conditions, but not in the form of pits or grooves and not for cause three of those given below.

Causes

It is found that pitting and grooving take place in connection with the use in boilers of three distinct general classes of water evaporated, as follows: 1, pure water; 2, water containing acids; 3, water containing alkaline salts, such as sodium sulphate, in excessive concentration.

Pure Water: It is a surprise to many to learn that absolutely pure water is not a good boiler water. Iron dissolves to some extent in pure water, and more rapidly in rain water, which is usually considered pure water. This is a fallacy, as rain picks up all sorts of impurities on the way down. Natural waters which contain small amounts of lime, as an impurity, are the best boiler waters.

Water Containing Acids: Mine waters usually contain sulphuric acid and since such water has to be pumped to clear the mines, it is frequently made use of for boiler supplies. Salt water frequently shows up hydrochloric acid (produced by reaction). This is met with by railroads near seashores and sometimes inland. The effect of either of these acids is to produce more or less rapid corrosion of the metal of the boiler, by acid solution.

Water Containing Alkaline Salts in Concentration: Where waters are very hard in sulphate scale and where a soda ash treatment is used to reduce this scale, sodium sulphate is a product of the reaction. This salt remains in solution in the boilers and concentrates as steam is evaporated off. This concentration seems to furnish the electrolyte for galvanic action, which means decomposition by stray electric currents. These currents travel between points of different electric potential always in the same direction and they carry off the metal with them.

Prevention

There being three general reasons for corrosion, as given above, it will be necessary, in attempting to prevent the condition, to first decide upon, and classify, the cause.

Any water which causes corrosion should be abandoned, if possible, and substituted with better water supplies. That is always the first consideration in attempting to improve boiler conditions. If it is impossible to get waters which are satisfactory in their natural state, then steps must be taken to change the nature of the waters which it is necessary to use, and which are troublesome. It would be best, however, to again call attention, at this point, to the secondary cause for pitting and grooving, dependent upon a general corrosive condition.

If boiler metal were entirely homogeneous; that is, if it were possible to have flues, for instance, with the metal exactly alike throughout their area, corrosion would not take the form of pitting, because if the reason for corrosion is acid action, it would be uniform throughout, and the flues would slowly dissolve away, in uniform manner. If, however, the cause of the corrosion is galvanic action, electrical couples would not be formed at different spots and again there would be no pitting, and in fact, in all cases, there would be very little corrosion of any kind. Therefore, under the subject of prevention, we must first consider metal quality.

It is generally believed that charcoal iron is more homogeneous than steel and that iron tubes are, therefore, more resistant to corrosion than are drawn steel tubes. Whether or not this is true, the writer is not prepared to say. It would seem as if steel could be made as homogeneous as iron and it is evident that if it were so made, it would be just as good.

Generally speaking, it is theoretically easy to draw conclusions as to the cure for corrosion in that the causes are so simple. The remedies suggest themselves when the causes are determined. In practice the matter is just a bit more difficult to handle in some cases. Acid action is stopped by alkaline neutralization. Galvanic action may be reduced by changes in the method of treatment, to prevent the concentration of sodium salts in the boiler, or by adding chemicals which will change its nature. Pitting and grooving can be reduced by obtaining more homogeneous metal.

Relative to the treatment of water, the railroad with which I am connected (C. I. & L.) has used polarized mercury chemicals for several years, and it is believed that this is one of the reasons why we are so little troubled with pitting and corrosion. In mine waters which we use in southern Indiana, acid action is prevented by the alkaline agents in this treatment. In other districts, notably the territory surrounding Lafayette, Indiana, at which point we are forced to use more and harder water than at any other single point on the line, the soda ash treatment was used several years ago, and abandoned on account of the necessity for using a very heavy treatment, to reduce all of the scale forming impurities. This caused foaming and probably was the cause of pitting, in that we had that condition, to some extent, in our boilers, indicating galvanic action.

The boilers operating in this district are using the mercury chemical treatment of somewhat different formula, from that used in the mine region. The mechanical action of the mercury assists the chemical action, so that the chemical treatment is never heavy enough to produce any great concentration of sodium salts in the boilers.

Moreover, it is noted that where this material is used there is a surface coating of a black glassy nature on the heating surfaces. This, I am advised, is a mercuric oxide of iron and is a good conductor of electricity. It seems logical to believe, therefore, that any lack of homogeneity in the iron is, to some degree, at least, offset by this surface coating which furnishes a pathway for the stray currents generated in the boiler; in other words, it makes a homogeneous surface on non-homogeneous metal, and that is all that is necessary.

We are now getting very good flue mileages averaging around 75,000 miles for all classes of engines, and fireboxes are giving us proportionately good service. This is in what we are told is the hardest water district in the country.

This report was prepared by a committee composed of Lewis Nicholas, chairman; H. V. West, and F. J. Howe.

Discussion

K. E. FOGERTY, C. B. & Q.: This is a subject in which I am deeply interested. I don't know whether the committee has included the Northwestern or C. B. and Q. in the report. If my particular problem is the condition of flues—the deterioration is around the front flue sheet. All the pitting of flues is not in one certain spot, some is in the middle and some outside.

I have corresponded with some of our chemists, but I have not been able to obtain any answer. This deterioration only goes back about seven inches. As long as we could not get any information from the chemists we tried to solve the problem by inserting a copper ferrule, for the purpose of showing if the pitting would go through the flue. We have tried all kinds of ferrules since; steel, iron, copper and one-fourth copper covered, and the steel is a little bit the favored. There is a good deal of scale, but it is on the sheet and not on the flue.

J. O. CRITES, Pennsylvania Railroad: On the road that I represent we had a great deal of trouble at the leg and firebox in pitting and at the top of the crown. It extended pretty well toward the side sheets. We had to patch the boilers quite often and fireboxes had to be removed. When we took out the fireboxes we found they had grooved the same way. We found that a great deal of the trouble could be eliminated by inserting a 1/16 inch copper liner above the rivets in the firebox. This will keep it intact and you will do away with a great deal of grooving and pitting.

H. J. WANDBERG, C. M. & St. P.: This matter of pitting is as old as the hills, but it is getting worse every day. We have, on our railroad, practically every kind of water there is in the United States. In some territories years ago we did not know what pitting was. There were other territories where the flues were only good for one year to fifteen months. We have put in treating plants and we have found that we now have to clean our flues, only every fifteen months.

Pitting and grooving are two different things. We have territories where the flues will groove and there is no way, seemingly, to prevent it. There are other territories where the water will pit the flue from end to end and you can only get from twelve to fourteen months' service and in some instances you have to throw the flues away.

We have had men tell us what does it, but we haven't gotten any remedy and until such time as we do the only way to avoid it and avoid engine failures is to have these flues compared right out of the washout. An engine may come in in perfectly good condition and tight, it is washed out and you have one or two leaky flues. We have adopted a system on the front end door. We have closed that and made a careful inspection. In this way we can get most of the pitting out, and it is seldom we have an engine failure due to a bad flue. Sometimes we have bursted flues, but this is the only remedy we have found so far, it is the most successful way we have found to prevent engine failures.

T. P. POWERS, C. & N. W.: The road which I am connected with has more trouble with pitting than with anything else. The condition is not getting better, it is getting worse, and we are getting pitting where we never heard of it before. Where we have no treating plants, we have had experience with increasing the alkalinity. We can do this you know, increase the alkalinity, though the trouble with that is that you cannot carry the water in the boiler. It seems to me the prevention of pitting could be accomplished through the use of proper chemicals.

M. C. FRANCE, St. P. M. & O.: About three years ago we put in five new engines. We were told to use thirty pounds of soda ash and lime. In six months we had to take out the flues as they were so badly pitted. We put back the balance that were all right. We cut it down to five pounds and those engines are running yet, twenty-seven months. I don't believe that treating plants will give us the results we want. If we can get the chemical analysis we are all right. I think some of the chemical does not act regularly on the water.

J. F. RAPS, I. C. R. R.: Two years ago when this subject of pitting came up and the treating of water was introduced I made the remark that we had gone into this very extensively and were getting good results. We have expended a great deal of money in the past year, and have put in treating plants. We used to remove flues after a year or eighteen months. We started the treating plants so we would not have to turn any of the boilers. After this was started the treatment of water developed that the reaction was causing a sulphite and chloride which we did not have before the treating, but we can take care of that by increasing the alkalinity.

It has been said that the flues, sheets and boiler side sheets all corroded together. I disagree with this view. We have places where they have only corroded on the bottom of the flues and there was no pitting anywhere else. We have other places where they are continually pitting on the sides and not pitting in the flue, and we have other territories where they are pitting all over, on the firebox sheets, flues and everywhere. This is a subject for the chemist and this is the only way to handle it.

In regard to the treating of water, I don't see that there is any trick in treating it at all. Our department is under the superintendent of water service. They make inspections of water and besides this they make a test of every tank they treat and the result of the test is sent to the superintendent, then to the engineer of test, who comes under the superintendent of motive power, and who checks the water department. After we get our plants going we cut the scale out and get the treating system working. Using the antifoam is the only way we can accomplish anything.

W. H. LAUGHRIDGE: I agree with Mr. Raps, this is the whole proposition. Let's know where the pitting takes place. I believe the information given here today is very valuable; it is not confined to one place. On the road I am with, a few years ago we did not know what it was. Now, we have some pitting, the pitting occurs in the large power and in the smaller power alike. Two years ago we bought six engines which had been built for two years, they had been tested out and started. It was my duty to go over and inspect them, and I was very much interested to see if there was any pitting going on in these boilers. They were cleaned because they had only been filled up and tried out.

I had the dome caps removed and I inspected the boiler. The first thing I saw was little spots. I looked down as far as I could see, down below the flues there would be a little round spot on the tube. I looked further around the top of the boiler. In May two years ago above practically everyone of those spots was a little bubble. That was investigated—to find out what was in that bubble—and what that little bubble would do. The tubes had little red spots on them, but they could not be rejected for this reason. We inspected them, placed them in service, in August, 1922, and last month we put most of them in the shop and 90 percent, about, of the tubes were scrapped.

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

THIS is the fourth instalment of a series of questions on both mechanical and boiler subjects which are liable to occur in state or federal examination papers for boiler inspectors. The earlier instalments appeared on page 105 of the April issue, page 139 of the May issue and page 180 of the June issue of THE BOILER MAKER. *The material should prove of benefit to all those who contemplate taking the examinations. The author would like to have those interested in the subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.*

79—Q. What is a locomotive boiler?

A. A locomotive boiler is an apparatus whose duty is to generate steam for power purposes.

80—Q. Describe the general form of a locomotive boiler.

A. A locomotive boiler is cylindrical in form; it usually has a rectangular-shaped firebox at one end; and a smokebox at the other.

81—Q. Describe a locomotive firebox and the materials used in the construction of same.

A. The firebox, like the back end of the boiler, is rectangular in shape; and is composed of a back head or door sheet, two side sheets, a flue sheet and a crown sheet. The materials used in the construction of the firebox are firebox steel for the side and crown sheets, flue sheet and door sheet; staybolt iron for the crownstays and staybolts; rivet material or steel for the rivets, and iron for the crown bars and crown bar stays when used.

82—Q. What is the difference between an externally fired and an internally fired boiler?

A. In externally fired boilers the fire is outside of the boiler, in internally fired boilers the fire is contained in the firebox as in the locomotive boiler.

83—Q. Why is the tube sheet thicker than the sheet plates?

A. The tube sheet is made thicker for the reason of its being weakened by the holes cut in it.

84—Q. To what strains is a firebox subjected?

A. To crushing strains and to those of unequal expansion and contraction.

85—Q. How are staybolts fastened in the firebox sheets and the outer sheets of a boiler?

A. They are screwed into each sheet and the ends riveted over.

86—Q. In what way do firebox sheets fail?

A. By gradual failure, by having a large number of small cracks, or by rupture due to eating or wasting away of the plates.

87—Q. On which side of the firebox sheets do cracks first appear?

A. On the water side.

88—Q. In what manner is the crown sheet supported?

A. By crown bars or radial stays.

89—Q. Why are domes placed on locomotive boilers?

A. Domes are placed on locomotive boilers to increase the steam space and to provide a place above the water level for the throttle and steam connections for the injectors, air pumps and other attachments.

90—Q. How are boiler tubes fastened in the boiler?

A. Boiler tubes are fastened and made steam tight by expanding them into the holes in the tube sheets.

91—Q. What is meant by factor of safety?

A. The factor of safety in a locomotive boiler is a percentage of additional strength above the safe working pressure.

92—Q. What is meant by the net section of the plate?

A. The difference between the original cross sectional area of the strip and the product obtained by multiplying the diameter of the rivet hole by the thickness of the plate is the net section of the plate.

93—Q. What is meant by the resistance of the solid strip to a tensile stress?

A. The resistance of a solid strip to a tensile stress, is the force which acts on the interior of the strip and resists the external forces which tend to change its shape.

94—Q. What other physical test is given?

A. The bending test; two bending tests are made, in one, the specimen is bent cold, steel up to ½ inch in thickness must stand bending double and hammered down on its self without showing any signs of fracture. In the other, the specimen is heated to a bright red and then suddenly cooled in water having a temperature of about 80 degrees F., after which it should bend flat on itself without showing any indication of fracture on the outside.

95—Q. What is the difference between a lap joint and a butt joint?

A. In a lap joint the edges of the plate are lapped over each other and riveted. In a butt joint the edge of the plates is brought together and another plate is placed over one or both sides. The plates are then riveted to the shell on both sides of the joint.

96—Q. What are the chief factors that influence the efficiency of the joint?

A. The efficiency of the joint depends on the diameter of the driven rivet; the pitch of the rivets, the tensile and shearing strength of the materials, and the disposition of the rivets.

97—Q. What are the average obtainable efficiencies of riveted joints?

A. The average efficiencies of riveted joints are as follows:

Single riveted lap joints........	56 percent
Double riveted lap joints........	70 percent
Triple riveted lap joints........	75 percent
Double riveted butt joints:	
With two cover plates........	76 percent
Triple riveted butt joints:	
With two cover plates........	85 percent

98—Q. How does the resistance of rivets in double shear compare with that of rivets in single shear?

A. Rivets in double shear average about 1.85 the resistance of rivets in single shear.

99—Q. Which must be made stronger in a locomotive boiler, the transverse or the longitudinal joints, and why?

A. The longitudinal joints must be made stronger as there is about twice as much strain on them.

100—Q. How does the size of the rivet compare with the hole into which it is to fit?

A. The rivet hole is about 1/16 inch larger than the rivet before it is upset in the hole.

101—Q. What is calking and why is it done?

A. Calking is the operation of driving the edge of the upper plate down close to the lower plate of a joint and is done to form a tight joint.

102—Q. What will cause grooving in a boiler?

A. Grooving is caused by the buckling action of the plates under pressure. The marks made by a sharp calking tool will generally lead to grooving.

(To be continued.)

* Locomotive Inspector, New York State Transit Commission.

What Constitutes Doing Business in Foreign States*

Court Decisions of Various States Dealing with Interstate and Intrastate Contracts

By Carroll C. Robertson†

MOST of the states have passed laws of one kind or another, seeking to prescribe the conditions upon which foreign corporations may do business within their borders, and the problem of what constitutes "doing business" within the meaning of the various state laws is one of vital concern to corporations which carry on business outside of the state of incorporation and dispose of their products in many different states. It has been suggested that "doing business" without permission in almost any state of the Union constitutes the gravest danger to the modern corporation.

This subject, therefore, should prove of particular interest to the members of the American Boiler Manufacturers' Association carrying on business, as many member companies do, in a number of different states.

Coming under the operations of the laws of the various states requires the filing of registration papers, the appointment of an agent to receive service of process, filing of reports and subjection to taxation. Naturally the average corporation unwillingly admits its liability in these connections and wherever possible attempts to overlook its duty to comply. In order to compel compliance in the interest of the stockholders in foreign corporations, in the interest of creditors and in the interest of the state itself in the matter of reports and taxation, severe penalties have been attached to these laws. These penalties are in the way of police regulations, in a broad sense, their object being to enforce compliance. The penalties are severe, the most severe being the surrender of the right to sue or defend in the courts of the state involved, and sometimes even the surrender of the right to sue or defend in the federal courts.

Not Allowed to Enforce Contracts

It is not unusual for a corporation to lose vast sums of money from its inability to enforce a single contract. Inability to secure redress in the courts even extends to agents of the corporation who have refused to account for the purchase price received by them for goods sold for the corporation.

Please keep in mind as we consider this question that a corporation may do either an interstate business or a purely local business. If a corporation comes into the state of Virginia and does an interstate business, the state of Virginia is powerless to interfere with it and it would be such an interference for the state of Virginia to impose conditions upon the corporations as the pre-requisite of its right to conduct that business. Consequently no conditions are or can be imposed by any state on a foreign corporation transacting an interstate business. The power to regulate interstate commerce is given by the Constitution to the Federal Government. But when it comes to local or domestic business, that is within the sphere of the legislative bodies of the different states. Now the question comes, how are we to know when a corporation is engaged in interstate commerce or when it is engaged in "doing business" in the sense that it would be required to take out a license? The dividing line is a very fine one and has provided a wide battlefield for constitutional lawyers.

But let us look at a couple of cases which illustrate the difference between a transaction which is interstate and one which is local or intrastate.

Suppose a corporation sends an agent or salesman into the state of Pennsylvania to take orders for its product. These orders are then sent to the home office of the corporation outside the state for approval. When approved, the order ripens into a contract binding on the customer and the corporation, and shipment is then made to the purchaser in Pennsylvania. This contract is deemed a contract not of the state where the order was taken but in the state of approval. The whole transaction is not carried on and completed in Pennsylvania. It is a transaction in interstate commerce. (Mearshon and Company v. Lumber Company 187 Pa. St. 12.)

Change the facts a little; suppose the agent instead of merely taking orders subject to approval outside the state, actually makes contracts binding on the corporation; or suppose he actually sells and delivers in the state some equipment or goods he has with him. Here the whole transaction is begun and completed within the state. It is a local transaction and constitutes "doing business."

In the first case the corporation could enforce payment of the purchase price of the product, although it had not taken out a license; in the second case it could not.

If a corporation doing business in other states is not engaged in interstate commerce, it must be engaged in a local intrastate business and if it is, it is doing business in the technical sense.

The tests laid down in some of the states as to whether a corporation is "doing business" therein is whether the corporation has an agent located in the state or has offices in the state for the general conduct of its business, or whether it conducts within the state the business for which it was organized, or whether it employs or invests a part of its capital in the state. All or any of these things indicate the presence of the corporation within the state for the purpose of doing business and the corporation is required to take out a license.

A corporation's activities in a foreign state are frequently confined to the storage of goods therein in some warehouse or elsewhere, orders within the state being accepted at the home office of the corporation and delivery being made from the warehouse in the foreign state. Whether such an operation constitutes doing business so as to require the corporation to secure permission to do business as a foreign corporation in the state where the warehouse is located, is a question which requires careful consideration.

A comparatively early discussion of the question is contained in a Minnesota case (Thomas Mfg. Co. v. Knapp, 101 Minn. 432, 112 N. W. 989). In this case it was held that a foreign corporation, which shipped its goods to a distributing warehouse within the state, where they were forwarded by the distributing agent, on the order of the corporation, to customers within the state, who received the goods under contracts contemplating their sale at retail within a defined territory and the title to the proceeds of the sales was to remain in the corporation until it received the full contract price, was "doing business."

New York case holds (American Can Co. v. Grassi Contracting Co., 168 N. Y. Supp. 689) that a corporation which maintained a warehouse in New York, from which it delivered goods under a contract signed in New York, is

*Paper presented at annual meeting of American Boiler Manufacturers' Association, Hot Springs, Va., June 10, 11 and 12.
†Pittsburgh secretary, The Corporation Trust Company.

"doing business" in the state, even though the contract contained a printed notice that it was subject to approval in Chicago; and such a corporation may not sue in New York on a contract made prior to its qualification to do business therein under the foreign corporation laws.

As you gentlemen know, the consigning of goods involves sending them to another to be sold or disposed of by the consignee for the benefit of the consignor. The consignor retains title until the goods are sold, the consignee being accountable to the consignor for the proceeds of the sale, less commission or other compensation and expenses. The terms of the sale on consignment will vary, but under all circumstances, the title will be retained in the seller. In view of the fact that the goods are kept by the consignee until sold, for the benefit of the consignor, it is difficult to clearly distinguish this line of cases from the storage of goods in warehouses.

However, the storage of goods in warehouses by a foreign corporation has frequently been held by the courts to constitute "doing business" by a foreign corporation so as to subject it to the necessity of taking out a license in the state in which the warehouse is located. The similarity of warehouse cases to the sale of goods on consignment, however, does not appear to have been, as yet, recognized by the courts and in most instances in which consignment alone is involved, the foreign corporation has been held to be engaged in interstate commerce only, and not to be under the necessity of qualifying.

The courts in several of the states have decided that a corporation contracting for the installation of equipment, machinery, etc., in a foreign state, must take out a license in the state where the work is to be performed.

A Pennsylvania case holds, however, that the mere installation of a product sold in interstate commerce is not "doing business." (Williams v. Golden and Crick 247 Pa. 397.)

The decisions interpreting the expression "doing business" continue to multiply. It cannot be said that the courts have given us any formula which can be applied with certainty to all cases or any considerable part of them. Each case seems to be decided largely on its own facts, since the methods of conducting corporate operations are susceptible of almost infinite variations. You will see, therefore, that it is not an easy thing to decide whether a contemplated transaction or series of transactions will constitute "doing business." It is certainly a matter for the opinion of an experienced lawyer after careful study.

COURT DECISIONS VARY

An excellent illustration is given of the difference in the opinion between courts of the various states, by two holdings, one in Texas and one in Wisconsin. Both cases involved the installation of the same equipment, gasoline tank and pump, by the same company and the installation, in each instance, was made in the same manner. The Texas court held that the company in making the installation was "doing business" within the state, as it was necessary to employ state labor, purchase some of the materials in the state and that the price agreed upon was not for the machinery alone or any part of it but was for the installation, including all material and labor. The Wisconsin court held that the installation was merely an incident of interstate commerce, in other words that the contract to install could not be separated from the contract of sale and that the company was not "doing business" within the state in making the installation. (S. F. Bowser & Co. v. Savudusky, 154 Wis. 76 and Bryan v. S. F. Bowser & Co., 209 S. W. 189.)

TANK ERECTION IN "FOREIGN" STATES

In a case decided in Pennsylvania (Nickerson v. Warren City Tank and Boiler Co., 223 Fed. 841) a foreign corporation was in the business of constructing and erecting oil tanks, which when possible were constructed at its main factory in the state of its incorporation and shipped in charge of its employees, who erected it for the purchaser; the foreman in charge of the erection employed such local labor as was necessary. The court held that the corporation was doing a local business in the district where the tank was erected. While nothing was said regarding it, it would not seem that the erection of an oil tank is of such a nature as to require erection by the manufacturer in order to make sales. Or that it is so complex a proposition as to require the services of an expert.

In conclusion, let me repeat and re-emphasize the warning that no important transaction should be entered into in other states without first examining the laws and ascertaining what standing you will have in the courts of the states to which your products are to be shipped. Keep in mind that not only are the statutes of the different states widely divergent but even where they are generally alike in their terms, the courts differ in their interpretation. The only safe course, therefor is to consult your attorney before signing a contract with respect to business to be undertaken in any foreign state. He will make careful investigation for you with reference to the possible penalties for non-compliance before the contract in question is entered into or the proposed business is commenced.

Work of the Boiler Code Committee

(*Continued from page* 195)

mounting thereon a wrought steel flange attached either by Van-stoning, or by threading the flange on the projecting neck and peening over the edges of the neck into a recess or groove turned in the flange?

Reply: There is no rule in the Code for the computation of the strength of a boiler nozzle. It is the opinion of the Committee that if the shell plate or drum is of a greater thickness and the other dimensions of the shell are greater than are required for the maximum allowable working pressure thereon, it will be permissible to utilize such an integral nozzle construction for a working pressure not in excess of that which would be allowable on shell plate of a thickness equal to that in the thinnest portion of the projecting neck of the nozzle. If, however, it is the desire to operate the boiler with the full working pressure allowable with the thickness of shell plate used therein, an integral nozzle construction as described should be reinforced with an annular ring in accordance with the requirements of Pars. 259 and 260. In the absence of any rule in the Code for computing the strength of a nozzle, the only way to determine the maximum allowable working pressure on such an integral nozzle construction would be to test a sample nozzle construction as described, to destruction in the presence of a representative of the Boiler Code Committee as specified in Par. 247 of the Boiler Code.

CASE No. 443—(In the hands of the Committee.)

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One of the innovations introduced by the 1924 edition of the A.S.M.E. Boiler Construction Code, which has as its object the simplification of the stamping of Code boilers, is the requirement that all manufacturers using the A.S.M.E. stamp must now obtain a registration number from the Boiler Code Committee and use this number in conjunction with the symbol stamp. This new requirement appears in paragraph P-332 of the 1924 revised edition and was inserted at the request of state and municipal inspection departments.

In making provision for this registration in the Code, the Boiler Code Committee is in no way endeavoring to introduce any form of licensing nor is it an attempt to assume administrative or legal control of boiler construction. It is intended solely to protect the interests of holders of A.S.M.E. Code stamps and to simplify stamping.

For some time the question of the proper method of rating heating boilers of all types has been discussed by the various bodies interested in the matter. Cast iron boilers have been rated on the basis of the square feet of radiating surface which they can supply, while steel heating boilers have quite generally followed power boiler practice in using the square feet of heating surface as the basis for capacity calculations. As a result, much confusion and more or less hardship have been imposed on the steel heating boiler companies in trying to compete with the prices established on cast iron boilers, due to the fact that cast iron boilers have been overrated in many instances from 15 percent to as high as 50 percent.

Two years ago the Chicago local section of the Heating and Piping Contractors National Association established rating requirements for heating boilers which are based on actual performance records of these boilers.

In 1923, when the A.S.M.E. Boiler Code Committee brought out the revised Heating Boiler Section of the Code, the safety valve requirements were based on the capacities of the boilers served, expressed in terms of maximum load in square feet of radiation. This action was protested and in the state of Ohio the Code was adopted with this section of the safety valve rules replaced by another making the grate area the basis for computing safety valve capacity. The matter finally came before the Boiler Code Committee at the May meeting this year, held in Cleveland in conjunction with that of the National Board of Boiler and Pressure Vessel Inspectors. The following motion was unanimously passed at this meeting: "That the requirements of the low pressure heating boiler section of the Code, relative to minimum allowable sizes of safety valves for steam heating boilers, be revised so that they may be determined on the basis of water heating surfaces for all low pressure heating boilers and that these areas of water heating surfaces shall be required to be stamped on each boiler or section thereon in an uncovered position."

At the June meeting of the Boiler Code Committee this important question was again brought up for discussion. Although the cast iron boiler manufacturers will undoubtedly protest the motion, the consensus of opinion is that it should be adopted as the basis for capacity calculations in future heating boiler construction.

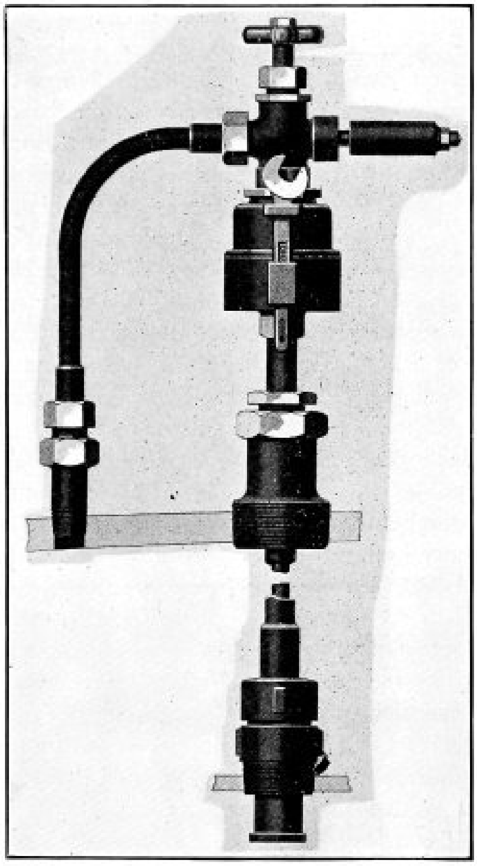
A number of manufacturers of power boilers have raised the question with state and city inspection departments as to when the requirements of the 1924 revised edition of the A.S.M.E. Boiler Construction Code would be put into effect on new work. According to information obtained from the office of the Boiler Code Committee, the following states and cities are now accepting boilers built under the revised Code: Arkansas, Delaware, Indiana, Maryland, Michigan, Minnesota, Missouri, New Jersey, New York, Ohio, Oklahoma, Oregon, Rhode Island, Utah, Wisconsin, Chicago, Ill.; Detroit, Mich.; Erie, Pa.; Kansas City, Mo.; Los Angeles, Cal.; Memphis, Tenn.; Nashville, Tenn.; Omaha, Neb.; Parkersburg, W. Va.; St. Joseph, Mo.; Scranton, Pa.; Seattle, Wash.

Engineering Specialties for Boiler Making

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

Low Water Alarm for Promoting Locomotive Boiler Safety

LOCOMOTIVE boiler explosions and damaged crown sheets are almost invariably due to either low water or accumulation of scale. Low water may be caused either by the failure of the engineer to observe the water level, the stoppage of ports in water indicating apparatus or the incorrect reading of such apparatus due to location or circulation. To eliminate these hazards the Ohio low water alarm was developed by a series of tests made under actual service conditions on a locomotive boiler built especially for the purpose. The device was shown at the Master Boiler Makers' Association convention this year by the manufacturers, the Ohio Injector Company, Chicago, Ill.



Ohio Low Water Alarm for Locomotive Boilers

The alarm consists of a fusing chamber shell screwed into the crown sheet. A fusing chamber plug passes through this shell and extends 1¼ inches into the firebox, this portion being protected from the action of the fire by a protecting cap. The upper portion of the plug is provided with a chamber to receive the fusible material which consists of pure Banca tin. A tube is screwed and welded into the plug, passing up through a stuffing box in the wrapper sheet and supporting a valve cage. Into this cage is screwed a complete valve assembly which controls communication between a steam supply pipe from the boiler and a whistle.

The operating rod which actuates the mechanism is threaded at its lower extremity and these threads are in engagement with the fusible material in the plug. The upper end is provided with a hexagonal portion to permit its being rotated by a special wrench and is in contact with the valve stem through an expansion spring. With the rod screwed up the valve to the whistle is closed. As long as the proper level is maintained in the boiler, water will surround the upper portion of the plug and absorb the heat conducted by the extension into the firebox thereby keeping the fusible material below its melting point and providing support for the actuating rod.

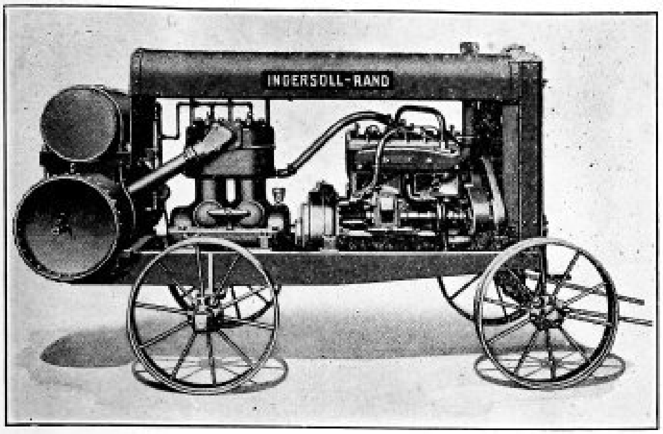
When the water becomes lowered to a danger point it no longer surrounds the upper portion of the plug and cannot absorb the heat being conducted from the firebox. This results in a rapid rise in temperature in the upper portion of the plug causing the fusible material to melt. The rod then having no means of support drops in the molten tin to the bottom of the chamber in the plug, being assisted in its downward movement by a spring which opens the valve to the alarm whistle thus giving warning of the low water.

When the alarm whistle sounds, giving warning that the water is low, although the crown sheet is not uncovered, the engineer should proceed at once to start his injectors and bring the water to the proper level which will again surround the upper portion of the plug thereby cooling the tin and solidifying it. The lower extremity of the rod being threaded and having dropped to the bottom of the chamber in the plug will have the solidified tin cast around it somewhat in the form of a nut. After making certain that he has 2 inches of water in the water glass, the engineer should remove the cage sleeve with a special wrench provided thereby gaining access to the hexagonal portion of the rod. He can then rotate the rod thereby shutting off the whistle and restoring the device to its initial position. He should then continue to revolve the rod about five or six turns to strip the thread of the fusible material.

Small Portable Air Compressor

A SMALL portable air compressor plant of modern design and construction, has been developed and is now being offered by the Ingersoll-Rand Company, 11 Broadway, New York. This small portable air compressor, designated as the 4¼-inch by 4-inch type "Twenty," has a piston displacement of 60 cubic feet per minute and is built along the same lines as the larger type "Twenty" portables. All of the proven features of the larger units are retained, e. g., duplex, vertical compressor, direct-connected to a four-cylinder, four-cycle, tractor type gasoline engine; enclosed construction; circulating water cooling system for engine and compressor with sectionalized-radiator, fan, and pump; compressor regulator and engine control for reducing speed during unloaded periods; one-piece cast steel frame; sheet steel roof and removable side doors.

This compressor can be furnished with a variety of mount-



New Portable Air Compressor

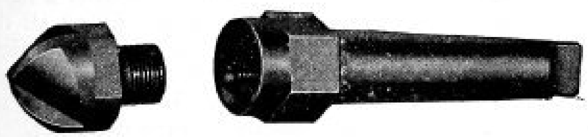
ings; steel wheels and axles; wooden artillery wheels with solid rubber tires and steel axles; on a Ford truck; and on skids for mounting in a car or truck. This and other sizes of type "Twenty" portable compressors are available with either gasoline engine or electric motor drive.

There are four larger Ingersoll-Rand portable compressors having the following piston displacements: 91, 160, 210 and 250 cubic feet free air per minute.

Two Piece Rivet Set and New Re-Cupping Tool

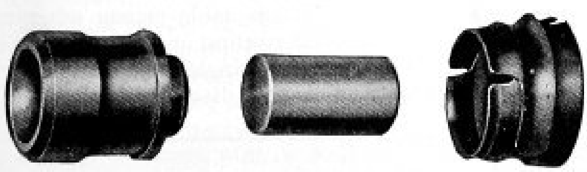
THE Lovejoy Tool Works, 313 West Ohio street, Chicago, is manufacturing two new tools known as the Mack re-cupping tool and the Mack universal two-piece rivet set for use in the boiler shop.

The re-cupping tool is intended for the reclamation of rivet sets of all shapes which have become battered and in



Mack Recupping Tool for Rivet Sets

this condition cannot be of further service. With the new tool, rivet sets can be re-cupped without annealing or other heat treating process. The re-cupping tool, which is made of a special tungsten steel and of a form developed after years of experimental work, will re-shape the cup of a rivet set even though it is quite hard. This tool is made in two parts,



Mack Two-Piece Rivet Set

the heads being removable and interchangeable, with a standard No. 3 Morse taper shank so that different size heads can be used with a single shank.

The re-cupping operation is accomplished by placing the rivet set in the chuck of a lathe and the re-cupping tool in the tail stock.

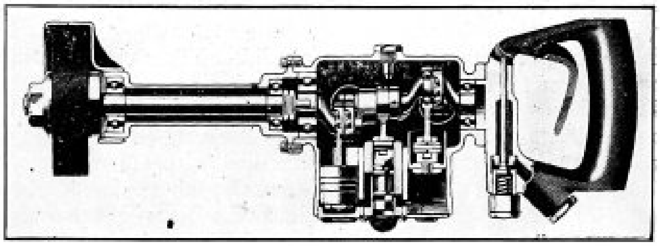
Universal Two-Piece Rivet Set

In attempting to lengthen the life of rivet sets, the new Mack universal set has been made in two pieces which are held together with a special spring steel clip. The only wear takes place on the head of the rivet set, the shank being practically a second plunger. These tools are made from special vanadium steel and, as stated by the company, will be supplied for trial on request. The special two-piece clip fits all standard pneumatic hammers.

A Pneumatic Motor and Portable Grinder

THE Cleveland Pneumatic Tool Company, Cleveland, Ohio, has put on the market an air motor which is designed to meet the requirements of railroad work for drilling, reaming, tapping, flue rolling and setting plain and flexible staybolts, sleeves and caps.

The semi-sectional illustration of the motor shows its unique construction, in that all the moving parts are mounted on ball bearings. The motor is the four-cylinder type, having four single acting pistons connected to opposite wrists of a double throw crank. The wrists of the crank are

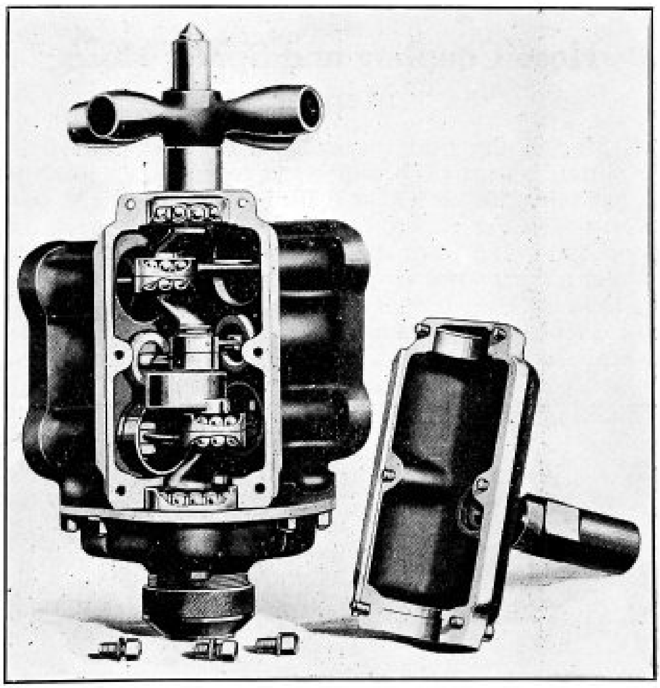


A Cleveland Portable Grinder Having an Enclosed Handle with Throttle Lever Inside

grooved, hardened and ground to act as an inner ball race, and the connecting rods, the outer ball race.

The four connecting rods each have a ring end large enough to be strung onto the crank. After the connecting rods are placed in position on the crank the balls are then inserted and are held in position by a spring ring retainer.

The pistons are screwed in the piston sockets, which in



A Pneumatic Motor with All the Moving Parts Mounted on Ball Bearings turn are attached to the connecting rods by a floating wrist pin which is provided with oil holes for lubrication. The main valves are of the slide piston type and are operated from eccentrics on the crank shaft. They are placed between each set of cylinders, from which they are separated only by a thin wall in which liberal air ports are provided. The live air is injected almost instantly into the piston chamber, which insures quick motor action and tends to conserve air.

Because of the reduced bearing friction and the added power from the quick delivery of the air to the pistons, a high motor speed is developed. This is transmitted to the spindle through different gearing ratios and an unusually high drilling capacity is said to be obtained. The bearings on the crank and the connecting rods run constantly in a bath of lubricant, as also do the valves and pistons. The gears are housed in chambers opening directly into the crank case and filled with a lubricant, and are so constructed that the lubricant is not driven out of the case when the motor is in action.

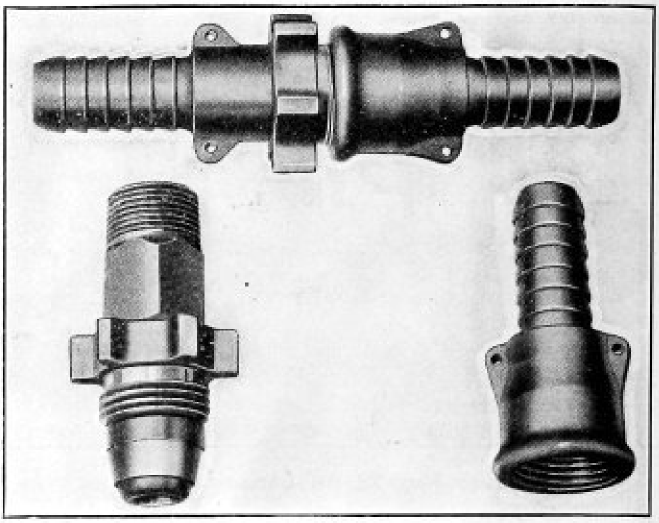
The portable grinder embodies the same principle of design as the air motor. The single piece connecting rods contain ball races which operate directly on the crank. These races, as well as the annular ball bearings on the crank and the arbor bearings, are open to continuous lubrication, both in the crank chambers and in the forward quill housing. The arbor is connected directly to the crank and is mounted on annular ball bearings at both ends, the same as the driving crank. This machine can be furnished with either one of four types of throttle handles; namely, an enclosed type with an outside or inside throttle lever; a straight handle with a snap throttle lever, and a straight handle with a twist throttle sleeve.

The body casting of the grinder is split into two pieces, which permits the removal of the entire crank assembly without disconnecting the pistons or the valves from the crank. The piston cups are screwed into the piston sockets and reinforced by a lock nut at the base of each cup. The connecting rods are attached to the piston sockets by a floating wrist pin, which is perforated for lubrication. The grinder weighs 12 pounds and drives a 6-inch emery wheel at a speed of 4,600 revolutions per minute.

Hose Coupling and Spider Hose Mender

IN view of the great amount of compressed air used in railroad shops, enginehouses and car repair tracks it is plain that this air should be used as economically as possible. Moreover the efficient operation of thousands of pneumatic tools is dependent on the supply of an adequate amount of compressed air at the pressure required to operate the tools. A leaky hose, if it occurs too often, is the cause of considerable waste and unnecessary expense.

Realizing these facts and their relation to tight hose connection fittings the Gustin-Bacon Manufacturing Company, Kansas City, Mo., has developed a coupling and a Spider hose mender designed to be positively air tight. The coupling is a simple, positive connection without springs or locking teeth, the connection being made and wear taken up by turning a swivel nut.



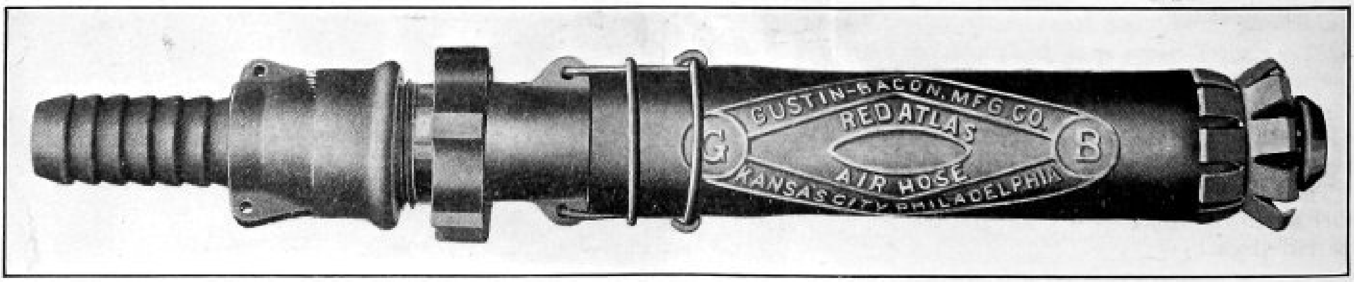
Lowrey Air Hose Coupling

Referring to the illustrations the construction of the coupling and its various parts will be evident. The gasket fits in a taper groove in the male end and turning the swivel nut forces the gasket against the shoulder in the female end. The gasket is said to be easily applied and not subject to blowing out. Special provision is made to prevent the couplings themselves from blowing out of the hose by a method of clamping shown.

The G-B Spider hose mender, that is shown below has been designed as a simple, rapid and effective method of splicing air hose or joining the ends after a defective piece has been cut out. In applying this fitting all that is necessary is to cut the ends of the hose square, lubricate the nipple ends of the mender, slip the hose over the nipples and hammer the points into the hose. It is said that this mender will not leak or pull out under high pressures. An important advantage of this device is that on account of its short length there is practically no interference with the flexibility of the hose.

New 100-Foot Portable Compressor

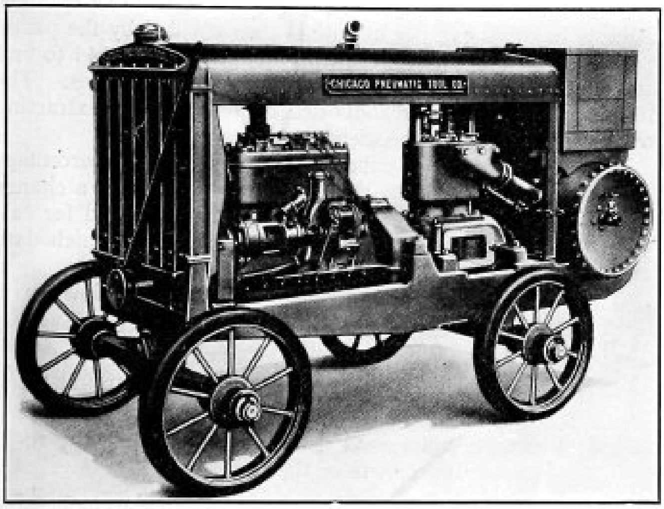
THE new 100-foot Chicago Pneumatic Tool Company, New York, gasoline-engine driven portable air compressor now available is adaptable among other uses to field work and will operate 2 riveting or calking hammers. The compressor is of the vertical, single-acting duplex type equipped with simplate inlet and discharge valves. The



Hose Coupling Assembled and Spider Mender

CP differential unloader regulates the air supply and the auto-pneumatic throttle provides additional fuel economy by slowing the engine to idling speed during the unloaded periods and speeding it up again just before the load is resumed. Splash lubrication is used and a small pump, gear-driven from the crankshaft, maintains a constant level of oil in the connecting rod splash troughs and supplies oil to the main bearings. Glass inserts, in the removable doors of the crank-case, are convenient for the inspection at all times of the lubrication system.

A flexible coupling, which can be quickly disconnected for starting, when desired, connects the compressor directly to a heavy-duty four-cylinder gasoline engine. Both engine and compressor are thoroughly cooled by a large capacity radiator, built in sections and protected against damage by seven vertical bars. A cast-steel deck provides a common base for engine, compressor and air receiver. The gasoline tank is carried in a separate section of the tool box which may be locked when so desired.



New Chicago Pneumatic Portable Compressor

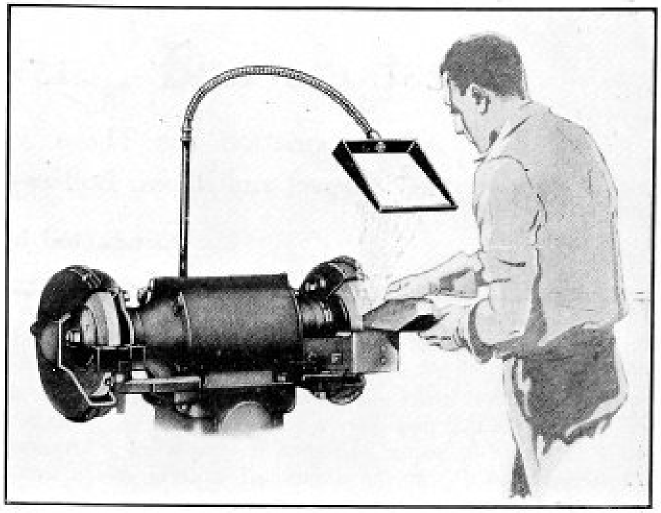
The complete unit is supplied in the regular steel-wheel or rubber-tired portable model, the rubber-tired trailer type or mounted on a 1-ton Ford truck chassis.

Eye Shield for Grinding Machines

THE ACME eye shield, shown in the accompanying illustration, has been developed by the Dreis & Krump Manufacturing Company, 74th street and Loomis Boulevard, Chicago, to eliminate the necessity of grinding wheel operators wearing goggles and to reduce eye accidents.

Various arrangements are provided for attaching the shield to grinding machines; either by bolting the standard to the base of the grinder, tapping into the grinder frame or attaching it to an adjacent post or wall. The glass used in the shield is non-scatterable glass, which not only prevents particles of emery or steel from getting in the workman's eyes but also protects the face and head in the event of larger objects striking the glass. The glass will not scatter when struck with sufficient force to crack it. The size of the glass is 7 inches by 9 inches, which is ample for all requirements.

The shield is mounted in a steel frame and can be readily replaced. The flexible arm to which the frame is attached allows instant adjustment to the front or side of the wheel and to any convenient height. The shield can be used to cover both wheels if belt guards do not obstruct the movement of the arm. The shield is furnished complete with adjustable steel brackets, an 18-inch length of pipe, floor flange, street elbow, nipple, lock nuts, 18-inch flexible arm, steel frame and 7-inch by 9-inch non-scatterable glass.

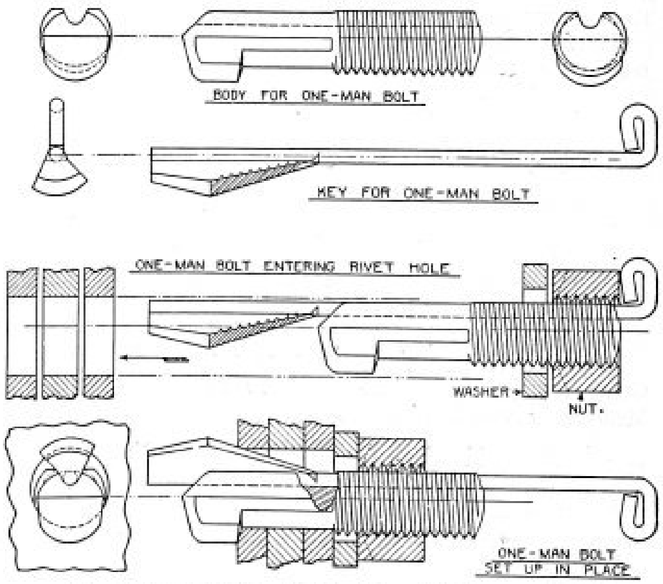


Eye Shield for Protecting Grinder Operators

Bolt for Fitting Up Steel Plate Work

AS a time saver in fitting up steel plate work, a one-man bolt has been developed and is now being produced by T. L. E. Haug, 2315 Durant avenue, Berkeley, Cal. The bolt consists of two parts—a key and a bolt body, assembled with a standard square nut. It is possible for one man to put this bolt in place and set it up.

The accompanying illustration shows the construction of the bolt and demonstrates how the nut and bolt are handled as one piece on the outside of the work. When the bolt is to be removed, the nut is slackened off a turn instead of removing it entirely and the several parts of the bolt come away as one piece, the nut holding the key and body together. The bolt is made of a special high grade steel and in cases of excessive strain the nut strips out leaving the bolt uninjured. Referring to the diagram for the various parts of the bolt; when putting it in use, pass the bolt head through the washer and rivet hole with the key resting on top, turn the lug down, keep pulling it out until the bolt stops turning as the nut is screwed up tight.



Operating Details of One-Man Fitting-up Bolt

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Air Compressors and Tank Problem

Q.—I have two questions that are beyond me, but which I would certainly like to know how to answer; they may be beyond the limits of your department, but no harm is done if I ask you.

(1) The following air tools are to be operated:

16 riveting hammers, up to 7/8 inch rivets.
8 chipping and calking hammers.
8 reamers, up to 1 inch holes.
1 McCabe flanger, up to 1/2 inch plate.

a. How can I arrive at the size of compressor of suitable commercial type to furnish sufficient air to supply the above tools?
b. How do I arrive at the size of receiver tank to take supply from the above compressor?
c. I have the formula, $W = PV \div 53.2T$, which gives the weight of air in pounds that any tank will contain, but this does not do me any good in trying to answer (a) and (b), does it?

(2) An oil tank 25 feet diameter by 25 feet high has a conical roof 1 foot 6 inches high in the center, of 3/16-inch plate, single riveted with 1/2-inch rivets, 1 5/8-inch pitch. This roof is secured to the tank only by being riveted to the angle around the top of the shell of the tank.

Now, it is required that this roof withstand a pressure of 1 ounce on the inside, as this pressure is required to operate a certain safety valve arrangement to relieve the pressure of fumes that arise from the oil.

Is it possible for me to calculate if this roof is strong enough to withstand this internal pressure of 1 ounce per square inch, and prove it?

If not too far from the work you allow done in this department I would like to hear from you on these subjects in the next two or three months.—G. H. A.

N. B.—Roof lays on supporting structure like a "skin."

A.—To determine the size of a compressor first estimate the amount of air required in cubic feet at the given pressure needed to do the work. Only general data is available as the altitudinal and other conditions vary; also machines of the different manufacturers differ in the amount of air used for their operation.

The following tables give the amount of free air per minute required at sea level under good conditions:

RIVETING HAMMERS

Size	Free air in cubic feet per minute
40	18
50	19
60	20
80	20
90	20

CHIPPING AND CALKING HAMMERS

General chipping and calking	17 cubic feet per minute
Medium heavy chipping and calking	20 cubic feet per minute
Heavy chipping and calking	20 cubic feet per minute

Air drills and grinders, based on intermittent service at 80 pounds pressure per square inch from 15 to 30 cubic feet per minute.

For McCabe flanger, from 15 to 50 cubic feet per minute at 100 pounds per square inch depending on the plate thickness.

After determining the required volume of air at sea level, divide the amount by the volumetric efficiency of the compressor (which ranges from 75 to 85 percent) the quotient is the cylinder volume in cubic feet per minute. The cylinder volume in cubic feet per minute is then divided by the piston travel in feet per minute; multiply the quotient by 144 to find the area of the piston or cylinder in square inches. The diameter equals this area divided by 0.7854, and extracting the square root of the quotient.

The "volumetric efficiency" is expressed as the percentage of "free air" delivered by the compressor. There is a change in this efficiency which varies with the altitude, and for calculations of this kind an altitude factor is used which data can be found in engineer's handbooks.

The size of the air receiver may be found as follows:

1. Determine the maximum capacity of the compressor in free air per minute.
2. Determine what volume this air will occupy at the required pressure.
3. From the volume as determined, calculate the required dimensions of the tank.

Example.—Assume that the maximum displacement of a compressor at sea level is 100 cubic feet per minute. Working pressure equals 90 pounds per square inch.

The formula, $$V_2 = \frac{14.7 V_1}{P_2 + 14.7}$$

may be used to determine the volume of 100 cubic feet of free air compressed to 90 pounds pressure. In the formula—

V_1 = maximum piston displacement in cubic feet per minute.
V_2 = volume of air under given pressure.
P_2 = working pressure.

Then using the given values,

$$V_2 = \frac{14.7 \times 100}{90 + 14.7} = 14 \text{ cubic feet.}$$

In one cubic foot there are 1,728 cubic inches.

$$14 \times 1{,}728 = 24{,}192 \text{ cubic inches.}$$

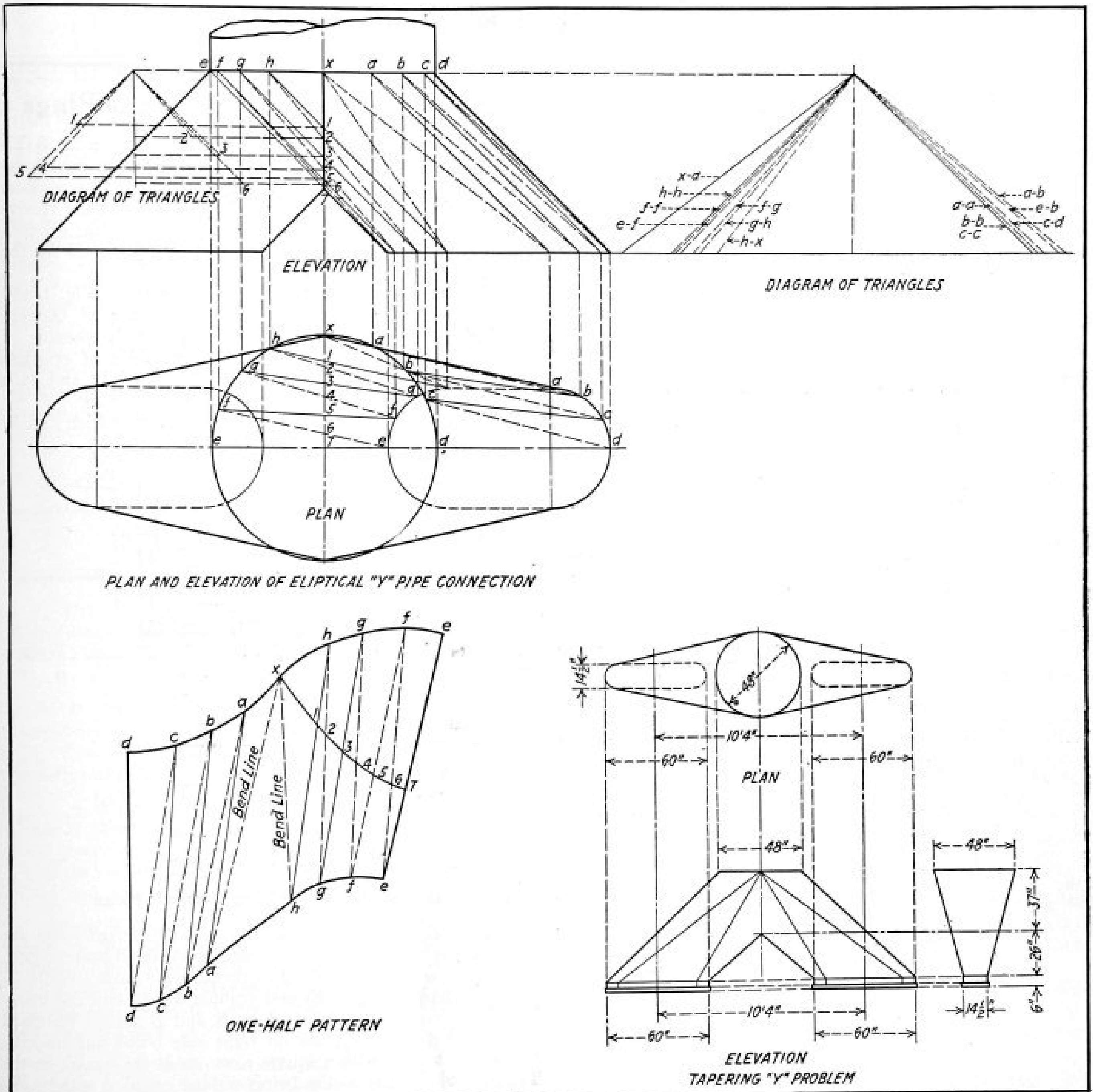
Assume that the diameter of the required tank is 20 inches. The area of the circular end equals $20^2 \times 0.7854 = 314.16$ square inches. $24{,}192 \div 314.16 = 77.3$ inches, the required height. The solution given is approximate for determining the size of tank, and in making a selection it is customary to use a tank somewhat larger in size as there is no objection in having a receiver larger in size than required. By using a larger tank, no trouble arises from fluctuation in pressure, and the air has ample time to cool and deposit part of the moisture.

For the second question, no calculations seem necessary as the weight of the structure and means of fastening it to the supports is more than sufficient to carry such a slight pressure.

"Y" Breeching Layout

Q.—Herewith is a sketch of a "Y" breeching, tapering from two oval uptakes, 14½ inches by 60 inches, to 48 inches diameter stack. Our layerout is experiencing considerable difficulty in laying this out and requests that we write to you for information. This is holding up a large job at this time and your prompt attention will be greatly appreciated.—C. M. H.

A.—The solution of this problem is given in the accompanying drawing. The triangulation method of development is used in this case. As all lines of development are numbered to correspond in the plan, elevation and diagram of triangles the construction of the pattern should be readily understood.



Development and Pattern for Y Breeching

Information on Tube Cutter Desired

Q.—We have many tubes to cut out and renew in Yarrow boilers. The tubes are 1¼-inch diameter and 1-inch diameter respectively. Each row of tubes varies in length, and if the boiler has settled at all, then the tubes in each row will vary in length when renewing them. Our system has been when renewing these tubes: First, get the correct measurement in length of each tube, cut off the ends of tubes required with a hack saw before putting tubes in to be expanded. Now this method takes a great deal of time to get the correct lengths. I would like to see a machine constructed to cut the ends of the tubes off uniformly after being put in and expanded, leaving ¼ inch of the tubes out from the header. This method would reduce a great deal of time I am sure. If such a cutting apparatus could be had, my repair office would gladly obtain it just by my asking. I may see a drawing of such a tool in one of your coming issues in The Boiler Maker. I will look with interest, however.—W. R. S.

A.—Will some of our readers supply the information required?

Steam Dome Proportion

Q.—I am a subscriber and would like to ask of you one question. What is the ratio of the diameter of a shell boiler to the ratio of the diameter of a steam dome?—W. L.

A.—The steam dome should be from one-fourth to one-third the cubic capacity of the boiler.

Letters from Practical Boiler Makers

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

Flue Pockets and Flue Sheet Patches

So many boiler makers do not know how to install flue pockets that the suggested methods of doing the work, proposed by T. P. Tulin in an article on page 135 of the May issue of THE BOILER MAKER, should prove very interesting. If a flue pocket is put in with the prosser expander there is no danger of its ever blowing out. Inserting blind flues or welding a small piece in the flue hole is much more dangerous than a flue pocket; first, because of the fact that the weld will not be over 75 percent efficient and then because of the danger of cracking.

If a locomotive is in the roundhouse and has to be put on the road to make up her mileage a flue patch is all right temporarily. If, however, the locomotive goes into the back shop for class 3 repairs it is not advisable to patch the sheet. The only proper way in this case, if it is so badly worn as to need a patch at all, is to put in a new flue sheet or three-quarter sheet.

Welding is an excellent aid in repair work if it is used properly but so many foremen use it in places where it is not the best practice. This is particularly true in welding up flue holes and cracks in the flue sheet and welding patches in the flue sheet without reinforcing them with riveted patches as required by the Bureau of Locomotive Inspection. In fact, if these foremen did not have the welding or cutting torch to fall back on they would hardly ever get a job out of the shop on time.

If it is planned to put in a half flue sheet I personally cannot see the object of going to the trouble of putting in blinds. Why not fit up a three-quarter sheet and have only the weld at the bottom of the sheet and not in the flue holes. Make a first class mechanical job of it at the beginning and have all new flue holes to work with.

I was in a boiler shop not long ago where they were putting in a new firebox. In this case the two knuckles were cracked and the throat sheet was in bad shape. Neither the flanger nor the foreman knew how to flange a new one so they put on two knuckle patches and cut out the throat sheet on both sides and across the top of the flange and welded in a new piece. This made two patches and three welds in doing the job and required more time than a new sheet would have without getting a satisfactory job. There are some cases in the shops of the country where the foremen were only helpers or water boys up to the time of the strike and who have had no experience in back shop work whatsoever. A lot of the good men are working at some other trade. To me it is no wonder that there were so many boiler explosions and railroad accidents in 1923.

In another boiler shop than the one mentioned above, I saw the layerout trying to layout a front flue sheet by placing the old one on the new sheet and marking through the flue holes with a long piece of round wood dipped in paint. He was supposed to be a layerout. The argument is often presented that the blue print supplied to layout from is not accurate. In some cases this may be true, but if a layerout knows his business and how to read a blue print and check it as he goes along, the work will be pretty sure to come out right.

Pittsburg, Kansas. A. WENDT.

Device for Cleaning Washout Plugs

The cooperative movement now in operation on the Baltimore & Ohio Railroad, whereby the local managements and all employees are brought together by the medium of local committees for the exchange of ideas and the receiving of suggestions from employees for the benefit of all concerned, is resulting in much good and promises well for the future.

One idea suggested and accepted is shown by Fig. 1 and 2 designed by Charles Hopper, boiler maker of Garrett, Indiana. Used for the purpose of cleaning the threads of washout plugs from the hardened accumulation of graphite and sediment, it answers the purpose splendidly and is a great improvement over the former methods followed.

Fig. 1 shows an elevation of the machine, which can be

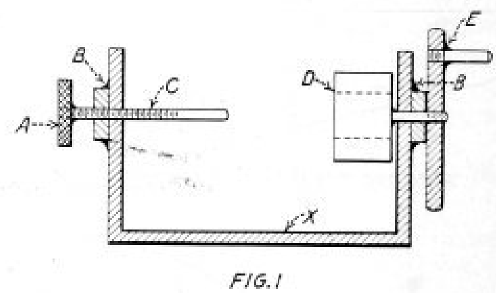


FIG. 1

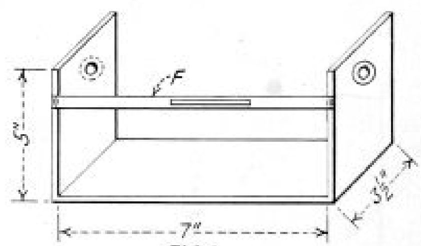


FIG. 2

Hand Lathe for Cleaning Washout Plugs

appropriately termed a hand lathe. The different parts are enumerated thus: *X*, body of machine, ⅜-inch boiler plate; *A*, small valve wheel welded to threaded ⅞-inch spindle *C*, 6 inches long, left smooth and pointed at one end for insertion into recess of washout plug; *B* and *B* are ⅞ standard nuts welded to frame, one on right side bored out smooth; *D* is socket made with a square recess to fit the square on the washout plug, this socket being welded on to a spindle, as shown, and made long enough to allow for the application of the operating wheel *E* which is made from a piece of ½-inch plate, with the handle applied, as shown, the wheel being 7 inches diameter.

Fig. 2 is given to show the dimensions and to show more clearly the tool rest, which is a piece of ⅛-inch by 1-inch steel welded to the frame. A slot ¼ inch by 3 inches is cut in as shown for cleaning the tool. A short length of 3/16-inch steel wire, ground to a sharp point, is used for cleaning the tool. This device when in use is clamped into a vise; when not in use is carried in the boiler washer's tool truck.

Lorain, Ohio. JOSEPH SMITH.

Repairing Locomotive Boilers at Bischheim, France

(*Continued from page* 200)

(3) A distributing valve which by means of a single rotation enables the following operation to be performed:
- (a) Clamping of the tube under reduced pressure.
- (b) Filling with water under shop pressure.
- (c) Shutting off of the water and at the same time applying 427 pounds pressure and increasing the clamping pressure.
- (d) Releasing the tube and evacuating the water.

General Tool Equipment

Besides the arrangements especially planned for the repair of fireboxes which have been considered in this article, the equipment of the Bischheim Shop also includes, among others, a 600-ton press served by an oil furnace for producing stampings; a shaping machine for plates; a small compressed air hammer; a four-spindle drilling machine for drilling tube sheets; five radial drills with jointed arms for drilling plates; two long-reach radial drills operated by variable speed motors; a plate beveling machine having a special guiding device; a 50-kilowatt transformer to be used for electric welding; a Javal generator connected with an acetylene line running through the shop, and a 150-cubic foot per minute compressor feeding the boiler shop as well as the erecting shop.

BUSINESS NOTES

C. E. Lester has resigned his position with the H. K. Porter Company to become foreman boiler maker at the Newport News Shipbuilding and Dry Dock Company, Newport News, Va.

E. H. Benners and R. W. Benners, railway sales representatives at New York of the American Forge & Machine Co., Canton, Ohio, have removed their office from 2 Rector street to 30 Church street.

K. A. Hills, representative of the General Electric Company at Davenport, Ia., has been promoted to manager, with the same headquarters. S. E. Gates, manager of the Spokane, Wash., office, has been transferred to Los Angeles, Cal., and will be succeeded by Bernard Olsen.

George R. Hine is now in charge of the factory management of the New Process Twist Drill Company, Taunton, Mass. Mr. Hine served as general superintendent of the Whitman & Barnes Manufacturing Company, Akron, Ohio, for the past 15 years and was associated with that company for over 23 years.

B. Franklin Paist, formerly night superintendent of the Baldwin Locomotive Works, died on June 1, at the age of 70. Mr. Paist had been connected with the Baldwin plant for about 48 years. He traveled extensively as a representative of the locomotive works, and during the World War was one of the contingent of American engineers who went to Siberia, serving with the rank of major.

F. J. Lisman & Co., 24 Exchange Place, New York, has announced that it is prepared to assist railways in financing on the installment plan, purchases of new shop machinery and tools or improvements to shops, terminals, etc. In the announcement, F. J. Lisman & Co. says that it was a pioneer 30 years ago in handling equipment trusts before such obligations were as popular as they are today.

TRADE PUBLICATIONS

Air Hoists and Trolleys.—Several types of air hoists and trolleys are described in a circular recently issued by the Hanna Engineering Works, Chicago, Ill.

Welders and Cutters.—A 31-page illustrated catalogue has been issued by the Burdett Service, Chicago, descriptive of oxy-acetylene and oxy-hydrogen welding and cutting apparatus.

Machine Shop Tools.—Expanding mandrels, drill and reamer holders and arbor presses comprise the trio of time savers described in Bulletin No. 424 recently issued by W. H. Nicholson & Company, Wilkes-Barre, Pa.

Grinder Chucks.—Circular H, descriptive of pressed steel grinder chucks made in nine sizes to hold 10-inch to 30-inch rings, with hubs to suit all kinds of spindles, has recently been published by the Graham Manufacturing Company, Providence, R. I.

Fans.—The constructional features and applications of fans of the Ventura disk and Sirocco types are outlined in Bulletins Nos. 1613 and 1002, respectively, which have recently been issued by the American Blower Company, Detroit, Mich. Tables of dimensions and capacities are also given.

Hytempite.—"Hytempite in the Power Plant" is the title of a 20-page illustrated bulletin issued by the Quigley Furnace Specialties Company, New York. Firebrick masonry; hytempite, why, where and how to use it; boiler furnace economies, etc., are among the details of furnace construction and maintenance described.

Packing.—A short story in pictures entitled "Quality Controlled Packings Have the Same Service Stamina Today and Tomorrow as They Had Yesterday," has been issued by the Garlock Packing Company, Palmyra, N. Y. The booklet contains a number of actual photographs as made in the general factories of the Garlock Packing Company.

Bench Grinder.—The "Hisey" six-inch bench grinder driven either by a d. c. or a. c. one-quarter horsepower motor is described in bulletin No. 1305-A, recently published by The Hisey-Wolf Machine Company, Cincinnati, Ohio. The machine is well provided with standard safety guard, is equipped throughout with ball bearings and is designed only for very light grinding.

Oil as Fuel.—Bulletin "D," a 13-page brochure entitled "Co-operative Advertising of Oil as Fuel," has just been issued by the Mahr Manufacturing Company, Minneapolis, Minn. This bulletin contains a copy of the paper presented by W. M. Horner, president of the Mahr Manufacturing Company, at the first annual meeting of the American Association of Oil Burner Manufacturers held on April 2 at St. Louis, Mo.

Automatic Surface Grinder.—An 11-page illustrated circular has been recently issued by the Blanchard Machine Company, Cambridge, Mass., descriptive of the Blanchard automatic surface grinder No. 16-A. This booklet is devoted principally to illustrations of various classes of work handled on this machine, giving complete production data in each case and a brief description and specifications for the machine itself.

Feed Water Heaters.—The second edition of a preliminary catalogue on Elesco feed water heaters has just been issued by the Superheater Company, New York. It describes construction details and fully illustrates the application of the closed, or non-contact heater to locomotives.

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—George Uhler, Washington, D. C.

Deputy Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law Society

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Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 West 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—J. F. Scott, Trenton, N. J.

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Vice-Chairman—R. L. Hemingway, San Francisco, Cal.

Statistician—E. W. Farmer, Rhode Island.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

J. A. Franklin, International President, suite 522, Brotherhood Block, Kansas City, Kansas.

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, suite 524, Brotherhood Block, Kansas City, Kansas.

H. J. Norton, International Vice-President, Alcazar Hotel, San Francisco, Calif.

International Vice-Presidents—Thomas Nolan, 700 Court St., Portsmouth, Va.; John Coots, 344 North Spring St., St. Louis, Mo.; M. A. Maher, 2001-20th St., Portsmouth, Ohio; E. J. Sheehan, 7826 South Shore Drive, Chicago, Ill.; John J. Dowd, 953 Avenue C, Bayonne, N. J.; R. C. McCutcheon, 15 La Salle Block, Winnipeg, Man., Can.; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; John F. Schmitt, 605 East 11th Ave., Columbus, Ohio.

Master Boiler Makers' Association

President—Frank Gray, tank foreman, C. & A. R. R., Bloomington, Ill.

First Vice-President—Thomas F. Powers, assistant general foreman, boiler department, C. & N. W. R. R., Oak Park, Ill.

Second Vice-President—John F. Raps, general boiler inspector, I. C. R. R., Chicago, Ill.

Third Vice-President—W. J. Murphy, general foreman boiler maker, Penn System, Fort Wayne Shops, Allegheny, Pa.

Fourth Vice-President—L. M. Stewart, general boiler inspector, Atlantic Coast Lines, Waycross, Ga.

Fifth Vice-President—S. M. Carroll, general master boiler maker, C. & O. R. R., Richmond, Va.

Secretary—H. D. Vought, 26 Cortlandt Street, New York.

Treasurer—W. H. Laughridge, G. F. B. M., Hocking Valley R. R., 537 Linwood Avenue, Columbus, Ohio.

Executive Board—E. J. Reardon, Locomotive Firebox Company, 632 Marquette Building, Chicago, Ill., chairman; H. J. Raps, G. F. B. M., I. C. R. R., 7224 Woodlawn Avenue, Chicago, Ill., secretary.

Boiler Makers' Supply Men's Association

President—J. P. Moses, Jos. T. Ryerson & Son, Chicago, Ill.; Vice-President—F. H. McCabe, McCabe Manufacturing Co., Lawrence, Mass.; Secretary—W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

American Boiler Manufacturers' Association

President—E. R. Fish, Heine Boiler Company, St. Louis, Mo.

Vice-President—E. C. Fisher, The Wickes Boiler Company, Saginaw, Mich.

Secretary-Treasurer—H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

Executive Committee—George W. Bach, Union Iron Works, Erie, Pa.; G. S. Barnum, The Bigelow Company, New Haven, Conn.; F. G. Cox, Edge Moor Iron Company, Edge Moor, Del.; W. C. Connelly, D. Connelly Boiler Company, Cleveland, O.; W. A. Drake, The Brownell Company, Dayton, O.; A. R. Goldie, Goldie-McCulloch Company, Galt, Ont., Can.; J. F. Johnston, Johnston Brothers, Ferrysburg, Mich.; M. F. Moore, Kewanee Boiler Works, Kewanee, Ill., and A. G. Pratt, The Babcock & Wilcox Company, New York.

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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

THE BOILER MAKER

AUGUST, 1924

Repairing Locomotives Under Contract*

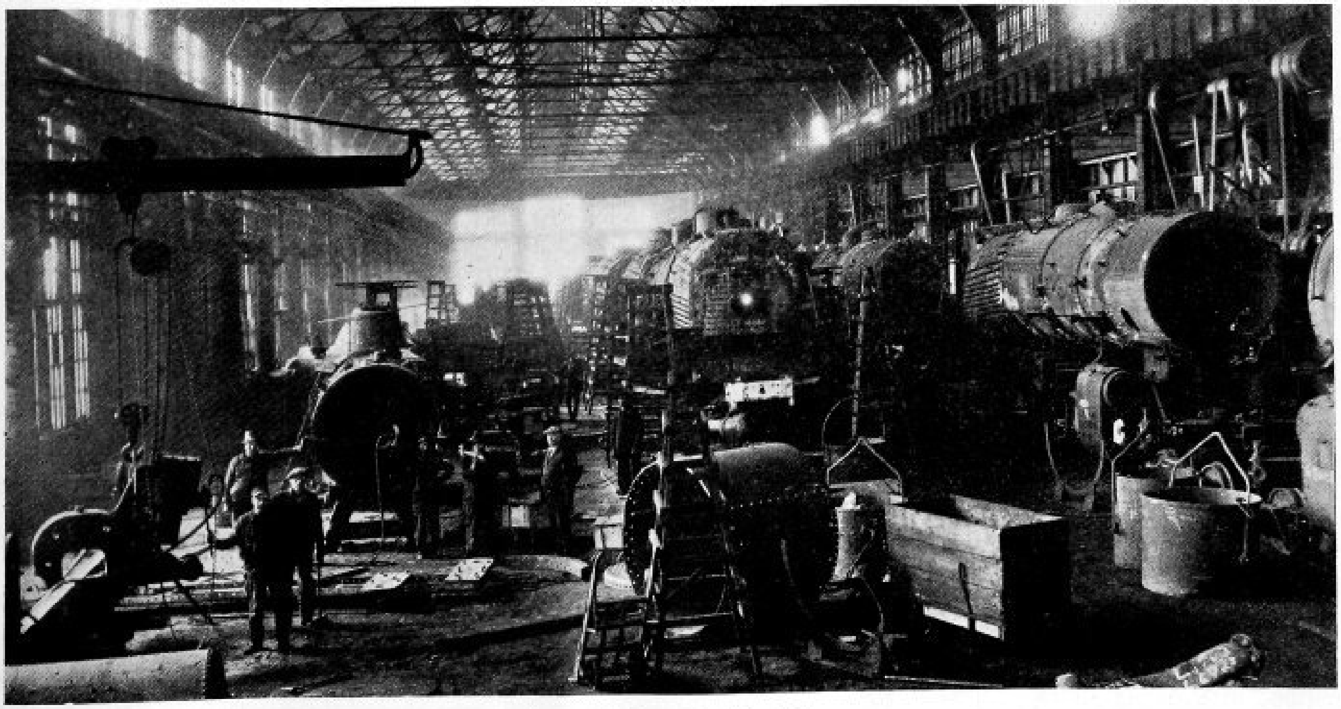
Beech Grove Shop Operating System Developed by Railway Service and Supply Corporation Performs Valuable Service for Big Four

CONTRACT repair shops are being utilized by a number of railroads throughout the country to carry the peak of their repair requirements, but nowhere is the advantage of this system more in evidence than at the Beech Grove Shops of the Big Four whose operation has been developed by the Railway Service and Supply Corporation of Indianapolis. Here not only the peak demand for motive power maintenance is met, but all power requiring service at this point on the system is handled. In addition a greater or less number of New York Central locomotives come to the shop for repairs. Even with these demands on its facilities, Beech Grove can still accommodate many more locomotives than are repaired at present.

Three factors are mainly responsible for the success of the plant. First in importance is the personnel, which from the management down to the youngest helper in the shops, is devoted to the idea of production. Then the piece work principle on which this production is based is more or less unique in a locomotive repair shop and is, above all, founded on correct fundamentals. Throughout the entire organization a spirit of good will and co-operation prevails, tending to increase output and bring greater returns to the men. Last, and fully as important as the other factors, is the equipment of the entire plant, which is absolutely modern and an important aid in realizing production. The policy of the service company is to install machinery wherever and whenever it can be shown advisable by the shop forces.

The organization in itself has been a most interesting combination of service company and railway company officials. At the head of the service company is a general manager, as in any privately operated concern, and under him come the plant manager and his staff, the production department and the shop staff. The shop staff is in effect a distinct organization of small units. Each foreman has his crew and hires and discharges the men independently. The point of contact

* Since this issue of the magazine was made ready for publication, word has been received from the management of the Beech Grove Shops that the operation of the plant had been restored to the railroad company. The same personnel, methods and equipment will be continued so that the subject matter of this article still represents certain phases of the work at Beech Grove. A further comment on the matter appears as an editorial on page 239 of this issue.



General View of Boiler Shop

between the shop forces and the management comes through the production department. No shop inspection force is maintained. Every foreman, and in fact, every man in the entire plant must be his own inspector.

To safeguard the railroad company's interests, and the only direct element of control in the conduct of the plant, is the inspection staff maintained by the superintendent of motive power of the Big Four, which has the duty of final inspection and acceptance of the finished locomotives.

That the system is successful in operation is indicated by the fact that the company can at any time estimate within 5 percent of the cost of the work on any locomotive before it comes to the shop. The 5 percent allowance provides for items such as new flues and the like, which cannot be determined until the engine is stripped.

The erecting shop is provided with 52 pits and repairs run from 50 to 70 locomotives a month, depending on requirements. In a rush period the shop can accommodate as many as 80 locomotives for heavy repairs.

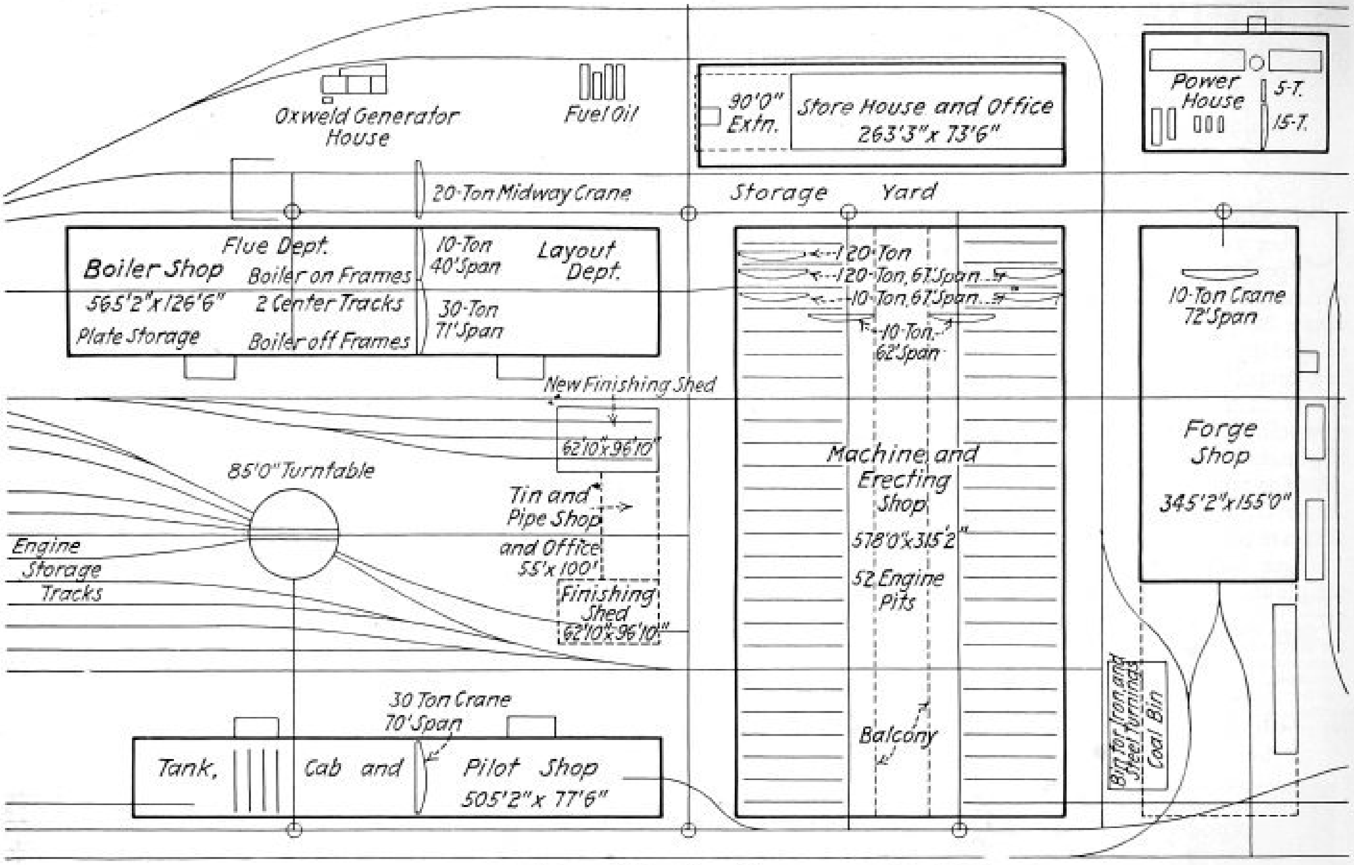
An Efficient Scheduling System

The practice is to assign one, two or three locomotives to a pit if necessary. This is possible where boilers are removed from the frames and sent to the boiler shop for repairs. The trucks on such a job are sent to the yard and another locomotive is stripped on the same pit. To do this without interference necessitates an efficient scheduling system and is possible through the close supervision of the production or routing department. In a later article details of the monthly department production record chart which has been developed in conjunction with the scheduling system for the information of the manager of the company and the superintendent of motive power of the railroad will be explained, as well as the method of reducing all repair jobs to the production unit basis for the application of the piece work system.

The erecting shop comes under the joint supervision of the mechanical department and the general boiler foreman. At the time of the writer's visit to the shop the crane system in the erecting shop, which is divided into three bays, was being changed to accommodate heavier power. The shop is of brick and steel construction, 578 feet long and 315 feet 2 inches wide. In the northwest and southeast bays of the shop are located the pits, while the center bay and a gallery are given over to the machine shop, pipe shop, jacket room, electrical department, tool room, washrooms, showers, etc.

New Crane Equipment in Erecting Shop

When the railroad company decided to convert some of the H-10 and H-17 locomotives, it was found that the cranes in the erecting shop were not of sufficient capacity to handle them. To meet the requirements, the railway company installed a new Whiting 120-ton crane in the southeast bay of the shop to replace one of like capacity. This crane was then removed to the northwest bay, where it was coupled with another 120-ton Whiting crane to provide handling facilities for the heaviest power that the shop will be required to repair. The complete crane equipment here consists of three 120-ton cranes, two 20-ton auxiliaries in the erecting bays, and two of 10 tons' capacity in the machine bay.



Arrangement of Boiler and Erecting Shops, etc., at Beech Grove

Boiler Shop Equipment

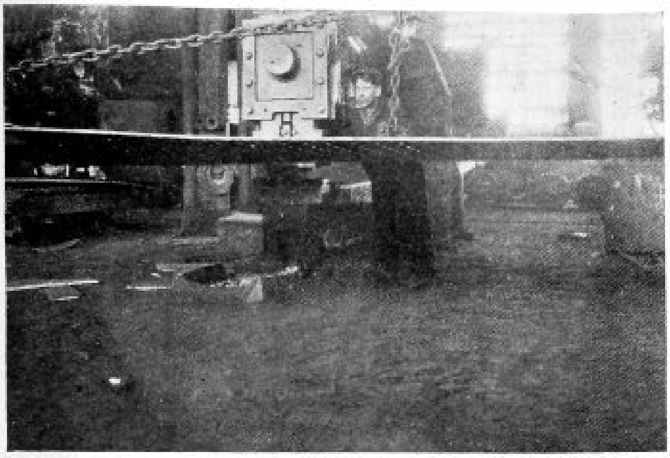
The boiler shop is located at the northwest corner of the erecting shop and at right angles to it. It is 565 feet 2 inches long and 126 feet 6 inches wide.

The equipment in the boiler shop includes the following:

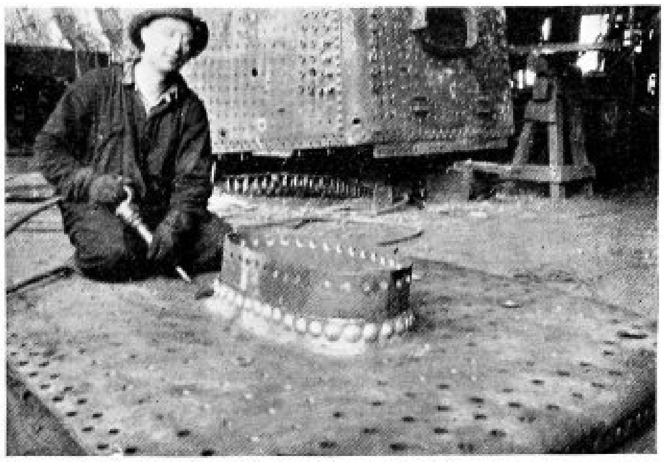
1 50-hp. 440-volt alternating current, 900 r. p. m. motor.—General Electric Company.

1 30-ton, 71-ft. span, single hoist traveling crane.—Niles-Bement-Pond.

1 10-ton, 40-ft. span, single hoist traveling crane—Niles-Bement-Pond.



Handling a Long Plate in the Punch



All Fire Doors Are Riveted

1 30-ton, 25-ft. span crane in hydraulic riveting tower—Chambersburg.
1 17-ft. gap, 150-ton bull riveter—Chambersburg.
1 Ferguson rivet oil burning furnace.
1 100-ton, 3-plunger hydraulic sectional flanging press—Chambersburg Engineering Company.
1 13-ft. by 13-ft. Ferguson annealing oil furnace.
6 2-ton, 22-ft. radial bracket cranes—Whiting Foundry & Engineering Company.
3 1-ton, 22-ft. radial bracket cranes—Whiting Foundry & Engineering Company.
1 244-in. by 88-in. flange fire—C. C. C. & St. L. design.
2 10-ft. pneumatic flanging clamps.
1 1-ton, 20-ft. radial bracket crane—Whiting Foundry & Engineering Company.
1 No. 10 gas blower—B. F. Sturtevant Company.
1 12-ft. by ½-in. bending rolls—Niles Tool works.
1 2-ton, type L, 18-ft. jib crane—Whiting.
1 4-spindle drill press—Foote, Burt & Co.
1 Horizontal power punch—Cleveland Punch & Shear Works.
1 1-ton, 18-ft. radial—Whiting.
1 34-in. diameter forge.
1 2-ton, type M-16 bracket crane—Whiting.
1 No. 3, 1-in. rotary bevel shear—J. T. Ryerson & Son.
2 2-ton, type N, 22-ft. jib cranes—Whiting.
1 No. 4, 60-in. single shearing machine—Hilles & Jones.
1 Type A, 60-in. single punching machine—Long & Alstatter Company.
1 24-in. by 88-in. flange fire.
2 48-in. radial drill presses—Niles.
1 No. 4, 12-in. by 3-in. double emery grinder—Sterling Emery Works Company.
1 Safe-end flue cutting machine—C. C. C. & St. L. design.
1 Double head staybolt cutter—Acme Machinery Company.
1 No. 3, 6-spindle staybolt threading and reducing machine—Edwin Harrington, Son & Co.
1 6-in. flue cutting-off machine—C. C. C. & St. L. design.
1 24-in. by 43-in. cast iron forge.
1 No. 8 double dry emery grinder—Bridgeport Safety Emery Works Company.
1 3-in. flue cutting-off machine—C. C. C. & St. L. design.
3 Oil flue furnaces—Ferguson.
1 1½-in. to 3½-in. flue welder—H. V. Hartz.
1 1½-in. to 3½-in. flue swedger—H. V. Hartz.
1 24-in. by 43-in. cast iron forge.
2 1½-in. to 3-in. flue cutting-off machine.
1 flue testing machine.
1 No. 29 pneumatic flue welder—Draper Manufacturing Company.

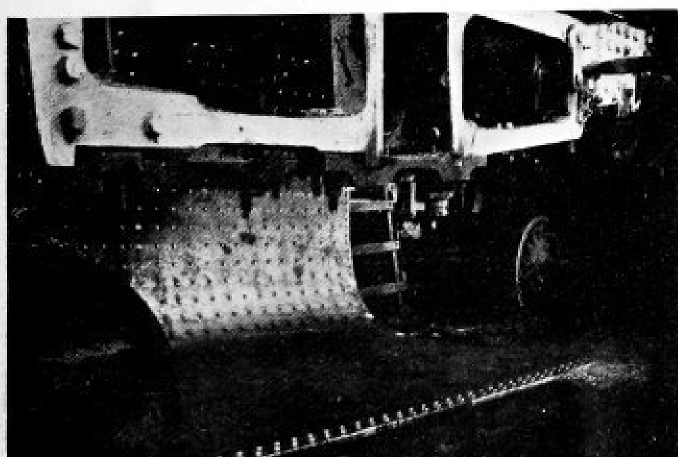
Shop Staff

At the head of all boiler, tank and boiler erecting work is a general boiler foreman with an assistant foreman in each bay of the erecting shop, one in the tank shop, and an assistant general boiler foreman in the boiler shop. The shop staff, distributed on boiler and tank work, includes 7 welders, 95 boilermakers and 125 helpers. There is also one general boiler inspector in the boiler shop.

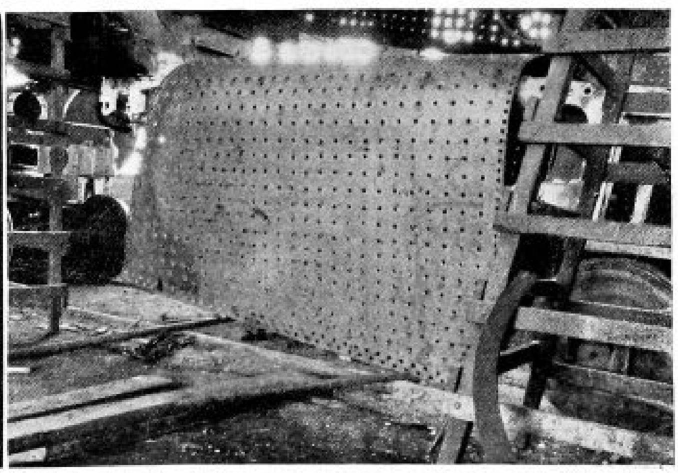
Boiler shop gangs are divided into five, four and three men, depending on the class of work they are engaged in doing. The usual gang consists of two boilermakers and two helpers.

Renewing Fireboxes

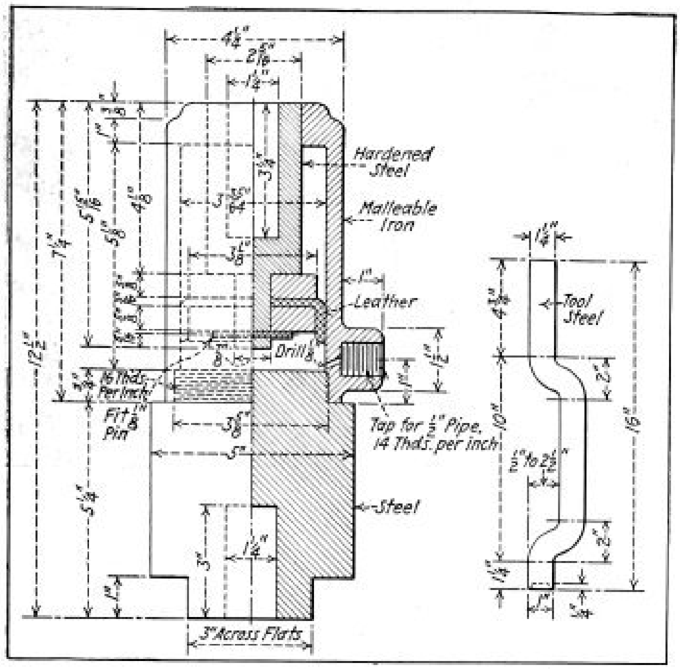
Among the special methods of doing repair work developed at this shop is the practice of removing firebox sheets without removing the boiler from the frames. This practice, which is considered advantageous in many ways in the few shops where it is in operation, was the subject of a paper at the recent convention of the Master Boilermakers' Association, and brought forth considerable discussion. At Beech Grove the system is proving to be a real factor in economy—both in



Firebox Sheet Being Inserted Over Frames for Replacement



Sheet in position on Frames Ready to Be Raised Into Place



Air Jack Used for Holding on Firebox Rivets

time and expense, with no adverse features. So much so is this true that where the firebox is of a type suited to the practice and other work on the locomotive does not require the removal of the boiler from the frames, no other method is used. In this system the old firebox is removed in the usual way; that is, the acetylene torch is employed to burn off the mud ring rivets, staybolts, tube sheet and door sheet rivets. The new firebox is fitted on the floor of the shop and then assembled in the boiler by bolting up the crown and side sheets, door sheet and tube sheet. The only difficulty offered by the process is in adjusting the crown sheet, saddle fashion, over the frames before it is lifted into place. The accompanying illustrations indicate how this is accomplished. Once the sheet is in place over the frames a cable from the shop crane is dropped through one of the holes in the wagon top and fastened to the sheet, when it is raised to the proper position and bolted to the mud ring. The door sheet and tube sheet are then installed and bolted up.

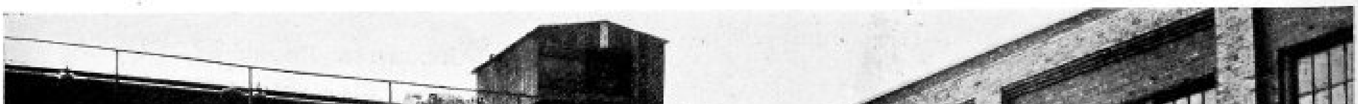
All Riveted Fireboxes

At Beech Grove all fireboxes are riveted. This would seem to offer difficulties for carrying out the work on the frames, but special equipment has been developed that permits both accurate and rapid riveting. Rivets are inserted through the staybolt holes into position in the sheet, with a pair of bent spring tongs. The holder-on is in the form of an air jack, applied on the outside of the shell and fitted with small bars of different angles inserted through the flexible staybolt holes in the outside sheet. Details of the jack are shown in the illustration below. When operating the jack two old men are fitted, one at each end of the firebox, and a 2½-inch by 12-inch plank placed between them. This acts as a spring-board for the holder-on. By means of this arrangement rivets can be driven in any part of the firebox and held on after all sheets have been applied and bolted up.

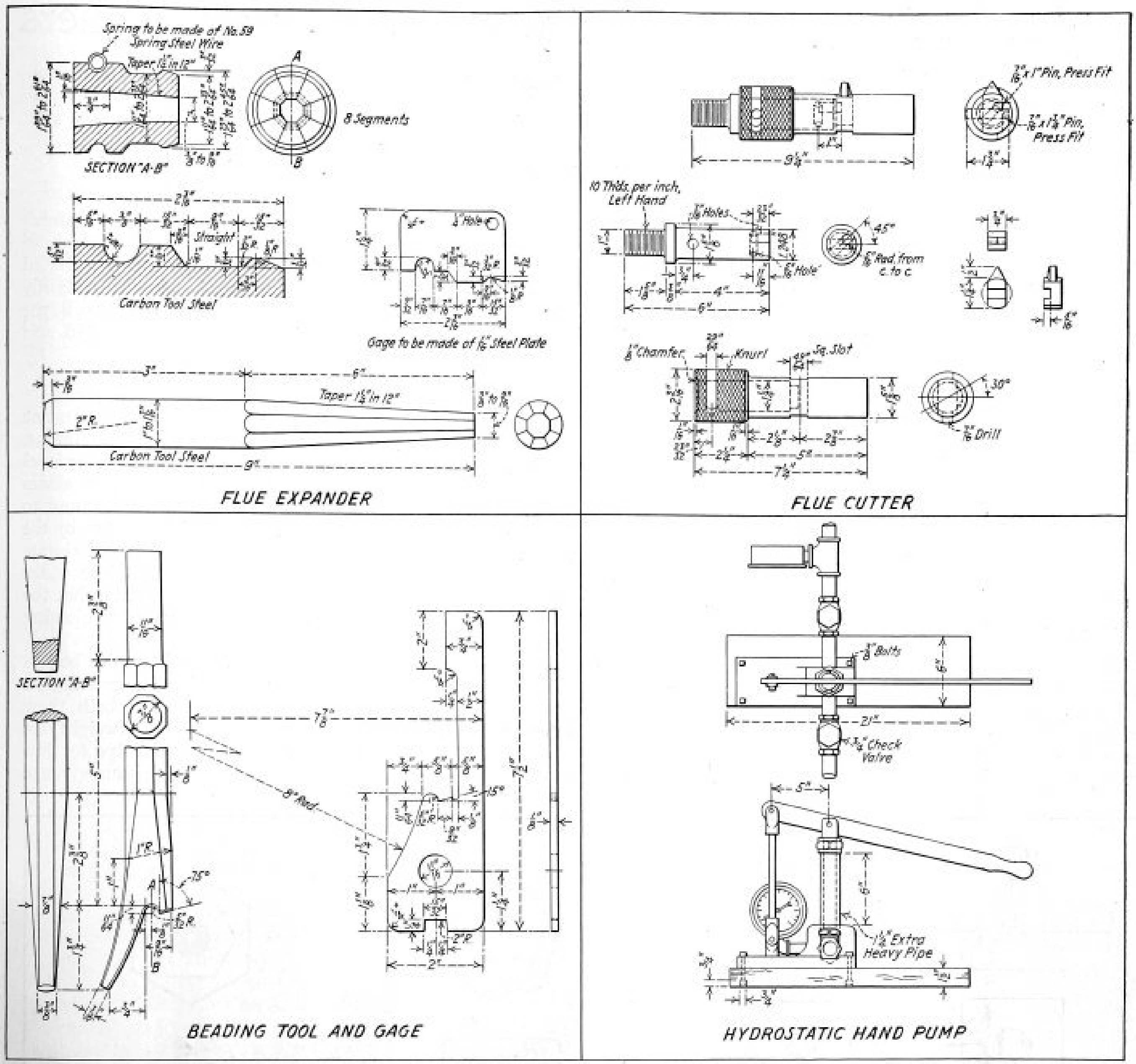
Flue Work

Flue work is carried out at Beech Grove along one side of the boiler shop. When a set of flues is removed in the erecting shop they are slung in chains and stored in the stock yard. Flue rattlers of which there are two are of the wet type and were built in the shop. A picture of the rattlers taking a charge is shown below. Although each rattler has a capacity of about 700 small tubes, it is customary to clean only a complete set at a time. About 800 flues are cleaned each day.

The flue shop force consists of one man for operating the rattlers, two small tube welders, one welder for large flues and three helpers. All of the equipment in the flue shop—welding apparatus, cutting-off machines, etc., are shop made, with the exception of the oil furnaces, which are of the Ferguson type.

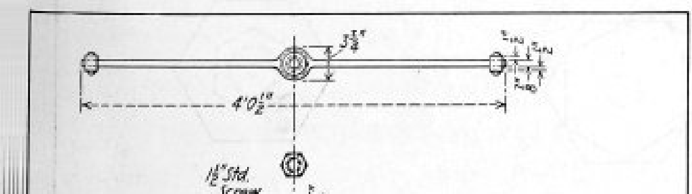


Beech Grove Built Flue Rattlers Taking a Charge



Tools Developed at Beech Grove That Are Departures from Standard Types

Great savings in material are accomplished in the shop. For example, reamers are made out of old taps, scrap metal is collected, and as the plant is equipped with a rolling mill, considerable material is reclaimed.



Arch Tube Straightener

A number of boiler tools that have been developed along slightly different lines from standard tools, are shown in the accompanying plate.

In a later article the production system, the unit system applied to boiler work, the association of shopmen at Beech Grove and other features peculiar to the plant will be explained.

SEVEN MISTAKES

Supposing the public does not appreciate perfection.
Thinking the help does not respond to fair treatment.
Expecting fancy wrappers to atone for poor merchandise.
Waiting for business to turn up.
Delaying improvements until our competitors compel them.
Hoping for increased business without deserving it.
Considering any moral issue insignificant.

Fusible Plugs for Locomotive and Stationary Boilers

A Discussion of Various Design Fusible Plugs Developed to Prevent Low Water Explosions

By "Boilers"

THERE exists a difference of opinion among engineers regarding the advantages of using fusible plugs in steam boilers. The majority of locomotive and stationary land boilers in this country (England) are fitted with these plugs but they are not used in marine boilers. It is curious that the reason for the use of fusible plugs on land does not apply at sea. Its primary use is to indicate that the boiler has become short of water, to reduce the furnace temperature and to prevent collapse and explosion. A well designed plug will perform this function, but many at present in use are unreliable. It is better to have no plug at all in preference to one which is unreliable.

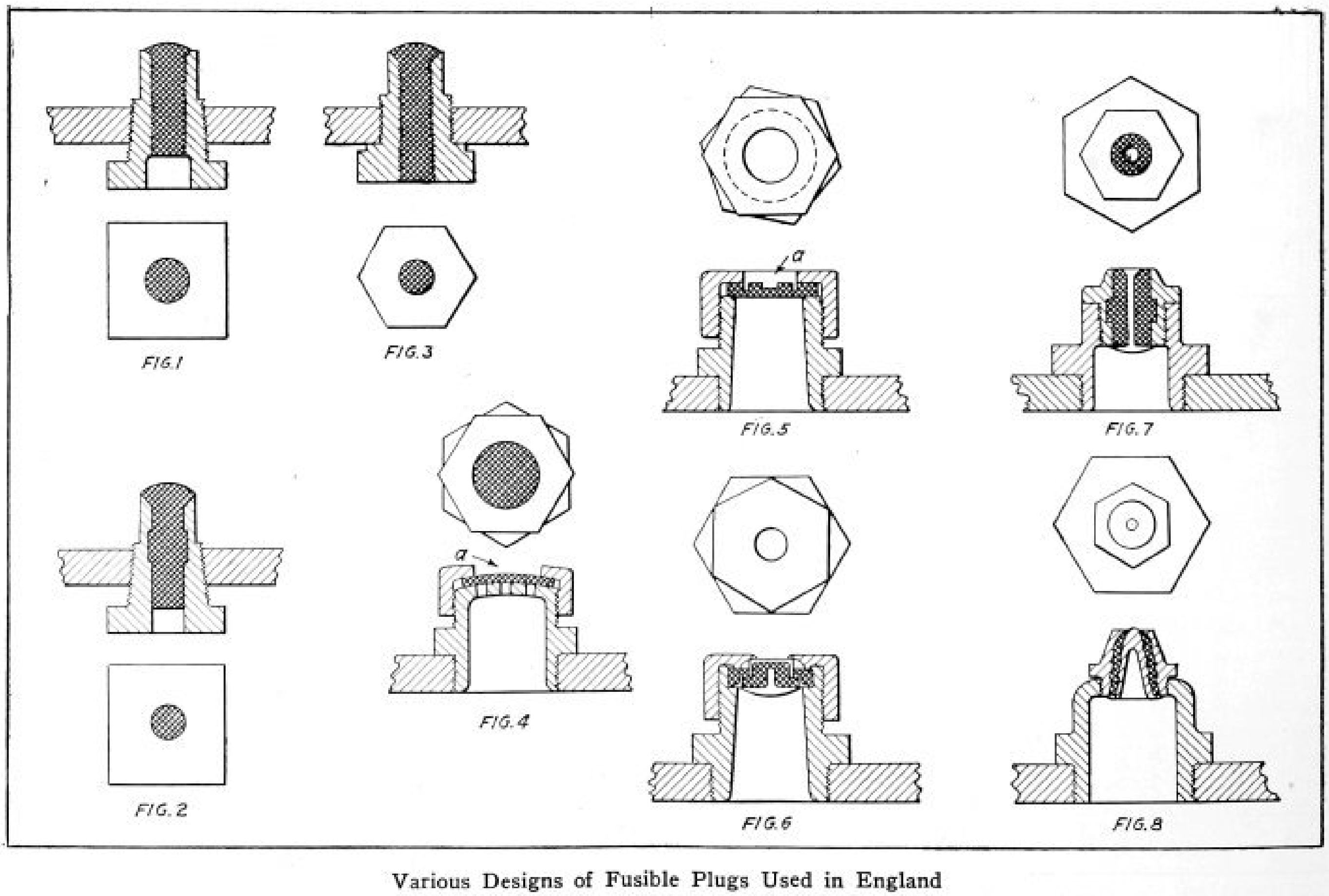
Plugs Not Used in Marine Boilers

The argument against the use of fusible plugs at sea is that in the event of the fusible metal blowing out when the crowns have become bare of water the boiler would be put out of commission for some hours and that this might occur when owing to weather all the steam power is required. Also that the combustion chamber crown being some distance from the furnace is not so liable to become overheated as quickly as the furnace crowns of land boilers. It is also stated that the boiler supervision at sea is more efficient than on land although this is a very debatable point when one considers present boiler practice in an up-to-date mill or power plant. There can be no doubt that if a marine boiler becomes short of water there is a risk of collapse of the combustion chamber crown and top rows of tubes from overheating or risk of cracking from sudden contraction when the pumps are started again. The combustion chamber crowns would certainly take some time before becoming sufficiently hot to collapse but cases are on record where these plates have failed and explosions occurred.

Use of Low Water Alarms

In land practice where low water alarms are used some engineers are of opinion that fusible plugs are superfluous, as ample warning is given by the alarm when the water level is becoming low. The writer's experience is that these alarm valves are not infallible. Sometimes the floats are found to be wrongly adjusted and they are liable to interference by the boiler cleaners. Furthermore, some waters rapidly deteriorate the float material. Where the high steam and low water safety valve is used the attendant is liable to assume that the valve is blowing for high steam when the valve is blowing for low water.

It is often the practice with Lancashire and Cornish boilers to fit a deadweight safety valve and a high steam and low water safety valve. It sometimes happens that both these valves are blowing at the same time; the deadweight for high steam and the high steam and low water valve for low water and high steam. The boiler attendant is thus given a



Various Designs of Fusible Plugs Used in England wrong impression and will probably adjust the dampers to reduce steam pressure. A good fusible plug even where a low water safety valve is used is a safeguard against damage from shortness of water. It is always inconvenient to have to shut down a boiler but it is better to shut down for a day than cause the crowns to be overheated and bulged.

WARNING GIVEN BEFORE FAILURE

It is necessary that fusible plugs be designed to give the alarm before the water has entirely left the crown so that the fire may be withdrawn or dampened without danger and before the overheating has reached the danger point. There is nothing gained in working the water level to a bare margin. One may as well instruct boiler attendants that the plugs will fail with 1½ inch of water on the crowns as 1 inch below the crowns. If the plug is properly designed it will fail while there is still some water over the crown, the steam only escaping and damping down the furnace temperature. The attendant will then be enabled to draw the fires after re-starting the pumps or injector without danger. The boiler will then be out of commission until a new plug has been inserted which is only a matter of a few hours.

Some plugs are designed with the orifice too large and are positively dangerous to anyone at the boiler front when they fail owing to the large volume of steam suddenly released. They are designed with a view to releasing the pressure rapidly and so quenching the fire to prevent overheating. Such plugs are not so liable to be rendered inoperative by scale or clinker as plugs having a smaller orifice. A suitable orifice is ½ inch to ⅝ inch and the hole should taper to allow free release of the fusible metal.

CAUSES FOR PLUGS LEAKING

Fusible plugs sometimes give trouble from leaking especially those in locomotive boilers. This is due to plugs becoming uncovered when negotiating gradients, improper filling, incorrect mixture of fusible alloy; and wasting from action of fire or water.

The plugs used by railway companies are ordinary screwed plugs with screwed or slotted recess for the alloy as shown in Figs. 1 and 2. In some cases the plug body is heated before filling to allow it to cool as the fusible metal cools but this method does not allow for shrinkage of the alloy. Another method is to fill the plug while it is cold, afterwards heating the whole, adding more metal to make up for shrinkage. The interior of the plug is previously tinned to allow of a good joint between the alloy and the gunmetal body. After the plug is cold the alloy is compressed by punching on the fire side. Locomotive firebox plugs are usually tapered which allows the person fitting them some latitude as to how far they are screwed into the crown. The valve seated plug is better in this respect and allows the correct amount of fusible metal to project into the waterspace without it being left to guesswork. Also the head of the valve seated plug is more protected from the abrasive action of the solids carried with the gases owing to its close contact with the crown. Fig. 3 shows a valve seated plug for locomotive boilers.

REQUIREMENTS FOR SATISFACTORY PLUGS

Ordinary screwed plugs are not in favor for stationary boilers and various types of fusible plugs have been designed to meet the requirements of stationary boiler engineers. The points governing the design of these plugs are: (1) to protect the fusible metal from the action of the fire; (2) to protect the fusible metal from the action of the feedwater; (3) to enable the fusible metal to be changed without removing the plug body; (4) to prevent the plug body from wearing quickly and (5) to ensure reliable action in case of shortness of water. Several plugs embodying some if not all of these principles are on the market. Fig. 4 shows a type of plug designed to enable the fusible metal to be changed without removing the body. The lead is not protected from the action of the gases or water and the cavity *a* on the sketch forms a lodge for scale and sediment.

Fig. 5 shows a plug the fusible metal of which is protected from the water by a cap *a* which falls when the fusing point of the lead is reached. It is only necessary to renew the cap of this plug, the body remaining in the crown. The plug shown in Fig. 6 is designed to protect the alloy from water and gases. Its design is somewhat complicated and it has the disadvantage of cavity *a* similar to the plug shown in Fig. 4.

Fig. 7 shows a fusible plug with a flanged stalk which effectively prevents the gases from coming in contact with the fusible metal and allows ample clearance for the flange to fall should the plug fail from shortness of water.

The National Boiler and General Insurance Company have designed a fusible plug which has been successfully used in many countries and which is shown in Fig. 8. The fusible metal is protected both from the action of the feedwater and fire. Ample clearance is provided for the inner cone and fusible metal to fall in case of failure and the cap can be renewed when required without removing the body of the plug. It will be noticed that the inner cone is hollow which assists the action of the plug by allowing the whole of the fusible metal to be melted in case of shortness of water. The plugs are filled by a special process and one of each batch is tested in a specially constructed furnace to ensure that the metal will fuse at the correct temperature and pressure. The body of the plugs are usually made of gunmetal but where the water is alkaline, iron bodies are specified. The stated life of the body is ten years and it is desired that the cone shall be refilled at one to two yearly intervals.

The same company has plugs to screw into the crown from the fire side for locomotive and other boilers. These are made on the same lines with the renewable cone and the fusible metal protected. They are, no doubt, the result of long experience in boiler work and appear to meet all the requirements of the boiler engineer without complications.

LOW WATER CAUSE OF MANY EXPLOSIONS

Quite a large number of boiler explosions can be traced to shortness of water and it is the writer's opinion that fusible plugs should be fitted to all steam boilers with the exception of certain types of watertube boilers. The small comparative additional cost is justified by immunity from disastrous explosion as a well designed plug will give the engineer ample time to take the necessary steps to prevent damage.

The writer has inspected many boilers after fusible plug failures and in the majority of cases found little damage has been done to the boiler structure.

Increasing Locomotive Productivity

The steam locomotive of the present day represents such a vast improvement over, and such a striking contrast to the locomotive of even so recent a time as 15 years ago, that the question arises daily as to what the next step in mechanical development may be. Heretofore unknown traffic demands have stimulated the efforts of locomotive designers and builders and much credit is due them for having developed a machine capable of the remarkable possibilities of some of the present types. But, while striving at all times to develop new types and to increase the efficiency of existing ones, mechanical men should not fail to consider the answer to this question, "Are we getting out of this machine all that it is capable of producing?" Any method by which the service hours and mileage of a locomotive can be increased is a means of increasing its productivity and one way of doing this is by carrying out repairs conscientiously.

Rock Island Tests New Boiler Water Chemical

WITHIN the last few weeks the Chicago, Rock Island & Pacific concluded a series of experiments in the treatment of water with sodium aluminate, a chemical which has not been available in the free state but which is now being obtained in large quantities as the chief constituent of a solution formed as an intermediate product in the production of aluminum. Its composition is as follows:

Water	61.75 percent
Sodium Aluminate	18.14 "
Caustic Soda	8.02 "
Soda Ash	10.00 "
Sodium Chloride	0.34 "
Silica	0.02 "
Organic Matter	0.73 "

In the tests made on the Rock Island, the chemical was used both as a boiler compound and in water treating plants.

The troubles with water treatment or treated water which led the Rock Island to investigate the new chemical are principally of two classes. On one hand, the lime and soda ash treatment at some points has been found to give only partial softening of the water unless resort is had to the use of an excess amount of chemical which is considered objectionable, and occasionally even excess treatment proves ineffective. Under such conditions considerable scale forming material remains in the water when it reaches the boiler where it settles on the flues or promotes foaming. Again, considerable trouble is regularly experienced in producing a treated water that is clear of all suspended matter when it leaves the treating plant, notwithstanding the use at the most troublesome points of alum or iron sulphate solutions as coagulants to aid in the clarifying process. The result of this is to prolong the time which the treated water must be retained in the settling tanks, thus limiting the capacity of the plant, and also causing considerable highly objectionable incrustation of pipe lines, locomotive branch pipes, boiler checks, etc. Also, where efforts at improving the water are confined to the use of boiler compounds, considerable trouble is encountered on occasions from foaming, as a result of the excessive concentration of mineral salts in the boiler.

The sodium aluminate solution is claimed to be more effective than alum and iron sulphate as a clarifying agent. This substance is also alkaline instead of acid in character, which makes it less likely to promote a corrosive water than some water treating chemicals are suspected of doing. It is also claimed that the substance, aside from being a clarifying agent, actually has softening properties and that less foaming will result where this is used as a boiler compound than where soda ash alone is used.

Boiler Compound Tests

Two locomotives were used in testing out the solution as a boiler compound one a switch engine working in the yard at Silvis, Ill., the other a transfer engine working between Silvis and Davenport, Iowa. The tests were started in November, 1923, and continued until January 5, 1924. The solution was introduced in the boiler by syphoning through the injector, 1¼ gallons being introduced in the boiler of the switch engine each 24 hours and 1⅝ gallons in the boiler of the transfer engine each 24 hours. Previous to the tests the switch engine had run 5,256 miles since the last shopping and the transfer engine 15,330 miles. In both cases there was an average of ⅛-inch of scale on the tubes and crown sheets with large areas of scale in places as thick as ½-inch. During the tests the switch engine ran 4,734 miles and the transfer engine 3,110 miles. While the engines were not entirely free from scale at the end of the tests, the solution had a marked effect in removing the old scale and in keeping new scale from forming. While the precipitate formed was of a flocculent nature and in spite of a large accumulation of this precipitate in the boiler at times, only one work sheet showed a record of foaming.

These observations led to the recommendation that the new substance be used as a compound, but only in stationary boilers since it is considered objectionable on the Rock Island to apply compound to locomotive boilers through the injectors. The opinion was expressed, moreover, that when beginning the use of sodium aluminate solution in a badly incrusted boiler, the amount of soda ash and caustic soda in the solution should be increased, also that with very bad water such an excess of soda ash and caustic soda might better be carried regularly.

Various Tests Conducted at Treating Plants

The first experiments with the new chemical in roadside water treating were carried out at Burr Oak, Ill., where the Rock Island has a continuous type treating plant. The first tests covered a period from November 20, 1923, to December 10, when the hardness of the untreated water ranged from 25 grains per gal. to 29 grains, with a range in sulphate hardness from 14 to 18 grains. The tests were made by using the lime and soda ash in the regular way and then introducing the sodium aluminate solution in a manner similar to that in which alum or iron sulphate is introduced. During these tests the water was observed to clear more quickly than where the lime and soda ash was used alone, but the improvement in softening anticipated by the results of laboratory tests did not take place, the treated water continuing to show about 7 grains hardness, 8 grains alkalinity and 10 grains causticity as before.

The decision was then made to try out the chemical at Herington, Kan., where the Rock Island has an intermittent plant, the thought being that a better control of operations would be obtained here than with the continuous system at Burr Oak. The untreated water on the first day was 28 grains hard with 20.8 grains alkalinity. In the first test, lime at the rate of 3.33 pounds per thousand gallons and soda ash at the rate of 1.39 pound per thousand gallons were added and the solution agitated 45 minutes, and then allowed to settle for 2½ hours, whereupon a treated water was obtained with 8.5 grains hardness, 10.2 grains alkalinity and 13 grains causticity. Sodium aluminate was then added to the amount of 1 pound per 1,000 gallons, with the result that the water was reduced to 4.9 grains hardness, 7 grains alkalinity and 3.6 grains causticity.

A second test made under similar conditions except for the use of only 0.84 pound of sodium aluminate per 1,000 gallons produced like results. On the following day both tubs were first treated by using 3.33 pounds of lime per 1,000 gallons and 1.11 grains of soda ash, but without sodium aluminate. After three hours' settling the water in one tank was found to be only 5 grains hard with 8 grains of alkalinity and 11.6 grains causticity, which was almost as good as the water treated on the previous day with sodium aluminate. This water settled three hours before treatment, however, and the water in the second tub was no better than was obtained with lime and soda ash treatment on the previous day. A second test on this tub, moreover, using 3.055 pounds of lime per 1,000 gallons and 0.833 pounds soda ash, produced a similar water which, when treated with 0.84 pounds per 1,000 gallons of sodium aluminate, was reduced to 4.5 grains hardness, 7.4 grains alkalinity and 10.4 grains of causticity, practically that obtained by sodium aluminate treatment on the preceding day.

The treatment on the third day, by a similar method, did not produce as good a water but in all cases showed a substantial reduction in the hardness over that with lime alone without excess alkalinity. Similar results were produced on the fifth and last day. In all cases, the water was observed to clear more quickly than where lime and soda ash was used alone, the time required for settling being reduced more than one hour in some cases. Added interest was taken in these observations when subsequent tests made in the laboratory indicated that even better results in clarifying could be obtained with equally low alkalinity by replacing the soda ash in part by the sodum aluminate and introducing the required amount of lime, soda ash and sodium aluminate at one time, which, from the nature of the new chemical, can be done without additional equipment.

With the experience gained in the use of the new chemical a second series was ultimately carried out at Burr Oak, beginning February 28, 1924, and running until April 22. In this case the aluminate was mixed with the lime and soda ash and all three chemicals introduced into the untreated water at the same time. Unfortunately, this was a period when an erratic condition of untreated water prevailed, the hardness falling from 21 grains at the commencement of the test to 8.3 grains. As a result, the tests were not altogether satisfactory. It was observed, however, that treated water with a hardness as low as 2 and 3 grains was obtained in some tests. This is shown in the accompanying partial table of analyses for consecutive days.

COMPARATIVE WATER ANALYSES

Raw water hardness	Treated water: Hardness	Treated water: Alkalinity	Treated water: Causticity
18.9	3.2	5.4	7.3
10.8	3.7	4.2	7.4
10.5	2.9	3.7	4.0
10.0	2.8	3.6	4.3
11.2	3.0	3.7	4.7
14.1	3.2	3.7	4.5
16.1	4.5	4.2	5.5
17.8	6.1	5.5	6.7
18.8	7.5	7.7	9.8
16.9	6.7	8.9	11.5
16.0	5.8	6.5	8.0

These were exceptional results from Burr Oak water. Excellent results were also obtained in clarification. The water settled readily and in some cases no after-precipitation was observed after boiling. The temperature of the water when treated averaged 40 degrees F.

ADDITIONAL TESTS MADE

At the same time that these treating plant experiments were being carried out at Burr Oak several tests were made to determine, if possible, the action of the water treated with aluminate of soda in actual practice as compared with that treated with iron sulphate. These tests were made on a switch engine by taking samples after the engine had completed one or two runs. While a different engine was used in the tests of the water treated with lime, soda ash and aluminate of soda than in that treated with lime, soda ash and iron sulphate, and while the latter tests were made a week later than the former, the results were considered significant.

They are reproduced in condensed form as follows:

ANALYSES OF BOILER WATERS

	With aluminate		With iron	
	Beginning	16 Hours	Beginning	16 Hours
Hardness	2.60	2.90	5.50	0.50
Alkali Sulphate	7.45	62.42	23.79	85.01
Total alkali	10.23	78.72	26.11	100.65
Total solids	12.85	81.62	30.61	101.15
Suspended matter	1.98	1.98	5.48	24.60

As the tests indicate, a much lower concentration of the alkali sulphate was found in the water treated with aluminate soda than in that treated with iron sulphate, as well as less matter in suspension.

CONCLUSIONS

The conclusions drawn from these experiments and included in the report of P. M. La Bach, engineer water service and T. D. Sedwick, engineer tests, are abstracted as follows:

Sodium aluminate solution is recommended for use in treating raw water in treating plants in conjunction with lime and soda ash, the soda ash being substituted in part for the sodium aluminate, the aluminate taking the place of alum or copperas at points where these chemicals are now used. The advantages gained by the use of sodium aluminate solution are: (1) increased plant capacity or output due to more rapid clarification or settling; (2) less total hardness without the necessity of carrying excess alkalinity and causticity which should, in turn, result in reduced trouble from foaming; (3) the avoidance of the increase of alkali sulphates in treated water resulting from the use of either alum or copperas; (4) the elimination or material reduction in the amount of after-precipitation which will result in (a) reduced trouble of pipe lines, heaters, branch pipes and injectors becoming clogged; (b) a material reduction in foaming troubles; (c) a decided reduction in the number of boiler washings.

The possible necessity of preliminary heating of the sodium aluminate solution by steam or some other agency preliminary to its use in cold weather was taken into consideration but the thought was expressed that this present drawback to the use of the solution can be avoided by improved methods of manufacture.

Locomotive Washing Sheds

ONE of the important operations at engine terminals is the washing, or cleaning, of the locomotives, made necessary for the sake of appearances and to facilitate the inspection and repair of moving parts. Whatever the method of cleaning employed, difficulty is at once encountered in northern parts of the country with the advent of winter weather. Locomotives come to the terminal covered with snow and ice and when steam is used in the cleaning operation additional ice forms. Locomotives must then be taken into the house and thawed out before the inspectors can locate defects or the enginehouse men make necessary repairs. To prevent this delay as well as to provide better working conditions for the enginewashing crew a few of the northern roads have constructed light and relatively inexpensive washing sheds or houses, equipped with steam heat and locomotive washing facilities, and located at some point on the incoming tracks, usually between the ash pit and the enginehouse. During the summer, the end doors are kept open and the washing shed merely serves as a protection against rain, but with the arrival of severe winter weather the doors are closed and the temperature inside the shed raised to such a point that ice will melt rapidly under the washing operation, enabling locomotives to be cleaned quickly and made ready for inspection and repair. In the construction of locomotive washing sheds one of the features sometimes overlooked is the provision of an adequate drainage system so that water and oil from the locomotives can flow unobstructed to the sewer, leaving the floor of the shed as dry and clean as possible.

WASHING SHEDS IN SUMMER

During summer operation of one of these washing sheds, locomotives were observed to go through the shed at ten and fifteen minute intervals and when asked if this was a sufficient length of time for thorough washing, the enginehouse foreman said, "Not when locomotives are very dirty, but we never let ours get in that condition." By giving locomotives a little attention each time they come to the enginehouse they can be kept clean at less cost and no doubt with less total delay to power than when cleaning is done spasmodically. There are relatively few locomotive washing sheds on American railroads at the present time but if the results accomplished with those already in operation are any criterion the more general consideration of this type of enginehouse facility is justified. Now is the time to prepare for next winter.

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, C. W. Obert, 29 West 39th Street, 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.

Below are given interpretations of the Committee in Cases Nos. 441, and 443 to 445, inclusive, as formulated at the meeting of May 27, 1924, all having been approved by the Council. In accordance with established practice, names of inquirers have been omitted.

CASE No. 441.—*Inquiry:* An interpretation is requested of the application of the rules of the A.S.M.E. Boiler Code to the computation of the strength of a flattened drum formed of two sections with riveted joints at their butting edges, one section comprising a semi-cylinder and the other a curved surface of long radius with flanged edges.

Reply: It is the opinion of the Committee that if the stress of the proposed drum is computed, neglecting the holding power of the tubes, it will be found to be extremely weak. The holding power of the tubes strengthens the drum, but there is no exact way of computing how much the tubes will assist in strengthening the drum. There are three alternatives which may be followed:

1. The simplest way would be to use a circular drum the stress in which can be readily computed.

2. Stays could be run between the two sheets forming the drum, the stays being proportioned so as to stay the sheets as flat surfaces.

3. A full-size section with tubes attached could be tested hydrostatically in accordance with Par. 247 of the Code. Should such a test be made the hydrostatic pressure should be applied and released at successively increasing pressures to induce a breathing action. The lowest pressure that will cause the breathing action to produce a permanent set of a magnitude to indicate that the metal has been stressed beyond the yield point, should be determined. Should such tests be made the Boiler Code Committee will be pleased to appoint a representative to witness the same and will specify the maximum allowable working pressure on the basis thereof.

CASE No. 443.—*Inquiry: a* An interpretation is requested of Par. H-51 of the Heating Boiler Section of the A.S.M.E. Boiler Code, in its application to the capacity requirement for water-relief valves. Was it not the intent of the second sentence, in specifying the set pressure of 15 pounds per square inch, to refer to safety valves for use on steam-heating boilers, so that by inference it will be permissible to rate water-relief valves at 33⅓ percent above the set relieving pressure, whatever that may be, up to 160 pounds per square inch allowed for hot-water boilers by Par. H-3?

b Also, information is requested as to the method of application of the three right-hand columns in Table H-7 to water-relief valves. Is it understood that the rated capacities in gallons per hour apply to the heating capacities of the boilers and not to the discharge capacities of the water-relief valves?

Reply: a It is the opinion of the Committee that in referring, in the second sentence, to the set relieving pressure of 15 pounds per square inch, it was the intent that this set pressure should refer to safety valves for use on steam-heating boilers only. For water-relief valves the capacity requirements of Tables H-7 and H-11 are applicable for set pressures not exceeding 160 pounds per square inch.

b The values in the three right-hand columns of Tables H-7 and H-11 pertain to the heating capacities of different sizes of hot-water heating or hot-water supply boilers and do not apply to the discharge capacities of relief valves. It is the opinion of the Committee that if relief valves of the sizes indicated in Table H-7 and H-11 are applied to hot-water heating boilers or hot water supply boilers of the various capacities therein tabulated, safe operating conditions will be obtained provided the relief valves meet the requirements of the Code.

CASE No. 444.—*Inquiry:* In the flanging of stayed heads for boilers, is it the intent of the Boiler Code that the same specifications for the corner radius of the flange shall be applicable as are found in Par. 194 relative to the construction of domes?

Reply: There is no rule in the Boiler Code which applies specifically to the corner radius of the flange of flat or stayed heads.

CASE No. 445.—*Inquiry:* In the construction of a vertical water-leg type of low-pressure boiler, with furnace extending the full height of the shell and the upper part of which furnace is filled with pipe coils for the heating surface, what formula is applicable for the calculation of the thickness of the inside or furnace sheet of the water leg, and is it necessary that the inside shell be staybolted when it is 40 inches or over in inside diameter?

Reply: There is nothing in the Low-Pressure Heating-Boiler Section of the Code to cover the calculation of the furnace sheet of this type of boiler. It is the opinion of the Committee, however, that if the rule in the Power Boiler Section of the Code for Adamson-type furnaces (Par. 242) be applied to this construction, using 30 pounds per square inch as the maximum allowable working pressure, safe construction will be obtained. If the length of the furnace sheet of the water leg does not exceed 6 diameters, between the supporting girth joints at opposite ends, it is the opinion of the Committee that staybolting will not be required for low-pressure heating boilers.

Annual Safety Congress to Be Held in Louisville

WHAT has happened in safety during the past year will be the keynote of the thirteenth annual Safety Congress of the National Safety Council which meets in Louisville, September 29 to October 3.

The story of progress related by speakers of national and international prominence, will be shown vividly by exhibits, motion picture films and lantern slides and will be demonstrated in the daily sectional sessions and general sessions of the greatest safety congress in history. More than 4,000 industrial plants, and community safety councils in 60 American cities, members of the National Safety Council, will be represented at the congress. Indicative of increased safety activities and safety interest by industries is the increase in the membership of the National Safety Council. The membership is now the largest since the council was founded 12 years ago.

It is planned to have Secretary of Commerce Herbert Hoover and Secretary of Labor James J. Davis speak at the congress.

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

THIS is the fifth instalment of a series of questions on both mechanical and boiler subjects which are liable to occur in state or federal examination papers for boiler inspectors. The earlier instalments appeared on page 105 of the April issue, page 139 of the May issue, page 180 of the June issue and page 208 of the July issue of THE BOILER MAKER. *The material should prove of benefit to all those who contemplate taking the examinations. The author would like to have those interested in the subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.*

103—Q. What is meant by internal corrosion in a boiler?

A. Internal corrosion is the eating away or wasting of the plates due to the chemical action of impure water.

104—Q. What is meant by priming in a boiler?

A. Priming is the lifting of water in a body.

105—Q. What should be done when the boiler foams?

A. The cylinder cocks should be opened and the throttle valve closed slowly to prevent the water from dropping below the crown sheet.

106—Q. How should the interior of a locomotive boiler be inspected?

A. The entire surface of the boiler must be examined for cracks, pitting and grooving, or indications of over-heating and for damage where mud has collected or heavy scale formed. The edges of plates, laps, seams, and points where cracks are likely to develop must be given careful inspection. All braces and stays should be carefully examined for defects, and that all pins are properly secured in place, and that each brace and stay are taut and supporting its proportion of the load.

107—Q. What is the source of power in a locomotive boiler?

A. Heat is the source of power in a locomotive boiler.

108—Q. How should patches be applied to the barrel of a boiler?

A. Patches should be riveted in place on the barrel of a boiler.

109—Q. What parts of a locomotive boiler may be welded by autogenous welding?

A. Autogenous welding is permitted only on stayed portions of boilers, autogenous welding is not permitted on any part of a boiler that is wholly in tension under working conditions.

110—Q. What will cause a locomotive boiler to explode?

A. A locomotive boiler explosion can be caused only by over-pressure of steam. Either the boiler is not strong enough to carry its ordinary pressure or for some reason the pressure has been allowed to rise above the usual point.

111—Q. What kind of metal should be used for the filling in a fusible plug?

A. Banca tin makes the best filling for a fusible plug.

112—Q. In what way is the heat transferred from the fuel to the water in the boiler?

A. Heat is transferred from the fuel to the water by radiation, convection and conduction.

113—Q. Trace the steam from the boiler through the cylinders to the atmosphere.

A. Steam enters the throttle box then passes through the stand pipe and dry pipe out of the boiler to the tee head, then through the steam pipes to the steam chests. A steam valve in each steam chest admits steam to the cylinders, after the steam forces the piston to a point near the end of its stroke, the steam valve opens communication to the exhaust port through the exhaust cavity in the valve, the steam then passes through the exhaust pipe and nozzles through the stack to the atmosphere.

114—Q. What is saturated steam?

A. That with just enough heat to keep it from condensing

115—Q. Describe the construction and location of the superheater and connections.

A. A superheater consists of a system of units located in large flues through which the steam passes on its way from the dry pipe to the steam pipes and a damper which controls the flow of gases through the large tubes. The header is a casting divided by partition walls into saturated and superheated passages. It is located between the dry pipe and the steam pipes. The dry pipe is in communication with the saturated steam passages and the steam pipes with the superheated steam passages and these are in communication with each other through the superheated units.

The units are composed of four seamless steel pipes, connected by three return bends. Of the four pipes, two are straight and two are bent upward and connected to the header by means of a clamp and bolt. One end of the unit is in communication with the saturated steam passages and the other with the superheated steam passages in the header castings.

116—Q. What is steam and how is it generated?

A. Steam is water in the condition of a vapor and is generated by heating the water above the boiling point.

117—Q. What is the advantage of superheating?

A. Carrying more heat to the cylinders to do mechanical work.

118—Q. What does the black hand on each of the air gages indicate.

A. The black hand on the large gage indicates the equalizing reservoir pressure; on the small gage, brake pipe pressure.

119—Q. What must the air pass through in flowing from the main reservoir to the brake pipe?

A. Through the automatic brake valve.

120—Q. What are the different positions of the brake valve?

A. Full release, running, lap, service and emergency positions. The brake valve used with the E. T. or L. T. equipment has still another position known as holding position.

121—Q. How is the automatic brake applied? How released?

A. The automatic brake is applied by a reduction of brake pipe pressure, and is released by restoring the brake pipe pressure.

122—Q. On what is the E. T. or L. T. air brake equipment designed to operate?

A. On engine and tender.

123—Q. What are some of the advantages of the E. T. or L. T. equipment?

A. May be used on engines in any class of service, brake cylinder pressure not affected by piston travel or brake cylinder leakage, locomotive brake may be applied or released, independent of the train brake, brake on second engine may be applied or released independent of the brakes on the leading engine.

124—Q. At what temperature is superheated steam worked in locomotive cylinders?

A. At about 650 degrees F.

(To be continued)

*Locomotive Inspector, New York State Transit Commission.

Cold Flanging of Locomotive Boiler Sheets

Pneumatic Flanging Machine Developed to Speed Up Sheet Metal Production

FOR several years past a unique pneumatic cold flanging machine has been shown and demonstrated at the conventions of the Master Boilermakers' Association and at meetings of other railroad mechanical bodies. Practically every modern locomotive repair shop has been equipped with one or more of these machines which are made by the McCabe Manufacturing Company of Lawrence, Mass., and yet the possibilities of the flanger are not generally understood. Below is given an outline of the work of the machine with illustrations of flanging jobs accomplished rapidly and accurately.

The pneumatic flanging machine was originally developed for use in the shops of the McCabe Company, which was engaged in general boiler and sheet metal work. Although modifications and changes have been made in the machine since its early design, the principle of operation remains unchanged. With its wide application throughout the country new uses have been found for it, but the basic idea of flanging sheet metal by bending with power over dies which can be readily changed or arranged to include jobs of many shapes and sizes, is still present in the latest type of machine.

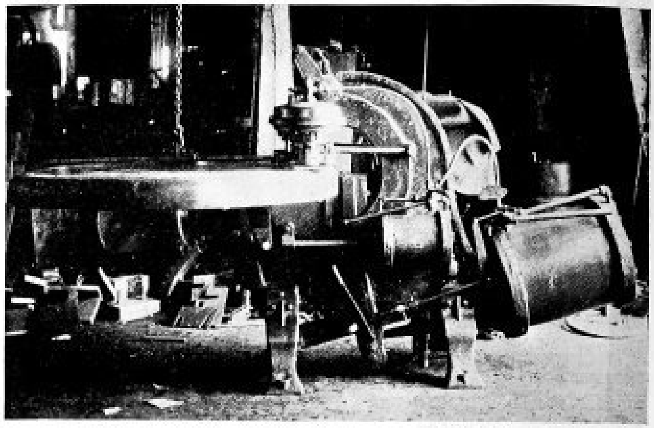
Improvements Made from Time to Time

Improvements in the design have included the change from a cast iron housing for the working parts to one of cast steel. A larger pressure cylinder is now used to provide ample power to handle heavy sheet metal. Power holding clamps have also been adopted for more rapid operation and to lighten the labor of the operator. Because of the character of the work performed on the McCabe machine, it has been deemed advisable to deal with this subject by presenting actual examples of jobs with descriptions of the operations in their order. The examples selected have been chosen because of their adaptability to working on the pneumatic flanger and because the saving in time on such jobs was the greatest. In these examples a complete range of required flanging in a locomotive shop is covered, including straight flanging, continuous round head flanging and square corner flanging. There are many combinations of these three general classes, but in all such, the basic principle is the bending of sheet metal to a shape which is round or square or irregular, comprising both straight and round formations.

Typical Examples of Flanging

In the case of a firebox tube sheet, flanging may be done in three operations. First, there is the straight flanging of the sides, then the flanging of the sweeping curved top, and finally, the flanging of the two corners which connect the top flange with each side. To complete this job the dies in the machine are changed three times. This changing of dies may appear to be a complicated operation, but actually it may be done in a few seconds' time, for the dies are light, weighing only a few pounds apiece and are held in place by one pin or bolt.

In flanging round heads, such as front tube sheets, a job common to all metal working shops, it is not necessary to change dies, as the finished job represents a continuous circle. A variety of flanged heads worked on the machine are shown in the accompanying illustration.



Pneumatic Flanging Machine

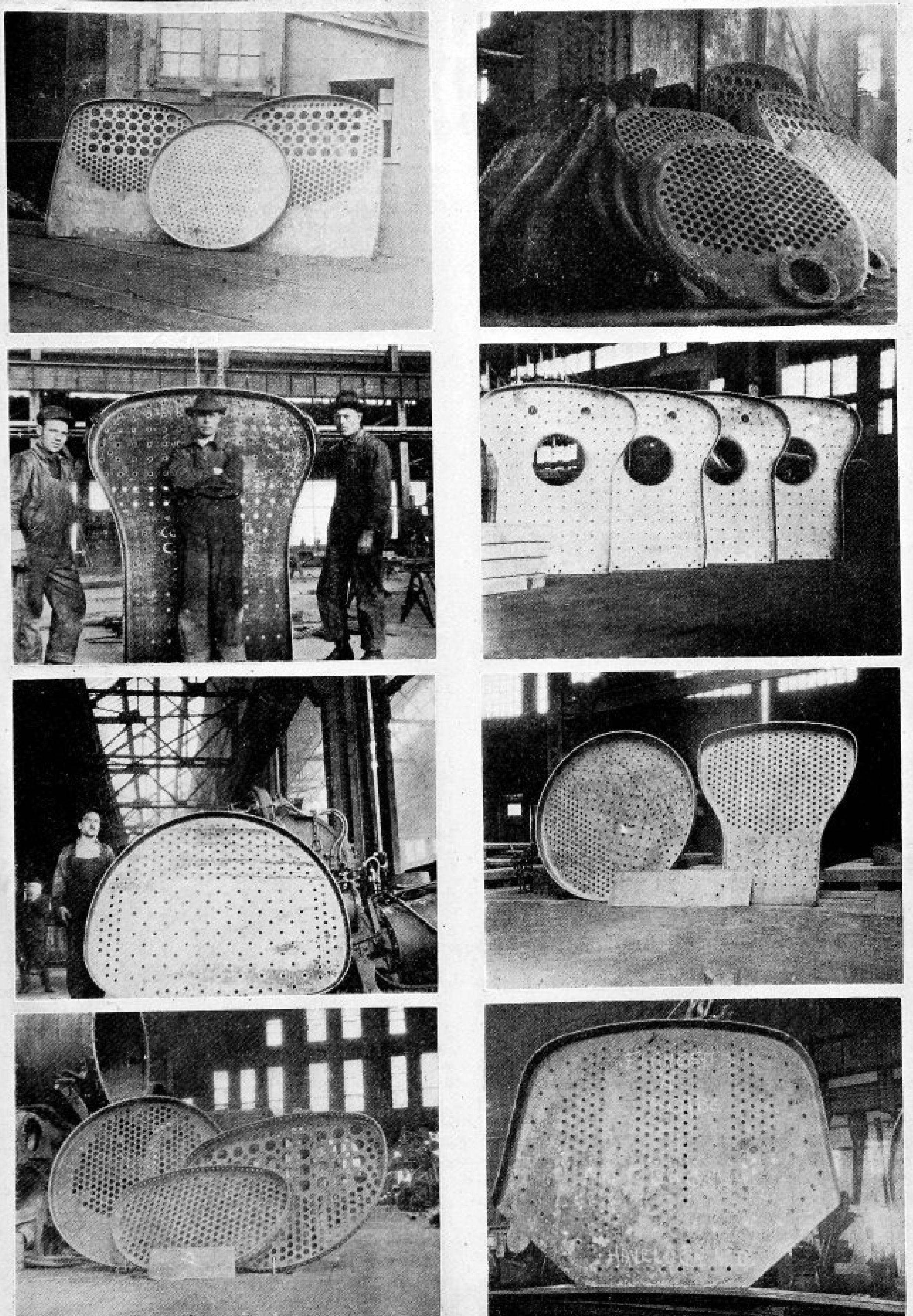
In general, set rules to govern the handling of flanging work are not practicable for the reason that no such rules can be made complete enough to cover more than a few cases arising in general practice. In view of the variety of methods and principles that may be used to obtain a given result, the application must necessarily become a matter of choosing the best one for each purpose, and in this selection is shown the individuality and versatility of each worker, since no two men working independently arrive at a given result in exactly the same way. Two outstanding features of flanging parts with the pneumatic flanging machine are that the peculiar bending action of the metal at the point of being flanged permits such bending without preheating the sheet and that a powerful bending action is applied to the sheet without distorting the metal or causing any fracture to be started. With this in view it may be claimed that with the machine it is both possible and practical to originate certain and specific rules to follow when flanging the more common jobs found in the average shop.

Operation of the Machine

With the machine the sheet is clamped in position and the bending action of the dies does not place undue strain on the sheet at any given point which would result in a stretch or fracture. Shearing strains are totally absent at the point of the bend. It is claimed that a sheet may be flanged exactly to the required finished size, due to the perfect clamping action of the holding clamps. A sheet may be laid out and run through the machine, or a guiding jig may be used to move the sheet along to complete the entire flange, resulting in a finished job true to shape and size. In round head work, where a true circle is demanded, the guiding feature is preferred and it is quite essential in speeding up the rate of production.

The average run of flanging requirements met with in metal working shops do not require a large number of forming dies. It might be stated with due justice to this equipment that a range of 12 dies will handle all required flanging. A straight face die will of course come into more general use, for straight flanging represents the bulk of the work. Circular work of many diameters can be handled with one set of bending dies. Corners with sharp angles require special dies, due to the necessity of gathering the metal for forming the corners.

The machine has a capacity of flanging sheet metal cold up to a thickness of ¾ inch. The original machine had a capacity up to ½ inch and this range is ample for many shops today. As the machine is entirely self-contained, power being furnished by the compressed air shop lines of about 100 pounds, it has the exclusive feature of being easily transferred from one department to another or from one shop to another.



Examples of Cold Flanging Boiler Heads

Saving Time in Laying Out Locomotive Boilers

Short Cuts Used in Laying Out Regular and Irregular Cones and Gusset Sheets for Boiler Repair Work

By C. A. Chincholl

As stated in the preceding article on this subject which appeared on page 197 of the July issue of The Boiler Maker, the following section will deal with the laying out of regular and irregular cones. In developing the work short methods unknown to most boiler shops will be followed. The system used has been found much more rapid and accurate for the laying out of regular cones and gusset sheets than triangulation methods.

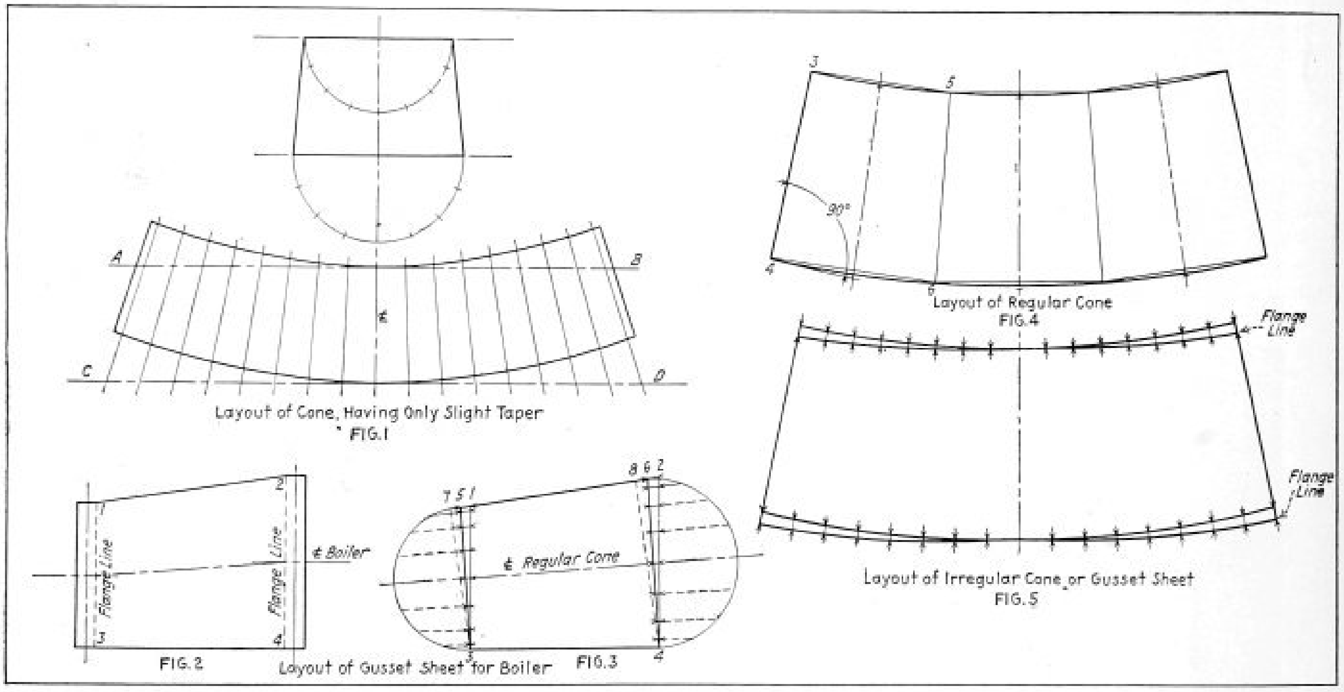
Commencing with a cone having only a slight taper, say 1 inch in every 20 inches of pipe, it is out of the question to begin the laying out by projection or by bringing the tapering side lines to intersect at a point which could be used as a center from which to describe the camber line, in which case the side of the cone, plus the distance to the center, would be the radius. The following method, however, is a simple one and will accomplish the required result with accuracy. The details are given in Fig. 1.

The outline of the cone to be laid out is first drawn, showing the diameters for the top and bottom, as well as the height. Next arcs are described to represent the top and bottom circumferences. These are divided into four parts for each quarter of the circumference. Then lay-out on the sheet to be used for the stretch out, two parallel lines, the distance apart being equal to the height of the cone—see *AB* and *CD* on sketch. On line *AB* set off eight spaces from each side of the center line, obtaining the pitch from the top circumference. On line *CD* set off the same number of spaces, with the pitch obtained from the bottom circumference on the outline of the cone. Connect each space on line *AB* with the points spaced off on line *CD*. Beginning with the center line, square off a line to the next space line, continuing this until each pitch has been covered, both top and bottom, and the camber lines are completed. It is now necessary to step off on the circumference, on the top and bottom, camber lines to obtain the true length of the circumference, using the same pitch as on lines *AB* and *CD*. This completes the layout of a cone having a slight taper, with the exception of laps which must be added where rivets are to be used.

Lay-Out of the Gusset Sheet

The next problem in this article is the laying out of the gusset sheet of the boilers. This lay-out is generally dreaded by boilermakers, one reason being that the sheet is seldom replaced in the boiler and there is therefore little chance to gain experience on this particular job. When it is necessary to renew one of these sheets, it is nearly always laid out by the triangulation method, which requires a great many lines, and the stepping off of many spaces to accomplish very little towards the complete lay-out. In the method here followed we will take the gusset as it appears in Fig. 2, rolled up and flanged, ready for the boiler. Starting with the outline 1, 2, 3 and 4, which forms an irregular cone, the first step is to change this to a regular cone, as in Fig. 3. By squaring a line to intersect points 3 and 4 from points 7 and 8 on the sloping lines, divide the space between 7 and 1 at the front of the sheet and the space between 8 and 2 at the back of the sheet into two equal spaces, numbered 5 and 6 in Fig. 3. Draw a line from 5 to 3 at the front, and 6 to 4 at the back and we have a regular cone, 5, 6, 3 and 4.

At each end of the regular cone describe an arc which represents one-half of the circumference on the front and back ends of the cone. Divide the semi-circumference line into eight spaces. Project lines from each of these points of division to intersect diameter lines of the regular cone 5-3 at the front, and 6-4 at the back. Also intersect the



Details of Cone and Gusset Sheet Development diameter lines of the irregular cone 1-3 at the front, and 2-4 at the back. This gives us the differences in the camber line of the regular and irregular cones shown in Fig. 3 between the arrow heads.

To begin the lay-out on the sheet, set down the outline of the three regular cones, adjoining each other as in Fig. 4. Square a line from the side line of the cone to the center line as shown, and indicated by 90 deg. in the sketch. One-half of the distance between the lines squared and the diameter line of the cone equals the pitch to be set out at each center line of the cones to obtain the points of camber to the back end of the gusset. Repeat the same operation at the opposite ends of the cones, only set the distances in from the diameter lines, instead of out to the back end. Connect these points by drawing a line, using a bent stick. This will complete the camber lines and give us the lay-out of the regular cone. However, since the object in view is the laying out of an irregular cone, we must proceed further. On the camber lines, front and back of the regular cone, space off eight sections on each side of the center line of the lay-out, taking the pitch from the circumference line, Fig. 3.

Beginning with the front end of the gusset sheet which is shown as the small end of the cone in Fig. 3, we will start changing the camber line of a regular cone into the camber line for an irregular cone on the stretch out. At the center line obtain the distance between the arrow heads from Fig. 3. Set in this distance at the first pitch on each side of the center line, Fig. 5. Get the distance at the second pitch, Fig. 3, and transfer to the second pitch from each side of the center line in Fig. 5. You will notice that each space increases as we proceed. Continue transferring the distances between the arrow heads from Fig. 3 to the stretch out, Fig. 5, until you have arrived at the eighth division.

The back end of the cone is changed in the same manner, only the distance each time is set out from the camber line instead of in, as at the front end. When you have completed the camber for the irregular cone of the gusset sheet you will observe that it appears as lines marked "flange line," Fig. 5. These lines cannot be used as rivet lines, but additional material must be added to provide at least two inches between the flange line and the rivet line. Add to this an amount desirable for lap, the size of rivets used governing the lap.

Locomotive Boiler Washing and Tools Used

An Important Subject Discussed at the Annual Convention of the Master Boiler Makers' Association

FROM observation on our own road and information from a number of other sources, it is concluded that boiler washing is conducted along similar lines on quite a number of railroads, and that the requirements of the service, the water conditions and the care of the engine in actual service, tend largely to govern the frequency of boiler washouts and water changes.

Boilers that are properly cooled down and thoroughly washed as frequently as the conditions under which they work require washing, will give longer firebox sheet and flue service and reduce repair bills so appreciably that an extra dollar carefully spent in boiler washing seems to be a good investment and indicates that the practice of setting a maximum time for washing a boiler with a given number of plugs which in so many cases is not sufficient to give all the plug holes the attention they should have, is an uneconomical rather than an economical practice.

As near as I have been able to determine, 20 percent of the engines washed out on the mileage basis, make less than 500 miles between washouts, 25 percent more than 500 and less than 1,000 miles, 15 percent more than 1,000 and less than 1,500 miles, and 40 percent more than 1,500 miles.

Passenger engines make about 30 percent more mileage than freight. Only about 17 percent of the roads in the country make a practice of changing water in boilers.

About 35 percent practice some regular system of blowing out boilers at terminals and about 55 percent are blown out regularly and systematically while on the road, to remove mud or sludge that may have accumulated in the boiler and to prevent foaming.

Washout Holes in Boilers

The number of plugs in locomotive boilers ranges from about 15 to 65, but the average number in our modern boilers is about 32, which I believe, if properly located, is sufficient for all washout purposes.

Cost of Washing Boilers

The answers to this question show a wide variance. Some costs per boiler are shown ridiculously low and others seem to be rather too high, but a fair idea of the difference in the cost between the hot and cold washout systems can be arrived at from the following, based on a boiler 5,000 gallons capacity, 32 plugs, cold water system.

Cost of Washing a Modern Boiler, 100 Pounds Steam, and 4 Inch Water in Glass

Cooling to 90 degrees F., cooling water 57 degrees F., 11,500 gallons	at 10c per M....	$1.15
Time draining and cooling boiler, 2½ hrs.,	at 49c..........	1.22
Removing and replacing 32 plugs, 1½ hours, 2 men,	at 49c..........	1.47
Washing boiler, 2 men, 1½ hours,	at 49c..........	1.47
Water used in washing, 4,000 gallons,	at 10c per M....	.40
Water used in filling boiler, 5,000 gallons	at 10c per M....	.50
Time to refill boiler, 1 man, 40 minutes,	at 49c..........	.33
Laying fire bed, 1,000 pounds coal,	at $4.50 per T...	2.25
Additional fuel to raise 100 pound steam pressure, 1,100 pounds	....	2.47
Time of fire builder, 45 minutes	....	.37
Add 20 percent of time to change tools from engine to engine	....	.82
		$12.45

Hot Water System

Blowing off steam and water for one hour,	at 49c..........	$ .49
Remove and replace plugs, 2 men,	at 49c..........	1.47
Washing boiler, 2 men, 1½ hours,	at 49c..........	1.47
Water used to wash, 4,000 gallons,	at 10c per M....	.40
Water used to fill, 5,000 gallons,	at 10c per M....	.50
Time to fill, 40 minutes, 1 man,	at 49c..........	.33
Lay fire bed, 1,000 pounds coal,	at $4.50 per T...	2.25
Additional fuel to raise 100 pounds steam, 100 pounds	....	.22
Time of fire builder, 30 minutes	....	.24½
Add 20 percent time to change tools from engine to engine	....	.79
		$8.16

A Saving of $4.29

From this it is readily seen that the hot water system has its economical value in washing alone without giving any consideration to the prolonged life of sheets and flues, time saved in turning engines on washout dates, etc., as well as the proportionate saving in water changes.

It might be well at this time to observe that the saving in water and fuel of hot water over the cold water system depends upon how well the hot water plant is operated. Observation has proven the well kept hot water boiler washing plant to be certain economy, while a poorly operated and maintained plant may be conducted at a loss.

The temperature of the washing water should be maintained at not less than 130 degrees, and the filling water as much hotter as it can be obtained without the use of live steam. In order to insure an ample supply of washing and filling water at high temperatures, reservoirs of ample capacity should be provided to conserve heat which may be collected from various sources, other than that blown out by locomotives and which can profitably be applied in heating the washing or filling water for locomotive boilers.

To attempt a description in a paper of this kind of the numerous engine failures, traceable directly to improper boiler washing, would be impossible and to most of the gentlemen present are too well known to need description; so I will pass on to an explanation of the washing system used on our lines, which we have found to be very efficient, fully as good as the best in existence and better by far than some that are being used.

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 have not been considered as washouts, and no objection has been 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.

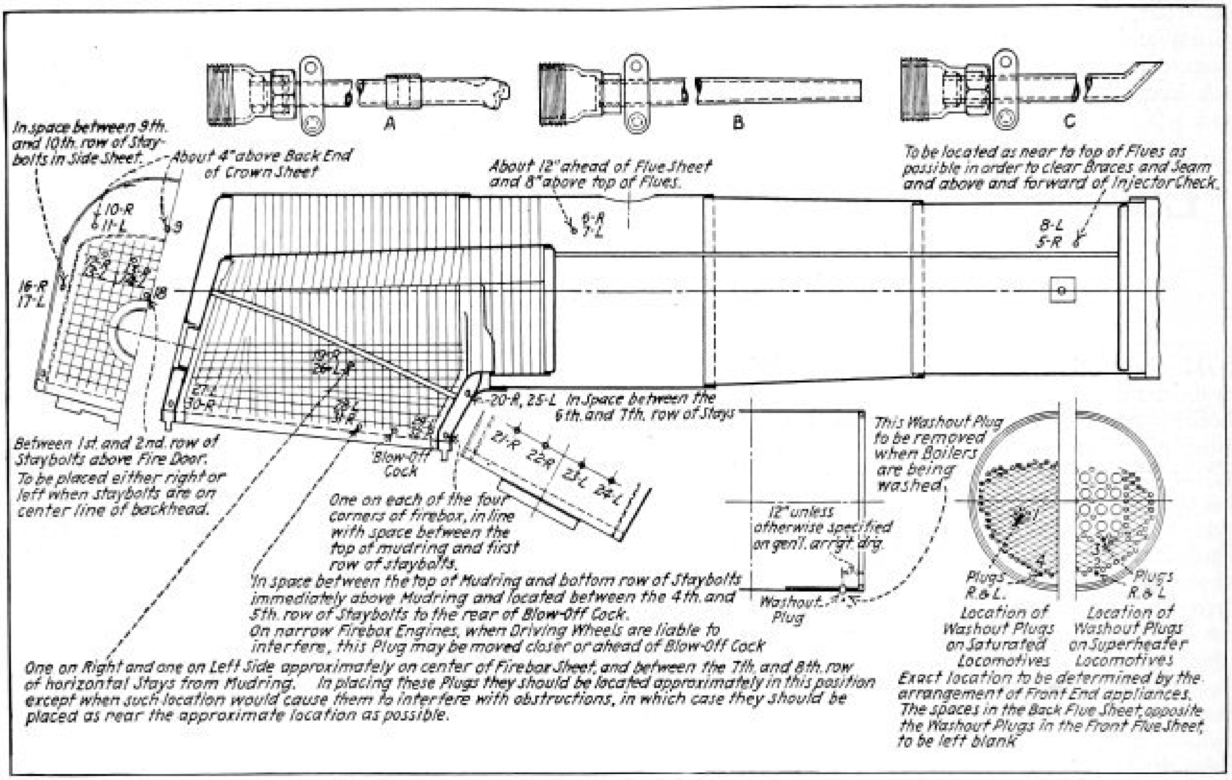
When boilers are washed all washout, arch and water bar plugs must be removed. Special attention must be given the arch and water bar tubes to see that they are free from scale and sediment. It has been claimed that washout plugs are inspection plugs; but all inspection plugs should be considered as 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 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 employe who removed the spindles and cleaned the cocks.

Washout book Form 5020 has been approved 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.



Position of Washout Plugs and Types of Boiler Washing Nozzles

Form 5020

Chicago, Milwaukee & St. Paul Railway Co.

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 Employe 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 depends largely upon the condition under which they are being operated. The performance of the boiler during operation, if it is good, indicates that the washout requirements are being met with, 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, 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:

Use of Injector Cooling Boilers: 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 water full, allowing the remaining steam pressure to blow through syphon cock or some other outlet at top of boiler. Open blow-off cock and allow water to escape, but not faster than it is forced in through the check, so as to keep the boiler completely filled until the temperature of the steel in the firebox is reduced to about 90 degrees, then remove all plugs and allow boiler to empty itself.

Washing Flue Sheets: First wash flue sheet using nozzle C and start at hole No. 5 just over flues and back of front flue sheet. Manipulate this nozzle so as to wash all parts that can be reached through the hole. 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 front flue sheet and push it back to rear flue sheet before turning on water, this in order that sludge will not be forced ahead of the nozzle and on to the warm flue sheet where it is liable to adhere or bake on, making difficult of removal, then work nozzle by means of swivel with rotary motion to the front flue sheet, and with same motion work it to back flue sheet. After reaching back flue sheet hold nozzle against same for a short period, at the same time revolving nozzle, then withdraw nozzle, using a rotary motion in the same manner as used in entering. The nozzle should be worked backward and forward three times, and same procedure followed in opposite top hole No. 3. Then wash lower holes No. 4 and 2 in a similar manner except to 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 center hole above crown sheet No. 9, nozzle should be inserted so as to direct the stream parallel to the crown sheet and turned toward the right so that scale will be washed into water legs and not on flues, working same entire length of crown sheet, nozzle should then be withdrawn and directed toward the left or in the opposite direction to that used in working forward. Same procedure should be followed in holes 10 and 11. Work nozzle forward and backward through each hole once, and turn nozzle upward occasionally so as to wash top of boiler and all radial stays or bolts as well as crown sheet, and a final run made through center opening to insure that no scale is left on 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 back end of arch tube as possible through hole 12, operating same with short forward and backward movement until end of tube is reached and work cleaner back in same manner. Follow same method through holes 13, 14 and 15. After arch tubes are cleaned take nozzle B and wash through arch tube holes 12, 13, 14 and 15, manipulating in such a way as to wash all parts that can be reached through hole. Wash through holes 16 and 17 on corners of back head in same manner. If scale is allowed to form in arch tubes the metal becomes overheated and bulges are formed, and if allowed to remain, tube warps out of line with holes, strains are set up, and cracks develop, and the tubes are very dangerous and 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 strictly comply with the rule. The condition of an arch tube as to scale on the water side can readily be determined 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 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.

With nozzle C wash through hole No. 18 just above fire door on back head, manipulate nozzle in such a way as to wash all parts that can be reached through hole.

Washing Side Sheet Water Spaces: With nozzle C wash through holes in firebox, manipulating nozzle in such a way as to wash all parts that can be reached, through hole. Start with hole 19 on right side of 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 mud ring, one on each side of 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 boiler is cleaned, but all spaces must be examined carefully, inserting torch made by wrapping waste saturated in oil on 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 pilot beam.

To secure best results in washing boilers a pressure of 100 to 120 pounds is desirable.

Location of Washout Plugs

Print D-312 shows location of washout plugs and 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 print D-312. Some locomotives may be found with more plugs than shown on firebox sides, also on barrel of boiler above the front end of the crown sheet on both sides, in which case they can be allowed to remain. However, all washout plugs must be removed at the time the boiler is washed.

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 removed at the time the boiler is washed.

This report was prepared by a committee composed of F. T. Litz, chairman; L. E Hart and H. V. West.

Discussion

H. V. West, El Paso & S. W.: The report covers the subject very well, all I can say is to wash boilers when they need it. Keep them clean at all times, get a thorough washout when possible and thus keep them from clogging.

J. T. Johnston, A. T. & S. Fe: There is just one question I would like to ask whether the washout plug should be applied over the fire door because so many have it 16 inches and it is almost impossible to get the boiler clean at this place.

R. A. Pearson, Can. Pac.: I think the plug should be located between the second and third row of stays, above the door hole because if it is too low the crown bar covers it.

T. F. Powers, C. & N. W.: We found that the location of the plug is a question dependent on the type of engine. On certain types of engines you have to put it up high, above the first and second row of stays.

K. E. Fogerty, C. B. & Q.: A good many roads apply the washout plugs at the first and second, some state it should not go past the third; 16 inches is too far above the door to get the sediment down. It would be my recommendation that it not be placed any higher than the second or third—or between the first and second row of stays if possible.

W. J. Murphy, Penn. System: This boiler washing subject has certainly been covered well by the committee. However, they have not given any location to plugs or nozzles. A lot of us have been washing them for a long time, but there are a number of young members here, and we would be glad to hear how they wash them.

E. P. Fairchild, At. Coast Lines: Under the heading of the washing of arch tubes, the condition of the arch tube as to the scale on the water side can be readily determined by the scale on the outside.

Captain King, Northern Pacific: Boiler washing is one of the most important subjects which could be brought before the convention. The Northern Pacific has been working at this and has gone into it pretty thoroughly on account of the water conditions. When we wash the boilers thoroughly we get out 50 percent of our tubes clean, and sometimes more. We have plenty of washout plugs. We use three different types of nozzles of different lengths. We start washing from the highest point down, washing between every row of tubes. We have long nozzles so as to reach the front end of the crown sheet.

In order to keep scale down in bad water districts we use soda ash. In some of our districts, we wash the boilers every trip and we change the water at each end of the line. At other points it is only necessary to wash them once a month. You cannot wash them too frequently. We pay more attention to boiler washing than we do to anything else.

H. J. Wandberg, C. M. & St. P.: The report tells us what is good practice. No doubt, it is practised on a good many railroads, but we should be big enough to say when we should do it—the report says once a month. It has been said that some are washed every trip. Boiler makers as a rule are good fellows, and sometimes they say, "We washed this engine such and such a time, I think it ought to make another trip." I believe that is a mistake. If we have a day set it is just as important as any other work; the boiler is used more than any other part of the locomotive. If there is anything wrong here the whole mechanism is out of order. I don't think anyone should ever take a chance, I think the boiler maker should be big enough to say when it should be washed.

F. C. Reinhard, A. T. & S. Fe: On our road we pay a great deal of attention to the accumulation in the tubes, and the firebox conditions, we consider the time it requires to wash these out more than the row in front of the washout plug. We have a difficult time keeping the syphon clean from scale. It is almost impossible to wash parts of the syphon. I should like to hear someone tell how this is done.

G. W. Bennett, I. C. C.: Answering Mr. Johnston's question as to the location of the washout plug over the fire door hole; it should be located where required by the inspector, whether it be between the first and second row or the third row of staybolts. The collection of matter is great, and if you don't get it clean you will have a crack. Washing of boilers doesn't amount to anything if you don't have thorough inspection. About pockets in the back flue sheet, I think they should all be removed. Then another important thing to consider in boilers equipped with combustion chambers is to see that they have washout plugs on the sides opposite the combustion chamber so as to keep the mud-ring from touching the combustion chamber and tearing. If you don't have the washout plugs there it will break in no time. Only recently I found a locomotive on one road equipped with combustion chambers and it did not have these washout plugs. It plugged up solid, they had to put washout plugs there and remove a hundred staybolts to get the mud out. One of the sheets was entirely plugged up.

T. W. Lowe, Canadian Pacific: This report tells us about using the injector to help to cool the boiler down. The use of cold water for washing is what I wish to refer to. I have made quite an extensive study to see what was accomplished by the two methods; cleaning it down with the use of the injector after the fire is removed and the opposite way by wasting the steam, and I always found that when I blew the steam off and cleaned the boiler in the regular way by taking the steam I did not have to put the boiler maker in to follow up. If I used the injector I had to put the boiler maker in to go over all my work. Therefore, I do take exception to that one particular point.

There is another point and that is in connection with what Mr. Johnston brought out, regarding the location of the plug over the fire door. In our latest construction we have gotten away entirely from any accumulation forming upon the rivet heads. The face of the sheet extends right out to the back head without any rivets, and we find it is of little importance just where the washout plug is to be located. We have to fit it around the butterfly piece, but that does not concern us so much.

J. F. Finucane, Texas & Louisiana: The method I would recommend in addition to the steam being blown off is that it be brought down to zero before the water is really off. I have recommended this to the superintendent of motive power. We allow all the large boilers to stand two hours before the steam is blown off. Cleaning the boiler down too fast is bad.

When the locomotive is put in the roundhouse we cover the stack until the fire is out.

About six years ago, on the Southern Pacific, it was decided to bring this before the standard committee. I just want to say that on two locomotives I was having trouble with the flues cracking and breaking off. We had two braces on the front flue sheet. I also took up this matter with the committee in regard to the mud under the combustion chamber. We got together and the only way we could eliminate the brace was to make the bottom a complete circle. To get the proper bracing in the inside throat we increased the radius from 8 inches to 24 inches on the center line; it had a 5-inch radius up the side. This eliminated the brace. We now have twenty-five engines of this type on the Atlantic system and from reports I get they are having no trouble getting them clean.

A Top Notcher

Is one who holds his work in high respect.

Is never afraid to share his ideas with other men.

Is never satisfied with anything less than his best effort.

Never considers anything his masterpiece.

Never has time to knock his competitor.

Knows that the best deal is the one in which everyone profits.

The Boiler Maker

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CONTENTS

In order to accurately maintain the records in the office of the A.S.M.E. Boiler Code Committee and to simplify the stamping of code boilers, all manufacturers using the A.S.M.E. stamp are now required to obtain a registration number from the committee and to use this number in conjunction with the symbol. This requirement has been included in paragraph P-332, 1924 revised edition of the Construction Code, at the urgent request of boiler inspectors.

In making provision for this registration in the code, the Boiler Code Committee wishes it to be understood that such registration is not in any way a form of licensing nor is it an attempt to take administrative or legal control of boiler construction. It is intended solely to protect the holders of A.S.M.E. Code stamps and to simplify stamping.

So far about 200 manufacturers have been assigned registration numbers. These numbers have been issued by the Committee in the order of applications received for registration.

In explanation of the present status of the Beech Grove shops of the Big Four system, a further statement is necessary than that given as a footnote to the leading article in this issue. Two years ago, at the time of the disruption of operation of railroad shops throughout the country, a contract was made by the C. C. C. & St. L. Railroad with the Railway Service & Supply Corporation of Indianapolis, to take over the management of the Beech Grove shops and re-establish operation on a distinctly independent basis.

The two years of control by the Service Corporation have been eminently successful as measured by production and by the satisfaction of the men employed. A piece work system, difficult to apply satisfactorily to any form of repair work and particularly hard to utilize in locomotive repairs, has been developed to suit the unit basis requirements of such work. With its application a highly efficient production, scheduling and routing system has been installed, aiding operation generally. One of the greatest aids to the operation of the shops has been the establishment of an association of federated shop crafts by the personnel of the shops. This association has to a remarkable degree stabilized employment at Beech Grove.

In a recent statement to The Boiler Maker a high official of the Service Corporation outlined the present agreement with the railroad company by which the operation of the shops has reverted to the railroad. The shops are to be operated in substantially the same manner as when under the contract with the Service Corporation, this arrangement being made possible by the conclusion of a satisfactory agreement with the federated shop crafts. The understanding with the association is such that the railroad company will be enabled to continue the operation of the shops, employing the entire personnel, methods and equipment of the Service Corporation.

About 900 men are now employed at Beech Grove and all those who were with the railroad prior to the change in management in 1922, will have their seniority rights restored, if the offer is taken advantage of within a given stated period.

Too often the importance of proper and frequent boiler washing is lost sight of in its relation to the scheme of locomotive maintenance on the railroads of the country. In general, a clean boiler is a safe boiler and the suggestion made in the Master Boilermakers' Association report on this subject, appearing elsewhere in this issue, will go a long way towards improving the methods and tools used in washing locomotive boilers, where the subject has not been given the amount of attention to which it is justly entitled.

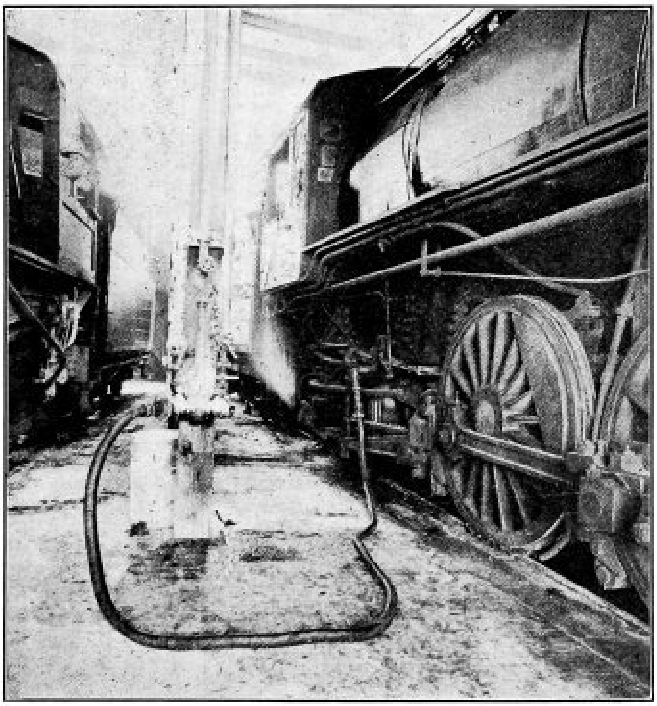
Engineering Specialties for Boiler Making

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

Flexible Metal Hose Adapted to Railway Use

CONSIDERABLE interest is being taken by railroad men in the application of metal hose to railroad requirements. Rubber hose has been used extensively for many purposes, including the conveyance of hot water and steam under pressure. However, when it is used for hot water or steam, the rubber has a tendency to deteriorate rapidly and, as a result, has been the cause of many serious injuries to railroad employees. Unless rubber hose is renewed frequently, its use for such purposes involves an ever present element of danger.

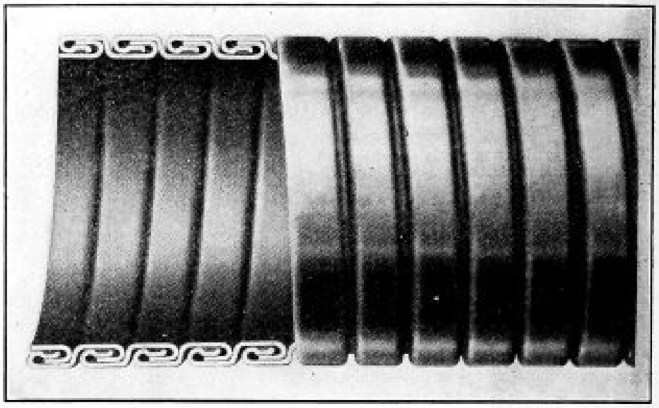
To eliminate such difficulties, the American Metal Hose



The Hose Is Suitable for Conveying Hot Water or Steam

Company, Waterbury, Conn., has developed a flexible metal hose that is adapted to a wide variety of uses. It is specially adapted to railroad work as a high pressure hose, which may be used for boiler washing, blowing boiler tubes and for general service around enginehouses. It may also be used for such work as unloading tank cars, carrying oil and other heavy or inflammable liquids.

As shown in the cross-sectional view, the hose is manufactured from a continuous strip of bronze or galvanized steel of high tensile strength. The strip is first profiled to the desired shape and then wound spirally over itself. During the winding operation, a packing in cord form is fed in place between the metal surfaces, thus making a tight joint. The hose is made in various sizes ranging from ⅜ inch to 6 inches inside diameter. The ⅜-inch hose can be bent to form a circle 9 inches in diameter, while the 6-inch hose will form a circle 72 inches in diameter. Two types are manufactured. It requires approximately 1,000 pounds per



Sectional View of Flexible Metal Hose Showing How the Strips Are Interlocked

square inch of hydraulic pressure to burst a ¾-inch hose of the lighter type of construction, while the bursting pressure of the same size in the heavier type is 2,500 to 3,000 pounds per square inch.

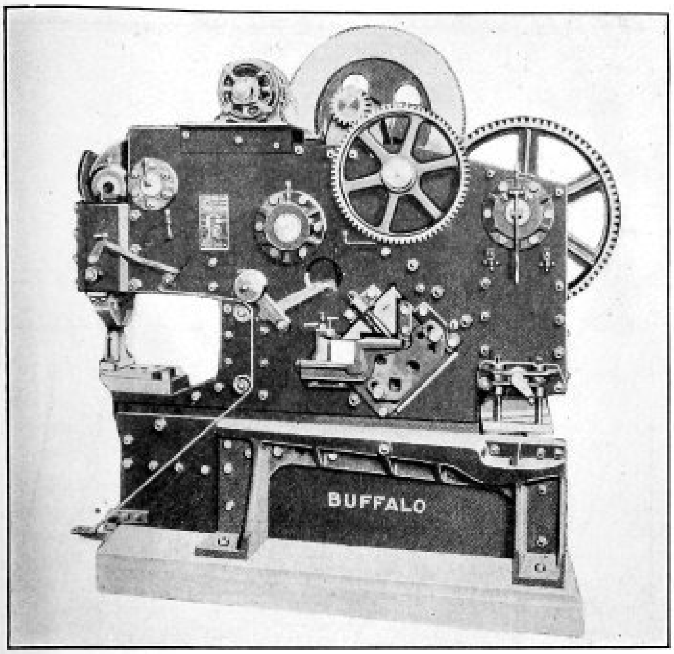
New Series Slitting Shear, Punch and Bar Cutters

A SERIES of new triple combined slitting shear, punch and bar cutters with diagonal bar cutter plunger, representing enlarged capacities and reduced size over the old Buffalo universal machines which they displace, has been brought out by the Buffalo Forge Company of Buffalo, N. Y. The two smaller sizes of the series, designated as the No. 1 and No. 2 Universal Iron Worker, are differentiated only from the larger in design and operation in that there is but one plunger for both the bar cutter and slitting shear, whereas in the larger universal machines there is a separate plunger for each of these operations.

In design and construction, several important changes are evident between the new series and the old. Chief among these should be noted an improved mitering arrangement, new type main gears, a heavier side bracket and a shift in the position of the gear shear clutch.

Important from an operating angle and the facilities afforded are to be noted some of the following. In this series machines are made with an extra high throat for handling "I" girder beams, channels and "H" columns. The semi-floating punch is engaged by handle or foot treadle. By means of dieblocks, furnished with each machine, it is easy to punch beams, channels, girders and "H" columns in the web and flanges of any standard size made.

Two dieblocks, two punch holders, two punches and one



New Design Combination Slitting Shear and Punch

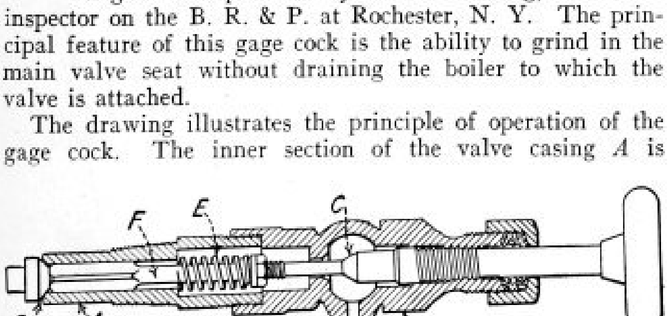
straight and one bevel die are furnished with each machine. The bar cutter plunger, the punch and shear plungers are all made of cast steel, while all gears are machine cut. All bearings are bronze lined. The frame construction is of armor plate, having seven and one-half times the tensile strength of cast iron; this construction is guaranteed unbreakable.

The punching capacity of the new series ranges from 1 inch by ½ inch for the smallest machine to 1¾ by 1½ inch for the largest; the slitting plates capacity ranges from ½ inch to 1½ inch. Other capacities, such as that for squares, rounds, angles, etc., have a corresponding range.

A Gage Cock Permanently Attached to Boiler

The Buffalo, Rochester & Pittsburgh is using on some of their locomotives a new type of gage cock which was designed and patented by H. C. Vormeng, locomotive inspector on the B. R. & P. at Rochester, N. Y. The principal feature of this gage cock is the ability to grind in the main valve seat without draining the boiler to which the valve is attached.

The drawing illustrates the principle of operation of the gage cock. The inner section of the valve casing *A* is



Valve C Can Be Ground Without Removing the Valve from the Boiler

screwed into the boilers and remains permanently in this position. The outer section *B* of the gage cock is screwed in to the protruding end of the inner section *A*. Passing through the two sections of the gage cock is a valve stem containing valve *D* at the extreme end of stem and valve *C* in the valve chamber which communicates with an outlet spout. A coil spring *E* surrounds the outer end of the inner valve stem *F*. Tension is applied to the spring by means of the nut and washer as shown. At the extreme inner end of the valve stem are guiding members formed which cause the valve stem to be supported in proper alinement to insure the seating of valves *C* and *D* upon their seats. A study of the illustration will show that by unscrewing the outer section *B* of gage cock from the inner section *A* and likewise disconnecting the inner valve stem *F* the tension of the spring *E* seats the inner valve *D* thereby preventing leakage while the outer valve *C* is removed to be ground.

TRADE PUBLICATIONS

The Speednut Wrench.—An entirely new type wrench, which automatically adjusts itself to all sizes and shapes of nuts, is illustrated and described in a folder issued by the Speednut Wrench Company, Ltd., 20 East Jackson Boulevard, Chicago, Ill.

Steel Plates.—The Lukens Steel Company, Coatesville, Pa., has issued a series of three bulletins describing products of this company, including pressed and stamped steel parts, details of the largest one-piece flanged boiler head in the world and locomotive firebox plates.

Reamers.—Catalog No. 5 recently issued by the Wayne Tool Manufacturing Company, Waynesboro, Pa., contains in 20 pages a description of the complete line of Wayne bridge reamers, high speed steel counter-sinks and the Wayne drill chuck for salvaging broken twist drills.

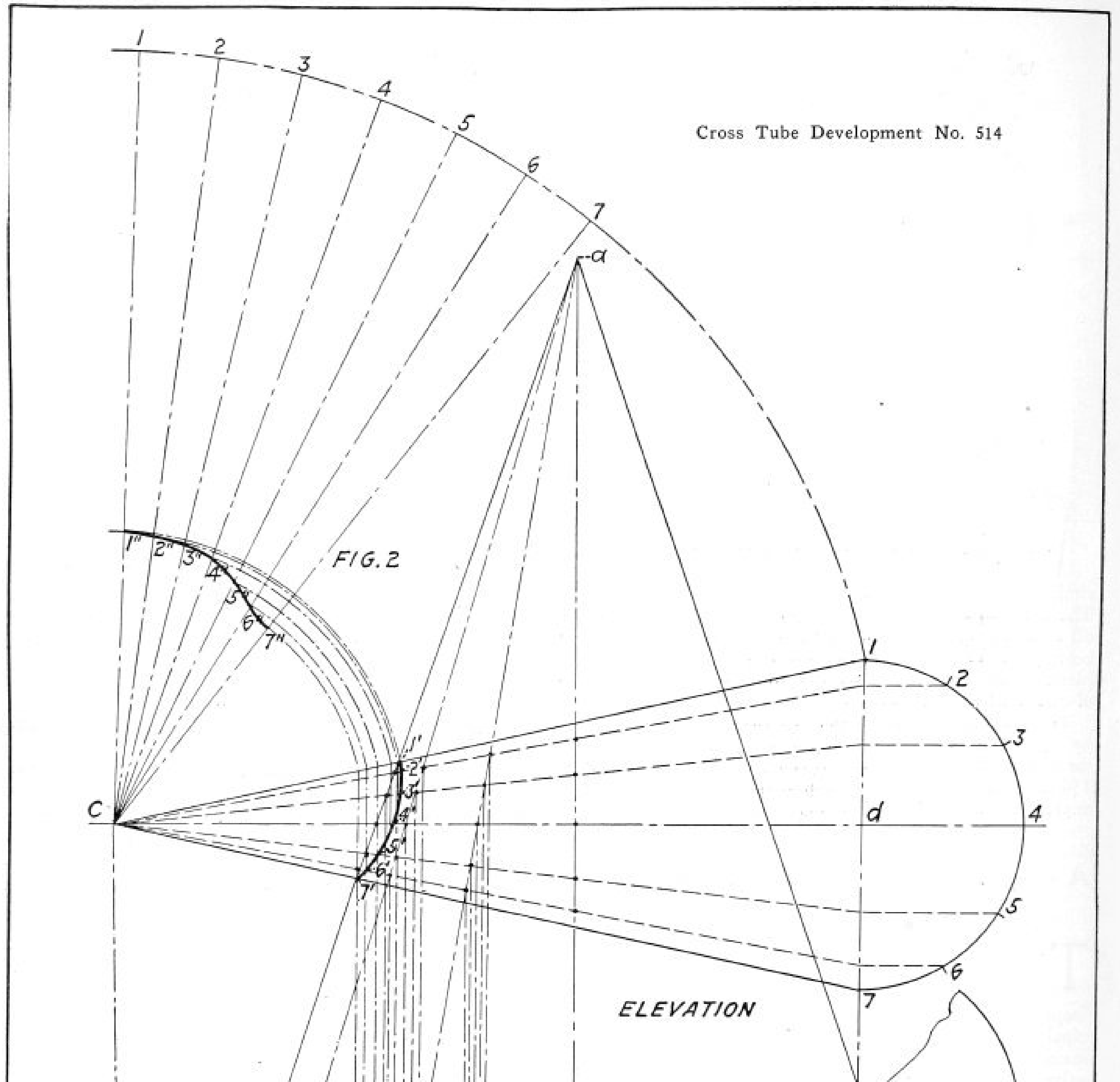
General Electric Company.—A pictorial record of the plant and operation of the General Electric Company at Schenectady, N. Y., the works at Lynn, Mass., and at Erie, Pa., Fort Wayne, Ind., Pittsfield, Mass., Bridgeport, Conn., Harrison, N. J., and Cleveland, Ohio, is contained in catalogue Y 863-B recently issued by the company.

Welding Equipment.—A new 48-page catalogue, illustrating and describing in detail the complete line of acetylene generators and oxy-acetylene welding, cutting, brazing, lead burning, heating and decarbonizing equipment manufactured by the Oxweld Acetylene Company, Long Island City, N. Y., is now available for distribution to all those interested in the subject of gas welding.

Electric Welding of Large Storage Tanks.—A reprint of a paper read by Harold C. Price, presented before the American Institute of Mining and Metallurgical Engineers at the New York meeting in February, 1924, on the subject of "Electric Welding of Large Storage Tanks," has been sent out by the Wilson Welder & Metals Company, Inc., Hoboken Factory Terminal, Hoboken, N. J.

Mayari Pig Iron.—What constitutes a handbook of Bethlehem Mayari Pig Iron, a natural nickel chromium alloy iron for making high grade castings, is listed as publication No. 26 and is now for sale by the Bethlehem Steel Company, Bethlehem, Pa. Two articles by Dr. Richard Moldenke, international authority on foundry work, have been included in this book. The physical and chemical properties, structure, test and application of this type pig iron are given.

Blacker Hammers.—A new catalogue, describing the Blacker "B" blacksmith hammer, with suitable illustrations of various types operating on the same principle, has been prepared by the Blacker Engineering Company, Grand Central Terminal, N. Y. The special feature of this hammer is that it travels over the anvil face, thus making hand forging operations and utility smithing possible without helpers. Illustrations of forging work done with this hammer are contained in the catalogue.



Radial Method of Cross Tube Layout

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Cross Tube Development

Q.—Would you kindly tell me how to develop the full pattern for the layout of a vertical boiler firebox, giving the method of finding the size of plate for working up the crown *B*, and the development of the cross tubes *c*. Thanking you in advance.—J. J. H.

A.—The solution of this problem consists of first finding the line of intersection between the two conical sections. The accompanying drawing illustrates the method to be used which is commonly called the radial method. A one-half plan and elevation are drawn showing the intersection of the radial sections of the small cone with the larger one. The shape of the sections obtained by passing radial planes through the large cone is elliptical in each case as indicated by the irregular curves in the plan. Where the elements of the small cone in the plan intersect these sections of the cone, as shown at 1, 2, 3, etc., of the plan, are the points on the miter. These are located in the elevation by projection. A one-half development of the intersection of the small end of the tube and the conical firebox is shown in Fig. 2.

A complete discussion of this development has been fully covered in a previous issue of THE BOILER MAKER. I would advise you to procure the new edition of the book, entitled "Laying Out for Boiler Makers."

The head calculations have also been explained in the May issue.

Question on Conical Stack and Breeching Development

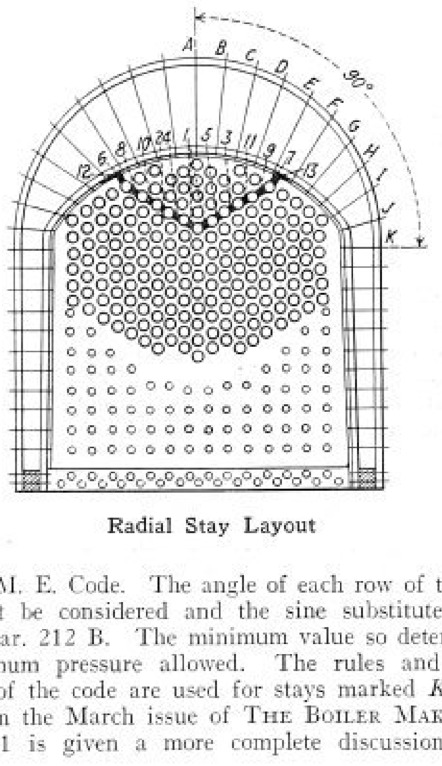
Q.—In the January issue of THE BOILER MAKER, 1924 (page 29), in the development of the intersection of a conical stack and elliptical breeching, take pattern for section *B*, Fig. 7, where do you get the length from *1* to *12*, *12* to *11*, etc.? I mean the side that connects to the stack; the front is a semi-circle and its length can easily be determined accurately.—A. P.

A.—In all developments of this kind the stretchout lengths on the miter are taken from the development of the opening in the cone. Refer to Fig. 5 and use the lengths between the points *1—12*, *12—11*, *11—10*, etc.

Radial Stay Calculations

Q. In the issue of THE BOILER MAKER for October, 1923, on page 294 you explain how to work out the problem Paragraph 212-B of Part 1, Section 1 of the A. S. M. E. Boiler Code. The March, 1924, issue on page 80 explains how to find the sines of the different angles which the crown stay makes with the vertical axis of the boiler. If convenient, I would like to ask you to explain how many rows of bolts must be considered in such calculation? Is it only the bolts that are within the radius of 60 degrees as your issue of THE BOILER MAKER for October, 1923, shows, or must all the bolts within the radius of 90 degrees be considered, as shown in the attached sketch, which would be 10 bolts exclusive of the bolt marked *A*, this bolt being in the center, the sine would be *O*, while the last bolt considered would be the bolt marked *K*, which is 90 degrees from the vertical axis of the boiler and the sine being 1.0. Hoping that this will be explained in an early issue of THE BOILER MAKER.—W. J. C.

A. The maximum allowable working pressure for a wrapper sheet of a locomotive boiler may be determined in accordance with the rules and formula given in Par. 212 of



Radial Stay Layout

the A. S. M. E. Code. The angle of each row of the radial stays must be considered and the sine substituted in the formula Par. 212 B. The minimum value so determined is the maximum pressure allowed. The rules and formula Par. 199 of the code are used for stays marked *K* in your sketch. In the March issue of THE BOILER MAKER pages 80 and 81 is given a more complete discussion on this subject.

Tank Calculations

Q.—If possible I would like information on the following questions that have come up in the last six months, and which I am unable to work out.

(1) I inclose copy of small blue print that shows a vertical cylindrical tank 6 feet by 20 feet, operated at 75 pounds pressure. The brackets or feet underneath the tank and which support the same are of steel plate welded construction as detailed. This drawing was given to me to work from, but I am not satisfied that the design was all right. The questions are:

a. How do I calculate the strength and size of the steel plate brackets of the cross section and thickness and height shown to support the weight of the tank and the water contained in the tank?

b. Is the bottom dished head of sufficient thickness to support the load of the tank as distributed on the tops of the 4 steel brackets, without reinforcement? How is this determined—can you explain?

(2) I inclose sketch showing a tank 108 inches in diameter by 120 inches long, designed to be operated under a perfect vacuum of 30 inches. The compartment at each end would be operated under vacuum at different times, that is, vacuum might be on one end compartment at the same time the adjoining compartment be open to the atmosphere. Have not shown manholes nor pipe openings as they have no part in my question:

a. How do I determine the thickness of the central partition plate for any given diameter for this or any similar tank?

b. How do I figure that the weld on each side of such partition plate is strong enough to hold the head under the pressure on the one side of same? Refer to the detail *A* showing same.

c. If a flanged head is used instead of the flat head for the partition, how is the additional strength of the flange of the head figured in regard to bracing the edge of the partition plate along with the weld on each side of the partition plate? See detail *C*.

d. If, as was suggested by one party, the partition plate should be firmly secured with two angles, how is it possible to determine the size of such angles required? See detail *B*.

e. How do I determine the thickness of the Cylindrical shell, and the thickness of the dished heads to withstand the vacuum pressure against collapse?

f. I have been told that such cylindrical shells used under vacuum must be reinforced at regular intervals with stiffening bands. Is this so? The object as I understand it being to hold the shell in the form of a true cylinder so that no flat places are left for the atmospheric pressure to act on.—G. H. A.

A.—To find the breaking strength of a column, use the formula:

$$P = \frac{S\,A}{1 + q\,\dfrac{l^2}{G^2}}$$

in which, S = ultimate strength of material, pounds per square inch of section.
A = area of cross section, square inches.
q = length of column, inches.
l = length of column, inches.
G^2 = square of least radius of gyration.
P = breaking strength in pounds.

Material	Constants Both Ends Fixed	One End Fixed	Both Ends Hinged
Cast iron	1/5000	1.78/5000	4/5000
Wrought iron ..	1/36000	1.78/36000	4/36000
Steel	1/25000	1.78/25000	4/25000
Wood	1/3000	1.78/3000	4/3000

ULTIMATE STRENGTH OF METALS

Material	Tension lbs. per sq. in.	Compression lbs. per sq in.	Shear lbs. per sq in.
Cast iron	15,000	80,000	18,000
Wrought iron	48,000	46,000	40,000
Steel castings	70,000	70,000	60,000
Structural steel...	64,000	64,000	50,000
Boiler steel	55,000	95,000	.....

The calculation of the strength of a column involves the function of its least radius of gyration which is denoted in structural handbooks by the letter "r."

The bottom dished head is of sufficient thickness to withstand the load due to the weight of the tank. No calculation need be made for this condition, for the internal pressure tends to keep the head in spherical form.

(2) The total pressure on the central partition under vacuum depends on the diameter of the tank and depth of liquid. At sea level the atmospheric pressure is 14.7 pounds per square inch and a column of mercury 30 inches high under vacuum corresponds approximately to this pressure. When there is a partial vacuum the pressure may be found from the formula:

$$p = \frac{14.7 \times (30 - h)}{30}$$

in which, p = absolute pressure, pounds per square inch.
h = height of mercury column in inches.

There are a number of formulas for finding the required thickness of flat plate subjected to pressure. Assume in this example that the tank is filled with water on one side and the other is under a perfect vacuum. The pressure due to the head of water is equal to the product of the head in feet multiplied by 0.434 or $9 \times 0.434 = 3.906$ pounds per square inch. The pressure 3.906 pounds is at the bottom of the head and decreases as the head of water decreases, but for calculating the plate thickness and method of fastening the head in place the maximum pressure due to the head of water is used. Therefore the total pressure in pounds per square inch due to the head of water and perfect vacuum equals $3.906 + 14.7 = 18.6$ pounds.

From the following formulas the maximum stress, plate thickness and deflection for given conditions may be determined:

$$S = K\,r^2\,\frac{p}{t^2} \qquad (1)$$

$$t = \sqrt{\frac{K\,r^2\,p}{S}} \qquad (2)$$

For deflection, $f = K\,r^4\,\dfrac{p}{t^3}\,E$.

in which, S = maximum stress, pounds per square inch.
K = constant = 0.50 for mild steel with fixed edge.
r = radius of head, inches.
p = load in pounds per square inch.
t = plate thickness, inches.
E = modulus of elasticity = 30,000,000 pounds for mild steel.
f = deflection, inches.

The strength of the weld depends on the character of the electrode and form of weld. A welded joint can be made to have the same strength as the parent metal, but in general practice the strength averages from 50 to 80 percent of the strength of the plate.

A flanged head welded in place is stronger than a straight head without flange, due to the bearing area of the flange against the shell. Refer to page 350 of December's issue of THE BOILER MAKER on angle iron ring calculations. Refer to the A. S. M. E. Boiler Code for the calculations of the plate thickness required in shells to resist collapsing pressure. Therein is also given the formulas for allowable pressure on dished heads. When a shell is not of sufficient thickness to resist safely collapsing pressure, it must be properly stayed.

BUSINESS NOTES

F. M. English, who has been in the service of the Reading Iron Company, Reading, Pa., since 1919, has been appointed assistant sales manager to succeed A. F. McClintock, resigned.

B. W. Beyer, Jr., sales engineer of the Union Special Machine Company, Chicago, has been appointed district sales engineer of the Industrial Works, Bay City, Mich., with headquarters at New York.

C. A. Fisher has been appointed district representative of the Central Iron & Steel Company, Pittsburgh, Pa., with offices at 303 Keystone building, Houston, Tex., and 1918 W. T. Wagoner building, Fort Worth.

Hanna Engineering Works, 1765 Elston Avenue, Chicago, manufacturers and distributors of Hanna riveting machines, Hanna air hoists, Hanna sand sifters, Hanna I-beam trolleys and Mumford molding machines, is now represented in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island, by Eggleston Supply Company, 259 Franklin Street, Boston, Massachusetts.

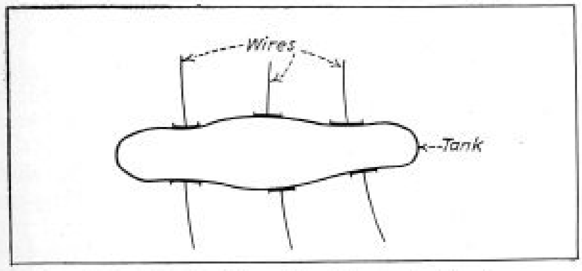
The Chicago Pneumatic Tool Company announces the transfer of Ross Watson, formerly district manager of the Cleveland branch office of this company to the district managership of the Minneapolis branch to succeed D. M. Wesbrook, now general manager of the Canadian Pneumatic Tool Company. Other recent changes include the transfer of L. J. Westenhaver, from the Pittsburgh Office to Cleveland as district manager of that branch and E. C. Stroup, compressor engineer in the Boston territory, has been moved to the Pittsburgh district.

Letters from Practical Boiler Makers

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

Straightening Dented Sheet Metal Vessels

I HAVE a number of times succeeded in straightening copper floats and removing dents from sheet metal tanks by simply soldering a number of protruding wires around on the tank as indicated in the sketch and then simply pulling



Method of Taking Out Dents in Tanks

the dents out and the tank back to its original shape. After the straightening is completed it is a simple matter to remelt the solder and remove the wires. I believe this method is easier and quicker than any other method because it is not necessary to make the vessel air tight. No air tight joint is necessary. This method applies to vessels that are closed as well as those that are not closed.

Newark, N. J. N. G. NEAR.

Makeshift Staybolts

THREE days after I hired out to run a logging locomotive for The Bluestone Land and Lumber Company, at Gardner, W. Va., the fireman reported that several staybolts were leaking in the flue-sheet, about ten or twelve inches above the grate level. They were, and were leaking badly—a mud-burn.

I promptly reported this to the manager, expecting that he would wire to Bluefield at once for a boiler maker. Instead, I was told that they could not spare the locomotive from service at this time and that I myself must repair that boiler. I argued that I was no boiler maker, and was ignored. I then reminded him of the fact that they had neither staybolt taps nor staybolts on hand. Still he would not budge—I myself must repair that boiler, and do so at once.

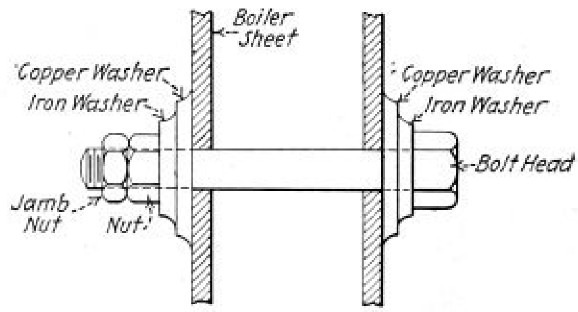
So I got busy. I first drilled out eight leaking staybolts and cleaned out a mud clot that had caused the flue sheet to scorch and bulge until it had slipped the threads on the staybolts. Then I made the sheets, inside and outside the firebox, as clean and smooth as possible around the holes. Next I secured eight ordinary iron bolts that had good threads and were 1/8 inch larger in diameter than were the damaged staybolts.

Against the boiler sheets, inside and outside the firebox, I then placed on each iron bolt copper washers which had been annealed, then against each of these copper washers I placed smooth iron washers which were slightly smaller than the copper washers. Next, I tightened these bolts with hexagon nuts and jamb-nuts. See sketch.

Before the boiler was fired up and hot, I beaded the copper washers with a small beading tool, then tightened the nuts a bit more. And none of those bolts did more than weep slightly. I had the nuts and jamb-nuts outside the firebox, where I could get at them readily, and whenever the bolts showed signs of a leak, I was able to draw them up and stop it.

Those makeshift bolts were left there, until the following year; and perhaps would have been left still longer, but for the fact that a hostler allowed the boiler to go dry one night, thereby causing it to drop its crown-sheet. Then, of course, they had to send for a real boiler maker.

Now I did that first repair job under protest, and I do not fancy doing any more of them, except in a case of extreme emergency. I had to carry 175 pounds pressure on that boiler, consequently I was never quite at ease whenever riding over that makeshift job. You see, I had no way of testing the iron bolts, before putting them through those sheets.



Emergency Staybolt Repair

Neither could I determine whether or not the sheet had been dangerously damaged by the mud-burn. So I was not at all sorry when that dropped crown-sheet compelled that manager to send for a boiler maker.

Cincinnati, Ohio. CALVIN H. COVEL.

New British Boiler Generates Steam Under 3,200 Pounds Pressure

FOR a considerable time past there has been under construction at the engineering works of the English Electric Company at Rugby (England) a remarkable coil type of steam generator, or "boiler." The process is the invention of Doctor Benson, the well known engineer and scientist, and the plant he has designed suggests a complete revolution in accepted methods of generating power by means of steam.

The apparatus is a steam generator constructed of coils of narrow bore steel tubes, in which the essential difficulty hitherto preventing success—the fact that under these conditions the generation of steam is violent and spasmodic because of ebullition and the formation of bubbles of steam—has been entirely eliminated by working at such high pressures that ebullition is entirely absent. The generator operates at the almost incredible pressure of 3,200 pounds to the square inch. The main object of all steam power engineers has always been to increase the steam pressure and the superheat as much as possible, because the higher these factors are the greater is the proportion of energy added to the original water as total heat available for effective work.

Efficency of Boilers

As is well known, the thermal efficiency of steam power is extremely poor, and even in a modern "super-power station" at 350 pounds pressure and a total temperature in the steam, obtained by superheating, of 700 degrees F., only about 17 to 18 percent of the total heat in the coal is actually used for generating power at the switchboard. But in the case of the Benson generator, at 3,200 pounds, the thermal efficiency is claimed to be no less than 28 to 30 percent.

Construction of Generator

This boiler, as now installed at Rugby, is only one of a number of possible arrangements covered by the patents. It consists of coils of ¾-inch bore steel tubing, ¼-inch thick of a total height of 8 feet, wound round a vertical inner cylinder of refractory material, which is covered with sheet metal, the coils therefore being between two walls. Subsidiary coils at the top are arranged to form a superheater, the overall dimensions of the entire casing being 17 feet in height and 7 feet diameter.

Distilled water is forced in continuously at the bottom of the coils at a normal rate of 10,000 pounds per hour, by means of a motor-driven hydraulic force pump working at 3,200 pounds per square inch, and the generator is heated up with an oil blast flame. This is simply as a convenience in experimenting; pulverized coal or gas would be equally as effective. The water as it travels upwards and round through the coils is gradually heated to a higher and higher temperature, until when a greater part of the length of the coils has been traversed the temperature of the water is approximately 706 degrees F., the pressure being constant at 3,200 pounds because of the pump. This point is the "critical temperature," the point at which water occupies about three times its original volume taken at 60 degrees F.

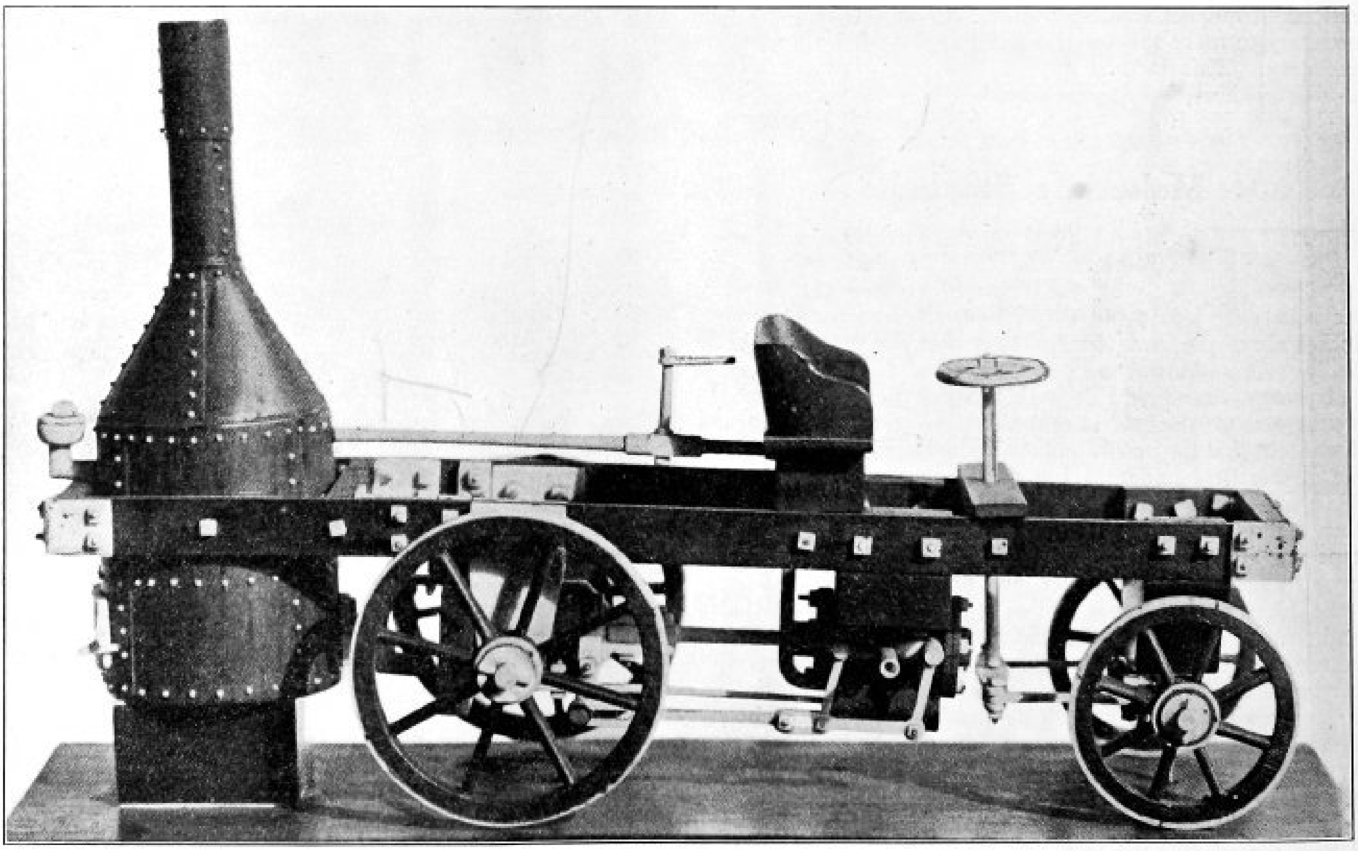
At this stage it is completely and bodily converted into steam without ebullition or boiling and without the absorption of latent heat—the steam occupying the same volume as the water. The process is thus quite different to ordinary boiling. In the remaining portion of the travel the steam is slightly superheated to about 720 degrees F., and is subsequently passed through a reducing or back pressure valve, being reduced thereby in temperature to 620 degrees F. into the superheater coils. Here it is heated to about 850 degrees, with 910 degrees F. as a maximum, the final pressure being 1,500 pounds.

The steam, at present being discharged to a surface condenser against back pressure, will then be utilized in a very high pressure steam turbine, the construction of which is now almost completed, running at 20,000 to 25,000 revolutions per minute, exhausting at 200 pounds, and generating about 350 kilowatts by the drop of pressure. The exhaust steam, which will be reheated, will then be used for an ordinary condensing turbine, which will give a further 900 kilowatts, making a total of 1,250 kilowatts as a condensing set.

The safe generation of steam at the critical point should give rise to far-reaching developments in engineering practice, especially in steam turbines. Although it will probably be some time before it affects marine work, land power station experts throughout the world are even now showing great interest in its possibilities.

London, England. G. P. Blackall.

* * *



(International Newsreel)

Forerunner of the Modern Locomotive

From the Sir Isaac Newton to the Modern Pacific Type the evolution of the locomotive has been portrayed in models carved from black walnut, ivory and pearl by Ernest Warther, of Dover, Ohio, and placed on exhibition at the Service Progress Exposition at the Grand Central Terminal, New York. The illustration above shows a model of Read's Road Locomotive of 1791, the first Multitubular Boiler—the Father of the Auto.

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Bureau of Locomotive Inspection of the Interstate Commerce Commission

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

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, suite 524, Brotherhood Block, Kansas City, Kansas.

H. J. Norton, International Vice-President, Alcazar Hotel, San Francisco, Calif.

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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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

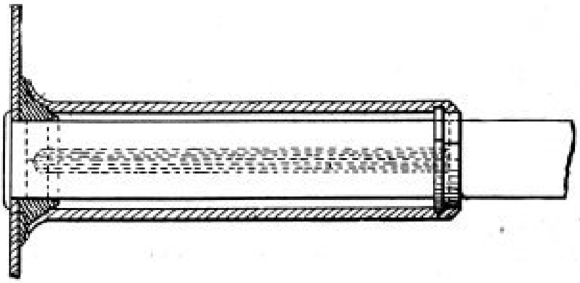
SELECTED BOILER PATENTS

Compiled by
GEORGE A. HUTCHINSON, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

1,493,245. BOILER-TUBE PROTECTOR. NOAH D. CLARK, OF CLEVES, OHIO.

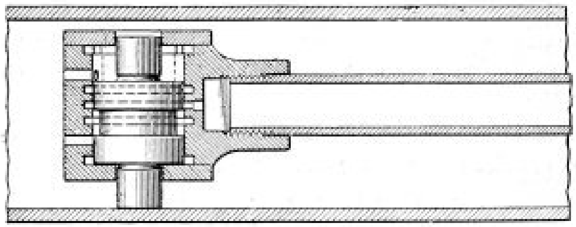
Claim 1.—A tube protector consisting of a shield, said shield being in separable sections, said sections being flared outwardly at one end, slidable



fastening means for the sections engageable with the sections at the flared portions and a tube engaging gasket within and adjacent the end of the shield opposite to the flared portions. Seven claims.

1,491,640. BOILER-TUBE SCALER. STEPHEN SORENSEN, OF PORT RICHMOND, NEW YORK.

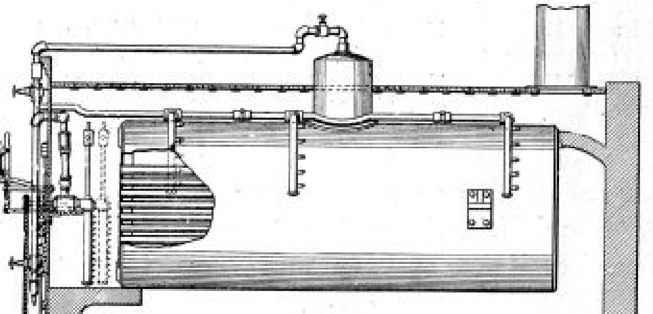
Claim 1.—A device for removing scale from boiler tubes, which comprises a head to be disposed within the tube, said head having a cylinder therein,



a reciprocating piston within said cylinder, and hammer portions on opposite ends of said piston extending through the head during the movement of the piston to engage with the walls of the tube and remove the scale therefrom, the outer surfaces of the head from which the hammer portions extend being flat to provide a clearance space between the head and the curved walls of the tube, in which space the hammer portion can move to achieve an effective blow on the walls of the tube.

1,497,172. BOILER BLOWER. EDWARD C. HAFER, OF CHAMBERSBURG, PENNSYLVANIA, ASSIGNOR TO JAMES A. HAFER, OF CHAMBERSBURG, PENNSYLANVIA.

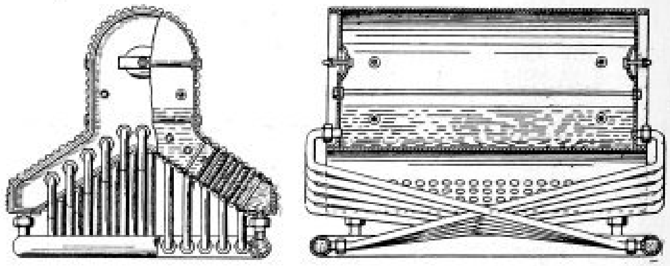
Claim 1.—In a boiler blower, the combination, with a support adapted to be mounted adjacent a boiler, of a reciprocally mounted block carried by said support and movable toward and away from the boiler, a tube swivelled in the block, the block being formed with a groove and the tube with an



aperture communicating with the groove, the said swivelled tube having a distributing arm positioned to lie parallel to the adjacent portions of the boiler so as to extend across the tubes thereof, the distributing arm being adapted to swing on the swivel for successively moving across substantially all of the tubes of the boiler, the said arm having discharge nozzles directed toward the boiler, means for supplying fluid under pressure to the groove of the block, a lever for shifting the block to various adjusted positions while leaving the distributing arm free to swing on the swivel, means for locking the lever in such adjusted positions, and means for actuating the distributing arm. Three claims.

1,497,216. STEAM BOILER. FRANK G. KRAKAN, OF PITTSBURGH, PENNSYLVANIA.

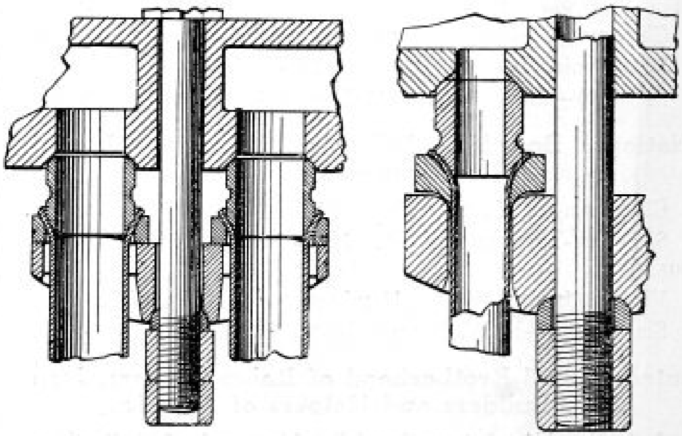
Claim 1.—A steam boiler comprising a steam dome, hollow divergent legs extending from the lower end of said dome, fire tubes arranged at spaced



intervals in the legs, depending nipples on the under sides of the divergent legs, a rectangular mud-drum connected to the nipples and lying horizontally beneath the boiler, and pipes connecting opposite runs of the mud drum with opposite ends of the boiler. Two claims.

1,497,497. SUPERHEATER-TUBE CONNECTION. JOHN GAPP, OF SCRANTON, PENNSYLVANIA.

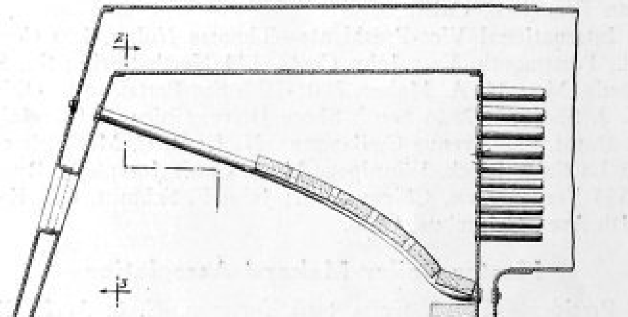
Claim 1.—Means for connecting the ends of superheater tubes to a header, comprising a clamping bar having openings through which said



ends are passed, a collar surrounding each tube end above said bar, said collar being chamfered on its upper side around the hole therein and the tube end being outwardly flared to fit said chamfer, and nipples having tapered ends to fit in the flared ends of the tubes and engaging the header at their other ends. Three claims.

1,492,797. FIRE-BOX FOR OIL-BURNING LOCOMOTIVES. RALEIGH J. HIMMELRIGHT, OF ENGLEWOOD, NEW JERSEY, ASSIGNOR TO AMERICAN ARCH COMPANY, A CORPORATION OF DELAWARE.

Claim 1.—In an oil burning locomotive, the combination with a fire box, of a radial refractory pan in the bottom of the fire box and substantially



coextensive therewith, a flash wall at the forward end of said pan, a back end burner for said pan directing its flame forward against said flash wall, and a refractory arch extending from adjacent the forward end of the fire box a portion of the distance rearward in the fire box. Three claims.

THE BOILER MAKER

SEPTEMBER, 1924

Important Boiler Construction in French Shops

The Fives-Lille Boiler Works Enlarged Since War—Improvements Made in Delaunay-Belleville Boiler

By Captain Godfrey L. Carden

THE Fives-Lille shops at Lille, France, are a striking example of what the French have accomplished in restoring and enhancing the pre-war effectiveness of manufacturing plants in the devastated region. From a 3,500 personnel strength, the Fives-Lille shops are today employing 5,000 men. The shops are highly modernized, equipped with leading makes of American machine-tools, and practically all the buildings are new. At no time were these shops in position to turn out so much finished material as now.

While Fives-Lille has long been identified with boiler work, there are important departments devoted to locomotive construction, and the building of general machinery. Sugar machinery has been a leading feature, and Fives-Lille installations of sugar plants equipment are familiar in many foreign countries.

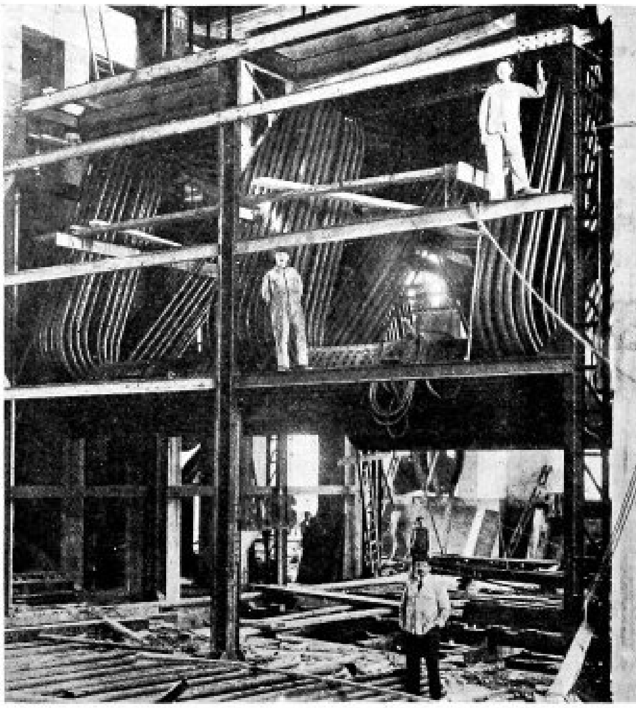
The Fives-Lille shops are building the Stirling boiler under modifications of French engineers. Generators of this type, as made at Fives-Lille, are working at 28 kilograms (about 355 pounds) pressure. A noteworthy installation is the Gennevilliers power station near Paris. The Fives-Lille Stirling is seen in the form of a double boiler with 5 collectors, resembling a big W, and equipped with opposing grates. There is also a two-boiler combination with 3 collectors, one of the collectors uniting the two.

In the combination, the principal features are:

Height of the heating surface up to the axis of the superior middle collector	28.6 feet
Front width	34.8 feet
Length of sides between end facings	37.7 feet

In this Fives-Lille arrangement, with its 5 collectors, 3 superior and 2 inferior, all united by the appropriate number of tubular nests, directly dudgeoned, there is an hourly vaporization capacity of 60,000 kilograms (about 132,200 pounds) at economical work under normal conditions. Under intensive conditions this vaporization capacity may be

Assembly Bay of Fives-Lille Boiler Shop



Erecting a Fives-Lille Built Sterling Boiler

increased to 176,000 kilograms of steam per hour. This showing, it is declared, can be maintained for a period of 2 hours without danger to structure or installation.

In the Fives-Lille construction, the boilers are disposed so as to permit of a free expansion under maximum conditions. The inferior collectors are suspended to the superior ones by 1.680 meter water tubes (about 3.57 feet), with interior diameter of 74 millimeters (about 2.91 inches) and exterior diameter of 82 millimeters (about 3.23 inches). The superior collectors are quite independent of the masonry frame of the boiler, and are suspended to the frame beams by means of rods supporting all the load.

At normal, the boilers work on a level of 81,000 litres (about 21,400 gallons) of water and 25,000 litres (about 885 cubic feet) of steam. Feed water is delivered at 155 degrees C. by four independent pipings.

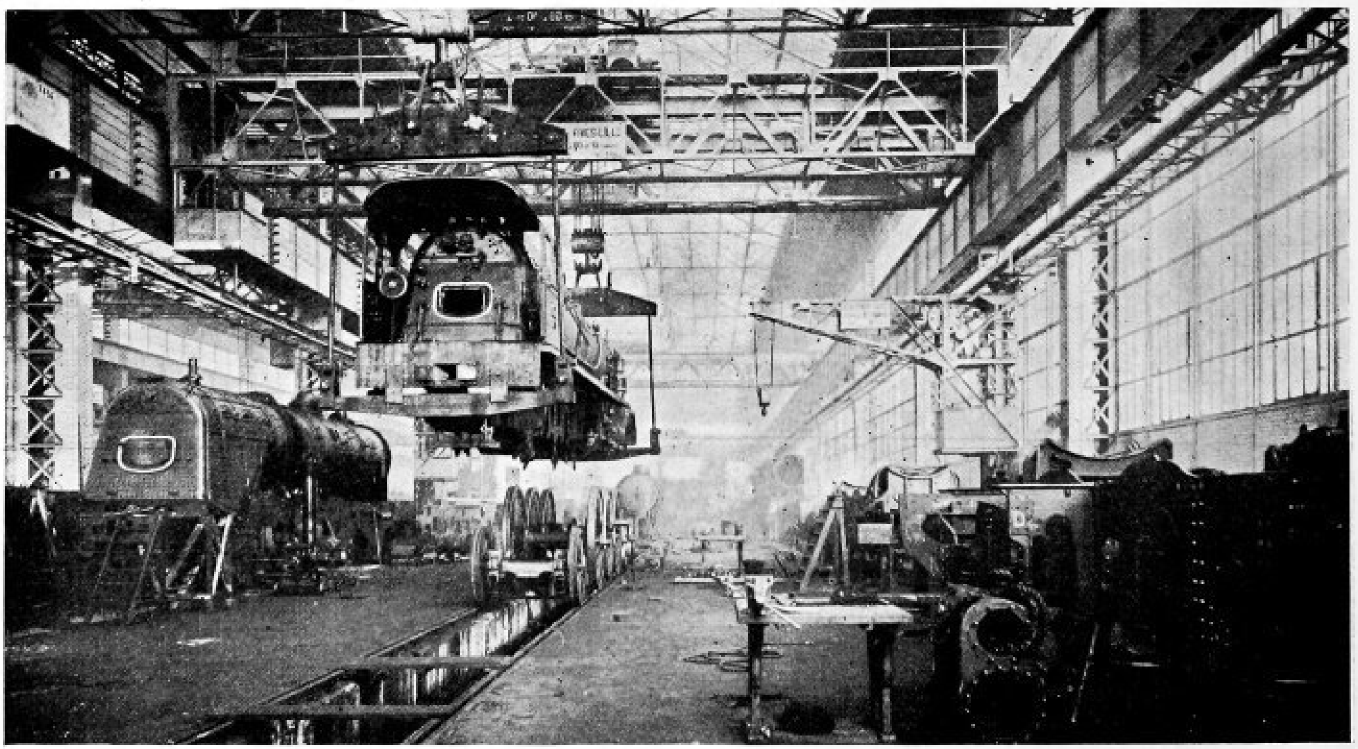
Just now the Fives-Lille shops are building 9 boilers of the collector type, five of which number will have 2,000 square meters (about 21,500 square feet) heating surface, to work at 25 kilograms pressure (about 355 pounds), and four with 2,100 square meters (about 22,600 square feet) to work at 20 kilograms (about 285 pounds). These nine boilers go into power stations in the vicinity of Paris. While 25 to 28 kilograms pressures (355 to 398 pounds) are now in service, the Fives-Lille shops offer boilers with working pressures of 32 to 35 kilograms (455 to 495 pounds per square inch) per square centimeter.

Personnel Depleted in War

The Fives-Lille shops were directly in the road of the German advance, and, when the personnel in the early days of the war (1914) were called out, the Fives-Lille plant was stripped of all but old men and boys. Even with this curtailment, the shops kept up deliveries of material, especially for military ones, right down to within 48 hours of the arrival of the Germans. The Germans took over the shops and converted them to their own use and this continued throughout the German occupation. When finally the Germans withdrew they stripped the shop of machine tools, demolished floorings and left the works only a shell of what they formerly represented.

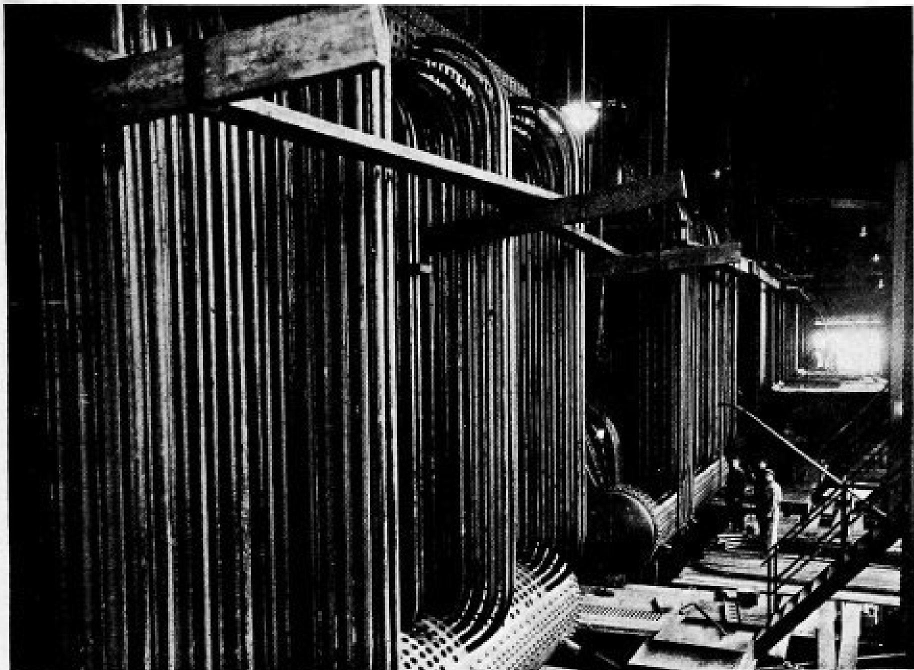
The principal French officers of Fives-Lille were on the ground again in a short time, the engineer-in-chief within 30 hours of the German withdrawal, and the works as they appear to the visitor now represent what has been accomplished in the interim.

Many of the machine tools which were shipped to Germany were recovered, although not a few were returned in a more or less damaged condition. The buildings entirely de-

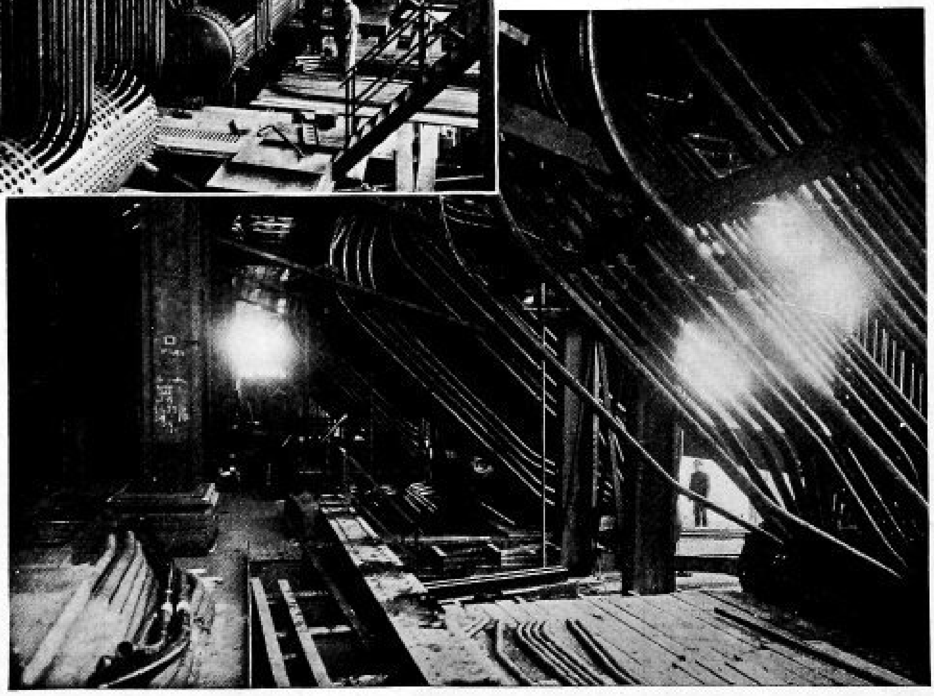


Locomotive Shop at Fives-Lille Works

stroyed by the Germans were those formerly devoted to turbine building, armored turrets, metal construction, and the locomotive shop. All other shops were used as store houses by the Germans up to the last moment, and there was evidently no time to complete the destruction before the arrival of the French. So quickly did the Fives-Lille shops recover that orders were taken in hand and have been executed for 150 locomotives for the French State railways, numerous bridges, several sugar installations for South America, one installation of 500 tons capacity for England, several of the same capacity for France, and numerous boiler erections of the heating type. As early as 1921, the personnel employed had risen to 4,500. The ground of the Fives-Lille Works covers 40 hectares (1 hectare = 2.47 acres) of which more than 12 hectares are entirely covered by buildings.



Typical Installation of Delaunay-Belleville Boilers Being Made at the Power Station, Bussancy, Belgium



Another Type of Boiler, the Ladd-Belleville, Is Also Being Erected at the Bussancy Station

Delaunay-Belleville Shops

General Director M. Moncy of the Delaunay-Belleville works informs me that the new Ladd-Belleville boilers now under construction at their plant will be worked at 28 kilograms (398 pounds) pressure. Heretofore Ladd-Belleville boilers embodying the Ladd features familiar in the United States but modified to meet French requirements, have been built at the Delaunay-Belleville shops for 10 or 20 kilograms (140 to 280 pounds) pressures. The new designs, therefore, represent a marked advance in working pressures. The boilers now under construction for 28 kilograms (398 pounds) working pressure have a heating surface of 1,830 square meters (about 19,700 square feet), a surface of 1,300 square meters (about 14,000 square feet) for the steel economizer and 480 square meters (about 5,160 square feet) for the superheater, Elesco type.

While the Delaunay-Belleville shops have taken up the Ladd features, the French engineers there have exerted themselves as Mr. Moncy says, to improve the Belleville boiler *per se*. The policy is employed of utilizing the Ladd-Belleville type as modified by the French for large units and confining the Belleville boiler for units of relatively small surfaces. For medium sized units the Delaunay-Belleville shops build both types. Such for example is the new Delaunay-Belleville installation at the Bussancy power generating plant in Belgium, the features of these boilers are:

	1st Size	2d Size
Heating surface of boiler, square feet......	3,800	4,400
Heating surface of superheater, square feet	1,290	1,470
Heating surface of economizer, square feet.	2,000	2,300
Vaporization, normal, pounds........	19,800	26,400
Vaporization overcharge, pounds.........	23,800	31,800
Steam temperature, degrees C............	375	375
Pressure, pounds per square inch.........	285	285

Yarrow Boilers for Power Plant Service

Recent Developments Made in Famous Watertube Boilers for Land Installations

THE Yarrow watertube boiler stands well to the front among the various boilers on account of the excellent results it gave in naval service during the war, while recent experience with similar boilers of a modified continental form on large Atlantic liners has proved equally satisfactory. Since its inception in 1885, the use of the Yarrow boiler, both afloat and ashore, has steadily increased, and its most recent development in connection with the economic generation of steam in large electric power stations is of special interest.

In designing a boiler to meet the particular needs of power station work, the firm was enabled to make use of its valuable records of experimental and research work carried out at Scotstoun, and the following were some of the points which were kept in view: It was desirable that the design should be as simple as possible, and that ample provision for examination and access to the boiler should be made. The straight generating tubes of the Yarrow boiler are easily examined and cleaned, and the number of bolted joints and inspection doors is reduced as far as possible. Apart from the boiler mountings, which are naturally bolted to the boiler, the only other bolted joints in the design adopted are the manholes at each end of the steam drums and the water collector. Flexibility in operation was also required in order that the boiler when under steam might meet sudden and considerable overloads, and for this reason the straight and nearly vertical tubes were particularly advantageous, because the circulation in such tubes is rapid and enables unexpected and high overloads to be met without risk. The efficiency of the final design is enhanced by the large radiating surface exposed to the furnace, which increases the overall efficiency of the boiler owing to the large amount of heat absorbed by this surface. In order to secure an even greater overall efficiency, pre-heating of the air delivered to the furnace grate is adopted, tubular air heaters being used.

*From a recent article in *The Engineer*.

The Dunston Boiler

The first large boiler designed in accordance with the foregoing principles was that supplied to the Dunston power station of the Newcastle-upon-Tyne Electric Supply Company, Limited.

The drawing reproduced in Fig. 1 illustrates the general arrangement of the boiler at Dunston. It will be seen that it is of the Yarrow straight-tube type, fitted with a superheater and air heaters, the elements comprising a steam drum 5 feet in diameter and four water drums. The steam drum and the water drums are connected by 1¾ inch cold-drawn steel tubes, which are expanded and bell-mouthed at each end by pneumatic power in accordance with the usual practice in this type of boiler. The outside water drums are 30 inches in diameter and are connected to the steam drum by 12 rows of tubes, while the two drums nearer the fire, which are 23 inches in diameter, are joined to the steam drum by four rows of tubes. The total evaporating surface of the boiler is 9,100 square feet, of which 2,135 square feet are provided in the two tube nests on either side of the fire and 6,965 square feet in the outer nests.

At each side of the boiler between the two nests of tubes one-half of the superheater is installed, the steam passing first through one and then crossing by a pipe to the other.

The superheater, which has a heating surface of 2,000 square feet, is composed of a number of U tubes, 1⅛ inches diameter, which are expanded and bell-mouthed into a circular drum, access to the tube ends being obtained from inside the drum which may be entered by a manhole in the usual way. The superheater is of the self-draining type, and is designed so that the steam makes two passages through each

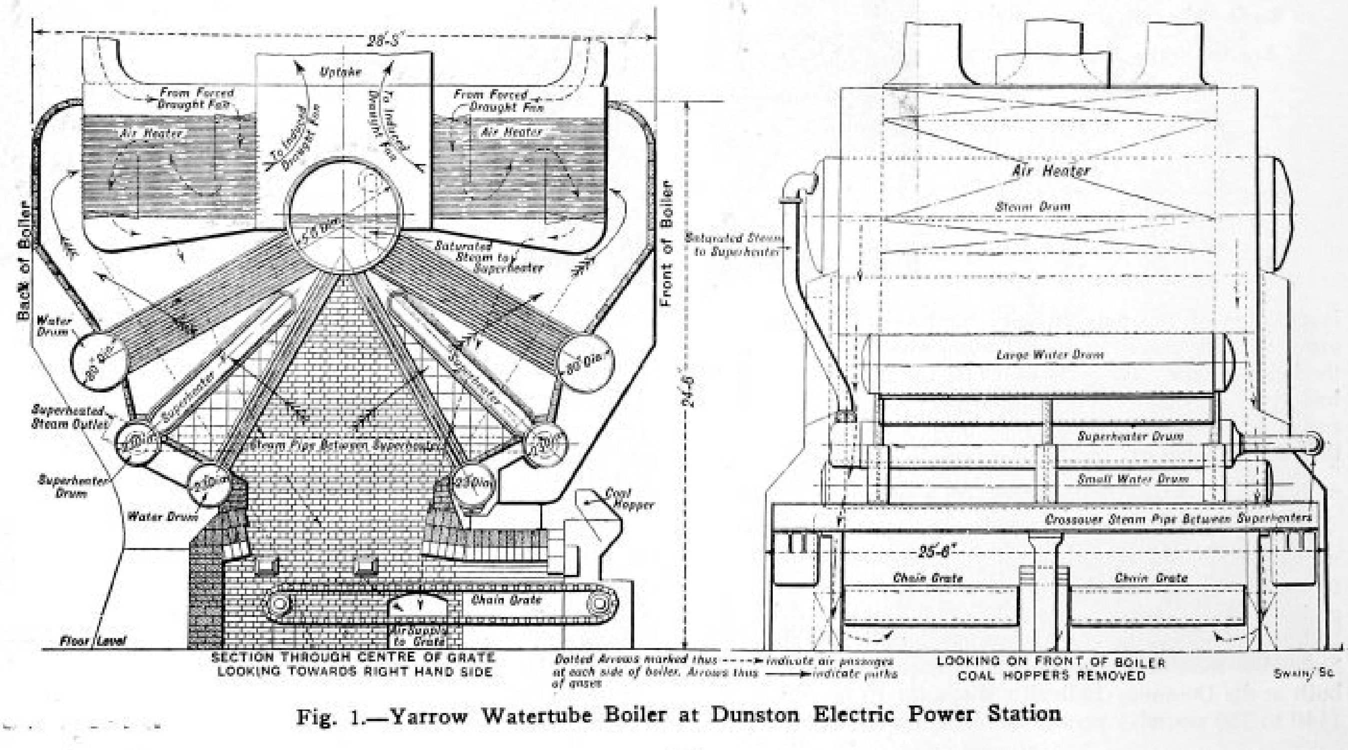


Fig. 1.—Yarrow Watertube Boiler at Dunston Electric Power Station

part, or four passages in all. The drop in steam pressure through each part under the highest rates of evaporation does not exceed 1 pound per square inch.

A feature of the boiler is the large combustion space of 1,800 cubic feet, and the extent of the evaporating surface which is exposed to the direct radiation of the fire. An examination of the combustion chamber after the boiler had been in commission for some months showed that the tubes had remained quite straight.

The Dunston boiler is fitted for coal firing, and two chain grate stokers were supplied by Edward Bennis & Co., Ltd. The width of each grate is 8 feet, and the total grate area 220 square feet. Both grates are provided with closed riddling pits to seal the space which receives the heated air supply. It will be seen from the sectional drawing in Fig. 1 that the air heaters are placed in the uptake. They are of the tubular type, and contain 1,504 tubes, 8 feet in length and 2¾ inches external diameter, the combined heating surface being 8,631 square feet. The gases pass through the inside of the tubes, and the air to the grates is heated by passing over the outside of the tubes. The air to the grates is not only heated by passing through the air heater itself, but it also absorbs additional heat during its passage over the boiler casings, both to and from the heater. By this means the boiler casing is used to assist in heating the air and at the same time the radiation losses through the casing are reduced.

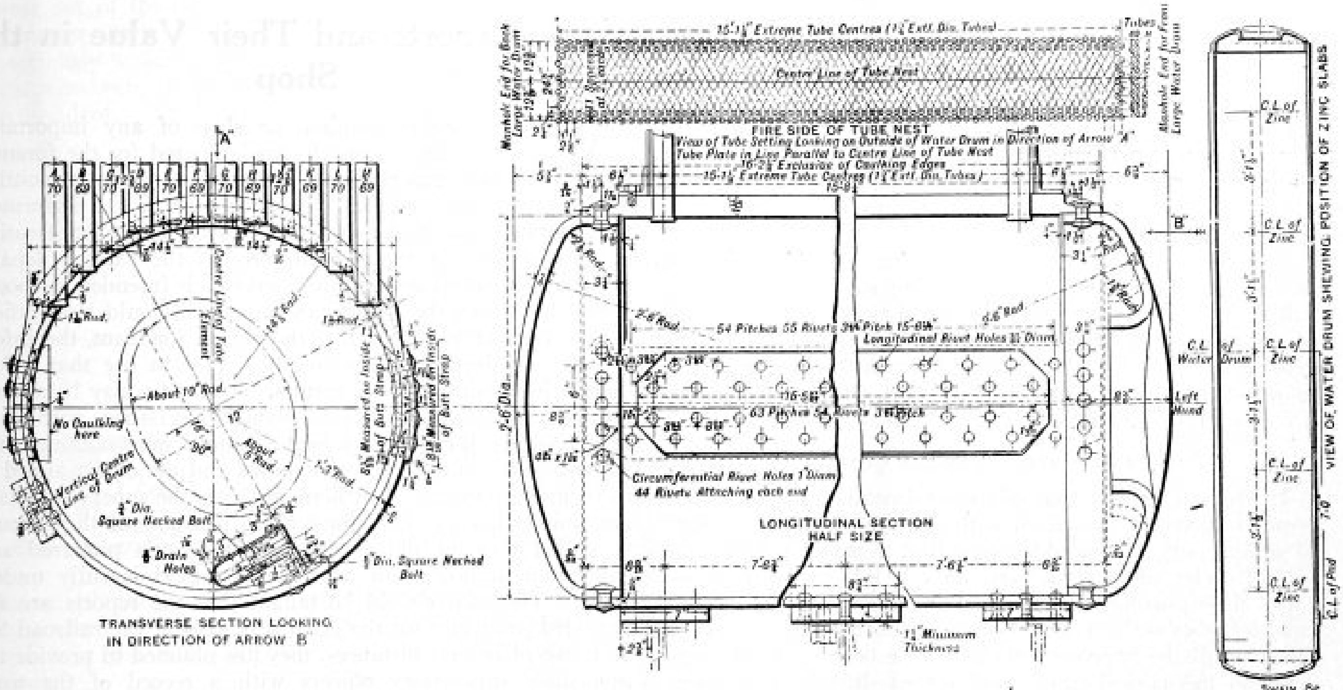


Fig. 2.—Typical Water Drum for Yarrow Land Type Boiler

Tests

The normal output of the boiler is 64,000 pounds of steam from and at 212 degrees F. The trials, however, were made from a feed temperature of 80 degrees F. to superheated steam of about 720 degrees F., which at the working pressure of 215 pounds per square inch corresponds to a degree of superheat of about 330 degrees F. This feed-water temperature was used on the trials, and was fixed to meet certain specified conditions, but in general practice it is considerably higher. An output of 64,000 pounds of water evaporated per hour from and at 212 degrees F. corresponds to an evaporation of rather more than 7 pounds of water from and at 212 degrees F. per hour per square foot of generating surface. At this rate of evaporation, approximately 30 pounds of coal were burned per square foot of grate area per hour. An analysis of coal was obtained in accordance with recognized methods, and an efficiency on the normal load trial of 86 percent was obtained, the analysis of the waste gases at normal load showing 12.6 percent of CO_2. During the overload trials the output obtained was approximately 90,000 pounds of water evaporated per hour from and at 212 degrees F., and it was shown that the limit of output on this trial was determined by the capacity of the forced draught fan, which had not been designed for so high an overload demand; otherwise there was no reason why the boiler should not have been worked up to a greater output.

Careful records of temperatures were made by means of pyrometers placed between the different rows of generating and superheating tubes in order to show the fall in temperature as the gases passed through the two nests of tubes and through the superheater. It is of interest to note the rapid drop in temperature of the gases in the first two or three rows. The curve of temperatures exhibits a slight rise in the region of the superheater showing that the temperature of the gases was not reduced to quite such an extent when passing over the superheater tubes, but as soon as they again come into contact with the generating tubes, which were, of course, at a lower temperature, the curve falls more rapidly.

There is one feature in the trials which is particularly interesting, that is, the difference between the draught at the funnel base and that over the grate. At normal load the draught at the funnel base was 0.32 inch of water, while a similar reading taken over the grate was 0.25 inch. This small difference is to be attributed by the large area provided for the passage of the gases from the furnace, through the nests of tubes to the chimney, as well as to the absence of baffles or any other restriction. Possibly the absence of bird-nesting experienced with this boiler is to some degree to be accounted for by the slow velocity of the gases through the tubes.

At normal load the temperature of the flue gases was reduced by about 220 degrees F. by the air heater, while the average temperature of the air passing under the grate was about 300 degrees F. So far no injurious effects have been experienced on the grates or the brickwork or any other part of the boiler by air temperatures up to 362 degrees F., which is the limit reached during the trials, and it would appear that the grates might have been worked at a still higher temperature without harm.

In order to collect additional data, in the first instance the boiler was run under induced draught conditions only, the motor-driven fan being situated above the boiler and drawing air from the back and front of the casings, and delivering it through the air heater down the sides of the boiler casing to the grates. These passages, together with the air heaters, increased the resistance so that the draught over the grate was about 1.5 inches of water, with the result that cold air was drawn into the furnace through the coal hoppers. Trials were then conducted under balanced draught conditions, a forced draught fan being introduced into the system. It reduced the draught over the grate at normal load from 1½ inches to about ⅛ inch to ¼ inch water gage as desired. The advantages of balanced draught are well known, and, as was expected, the output and efficiency secured on the trials carried out under these conditions was somewhat higher than when the boiler was working with induced draught only. It was also found that under balanced draught the furnace conditions could be kept more uniform and were more easily controlled.

The result of these trials showed that a high output can be obtained per square foot of heating surface without any falling off in efficiency, this characteristic being largely due to the ample combustion space and the large area of the generating surface, which in a Yarrow boiler is subject to direct radiation. The well-inclined straight tubes also promote rapid circulation.

Land and Marine Boilers Compared

If the size and output of boiler installations in electric power stations are compared with marine practice for boilers of similar output, it would appear that in many instances the size of boiler adopted for land work is larger than is necessary. It is possible to force a boiler of the Yarrow type to a considerable overload with safety, especially if advantage is taken of all the improvements that have been made in recent years to mechanical grates and forced draught appliances. If, for instance, in a certain power station it is necessary to cope with a peak load of 50 percent or more for a short period, it will often be found that the boilers installed to meet this requirement are of such a size that they will be working most of the day very much below their normal rating. Boilers are often designed to provide 25 percent overload above their normal capacity, so that in stations in which more than 25 percent overload is demanded, even for a very short period, it follows that under normal conditions the boiler is larger than is necessary, and is being worked below its designed capacity.

Considerable saving in capital outlay is possible in many instances by installing a boiler of such a size that it can work at its normal rating most of the day and yet be found capable of giving an extra output of 50 percent or more when it is necessary to deal with peak loads. Not only is there the saving in initial costs and other advantages that a smaller unit possesses but the boiler will be working generally at its normal and designed load, and therefore at its maximum efficiency. The efficiency will, of course, be somewhat less when working at a considerable overload, but as the overload is only carried, in most instances, for a short period the loss is not of great importance.

There are cases in which a very high peak load has to be dealt with, and in such instances oil burning may be adopted with advantage. The very high evaporation which has been obtained with the Yarrow type of oil-fired boiler is of particular service where very large overloads have to be met.

It may be of interest to mention that in torpedo-boat destroyer work a Yarrow boiler evaporates 25 pounds of water from and at 212 degrees F. per square foot of heating surface per hour continuously.

Some Other Designs

The drawing given in Fig. 2 shows the details of a typical water drum for the Yarrow land type of boiler. It will be seen that although the angle at which the outside rows enter the steam drum is considerable, the tube holes are drilled so that the tubes can be kept quite straight. With this design there is no difficulty in expanding and bell-mouthing the tubes, so that they are quite tight, the procedure being in accordance with the usual practice adopted in connection with the manufacture of Yarrow boilers extending over a period of many years.

Work Reports and Their Value in the Shop

At every engine terminal or shop of any importance reports, charts or graphs are prepared for the foremen and their superior officers, which show on a monthly comparative basis various phases of the work performed. Considerable time and money is involved in the preparation of these reports by the clerical force of the various departments. The question is, do they serve their intended purpose? Those for whom the reports are intended should study them with a view to understanding the reason for them, the information contained in them and how best to use that information in obtaining better results. That this may be accomplished, detailed instructions should be issued with each report setting forth clearly how the data were obtained, the method of deriving the results shown and the object aimed at in issuing the report. Furthermore, after the supervisors have had ample time to digest the written instructions they should be called into the office where the report is prepared and closely questioned as to whether the report is fully understood. The men should be taught that the reports are not prepared primarily for the general officers of the railroad but that, except in rare instances, they are planned to provide the immediate supervisory officers with a record of the work being done. These reports should regularly be used to provide a proper incentive for the supervisors, to compare their work and their results with others and to use the results shown to inspire their associates and subordinates. Reports using the man-hour unit of measure for determining the cost of work done on locomotives and cars can be used to a good advantage if properly studied. Beneficial results can be obtained in studying the cost for each class of work performed on equipment by measuring the results in man-hours, not only for labor but for material as well. If reports of this nature are properly explained and exhibited to the workmen each month, they will know what their work is costing in comparison to that done by their associates. This will create an incentive for efficiency and economy. Foremen should be taught to analyze and use reports of this kind so that they can in turn, convey the information among their subordinates and associates and use it if they are promoted to positions of greater authority and responsibility. If they are not used as is too often the case, how can the cost of their compilation be justified?—*Railway Mechanical Engineer.*

Common Sense

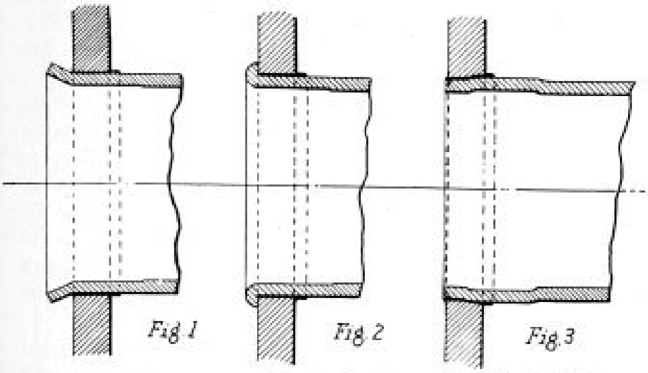
Is the most uncommon thing in the world.
Is what we all want credit for using.
Is what makes any system work.
Always recognizes the value of another man's ideas.
Never has to wait long for a market.
Is composed of observation, experimentation, judgment and work.

Arch Tube Failure Causes Serious Locomotive Accident

Drastic Action Taken by the Bureau of Locomotive Inspection Against Inspector Responsible for Dangerous Condition of Boiler

IN answer to a request from numerous readers for details of the accident to the Boston & Maine Railroad locomotive 3009, which occurred in the Hoosac Tunnel, Massachusetts, last February, the report of the chief inspector of the Bureau of Locomotive Inspection covering the disaster is given. This report, only made available for publication a short time ago, appears below in detail.

On February 14, 1924, at 6.15 a. m., an arch tube was blown out of the throat sheet of Boston & Maine Railroad locomotive 3009, while in Hoosac Tunnel, which resulted in seriously scalding and burning the engineer and the fireman, who were in charge of the locomotive at the time of the accident. The accident occurred near the middle of Hoosac Tunnel, which is approximately 4½ miles long, while the train was being hauled by an electric locomotive and while locomotive 3009 was being hauled with the throttle closed.



Correct and Incorrect Method of Installing Arch Tubes

Locomotive 3009 is a 2-10-2 or heavy Santa Fe type used in freight service, equipped with a wide firebox and five arch tubes, 3½ inches in diameter, carrying a steam pressure of 190 pounds.

When the arch tube blew out the scalding steam and water were blown through the 3½-inch opening into the firebox and cab, seriously scalding the engineer and fireman, who in trying to escape from the scalding steam and water made their way back over the tender where in doing so they were compelled to come in close proximity to the overhead electric wire, carrying a high voltage, supplying current for electric locomotives.

The fireman described the accident substantially as follows:

"We were not going very fast in the tunnel because the train was cold, it being about 10 degrees below zero. When in the tunnel about 2 miles, steam poured out through stoker elevators and drove us back into the coal pit. But the steam was coming up through conveyors, making it impossible to stay there. We became separated and when on the back of tender I put my head down in cistern filling hole, but that proved useless. I went down between the tender and head car and tried to open the angle cock but couldn't, so I jumped out onto the other track. I thought the engineer was in the coal pit but later learned that he went over the side of the tender. I don't know how close we were to the overhead wires."

Examination disclosed that the center arch tube had not been properly rolled and had been cut too short to extend through the throat sheet far enough to be either belled or beaded to secure it in place. Fig. 1 shows the method of belling which had been followed in securing the other four tubes in place. Fig. 2 shows the method of beading arch tubes to secure them in place. Either of these methods is recognized standard practice and is acceptable under the law. Fig. 3 shows the way the tube that blew out was applied.

The unsafe condition created by the failure to properly roll and to bell or bead arch tubes to secure them in place is so generally well recognized that comment hardly seems necessary. Notwithstanding, many serious and fatal accidents have been caused by the failure to bell or bead arch tubes, and our inspectors are finding many cases where arch tubes have been cut too short to bell or bead and are held in place only by friction which sooner or later will give way.

Records of the Boston & Maine Railroad Co. show that the tube which blew out had been applied in its shop at Mechanicsville, N. Y., on December 24, 1923, after which the locomotive was used until January 6, 1924, when it was withdrawn from service and remained out of service until January 17, when it was given an annual inspection and hydrostatic test at Mechanicsville, N. Y., by the carrier's inspectors, Robert Addison and H. Pendl, and an annual locomotive inspection and repair report was filed covering this inspection, dated at Mechanicsville, N. Y., on January 17, which stated that the inspection had been made in accordance with the law and the rules and instructions issued in pursuance thereof and approved by the Interstate Commerce Commission, and that all defects disclosed by such inspection had been repaired.

This report was subscribed and sworn to by two of the carrier's inspectors, and the report signed and approved by a foreman as officer in charge. The report further showed that one inspector examined the arch tubes of locomotive 3009 and swore that they were in "good" condition, notwithstanding the fact that the center arch tube was in a dangerous condition and had been in this condition since the date of its application on December 24, 1923, thus endangering the life and limb of every person who was on or about this locomotive each day it was under steam pressure from the date of the application of this tube.

It appearing that this inspector did willfully subscribe and swear that the arch tube was in good condition when he did not believe the same to be true, the matter was presented to the United States grand jury, when, on June 5, 1924, an indictment was returned in the United States District Court for the Northern District of New York, and a warrant issued for the arrest of the inspector for the commission of perjury in accordance with section 125, Revised Statutes of the United States, which prescribes a penalty for perjury of not more than $2,000 and imprisonment for not more than five years if found guilty.

The seriousness of subscribing to false statements in the reports of inspection is evidenced by the fact that men have been killed and seriously injured due to false information, and the failure to make proper repairs at the proper time, whether maliciously or otherwise. Incorrect statements made in connection with the inspection and repair of locomotives can not be too strongly condemned on the part of those who make the inspections and on the part of the railroad companies who are responsible for compliance with the law.

Information is being prepared to be lodged with the proper United States attorney for prosecution in the court, in accordance with section 9 of the act, against the Boston & Maine Railroad Co. for each use of this locomotive while in an unsafe and defective condition, thus creating an unnecessary peril to life and limb.

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, C. W. Obert, 29 West 39th Street, 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 interpretations of the Committee in Cases Nos. 446-453, inclusive, as formulated at the meeting of June 17, 1924, all having been approved by the council. In accordance with established practice, names of inquirers have been omitted.

Cases Interpreted Under the Rules of the 1924 Revised Edition of the Boiler Code

Case No. 446

(In the hands of the Committee)

Case No. 447. *Inquiry:* An interpretation is requested of the application of Par. S-15 in the Specifications for Steel Boiler Plate, which permits an undergage variation of not more than 0.01 but leaves the overgage allowance as a matter of contract between steel manufacturer and boiler builder, to Par. P-253, which prohibits the punching of any part of a rivet or staybolt hole in material more than ⅝ inch in thickness. What is the permissible overgage variation in steel boiler plate when considering Par. P-253?

Reply: It is the opinion of the Committee that where the overgage limits of steel boiler plate are under consideration, the prohibition of punching of rivet or staybolt holes in material ⅝ inch in thickness need not be considered applicable as long as the overgage variation of the plate thickness does not exceed ⅝ inch in thickness by actual measurement at the edge of the plate by more than 6 percent.

Case No. 448. *Inquiry:* Is it permissible, in the construction of watertube boilers, with tubes inserted in the shells of the drum, to so locate the riveted longitudinal joints of the drums that they are exposed to the products of combustion? Attention is called to the fact that the Boiler Code prohibits the exposure of longitudinal joints of boilers to the fire or products of combustion.

Reply: Attention is called to the fact that the prohibition in the Boiler Construction Code of the exposure of longitudinal joints to the fire or products of combustion which appears in Par. P-189 is applicable solely to horizontal-return tubular boilers. Attention is called to Par. P-193 of the 1924 revised edition of the Boiler Code in which the last sentence stipulates that "when reinforcing plates or butt straps are exposed to flame or gas of the equivalent temperature, the joints shall be protected therefrom."

Case No. 449. *Inquiry:* Is it permissible, under the requirements of the Boiler Code, to attach the lower tube sheet of a vertical-tubular boiler to the furnace sheet by lapping and welding the lapped edges on both the fire and water sides of the sheets, provided the welded seam is located between two rows of staybolts to the outer shell of the boiler?

Reply: It is the opinion of the Committee that inasmuch as the expansion and contraction in the vertical tubes may set up a tensile stress in the welded section, Par. P-186 would prohibit the construction.

Case No. 450. *Inquiry:* Is it permissible, under the Boiler Code, to use autogenously welded longitudinal and circumferential seams instead of riveted construction in the furnace sheet and in the outside shell plate of an internally fired vertical boiler, provided the furnace is supported by staybolts screwed through the outside shell? The type of boiler is a vertical, cylindrical boiler having an internal furnace the full height of the boiler, which is practically an annular water space, into the inner shell of which are fitted spiral coils attached by threaded and expanded connections to the upper and lower part of the boiler.

Reply: It is the opinion of the Committee that the use of autogenous welding for the outside sheet will not be permissible under the requirement of Par. P-186, and that such construction will be permissible only for boilers constructed to the requirements of the Low-Pressure Heating Boiler Section of the Code. For the inside of furnace sheet, see Case No. 375.

Case No. 451. *Inquiry:* Is it permissible, under the requirements of the Boiler Code, in attaching the ends of through stays to the heads of Scotch marine-type boilers to thread the ends of the through rods into heavy plates or blocks that are fastened to the inner surface of the head by rivets? The purpose of this proposed construction is to avoid the large nuts on the projecting ends of the through rods outside of the head where they are very much in the way of the smoke box and furnace front.

Reply: The theory of the formula and constants provided in Par. P.-199 is predicated upon the ends of the through rods being secured in some more positive way than by the holding power of the thread in the plate, and inasmuch as no such additional provision is made in the arrangement submitted, the Boiler Code Committee is of the opinion that this form of construction does not meet the requirements of the Code.

Case No. 452. *Inquiry:* In the application of Pars. H-51 and H-107 of the Heating Boiler Section of the Code, to water-relief valves, interpretation is requested as to what may be considered the relieving point of the valve. In actual practice with water-relief valves of the diaphragm-operating type, it is found that there is a difference of from 3 to 8 pounds between the pressure at which the valve begins to drip and that at which it opens sufficiently to deliver a stream of water.

Reply: It is the opinion of the Committee that the pressure at which such a water-relief valve begins to drip should be taken as the relieving point.

Case No. 453. *Inquiry:* Is it permissible, under the Low-Pressure Heating Boiler Section of the Code, to so locate the water-gage glass on heating boilers fitted with a two-pass arrangement of tubes that the lowest visible part of the glass is on a level with the bottom of the top row of tubes at the front end of the boiler?

Reply: It is the opinion of the Boiler Code Committee that the lowest visible point of the water-gage glass should not, for low-pressure heating boilers, be located at a point lower than that specified for fusible plugs in Par. H-64.

46.8 Percent of Locomotives Found Defective.—Of 5,460 locomotives inspected by the Bureau of Locomotive Inspection during July, 2,553 or 46.8 percent were found defective and 282 were ordered out of service, according to the Interstate Commerce Commission's monthly report to the President.

Proposed Code of Rules to Govern Autogenous Welding on Steam Pressure Boilers*

IN drawing up the appended set of rules governing the autogenous welding of steam pressure boilers, doubt was expressed as to the use of certain types of welded joints. Particularly was there doubt as to the relative efficiency of lap versus butt welded joints, and it was felt that some effort should be made to clear up this disputed point before drafting any set of rules.

Before presenting the set of rules recommended to govern boiler welding practice therefore, and in order that certain recommendations hereinafter made may be the better understood, we are giving below first the results as obtained from these tests.

Butt vs. Lap Welded Joints

The following tests to determine the relative efficiency of butt versus lap welded joints were made on one-half inch boiler plates and executed in conformity with the plate bevels shown on the accompanying print for single "V" butt welds and for lap welds. The double "V" butt weld was not tested in this case.

The main object was to fulfill as far as possible the same conditions as obtain in the welding of a boiler in the shop. Hence the plates were clamped into position during welding to prevent warping and drawing and any internal strains

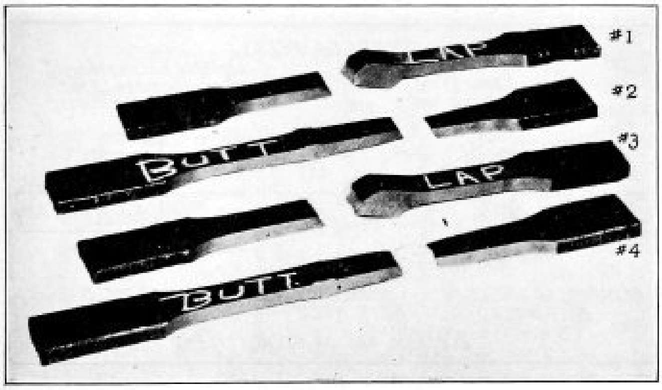


Fig. 1.—Lap and Butt Welded Specimens for Test

likely to be induced in the boiler by such practice should also have been present in the appended test welds.

When completed, no attempt was made to machine off the reinforcing or extra depth of thickness in the welds. This reinforcing is added to the average boiler weld with the idea of making up any discrepancy in strength between the cast metal of the weld and the rolled metal of the plate, and should be left on the plates to give a true representation of conditions as they occur in practice. Past results on test plates where this reinforcing has been machined off, have been in the neighborhood of 85 percent of the strength of the plate. This is accounted for by the fact that a cast metal is always weaker than a rolled one, and from the presence of impurities in the weld zone such as the oxides from burning. To make up this percentage of weakness is, of course, the reason for reinforcing, and since the boiler in service has such reinforcing or extra depth of thickness in the welds, it was left on our test plates when they were tested. The results as given refer to the tensile strength per square inch of the original plate section or section beyond the weld.

Summary of Tests

Twenty plates were prepared from boiler plate of 55,000 pounds minimum tensile strength per square inch and tested as follows:

Plates Reinforced and Welded on Both Sides of the Joint

Tensile Tests:

Butt Welds: Four plates of this type were prepared for tensile tests. All broke entirely outside the weld zone in the untouched

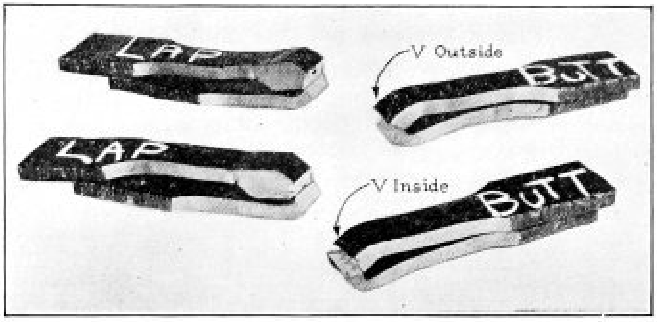


Fig. 2.—Bend Tests on Welded Plates

plate section and about two inches from the weld. The elongation varied from 20 to 25 percent and the breaking strength averaged close to 56,000 pounds per square inch of original plate section. The weld itself did not visibly stretch and the above elongation is due to the stretch of the original plate metal, which is plainly seen in the appended photograph, which shows two of the butt welded plates with two of the lap welded type.

Lap Welds: Four of this type were prepared and welded for tensile tests. Two of these broke outside the weld in the original

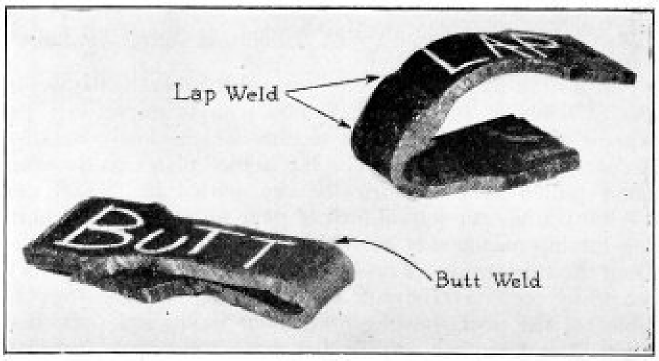


Fig. 3.—Butt Weld Here Shows Greater Strength Than Lap Weld

metal. The other two broke at the edge of the weld at loads of 54,000 and 56,000 pounds per square inch of plate section respectively, or practically the full strength of the plate.

Bending Tests:

Eight plates were prepared and welded, four by the butt weld and four with lap welds, to be used for bending tests. These were then bent 180 degrees and flattened more or less completely. One of the butt welds stood complete flattening without failure. The other three butt welds stood bending 180 degrees on a curve whose

* This report of the committee on recommended practice and standards, composed of Leonard C. Ruber, chairman; E. W. Rogers, A. S. Greene, J. W. Kelly and G. B. Usherwood, was read at the annual convention of the Master Boiler Makers' Association. The report is published for the information of all members of the Association and will be open for general discussion at the 1925 convention, when it will be acted upon.

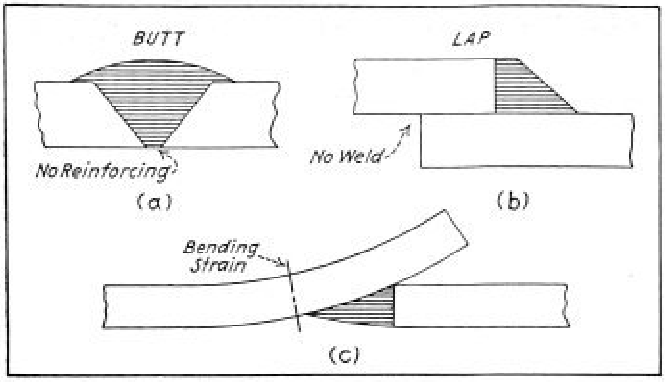


Fig. 4.—Tensile Test Results on Different Welds

radius was one inch, without failure, but parted on the edge of the weld on complete flattening.

The lap welds, due to the thickness of the joint at the weld, could not be bent to any small radius. However, they stood bending 180 degrees to a radius of two inches, but broke at the edge of the weld below this. The two photographs show some of these tests.

Plates Welded on One Side Only

In firedoor holes formed by the flanging of the outer and inner plates of the firebox, it is only possible to weld the joint on one side, due to the inaccessibility of the water space. This is also true of many repairs to stayed fireboxes of the locomotive type, where patches are often applied to the firebox while in place. To determine whether butt or lap welds were most suitable for this work some test plates were prepared and welded on but one side. In the case of the butt welds, Fig. 4 (a), the customary single "V" joint was employed, but no reinforcing or welding was done on the under side of the test plates. In the case of the lap welded plates, Fig. 4 (b), only one side was welded, as this is all that is accessible in the cases spoken of above.

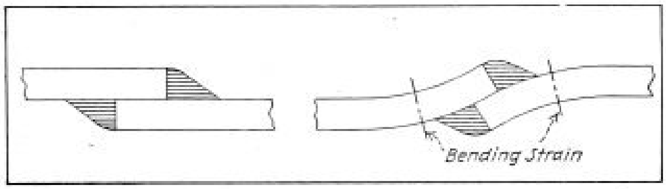


Fig. 5.—Effect of Bending Shown on Short Laps

On testing these plates, the butt welds broke in the welds, but at loads of 55,300 and 53,600 pounds respectively per square inch of original plate section, which closely equalled the strength of the plate. The lap welded plates on the other hand pulled very eccentrically and parted at 26,000 and 17,300 pounds per square inch of plate section. Before parting the lap on the side not welded opened nearly 30 degrees from the side strain. These side bending strains, Fig. 1 (c), set up by the eccentricity of the pull were of course, responsible for the poor showing of the lap welds and show how little dependence can be placed in a lap weld made from but one side.

Conclusions from Tests

Plates Welded on Both Sides of the Joint: On straight tensile tests, butt welds, properly reinforced on both sides of the joint, are as strong as the original plate and slightly stronger than lap welds. This is due to the eccentricity of pull in the case of the lap welds, which sets up side strains at the edge of the weld in addition to the strain of the direct pull itself. These side strains cause distortion in the metal at the edge of the weld, which having been in the heat zone during welding, is less able to stand the added strain. The result is that rupture on straight tensile tests occurs somewhat earlier than is the case with butt welds, which have no side strains.

On the bending tests, neither type of weld showed much flexibility in the weld zone itself, but the plates in all cases bent in the metal just outside the weld. The butt joints, being of lesser thickness, could be bent to a more complete degree than could the lap welds.

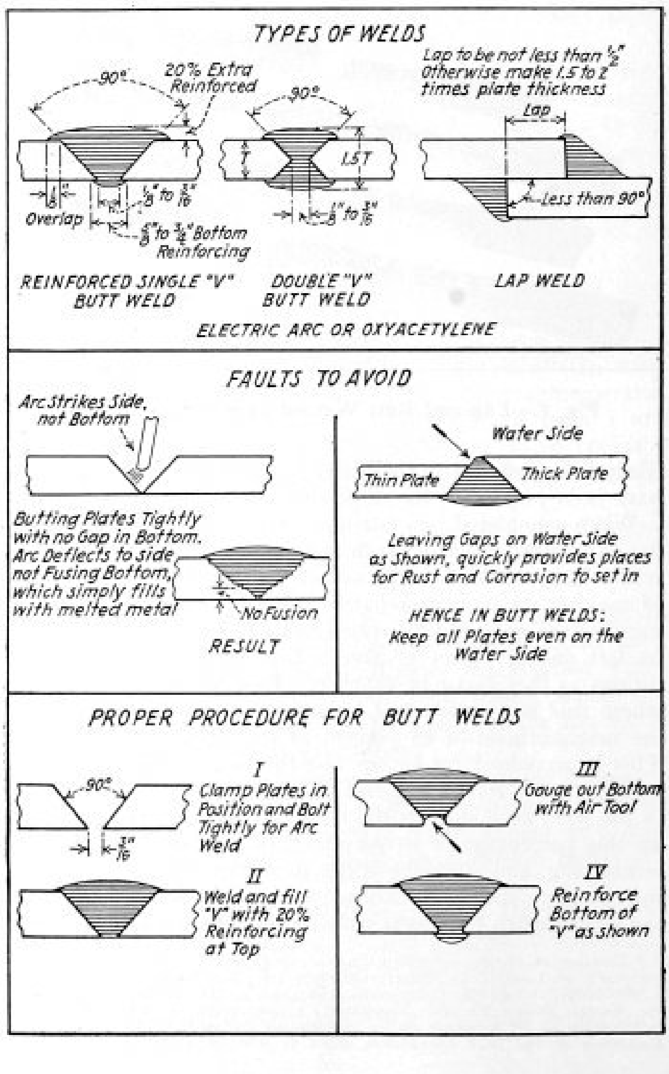
The conclusion formed from these tests seems to be that while the difference between these two types of joints, where properly made on both sides, is slight, still the butt welded joint does show a certain measure of superiority which would make its use preferable in the majority of cases.

Plates Welded on One Side Only: In the case of plates welded on one side only, the butt welds showed a decided superiority. The lap welds on the other hand showed a dangerous weakness in construction which would make their use inadvisable at any time.

Arc Welding Standards for Filling Rods

The recommendations given in the proposed code of rules are the results of chemical, physical and welding tests to which we subjected 17 different brands of welding wire. We also tested 16 different samples of wire of the same chemical composition, which had been rolled differently, or rather drawn differently. The cold drawn wires were the best.

Generally a cold or hard drawn wire, or a wire with any finish or surface, which increases the electrical resistivity of the surface as compared with the core, gives better results



than wire with the soft finish seen on a wire nail. The latter burns all around the edges and scatters too much to ensure a good weld. As a consequence the molten drops fall on surface sill prepared to receive it and a poor weld results.

RESULTS OF TESTS

Number	Method of Welding	Breaking Strength in Lbs. per Sq. In. of Plate Sect.	Remarks
1	Lap	54,000 Lbs.	Broke at edge of weld
2	Butt	55,700 Lbs.	Broke in plate 2½ inches from weld
3	Lap	56,000 Lbs.	Broke at edge of weld
4	Butt	55,870 Lbs.	Broke in plate 2 inches from weld

Tensile Strength of Plate = 55,000 Lbs. Minimum.

Recommendations Covering the Use of Autogenous Welding in Steam Boilers

1. Process to be Used: For use in the autogenous welding of steam boilers, either of the following processes may be used:

(a) The electric arc process, employing metallic rods as a filling medium and as one end of an electric terminal, the other end of which is the body being welded.

(b) The oxy-acetylene or other gas process, employing a mixture of oxygen and a combustible gas which is burnt in a torch. For steam boiler welding generally, either process may be used, although in the appended drawings, the electric arc process has been assumed as a basis for the sketches. Where the oxy-acetylene or other gas process is used, practically the same plate preparation and bevels are necessary as in the case of the electric arc process.

2. Operators: No welder should be employed on firebox or other steam pressure welding in boiler work who has not had at least six months experience in the particular kind of welding process employed on the boiler in question, whether it be the electric arc or a gas process, nor shall such welder be employed on such work who has not shown himself generally competent to produce a satisfactory job.

3. Preparation of the Work: (a) All plates before welding should have their edges properly "V"d or otherwise prepared for welding in accordance with the dimensions laid down for the preparation of plates in the accompanying prints. For seams generally the joints shown, the single and double "V" butt welds or the lap weld, all welded on both sides, are recommended. Where other bevels or shapes are used, the plates should be prepared in such a way as to ensure fusion on welding going all the way through.

(b) All plates before welding should be made clean from dirt, rust or grease by chipping, sandblasting or grinding. The weld must be executed on clean metal.

(c) In the case of internally fired boilers with welded fireboxes where the plates are uneven in thickness, they should be lined up evenly on the water side. The formation of ridges on the water space side, which act as catch basins for dirt and become fruitful-areas for the spread of rust and corrosion, is thus avoided.

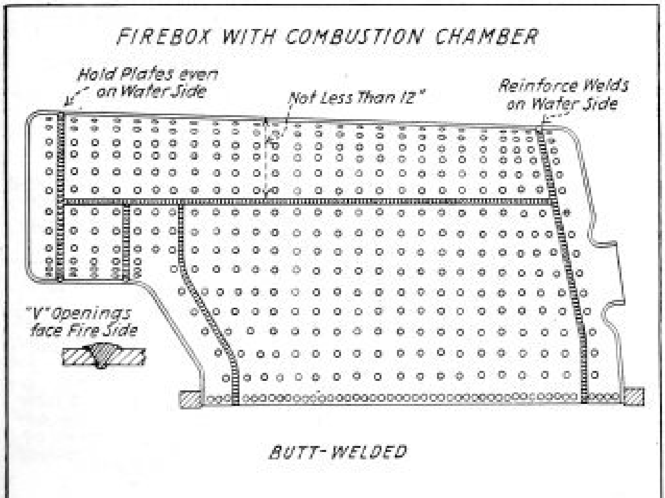
(d) In such welded fireboxes, where single "V" butt welds are employed, the "V" openings should face the fireside to facilitate repairs.

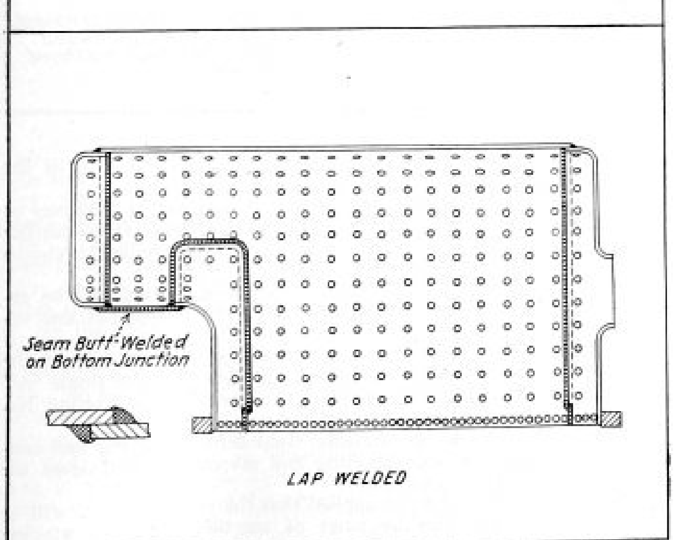
(e) In all cases during the act of welding, care must be taken to maintain the opening and position of the plates correctly and to this end proper safeguards must be taken against warping.

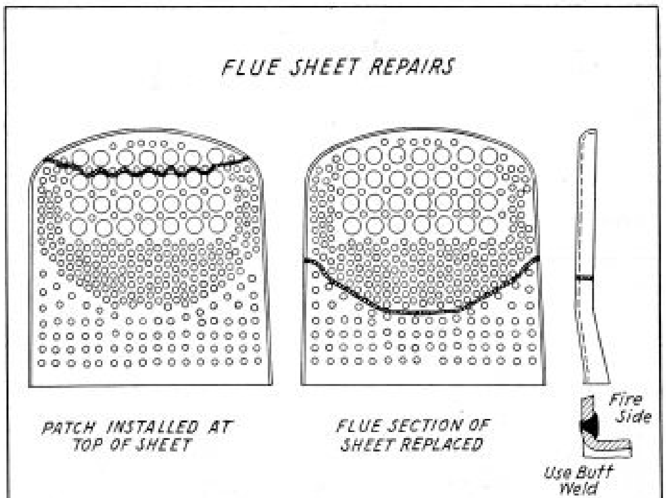
4. Welding—Where not Permitted: Autogenous welding should not be permitted on any part of a steam pressure boiler where the strains to which the structure is subjected are not carried by other construction which conforms to the requirements as set forth in the various boiler codes.

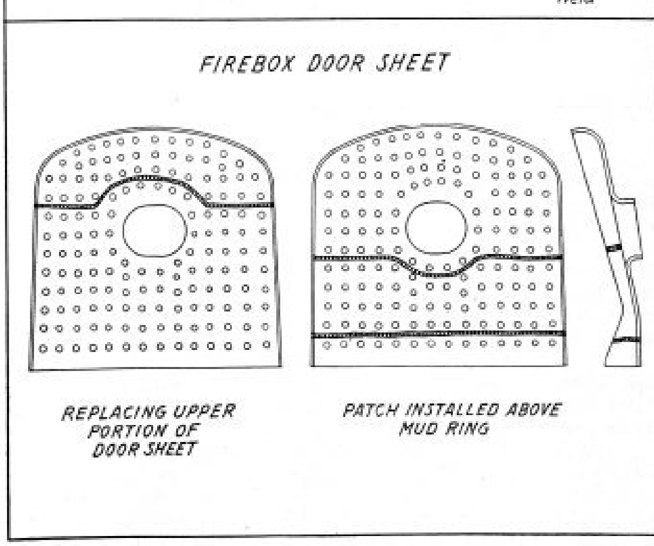
5. Rectangular Headers: For low pressure steel plate boilers operated at a pressure not exceeding 15 pounds per square inch, rectangular headers may be autogenously welded at the edges if the sheets are properly held together by stays.

6. Welding of Fireboxes: Fireboxes of internally fired boilers, which have the plates properly stayed, may be welded subject to the restriction provided in the clauses following:







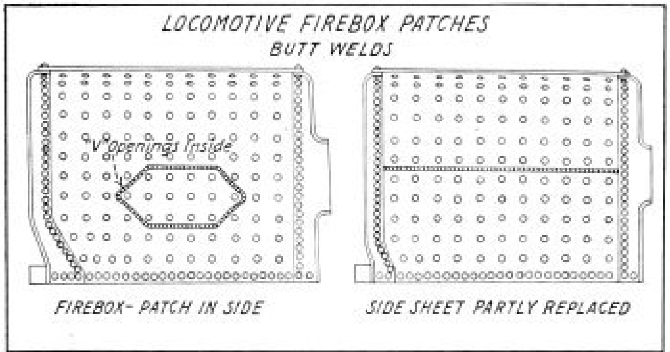


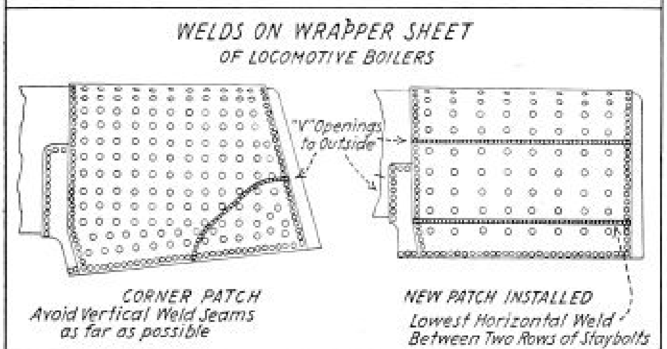
7. Welds in Firebox Crown Sheets: No welds should be made in the crown sheets of fireboxes of internally fired boilers closer than 12 inches vertically below the top of the crown, save as follows:

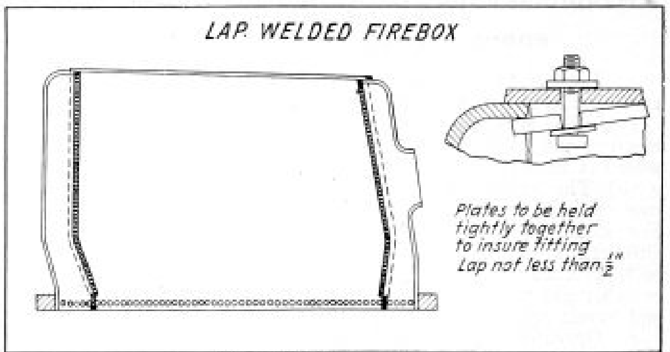
(a) In fireboxes of the locomotive type, where the flue sheet and door sheet are flanged, they may be joined to the crown sheet by welding in place of riveting, and by either the butt or the lap methods of welding, providing the welds are made as follows:

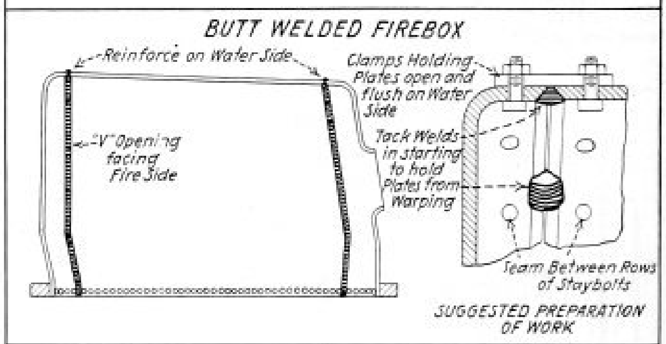
(aa) Where the single "V" butt weld is employed, the plates must be properly "V"d and welded with 20 percent reinforcing on the full side of the "V." The slag or loose metal on the under side of the "V" must then be removed, preferably with a gouging cut made with an air tool or hand chisel, and the weld should be reinforced on this side in accordance with the print.

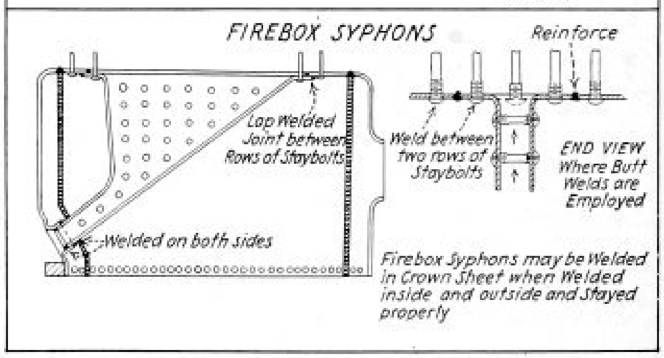
(ab) Where the double "V" butt method is used, it should be reinforced on each side to a total thickness of one and a half times the plate thickness, after which if desired, the extra thickness on the water space side may be partially ground off.











(ac) The lap method may be employed to join the flange plates to the crown sheet, provided the welds are made on each side of the lap equally. The overlap of the plates in such a case should be not less than one-half inch.

(b) In fireboxes of internally fired boilers where syphons for water circulation are located in the firebox and extending from the sides, front or back of box to the crown, the syphon entrance to the crown may be welded, provided the weld is made from both sides and provided also that the weld is properly stayed.

8. Location of Welded Seams: In fireboxes of the locomotive type, where autogenous welding is employed for joining the flanged plates to the crown and side sheets, these welded joints should as far as possible be located between two rows of staybolts.

9. Firedoor Holes: In forming the firedoor holes, stoker tube holes and other openings of similar character in boilers of the locomotive type or in vertical firebox boilers, the edges of the outer and inner plates may be joined by autogenous welding if the surrounding surfaces are thoroughly stayed with the nearest row of staybolts located at a distance dictated by the correct staybolt pitch for the boiler in question.

(a) Where tubes or sleeves are used to connect the inner and outer plates of such boilers for the purpose named, such tubes or sheets may be joined to the plates by welding, where these plates do not constitute part of the shell of drum or boiler, and where the surrounding row of staybolts is distant from the tube or sleeve at a distance dictated by the correct staybolt pitch for the boiler in question.

10. Welds Made on One Side Only: In all welds such as the firedoor holes mentioned in Section No. 9, or in the application of patches to internally fired boilers in place, where the weld can be made on but one side of the sheet, the single "V" butt weld should be employed to the exclusion of the lap weld or other forms of joint.

(See test results on welds made from one side.)

(a) Where possible all welds should be reinforced on both sides of the joint, and no weld which is not so reinforced, should be allowed closer than 12 inches vertically below the top of the crown in the fireboxes specified in Section No. 7.

11. Welding of Patches: In the stayed portions of fireboxes or in the stayed outside sheets of internally fired boilers, where patches may be inserted by autogenous welding, the following provisions should govern:

(a) Where a number of small adjacent patches would be required, the defective part of the sheet should be cut out and repaired with one patch.

(b) Where the weld can only be applied on one side of the sheet and where it cannot be repaired on the other, the single "V" type of butt weld should be employed, as provided in Section No. 10.

(c) Patches should be carefully fitted before applying and conform to the rules of plate beveling and preparation laid down for the welding of seams generally.

(d) Patches should be so applied that the resulting weld will be supported on both sides by rows of staybolts or other staying media.

(e) Autogenously welded-in patches on the shell of a boiler, unless supported by a liner or butt strap, will not be permitted.

(f) Patches should be so located as not to cut through any of the holes employed for holding the staybolts or other staying media.

(g) In the welding of patches which embrace the doorhole or other similar opening of fireboxes of internally fired boilers, at least one adjacent row of staybolts should be included in the patch.

(h) In fireboxes of the locomotive type, where one or more patches are placed on the side sheets as a roundhouse repair, the patched side sheets should be removed and a new side sheet should be installed, when the locomotive is sent to the back shop for dismantling and repair.

12. Firecracks: (a) Where firecracks in girth seams of stayed boiler surfaces extend from the edge of the plate to a rivet hole, they may be autogenously welded, provided the rivet is removed, the crack is properly "V"d and welded through for the depth of the plate. The rivet holes should then be reamed out before reapplying the rivets.

14. Staybolt Heads: Staybolt or crown stayheads should not be built up or welded to the sheet.

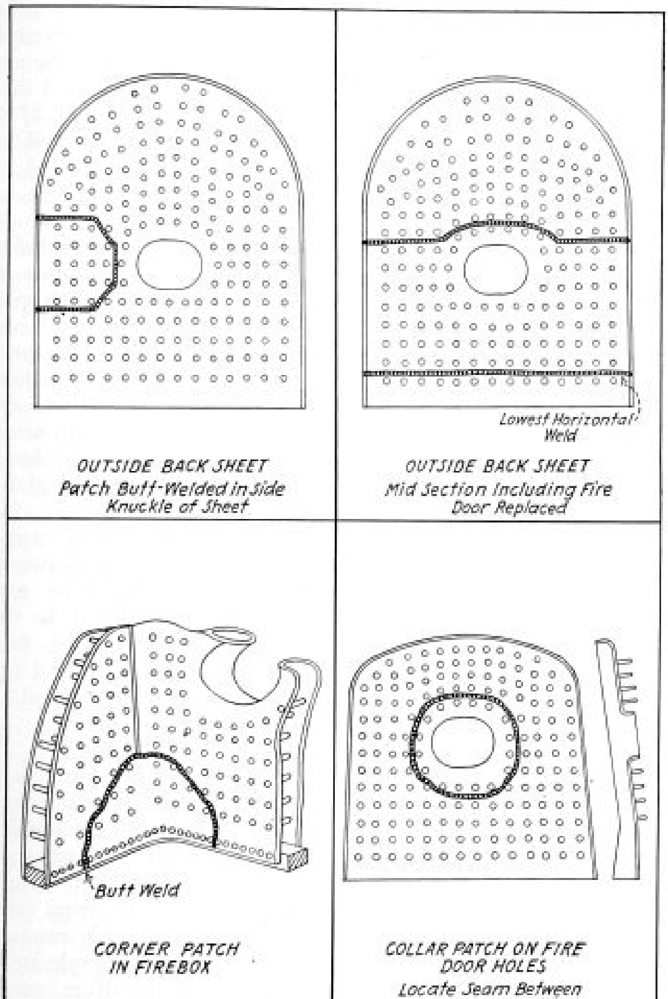
15. Calking Edges: Calking edges of plate boilers may be reinforced against leakage by autogenous welding, where desired.

16. Welding of Boiler Flues: Where flues are arc welded to the tube sheets, care must be taken to use an electric current of proer strength to avoid either the burning or the improper fusion of the plate. The current values given below are recommended as being reasonable:

	2 Inch Flues		5 Inch Flues
Diameter of Welding Wire....	1/8"	5/32"	5/32"
Electric Current in Amperes...	100-120	120-130	120-140

The amperes should be increased to the upper limits given:

(a) Where it is not practicable to sandblast the sheets or where considerable scale exists. In general the welding of flues to unclean metal is not recommended. Where excessive oxide impervious to sandblast exists, it should be removed with a gouging cut around the rim of the holes, prior to welding.

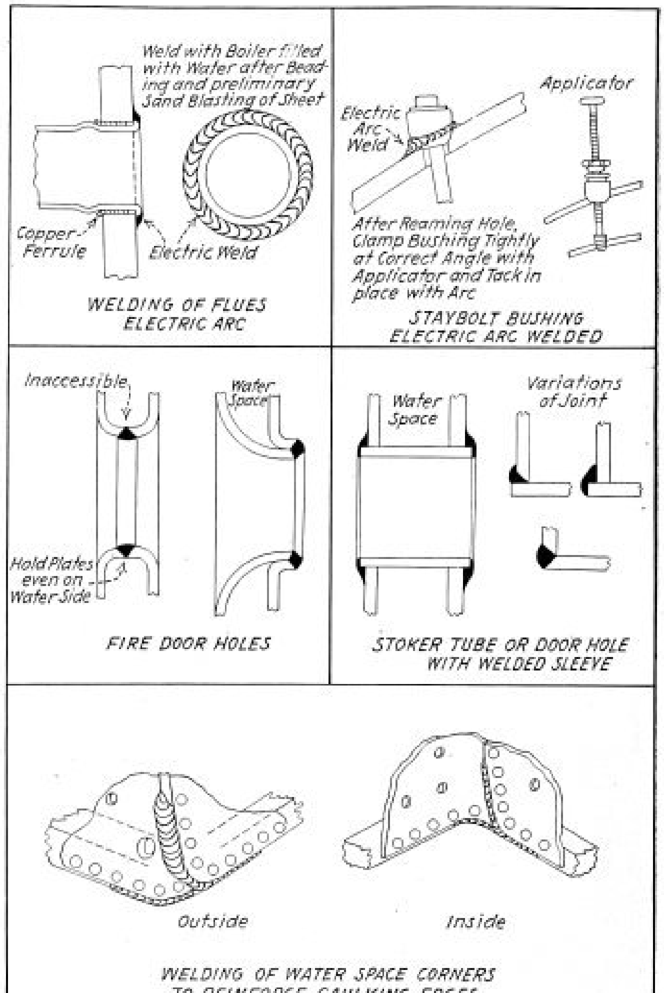


OUTSIDE BACK SHEET
Patch Butt-Welded in Side Knuckle of Sheet

OUTSIDE BACK SHEET
Mid Section Including Fire Door Replaced

CORNER PATCH IN FIREBOX

COLLAR PATCH ON FIRE DOOR HOLES
Locate Seam Between Rows of Staybolts



WELDING OF FLUES ELECTRIC ARC

STAYBOLT BUSHING ELECTRIC ARC WELDED

FIRE DOOR HOLES

STOKER TUBE OR DOOR HOLE WITH WELDED SLEEVE

WELDING OF WATER SPACE CORNERS TO REINFORCE CAULKING EDGES

(b) Where cracks develop between staybolts, the defective part of the sheet should be cut out and a new plate inserted.

(c) When cracks develop in shell plates, no welding should be permitted, unless thoroughly reinforced by liners and butt straps.

(d) Autogenous welding of cracks and fractures in cast iron boilers should not be permitted.

(e) Cracks in wrought iron, wrought or cast steel and cast iron headers of water tube boilers may be repaired by autogenous welding. In the case of cast iron headers, this repair should not be made by the electric arc process, but the oxy-acetylene or other gas process should be used.

(f) No cracks should be repaired by placing lap-welded patches over them.

13. Sandholes: Sandholes in cast iron or steel headers, manifolds and the like may be filled up by autogenously welding or fusing in metal to fill the cavity. In all cases the cavity must be cleaned of sand or dirt by chipping so that the weld may be executed on clean metal.

(b) Where the lead wires are long.

(c) Where the larger diameter of welding wire is used.

17. Tube Junctions to Tube Sheets: Tubes may be welded to the tube sheets as provided in Section No. 16, but only in boilers where the tube sheet does not constitute part of the shell of the drum or boiler.

(a) In the application of sectional pieces to tube sheets, the plate should be laid out where possible so that the line of welding does not extend through the tube holes. Where the holes are so close together that this cannot be accomplished, it is considered best to extend the area of replacement until this rule can be enforced.

(b) In the application of part flue sheets, the edge of the seam, beveled for welding, should not come closer to the tubes than one-half inch.

(c) Where the bridges between the tubes are broken, the tubes in that section may be removed, the cracks "V"d out and welded, provided the number of broken adjacent bridges is small. Where the number of bridges needing repair increases beyond a reasonable maximum, the tube area should be replaced at the first opportunity. A reasonable maximum may be construed as two adjacent broken bridges.

18. Holes: When holes larger than 1¼ inches in diameter are welded, they should have the welding properly stayed.

19. Mud Rings: Where the mud rings of boilers of the locomotive type are badly worn from the corrosive action of the water and the impurities settling thereon, they may if not too badly corroded, be restored to their original dimensions by the use of autogenous welding.

20. Standards for Filling Rods:

(1) Electric Arc Welding

(a) Filler rods should preferably be from ⅛ to 3/16 inches in diameter and of any convenient length for the job:

(b) Chemically their composition should be:

Carbon	Not over 0.18%
Manganese	0.25% to 0.60%
Phosphorus	Not over 0.05%
Sulphur	Not over 0.05%

(c) Cold drawn wire is to be preferred.

(d) Wire should be shipped and stored in covered bundles, boxes, burlap and the like to keep it from rust and deterioration.

(e) Wire may be either coated or bare.

f) Wire conforming to the above specifications should be subjected to a practical shop test to determine its utility in overhead welding, and not purchased or used for welding unless it flows satisfactorily and is free from such injurious phenomena as splashing, sparking, dropping and the like.

(2) Oxy-acetylene Filler Rods

These rods should be of a good grade of rolled mild steel, not widely different in composition from the materials on which they are to be used, but containing a sufficient amount of manganese or other deoxidizer to offset the effects of oxidation in the weld. Any approved brand of welding rod for gas welding may be used.

21. Finishing Welds: Where welds on finishing are still at a dark red heat, and before cooling to darkness, they may be hammered or peaned to increase their ductility.

22: Nothing in these rules shall be construed as interfering in any way with the A. S. M. E. Standards, the autogenous welding provisions of the boiler codes of the several states, or with the regulations of the Federal Government. Wherein these rules do not conflict with such code as legally does apply to the boiler in question, these rules should constitute and be maintained as a standard in the autogenous welding of steam pressure boilers.

The Value of Inspections*

In pointing out some of the advantages of inspection service, we have frequently emphasized the seriousness of the defects found. There have recently come to our attention, however, several instances of defects in boilers located by members of our inspection staff and which are of particular interest because of certain incidents attending their discovery. Most of them undoubtedly would have been passed over by men not specially trained and experienced in boiler inspection work, as several required not only all of the skill and resourcefulness at the inspector's command, but also courage and tenacity such as perhaps few can lay claim to.

One such incident was the direct result of an unofficial visit on the part of the inspector. It had been his practice to call at the various plants in his territory whenever he happened to be in the vicinity in order to keep in touch with the engineers and the conditions at the plants. On one of these visits, which was made particularly to find out when a certain boiler would be available, the engineer remarked that the digestors were not in service just then and that it might be a good time to inspect them. By availing himself of the opportunity thus offered, the inspector made an interesting and timely discovery. One of these digestors, which was constructed with five courses each 48 inches long, had a patch on one of the courses at the lap seam longitudinal joint and running the full length of the course. At the calking edge of the patch, about midway between the girth seams, there apparently had been some leakage but, in preparing the digestors for laying up, the plates had been cleaned for painting and the leakage stains almost obliterated. In fact they would not have attracted any particular attention had not the patch been slightly bulged, a condition which the superintendent said had existed for some time. The inspector felt that something was wrong and requested that a hand hole be cut through the sheet and that a small portion of the lining be removed. A lap seam crack was revealed which ran practically the full length of the patch.

*Published through the courtesy of *The Locomotive*, of the Hartford Steam Boiler Inspection and Insurance Co.

On another occasion, while inspecting two watertube boilers in a power station, an inspector found what appeared to be an inside crack in the mud drum. It was not continuous but was visible for a distance of approximately 1½ inches, then a space of perhaps ½ inch then the crack again. The chief engineer of the plant thought it was light corrosion, and stated that he was not afraid of it. The inspector, however, was not satisfied and asked the engineer to have the defective part of the shell thoroughly cleaned. Later, assisted by another inspector, a re-examination was made with the aid of a magnifying glass, and an inside crack was revealed into which the blade of a pen-knife could be thrust about 3/16 of an inch. A defect of the same nature was discovered in the corresponding drum of the other boiler.

Result of a Horizontal Boiler Inspection

Again, a general inspection of a horizontal return tubular boiler brought to light signs of distress at several points in one of the longitudinal seams. Two rivet heads were snapped off and there was evidence of leakage at four different places. From the inside of the boiler the seam appeared to be in good order, but the inspector was not satisfied. He requested that a sufficient number of bricks be removed to make the seam accessible on the outside. The joint was of double butt strap construction, and an examination of the outside disclosed that the outside butt strap did not lie close to the shell plate. This is shown clearly in the accompanying illustration. At several points where the strap had been forced away from the shell, a heavy rust deposit was evident in between, indicating that the plates were somewhat reduced by corrosion. The removal of sixteen rivets proved this to be the case, besides bringing to light the fact that five rivets had been broken. Owing to the condition of this seam and the age and type of boiler, its replacement was recommended.

Leakage in Watertube Boiler

A watertube boiler, operating at 225 pounds pressure, had just been placed in service after repairs to the furnace had been completed. On receiving notice that the inspector desired to make an internal inspection, it was immediately taken out of service and prepared for the inspection. Slight indications of leakage at the girth seam of one drum were evident, closer examination also revealing a crack running from a rivet hole to the edge of the plate. Superheaters, which were located within three inches of the drum, made difficult a satisfactory examination of the girth seam. The inspector, however, thought it quite likely that more cracks existed and so requested the removal of ten rivets. The surrounding plate was then cleaned with acid, whereupon it became evident that similar cracks existed in seven of the ten holes. Upon removal of all the rivets up to the butt straps on each side, it was found that 44 rivet holes were thus impaired. There were nine boilers in this battery and the turbine room was adjacent to the boiler room, from which we may obtain some idea of the probable loss had this defective boiler not been rigidly inspected at the time.

Leaky Tubes Discovered

A short while ago an inspector was sent to look over some leaky tube ends at a plant housing two 150 horsepower boilers operating at 120 pounds pressure. On arrival at the plant, one boiler was found in operation at but 80 pounds pressure and with the 4-inch tubes leaking badly. Inquiry developed that the tubes had been rolled several times and made tight to water pressure, but that steam pressure of 80 or 90 pounds immediately started them leaking again. The outside of the boiler was heavily covered with lagging so that not much was to be seen except the tube ends and fire sheets. The inspector, however, felt that the trouble needed careful investigation, particularly in view of the fact that it was located under a hotel with a moving picture theater and stores on the first floor. He accordingly requested the removal of the 4-inch tubes and suggested that in the meantime not over 15 to 20 pounds pressure be carried on the other boiler. An inspection after these tubes had been removed revealed that fourteen of the cross braces were broken and that the flat side-plates of the boiler were bulged out about 1½ inches. Subsequent removal of the 3-inch tubes revealed that 21 of the 35 braces were broken. A new boiler was recommended.

Mud Drum Found Corroded

Serious external corrosion of the mud drum of a boiler, which by the way was twenty-five years old, was brought to light recently by the removal of the bridge wall and brick work in front of it. The bottom sheet of the drum, for a distance of 18 inches circumferentially and running its entire length, had deteriorated until it was but 3/16 inch thick from an original thickness of ½ inch. The rivet heads were also considerably reduced, and a hydrostatic test showed that several of them were cracked. The condition in which this boiler was found led to the inspection of several others in the same plant with similar results though the defects were of a less dangerous degree.

Most defects of a very serious nature give some visible evidence of their presence, though this evidence, as in some of the cases cited, is very faint. In one case which came to our attention, however, with everything appearing sound and in good condition, the inspector, by means of the hammer test, discovered twenty-two broken staybolts.

Difficulties of Inspection

Frequently the inspector must labor for hours, and almost invariably in a most uncomfortable position, in order to satisfy himself as to the condition of a boiler. One such instance which stands out occurred in the examination of a firetube boiler. The only visible defect was a deeply pitted rivet. The setting of the boiler was of such a nature that the hammer and light could not be used to advantage. The inspector desired to investigate further, however, and so constructed a chisel of special shape with which to pick off the rust. Lying on his back in a small furnace, he manipulated this instrument for two and one-half hours. When this rusty scale had been removed, he was able to rip open the shell for a distance of approximately eight inches, the plate having been almost entirely eaten away.

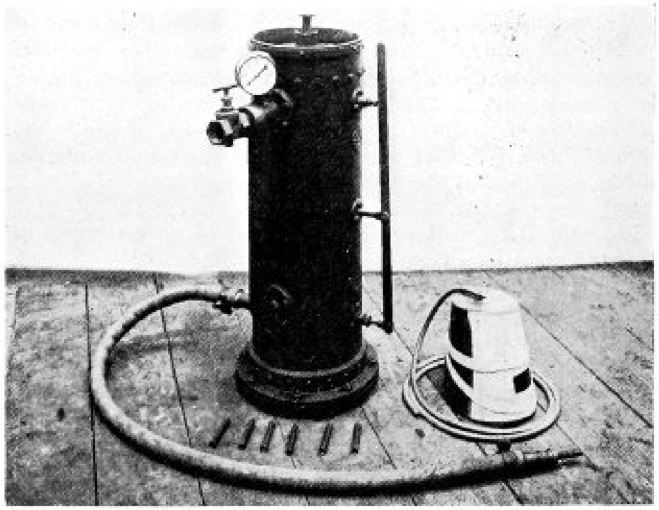
Scale as the Cause of Leaks

A somewhat similar experience was had by an inspector when called to investigate leakage around the bottom of a rear head seam. The through rods at the rear were so close together that it was next to impossible to reach the head, but by turning on his side the inspector was able to wedge in close enough to pick at the scale. The scale at this point was about ½ inch thick and very hard. After spending considerable time in this constrained position removing the scale, the inspector found that the head at the flange had wasted away until it was but 1/16 inch thick. A deep dent could be made with each blow of a light hammer. The scale had been so thick and hard that it supported the head plate. It is interesting to note in connection with this incident that an external inspection just two weeks previous failed to give any indication of the dangerous condition of this boiler.

New Method of Cleaning Boiler Tubes

By G. P. Blackall

A NOVEL method of rapidly cleaning the tubes of modern tubular boilers has recently been introduced in Great Britain. It is by means of the sand blast and constitutes an entirely new application of this apparatus. Boiler tubes may be rapidly cleaned of soot, etc., on the outside and in addition the interior of each tube may be cleaned

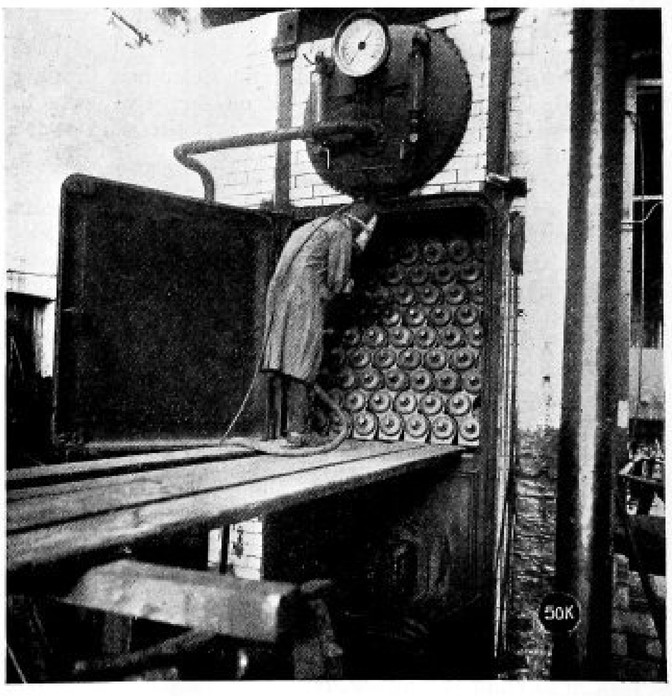


Apparatus Used for Sand Blasting Boiler Tubes

of scale or other deposit thoroughly and at a much greater speed than by any existing method.

A coarse silver sand is used for the purpose, this sand having to be collected and sieved after the operation. Such portion as has not been broken into dust is then put back into the apparatus for re-use. The apparatus used in connection with this process is placed close to the scene of operation, the compressed air being carried to it from the compressed air supply, and working at a pressure of 25 to 30 pounds per

(*Continued on page 265*)



Sand Blasting Equipment in Operation

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

THIS is the sixth instalment of a series of questions on both mechanical and boiler subjects which are liable to occur in state or federal examination papers for boiler inspectors. The earlier instalments appeared on page 105 of the April issue, page 139 of the May issue, page 180 of the June issue, page 208 of the July issue and page 231 of the August issue of THE BOILER MAKER. *The material should prove of benefit to all those who contemplate taking the examinations. The author would like to have those interested in the subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.*

125—Q. What will cause the air end of an air pump to run hot?

A. Lack of lubrication working against high pressure; continuous high speed; piston packing rings leaking; cylinder worn; air valves leaking; air passages in pump partially stopped up; air valves stuck shut; strainers stopped up; piston rod packing leaking.

126—Q. (a) Describe a direct motion valve gear.

(b) Describe an indirect motion valve gear.

A. (a) A direct motion valve gear is one in which the rocker arms move in the same direction. In some cases no rocker arm is used. In this case the eccentric rod is connected to the valve rod and the valve moves in the same direction as the eccentric rod that is doing the work.

(b) An indirect motion valve gear is one in which the valve moves in an opposite direction to the eccentric rod doing the work. A rocker is used in which the arms move in opposite directions.

127—Q. What is the difference between an inside admission and an outside admission piston valve?

A. With the piston at the front end of the cylinder an inside admission piston valve must move forward in order to allow steam to pass through the front live steam port. With an outside admission piston valve and the piston at the front end of the cylinder the valve must move backwards to open the steam port.

128—Q. What is a by-pass valve?

A. By-pass valves are connected to the steam ports leading to the cylinder. When steam is shut off the valve opens to allow air to pass back and forth from opposite sides of the moving piston.

129—Q. What is a vacuum relief valve?

A. A vacuum relief valve is usually placed in the steam chest or the live steam passage to the steam chest and opens when the steam is shut off and engine drifting, allowing atmospheric pressure to pass into the steam chest, and closing when working steam.

130.—Q. What would be considered defective driving, trailing wheels, engine or tender truck wheels?

A. A defective driving or trailing wheel is one in which there are three or more adjacent spokes or 25 percent of the spokes in the wheel broken. Loose wheels, loose broken or defective tires or tire fastenings, broken or cracked hubs, or wheels out of gage, wheels with slid flat spots, or worn flanges.

Cast iron or cast steel engine or tender truck wheels with any of the following defects should not be continued in service:

With flat spots 2½ inches or over in length or if there are two or more adjoining spots each 2 inches or over in length.

Broken or chipped rim, shelled out or cracked tread, tread worn hollow, cracked plate or brackets, wheels loose on axle, wheels out of gage, or worn flanges.

131—Q. What should be done in case an engine truck wheel or axle should break?

A. The defective engine truck wheels should be raised up to clear the rails and held in this position by passing a chain around the engine truck frame and main frame of the engine.

132—Q. What should be done in case a tender truck spring should break?

A. If it should be a coil spring on top of the truck box, a block may be used in place of the spring.

If an elliptic spring the tender should be jacked up and blocks placed between equalizers and truck frame.

133—Q. What should be done in case a driving wheel or trailer wheel tire should break?

A. In case a tire should break the wheel should be raised up to clear the rail. This may be done by removing the driving box cellar running the wheel up on a block or wedge and place a block between the axle and pedestal binder; would also block between top of driving box of the wheel ahead or back of the disabled wheel. It is also advisable to take down all side rods.

134—Q. How can a driving wheel be raised without jacking up the engine?

A. By raising the wheel on a hardwood block or iron wedge.

135—Q. How can a pound in a driving box be located?

A. Place engine on top quarter on side to be tested, reverse engine from forward to back gear under steam. At the same time note the movement of the journal in the box. Test in like manner for worn or loose rod bushings and wedges.

136—Q. What should be done if an injector stopped working?

A. Would see that there was sufficient water in the tender. Would see that no obstruction was in the tank hose, feed pipe or strainer. Would examine feed pipe for leaks. A small pin hole in the feed pipe if above the water level in the tank will prevent the injector from working. Should the tubes be obstructed the injector would stop working at once and it would be necessary to take out tubes to remove the obstruction. The overflow valve should be examined to see that it opens wide, to see that the overflow pipe was not obstructed. Would also examine the check. In case repairs could not be made it may be possible to bring engine to shop with one injector.

137—Q. How can a disconnected tank valve be opened?

A. Close overflow valve to injector and blow steam back into tank, this will generally lift valve out of seat.

138—Q. What should be done in case safety valve spring breaks?

A. After steam has blown off remove top casing on safety valve, take out broken spring, block between valve and top casing, care should be taken to see that the other safety valve will relieve the steam pressure.

139—Q. In case of a washout plug, a stud, gage cock, or any other valve should blow out of the boiler what should be done?

A. Draw the fire and if unable to make temporary repairs arrange to be towed to shop.

140—Q. What should be done in case a flue should burst?

A. Plug it with a wooden plug. The water would prevent the plug from burning and cause it to swell holding it in position against the pressure in the boiler.

(*To be continued*)

* Locomotive Inspector, New York State Transit Commission.

Report of Boiler Explosion on Steamer Panay

Steamboat Inspection Service Investigation of Combustion Chamber Failure on Great Lakes Steamer

FAILURES of steamboat boilers are comparatively few but when they do occur they generally cause fatal accidents. The following report of a boiler which failed on the steamer *Panay* a year ago was only definitely settled recently. The findings of the investigation carried out by the Steamboat Inspection Service of the United States Department of Commerce will be of interest to many of our readers who have the care of marine boilers in charge.

Events Leading to Disaster

On September 10, 1923, about 2:50 A. M., while en route for Marquette, on St. Mary's River, nearing Pt. Iroquois, the bottom sheet in the combustion chamber of the starboard boiler in the steamer *Panay,* owing to the thin and deteriorated condition of such sheet, pulled from the staybolts, causing an explosion, blowing open the furnace doors and filling the firehold with steam, fire, and water, and causing the death of the fireman on duty. The port boiler valve connection was closed, and every effort was made by the engineer officers of the steamer to rescue the fireman, but without avail.

The steamer returned to Sault Ste. Marie, Michigan, with reduced steam pressure on the port boiler, where, after notice given us by the master, while we were engaged in making the annual inspection of the steamer *Gladiator* at that port on September 10 and 11, 1923, we investigated and made a careful examination of both boilers. Finding the bottom sheet of the combustion chamber in the port boiler deteriorated and crowned between the threaded staybolts to such an extent as to render it extremely hazardous, in our judgment, for that boiler to carry a sufficient steam pressure to further navigate the vessel with safety, we so notified the master and owners of the steamer *Panay,* and withdrew the certificate of inspection, with the understanding that the vessel would be towed to Cleveland or Detroit for repairs to the boiler. This steamer was inspected and granted a regular certificate of inspection at Detroit, Michigan, on August 7, 1923, and allowed to carry a steam pressure on the boiler of 175 pounds. Amount of damage not known.

Supplementary Report

The following supplementary report dated December 26, 1923, was submitted by the Local Inspectors at Marquette, Michigan, in further reference to this matter:

Supplementing the report from this office on card, Form 924-A, dated September 18, 1923, we have to further respectfully submit the following additional particulars, namely: Subsequent to the failure of the starboard boiler on September 10, 1923, the steamer *Panay* was towed to Cleveland, Ohio, by the steamer *Paisley,* where satisfactory repairs to the boilers and equipment were made and completed under the personal supervision of the U. S. Local Inspectors and the withdrawn certificate of inspection returned by them to the steamer on October 6, 1923; also, the investigation in this case was continued and the sworn statements of the officers and crew were taken at Cleveland, Ohio, and mailed through the proper channels to this office.

From the investigation and testimony we find that the boilers in the steamer *Panay* were built by the American Shipbuilding Company at Cleveland, Ohio, in the year 1901, that these boilers were extensively repaired with new furnaces and new tubes by the Oldman Boiler Works at Buffalo, New York, during the winter of 1922-1923; that upon examination at this investigation the steam gages and safety valves on these boilers required considerable repairs, and, according to the testimony of the chief engineer, the first assistant engineer, and the two oilers on the steamer *Panay,* prior to the time of the accident on September 10, 1923, these safety valves during their experience never failed to blow off or release the pressure on the boilers by the engine room gages at between 175 and 178 pounds steam pressure.

Safety Valves Read Differently

It is stated in the testimony that there was a difference of about two or three pounds pressure between the two safety valves in blowing off—the port valve being the first to release. Just a moment before the rupture in the starboard boiler, the engineer on watch, noticed that the engine room gage registered about 175 or 176 pounds steam pressure but did not know whether either of the safety valves were blowing off at the moment of the rupture. At the hydrostatic test applied to the port boiler at Sault Ste. Marie, Michigan, by us on September 11, 1923, the engine room gage on that boiler registered 178 when the government test gage showed 175 pounds pressure and a like difference was shown by these gages up to and including the total hydrostatic pressure applied, namely, 225 pounds.

Officers Not Negligent

In view of the foregoing, and the fact that the wrapper sheets in each of these boilers were found in nearly the same condition as to thickness and deterioration, the failure of the wrapper sheet in the starboard boiler at 175 pounds steam pressure appears to be unaccountable, and we are unable to determine or conclusively give a well-sustained cause for this unfortunate accident other than the condition of such wrapper sheets as was stated in our first report to the Bureau under date of September 18, 1923. Every consistent effort possible was apparently made to rescue the fireman, by the officers and crew in the engine room, and, as this steamer was provided with short and convenient passageways of escape on each side of the boilers and on a level with the firehold floor to the engine room, we must conclude that the unfortunate man was instantly killed or rendered unconscious by the violent discharge of steam, hot water and ashes blown from the furnace doors which were blown open by the explosion.

After giving all the testimony and evidence in this investigation our most careful attention and thought, we do not find that the licensed officers of the steamer *Panay* were wilfully negligent, inattentive to duty or at fault for this accident, and, therefore, we are compelled from the evidence and testimony to dismiss the case without further proceedings.

New Method of Cleaning Boiler Tubes

(*Continued from page* 263)

square inch. A flexible blast tube of any length up to 30 feet can be used, and the nozzle of the apparatus is of 5/16 inch bore. By this method it is possible to discharge from 300 to 450 pounds of sand per hour.

In one of the illustrations the operator is seen cleaning the outside of the boiler tubes preparatory to removing the caps and cleaning the interior. The other shows the apparatus employed and the operator's mask.

Proposed Method of Testing Boiler Plates*

Tetmayer Formula to be Used Instead of Factor of Safety to Determine Allowable Stresses

THE present rules for testing steel boiler plates and figuring allowable pressures are becoming increasingly unsatisfactory both to boiler makers and to the manufacturers of steel plates, especially large thick plates, which are now coming more generally into use by reason of increased pressures. This is because the rules penalize the boiler manufacturer or designer who wishes to use soft, ductile steel, by requiring him either to cut down his pressure or to increase the thickness of the plates. The latter not only increases cost, but may introduce objectionable conditions, especially where the plates are exposed to the fire on one side and water on the other.

In the early days of supervision and control by the government, of the materials, construction, operation, etc., of steam boilers on river steamboats, under the United States

TABLE I—PLATE TEST

Thickness of Plate in Inches	Number of Plates Tested	Average Ultimate Strength—Pounds Per Sq. In. Grooved	Parallel	Difference	Reduction of Area Grooved	Parallel
3/8	3	60,600	54,100	6,500	60.0	66.5
7/16	4	61,300	53,500	7,800	61.7	65.2
5/8	5	60,900	51,400	9,500	Und.	63.2
3/4	6	62,700	52,800	9,900	51.4	64.5
1	4	65,600	53,100	12,500	52.0	58.0
1 5/16	1	75,580	62,250	13,330	39.6	51.0
1 11/16	2	82,435	64,370	18,065	33.9	41.6

Board of Supervising Inspectors of Steam Vessels, one of the first rules proposed was that all boiler plate, then generally made of iron, should be required to meet a stipulated minimum tensile strength. Attention of the Board was promptly called to the danger this would involve, by encouraging the use of hard, brittle iron, as the harder the iron the greater

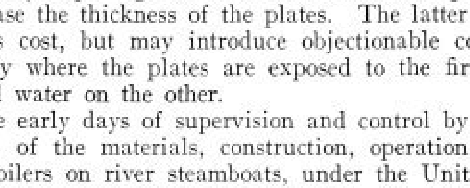


Fig. 1.—Original Form of Test Piece

the allowable pressure. To provide against this danger, an additional requirement was made in the shape of reduction of area in the fractured test piece to insure ductility.

In those days the plates were mostly ½ inch or under in thickness, and a short section test piece was used, having grooved sides, with 1-inch radius, as indicated in Fig. 1, the rules providing that a section greater than ½ square inch could not be used in the test piece, in order that the capacity of the machines of the government testing stations should not be overtaxed.

A little later, when steel began to be used, the same form of test piece was at first used, but as the supervision over all merchant vessels plying under the United States flag was included in the service, these restrictions necessitated preparation of test pieces in heavy thicknesses of plate for use in Scotch marine boilers, as shown in Fig. 2, a specimen for a steel plate of 1½-inch thickness, therefore having only about 5/16-inch width between the two curved sides. The effect of this form of test piece was rather peculiar, in that a piece of steel, which, in a parallel specimen of the form at present in use (Fig. 3) would show 55,000 pounds tensile strength, would in a ⅜-inch thick grooved specimen 1 inch wide show 60,000 pounds tensile strength, while steel made from the same melt and rolled into 1½-inch thick plate would, by reason of the proportions of the test section (Fig. 2) show 70,000 pounds tensile strength, and an 8-inch parallel specimen (Fig. 3) from the same steel and same thickness would show 52,000 pounds tensile strength.

In other words, in ⅜-inch steel the average difference be-

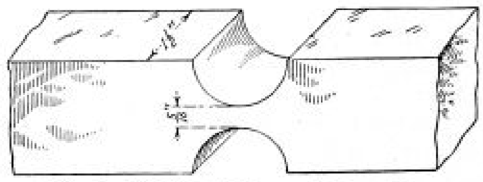


Fig. 2.—Modified Form of Test Piece

tween the parallel specimen and the grooved specimen was about 5,000 pounds, tensile strength, while in a 1½-inch specimen the average difference was about 18,000 pounds, tensile strength. Consequently, steel which, under present rules of testing, in parallel specimens would show only 52,000 pounds, tensile strength, under the rules then in practice showed 70,000 pounds, tensile strength, and they were accorded pressures in proportion thereto. Similar results are shown by the figures in Table I, applying to various thicknesses of plate.

A great many boilers were made in this way and, so far as the writer knows, never gave any trouble, because they were made of good soft steel and were always easy to form into shape.

A little later, however, when the practice was changed and the tensile strength was determined from an 8-inch parallel specimen and more carbon added to produce the necessary tensile strength in this form of test, the question began to arise continually with the Steamboat Inspection Service as to the tendency to brittleness in the steel. Additional tests were called for in order to try to keep this brittle tendency down to a minimum, the same difficulties having been encountered in foreign practice where specifications and similar testing rules prevailed.

In the early eighties, however, Professor Tetmayer, founder

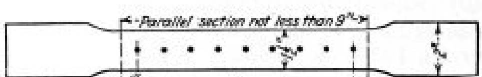


Fig. 3.—Present Form of Test Piece as Prescribed by A.S.M.E. Boiler Code

of the Swiss Testing Institute for Materials of Construction at Zurich, who for ten years was president of the International Association for Testing Materials (1895 to 1905), went thoroughly into the whole subject of the properties of mild steel, and arrived at the definite conclusion that, for determining stresses in such service, the tensile strength should not be used alone, but a figure obtained from multiplying the tensile strength of the specimen by its percentage of elongation would give a practically constant factor, called

*This is the reprint of an article by Dr. Charles L. Huston, vice-president of the Lukens Steel Company, which recently appeared in *Power*.

the "value figure," between the lowest tensile strength point of good clean rolling steel and the highest tensile strength test point consistent with absence from brittleness. Therefore, steel within these ranges, expressed in our U. S. Standards of, say, 48,000 pounds tensile strength per square inch multiplied by a required elongation of 31.25 percent would give a product of 1,500,000, and 70,000 pounds tensile strength multiplied by a required elongation of 21.43 percent would give the same product, 1,500,000. Consequently, all the steel between these ranges would be equally worthy of a given unit stress in service, say 11,000 pounds per square inch, such as is now arrived at and allowed by taking one-fifth of the minimum of 55,000 pounds tensile strength.

TABLE II—SHOWING ELONGATION AND REDUCTION OF AREA

Thick	Wide	T. S. Average Grooved	T. S. Average Parallel	Elongation 8 In. Average	Reduction of Area Average
⅜	x 1⅜	......	52,090	33.6	64.6
⅜	x 2¼	55,650	......	....	54.1
½	x 1⅜	......	58,810	28.75	56.6
½	x 2½	63,970	......	....	45.8
78/100	x 1⅜	......	61,710	28.25	50.3
78/100	x 2¾	64,790	......	....	41.0
1	x 1⅜	......	54,390	30.5	60.3
1	x 2⅝	60,150	......	....	39.4
1 1/16	x 1⅜	......	66,290	24.3	34.9
1⅛	x 2⅜	71,430	......	....	23.0
1⅜	x 1 7/16	......	61,340	30.0	50.9
1½	x 2⅝	67,420	......	....	62.3

This would give a little less than 4½ times the actual allowable working stress in the minimum tensile strength obtained from a parallel specimen, but this result would be more than 4½ times if tested in a short section, similar to that formerly used by the Steamboat Inspection Service.

In order to check this more carefully, the writer made a series of tests on specimens prepared in such a way that the section of the test piece would exactly correspond to the section between two rivet holes in a standard A.S.M.E. riveted joint, in longitudinal seams of different thicknesses of steam boilers. Results of these tests showed that in all thicknesses of plates from ⅜ inch to 1½ inch, with suitable proportionate test pieces, the tensile strength of the short-section specimen ran from about 3,500 to 6,500 pounds higher than the tensile strength of the same steel in the usual parallel test piece. (See Table II.)

These results, therefore, show that the standard section of metal at the riveted joint in service in a steam boiler, the riveted joint being the place where the stress figures are calculated, would give a minimum of 51,500 pounds and a maximum of about 55,000 pounds in the actual section of metal in service in the boiler, when the usual 8-inch parallel test specimen would show 48,000 pounds minimum tensile strength.

The strength of the metal in the joint, therefore, would be 4.682 times the actual allowed working stress in the boiler, an ample margin of safety, taking into consideration the larger ductility obtained from steel of this good soft range, this added ductility fully making up in service and safety value for the somewhat less actual tensile strength shown in the steel. Experience indicates that wherever failure has occurred in steam boilers, it has been because of hardness and brittleness in the steel and never where the steel was soft and ductile.

In the making of straight carbon steel, which is largely used in the construction of steam boilers, both locomotive and stationary, as well as in the construction of a variety of pressure vessels for different kinds of service, it is well known that, owing to the tendency for the carbon in the steel to group itself more in the central portions of the mass of the steel ingot, it is impossible to secure steel of uniform tensile strength throughout the mass, particularly of a large plate of steel made in this manner. This is clearly indicated by Table III, showing the location of a number of test pieces taken from the different parts of a plate, both transverse and longitudinal.

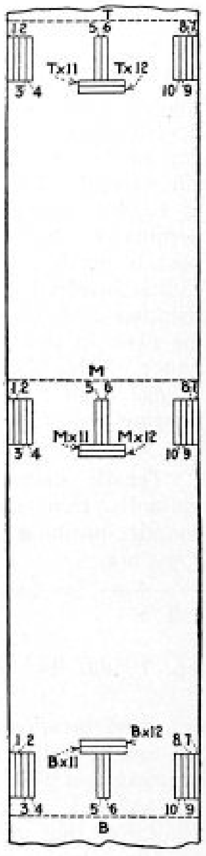
Formerly, it was the custom of makers of boiler plate to select a specimen taken from the side of the plate part way up from the portion that represented the bottom of the ingot and far enough in from the edge to secure a tensile strength approximating the average of the whole mass, as shown in Table III, specimens M-2 or M-3 accomplishing this purpose. In this manner the required minimum tensile strength of 55,000 pound could be obtained without increasing the carbon content of the steel to such a point as to cause any tendency to undue hardness in central or upper portions of the piece.

Later, however, when the present specifications and rules were adopted by the A.S.T.M. and incorporated in the A.S.M.E. Boiler Code, it was and is required that the specimen be taken from the bottom corner of the plate as rolled, always representing the softest material to be found anywhere in the plate. (See Fig. 3, specimens *B*1 or *B*7.) Since this practice has become general, it has resulted in the necessity of increasing the carbon content of the steel, so that the average tensile strength of each plate is from 3,000 to 5,000 pounds higher than it used to be under the former practice.

TABLE III—PLATE TEST FROM 30x12 IN., INGOT. WEIGHT 3000 LBS. ROLLED INTO ¾-IN. PLATE. WIDTH TO ROLL 72 IN.

Ladle Analysis: Car, .15. Man, .40, Sul., 025. Phos., .013.

Test No.	Tensile Strength per Sq.In.	Elongation Per Cent in 8 In.	Reduction Area in Per Cent
T 1	53,080	31	61.4
T 2	55,100	30.5	65.2
T 3	60,240	22 25	52.9
T 4	62,740	23.25	52.5
T 5	60,800	25	52.7
T 6	61,640	27.5	53.3
T 7	52,340	31	66.8
T 8	55,380	33	62.5
T 9	61,280	28	53
T 10	61,220	24.25	51.1
Tx.11	60,500	29	48.1
Tx 12	60,500	26	45.
M 1	53,440	33.5	66.7
M 2	54,360	31	60.9
M 3	57,820	29.5	62.
M 4	59,700	26.5	53.5
M 5	59,940	28	53.3
M 6	59,440	28	57.3
M 7	52,680	32.25	64.
M 8	53,550	33	62.6
M 9	57,040	31	57.5
M 10	59,240	27	51.8
Mx 11	59,080	25.5	51.9
Mx 12	59,620	26	49.8
B 1	52,440	34	62.7
B 2	53,060	30.5	65.6
B 3	54,520	31	64.1
B 4	54,340	35	63.6
B 5	54,800	28	63.1
B 6	54,800	30 5	62.8
B 7	52,960	30.5	61.5
B 8	53,280	31 5	63.
B 9	54,060	31.5	65 9
B 10	53,990	30	64 7
Bx 11	55,500	27 5	57.4
Bx 12	55,640	28 5	61 7



This has brought about the present situation, which results in steel being more difficult to flange in the boilermakers' hands, and with some tendency to failures in the harder portions of the plate in working, especially where the deformation required is beyond the ordinary, with the various new types of boilers which have been coming into the market. This has created considerable dissatisfaction among boilermakers, where the steel would not stand the work that they expected of it, particularly in the greater thicknesses which are now being much more largely called for, and where the additional thickness requires an increased carbon content, in order to produce the necessary minimum tensile strength in a specimen taken from the softest portion of the plate.

ALLOWABLE WORKING RANGE

Steel manufacturers always require 10,000 pounds working range, in order to produce the required tensile strength with a given location of test piece; consequently, when the steel, with minimum as now required, tests up into the higher portions of this range, say 64,900 pounds, it naturally follows that the central, and especially the upper central portions of the plate, are about 8,000 to 12,000 pounds higher and require much more careful working than is the general practice in boiler shops to avoid difficulties and failures in getting the steel satisfactorily worked into the boiler.

If the Tetmayer formula should be adopted, however, it would be possible and practicable to obtain, by using a minimum tensile strength of 48,000 pounds multiplied by its 31.25 elongation in 8 inches, equaling 1,500,000, and a maximum, taken from the top center of the plate, 70,000 pounds multiplied by its required 21.43 elongation, giving the same product, 1,500,000, to thus secure steel that would be much more satisfactory in working into shape in the boilermakers' hands. The boilermaker would know from his practical experience that he was making a far better boiler, and at the same time the actual section of the riveted joint would show a breaking stress of more than 4½ times the 11,000 pounds required working stress.

The following specification would necessitate very little change from the present standard A.S.M.E. Boiler Code Specification, with its privilege already allowed, in paragraph 28c. of the Boiler Code; namely, of using steel of lower tensile strength than 55,000 pounds minimum, provided a range of 10,000 pounds per square inch be adhered to. This now permits of a steel of, say, 48,000 pounds minimum to 58,000 pounds maximum in the standard test specimen, the only change involved in the proposed specification being the substitution of a transverse or longitudinal tension specimen in the place of the present transverse bend taken from the top center of the plate, as called for in paragraph 30a, and a change from factor of safety basis to unit stress basis in figuring pressure to be allowed in the boiler. The specification thus modified would read:

"Tensile strength from standard specimen taken longitudinally from the bottom of the rolled material 48,000 pounds minimum to 58,000 pounds maximum, elongation $\frac{1,500,000}{\text{T. S.}}$ for the specimen taken from the middle of the top, 70,000 lbs. maximum, elongation $\frac{1,500,000}{\text{T. S.}}$, with the usual modifications in elongation as set forth in paragraphs 29a and b, and the elimination of the bend test, as called for in paragraph 30b.

If desired, a yield point requirement could be included, stipulating that the yield point should not be less than twice the allowed unit working stress applied to the steel.

This matter has been brought before the Boiler Code Committee of the A.S.M.E., and to secure more thorough and widespread judgment of engineers and practical men competent to pass judgment upon such a matter, this article is prepared in order that it may receive such wide and full consideration, so that if such a rule is adopted by the Boiler Code Committee, it may be supported by the best judgment of men specially versed in this subject.

It is the margin of safety in the finished structure which is the essential point to consider, and this element in steam-boiler service depends largely on the ductility of the metal, especially where uneven heat between the different parts of the structure needs to be taken into consideration.

Most Economical Method of Cutting Off and Removing Mud Ring Rivets and Cost*

THE most economical method of cutting off and removing mud ring rivets is by the use of the gas torch in burning the rivet heads off, then backing them out in the regular way.

It is well known that some mud ring rivets are easier to remove than others. The hard ones are either drilled out or burnt out of the ring. Sometimes it is found advantageous to heat the mud ring, just above or below the rivets which are hard to back out. This expands the hole and in many cases makes the rivet easier to back out.

The cost of removing mud ring rivets depends upon several conditions. "Cost of gas, which some shops buy, while others manufacture." Whether or not the rivets are hard, or easy to back out, as well as the class of labor used in doing the work and the price per hour paid such labor. However, as a fair estimate would say six cents per rivet plus the cost of gas would be a fair price.

This report was prepared by a committee composed of Charles P. Patrick, chairman; J. P. Malley, M. G. Guiry.

DISCUSSION

L. M. STEWART, Atlantic Coast Line: We tried both ways, with the torch and with the hammer, and we found it better and cheaper with the long stroke hammer.

J. F. FENNEKER, Texas and Louisiana: We use a rivet buster, a home-made one. We can knock off the rivets quite fast, and do pretty well. If I can get any information regarding a way to do it better I will be glad to adopt it.

A. G. HASTINGS, M. & St. L.: We have been burning off rivets with the torch. We also use a long stroke hammer which does very good work. The hammer and punch will start the rivet where you cannot start it with a sledge hammer.

W. H. LAUGHRIDGE, Hocking Valley: We have followed the practice of burning rivets off with the acetylene torch. Recently, we got a hammer, which is used in conjunction with a side set chisel. As long as your rivets are tight you are all right. If you have a loose one change your chisel and put one in that is short and knock it off in six sections, two men working. We have had it in service about six weeks and we find it is the best thing we have had yet. You can have the pegging punch any length you want, usually the same as the hammer you take them out with.

H. H. SERVICE: What air pressure do you use?

W. H. LAUGHRIDGE: Ninety pounds.

R. A. PEARSON, Canadian Pacific: We use the acetylene torch and cut them off with the long stroke gun.

H. H. SERVICE: I would like to inquire if anybody has found it better to remove them from the outside or the inside?

A. E. CLEMENTS, N. W. P.: It all depends on the way the rivets have been put in. If you cut off the point first you cut from the inside.

R. A. PIERSON: We cut ours off on the outside.

* Report read at annual convention of Master Boiler Makers' Association.

PRICE CUTTING—

Never did anyone any permanent good.

Is an admission that the first price was too high anyhow.

Is unnecessary if your customers are getting a fair deal.

Is a poor way to establish public confidence in your business.

Is easy to start and hard to stop.

Is inefficiency's last resort.

Is the first step toward a receivership.

The Boiler Maker

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CONTENTS

The announcement has been sent out from the secretary's office of the Master Boiler Makers' Association at 26 Cortlandt Street, New York City, that the annual convention of the association for 1925 will be held at the Hotel Sherman, Chicago, from Tuesday to Friday, May 19 to 22 inclusive.

In spite of the great amount of publicity that has been given to various European, high pressure boilers that have been built in the past year, it is interesting to note that the tendency is not general and that the individual cases are more or less isolated. The French boiler construction practice for stationary power plants, as indicated in the leading article of this issue, seems to be towards well tried types of pressures not exceeding 400 pounds. This is somewhat higher than American practice, it is true, but structurally there are no difficulties to surmount with the materials available.

Undoubtedly the higher pressures tend towards economy within certain limits and the attempt is apparently being made by French shops to arrive at the point of greatest economy in first cost, balanced with the cost of future operation.

No industry is more greatly concerned with the possibilities of autogenous or fusion welding than that of building and repairing boilers, particularly those of the locomotive type, yet until this time the Master Boiler Makers' Association, made up as it is of practical men who must utilize this time and labor saver in their every-day work, has never gone on record as to the extent of its practical application.

In this issue appears a proposed code to govern the use of welding as it will be submitted to the 1925 convention for discussion and adoption with such revisions as seem advisable. It is altogether a commendable work and, while carefully avoiding any infringement on provisions contained in the American Society of Mechanical Engineers' Boiler Code or the Federal requirements, presents several new phases of the matter that will aid in standardizing the welding practice of the railroad shops throughout the country. The results of the series of tests on lap and butt welded joints, contained in the report, check closely with those of other bodies interested in the subject.

Probably of greatest importance in the entire report from a practical standpoint is the complete series of diagrams showing in detail the proper methods of carrying out welding operations on locomotive boilers. From time to time the subject of fusion welding has been brought before conventions of the association and similar descriptions have been given of where and how welds should be made. In the present proposed code all this material has been examined and the practices approved in other years have been brought abreast of present developments. Every portion of the boiler that can be welded, both in new construction and in repair work, has been included in the descriptive plates.

In every essential, the proposed code is one of which the Master Boiler Makers' Association may be justly proud and, if it is carefully studied and discussed at the 1925 convention, and any possible flaws corrected, it will both increase the confidence of railroad officials in the work of the association and heighten the prestige of the association throughout the entire industry.

The question often arises as to what penalties the Bureau of Locomotive Inspection can enact when the provisions of the Federal law governing the condition of locomotives are violated. The answer to this is contained in the report of Boston & Maine locomotive 3009 failure which appears in this issue, wherein the inspector responsible for passing an obvious defect, and the carrier are being prosecuted in the Federal courts. Many accidents are unavoidable but, when the law is flagrantly violated, as it was in this instance, those responsible for the failure should obviously suffer for the lapse.

Engineering Specialties for Boiler Making

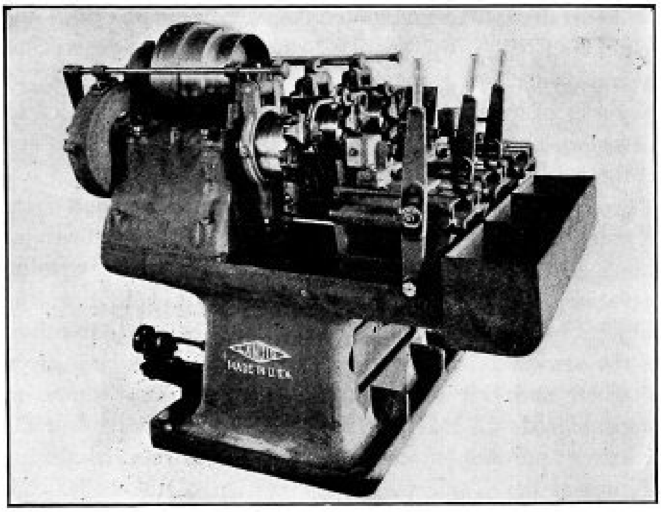
New Tools, Machinery, Appliances and Supplies for the Boiler Shop and Improved Fittings for Boilers

Landis Bolt Threading Machine

THE Landis Machine Company, Waynesboro, Pa., has placed on the market a new thread cutting machine. It is made in 1-inch and 1½-inch sizes in double and triple head types and in a 2-inch size in the double-head type.

The spindles on the machine are located sufficiently close together to permit an operator to handle a three-head machine without shifting from one lever to another. They are independent and are controlled by the clutches located at the rear. The clutches are operated by bars extending over the die heads. Any one head may be stopped without shutting down the entire machine.

The die heads are opened and closed automatically. The tripping rods which connect the carriage and the yoke of the die heads for opening and closing them, are provided with stop collars and are conveniently and quickly adjusted for various lengths of threads. All spindle gears have bronze bushings. The main bearings are capped and may be adjusted for any wear.



Landis Bolt Threader with Carriage Equipped with Vise Grips

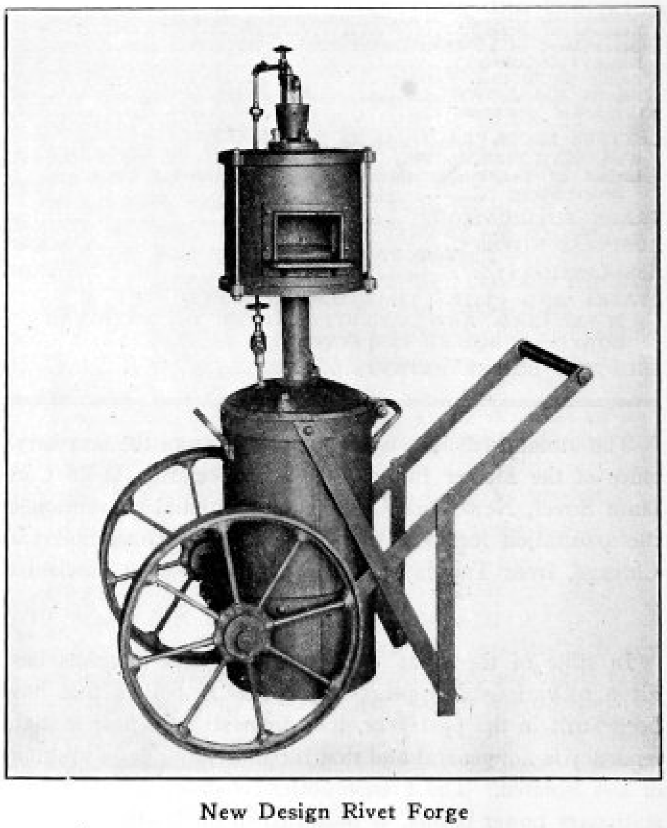
The carriage drive is in the center and comprises a rack and segment gear. These parts are thoroughly protected against dirt and chips. The levers operating the carriages are adjustable through a vee-toothed clutch which permits of a convenient position of the levers when cutting different lengths of thread. The levers may also be quickly changed from one side to the other side of the carriage for a right or left hand operator.

The carriages on the machine are furnished with either bolt holders or vise grips. They are easily taken off and quickly applied. Both have horizontal as well as vertical adjustment so that the work may be in proper alinement at all times. The vise grips are lever operated which facilitates production. The grips, which are separate from the sliding jaws, are hardened and are quickly changed without disturbing any adjustments. The machines are furnished with boxes for holding the bolts. These boxes are placed on the front of the machine, where they will not interfere in any manner with the operator, and may be removed when threading long bolts. A geared oil pump supplies an abundant flow of lubricant to the die head. All moving parts are protected so as to eliminate any danger of an accident.

Improved Features of Buffalo Oil Burning Rivet Forge

THE oil burning rivet forges designated as Nos. 1 and 2, manufactured by the Buffalo Forge Company, Buffalo, N. Y., have had two important changes incorporated in their construction. These consist of an extension of the fireproof liner through the fire opening in the steel shell and a redesigned bottom plate made with a liberal shelf extension to receive hot rivets.

In the old rivet forge a cast iron frame attached to the shelf with six rivets constituted the fire opening. The brick hearth itself extended only to the inside edge of this opening. The shelf for the rivets was cast as part of the frame itself and extended directly from the opening on a level with the fire. The results obtained with this design were at times unsatisfactory, the heat generated invariably resulting in a loosening of the rivets holding the frame which in turn was followed by the burning of the edges of the shelf itself.

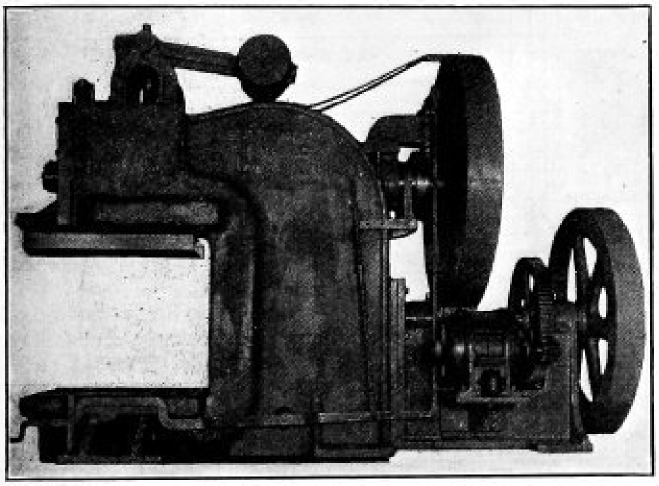


New Design Rivet Forge

With the new design difficulties of this kind cannot occur. The fire clay liner extending over and around the edges prevents a direct contact of the fire with the sheet steel casing; likewise the placing of the shelf on a lower level or, in other words, extending it in one piece with the bottom plate of the fire chamber, prevents all possibility of a burned out shelf occurring. The illustration herewith shows the forge made into a portable unit by mounting it on a special small size two-wheel truck which can be moved about by one man.

Heavy Duty Single End Punching Machine

A HEAVY duty beam punch which is adapted to the perforating of steel plates and structural shapes that enter into locomotive shop work has recently been placed on the market by the Beatty Machine & Manufacturing Company, Hammond, Ind. The principal feature of this machine is in the die space which must be large enough to assemble tools on it for production work. This permits the assembling on the machine in one setting of the necessary tools required to complete a piece of work, such as a center sill web plate, finishing all of the punching, coping and slotting in one pass through the machine.

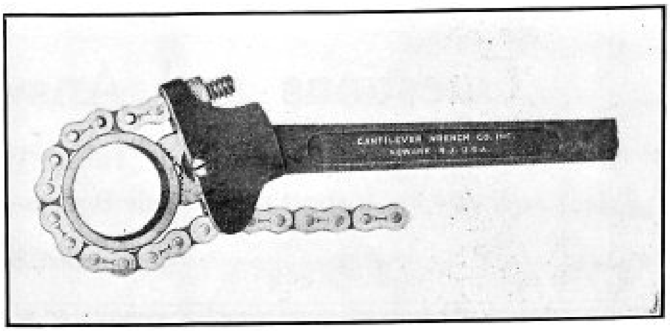


Punching Machine Equipped with a Hand Operated Spacing Table

The frame of the machine is of semi-steel; the bearings are of phosphor bronze with ring oilers; the gears are cut from solid steel. It is arranged for motor drive, all of the driving mechanism being mounted at the rear of the machine. The following are the general dimensions of the machine: The width of the ram from right to left is 34 inches and from front to back 42 inches; the width of the table from right to left is 34 inches and from front to back 44 inches; the stroke of the ram is 3 inches; its capacity is 240 tons.

Reversible Chain Pipe Wrench

THE Cantilever Wrench Company, Newark, N. J., has recently placed on the market a chain pipe wrench which is especially well adapted to pipe work in shops or on locomotives where working space is restricted. The principal features of construction are simplicity, ease of replacement of parts and light weight. The reversible feature enables the user to put the chain on either side of the pipe and insures an easy ratchet motion which reduces to a minimum the chances for the chain to jam or for the wrench to slip. An adjusting nut is provided which can be used in tightening up the chain grip when working in very restricted spaces such as on coil pipe work. It can be used on any pipes that are far enough apart to slip the chain between them.

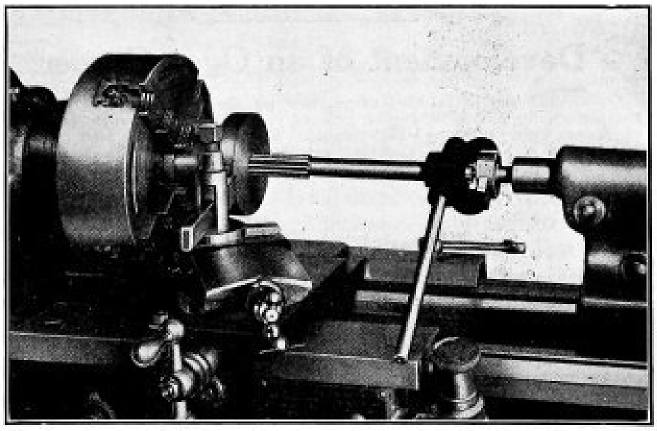


The Chain and Jaws of This Pipe Wrench Grip Instantly in Any Position

The design of this tool is such that it grips the pipe in any position. The direction of rotation can be reversed instantly without the necessity of removing the hands from the handle. This wrench is made in seven models suitable for use on pipe sizes from ½ inch to 12 inches and can be used not only as a pipe and fitting wrench, but also as a chain pipe vise.

Nicholson Drill and Reamer Holder

W. H. NICHOLSON & COMPANY, Wilkes-Barre, Pa., has recently put on the market a drill and reamer holder which can be used either on a lathe or drill press. When using it on a lathe, the holder takes the place of the live center and acts as a dog, driver and hold-back. It can also be used in a turret lathe and screw machine, where it acts as a floating holder. In this capacity it eliminates the adjusting of bolts or screws and also the changing of bushings. When used on a drill press it furnishes a strong, positive drive. Hardened steel plates are used to line up the drills and the center holds them in alinement, reducing bell-mouthed holes to a minimum. These holders are furnished in any taper or straight shank required up to 1½ inches in diameter.



Nicholson Reamer Holder Applied to a Lathe

L. P. Mercer, resident sales manager of the Parkesburg Iron Company, with headquarters at Chicago, has been appointed Chicago district representative of the Hall Draft Gear Corporation, with offices at 343 South Dearborn Street, Chicago, and will hold both positions.

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Removal of Scale

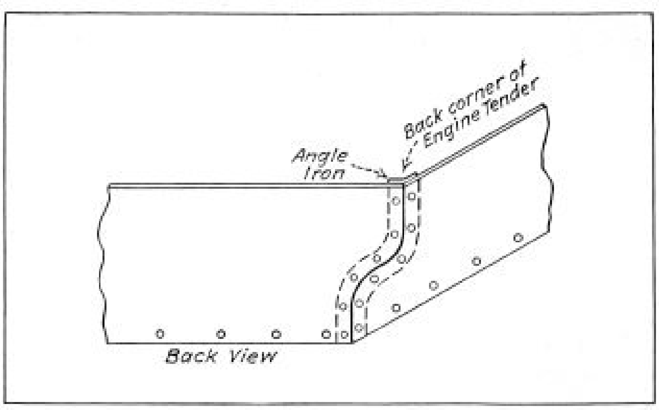
Q.—I am writing for some information on boiler scaling. I am bothered with scaling, and am in charge of two boilers of 500 horsepower, and have tried sal soda and boiler compounds which seem to have no effect on the scale. We are using city water, with some lime and magnesia, and I would certainly appreciate your advice on this question. R. P.

A.—There are two forms of scale, known as *hard scale* and *soft scale*. Soft scale usually settles to the bottom of the boiler, but does not affect the working of the boiler as hard scale. Soft scale can readily be removed by the use of one pound of *soda ash* to six or seven hundred pounds of water. Fill the boiler with this solution, vent the boiler at the top and boil the water at a good rate for a period of eight or ten hours. Then close the safety valve and bring up a pressure of 25 or 30 pounds, and blow off the water under pressure. Very hard scale cannot be removed by this method, but must be chipped off with the use of scaling tools.

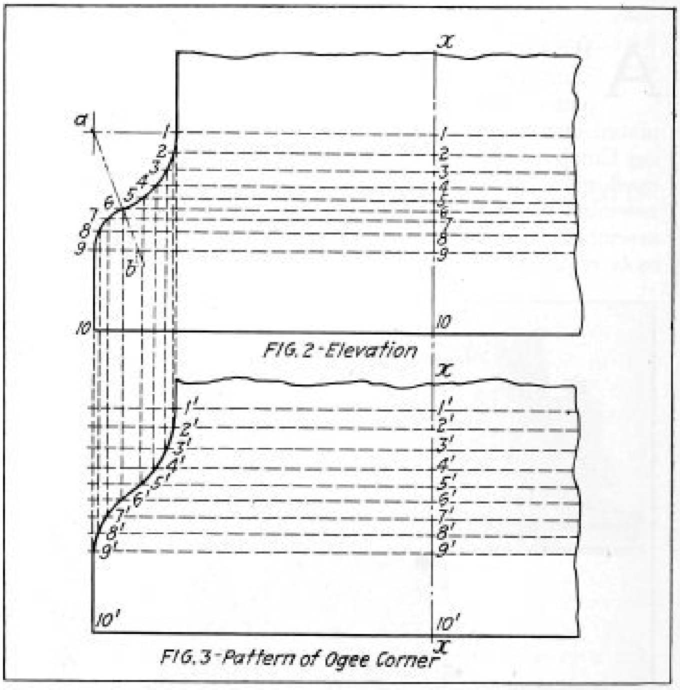
Development of an Ogee Corner

Q.—Would you be so kind as to show me the best method of developing the pattern for sketch of corner inclosed, which is a right angle bend made of $\frac{5}{16}$-inch plate, also the development of the bend if it had been greater or less than a right angle. Thanking you in advance for any information you can supply.—J. J. H.

A.—This example is a development of an *ogee* corner, which consists of a compound curve drawn with different radii, as from the points *a* and *b* shown in elevation, Fig. 2. After this view has been constructed, divide the arcs of the ogee into equal parts as from *1* to *6* and *6* to *9*. At right angles to the center line *x—x* and from the points *1* to *9* inclusive on the ogee curve draw parallel lines. The pattern can now be laid off as indicated in the view, Fig. 3.



Ogee Corner Problem



Development of Ogee Corner

Draw the base line *10'—10'* in Fig. 3 and on the center line *x—x* set off the lengths *10* to *9*, *9* to *8*, *8* to *7*, etc., all of which are measured on the arcs *6* to *9* and 1 to *6* respectively. Through the points *1'*, *2'*, *3'*, etc., located on *x—x* draw the parallel lines *1'—1'*, *2'—2'*, *3'—3'*, etc. These lines equal the lengths of the corresponding lines of the elevation, Fig. 2.

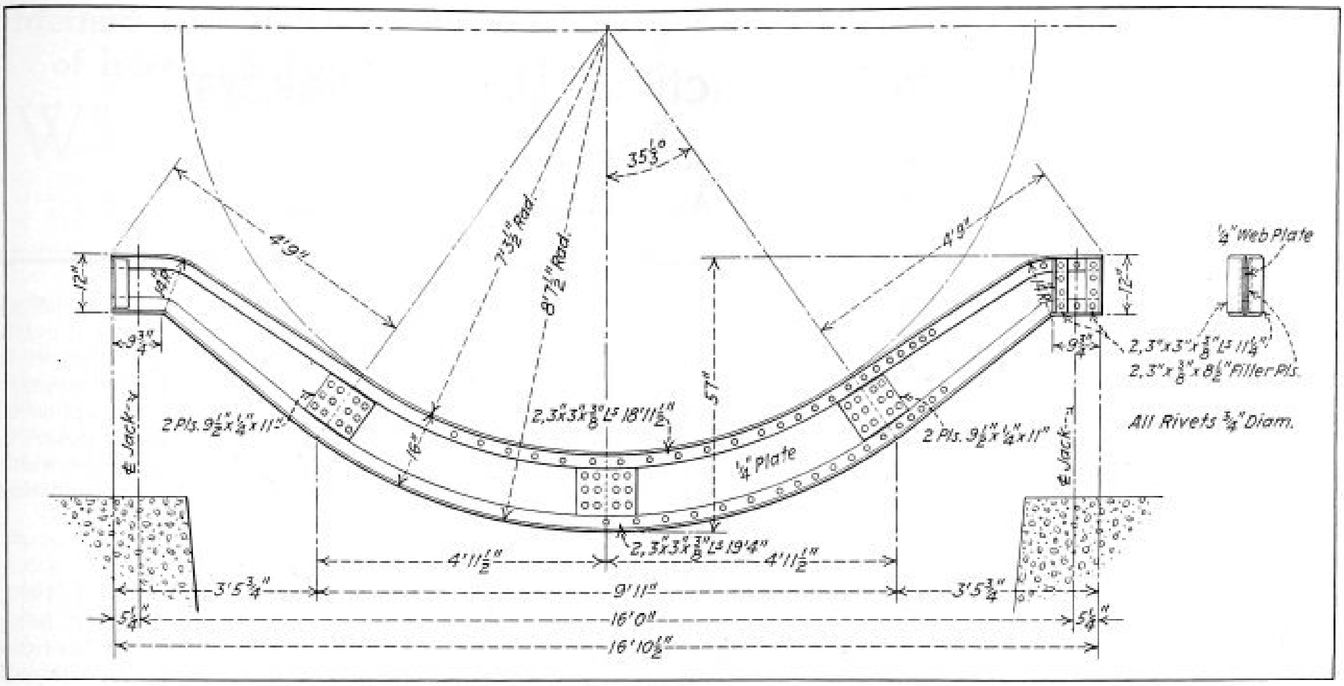
Beam Calculations

Q.—I would be very pleased if you would supply me with the necessary information in connection with built up beam as shown in the accompanying drawing. You will note from the drawing that three ¼-inch plates are used to make the web with two double riveted butt straps. If I should put four ¼-inch plates to make the web with double riveted butt straps at the center would it reduce the strength, if so, will you kindly explain to me the reasons and give formula? Owing to the design, I am of the impression that much greater stress would result where the curvature ends than there would be at the center of the beam.—J. B. R.

A. The greatest stress in the beam shown in your sketch is at the center. To determine the required strength in this form of beam consider the load concentrated at the center, then find the bending moment from the formula.

$$M = \frac{Wl}{4}$$

in which M = bending moment in inch pounds
W = the load in pounds
l = length of beam, inches



Details of Built-up Beam

The section modulus is determined by dividing the bending moment in inch pounds by the safe stress of the material which for tension and compression is taken at 16,000 pounds per square inch.

For a standard beam the required size can be found in structural steel hand books. To proportion the required cross sectional area of the plate, angles and splice or stiffener plates, several calculations are necessary. By finding the section modulus as stated the parts of the built up girder can be proportioned very closely for this form of beam.

In plate girders especially those of great length there is very little stiffness in the web plate. As a result the web plate tends to buckle or twist principally at the supports and where the load is concentrated. To offset this tendency the web is reinforced by stiffeners of some sort which are generally made of angles. In this case the splice plates act as stiffeners.

Repairs to Adamson Furnace

Q.—(1) What is the best method of taking out and putting in an Adamson furnace?
(2) What do you think of patching a furnace by rolling up a ring and riveting all around over the joint, first cutting the old metal out?
(3) Could a Morison corrugated furnace be made to replace the Adamson? P. R. V.

A.—To answer your first and third questions more information must be given on the type and size of the boiler, and the method used in connecting the furnace to the end plate.

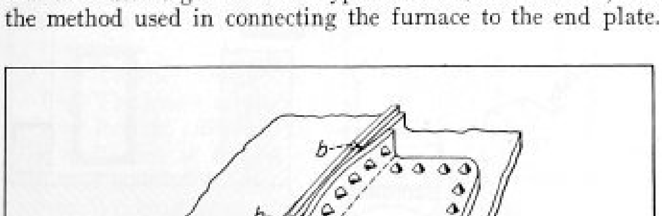


Fig. 1.—Method of Repairing Adamson Ring

In some constructions the furnace is fastened to the head by means of an angle ring which is riveted to the head or the furnace is flanged or the head may be flanged to receive the plain end of the furnace.

A defective Adamson ring may be repaired by removing the damaged plate and then rivet on a patch as shown in Fig. 1. The flange *a* in the damaged section is scarfed at *b* by chipping off the excess metal so that the flange of the patch will lay up snug on the ring *C*.

Repairs Made by Welding

Q.—As a reader of THE BOILER MAKER for the last three years, I would like to ask you to help me out on a question. I am a boiler inspector on the railroad, and would like to know if you could tell me where I can get the most truthful statements on what parts of a boiler can and cannot be welded. C. B.

A.—Refer to the rules of the American Society of Mechanical Engineers that apply to the locomotive type boilers, the reports of the Master Boiler Makers' Association which cover repairing of locomotive boilers by electric welding. In general autogenous welding may be used in boilers where the stress or load is carried by other construction, which conforms to the rules or requirements of the laws under which the boilers are operated. In other words, repairs may be made by welding where the safety of the structure is not dependent upon the strength of the weld. Very often in the heads of boilers cracks occur in the knuckle of the flange, these should not be welded. Tube sheet sections, leaky mud ring corners, defective calking edges, side sheet patches are repairs handled by welding.

Corrugated Furnaces

Q.—Kindly let me know what make of furnace the sketch accompanying my letter represents. Also the name of a book that gives all makes, such as Morison, Fox, Purves, Deighton and Leeds suspension.—M. M.

A.—The sketch that you sent represents the corrugations of a Deighton furnace. A very good treatise on marine boilers is "Marine Boiler Management and Construction," by C. E. Strohmeyer. The volume may be purchased from Longmans, Green & Company, New York, or THE BOILER MAKER, 30 Church street, New York.

Letters from Practical Boiler Makers

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

Waste Wood as Boiler Fuel

To fire boilers by just ordinary methods with any handy combustible refuse will generally prove an unsatisfactory procedure. If the supply of refuse is greater than the demand the mere fact that combustion is going on under very inefficient conditions might not be of much moment, but the troubles inherent to using wrong methods cannot be ignored. A furnace suited to burning coal is entirely unsuited to burning combustible refuse, the furnaces being too small. Unless therefore the boilers have been specially designed for dealing with this class of fuel, satisfactory working will not be obtained.

Given a boiler or set of boilers entirely suited to this purpose, then it will generally pay to lay out the plant on up to date lines. A saw mill, box or match factory is just the place for turning refuse to good account and as a pneumatic removal system is an essential part of a modern plant of this class the material so collected can be discharged into hoppers over the boiler room from which it can be fed into mechanical stokers of a suitable type. The heavier material in the shape of odd blocks, logs and pieces collected about the works can be hand fired with any other material not suited to mechanical stokers.

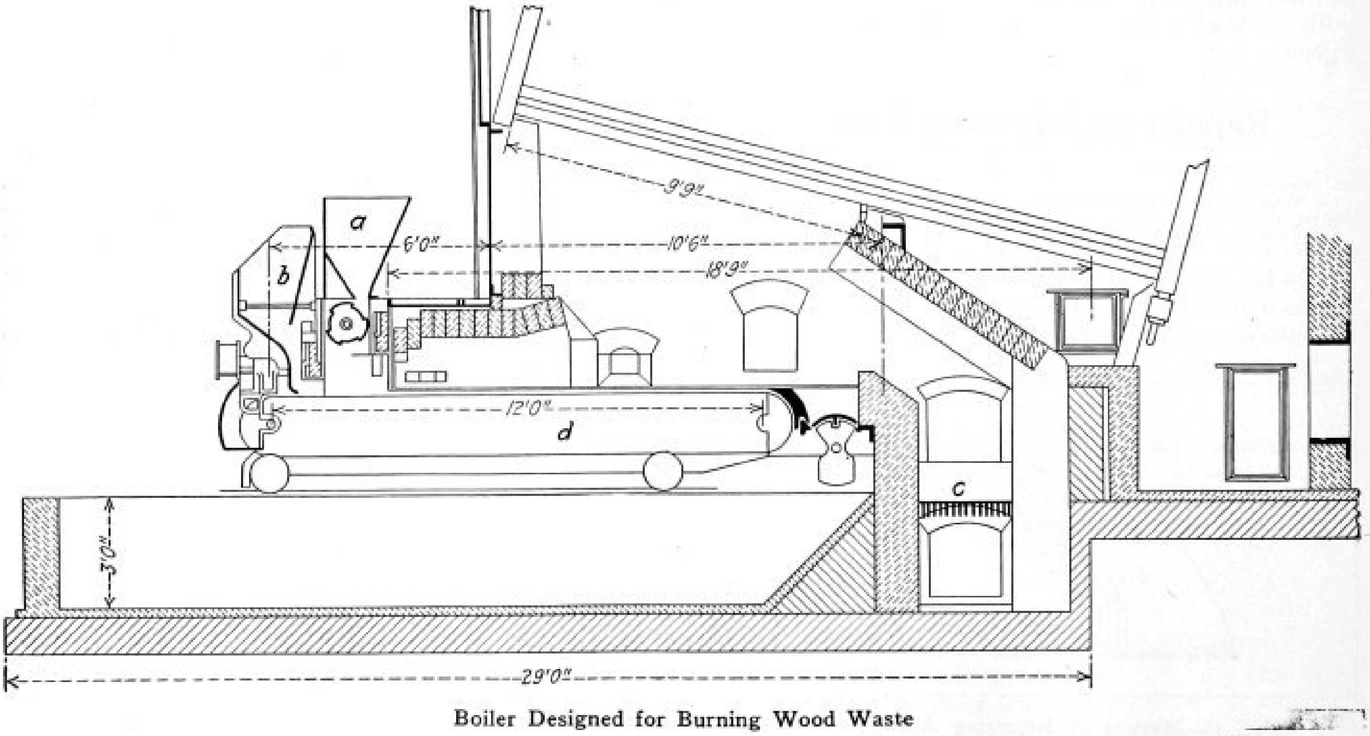
With a watertube boiler arranged as in Fig. 1, an evaporation from 3 to 3½ pounds of steam per pound of refuse (average saw mill refuse) is usually obtainable. The boiler it will be observed is of the Babcock type and the furnace has a chain grate stoker of 80 square feet area, the heating surface of the boiler being 3,900 feet.

Boilers of this type arranged as outlined have been installed in numerous instances in Britain and have given the greatest satisfaction. In this particular instance arrangements are made for burning coal should the amount of available refuse be insufficient at any time. The wood hopper is shown at *a* and the coal hopper at *b*, the small supplementary furnace at the rear shown at *c* being for the consumption of heavy material—hand fired. The chain grate stoker is shown at *d*. The leading dimensions are given, the width of the furnace being 9 feet and the length of the foundation 29 feet.

Advantages of Wood Waste as Fuel

Writing in "Power Plant Engineering" December 1, 1923, Morgan G. Farrell states the several advantages pertaining to the use of wood fuel. Expressing, no doubt, the American point of view, he states: "When used in combination with coal as is usually the case the result of such (inefficient) firing methods is to smother the fire, choke the draft and reduce the effective combustion of both coal and wood waste." He goes on to recommend a complete cyclone collecting system delivering into bins over the boilers. These boilers he states are return tubular boilers with Dutch ovens. "Drop legs fitted with measuring valves led direct from the overhead shavings bin to the center of the top of each Dutch oven. . . . The fuel consisted of two-thirds semi-bituminous coal and one-third wood waste by weight. A constant thickness of coal fire bed of about 6½ inches was maintained and a constant feed of shavings and saw-dust amounting to an additional 2½ inches of fire bed was supplied by regular operation of the valves in the drop legs" these valves being operated "so that just the right amount of fuel was fed at the right intervals to ensure complete and continuous combustion."

Cheshire, England. MAJOR JOHNSTONE-TAYLOR.



Boiler Designed for Burning Wood Waste

Method of Determining the Seriousness of Internal Pitting of Boiler Shells

WHEN boiler inspectors, in making examinations of the interior of boiler shells, detect any pitting, the first thought is to ascertain the various depths and area so defected. The article on page 194 of the June issue of THE BOILERMAKER illustrated and described the method pursued in ascertaining the extent and amount of strength lost due to pitting, and the remaining ultimate strength after pitting deductions are made, but where and at what *limit* would it be permissible to determine the loss of strength and still let the condition pass as being safe for operation until the next due internal examination? What about the required factor of safety? What about the breaking down of the structure and the change in molecular arrangement of metal so infected, as well as the wasting action which is enhanced and quickened by these changes?

These are the deeper questions which confront the boiler inspector and more often than not his decision and mind cause him to be at odds with himself as to what his recommendation shall be in regard to it. Consideration must also be given the approximate age and length of service, given by the shell which is pitted, when possible crystallization is present.

Isn't it because of these different elements and conditions, that the Interstate Commerce Commission directed the railroads to raise the factor of safety on all locomotive boilers, which ruling reads as follows:

The lowest factor of safety to be used for locomotive boilers constructed after January 1, 1912, shall be 4.

The lowest factor of safety to be used for locomotive boilers which were in service or under construction prior to January 1, 1912, shall be as follows:

Effective January 1, 1915, the lowest factor shall be 3, except that upon application this period may be extended not to exceed one (1) year, if an investigation shows that conditions warrant it.

Effective January 1, 1916, the lowest factor shall be 3.25.
Effective January 1, 1917, the lowest factor shall be 3.51.
Effective January 1, 1919, the lowest factor shall be 3.75.
Effective January 1, 1921, the lowest factor shall be 4.

Amendment: The dates on which factors of safety from 3.5 to 4 as provided above, become effective and shall be advanced for a period equivalent to the duration of the war.

Therefore, being mindful of these facts, I judge the matter by using the following solution:

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 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:

$$\left(\frac{55{,}000.}{4.22}\right) \times 4 \times 0.75 \times 20 = 781{,}980$$

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 — 737,344 = 44,636 pounds. This 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 tensile strength equivalent for a factor of safety of 4 by law.

For a more thorough understanding of this solution let us take the same boiler and same condition of the shell into consideration, but raise the factor of safety by reducing the steam working pressure from 200 to 175 pounds per square inch assuming as above, the percent efficiency of longitudinal seam to be 0.86, thickness of shell plate ¾ inch, tensile strength of plate 55,000 pounds per square inch and radius of largest course 42 inches.

```
              55,000
                 .75
             -------
             275,000
            385,000
             -------
   175     41,250.00
    42           .86
   ---     ---------
   350       247,500
  700     33,000
  ----    ---------
7,350)35,475.00  (4.82)  55,000.00  (11,410
      29,400               482              4
      ------               ---        -------
      60,750               680         45,640
      58,800               482            .75
      ------               ---        -------
      19,500             1,980        228,200
      14,700             1,928        31,948
      ------             -----        -------
                           520      34,230.00
                           482             20
                           ---      ---------
                           380      684,600 = SR
```

Now, you will note that by reducing the steam working pressure from 200 to 175 pounds per square inch, on the same boiler as considered above, G equals and exceeds SR therefore, $G—SR$ is 737,344—684,600 = 52,744 pounds of tensile strength between pits $A—A$ inclusive due to deteriorate before the RFS limit is reached.

In view of the evidence disclosed by the calculations against 3 to 4 years' operation before the next internal inspection is made from date of inspection, you will be convinced that to make recommendations for safety rather than taking a chance and passing up the condition is the best practice. T. P. TULIN.

Jersey City, N. J.

TRADE PUBLICATIONS

HEATERS.—A four-page, illustrated bulletin, descriptive of the Breezo-Fin unit heater, has been issued by the Buffalo Forge Company, Buffalo, N. Y.

CHAIN HOIST.—An improved electric chain hoist, Model No. 20, is described in an eight-page, illustrated folder recently issued by the Yale & Towne Manufacturing Company, Stamford, Conn.

INDUSTRIAL GASES.—A booklet describing Sunray acetylene and giving a number of rules to be observed in the use of compressed acetylene, has been issued by the International Oxygen Company, Newark, N. J.

SECURITY LATCH.—This latch designed to prevent grate shaker bars from working loose while being used, is described in a four-page bulletin recently issued by the United States Metallic Packing Company, Philadelphia, Pa.

ELECTRIC TOOLS.—Portable electric drills and reamers, grinding and buffing machines, etc., are described and illustrated in a 48-page booklet, Catalogue No. 32, being issued by the Hisey-Wolf Machine Company, Cincinnati, Ohio.

SPEED AND FEED TESTS.—The records of the tests made on Cleforge high-speed drills at the American Railway Association convention at Atlantic City in June, are being issued in booklet form by the Cleveland Twist Drill Company, Cleveland, Ohio.

TAPPING DEVICES AND APPLIANCES.—Jarvis high-speed tapping devices, tapping machines, quick change chucks and collets, and self-opening stud setters are illustrated and described in a 32-page catalogue recently issued by the Geometric Tool Company, New Haven, Conn.

LOCOMOTIVE SUPERHEATERS.—The origin, development and results of the Elesco locomotive superheater is the subject of a 24-page illustrated booklet just issued by the Superheater Company, New York. A brief historical sketch of the Superheater Company is given, also a brief outline of the introduction of the Schmidt superheater in this country.

REFERENCE BOOK.—The second edition of a 64-page, illustrated reference book of vertical turret lathe practice in railroad shops has been issued by the Bullard Machine Tool Company, Bridgeport, Conn. Installations from various shops throughout the United States are shown and, in most cases, diagrams indicate the tool equipment and typical operation layout.

STORAGE TANKS.—The Conveyors Corporation of America, Chicago, has published a new booklet describing the American cast iron storage tank, which is a sectional tank for the storage of dry, loose, bulky material, such as ashes, coal, sand, gravel, etc. The booklet is illustrated with diagrams and half-tones of tanks in use, and contains a table of weights, measures and capacities.

AUTOMATIC CONTROL OF COMBUSTION.—Catalogue No. 99, which is made up of two bulletins treating of the automatic control of combustion, and systems for the automatic control of combustion respectively, has been issued by the Carrick Engineering Company, Chicago. The former bulletin contains a complete discussion of automatic control methods and systems and brings out the limitations of the various systems and why they fail. The conditions to be met in co-ordinating supply of steam with the demand are analyzed and interesting charts of steam pressures are given, the fallacy of close steam regulation is exploded, and a graphic record of damper positions shows the comparative permanence of automatic control. Complete specifications, toegther with diagrams and a list of equipment required for thirty-three distinct methods of automatically controlling boiler room equipment, are given in the latter bulletin.

BUSINESS NOTES

R. L. Mead, engineer and salesman for the Brown Hoisting Machine Company, has been appointed western sales manager of the Ohio Locomotive Crane Company, with headquarters in the Railway Exchange building, Chicago.

The Hanna Engineering Works, 1765 Elston Avenue, Chicago, is now represented in Maine, New Hampshire, Vermont, Massachusetts and Rhode Island by the Eggleston Supply Company, 259 Franklin Street, Boston, Mass.

The American Locomotive Company has awarded a contract to the Chicago Bridge & Iron Works for the furnishing and erecting of a 50-000-gallon tank on a 100 foot tower at its Richmond, Va., plant. The tank will be used for the purpose of affording fire protection.

G. H. Burton, general foreman in the mechanical engineering department of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been promoted to assistant engineer of motive power, with the same headquarters, succeeding W. P. Rudd, who has been appointed general foreman, mechanical department, succeeding Mr. Burton.

The Buffalo, N. Y., office of the Cutler-Hammer Mfg. Co., in the Ellicott Square building, which was formerly a part of the eastern district, has been made a part of the central district, of which A. G. Pierce is general district manager, with headquarters at Pittsburgh. The central district includes the territories covered by the Buffalo, Pittsburgh, Cleveland and Cincinnati offices. B. A. Hansen is manager of the Buffalo office.

T. H. King, for the past twelve years sales manager of the Landis Tool Company, has resigned to become treasurer and general manager of the Wayne Tool Manufacturing Company, Waynesboro, Pa. Mr. King, who received his early training in tool manufacturing in the employ of the L. S. Starrett Company, Athol, Mass., and was later employed by the B. F. Sturtevant Company, Boston, Mass., had been actively connected with the Landis Tool Company for the past eighteen years.

The Victor Tool Company, Waynesboro, Pa., manufacturers of collapsible taps, automatic die heads, floating toolholders, and nut facing machines, has been merged with the Landis Machine Company, Waynesboro, Pa. In the future all correspondence applying to Victor products should be addressed to the Landis Machine Company, Victor plant, Waynesboro. The trade name "Victor" will continue to be applied to the tools formerly made by the Victor Tool Company, and there will be no change in the selling arrangements of these products.

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—George Uhler, Washington, D. C.

Deputy Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law Society

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—John A. Stevens, Lowell, Mass.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 West 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—J. F. Scott, Trenton, N. J.

Secretary-Treasurer—C. O. Myers, State House, Columbus, Ohio.

Vice-Chairman—R. L. Hemingway, San Francisco, Cal.

Statistician—E. W. Farmer, Rhode Island.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

J. A. Franklin, International President, suite 522, Brotherhood Block, Kansas City, Kansas.

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, suite 524, Brotherhood Block, Kansas City, Kansas.

H. J. Norton, International Vice-President, Alcazar Hotel, San Francisco, Calif.

International Vice-Presidents—Thomas Nolan, 700 Court St., Portsmouth, Va.; John Coots, 344 North Spring St., St. Louis, Mo.; M. A. Maher, 2001-20th St., Portsmouth, Ohio; E. J. Sheehan, 7826 South Shore Drive, Chicago, Ill.; John J. Dowd, 953 Avenue C, Bayonne, N. J.; R. C. McCutcheon, 15 La Salle Block, Winnipeg, Man., Can.; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; John F. Schmitt, 605 East 11th Ave., Columbus, Ohio.

Master Boiler Makers' Association

President—Frank Gray, tank foreman, C. & A. R. R., Bloomington, Ill.

First Vice-President—Thomas F. Powers, assistant general foreman, boiler department, C. & N. W. R. R., Oak Park, Ill.

Second Vice-President—John F. Raps, general boiler inspector, I. C. R. R., Chicago, Ill.

Third Vice-President—W. J. Murphy, general foreman boiler maker, Penn System, Fort Wayne Shops, Allegheny, Pa.

Fourth Vice-President—L. M. Stewart, general boiler inspector, Atlantic Coast Lines, Waycross, Ga.

Fifth Vice-President—S. M. Carroll, general master boiler maker, C. & O. R. R., Richmond, Va.

Secretary—H. D. Vought, 26 Cortlandt Street, New York.

Treasurer—W. H. Laughridge, G. F. B. M., Hocking Valley R. R., 537 Linwood Avenue, Columbus, Ohio.

Executive Board—E. J. Reardon, Locomotive Firebox Company, 632 Marquette Building, Chicago, Ill., chairman; H. J. Raps, G. F. B. M., I. C. R. R., 7224 Woodlawn Avenue, Chicago, Ill., secretary.

Boiler Makers' Supply Men's Association

President—J. P. Moses, Jos. T. Ryerson & Son, Chicago, Ill.; Vice-President—F. H. McCabe, McCabe Manufacturing Co., Lawrence, Mass.; Secretary—W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

American Boiler Manufacturers' Association

President—E. R. Fish, Heine Boiler Company, St. Louis, Mo.

Vice-President—E. C. Fisher, The Wickes Boiler Company, Saginaw, Mich.

Secretary-Treasurer—H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

Executive Committee—George W. Bach, Union Iron Works, Erie, Pa.; G. S. Barnum, The Bigelow Company, New Haven, Conn.; F. G. Cox, Edge Moor Iron Company, Edge Moor, Del.; W. C. Connelly, D. Connelly Boiler Company, Cleveland, O.; W. A. Drake, The Brownell Company, Dayton, O.; A. R. Goldie, Goldie-McCulloch Company, Galt, Ont., Can.; J. F. Johnston, Johnston Brothers, Ferrysburg, Mich.; M. F. Moore, Kewanee Boiler Works, Kewanee, Ill., and A. G. Pratt, The Babcock & Wilcox Company, New York.

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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

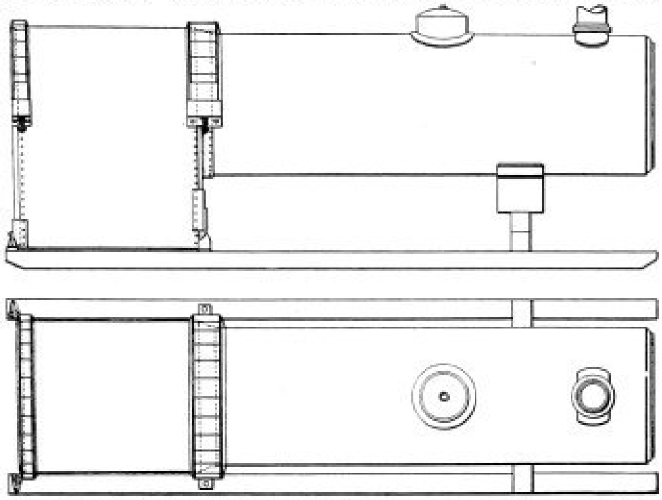
SELECTED BOILER PATENTS

Compiled by
GEORGE A. HUTCHINSON, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

1,501,789. BOILER ATTACHMENT. SAMUEL J. LINDELL, OF MANDEVILLE, LOUISIANA, ASSIGNOR TO C. SIDNEY FREDERICK, OF COVINGTON, LOUISIANA.

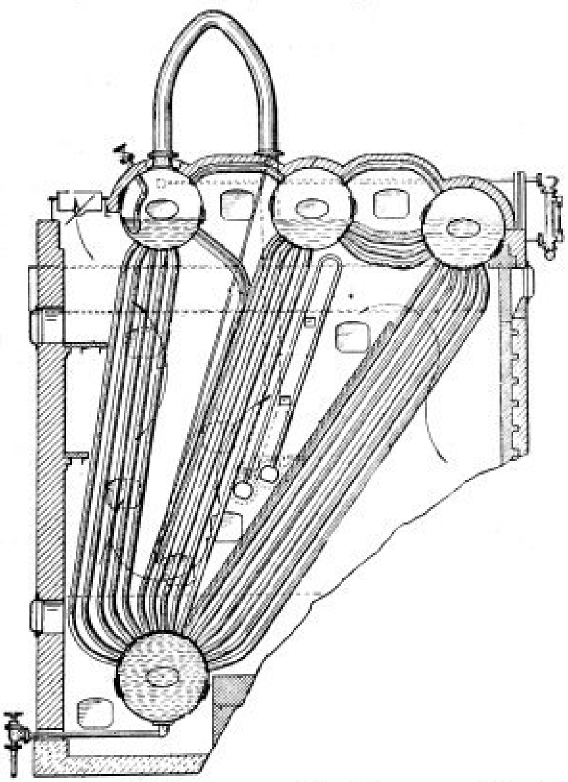
Claim 1.—A protecting device for a boiler seam, comprising a sectional covering engaging the boiler upon opposite sides of the seam, means for



removably securing the covering to the boiler and a refractory material engaging said boiler and the opposite sides of said covering as and for the purpose specified. Four claims.

1,493,278. STEAM BOILER. ARTHUR D. PRATT, OF SHORT HILLS, NEW JERSEY, ASSIGNOR TO THE BABCOCK & WILCOX COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

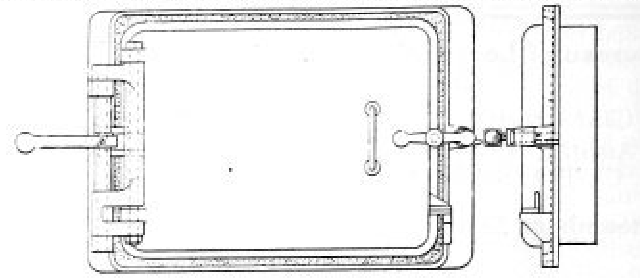
Claim 1.—A steam boiler of the class described comprising three upper, transverse drums connected by banks of tubes to a lower water chamber, a baffle extending downward from the middle upper drum at the rear of the



bank connected to that drum, some of the tubes connected to the rear upper drum being directed at their upper portions toward said baffle, and a protecting baffle supported on said upper portions and extending from the rear upper drum to said baffle to protect the rear upper drum from excessive heating. Three claims.

1,504,661. FURNACE DOOR. FERD ELIEL WERTHEIM, OF CHICAGO, and ASHUR URL WETHERBEE, OF EVANSTON, ILLINOIS, ASSIGNORS TO WILLIAM A. GILCHRIST, OF NEW YORK, N. Y.

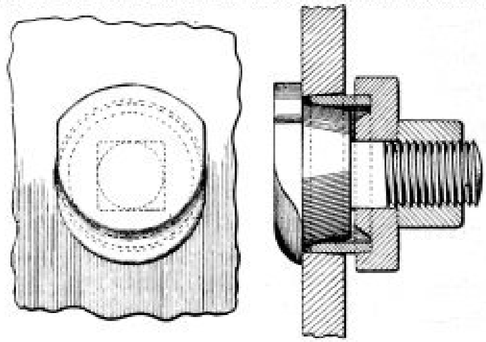
Claim 1.—In a furnace, the combination of a door frame, a door loosely mounted on the frame, and means for forcing the door tightly against the



frame, including a lever pivoted on the frame and having an arm serving as a handle and another arm adapted to have wedging engagement with the door as the lever is rotated. Eight claims.

1,502,038. BOILER PLUG. FREDERICK E. KEY, OF ST. LOUIS, MISSOURI, ASSIGNOR TO KEY BOILER EQUIPMENT COMPANY, OF ST. LOUIS, MISSOURI, A CORPORATION OF MISSOURI.

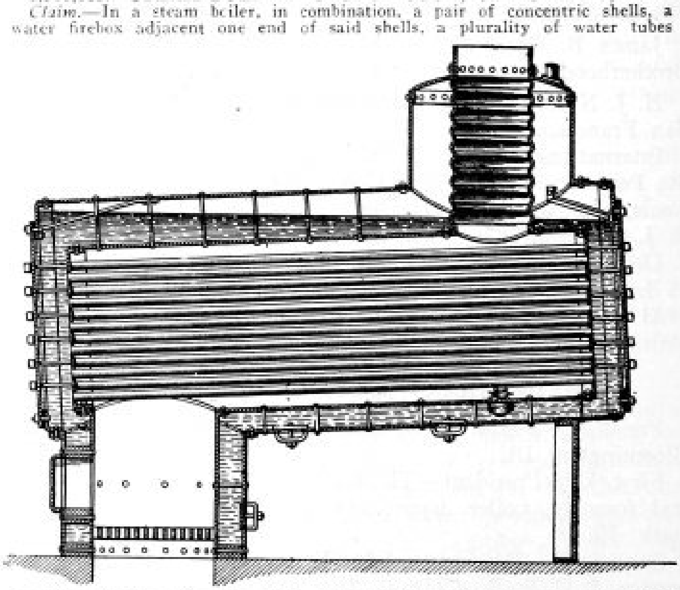
Claim 1.—In a closure for tapered holes in boiler walls, a tapered spreader comprising a head having a tapered portion located within the hole to be closed, the largest diameter of said tapered portion being smaller than the diameter of the hole, said spreader also having flanges adapted to pass through the hole and engage the inner face of the boiler wall to prevent outward displacement of the spreader, the spreader taper being at an angle to the tapered face of the hole so as to provide the converging faces, a sealing ring having its inner margin entirely within the hole to be closed, said inner margin being interposed between and in contact with said converging faces of the hole and spreader, the outer margin of said sealing ring being extended from the wall of the boiler, a thrust member seated on



the outer edge of said sealing ring and provided with an annular reinforcing flange overlapping and closely fitted to the extended outer margin of the sealing ring, a screw threaded stud formed integral with and extending outwardly from said spreader, the periphery of said spreader being so small that the spreader can be tilted and inserted through the hole without displacing the screw threaded stud relative to the spreader, said stud having a non-circular portion and said thrust member being slidably mounted thereon to prevent independent rotation of said thrust member and spreader, and a nut on said stud, said thrust member being movable toward the wall of the boiler in response to rotation of the nut so as to force said inner margin of the sealing ring into firm contact with said converging faces. Two claims.

1,500,182. STEAM BOILER. GEORGE COOK, OF BUFFALO, N. Y.

Claim.—In a steam boiler, in combination, a pair of concentric shells, a water firebox adjacent one end of said shells, a plurality of water tubes



connected to the end walls of the inner shell, said shells and water tubes being inclined upwardly from the firebox end, a steam dome connected to and projecting upwardly from the uppermost end of the outer shell, a flue passing through the steam dome and communicating with the inner shell, and means for maintaining said shells in spaced relation.

THE BOILER MAKER

OCTOBER, 1924

Suggestions for Inspecting New Locomotive Boilers

By George L. Price

No more important phase of locomotive boiler work exists than that of inspection and yet oftentimes familiarity with the job develops carelessness on the part of some men. At every stage in the construction of the boiler, careful examination must be made of all material entering into the work and of the manner in which this material is applied. The following article goes into specific detail on the methods of inspection that have proven satisfactory to the author. Other standards and methods on other roads may be equally good—and these we would like to learn of from our readers.

ALL boiler inspectors should familiarize themselves with all drawings, and specifications pertaining to boiler, tank, and sheet iron work, as well as the standard practice methods maintained by the company. When in doubt in regard to the grade of material used in the construction of boilers insist upon a physical, and chemical test of such materials, and keep a record of them. Demand a copy of the mill test, and check the heat and serial numbers on the material with the mill copy. Keep a constant check on the material during the entire period of construction to prevent a substitute being used. Oftentimes during the course of construction material will be rejected by the inspector, and towards the end of the order a material may be substituted that will not meet with the specifications.

See that all tools used in the construction of boilers meet with standard requirements. Check the prints with the specifications and correct all errors before the boilers get under way.

The first plates that are laid out are generally used for the pattern sheets, therefore check these plates closely for proper alinement of holes and proper lap distance before they are punched. The pattern sheets are generally punched to prevent bad holes that are liable to occur when they are drilled on account of the drill running. After the sheets are punched check them again for proper alinement of holes.

Punch all holes ⅛ inch smaller than the required size and then ream them to the required size after the sheets have been rolled into shape. Drill all longitudinal seams 5/16 inch smaller than the rivet size and redrill to the proper size after the plates have been rolled and assembled. All holes in the gusset or taper course and all rivet holes in the firebox casing or wrapper sheet should be drilled 1/16 inch smaller than rivet size, and reamed 1/16 inch larger than rivet size after the plates are rolled and assembled.

All staybolt holes in the firebox and casing should be drilled as nearly full size as will permit a full thread when tapped. Make frequent examinations of all burrs and punchings to detect laminations. Reject all laminated sheets. Rivet holes must be the proper distance from the edge of all sheets to insure the proper lap.

Inspect all plate after it is rolled to see that it is rolled to its true radius. Insist upon dome hole plate being cut out after the shell is rolled into shape; this to prevent the sheet from bending from its true radius through the center line of the dome hole which is often the case when the dome hole is punched out before the sheet is rolled into shape. Insist upon all shell sheets being rolled to their true radii at the ends before the butt straps are applied. See that the butt straps are rolled to their true radii before they are applied; this to eliminate all flat spots in shell sheets where they are joined together.

Reject all wrought iron mud-rings showing laminations, and imperfect welds and all cast steel mud-rings having pin holes, blow holes and cracks. Insist upon all mud-rings having their corners milled inside and out, to detect weak or bad corners and to supply a smooth surface for the fitting of the firebox sheets. The width of the mud-ring should not exceed 1/32 inch variation in water space from card dimensions. Extreme over-all dimensions, both length and width, must not exceed 1/16 inch variations from card dimensions. After a cast steel mud-ring is drilled, inspect the drilled holes in the center of the ring to detect sand or blow holes that may be in the center of the ring.

Flanging

Insist upon all flanges being smooth and true to card radius. Reject all flanges showing signs of over-heating, hammer marks, cracks, and laminations. Examine all flanges for cracks after they have been laid up. Examine frequently the punchings from all flanged sheets for laminations. Insist upon all flanged sheets being trued up and straightened before they are fitted up; as this has a tendency to relieve them from all unnecessary strains.

Anneal all flanges. Watch for flanges that have been made too large, or too small. Do not permit excessive laying up of sheets, or do not permit sheets that have been flanged too large to be forced into place to the extent that they bulge, or buckle. Do not permit sheets to be scarfed out to gain the necessary lap when they fall short of same, or do not permit them to be built up when the shortness is excessive.

Inside and outside firebox sheets should extend within ¼ inch of full depth of the mud-ring.

Fitting Up

Before sheets are punched inspect same for perfect alinement of holes and after sheets have been punched or drilled again inspect them for the same purpose and reject all sheets that you find with holes out of line.

Make frequent examinations of burrs or punchings while sheets are being punched to detect laminations; rejecting all laminated sheets. Rivet holes must be proper distance from the edge of all sheets and butt straps to insure proper lap. When lining up the boiler shell to the firebox they must be straight with each other, and central. In the length of the firebox the outer casing sheet at the mud-ring must not exceed ½ inch out of parallel with center line of boiler for wide fireboxes; or ¼ inch for narrow fireboxes. The latter type must be straight and central as possible. Have all holes burr reamed on both sides of the sheet. Insist on having all sheets up iron to iron even though it becomes necessary to put a bolt in every other hole. Heat and lay up all shell sheets from the inside whenever possible. Flue sheets must be square with the boiler, and parallel with each other within ¼ inch. Water spaces on both sides of the firebox should measure the same within ¼ inch. Staybolt holes should be in perfect alinement, but a variation of 1/32 per inch width of water space is permissible.

All dome collars should fit the boiler shell closely. Reject all that will permit a feeler of 1/32 inch thick passing between shell and dome collar where bolted ready to rivet. Check the distance between the center of the cylinder seat in the smokebox to the bottom edge of the throat sheet; allowing not more than ¼ inch variation in length from drawing size, or dimensions.

Drilling and Riveting

Before shell sheets are rolled into shape drill all longitudinal seam rivet holes 5/16 inch smaller than required size. After the sheets are rolled and butt straps are fitted into place redrill longitudinal seam rivet holes to required size. All holes in gusset or taper courses and all rivet holes in the firebox casing or wrapper sheets should be 1/16 inch smaller than rivet size and reamed to 1/16 inch larger than rivet size after sheets are assembled.

All staybolt holes in the firebox and casing should be drilled as nearly full size as will permit full thread when tapped. All punched holes should be punched 3/16 inch smaller than rivet size and reamed to 1/16 inch larger than rivet size after plates are rolled and assembled. Care must be taken to insure cups in rivet dies being of proper depth and shape; also see that rivets are of proper length to insure being sufficiently upset to thoroughly fill their holes. In no case must rivets be short enough, or dies deep enough to allow the riveting dies to touch the plates. A rivet will be assumed to be loose if the plate shows any impression of the die around it. Such rivets should be removed and replaced with a rivet driven properly.

To insure tight rivets, all holes in boilers must be inspected to see that they are fair, and in proper shape to receive the rivets. All rivets should be tested for tightness before the firebox is applied and before the boiler is fully assembled.

Rivets should be central with the holes; however, a deviation of 1/16 inch to one side may be passed. Steel rivets should be driven at a red heat; iron rivets should be driven at a white heat.

Pressure for riveting should not be less than the following:

¾ inch to ⅞ inch	75 tons
15/16 inch to 1 1/16 inch	100 tons
All rivets in excess of 1 1/16 inch	125 tons

When driving rivets they should be held under pressure until they are reasonably cool before proceeding to the next rivet. Chamfer the edge of all rivet holes under the head 1/16 inch radius. The die size of all punched holes should be taken as the punched size. Test all rivets for tightness by the hammer test.

Reject all rivets that show signs of being overheated, or burned. Use the hydraulic riveter whenever possible and see that proper pressure is maintained during the entire course of construction.

Calking

Standard calking tools should be used and all calking done in a manner not to injure the sheet. If a square tool is used see that it is not ground sharp, as this has a tendency to cut the plate which opens an avenue for a fracture, or break. Do not calk the flues until the boiler is tested, as this method will insure you a better class of work on your flues. After the boiler is tested sand blast the back flue sheet, then calk or bead the flues, but do not permit oil to be used in beading. Your flues are now in first class shape for welding should you desire to do so. Do not permit crown bolt heads to be calked. Should they need calking have them removed and replaced with tight bolts. Do not permit flexible staybolt sleeves to be calked, especially where they are installed in the straight part of the firebox sheets. Have your boiler plate planed at the calking edges wherever it is possible to do so. Have it planed about 45 degrees.

Types of Braces

See that all braces have perfect welds whenever specifications call for welded braces. However, it is better to use braces made without welds. See that all braces have a slight tension when applied. Reject all braces having curves or offsets. Do not permit braces to be punched; have them drilled. All boiler braces running from the back head must clear the crown sheet, radial and firebox stays. All tee irons applied to the wagon top for sling stays or crown bars must be a good fit and arranged not to interfere with boiler stays to the back head. Reject all that will admit a 1/64-inch feeler between the tee iron and sheet. Whenever possible have all braces, jaws and brace lugs drop forged. Have all braces made from double refined iron, or sheet steel of high tensile strength. Have all brace pins made from engine bolt iron. Do not permit brace pins to be pointed back of the cotter key hole. Do not apply braces hot. See that jaws have full body bearing on pin. Test your braces for tension before they are washered and keyed up. See that brace jaws do not grip on the lugs, or in other words see that the jaws are far enough apart, but not too far for a proper fit. Do not permit any grinding on braces for clearance. See that the body of the brace is not reduced in diameter when it is being fitted up. Have the braces made ⅛ inch larger than calculated diameter due to losses in corrosion. Whenever possible have all braces at right angles to the sheets that they support.

Bolts and Stays

Threads on bolts and crown sheets must be perfect, and the bolts must fit tight on the thread when screwed into place. The inspector should loosen up some bolts in each firebox to satisfy himself that this condition exists and that the bolts are not made tight by drawing them up against the head, or by cross threading. See that all crown bolts are at right angles to the sheets that they support.

Expansion stays must be applied so that the stay is in tension, with provision for expansion in the proper direction. Eye sockets must screw on all expansion stays when used not less than 1¼ inches. Throat stays should conform to drawings, and be carefully checked for alinement, vertically, and horizontally.

Flexible Bolts

All threads in the sheets must be full and smooth. Bushings when in position should be at least flush on the short side of the sheet in the water space. When applying them in double, or thick sheets they should be in the sheet not less than ⅞ inch on the short side. Bushings should be tight enough to require a 48-inch wrench to apply and, if the bushing has a shoulder, it must be absolutely tight before coming up against the shoulder. The threads for caps must be good and the joints on the bushings and caps must not be marred. All foreign matter must be removed from the joint before screwing the caps in place. Stays when applied must not be tightened enough to place tension on the bushing, but merely seat the head into the socket. Special tools should be used to apply flexible bolt bushings. After flexible bolts are applied check up on the inside firebox sheets to see that they are not pulled in.

Crown and Radial Stays

Ends of radial and crown stays projecting through crown and roof sheets for riveting must be closely examined and all having defective threads, or loose in the sheet, must be removed and the holes retapped and new bolts applied. Holes inside and roof sheets should be closely examined for distortion of thread on the lower sides of the holes due to not properly supporting the weight of the machine when tapping. Holes found defective in this manner should be retapped to a perfect thread. Threads on crown and radial stays must extend entirely through the sheet. Do not permit calking on the heads of crown bolts. If they leak on test have them removed. See that crown and radial bolts clear all braces.

Short or Side Stays

Threads on staybolts must be full and should exactly match the taps. Staybolts must be tight enough to require at least a 12-inch wrench to screw them into the inner or the outer sheet. See that the bolts are all set to proper length for riveting before cutting them off. Telltale holes must be drilled central and straight with the bolt and in accordance with standard practice. They must be thoroughly opened up after they are riveted. In hammer testing staybolts for tightness before riveting, test them on the outside and inside of the firebox, and in addition to this back a few of them out of the sheets. If your specifications call for a certain style of thread check up at frequent intervals with the thread gage to see that threads on the bolts match with the taps you are using: oftentimes a mistake is made in this manner and your bolts will run tight in the sheets giving you the impression that you are getting a good job when in reality you are getting a very poor one that will cause you considerable trouble in the future. See that the inside side sheets are straight before you drive the staybolts, as oftentimes a stripped staybolt will push them out in different places when you run in your bolts.

For iron staybolts 3/16 inch should be left protruding from the sheets for heading over, except when otherwise specified. For copper bolts ⅜ inch should project for heading except when otherwise specified.

Flue Practice

Tube holes in tube sheets must be drilled to specified size and must be smooth and true; the edges of holes should be slightly chamfered to 1/16 inch radius inside, and outside on front and back flue sheets. See that tube sheets are straight before flues are put in the boiler. See that flue coppers are applied according to your standard practice. Should you have safe ends welded on your flues see that they are tested in the following manner:

A good practice for testing safe ended boiler tubes is to partially fill the tubes with water, then turn on the air at a pressure of 100 pounds, and while under pressure tap the safe end with a hammer, and inspect for leaks.

See that the swaged end of a flue is not thinned out, or overheated by burning the metal. Also see that all scale is removed from the swaged end of the flue before it is applied to the boiler. Flues must be swaged so as to require a slight driving to reach the proper distance through the firebox tube sheet. The distance is governed by the shape and size of the beading tool used. Flues should not project through tube sheet more than ⅜ inch nor less than 3/16 inch for beading. If tube holes in the firebox sheet are 1/16 inch larger than the outside diameter of the flue, the flue should be opened up by heating before entering the boiler. See that the flues are expanded properly in the back tube sheet. Do not permit excessive rolling of the flue in the smokebox end. See that 10 percent of your flues are beaded over in the front end. All flues that split open while they are being belled out have removed and replaced with new flues.

Have a hydrostatic test applied to the boiler before the flues are beaded; after the test, bead the flues, then apply a fire test to the boiler. After the fire test sand blast the sheet and electric weld the beads to the tube sheet. By this method you have the assurance that your flues are expanded tight in the sheet by the prosser and not made tight by beading. You also have the assurance that all dirt and grease will be burned off the sheet before the beads are welded; consequently you can expect a good job in welding your beads.

Testing the Boiler

Test all boilers in the following manner: Fill the boiler with warm water not over 150 degrees F. and raise the pressure by the use of a pump or injector to 25 percent above the working pressure. By working pressure I have in mind the maximum working pressure for which the boiler is built, or designed. After the hydrostatic test has been applied fire the boiler up and test under its own steam to 20 percent above its working pressure. Then blow the boiler entirely out and let it stand until thoroughly cooled through and refill with warm water, not over 150 degrees F. Fire up and test under steam the second time to 20 percent above the working pressure.

Miscellaneous Suggestions

See that the cab sides do not present a wavy appearance, due to improper riveting. Sheets must be smooth and regular, laps and adjoining sheets must fit closely at joints. Have wavy sheets straightened before they are punched to insure good holes when fitting up. When fitting up have the burred side of sheet to the outside. Holes for injector or other pipes must not be excessively large in size and must not present a ragged appearance.

See that all front end appurtenances fit closely and are bolted in tight. Do not permit holes in joints to exceed that of the mesh in the netting. This to prevent the engine from throwing fire. See that a tight joint is made at the smokebox front to prevent the engine from taking air; which has a tendency to impair the steaming qualities of the engine.

See that all of the running boards are knobbled to prevent engine men from slipping. Also see that they are designed so as to not hold an excessive amount of cinders which are bad on the eyes of enginemen. Have cab and running boards parallel on sides and back. The front must not be buckled, which is sometimes caused by being sprung into place. If cab windows are made of metal see that they work freely and close tight. The same applies to the cab doors. Have cab and running boards bolted down with bolts long enough to take a double nut on the bolts.

See that all flanges of I-beams and channel iron sills are not cut away or have holes that would have a tendency to weaken them. See that all rivets are driven tight and that all fitting together of parts are metal to metal before the rivets are driven.

See that all rivet heads exposed to view on the tank are of uniform size and are in line. All outside sheets must be straight and free from waves in addition to being smooth. All exposed edges of sheets are to be smooth and regular. The tank must rest solidly on the floor and no rivet, bolt, or nut heads, or other metal parts should protrude above floor that would chafe the tank.

Shop Kinks for Locomotive Boiler Work*

Time and Labor Saving Devices and Shop Methods Developed by Practical Boiler Makers

UNFORTUNATELY the committee did not receive replies to requests for information from a large number of members solicited. However, we are endeavoring to give the members of the association the benefit of what "Shop Kinks" we have been able to collect.

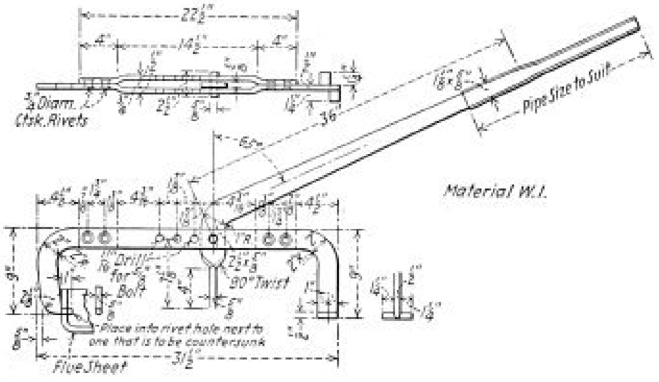


Fig. 1

Fig. 1 is a device for holding an air motor in place when countersinking flue sheet rivet holes and is furnished by H. J. Raps of the Illinois Central. This looks to be a very useful device and will probably be of interest to many.

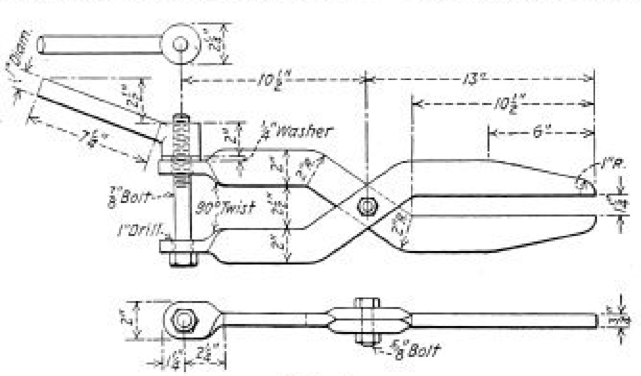
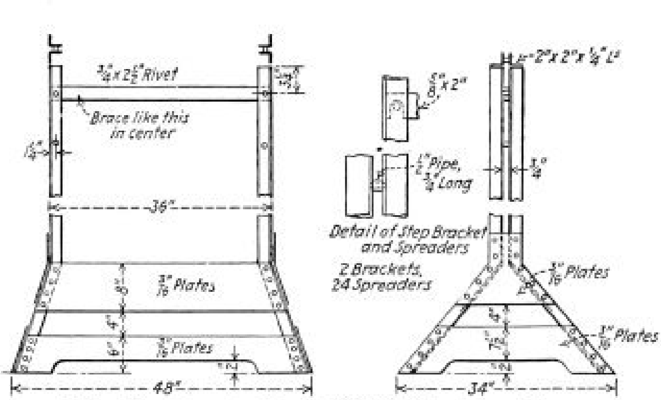


Fig. 2



Boiler Shop Horse Used For Scaffold Drilling - Boone Shops

Fig. 3

Fig. 2 is a template clamp used at the Burnside shop of the Illinois Central Railroad and is furnished by H. J. Raps.

Fig. 3 is a combination of a boiler shop horse, scaffold and drilling rack used at the Boone shops, C. & N. W. Railway. This is a very handy device for drilling out staybolts and an excellent and safe scaffold for the use of the boiler maker and others when working around the outside of the firebox.

Fig. 4 is a front end scaffold used at the front end when applying superheater units, steam pipes, front ends and for the use of any other work in front end of the locomotive. The value of this scaffold is that it is high enough above the floor to make it possible for other mechanics to work around the cylinder bumper beams, etc., without interference from horses, planking, etc., generally used in railroad shops. This scaffold can be left in place when transferring locomotives from the machine shop to hoists or cranes. Both Figs 3 and 4 were furnished by J. P. Powers, boiler foreman, C. & N. W. shops, Boone, Ia.

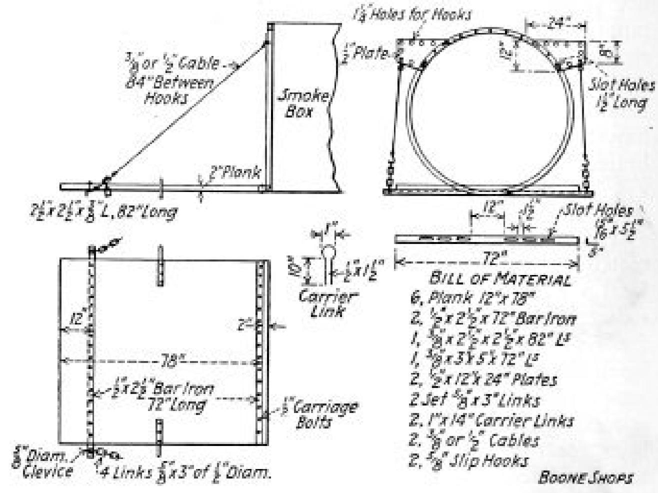


Fig. 4

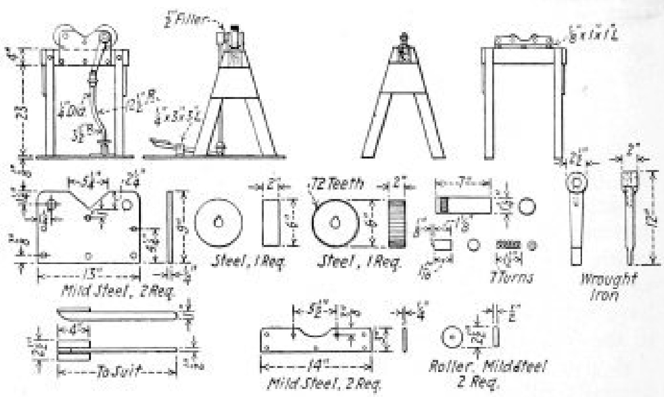


Fig. 5

Fig. 5 is a roller operated by foot pressure used in welding superheater and other flues or any other round metal that is required to be turned. The flue axle or anything else that is being welded can be turned by the welding operator without the aid of a helper.

*Paper presented at the 1924 convention of the Master Boiler Makers' Association.

Fig. 6 is a rack used for welding flanged flue sheets, door sheets, etc., and saves piling sheets on top of one another making it easy to pull any required sheet from the rack without disturbing the other sheets. Both Figs. 5 and 6 are

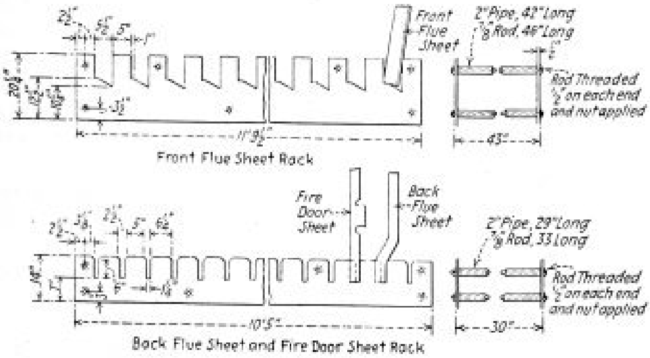


Fig. 6

used by the C. & N. W. shops at Chicago and were furnished by T. F. Powers.

Fig. 7 is a guard for a bench vice used on the Canadian Pacific Railroad at Winnipeg.

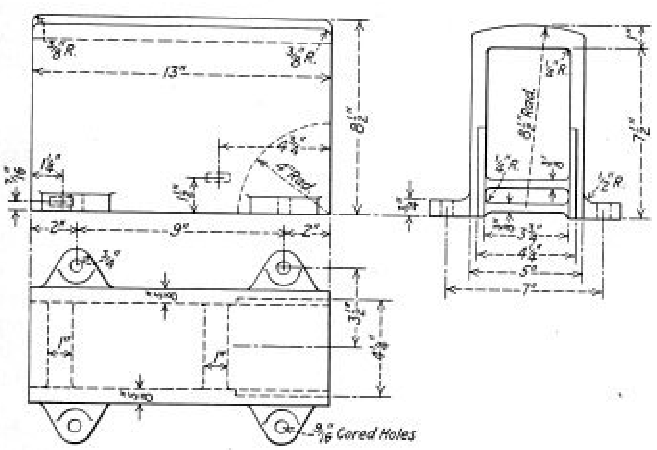


Fig. 7

Fig. 8 is a boiler tube cutter used on the Canadian Pacific at Winnipeg shops.

Fig. 9 is a flue shop layout furnished by the Canadian

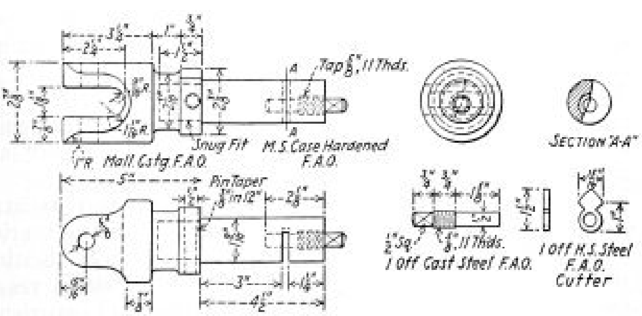


Fig. 8

Pacific and in use at their Winnipeg shops. Figs. 7, 8 and 9 were furnished by Thomas W. Lowe of the Canadian Pacific.

Figs. 10, 11 and 12 show a reducing valve used on the hydraulic riveter, Dale St. shops of the Great Northern Railroad and was furnished by M. J. Guiry. Mr. Guiry claims that this valve is very beneficial with the use of the hydraulic riveter in controlling and maintaining the proper pressure.

Franklin T. Litz, general boiler foreman of the C. M. & St. P. Railroad, advises that they have in use a combination radial stay tap, which has a guiding spindle taking the place of the reamer. Mr. Litz did not send a cut of this but undoubtedly will be glad to furnish members with sketch of same if asked for. He also advises that they are driving staybolts with the shanks of broken rivet sets. These shanks are ground on the broken end in a ball shape and are used as bobbing tools. This feature has eliminated die breakage in staybolt riveting. The above design is used on numerous other railroads to take the place of the so-called flat set.

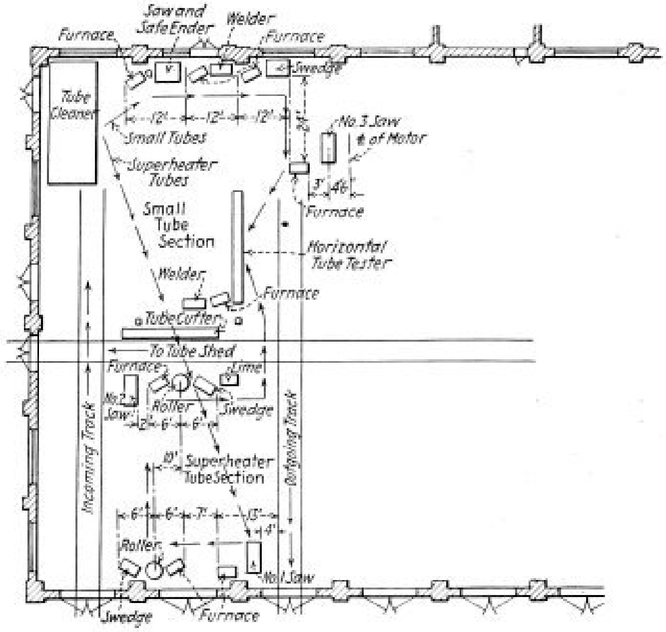


Fig. 9

Your committee is also advised that several railroads are using the cast steel and cast iron petticoat pipes instead of those of sheet steel. We suggest that this be discussed and the merits of cast steel and cast iron be brought out.

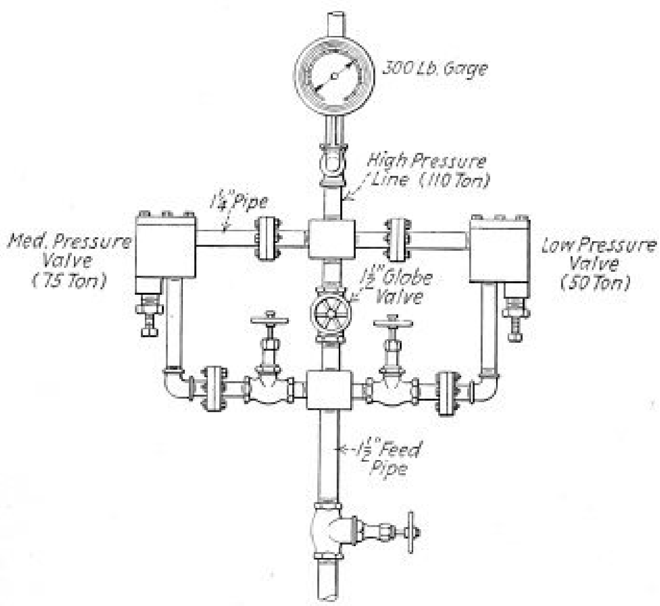


Fig. 10

Thomas Lewis of the Lehigh Valley Railroad advises (but does not send a sketch) that they have a new design of a superheater flue roller expander. The new roller is designed with seven rolls instead of five as on the old type superheater roller and Mr. Lewis states that the work is done much cheaper and faster than with the old style roller.

Your committee is in receipt of numerous "Shop Kinks"

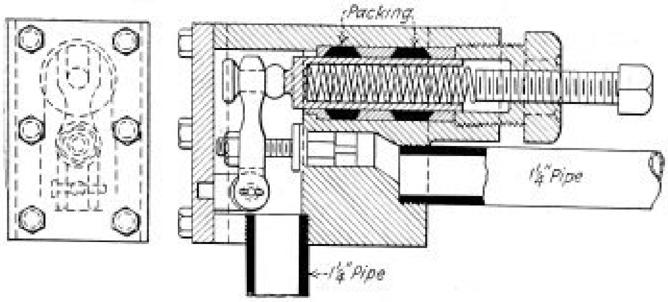


Fig. 11

where the use of electric and acetylene welding is involved but it is our belief that this should be handled by the committees dealing with these subjects. Therefore, no mention is made of them.

Your committee wishes to thank the members whose names are mentioned in this paper for their contributions to the above subject and we are only sorry that we are not able to

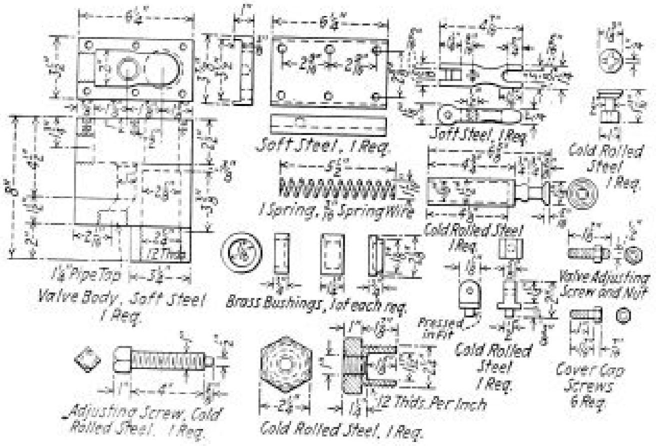


Fig. 12

get a larger assortment of "Shop Kinks." It is our hope, however, that in the discussion of this paper numerous short cuts and other "Shop Kinks" can be brought out.

This report was prepared by a committee composed of T. F. Powers, chairman, E. W. Rogers, O. C. Voss, C. E. Elkins.

Power Show Broadening Its Scope

The interest that has been shown in past Power Shows by the executives and engineers that visited them has stimulated the exhibitors to great efforts to develop interesting and instructive showings of the progress during the past year in the arts and sciences of producing, distributing and using power. The Third National Exposition of Power and Mechanical Engineering will be held in the Grand Central Palace, New York, from December 1 to 6, 1924. The preceding shows have thoroughly covered the field of power production with the exception of hydraulic machinery, but in the coming event there will be an excellent representation of the manufacturers of large turbines and hydraulic power plant equipment.

The large increase in the use of the individual motor drive on machine tools has led the managers of the coming show to make a determined effort to bring a group of manufacturers of modern economical motor-driven machine tools into the show as an object lesson to the many visitors of what can be accomplished in securing savings in operation by the greater use of the electric motor in general manufacturing. The field of power transmission and use has been one of great interest to visitors to the Power Show and the exhibits of bearings, couplings, belting and belt drives and gearing have always attracted large groups. They will be extended and elaborated at the coming exhibit.

High pressures and temperatures brought into the power plant for increasing economy of fuel consumption have also brought great complications and the majority of these are in the piping and fittings. In this line many advances have been made through the past year and all of these will be shown.

One of the important features of the Power Show is its educational value which will be broadened by a series of lecture courses in conjunction with the show. Competent lecturers will treat the critical problems of power development and those who attend will then have the opportunity to go out on the floor of the exhibit and observe how the problems are solved by the different manufacturers represented.

The Power Exposition is rapidly establishing itself as the great clearing house of progress in the mechanical field. The offices of the management are in the Grand Central Palace, New York.

Examinations to Be Held for Marine Boiler Inspectors

An open competitive examination is to be held in the near future for local and assistant inspectors of boilers by the United States Civil Service Commission. These examinations will be held throughout the country on October 22 and 23, to fill vacancies in the steamboat Inspection Service. Entrance salaries range from $2,100 to $2,950 a year.

The examinations for these positions are divided into the following classes: Those for seaboard ports on inland waters of the Atlantic and Pacific coasts; inland ports on the inland waters of the Atlantic and Pacific coasts; ports of the Gulf of Mexico; ports of the Great Lakes; and ports on central western rivers. Applicants should state in their applications the kinds of optional examinations they desire to take.

Applicants for these positions must have had certain specified training and experience, such as would be obtained as chief engineer of inspected ocean or inland vessels of American registry, propelled by machinery and of over 200 gross tons; or as master or chief mate of inspected seagoing vessels of American registry, propelled by machinery and of over 500 gross tons, etc.

Competitors in the examination for local and assistant inspector of boilers will be rated on letter writing; arithmetic; boilers and machinery, comprising practical questions relating to boilers, engines, and machinery of steam vessels and strength of boiler material; and training and experience.

Competitors in the examination for local and assistant inspector of hulls will be rated on letter writing, arithmetic, hull construction, pilot rules and inland navigation, lifeboats and life rafts, sea navigation, and training and experience.

Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. civil service examiners at the post office or customhouse in any city.

The Small Tool Hazard

SINCE the time when man first walked on the earth and began to use crude implements, millions of painful bruises and cuts have been caused by mishandling small tools and appliances. There are, of course, no data concerning the accident rate among primitive men, nor is there a record of any preventive measures that might have been adopted in those days to forestall accidental injuries. Preventive measures were probably undreamed of, even in their simplest forms. We may well believe, however, that accidents began when man first learned to use a club, and that as he progressed into the Age of Stone there were many untoward incidents which called for vigorous expression of feeling—and which perhaps helped, in that way, in the development of language. Modern man uses far better tools than his early progenitors, but the very efficiency of a tool sometimes means greater likelihood of serious accident.

The unwary father—unwary if he values his own immediate peace and comfort—is likely to consider a saw and hammer (or, better still, a small tool-chest) a suitable gift for his *first* young heir and hopeful—though the *second* one usually gets something else. Tools are always welcome in a boy's collection of valuables, and a hammer appeals to him particularly, because it satisfies two of his most urgent needs—(1) it makes a noise, and (2) it leaves visible evidence of his activity—though the said evidence sometimes consists in deep marks on beautifully-polished furniture. Even when gifts of this sort are withheld, the average boy knows where to find the family tack-hammer or claw-hammer, and he can use it just as well as though it were his own. In fact, the male of the species is more or less familiar, from his earliest years, with the use of the hammer—and yet this humble implement causes a great many injuries of a minor sort.

Whenever there is occasion to use a hammer, there must be something to strike, and the thing to be struck may have to be held. It may be a chisel, for example, in a chipping operation; or it may be a common, every-day nail, which must be supported until it is well started. This requires co-ordination of muscular effort and often a nicety in judgment, if painful bruises are to be avoided. Some persons can hold a chisel in one hand, moving it about apparently at random, while with the other hand they swing a hammer squarely down upon the chisel head every time—all this, perhaps while the eyes are directed anywhere except towards the work. The same sort of thing may be seen when a pianist keeps his eyes on the music score while his hands dexterously manipulate the keys. It takes long training to do either of these things successfully, bruised fingers being the common result in one case, and jangled chords in the other. Tyros with a hammer have to figure that in starting a nail two out of every three blows will hit it on the head, while the third one may land anywhere in its general vicinity. They try to get the nail started with two blows, and trust to luck that they are the right two.

The majority of persons come between these extremes, and among this class a great many misdirected hammer blows result in painful hand wounds. There is little that can be said or done to prevent accidents of this nature. A high measure of safety could be secured by using pliers or small tongs when starting to drive a nail, but we know quite well how advice of this sort would be received. The exercise of due care, and a proper recognition of the driver's limitations and failings, will help to a certain extent. When a good deal of chipping and chiseling has to be done, a rigid handle offset at right angles to the chisel affords a certain amount of protection, without undue interference with the work. If a workman's aim is so poor that he often hurts himself even with this protection, his employer should recognize that the man is a heavy liability when engaged in work of that sort and should give him a broom or a shovel, so that he may become an asset, instead.

A ball-player who makes an error while trying to execute a play with one hand when both hands might have been used to better advantage is usually advised by some leather-lunged enthusiast on the bleachers to "use both hands." Yet the very man who gives the advice may have tried to handle a heavy milling cutter (for example) with one hand when he ought to have used two, and the cutter may have escaped from his grasp and dropped upon his foot, leaving him with nothing to blame for the accident except his other hand. It is just such a man who will leave sharp-edged tools—such as hatchets, axes, chisels and drills—projecting beyond the edge of a work-bench. If he has to stoop down and reach under the bench, he is likely to receive a painful scalp wound when he straightens up again.

A good deal has been said about keeping cold-chisels and other such tools properly dressed, but apparently there is need for yet more counsel in this direction, because bad burrs are still altogether too common. The writer nearly had an eye knocked out, a while ago, by a flying burr that came from a cold-chisel in the hands of a workman who was cutting concrete, out on the street. The burr was a big one, and it missed the eye by about two inches.

We often read of severe injuries, and occasionally of a fatal accident, caused by workmen laying down tools that will roll—such as screwdrivers, chisels, or drills—and then inadvertently stepping on them and getting a heavy fall. If the man who does this is on a raised platform (where many such accidents occur), the chances for severe injury are very great. Accidents of this general type are primarily due to a violation of one of the fundamental rules in safety work—"A place for everything, and everything in its place."

Many workmen daily confuse the real purpose of a wrench with that of a hammer. Their guiding principle for the moment appears to be—"A wrench in the hand is worth two hammers on the bench." Now a wrench isn't such a bad thing if we only have to give something a slight tap or two, but it is a poor substitute for a real hammer when several solid blows are required. If the object to be hit must be held or guided with one hand the chances for injury are increased, because few of us have the same deftness in dealing a blow with a wrench that we have in using a hammer. There is an old saying to the effect that every man uses his thumb-nail as a screwdriver *once*, and that he uses his monkey-wrench as a hammer until the boss catches him. The thumb-nail experience teaches its own lesson, but the wrench-hammer habit appears to fasten itself upon a man like a dreadful disease—until the foreman applies some curative remarks.

Even the apparently harmless task of carrying small tools from the tool room to the work-bench or to a machine may have its dangers. A certain workman, for example, requisitioned several drills and dropped one of them into his hip pocket, but carried the others in his hands. The drill in the hip pocket tipped over in such a way that when the man swung his arm his elbow and the drill point met, and a deep cut was the result. On another occasion a workman, while carrying in each hand several sharp-pointed tools with the points downward, was jostled so that one of the tools slipped out of his grasp. In falling it nearly cut off one of his toes. It should hardly be necessary to say that if proper receptacles are not provided for safely conveying a number of tools of this kind at once, the workman should carry only a few at a time, and should rest them in the crook of his elbow and hold them firmly with the other hand—being sure that the cutting edges point upward.

A skilled carpenter takes pride in keeping his tools sharp and in good repair. Yet carpenters do not always take the same care in handling or placing their tools, that they do in keeping them in good condition. Many an accident has been caused, for example, by sharp hatchets that have been carelessly laid down on a bench or some other resting place. On one occasion that we recall, a hatchet was left on a saw-horse so that one of the sharp corners projected over the edge of the horse. Another man started sawing a piece of timber on another horse near by, and immediately received a severe cut on the forearm.

It would be easy to go on citing accidents of this nature, all caused by the mishandling or neglect of tools. Many of them are trivial and have no serious results, but on the other hand there is always the *possibility* of a serious accident, and every little while the serious one occurs. It is often mere chance (or shall we say a beneficent Providence?) that decides between a serious injury and no injury; and just as long as workmen fail to observe simple safety precautions, and continue to work in careless and thoughtless ways—just that long will needless accidents be associated with the use of small tools.

Moreover, do not forget that you can get just as bad a case of hydrophobia from a little dog as you can from a big one. This, being interpreted, means that blood-poisoning is equally likely to cost you a hand or a foot, whether the injury that leads to it comes from a small tool or from a big one.—*The Travelers' Standard.*

Fall Meeting of the American Welding Society to Be Held in Cleveland

THE fall meeting of the American Welding Society will this year be held in Cleveland, on October 30 and 31, with the Hotel Winton as headquarters. Strenuous efforts are being made by the Meeting and Papers Committee to make this meeting one of the outstanding accomplishments of the American Welding Society. Members will find that the program is both interesting and profitable.

Thursday morning will be devoted to registration of the members and an address of welcome by the chairman of the Cleveland section and the president of the American Welding Society. An opportunity will also be afforded for members to get together and renew acquaintances and friendships.

Inspection Trip Planned

An inspection trip will be arranged by the Cleveland committee on Thursday afternoon, although full details have not yet been reported to headquarters. Efforts are being made to arrange a boat trip to the National Tube Company's plant at Lorain. If such arrangements are concluded satisfactorily, and the weather permits, lunch will be served on the boat on the way out and dinner on the return trip.

The technical session will be held Friday morning and will be devoted to a number of papers on the general subject of applications of welding. In order to bring about this extension a great deal of information is needed which will require elaborate and costly investigations. Not only will it be necessary to summarize in usable form results attained in service where welding has already been used, but it will also be necessary to furnish engineers, designers and draftsmen with accurate data as to costs, methods to be used and engineering data as to types of joints, strength to be expected, factors of safety, etc. Moreover, it will be necessary to convince legislators that welding is safe and adequate for the purpose intended. All of this requires data that does not now exist and it is the intention of the American Bureau of Welding to secure this information at a minimum cost to the industry and in such a way that it will be recognized as authoritative. The problem of the Bureau does not even end here, as it will then be necessary to show engineers and contractors how to go about the adjusting of their fabricating and shop methods so that the work can be satisfactorily and economically performed.

In order to bring to the attention of our members the importance of the work and its possibilities, the Meetings and Papers Committee has decided to devote the technical session of the fall meeting to this general subject.

The demonstrations and exhibitions scheduled for Friday evening are in themselves worth the trip to Cleveland. No expense and trouble has been spared by the Society and co-operating companies. There will be a motion picture presented by the Air Reduction Sales Company, "Oxygen—The Wonder Worker." This film which consists of four reels, shows how liquid air is made; why it is possible to separate the gases of the atmosphere; how oxygen is extracted from the air; how the high temperature (6,300 degrees F.) of the oxy-acetylene flame is produced; how carbide is made and acetylene gas generated; how iron, steel, copper, brass, aluminum, and other metals are welded; how steel and cast iron are cut; how the oxy-acetylene torch is adapted to mechanical cutting and welding; and how welding and cutting operations of great economic value are performed in some of the country's important industrial plants and railroad shops.

Through the courtesy of the General Electric Company and the assistance of their projector the actual process of metallic arc welding will be shown on the screen where everyone can see it. What are the possibilities of liquid oxygen? You will see mercury frozen so hard that it can be used as a hammer to drive nails or a rubber ball so stiff that it can be broken like glass with a hammer. These and other stunts will be included in the demonstration arranged through the courtesy of the Air Reduction Sales Company. Some of our members have also been fortunate enough to actually see some thermit welding and how it is accomplished, starting with the preparation of the molds to the ignition of the thermit mixture. An actual demonstration will be shown during the meeting.

Simplified Practice*

By R. M. Hudson

NEVER before in the history of American industry have our business leaders and executives had so many perplexing problems to solve as they have had to meet in the past few years!

Not only has the buying public become more inquisitive as to the actual values it is likely to get for each dollar it spends, but purchasers everywhere are more exacting in their requirements. The market is no longer a seller's market. The man with money to spend holds the whip hand, he knows the situation, and won't buy until he knows for certain he can get what he wants when he wants it.

The manufacturer striving to give the buyer what he wants has also had to reckon with high wage scales, high material prices, high transportation charges and high taxes.

Eliminating Waste

Executives in many fields are finding a new source of profit in "Simplified Practice." When Secretary Hoover was president of the American Engineering Council, he organized a committee of 18 leading industrial engineers to make a survey of waste in industry. This committee made a comprehensive study of 6 of our major industries, and found an average waste of 50 percent of all labor, material, time and energy expended in the fabrication of the products of those industries. If we apply this waste-factor to the $60,000,000,000 worth of products made in this country each year, we have an annual waste of $30,000,000,000.

Among the chief causes for this huge deduction from the

(*Continued on page 306*)

*Abstract of a paper read at the Annual Meeting of the American Boiler Manufacturers' Association.

Calculating the Stresses in Mouthpiece Rings for Unfired Pressure Vessels

In the February issue of THE BOILER MAKER (page 55) appeared a complete article on the "Design of Mouthpiece Flanges for Vulcanizers and Other Unfired Pressure Vessels," through the courtesy of *The Locomotive* published by the Hartford Steam Boiler Inspection and Insurance Company. Letters have been received from a number of our readers stating that the mathematical discussion of this subject, which was referred to in a footnote in this article, would be of value to all who have to deal with the construction of vessels of this type. Permission has been given by *The Locomotive* to publish this information as follows:

In the former article on the general subject of mouthpiece rings for vulcanizers a formula was proposed for computing the circumferential stresses that occur in them. The present article is to be considered as supplementary to the other one. The notation employed will also be substantially the same as in the preceding article.

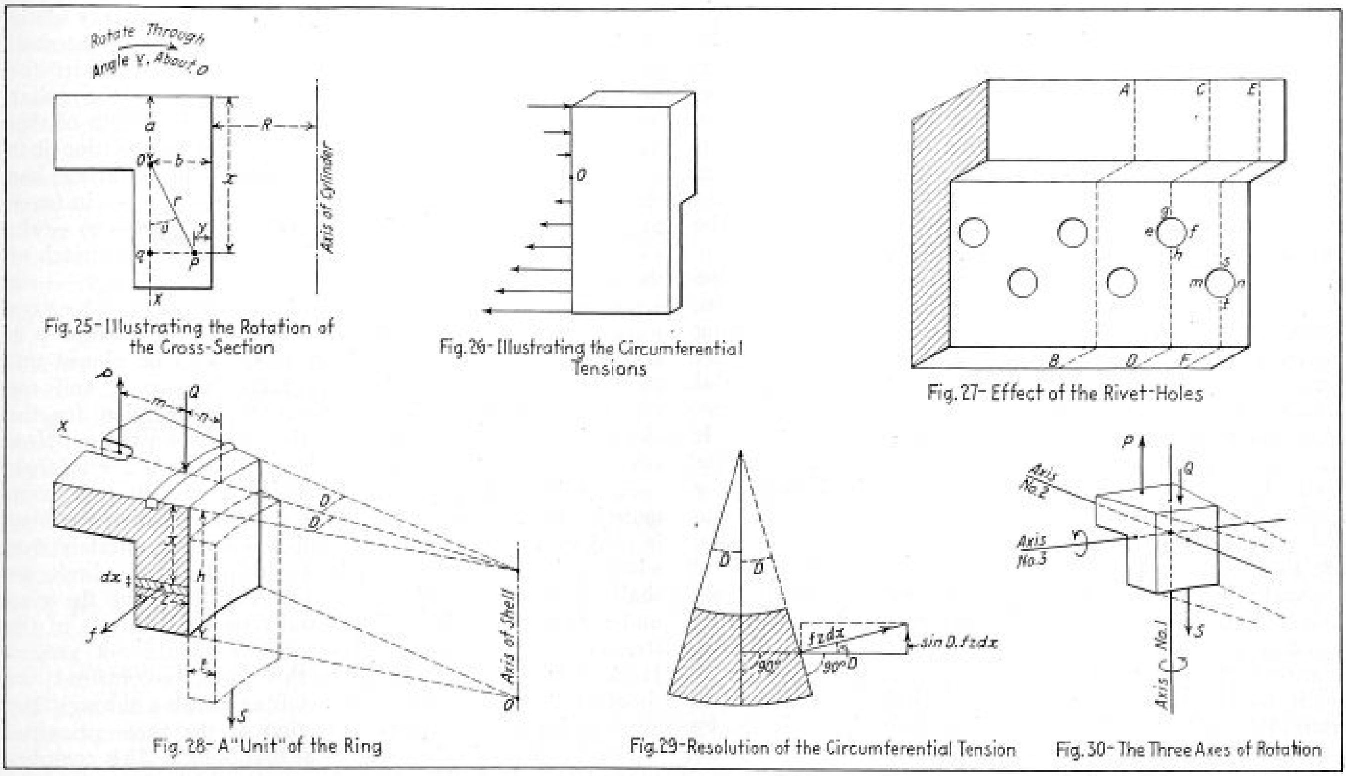


Fig. 25—Illustrating the Rotation of the Cross-Section

Fig. 26—Illustrating the Circumferential Tensions

Fig. 27—Effect of the Rivet-Holes

Fig. 28—A "Unit" of the Ring

Fig. 29—Resolution of the Circumferential Tension

Fig. 30—The Three Axes of Rotation

Application of Mathematical Principles to the Computation of Pressure Vessel Mouthpiece Flange Design

In order to deal with the stresses and forces in a satisfactory manner, we will consider the equilibrium of a wedge-shaped section of the ring; this section being bounded by two planes which each pass through the axis of the vessel to which the ring is attached, and which include, between them, a segment of the ring equal to one Nth of the entire circumference, N being the total number of cover-bolts. There will then be one cover-bolt to every such segment; and we will suppose that the planes of section are so situated that the cover-bolt that they include comes in the center of the segment. A segment of the ring such as has here been described will be called, for definiteness and brevity, a "unit" of the ring. The entire ring, it will be seen, is composed of N such units, all exactly alike, except that the number of rivets passing through the shell and the ring will not necessarily be the same in each unit, and hence the stress communicated from the shell to the unit of the ring will not be identically the same in every case. We shall *assume* the stress thus communicated from the shell to the rivets to be the same in every case, however, because the division into units, here suggested, is a purely imaginary one, and the stresses that are transmitted through the rivets will average, when considered along a few contiguous units, very much the same as we are here assuming. Fig. 28 shows one of these "units" of the ring.

If R is the internal radius of the vessel, and p is the steam pressure in pounds per square inch, then the total steam load that comes longitudinally upon the shell is $\pi R^2 p$, where π, as usual, stands for 3.1416; and hence the stress S, that is sustained by that part of the shell which corresponds to a single unit of the ring, is $S = \pi R^2 pN$. P being the total tensile stress upon a single cover-bolt, and Q being the total compressive force exerted downward upon as much of the packing circle as is included in one unit of the ring, we have next to consider that one of the conditions of equilibrium of the ring-unit is, that the resultant of all the external vertical forces acting upon it must be zero. (In strictness, we should observe that the steam pressure acts vertically downward upon that strip of the ring-unit which lies within the packing-circle, and hence we should take account of this vertically-directed steam pressure, in considering the equilibrium of the vertical forces. The effect of this steam pressure is insignificant, however, when compared with the effects of the other forces involved; and hence we shall omit it from consideration, since its inclusion would complicate the problem, without adding any precision that would be of practical importance.)

The equilibrium of the vertical forces acting upon a ring-unit therefore involves that the sum of all the upwardly-directed external forces should be equal to the sum of all the downwardly-directed external forces. That is, $P = Q + S = Q + \pi R^2 pN$.

We cannot yet treat of the equilibrium of the ring-unit with respect to horizontal forces, nor with respect to the tendencies of the various forces to produce rotation of the ring-unit; for in order to write the equations which express these conditions, we have to include the internal stresses in the ring, which we have not yet considered.

A few remarks must be made about the foregoing equation between P and Q, before we pass to the next subject. When the nuts on the cover-bolts are first screwed up, before steam is introduced into the interior of the vessel, it is obvious (since $p = o$ in that case) that $P = Q$. The total tensile stress, P, to which the cover-bolt is then subject, depends solely upon the force with which the attendants have screwed up the cover-bolt nuts. We may compute the approximate value of P by means of a formula on bolt-tensions, if we have sufficient data for that purpose. In practice, we can only conjecture what numerical values should be assigned to these various data; and hence the calculation of P, even in the simple case in which the steam pressure is zero, is necessarily uncertain and unsatisfactory. Suppose, however, that we have determined, in some manner, what the value of P (and therefore of Q) is, when there is no steam pressure within the vessel; and let us suppose that steam is then introduced, until the pressure rises to p, the pressure at which the apparatus is to be operated. How will the values of P and Q be changed by the introduction of the steam? It has been shown that the change in the value of P, due to the introduction of steam, depends to a large extent upon the nature of the packing against which the cover-plate bears. In fact, if the packing is absolutely inelastic, the steam will not cause any material increase in the value of P; the steam load, in this case, being balanced by a diminution in the value of Q. It has also been shown that if the packing is exceedingly elastic, the stress, P, on the cover-bolt may be increased by nearly the full value that corresponds to the total steam load. In actual practice we must admit, in most cases, that the packing possesses *some* elasticity; but the elasticity is usually not very great, and hence we may fairly conclude that in practice the turning on of the steam pressure is not accompanied by an increase in the value of P that is greater than a small but unknown fraction of the total steam load; the balance of the vertical forces that are externally applied to the ring being maintained chiefly by a reduction in the value of Q, rather than by an increase in P.

INTERNAL STRESSES

We come, now, to the consideration of the internal, circumferential stresses in the ring, whose existence and cause was pointed out in the earlier article. The deformation of the ring, under the combined influence of the pull on the cover-bolts, the pressure downward upon the packing circle, and the longitudinal tension on the shell is of such a nature that every cross-section of the ring experiences a rotation in its own plane, about some point whose position we have yet to determine. (It will be observed that we are tacitly assuming that the shape of the cross-section of the ring is not materially altered by the action of the external forces. This assumption may not be sufficiently accurate in the case of wrought iron or steel rings which are light in construction, and which are unprovided with brackets between the leaf and the hub of the ring. It is doubtless very nearly true, however, for heavy rings, and for rings which are stiffened by brackets. At all events, we shall make the assumption, as we consider it accurate enough to serve the purposes of a first approximation to the theory of these rings; and a first approximation is all that the present investigation purports to be.)

Let us now consider a cross-section of the ring, and let us define the position of the as yet unknown center about which this section rotates in the following manner: Denote its distance below the upper surface of the leaf of the ring by a, and its distance from the inner surface of the hub of the ring by b. These dimensions are indicated in Fig. 25, to which our attention will be for the moment confined. (It is to be understood, of course, that either a or b, or both of them, may be negative.) O being the unknown center of rotation, let us suppose that a line OX is drawn through it, parallel to the axis of the shell. Then consider any point, P, in the cross-section of the undeformed ring. Let its distance from O be r, and let the line OP make an angle u with OX, as indicated in the diagram. The distance of OX from the central line of the shell being $R + b$, and the length of Pq being $r.\sin u$, the distance from the point P to the axis of the shell is $R + b - r.\sin u$. Now let the stresses be applied to the ring, so that the section shown rotates clock-wise through an angle v, about the point O. After this rotation, as may be very easily shown, the distance from the point P to the axis of the shell becomes $R + b - r.\sin (u - v)$. If we now consider the fiber of material that runs circularly around the collar through P, we see that *before* the rotation the length of this fiber is $2\pi [R + b - r.\sin u]$; while *after* the rotation it is $2\pi [R + b - r\sin (u - v)]$. Hence the rotation has stretched this fiber by the amount $2\pi r [\sin u - \sin (u - v)]$. We know from trigonometry that $\sin (u - v) = \sin u.\cos v - \cos u.\sin v$; and hence it appears that the stretch of the fiber under consideration is equal to $2\pi r [\sin u - \sin u.\cos v + \cos u.\sin v]$, or to $2\pi r [1 - \cos v] \sin u + 2\pi r.\cos u \sin v$. In the actual conditions of practice the angle v is exceedingly small,—so small, in fact, as to be almost unmeasurable. We may therefore take $\sin v = v$, and $\cos v = 1$. With these simplifications, the expression for the elongation of the fiber reduces to the form $2\pi r\, v.\cos u$. Now $r.\cos u = Oq$. Tence the stretch of the fiber is $2\pi v.(Oq)$.

According to Hooke's law, the increase in length of a given material fiber is proportional to the stress to which the fiber is subjected. This principle, which is quite accurately true when an isolated fiber is strained within its elastic limit, we shall apply also to the circumferential fibers of the ring under discussion. In an ideal and complete analysis of the stresses in a structure of this sort, we should not assume Hooke's law to be of precisely this form, but, instead, we should take the elongation of the fiber passing through any given point to be a linear function of the three principal stresses, existing in the material at that point. This complete analysis involves difficulties, however, which the writer has not succeeded in overcoming satisfactorily; and hence in the present tentative analysis, the extension is taken as proportional to the circumferential tension alone. It is to be noted that this mode of treatment of elastic problems is a very common one, it being adopted, in fact, by practically all of the writers to deal with the theory of beams and similar structures. Hence we may presumably be permitted to make use of it in the present case, without reproach.

If we adopt Hooke's law in the simple form stated above, and if we knew the modulus of elasticity, M, of the material, and the angle, v, through which each of the cross-sections of the ring is rotated, as well as the position of the point O about which the rotation takes place, we could compute the intensity of the circumferential tension, f, at any point of the material. We should have, in fact,

$$f = \frac{2\pi vM.(Oq)}{2\pi (R + b - r.\sin u)} = \frac{vM\,(Oq)}{R + b - (Pq)}$$

Or, with the notation of Fig. 25, $f = \frac{Mv\ (x - a)}{R + y}$

In the practical case we never know the angle v. We *do* know, however, that for any given condition of stress, this angle is the same throughout the ring. We may therefore write the last expression thus: $f = K \frac{(x - a)}{(R + y)}$, where K is a constant throughout the entire ring, for any given state of strain; although (since it is equal to Mv and therefore changes with v) K will vary with different states of strain,—that is, with varying conditions with respect to the intensities of the external forces.

In the denominator of this last equation we find the expression $R + y$. This shows that the intensity of the stress at any given point in the cross-section depends to some extent upon the horizontal distance of that point from the inner edge of the section. Now those parts of the circumferential forces which mainly determine the equilibrium of the ring are confined to the hub and in all the important practical applications of the theory to vulcanizers and like structures, the entire thickness of the hub will not exceed (say) 6 percent of the radius of the shell of the vessel, and hence the total variation of the denominator of the foregoing expression for F will not exceed (say) 6 percent of the value of the said denominator. If we take the denominator as constant and equal to the radius of the *middle* of the cross-section of the hub, the error of the new formula so found, when that formula is applied to the calculation of the circumferential stress at any point of the hub, will not exceed (say) 3 percent of the value of that stress as computed from the more exact formula. This error will be of no consequence whatever, in practical applications, and hence, for the purposes of those applications, the formula may be written

$$f = C\ (x - a) \ldots\ldots\ldots\ldots (1),$$

C being a new constant, numerically equal to K divided by the mean radius of the hub.

We have now found an expression which shows how the intensity of the circumferential stress in the ring varies from point to point of the cross-section of the ring, for any one given state of strain. To make this formula perfectly definite and to adapt it to purposes of numerical computation, it only remains to find the numerical values of the constants C and a. These will be determined, presently, by a further study of the conditions essential to the equilibrium of the ring.

Distribution of Circumferential Stresses

The distribution of the circumferential stresses, according to the formula just derived, is of the nature indicated in Fig. 26. This is supposed to represent a section of the entire ring, and the arrows indicate the nature of the circumferential forces. They vary in a linear manner as we proceed from the top of the leaf of the ring to the bottom of the hub; being compressive at the top, and tensile at the bottom. At the point O there is (circumferentially) neither tension nor compression. (The position of this point O is indicated on the sketch in accordance with the results of the analysis for determining its position, which is given subsequently.)

It will be observed that no attempt has been made, in the foregoing investigation, to take account of the fact that the hub of the ring is perforated by rivet holes; the ring being treated as though the hub were solid, and brazed to the shell, or united to it in some similar manner which would not require its integrity to be disturbed. This method of procedure has been adopted, partly because it would be exceedingly difficult to take accurate account of the effect of the rivet holes upon the circumferential stresses, and partly because it is believed that the circumferential stresses in the ring are not disturbed to any serious extent by the holes, except in the *immediate vicinity* of the holes. No doubt the stress upon the material of the hub is increased, close to the holes, by the fact of their presence; and hence the holes should in no case be too near the free end of the hub, where the circumferential stresses (as we shall subsequently see) are greatest. If this condition be fulfilled, however, it will be assumed that the effects of the holes may be neglected. By way of illustrating the point at issue, Fig. 27 may be considered. This represents a portion of the ring, with rivet holes punched through it. The distribution of the circumferential stresses across a section, such as AB, which passes midway between a pair of rivet holes, may be assumed to be much the same as it would be if the ring were solid, and had no rivet holes in it at all. In a section, such as CD, which passes through the center of one of the upper rivet holes, we may also assume that in those parts of the section which are remote from the rivet hole, the circumferential stresses will also be sensibly the same as they would be if the ring were solid. The tension that would exist (in the solid ring) across the line ef, however, must be borne by the material in the immediate vicinity of the hole in the perforated plate; and we may think of the lines of circumferential tension as diverging, as they approach the hole, so as to allow those that naturally tend to cross the hole to pass around it, immediately above and below it. The metal in the vicinity of g and h, therefore, must bear not only the tension that would naturally belong to those points, but also that which would come upon the metal between g and h, if the hole did not exist. We need not discuss, at present, the precise increase in the intensity of the circumferential tension in the vicinity of the hole, this being a subject reserved for more extended treatment on a future occasion; but we shall assume that the disturbance of the stress, due to the presence of the hole, is mainly confined to the metal in the near neighborhood of the hole; so that the effect of the holes may be neglected, so far as the formation and discussion of the general equations of equilibrium of the ring are concerned. In the design of the ring, care should be taken that the holes are not unnecessarily large, and that they do not come unnecessarily close to the free edge of the hub. Chain riveting should also be avoided, in securing the hub to the shell, since it is manifestly better to have only one hole in any single vertical section of the hub, than it is to have two.

We have considered above the condition that must be fulfilled in order that the forces acting vertically upon the ring-unit may be in equilibrium. A second condition essential to the equilibrium of the unit is, that the forces acting upon the unit in a direction perpendicular to the plane OX in Fig. 28 shall balance one another. This condition is evidently fulfilled identically, by reason of the symmetry of the system. Hence this condition gives us no information with respect to the forces acting within the ring.

The third and final condition of equilibrium, so far as translation is concerned, is that the forces acting upon the ring-unit horizontally and parallel to the plane OX shall balance one another. To investigate this condition, let f be the intensity of the circumferential tension at the depth x, which is to be measured from the top face of the leaf of the ring. Then the total tension acting normally upon the little rectangle whose width is dx and whose length is z, is $fz.dx$. This force has a horizontal component, parallel to OX, whose magnitude is $\sin D.fz.dx$, as will be understood by reference to Fig. 29. (It is to be noted that z is equal to the thickness of the hub in the lower part of the ring, and to the width of the leaf, measured to the bottom of the bolt-slot, in the upper part.) This component, it will be noted, is directed towards the axis of the shell, when the circumferential stress is a tension; and if we integrate it between the limits $x = 0$ and $x = h$, we shall obtain the total force acting upon the shaded face of Fig. 28, in a direction horizontal and parallel to the plane OX. From our previous investigation it appeared that

f is of the form $C\ (x - a)$; so that the expression to be integrated is $C\ (x - a) \sin D . z . dx$. It will not be necessary to give the details of the integration, as it involves no difficulties of a mathematical nature. The result is $C \sin D . A\ (a_0 - a)$ where A is the area of cross section of the ring, and a_0 is the distance of the center of gravity of the section below the upper face of the leaf of the ring. The back face of the ring-unit (corresponding to the shaded one) contributes an equal amount to the force in question, so that the total component of the internal, circumferential tension of the ring, acting in a horizontal direction and parallel to the plane OX, is $2C\ A \sin D\ (a_0 - a)$.

Other Forces Act on the Ring

In addition to the component of the internal, circumferential tension just found, there are certain other forces acting upon the ring, in a direction parallel to that component, and these should in strictness be taken into account. In the first place, the steam pressure within the vessel acts directly upon the upper part of the interior surface of the ring, where the ring is not covered by the shell-sheet. Also, it is plain from the diagram that the rivets that unite the shell to the ring are in a state of tension, so that they pull inward upon the hub of the ring. Both of these influences favor the ring, and tend to diminish the circumferential tension in the hub. The effect of the direct steam pressure against the upper part of the ring is slight, however, and may be omitted without serious error. The magnitude of the tension upon the rivets is uncertain, and hard to compute with any approach to precision. Moreover, it is our opinion that the ring should be quite strong enough, in itself, to resist the stresses that may be thrown upon it, without any assistance whatever from the shell. This last consideration, combined with the uncertainty as to the real magnitude of the tensions on the rivets, and with the knowledge that the rivet-tension favors the ring, leads us to exclude from consideration the rivet-tension and the steam pressure on the upper part of the ring, and to treat the problem as though the inwardly-directed component of the circumferential tensions in the hub were the only force acting upon the ring-unit, in a direction horizontal and parallel to the plane OX. Now since the ring-unit does not move either in or out, this assumption forces us to conclude that $2CA \sin D\ (a_0 - a) = 0$; and this cannot be the case unless $a = a_0$. In other words, we are led to the conclusion that the a of formula (1), above, is equal to the depth of the center of gravity of the cross-section of the ring, below the upper surface of the leaf of the ring. We may therefore consider that the ring, under the influence of the externally applied forces, becomes deformed in such a manner that each cross-section of it rotates about its own center of gravity. It being no longer necessary to distinguish a_0 from a, the zero subscript will be omitted in the remainder of this article. (It will be observed that we have not really proved that the center of gravity *is* the center about which the rotation occurs, because we have not learned anything, as yet, about the distance of the center of rotation from the inner surface of the ring. In other words, we have not found the value of b, in Fig. 25. But the value of b, as will appear when this investigation is complete, plays no important part in the theory of the internal stresses in the ring; and hence there can be no objection to taking the center of rotation of the ring-section as identical with the center of gravity, even though we have not proved the identity in this one unessential respect.)

We have now investigated the conditions which must hold, in order that the ring-unit under consideration may be in equilibrium so far as *translation* is concerned. We have next to discuss its equilibrium with respect to *rotation*. It will be sufficient to make the turning moments zero about any three axes, of which no two are in the same plane. Let us, for the sake of definiteness and simplicity, consider the tendency towards rotation about each of the three mutually perpendicular axes shown in Fig. 30. Two of these axes are horizontal, and one is vertical. The vertical axis ("No. 1") and one of the horizontal axes ("No. 2") lie in the plane designated as OX in Fig. 28, while the third axis ("No. 3") is perpendicular to that plane. The point of intersection of the three axes that we have thus chosen is taken at the center of rotation (or center of gravity) of the section of the ring that is made by the plane OX, in Fig. 28.

Passing now to the consideration of possible rotations about these three axes, we observe, first, that there is no resultant tendency to produce rotation about axes Nos. 1 or 2, on account of the symmetry of the forces involved. We therefore have to consider nothing, in the way of rotation, save the tendency to produce rotation about axis No. 3. The forces that tend to produce rotation about this axis are (1) the tension, P, on the cover-plate bolt, (2) the compressive force, Q, acting upon the packing circle, (3) the longitudinal tension, S, upon the shell plate, and (4) the inwardly-directed component of the circumferential tension that acts upon the ring-unit. We will take these up in order.

The turning moment of the force P, with respect to axis No. 3, is equal to $P(m + n - b)$, and the direction of the rotation that it tends to produce is "clock-wise," when viewed from the left-hand end of axis No. 3, as shown in Fig. 30. (The notation employed will be understood by reference to the diagrams.)

The compressive force, Q, on the packing circle, acts upon a curved arc of radius $R + n$ and amplitude $2D$. If D_1 is the angular distance of any point of this arc from the plane OX, then the total force acting upon the little arc included between D_1 and $(D_1 + dD_1)$ is $Q . dD_1 / 2D$, and the moment of this elementary force with respect to axis No. 3 is $Q\ [(R + b) - (R + n) \cos D_1]\ dD_1/2D$. The total moment of the compressive stress upon the packing circle is the integral of this between the limits $D_1 = -D$ and $D_1 = +D$, which is $Q\ \left[(R + b) - (R + n)\frac{\sin D}{D}\right]$. This moment acts in the same direction as the moment of P, previously considered.

The longitudinal tensile stress, S, upon the shell sheet will be assumed to be applied at the middle of the thickness of the sheet. Like the packing-circle stress, it acts along a curved arc; the radius in the case being $R - \frac{t}{2}$. By a process precisely analogous to that employed in the previous paragraph, we find that the moment of the shell-tension with respect to the axis No. 3 is $S\ \left[(R + b) - (R - \frac{t}{2})\ \frac{\sin D}{D}\right]$, acting in the same direction as before.

When (as happens in large vessels) the angle D is small, we may safely take $\sin D = D$; and with this simplification in the formulas of the two preceding paragraphs we have: Moment of $Q = Q\ (b - n)$; and Moment of $S = S\ (b + \frac{t}{2})$.

Referring back, now, to Fig. 28, we note that the total circumferential tension acting normally on the little rectangle of length z and with dx is, as we have already found, $C\ (x - a)\ z . dx$. This has a horizontal component, parallel to the plane OX, of magnitude $\sin D . C\ (x - a) . z . dx$. There is also a similar and equal component force acting upon the symmetrically situated elementary rectangle on the back face of the ring-unit under consideration; and as both of these little rectangles are at a depth x below the top face of the leaf of the ring, the total moment (which is counter-clock-wise) of the circumferential tension with respect to axis No. 3 in Fig. 30 is the integral, between the limits $x = o$ and $x = h$, of $2 \sin DC (x - a)^2 z . dx$. That is, it is the integral, between these limits, of $2C \sin D (x^2zdx - 2a.xzdx + a^2zdx)$.

The integral of x^2zdx is what is known as the "moment of inertia" of the cross-section. We may designate it by I (as is usual in all writings that have to deal with it); the axis to which I refers being, it must be remembered, the horizontal line which constitutes the upper edge of the shaded section in Fig. 28. The integral of $xzdx$ is equal, as is easily seen, to the product of a and the area of the cross-section (which area will be designated by the letter A). Finally, the integral of zdx is of course equal simply to A itself. Hence the moment of the circumferential forces, with respect to axis No. 3, is equal to $2C \sin D. (I - 2a^2A + a^2A)$, or to $2C \sin D (I - a^2A)$; and this moment tends in a counter-clockwise direction.

Summing up the results that have been obtained with respect to the moments of the various forces with respect to axis No. 3, we find that equilibrium with respect to that axis requires that $P(m + n - b) + Q(b - n) + S(b + \frac{t}{2}) = 2C \sin D (I - a^2A)$. Now we found that $P = Q + S$; and and if, by means of this relation, we eliminate Q from the foregoing equation, we have simply

$$mP + (n + \frac{t}{2})S = 2C \sin D (I - a^2A.) \ldots\ldots (2)$$

(It will be noted that b cancels out, so that it does not appear in the final result.)

When N, the total number of cover-bolts, is fairly large, we have, approximately, $\sin D = \pi/N$; and if we attend to this relation, and then replace C in equation (1) by its value as deduced from (2), we have

$$f = \frac{mNP + NS(n + \frac{t}{2})}{B\pi(I - a^2A)}(x - a)$$

as the intensity of the circumferential tension in the ring, at the depth x below the upper face of the leaf of the ring.

We are more particularly interested in the *maximum* tension, which will occur at the lowest edge of the hub of the ring, where x has the value h. We may note, also, that NS is the total steam load on the lower head of the vulcanizer shell, and hence it has the value $\pi R^2 p$. Moreover, we may note that in order that there may be no leakage around the packing, it is essential that the united tension on all the cover-bolts taken together shall be at least as great as the total steam load on the cover of the vessel. It will simplify the formula if we let L stand for the total steam load on the lower head of the vessel, and let E be the *excess* of the tension on each cover-bolt, over and above that which corresponds to the total steam load on the lower head of the vessel. This will give $NE + \pi R^2 p$ as the value of NP. With these changes made, the foregoing formula becomes

$$F = \frac{mNE + L(m + n + \frac{t}{2})}{2\pi(I - a^2A)}(h - a)$$

as the value of the circumferential tension at the free edge of the hub. As $t/2$ is small with respect to $m + n$, we shall commit no serious error by omitting it entirely; in which case the formula reads

$$F = \frac{mNE + L(m + n)}{2\pi(I - a^2A)}(h - a) = \frac{(mNE + LD)(h - a)}{2\pi(I - a^2A)}$$

which is the form in which it is employed in the previous article.

Another Good Scheme Gone Wrong

By Elton J. Buckley

ANOTHER perfect scheme of controlling the market price of a product—this time the buying price rather than the selling price, however—so as to insure every member of it against competition, has been tried in the balance and found wanting. It looked as if nothing could destroy it, and it was, in fact, an absolute protection against the outsider, but the minute the United States Government trained the big guns of the Sherman Anti-trust Act upon it, it crumpled up like a pasteboard lighthouse.

The case I am referring to was brought in New York. I am not going to mention the product involved, because a surprising number of the men who read these articles, if their product was different, wouldn't apply what I said to themselves. That is wrong, as I have said whenever I had the opportunity. It ought to be self-evident that there is not a special law for shoes and another special law for boilers. A decision in the case of a contract to buy one product is of course directly applicable to a contract to buy another, but I cannot seem to get the fact over with a great many. Therefore I shall not mention the product at all.

This scheme was very carefully worked out. The goods involved were shipped into the New York market by a large number of shippers from all over the United States. The consignees were commission merchants doing business in New York, who received the goods as they arrived and resold them to wholesale dealers.

There was a lot of competition and finally the wholesale buyers evolved this scheme: They were to organize themselves into an association, and appoint a price committee of seven members. The seven members should each day look over the market, appraise the conditions and then fix the price at which they thought the holders should sell. And that price, and no more, the whole trade should pay. They also had it all figured out how to keep independent buyers from paying more and thus getting the bulk of the stock. They said to the commission merchants: "If you sell to any of the firms that we list to you (these were the independents who would have paid more) we will boycott you and wont buy from you at any price."

It was a fine scheme and it worked perfectly. The price committee met every day and went over conditions, which meant learning how many goods there were on market. Then they would fix the price they thought the buyer ought to pay, and instantly the whole trade would refuse to buy except at that price. Not only did this affect the New York market, but it affected markets outside of New York. Thus all competition among buyers as to what they should pay was eliminated. The court said:

> It would appear, therefore, that competition is eliminated in the purchase of such goods from the shippers, and it further appears that the effect of this combination, if not the avowed purpose, is likewise to destroy free competition in the sale by buyers or wholesalers to their customers. A great number of persons are affected by the methods referred to, beginning with the producer in the states distant from New York City, the shipper who purchases it from the producer, the receiver who acts as the agent for such shipper, the independent buyer or wholesaler, the retailer and the ultimate consumer.

The United States Government asked for an injunction against the operators of this scheme, and after hearing evidence along the above lines, the court granted it. The promoters came confidently into court with what they thought was a perfect defense. They said "in no case can it be shown that the price committee of seven fixed an unreasonable price. The price was based fairly on the state of the market and was in every case equitable."

That was to take advantage of the ruling of the United States Supreme Court in the American Tobacco case that the Sherman Act only forbade *unreasonable* interference with competition.

The court saw little in this defense. This is the way it disposed of it:

> The defendant's answer in substance admits that the defendant association and its officers and members have entered into a combination for the purpose of fixing in concert a price for all such goods sold in this market, as stated; but they say, by way of defense, that the price so agreed and announced by the price committee is not altogether an arbitrary price, but is based upon examination of the supplies available, and also upon conferences with the various receivers.
>
> The effect of the fixing of the price by action of the so called price committee of the defendant organization, by agreement of four persons of such committee, would appear to be purely an arbitrary act, and not the result of the free course of trade. It may well be that the price fixed is reasonable, but the effect is as though the defendants, acting in concert and admittedly controlling the purchase and distribution of a large proportion of the goods in this line received from week to week in the New York market from other States, said, in substance, to the receivers, acting as agents for the shippers:—
>
> > This is the price at which your goods will be taken off your hands. We are acting in concert, and our members are bound by our rules to accept our dictum as to purchase price, without independent thought or action.
>
> In fact, the defendants, through the price committee, establish a market quotation at which all of these goods must be sold for use and consumption in New York City, and the publication and acceptance of this agreed price must of necessity directly affect the price paid over a very large area of the country.

The conclusion is inevitable that the time has passed when you can pull anything like this off in this country. The study of the cases in which somebody has tried to sew up competition, usually in selling, but occasionally, as in the above case, in buying, is really a study in human ingenuity. Up to now, however, not one case has ever been successful.

Factors in Good Boiler Service*

No locomotive is better than its boiler. Marked advances have been made in the design and construction of locomotive boilers, while the original principle is still retained, tending toward better circulation of water and better distribution of expansion strains. No matter how well constructed a boiler may be, it cannot be safely or efficiently operated without current inspections, tests, and repairs. No one disputes this but it is surprising to learn the large number of locomotives upon which defects have been reported trip after trip and day after day and still continued in service without regard to the peril created or the monetary loss indirectly incurred.

One of the first considerations in maintaining boilers is that of water supply. Those of you who are connected with the operation of locomotives in bad water districts know of the problems arising from this source, both from the maintenance viewpoint, and of getting over the road with a train. Too much cannot be said for the necessity of removing all washout plugs and thoroughly washing all parts of the boiler as often as water conditions require. It is too often true that boiler washing is neglected, which is always reflected by increased trouble and cost of maintenance. When sheets are coated with scale, thus insulating them from the water, the water cannot absorb the heat readily and the result is increased temperature and strain with a corresponding increase in trouble and decrease in evaporation.

Marked improvements in water supply have been made in many places by the installation of treating plants and in others by changing the source of supply. Conditions have been vastly improved, in many instances, by installing modern washout systems. These improvements cost money, but when one considers the reliability and efficiency of service that is today required of locomotives, it becomes apparent that any reasonable expenditure in providing better water and proper washing facilities is ultimately a paying proposition. There is a close and inseparable relation between locomotive maintenance and fuel economy. The increased cost of fuel has made it a matter of prime importance and is attracting the widest attention among the railroad managements at this time.

Efficiency and economy of operation has caused the application of brick arches, superheaters, combustion chambers, feed water heaters, thermic syphons, and many other appliances, which must be properly maintained if the desired results are to be accomplished. Since steam is the propelling power the problem to generate it freely and to use it economically is an all important question. To this end locomotives should be so maintained that the distribution of the steam to the cylinders be most effective, and that the machinery be in condition to utilize the energy created to the highest possible degree. Rod bearings which are loose and in bad condition, boxes loose on journals, shoes and wedges out of adjustment, loose and worn cylinder packings which blow, valves out of square and blowing, are poor mediums through which to transmit the energy; they adversely affect the drawbar pull and the earning power of the locomotive.

*From a paper "Locomotive Maintenance," read by A. G. Pack, Chief Inspector, Bureau of Locomotive Inspection, before the recent meeting of the Traveling Engineers' Association, held in Chicago.

Too Rapid Locomotive Repair Work Bad Practice

Emphasis is rightly placed on the need of handling locomotives quickly through repair shops and engine terminals in order that they may be returned to revenue service as soon as possible and also that the labor cost of repair operations may be minimized. Continual pressure for reduced shop operating costs, may, however, be productive of highly undesirable results unless it is also made clear that the quality of material and workmanship entering into the repair of locomotives is now and always will be of first importance. This point was strongly emphasized by H. T. Bentley, general superintendent of motive power and machinery of the Chicago & North Western, in addressing the International Railway General Foremen's convention held at Chicago, September 9 to 12. Mr. Bentley said: "Thoroughness in doing necessary work to locomotives in shops will probably reduce the shop output somewhat but materially improve the service and decrease the cost of enginehouse maintenance. Slovenly and improper work increases failures on the road and is not economical notwithstanding records of low costs in the shops." In other words, it is not so much *how quickly* locomotives can be put through repair shops, but *how long* these locomotives will stay in service after leaving the shops. Obviously the attitude of shopmen, gang leaders and foremen toward the quality of their work is a reflection of the attitude of the general foreman, shop superintendent and higher mechanical officers. There are always some men in every large shop organization who will do just as poor work as they think will pass the inspector and be accepted by their foreman. They will frequently cover up errors, which may later cause continual trouble on the road after the locomotives have been placed in service. If any shop management places its record for output ahead of its record for thorough going, reliable repairs, inferior locomotives are bound to be turned out.—*Railway Age.*

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

THIS is the seventh instalment of a series of questions on both mechanical and boiler subjects which are liable to occur in state or federal examination papers for boiler inspectors. The earlier instalments appeared on page 105 of the April issue, page 139 of the May issue, page 180 of the June issue, page 208 of the July issue, page 231 of the August issue, and page 264 of the September issue of THE BOILER MAKER. *The material should prove of benefit to all those who contemplate taking the examinations. The author would like to have those interested in the subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.*

141—Q. Who is responsible for the design and construction of locomotive boilers?

A. The Railroad Company is responsible for the design and construction of locomotive boilers under its control. The safe working pressure shall be fixed by the Chief Mechanical Engineer of the Railroad Company.

142—Q. What is the lowest factor of safety allowed in a locomotive boiler?

A. The lowest factor of safety for locomotive boilers shall be 4.

143—Q. What office records are required to be filed in the office of the railroad company?

A. The number of the locomotive.

Date that boiler of locomotive was washed out.

Signature of boiler washer or inspector.

Statement that spindles of gage cocks and water glass cocks were removed and cocks cleaned.

Signature of the boiler inspector or the employer who removed the spindles and cleaned the cocks.

144—Q. When are main air reservoirs tested?

How are main air reservoirs tested?

A. Main reservoirs must be tested at least once each 12 months. Main reservoirs shall be subjected to hydrostatic pressure not less than 25 percent above the maximum allowed air pressure and the entire surface of the reservoir shall be hammer tested each time the locomotive receives general repairs, but not less frequently than each 18 months.

145—Q. What parts of the air brake system are required to be cleaned and how often?

A. Distributing or control valves, reducing valves, triple valves, straight air double check valves and dirt collectors shall be cleaned as often as conditions require to maintain them in a safe and suitable condition for service, but not less frequently than once every six months.

146—Q. What is the minimum brake piston travel and why?

A. The minimum brake piston travel shall be sufficient to provide proper brake shoe clearance when the brakes are released.

If proper brake shoe clearance were not provided the brake shoes would drag and retard the speed of train also heat tires and wheels.

147—Q. What is the maximum brake piston travel?

A. The maximum brake piston travel when the locomotive is standing shall be:

For car type of driving wheel brake 3½ inches.

Other forms of driving wheel brake 6 inches.

Engine truck brake 8 inches.

Tender brake 9 inches.

148—Q. What is the maximum brake pipe leakage allowed?

A. Brake pipe leakage shall not exceed 5 pounds per minute.

149—Q. How should a test be made for brake cylinder leakage?

A. After a full service application from maximum brake pipe pressure and with communication to the brake cylinders closed, the brakes on the locomotive and tender shall remain applied not less than five minutes.

150—Q. (a) What is the maximum lateral motion allowed between the hubs of driving wheels and boxes, (b) between the hubs of engine truck wheels and boxes, (c) between the hubs of trailing truck wheels and boxes.

A. (a) Engine truck wheels with swing centers 1 inch. Engine truck wheels with rigid centers 1½ inches.

(b) Trailing truck wheels 1 inch.

(c) Driving wheels (more than one pair) ¾ inch.

151—Q. For what defects should springs and spring rigging be condemned?

A. Top or long leaves or two leaves in top half or any three leaves in spring broken.

Springs with leaves working in band.

Broken coil springs.

Broken driving pot saddle.

Equalizers, hanger, pin or bolt.

152—Q. What distance shall the male center casting extend into the female center casting?

A. Not less than ¾ inch.

153—Q. When are tender or engine truck wheels out of gage?

A. Wheels will be out of gage if the inside gage of flanges, measured on base line, is less than 53 inches or more than 53⅜ inches.

154—Q. What variation is allowed between wheels mounted on the same axle?

A. The distance back to back of flanges of wheels mounted on same axle shall not vary more than ¼ inch.

155—Q. What is the minimum height of flanges on driving wheel or trailing wheels?

A. The minimum height of flanges for driving and trailing wheel tires, measured from the tread, shall be one inch.

156—Q. (a) For what defects should driving trailing and engine truck axles be condemned.

(b) Tender truck axles.

A. (a) Driving trailing and engine truck axles with any of the following defects shall not be continued in service.

Bent axle, cut journal that cannot be made to run cool without turning, seamy journals in steel axles, transverse seams in iron axles, or any seams in iron axles causing journals to run hot, or unsafe on account of usage, accident, or derailment, driving, trailing, or engine truck axles more than one-half inch under original diameter, except for locomotives having all driving axles of the same diameter when other than main axles may be worn ¾ inch below original diameter.

(b) Bent axle, cut journals that cannot be made to run cool without turning. Seamy journals in steel axles transverse seams in iron axles, or unsafe on account of usage, accident, or derailment, collars broken or worn to ¼ inch or less in thickness, fillet in back shoulder worn out.

157—Q. What is the temperature in the fire box?

A. When the engine is working, about 2,500 degrees F.

158—Q. When are the draw bar and pins examined?

A. Draw bar and pins shall be removed and examined not less frequently than once each three months.

(To be continued)

*Locomotive Inspector, New York State Transit Commission.

Locomotive Inspector's Examination to Be Held Next Month

THE United States Civil Service Commission, Washington, D. C., has sent out the following announcement, which is of vital importance to all those men engaged in locomotive boiler work who have had the ambition to become federal boiler inspectors. The necessary qualifications are outlined in general below and detailed information on the matter may be gained from the Commission. The official civil service announcement follows:

An examination for inspector of locomotives will be held throughout the country on November 5 and 6. It is to fill vacancies in the Interstate Commerce Commission at an entrance salary of $3,600 a year. Appointees will be allowed necessary expenses when absent from headquarters in the discharge of their official duties.

The duties of this position are personally to inspect locomotives and to see that carriers make inspections in accordance with the locomotive inspection law and the rules and regulations established thereunder and that carriers repair any defects which such inspections may disclose before the locomotives or appurtenances thereof are again put in service; to investigate and report upon accidents caused by failure of any part or appurtenances of the locomotive or tender resulting in damage, injury, or death; and to perform other work as assigned.

Competitors will be rated on spelling; arithmetic; practical questions relating to the construction, testing, inspection, repair, and operation of locomotive boilers and their appurtenances; practical questions relating to the construction, testing, inspection, repair, and operation of locomotives, their tenders, and their appurtenances; report writing; training and experience in railroad work, and general fitness.

Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of United States civil service examiners at the post-office or custom-house in any city.

Boilers Built Under 1918 A. S. M. E. Code Acceptable to States Observing New 1924 Edition Requirements

THE question recently arose as to whether or not boilers that had been built by manufacturers according to the 1918 edition of the A. S. M. E. Boiler Code would be accepted in states operating under the Code and how much time would be allowed to manufacturers to clear the boilers so built. In order to determine the sentiment of the various states and cities operating under the Code in this matter, Charles E. Gorton, chairman of the American Uniform Boiler Law Society, prepared a questionnaire which was submitted to the states and cities in question, asking for this information.

Replies to Questionnaire

The replies to this questionnaire are given below and indicate in general that a reasonable time will be allowed for the sale of boilers built under the 1918 Code and now held in stock by the manufacturers.

States	Have adopted or will accept 1924 edition	Will allow time for disposal of boilers built under 1918 edition	Remarks
Rhode Island	Will accept...	Yes.	Until further notice.
New York	Will accept...	Yes.	Reasonable length of time.
New Jersey	Will accept...	Yes.	Boilers now being built in accordance with 1924 Code.
Pennsylvania	Will accept...	Yes, if manufacturers' data sheets have been filed in their office.	Time allowance will be determined by the Industrial Board.
Delaware	Will accept...	Yes.	New rules will not go into effect for at least six months.
Maryland	Will accept...	....	Approved and adopted as standard of construction for power boilers.
Ohio	Have adopted.	Yes.	Will accept stock boilers built to 1918 Code any time in the future.
Indiana	Will accept...	Jan. 1, 1924.	Manufacturers' data sheet must state whether boiler is built to 1918 or 1924 Code.
Wisconsin	Will accept...	Yes.	Boilers built to 1918 or 1924 Code will meet Wisconsin requirements.
Missouri	Will accept...	....	
Washington	Will accept...	Reasonable time.	1918 Code stock boilers accepted in accordance with State Safety Standards adopted Jan. 1, 1924.
California	Will accept...	Yes.	
Oregon	Will accept...	Yes.	This applies to stock boilers. New boilers should be built under 1924 Code.
Oklahoma	Will accept...	Yes.	
Arkansas	Will accept...	Yes.	
Cities			
Chicago	Will accept...	....	"We have not considered any particular date when boilers must be built strictly to the 1924 Edition, but feel that all boilers constructed after the issuance of the Code should be constructed in accordance with it. Any boilers built before the Code was issued and in stock, will be accepted by this Department at the manufacturers' request."
Detroit, Mich.	Will accept...	Yes.	
Erie, Pa.	Will accept...	Yes.	Applies to Power, Locomotive and Heating Sections of 1924 Code.
St. Louis, Mo.	....	....	Detailed information later.
St. Joseph, Mo.	Will accept...	....	1918 Code stock boilers will be accepted.
Philadelphia, Pa.	Will not accept	Yes.	1918 Code in effect until 1924 Code is adopted.
Los Angeles, Cal.	Will accept...	Period of one year beginning August, 1924, ending August, 1924.	Thereafter will adhere strictly to 1924 Code.
Tampa, Fla.	Will accept...	Yes.	1924 Revised Code will be effective Jan. 1, 1925.
Chicago, Ill.	Will accept...	No particular date.	1918 Code stock boilers accepted.
Nashville, Tenn.	Will accept...	....	No action taken as yet as to length of time for the 1918 Code to be eliminated.
Memphis, Tenn.	Will accept...	....	Will accept both Codes.
Scranton, Pa.	....	....	"All boilers that will be acceptable to the Dept. of Labor and Industry, Harrisburg, Pa., will be accepted by this Dept. for operation in the City of Scranton."
Seattle, Wash.	Will accept...	Undecided as to time.	Under City Charter, automatically accept the Code as revised from time to time.
Parkersburg, W.Va.	....	....	"All boilers and appurtenances built in accordance with the 1924 Edition of the Code will be accepted. All boilers constructed before July 1, 1924, in accordance with the 1918 Edition will be accepted. All boilers constructed after July 1, 1924, in accordance with 1918 Code, will be accepted until July 1, 1925."
Omaha, Neb.	Will accept...	Yes.	Reasonable length of time for disposal of 1918 Code boilers.

Boiler Inspection Department—Hawaiian Sugar Planters' Association—"Specifications call for all boilers to be built in accordance with the latest edition of the Boiler Code of the A. S. M. E." Boilers built according to 1924 Code, accepted; stock boilers built according to 1918 Edition, will be accepted, providing contract is signed prior to January 1, 1925, after that date 1924 Code should be followed.

In the case of each state and city to which the questionnaire was submitted the question was also asked whether these subdivisions would adopt the 1924 edition of the code later. Space did not permit the publication of this question in the above list, but with only one or two exceptions where the new edition had already been adopted the report was that it would be.

Standardizing Welding Practice in Locomotive Shops

By James S. Heaton*

The following suggestions for good welding practice have proven their merit in shops of the Wabash System which are under the supervision of the author. The methods of maintaining records of welding, the arrangement of a welding shop, the system of carrying out firebox repairs with the process, flue welding and care of equipment are all discussed in the article.

THE development of welding in locomotive repairs has been exceedingly rapid during the last few years. A few large railroads have employed experts to supervise the work, who report directly to the superintendent of motive power. It is the expert's business to make the practice of welding uniform in all the shops of the system so that the failure of one shop to get results can be traced to its origin. The supervisor of welding must find a successful method of performing each operation and require each shop to work according to his instructions. The standardization of welding is simple under such direction. It is more difficult to standardize on roads that do not employ a supervisor, but the necessity is even greater.

Keeping of Proper Records

Records should be kept of each particular welding job on a locomotive and should be filed for future reference. For example, on boiler work a form, showing the side, crown, door, flues and wrapper sheets should be used to show the repairs made and seams that were welded, together with the date, name of the operator and name of the shop. Three copies of the report are filled out, one to be forwarded to the superintendent of motive power, one to the supervisor of welding and one to be kept by the shop doing the work. For back shop work a form similar to the locomotive report should be used to show all the parts welded while the engine was in the shop. A careful check should be made at different times to ascertain the wear and condition of the welds and if any job does not come up to expectations, a satisfactory method should be found.

Standardization of Equipment

The supervisor of welding should be held responsible for the output and upkeep of all welding equipment. He should be allowed to select the equipment that he deems necessary to give the required output. All equipment, as well as the method of welding, should be standardized. This is necessary for two reasons: First, that repair parts be on hand at all times; second, that after teaching an operator one machine, he can work on any of them without further instruction. Some machines will give a greater output than others, while some will produce better work than others.

The supervisor of welding must be familiar with all makes of machines and competent to select the best suitable for the work. There are so many different kinds of wire, brass rods, cast iron rods, fluxes and other necessary supplies on the market today that it requires some one familiar with welding work to be able to select the best materials. The best obtainable is the cheapest and the supervisor should be on the lookout at all times for better materials.

As the repairs to welding equipment are of a delicate and exact nature, it requires an expert workman to perform such work. There should be a centralized repair shop to take care of the entire system. All torches and regulators should be forwarded to this shop for repairs when necessary. It has proved to be more economical to have enough equipment on hand to allow an extra set to be at the shop at all times, than to require the use of a faulty outfit, which is not only dangerous to the operator, but to others around him.

Layout of a Welding Shop

A welding shop should be laid out so that work may come in at one end and go out at the other. An enclosure of curtains, or a wall to keep the sand from flying over the machinery, should be erected for cleaning all material before it reaches the welder. A sand blast is best suited for this work. An enclosure should also be erected for chipping to prevent chips from flying. A preheating furnace served with a swinging air hoist and provided with a cast-iron slab high enough for a welder to work at comfortably should be placed adjoining the enclosure and next should be an open forge so constructed that it will accommodate three separate fires. A swinging air hoist that will handle all the heavy work from the cleaning rooms to the welder and on through the shop is an excellent aid in expediting the work. More work can be turned out if the proper facilities are installed to help the welder instead of ruining his temper and perhaps cause injury to him by lifting hot and heavy castings.

A stationary machine should be installed at any point in the shop, such as the valve, rod, tank, or driving box area, where there is sufficient work to keep a welder busy. This will eliminate the transporting of material to and from the welding shop and also save the time consumed in waiting for a traveling crane.

The Traveling Work Shop

One of the most useful equipments that a railroad can operate is a traveling work shop. This shop is equipped with a gasoline-driven electric welding machine, a gasoline-driven air compressor, an acetylene welding and cutting outfit, a small lathe, drill press and emery wheel. Tools capable of taking care of stationary boiler work can also be included. This work shop, operating over the entire system, can make repairs to stationary boilers at pumping stations and depots and to switches, frogs, bridges, pipe lines, etc., eliminating the cost of tearing down and replacing material that can be repaired cheaply where it is installed.

Proper Welding Instruction

In making preparations for a weld, the following must be given consideration: Condition of surfaces, bevel of material, position of material, provision for expansion and contraction, use of proper filler material and allowance of sufficient room for the welder to work.

Failure to observe any of the above considerations will tend to make a bad weld. All surfaces must be free and clean from foreign substance, such as dirt, scale and grease. Welding on a dirty surface will make a seamy and faulty weld. All boiler sheets, patches, frames and other material that is broken must be beveled to 45 degrees on each edge, leaving an opening at the underside of 1/8 inch to be sure that the weld will be made through the entire piece. The proper filler rods to be used for each operation should be noted in the instructions. It is important that the welder be allowed enough room to work. His work is tedious and if placed in such a position that he is under strain, the result is apt to be faulty. All of these precautions should be taken to assist in caring for expansion and contraction. Sheets and patches that are applied on a straight line must be corrugated along the line of welding. Smaller patches should be cut either in diamond or oblong shapes.

* Welding Supervisor, Wabash, Decatur, Ill.

Instructions for Welding Boilers

For purposes of standardization, the following rules have been drawn up to cover work on boilers:

1. Welding will not be permitted on any part of a boiler that is wholly or in part in tension.
2. Staybolts or crown stays must not be built up or welded to the sheets.
3. Holes which are larger than 1½ inches in diameter, when entirely closed by welding, must be properly stayed.
4. Only competent operators will be allowed to weld on boilers.
5. All parts must be clean before starting and must be kept so during the welding.
6. When repairing fireboxes a number of small patches should be avoided and full sheets applied.
7. Never cut through an old weld to apply a new patch.

If a cutting torch has been used to bevel a sheet, a chipping hammer should be used to remove all the burnt metal caused by the torch. The back-step method should be used in all boiler welding. This insures better expansion of the sheets than the old method of continuous welding. On calking edges and seams the welding should extend on the under sheet the same thickness as on the top sheet. By this method the seam will present a sloping edge to the heat, thereby eliminating fire cracks in the top plate at the rivets.

When welding jacket studs on a boiler head, the stud should be beveled on one end and the place to be welded on the boiler cleaned off. Then hold the stud in one hand and tack it to the boiler and weld completely around it. This eliminates drilling out the broken stud and tapping and renewing for a new stud. Care must be taken not to weld over the old stud as it is liable to leak. This method can be used for welding studs for oil pipes on the boiler, as well as sand pipe clamps and studs to the frames.

Welding Work on Fireboxes

When it is desired to weld a firebox without removing the back end, the welding edge should be prepared the same as on boiler sheets. Then bolt the sheet securely in place, taking care that there is a uniform opening of ⅛ inch all around the welding edge. Drill ½-inch holes, spaced about 14 inches apart, and use two pieces of ½-inch by 2-inch by 4-inch boiler plate on both sides of the sheet. Clamp with ½-inch machine bolts, being sure that all bolts are drawn tight. Rivet the top of the flue sheet to a point not less than 12 inches below the center of the crown, then start welding by using the back-step method, moving the clamps when necessary. Next weld the entire door sheet. All welding on riveted lap seams in a firebox should be applied to cover the entire edge of the sheet and should extend on the under sheet a width equal to the thickness of the top sheet.

In welding around the door, cut outside of the first row of staybolts and trim the outside edge of the sheet just inside of the rivet holes. Bevel all edges 45 degrees and fasten the patch in place, using the same method as for side sheets. Remove the row of staybolts adjacent to the patch and use a sand-blast to clean the edges. Weld by the back-step method.

In renewing the upper part of the door sheet, cut out a patch allowing enough metal so that the line of the weld will come below the second or third row of staybolts. This will take care of contraction. Have all edges beveled to 45 degrees and use a sand-blast to clean the edges. Butt weld to the crown and side sheets. The sheets should be held in position by the same method as used for the side sheets. Weld by the back-step method.

In welding the side sheets, cut the sheet 12 inches below the crown sheet. Remove all staybolts and rivets and also the adjacent row of staybolts in the upper sheet. Cut the door and flue sheet inside of the rivet holes and bevel each to 45 degrees. Place the sheet in position, using bolts in the mud-ring 1/16 inch smaller than the holes, and bolts in the top of the sheet with staybolts screwed in from the outside to force the sheet against the bolts to hold the sheet in position. Sand blast the edges and weld the sheet at the top first, using the back-step method, then weld the door and flue sheet. Remove all bolts and rivets before the weld has cooled.

Where possible, all side sheet patches should be cut either in diamond or oblong shape. Never allow more than 8 inches in the vertical seam. When applying such patches, allow sufficient bolts to hold the sheet in position with staybolts screwed in from the outside to force against the bolts. Remove the adjacent row of staybolts in the sheet. Clean the edges by a sand blast and weld by the back-step method, using a mild steel electrode. Remove the bolts and staybolts before the weld cools.

For all leaky seams that are beyond calking, remove the rivets and cut the outer sheet on a line with the center of the holes. Bevel the sheet to 45 degrees, sand blast the edges and lap weld, filling the holes in the under sheet. This eliminates the renewing of a sheet that has worn edges.

If a wrapper sheet is wheel-worn 40 percent or less, the worn place can be replaced by welding. Remove all staybolts in the section to be welded and clean off by using the sand blast. Then weld to the original thickness. Care should be taken to weld around all staybolt holes so they can be tapped out to full thread.

Flue Sheets

For the front flue sheet, the welder should use a cutting torch and cut the sheet at the knuckle. If the top of the sheet is in good condition, cut just above the top row of flue holes. If it is not in good condition, then cut out the entire sheet and bevel the edges to 45 degrees. Place in position by using a strong back and tack well around the sheet at points about 12 inches apart. Sand blast the edges and weld by the back-step method, using a mild steel electrode as in previous operations.

In welding broken flue sheet bridges, it is best to cut the crack to 90 degrees and have a ⅛-inch opening at the bottom. Clean off with a sand blast and drive an expander in the flue hole. Drive the expander out before the weld cools.

For a three-quarter sheet cut between the top of the staybolts and throat sheet braces and remove the top row of staybolts. If the crown and side sheets are in good condition, the flue sheet may be riveted. If not, then cut off behind the rivet holes and prepare the same as for welding a door sheet. Weld by the back-step method.

For a whole sheet, if it is in good condition at the mud-ring, cut between the bottom row of staybolts and the mud-ring. This saves time and the expense of removing the mud-ring rivets. Weld in the same manner as for a three-quarter sheet.

For a crack in the back flue sheet knuckle, bevel out the crack to 90 degrees from the water side, if possible. Sand blast the edges and weld by the back-step method, using a mild steel electrode. The weld should be reinforced ⅛ inch on the fire side.

In welding flues, have the sheet and flue beads cleaned off completely with the sand blast, begin welding at the bottom center of the flue and finish at the top center. Never weld down on the side of a flue. Start welding at the top of the flue sheet and then finish each succeeding row before starting on the next. This will keep the heat down.

Repairing Mud-Rings

For a mud-ring patch cut out all defective parts and remove the first row of staybolts adjacent to the cut. Bevel the edges of the sheet and patch and place the patch in position, using bolts 1/16 inch smaller than the rivet holes in the mud-ring. Use the sand blast to clean and weld by the back-step method.

To prepare for the welding of a broken mud-ring remove enough from the bottom of the firebox plates to permit free movement of the welding tools. Vee out the mud-ring to 45 degrees on the top side of the crack, leaving a 1/8-inch opening at the bottom and force open the fracture by driving in a small wedge. This will take care of expansion. Clean off with a sand blast and weld.

Where the mud-ring corners have deteriorated, have the edges of the sheet cut so that the mud-ring will show at least 1/4 inch. The worn places should be cleaned with a sand blast. Weld along the mud-ring first, and then along the vertical seams, filling both seams to 45 degrees.

When washout holes have been reamed beyond standard or have been worn away, countersink the hole and insert a bushing. Weld by filling the countersink and reinforce around the bushing. If the plate around the hole is deteriorated, insert a brass plug and weld around it. The plug can be removed very readily.

Patches may be welded on smokeboxes by either the butt weld or the lap weld method. Seams and edges of the butt straps should be welded, as this makes an air-tight job and a smokebox must be air tight.

Acetylene Welding

Before starting to weld or cut, be sure that the regulators are in proper condition. Turn the screws to the right until the right pressure shows on the small gage. The large gage registers the amount of pressure in the drum and the small gage registers the pressure in the hose.

If any trouble is encountered with the equipment, the operator should not try to repair it himself, but should take it to the foreman or to the toolroom. The equipment is of a delicate nature and requires skill to repair it. Do not connect a hose to a drum without a gage. It is dangerous as the hose may burst and result in injury to the operator. Have only the pressure required on the small gages so that the pressure will not have to be controlled by the valve on the torch.

Do not start a weld that has not been cleaned properly and all possible allowance made for contraction. Do not cut plates that can be sheared and never use a tip that is too large. This will save gas and will make a neater job. When practicable, the gasoline or oil torch should be used for heating large surfaces. It is too expensive to use the welding torch for such jobs.

Torches

Care must be used in lighting and shutting off the torch. To light a torch, the acetylene must be turned on first and the gas ignited. Then open the oxygen valve and add oxygen until a bluish flame with a small bulb appears. This is a neutral flame and must be used at all times except when welding cast steel ends on superheater units. When a carbonizing flame is to be used, it can be obtained by using excess acetylene.

When the operation has been completed, the acetylene valve must be shut off first and then the oxygen valve. If the oxygen valve is closed first and the acetylene valve is leaking, the flame may cause a back-flash in the hose. Never shut off the oxygen valve first except in case of a back fire.

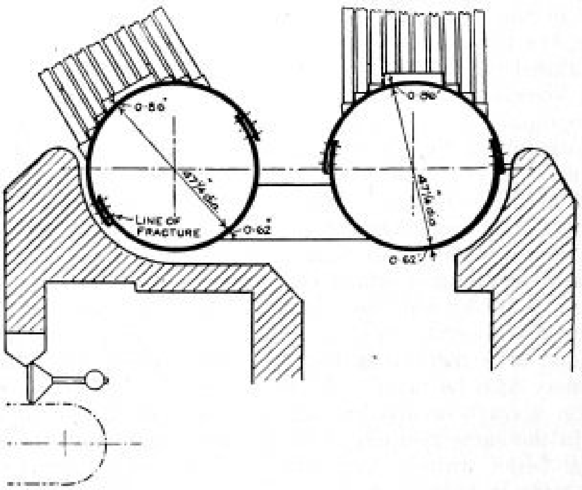
Back Fires

If a tip comes in contact with the molten metal, the holes will become clogged, thereby causing a torch to back fire. Loose heads and joints will also cause back fires in the welding torch. When a cutting torch back fires, the oxygen valve must be shut off first and then the acetylene valve. Then put the tip and the head of the torch in water to cool off. When a welding torch back fires, the oxygen valve must be shut off first and then the acetylene valve, then put the tip *only* in water until it is cooled, when the head may be immersed. When a cutting torch is leaking at the head from overheating, never tighten the tip nut until the head and tip have been cooled off completely, for by so doing the threads on the head will be stripped and the torch will be ruined.

Account of a Boiler Explosion at Reisholz, Germany*

THE central station at Reisholz, situated near Dusseldorf, is one of the largest central stations of the Rhenish-Westphalian Basin. It comprises seven turbines of a total output of 73,000 kilowatts and 30 boilers with a total heating surface of 18,520 square meters divided into three boiler houses. In No. 3 boiler house, the most recent, there were 12 boilers of the Garbe type working at a pressure of 214 pounds per square inch, and each having 7,104 square feet of heating surface and 215 square feet of grate area. A short time ago one of these boilers exploded with disastrous violence, killing 27 people and injuring 14 others.

At the time of the explosion eight boilers of this battery were at work, producing about 4.1 pounds of steam per square foot of heating surface at 199 pounds per square inch pressure. The working conditions at the time were normal, and there was no apparent cause for the primary rupture which occurred at the front of the riveted longitudinal joint of the lower front drum.



Lower Drums of Garbe Type Boiler

The two upper drums of the boiler, as well as the two nests of tubes, were projected upwards through the roof. The brickwork, together with Green's economizer, which was placed behind the boiler, was completely destroyed, and the fragments thrown in all directions.

The dynamic effects made themselves felt on the two boilers on either side, although passages separated these from the boiler which exploded.

That on the right, which was at work, had its fittings completely destroyed, and fell in such a manner that the upper drums rested in the combustion chamber, although no actual explosion of the boiler resulted. The boiler on the left, which was not at work, was, on account of the shock, displaced bodily sideways 8 feet while some masons who were repairing the brickwork were killed.

The inquiry made by the authorities having eliminated as

*Reprinted from *Vulcan*.

possible causes of the accident shortness of water, overheating due to deposit, excessive pressure or negligence in working, there only remained to be considered the quality of the plates and the construction of the boiler.

The lower vessel which exploded had a diameter of 47¼ inches composed of two rings connected at mid-length by a butt joint and cover straps with a circumferential riveted seam. Each ring was formed of two half plates, one being bossed out to form the top plate 0.86 inch in thickness, while the lower half was 0.62 inch in thickness. The two longitudinal seams were lap jointed and formed with three rows of rivets.

It was in the left lower half shell ring at the joint turned towards the furnace—from which it was protected by brickwork—that the failure occurred. The seam gave way throughout its length along the line of rivets nearest the overlap of the tube plate. The principal fracture had a crystalline appearance and showed signs of further minute fractures, which started at the rivet holes and radiated like lines of force towards the solid plates and from one rivet hole to another. These radiating fractures seemed to indicate that the plate was brittle. Specimens of the fractured plates, as well as the plate of the right half of the drum, which remained intact, were submitted to machine tests, with the following results.

The two plates showed a tensile strength of 21.58 to 26 tons per square inch and an elongation below 25 percent in the case of the specimens as submitted, though after annealing a higher elongation than 25 percent was obtained. Shop tests on notched bars showed the two plates to be very brittle, both in the neighborhood of the riveting and in the solid plate, but this brittleness was more accentuated in the plate that failed than in that from the other drum. This brittleness, however, disappeared after annealing. Chemical and micrographic analyses did not reveal any particular defect that explained this brittleness, nor did the tests indicate whether the brittleness was produced in the rolling of the plates or in the making of the boiler. The phosphorus content was found equal to 0.054 percent.

While the debris was being removed after the explosion, an incident occurred which confirmed the brittleness of the plates. A girder fell from the roof upon some of the plates, causing the latter to break like glass, and a piece as large as the hand to be detached without any deformation. A further fact may also be noted. About 11 months before the explosion a crack occurred in another boiler of the same battery in the same position as the primary rupture in the exploded boiler while a hydraulic test was being carried out after some leaking rivets had been calked. The plate that fractured on that occasion had been found to be brittle, but, as a micrographic examination and a chemical analysis did not give unfavorable results, it was thought that the brittleness was due to defective heat treatment or to work being carried out in the boiler shop on the plate at too low a temperature. After the explosion it was discovered that the plate which caused the explosion came from the same batch as the plate which failed 11 months before under hydraulic test.

Laboratory investigations having failed to furnish any complete explanation, one is reduced to hypothesis as to the cause of the brittleness which led to the explosion. The probable cause appears to be one of the following: (1) That the plates had been rolled at too low a temperature without subsequent annealing; or (2) annealed at too low a temperature; or (3) that after annealing the plates had been piled one on the other, with the result that the cooling was too slow. These hypotheses find some justification in the fact that the plates were made during the war at a time when all forges were hard pressed, and when it was not possible to give normal care to manufacture.

But if the brittleness of the plates is accepted as the primary cause of the explosion, it is certainly not the only one, as the construction of the boiler is not free from criticism. When dealing with large diameters and high pressures, it is always advisable to avoid lap-joints and employ butt-joints at the riveted seams. The latter form of joint permits the shells to take a truly cylindrical form, and avoids the deformations which must inevitably occur when lap joints are used. These slight departures from true circular form, due to the use of lap-joints, are the more objectionable when two different thicknesses of plate are riveted together, as was the case with the exploded drum. The greater rigidity of the top plate of the drum, due not only to its increased thickness but also to the bossing of the tubes, transmitted to the lower and thinner plate all the deformation and consequently it was in the line of attachment of the thin plate that the stresses brought into play by changes of form were most localized.

The cracks starting from the rivet holes lead one to suspect that the metal has been stressed beyond its elastic limit either by too heavy "flogging" of the edges of the plates when the boiler was being constructed or by the use of too high a pressure in the hydraulic riveting machine. It is known that hydraulic-riveting, while having considerable advantages over hand-riveting, presents this special danger, and can set up cracks starting from the rivet holes if too high a pressure is used. Tests made before the war have shown that this risk exists if a pressure higher than 51 tons per square inch of section of rivet is used.

While inquiries do not reveal any fault in the method of working of the boiler which could be held directly responsible for its failure, it is nevertheless deserving of notice that since its installation a short time previously the boiler had been repeatedly tested by hydraulic pressure following tube replacements. It is very possible that these repeated tests—made each time at an increase of 71 pounds over the working pressure, that is with a test pressure of 284 pounds on the inch—may have aggravated existing minute cracks, without leading to a complete rupture of the riveted seam, and was actually found to be the case with one of the neighboring boilers.

The preceding considerations show how greatly the safety of boilers, particularly those of large size and high pressure, depend upon little details of manufacture, such as the care given to annealing, the pressure of the riveting machines, the bending of the edges of the plates, etc., and how necessary it is not only to be sure that the materials employed are of good quality, but that in their use every care is taken to avoid injury by defective workmanship or ill-treatment. Anything which tends to make plates brittle or creates incipient fractures is a potential source of danger, and may, as in the present case, result in disaster. The riveted joints for high-pressure boilers, it may be also observed, should be made with butt-joints and double cover-straps. Lap joints particularly with plates of different thicknesses, should be absolutely prohibited.—*Associations Françaises de Propriétaires d'appareils à vapeur.*

American Riveting Practice

Although the statement is made in the above article that the use of riveting pressures greater than 51 tons (presumably the English value of 2,240 pounds) per square inch is attended with risk, this is not borne out in American practice. It is accepted as good practice in the United States to use pressures of 100 to 150 tons (2,000 pounds) per square inch of rivet area (based on the cold rivet before driving) and, so far as we can learn, no deleterious effects have been traced to the use of such pressures.

From a review of the facts presented above it is our opinion that faulty material was the principal cause of the accident. There is a possibility that the use of an hydraulic test pressure equivalent to 133 percent of the working pressure may

(*Continued on page* 304)

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CONTENTS

The simple announcement sent out by the United States Civil Service Commission, that an examination is to be held November 5 and 6 to fill vacancies in the inspection department of the Bureau of Locomotive Inspection, offers to a great many men the chance to try for the most sought after positions open to boiler makers. Those individuals who will finally be selected are the ones who have first of all worked faithfully at their chosen trade and who, in addition, have had the ambition and tenacity of purpose to improve themselves by study in the various phases of boiler and locomotive work that are required of inspectors.

The Boiler Maker has expended real effort in trying to emphasize the importance of developing a thorough understanding of the trade of boiler making. To do well what is part of the day's work is necessary to hold a place in the line, but beyond that, a man must develop a complete understanding of the whole machine if he wants to pull himself out of the ranks.

The opportunities in this coming examination are equal to every applicant. The qualifications of each individual will determine whether he is to be one of the fortunate ones who will obtain a berth in the federal inspection service. The magazine has published and will continue to publish every bit of available information on boiler inspection that will aid those men ambitious enough to study either for federal or other inspection positions. Other examinations will be held in the future and now is the best time in the world to lay the foundation for a future career in the inspection service and this can only be done by study.

The article "Calculating Stresses in Mouth Piece Rings for Unfired Pressure Vessels," appearing in this issue, is the sequel to an article on "Mouth Piece Ring Design" which appeared in the February issue. A note accompanying the original article stated that the mathematical explanation of the methods resorted to in the design of mouth piece rings would later be given if sufficient interest were shown in the subject by readers of the magazine. During the past few months, so many requests for this information have been received that, although the subject is a highly technical one requiring a knowledge of more than the usual shop mathematics, it is sufficiently important to a certain branch of the industry to be published.

If any difficulty is experienced by those dealing with this type of work in understanding the subject, it will be the object of The Boiler Maker to supply such supplementary information as may be required by our individual readers.

In an early issue of The Boiler Maker a new and original series of articles on the layout of sheets for locomotive boilers will commence. This series, which has been prepared by one of the foremost experts on boiler layout in the country, will take up in detail the complete methods followed by a prominent locomotive building concern in developing new boilers. Numerous drawings have been arranged to show how the process has been applied in specific cases.

Boiler layout work up to the developments that will be outlined has not progressed as rapidly as it might—rule of thumb methods having long been resorted to, much to the detriment of progress. Because the most complicated sheets can be laid out by the new system with precision so that when fitted in place they absolutely line up and all holes come fair, the methods are bound to be applied to repair work with the same success that they have attained in the building of new boilers.

Every layerout in the country, and all those wishing to advance to this important position in the industry, will find the articles of great interest. Before its publication, a more detailed outline of the series will be given in the magazine.

Engineering Specialties for Boiler Making

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

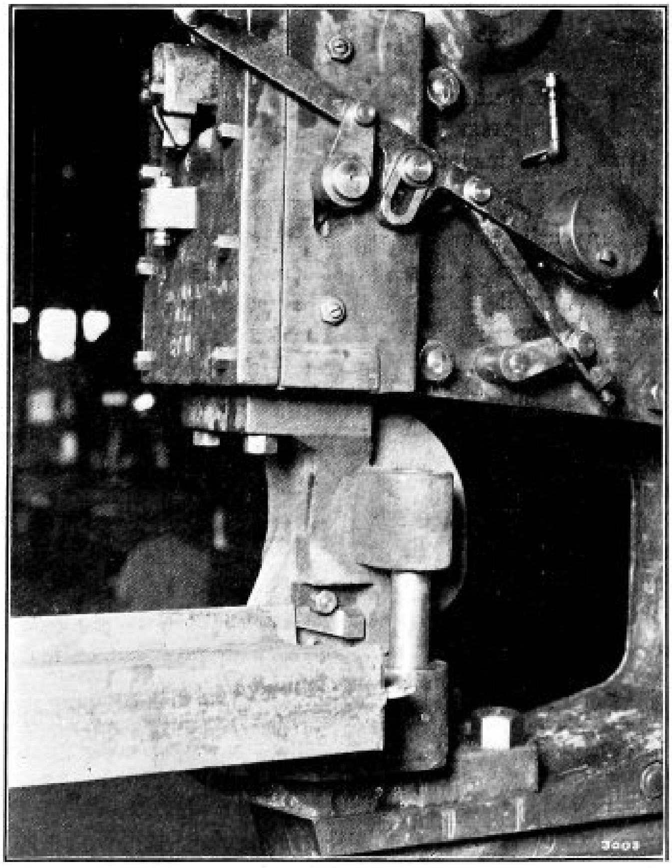
Coping Attachment for Use with Punches and Shears

THE Buffalo Forge Company, of Buffalo, N. Y., has placed on the market a combination flange and web coping attachment for use with any Buffalo punch, shear or combination machine with a high throat. Machines with standard low throat, however, will not take this new coping attachment. The new design will cope or notch channels, "I" beams, "Z" bars, tees, plates and angles; this diversity of performance is of value to the operator engaged in structural steel or fabricating work.

These coping attachments cover a wide range of sizes and capacities; each one, however, has a specified capacity which corresponds to that of the machine with which it is to be used. For handling webs and flanges, the coping attachment has six knives which are always in place.

The outstanding feature of the attachment just introduced is the self-alining arrangement of the knives. With the average coping attachment, the knife holders constitute two separate parts and must be alined before they can be operated. The design of the Buffalo coping attachment eliminates this. The upper knife holder has a machined extension which slides in a corresponding guide in the lower knife holder. In addition there are two vertical guide pins rigidly fastened to the lower knife holder and extending upward to machined openings in the upper knife holder. These pins hold the knives in alinement by preventing any shifting or turning of either knife in relation to the other. For gaging the depth of cut to be taken, or for gaging the depth of notching in flanges, adjusting screws are provided.

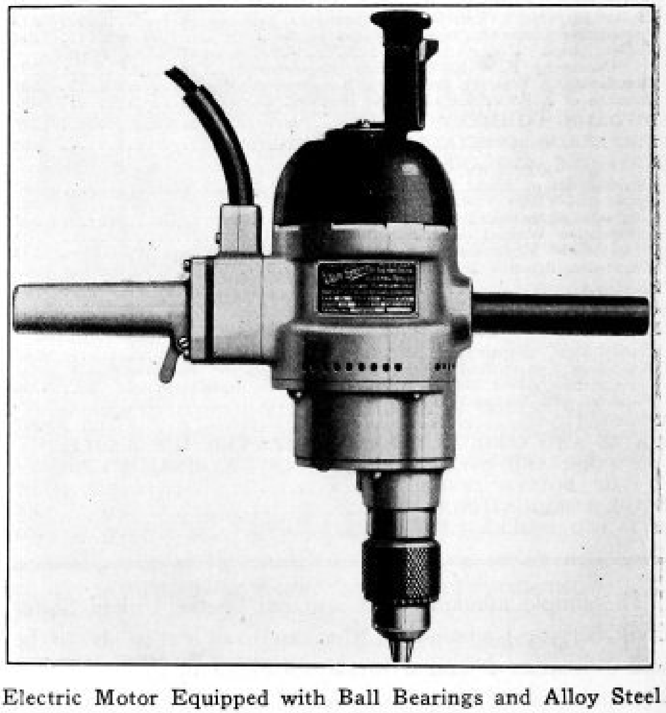
In addition to the regular work for which this flange and web coping attachment is designed, special knives for notching 90 degree or other angles can be obtained as well. The knife holders used here are steel castings, while the knives themselves are made of tool steel. The guide pins are of ample size and bearing surface to insure against possible breakage.



Combination Flange and Web Coping Machine

Van Dorn Electric Motor

AN electric motor adaptable to production and intermittent service has been added to its family of electric tools by the Van Dorn Electric Tool Company, Cleveland, Ohio. The armature is provided with an extra large shaft which runs in an oversized bearing correctly mounted.



Electric Motor Equipped with Ball Bearings and Alloy Steel Parts Throughout

The steel bearing retainers are cast in the aluminum and provisions are made for locking the inner races to the shaft at both ends. The ends of the shaft are provided with felt washers to retain the lubricant. They are confined by steel washers to prevent them from getting into the bearing. An alloy steel thrust bearing is provided for the spindle.

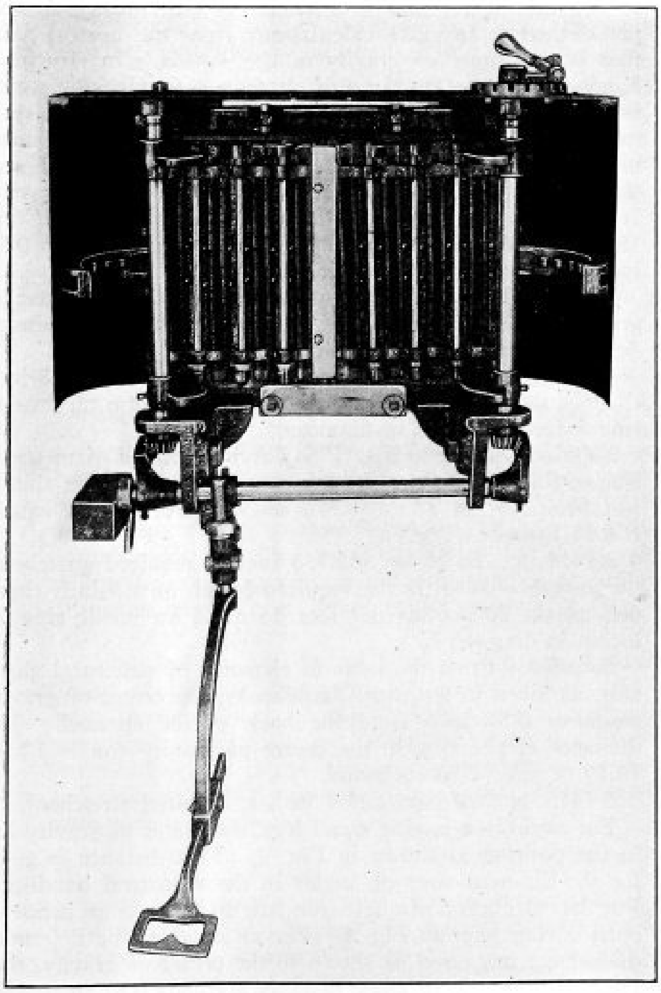
The drill is controlled by a semi-automatic switch which gives a quick make and break control. It is case lined with asbestos. The insulated motor is tested and rated to meet various standardization rules and is conservative in speed. One of the features of the drill is the strong construction of the motor housing. The new design brush holders are provided with a pigtail. This eliminates soldered connections, which make the motor easily accessible for repairs. At the top of the drill are two screws which permit the removal of the spade handle and the top head for attention to the brushes and the top bearing.

The gears are cut and hardened and assembled with ground fits and oversize keys. The armature pin is removable and is made from alloy steel. The teeth are formed to give maximum strength and smooth operation. The motor may be run on either alternating or direct current.

Revolving Locomotive Fire Door

A LOCOMOTIVE fire door constructed on the principle of a roll-top desk has been designed by Frank Matthews, Montreal, Canada. It is operated by its own mechanism without the aid or use of air, steam or electricity, thereby relieving the over-taxed pressure on the air pumps.

The door is strongly constructed of steel and cannot be blown open by an internal explosion. The front is made of eight panels, four on either side. The inside and outside panels are made of steel. The middle plate is made of asbestos and the whole is riveted together. This construction tends to make the door cool.



Locomotive Fire Door Operated by Its Own Mechanism Without the Aid or Use of Air

The top covering and the side wings act as deflectors, throwing the glare down to the floor of the cab enabling the engineman to see his signals more clearly at night, especially in inclement weather.

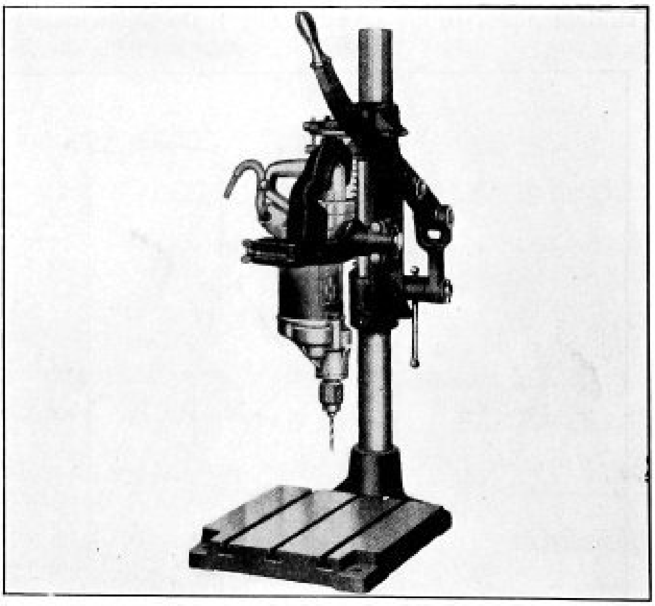
Method of Operation

It is operated by a foot pedal entirely above and free from the deck plate, which is responsive to the slightest touch of the fireman's foot; the necessary forward movement of the body in firing causes the door to fly open. The natural backward movement of the body brings the balance weight into action and quickly closes the door. By a slight pressure on the foot pedal the fireman can open the door any desired distance in order to observe his fire. By using the hand operating mechanism at the top of the door, it can be held at any opening desired in order to observe the fire.

Hisey Bench Drill Stand

THE Hisey-Wolf Machine Co., Cincinnati, Ohio, has added to its list of portable tools a bench drilling stand equipped with a lever feed. It will hold all portable Hisey drilling machines up to and including the 5/8-inch size. The illustration shows the stand supplied with the adapter required with the 1/4-inch and 5/16-inch drills.

The stand is fitted with an adjustable depth drilling stop which is convenient in producing duplicate work. The design of the stand is such that the drill can be attached without removing any part. The equipment consists of a portable sensitive drill press that can be operated from a lamp socket. A few of the specifications are as follows: Length of feed, by means of the lever, 4½ inches; maximum distance from the top of the base to the drill chuck, 17 inches; distance from the center of the drill spindle to the column, 6½ inches; size of the base, 12 inches by 11 inches; diameter of the column, 2 inches; net weight of the stand 90 pounds.



Bench Drill Stand with a Hand Lever Feed

Locomotive Shipments.—Shipments of locomotives by principal manufacturers totaled 104 in September as against 139 in August and 335 a year ago, while locomotive orders unfilled on September 30 totaled 386 as against 361 at the end of August and 1,178 on September 30, 1923.

Questions and Answers for Boiler Makers

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

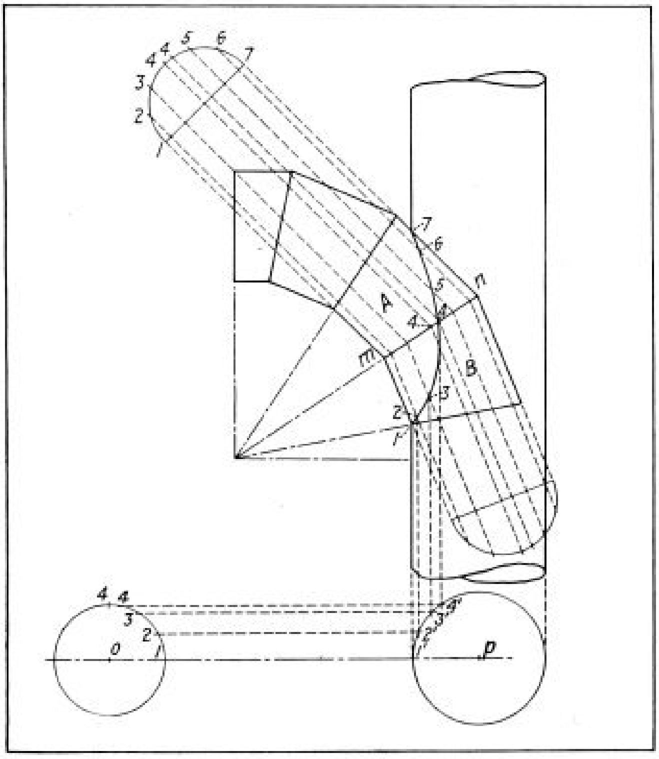
Conducted by C. B. Lindstrom

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 Miter Between an Elbow and Blast Pipe

Q.—I am having some difficulty in laying out the intersection of an elbow with a blast pipe. Will you please illustrate this problem.—A. R.

A.—Lay off first the elevation, Fig. 1, showing the location of the elbow sections with respect to the axis of the straight pipe. In the drawing, Fig. 1, the preliminary construction lines for the layout of the elbow sections are omitted as we understand that you are familiar with this part of the work. At right angles to the miter $m—n$ draw a one-half profile of the elbow section, and divide the view into equal parts. In the plan on center line $o—p$ draw a circle for the blast pipe from the point of intersection p between the vertical axis of the pipe and the axis $o—p$. From point o draw the circle representing the profile of the elbow sections. Divide one-quarter of this view as drawn to correspond with the spacing shown in the profile view of the elevation. Horizontal projectors are drawn parallel with $o—p$ from the points 1, 2, 3, 4 to intersect the plan view of the blast pipe at 1′, 2′, 3′, 4′. Vertical projectors are drawn from the plan to intersect the corresponding lines of the elbow section A and B, as shown at 1, 2, 3, to 7 inclusive. These points lie in the miter which may be drawn in by the aid of a batten or thin strip of metal.



Layout of Intersection Between an Elbow and Blast Pipe

Angle and Channel Rings

Q.—The angles shown in the inclosed sketch are to be cut to length before bending. Could you by return mail or in the next issue of The Boiler Maker give me formulæ to determine the length of the angles; also let me know where I can procure a book to find formulæ for different sizes of channels and also angles before bending.—A. P.

A.—Layerouts and anglesmiths use a number of methods in determining the length of angles and channels. A simple method is to make calculations from the neutral axis, that is the center of gravity of the section. In structural handbooks, tables are given of elements of sections, in which is included the location of the center of gravity in unsymmetrical sections. In Fig. 1 (a) and (b) is shown a channel section to form an inside and outside ring. The sectional view of the channel indicates the center of gravity. It lies on the axis $x—x$, and for an 8-inch channel weighing 18.75 pounds per foot length, the center of gravity lies 0.57 inch from the back or working line of the section.

The length of the stretchout is figured from the center of gravity, for it is assumed that the length will not increase or decrease along the neutral axis.

Example.—Determine the required length of an 8-inch channel weighing 18.75 pounds per foot, to form an outside ring 8 feet 11 inches in diameter.

Solution.—Refer to Fig. 1 (b) and determine diameter of ring to line $y—y$ taken through the center of gravity; thus 8 feet 11 inches + (2 × 0.57) = 9 feet 0.14 inch, equals 108.14 inches.

3.1416 × 108.14 = 339.733 inches, required stretchout.

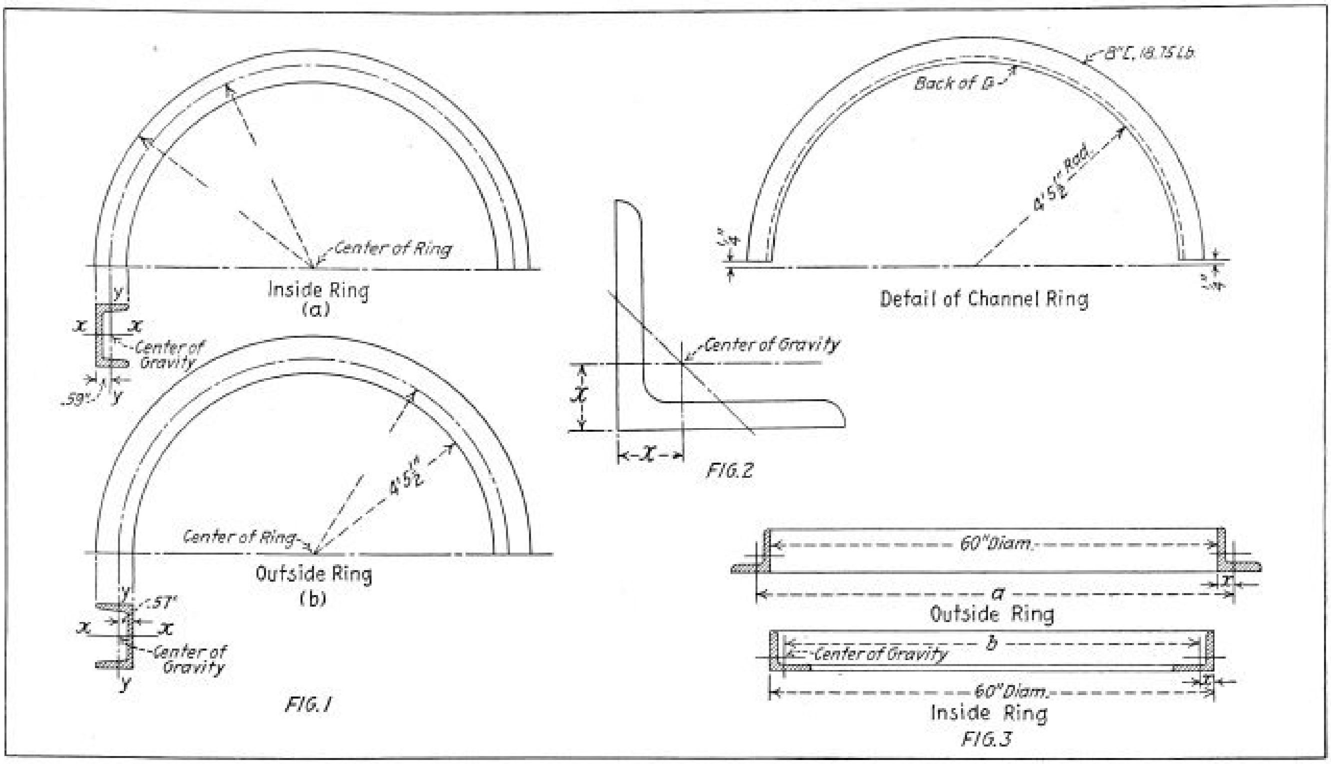
Example.—What is the required length of a 9-inch channel, weight 20 pounds per foot, to make an inside ring 72 inches in diameter?

Solution.—From the table of elements of structural channels, as given in structural handbooks, the center of gravity measures 0.59 inch from the back of the channel. The diameter of the ring to the center of gravity equals 72 + (0.59 × 2) = 73.18 inches.

3.1416 × 73.18 = 229.9 inches, required stretchout.

For angle iron having equal legs, the center of gravity lies in the position as shown in Fig. 2. This distance is given for the different sizes of angles in the structural handbook. For the calculation of angle iron lengths to make an inside or outside ring refer to Fig. 3. For an outside ring determine diameter a measured as shown to the center of gravity, thus for a 3 × 3 × 5/16 angle distance x equals 0.87 inch; then a = 60 + (2 × 0.87) = 61.74 inches.

3.1416 × 61.74 = 193.96 say 194 inches.



Method of Finding Actual Length of Various Type Rings

For an inside ring of the same size angle, the stretchout may be calculated as follows:

Diameter *b*, Fig. 3 equals $60 - (2 \times 0.87) = 58.26$ inches.

$3.1416 \times 58.26 = 180$ inches.

From the foregoing explanation you should have no further difficulty with the calculations of lengths for rings made of angles or channels.

Life of Locomotive Boilers

Q.—What would be the condition of a locomotive boiler 25 years in service, all conditions being favorable, feed water, etc., from a metallurgical point of view? I understand general deterioration takes place due to constant strains and stresses, also atmospheric changes. Is there any data from which calculation could be made so as to arrive at a definite solution?—J. K.

A.—The life of any boiler depends entirely on the original condition of the materials used, the general operation of the boiler, whether it is operated at normal rating or forced to produce greater volume of steam, its care and maintenance under operating conditions, etc. A boiler operated under its rated capacity is not subjected to as severe conditions as when forced, therefore the stresses are not as great under lower pressures.

There are no definite data on figuring the actual condition of boilers after years of service. Such conditions must be determined by periodical inspections and tests of the plates, stays, tubes, etc., as to their thickness, etc. After boilers have been in use for certain periods of time, the pressures are reduced to meet the requirements of the laws governing their operation.

Tube Cutters

There are a number of good patented tube cutters. Write Gustav Wiedeke & Company, Dayton, Ohio, and J. Faessler Manufacturing Company, Moberly, Mo., for descriptive matter on tube and flue cutters.

Our readers are requested to give their ideas on these questions.

Information Wanted on Locomotive Boiler Tests

Q.—In an article by Mr. Fry on "Notes on Locomotive Boiler Tests," which appeared in THE BOILER MAKER for September, 1921 (pages 249-252), he refers to two constants *m* and *n*; *m* is a constant for a given boiler design and *n* is a fuel constant. May I trouble you to tell me how those constants are calculated? Thanking you in advance for the information.—L. C.

A.—We are unable to advise you on this question, but possibly some of our readers will supply the necessary information.

Removal and Replacement of Cracked Headers in B. and W. Boilers

Q.—Would you publish in THE BOILER MAKER the operations and information regarding tools required to remove and replace a cracked header in a Babcock & Wilcox watertube boiler so as to save the tubes in the boiler.—D. M.

A.—The tube headers of Babcock and Wilcox boilers are made of cast iron for pressures up to 160 pounds per square inch and of forged steel for higher pressures. Forged steel headers can be burned or cut with the cutting torch without damaging the tubes. We do not know of any special tools for the removal of the headers. Will some of our readers give information on this subject?

Expansion Stresses Due to Welding

Q.—I am writing you on a subject on which I would like to get your decision: Supposing two identical patch or crack welding jobs come up on locomotives of the same type firebox and boiler. One job is done with the oxy-acetylene welding torch and the other with the electric welding apparatus. On which firebox or boiler is there the greater expansion due to the welding being done?—C. G. D.

A.—To produce welds by the oxy-acetylene method, a greater amount of heat must be supplied to the metal surrounding the joint than is required by the electric system of welding. On account of this condition, greater expansion and contraction occurs in oxy-acetylene welded constructions.

PERSONALS

CECIL C. ROBERTS of Cleveland, Ohio, who for a number of years has been connected with the boiler making industry in various capacities, has recently been appointed a sales representative of the Pritchard Manufacturing Company of Cleveland to handle air, water and steam line couplings which are products of this company. He also represents the Mattingly Automatic Valve Company of St. Louis, manufacturers of safety valves for gas welding and cutting equipment and safety water gages for steam boilers. Mr. Roberts, who was born in Mt. Vernon, Ohio, received his education at this place and later from extension courses of the La Salle Institute and others. His apprenticeship in boiler making was carried out with the C. A. & C. Railroad now a part of the Pennsylvania Railroad System. At Danville, Ill., he was engaged for some time as a boiler maker with the Chicago & Eastern Illinois Railroad and in Cleveland and Newark, Ohio, with the Baltimore & Ohio Railroad. Following this period of his career he was placed in sole charge of the boiler and structural iron work carried out by the American Bottle Company (now the Owens Bottle Company) of Newark, Ohio. Later he was instrumental in forming the partnership known as the Denney-Roberts Company to manufacture and repair boilers, tanks, steel stacks, plate and sheet steel work, foundry supplies, tube welding and structural work. With this company he held the position of president and general manager. He also worked at boiler making in Cleveland for the River Terminal Railroad Company, New York Central Railroad and various shipyards. From 1920 to July, 1923, he acted as shop inspector at the Erie City Iron Works for the Hartford Steam Boiler Inspection & Insurance Company and as a field inspector in the Cleveland district. Until his recent appointment as representative of the Pritchard Manufacturing Company and the Mattingly Automatic Valve Company he was engaged to supervise production tools for the Chicago Pneumatic Tool Company in the local plant. Mr. Roberts holds commissions of competency as an inspector of steam boilers from the various states.

Cecil C. Roberts

L. P. Mercer, resident sales manager of the Parkesburg Iron Company, with headquarters at Chicago, has been appointed Chicago district representative of the Hall Draft Gear Corporation, with office at 343 South Dearborn Street, Chicago, and will hold both positions.

BUSINESS NOTES

The Gibb Instrument Company of Bay City, Michigan, manufacturer's of Electric Welding machines and Electric Heating machines has broken ground for a new modern plant.

The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, manufacturers of hollow and solid staybolts, has appointed the Tabson Company as its special representative in Illinois, with offices in the Railway Exchange Building, Chicago.

H. D. Rohman of the R. C. S. Equipment Company, located at 8 East 41st Street, New York City, has taken over the agency for Taperod electrodes on the Interstate Steam Railways. These electrodes are manufactured by the Electric Arc Cutting and Welding Company, Newark, N. J.

The Hanna Engineering Works, 1765 Elston Avenue, Chicago, manufacturer and distributor of Hanna riveting machines, Hanna air hoists, Hanna sand sifters and Hanna I-beam trolleys, is now represented in Minnesota, North Dakota, South Dakota, Iowa, and the eastern portion of Nebraska by The George M. Kenyon Company, Room 303, Zenith Building, 116 East Fourth Street, St. Paul, Minnesota. In the provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island, Canada, the company is represented by Williams & Wilson, Ltd., 84 Inspector Street, Montreal.

Boiler Explosion at Reisholz, Germany

(*Continued from page* 298)

have contributed to the failure because of the presence of faulty material. However, the use of test pressures of 150 percent of the working pressure is accepted as good practice in the United States and, when applied to a properly constructed boiler, we see no reason to question such use.

Note: Comment by Editor of *The Locomotive,* Hartford Steam Boiler Inspection and Insurance Company.

BOOK REVIEW

THE MODERN FOREMAN. *By Robert Grimshaw, M. E., 297 pages. Size 5¾ inches by 8½ inches. Published by the Gregg Publishing Company, New York.*

The object of this book is to show the important part the foreman plays in increasing the efficiency of modern industrial plants. A comparison is given between the foreman of the past and present and his responsibilities to his employer, the workers and himself. Three chapters are devoted to men in the ranks and problems pertaining to them which the foreman must fundamentally understand. This is followed by an interesting discussion of the art of handling men with the object in view of obtaining the largest amount of production per man and still keep them contented and interested in their work.

Considerable space is given to the duties of the foreman. This includes a detailed discussion of the best methods of performing the various duties which confront the foreman during his daily routine. Considerable discussion has taken place in recent years as to the amount of clerical duties the foreman should have burdened upon him. The author, in a clear and concise manner, discusses the amount and best methods of performing this duty. In chapters nine and ten, it is pointed out that the foreman should aim to eliminate waste and also should study the most modern factory methods. These factors should be thoroughly understood in order that a foreman may function properly.

What the foreman should have and what he should know is covered in the two largest and most interesting chapters in the book. The importance of his mental training, his physique, his character, his personality, his imagination, his loyalty, etc., are interestingly discussed in these chapters. It is further pointed out that the foreman should have a general knowledge of human nature, of psychology, of teamwork, of management, etc., in order to successfully perform his duties and to prepare himself for further advancement.

Letters from Practical Boiler Makers

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

Class "Two" Repair Records

IN the February, 1924, issue of THE BOILER MAKER, there is printed a wonderful record of a class "Two" repair job that if *true* will stand for many years before being broken. To the thinking man who knows the amount of labor involved in such a job, it shows that the team work of the men who accomplished this record breaking job is beyond praise; *but is it true?* That is the question that has been asked some of the best boiler makers, men of 40 and 50 years of experience who today are expert in the laying out and fabrication of all classes of locomotive boilers.

Their answers invariably were, it cannot be done, in the ordinary way that class two repairs are made, and this writer quite agrees with Mr. Wendt of Pittsburg, Kansas, that the record is unfair and misleading. Like Mr. Wendt, the writer is an old master boiler maker and boiler inspector of wide experience and when reading the article it appeared to this writer that there was something funny about it, especially when looking at the picture of the master mechanic and his staff of white collared assistants (twenty-one men all told) the thought arises if all those men were puttering around a locomotive at the time they were trying for a record what chance had the workman to do ordinary work let alone record breaking work.

We know that it is possible to do wonderful work today with modern machinery, *but* to strip an engine, take the boiler out of the framè, burn out the firebox, fabricate a new firebox, install it, with all the attendant staybolts, tubes, etc., in the usual way, this writer is of the humble opinion that it cannot be done.

Again we know, that it is the practice of some roads to have wagon tops, and fireboxes up to the throat connection all ready with staybolts all installed, to replace old ones cut off at the throat, which involves much less labor, and it may be possible to make the repairs in the time mentioned, but we doubt it.

Of course making class two, or any other classified repairs that way is not the way that the majority of boiler makers accept the term and is entirely wrong. We also know that there are roads that have the duplicate system down to such a fine point that they run their engines into the shop, take the boiler out of the frame and replace it with another one, and the engine is returned to service in a few days leaving the old boiler to undergo the necessary repairs.

Wilkinsburg, Pa. FLEX IBLE.

An Easily Constructed Boiler Washout Trough for the Roundhouse

TO those of your readers whose duties are confined to roundhouse work, the accompanying sketch of a washout trough may be of interest and the idea be utilized, as it will convey the water and scale into the engine pit thus avoiding the usual sloppy and muddy condition of the roundhouse floor. The trough is constructed of light galvanized or jacket iron with all edges wired or panned down. The holes for connection purposes are reinforced with light iron. The legs and adjusting rod are made out of 1 inch by 1¼ inch iron. Slots, for adjusting a small trough to the various heights of the engine, can be applied at distances suitable for local conditions and also the dimensions given can be changed to suit local conditions.

REPAIRING THE ADAMSON FURNACE

The questions of—and the answers to "P. R. V." in the September issue of THE BOILER MAKER, in regard to repairs to an Adamson furnace, prompt the writer to tell what his experience has been with these furnaces, which may be of further benefit to the enquirer.

One peculiarity of the Adamson furnace, as far as my own experience goes, is that deterioration and cracks are found below the grate line, as marked by arrow in Fig. 2, more often than on any other part of the furnace, this being caused by the difference in temperature. We have found it good

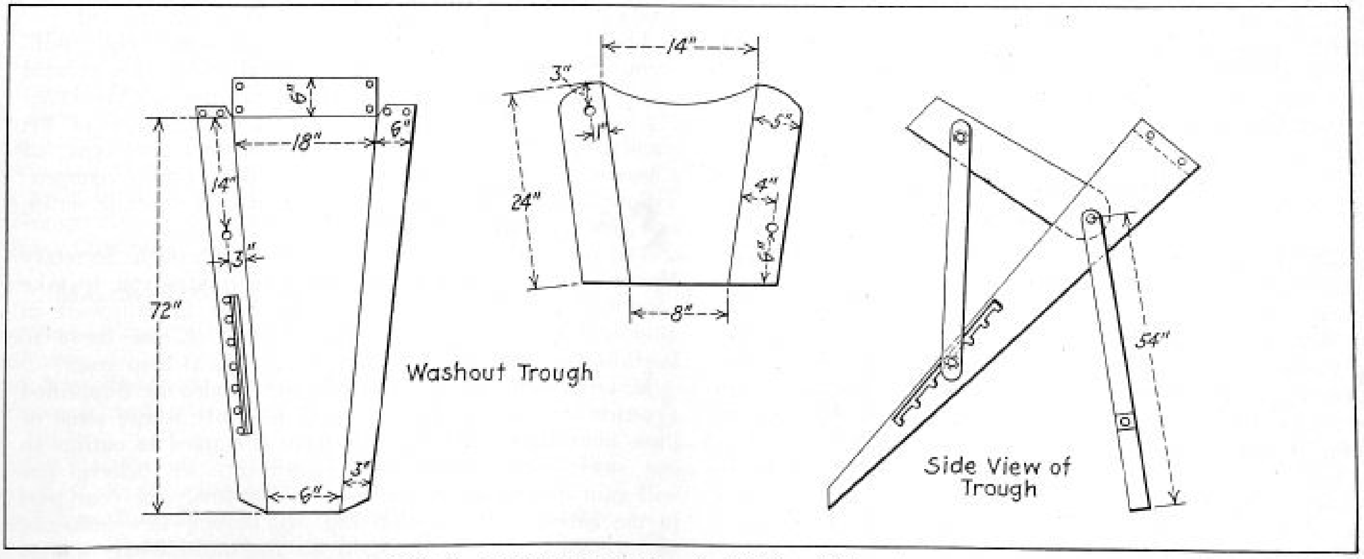


Fig. 1.—Handy Trough for the Washout Department

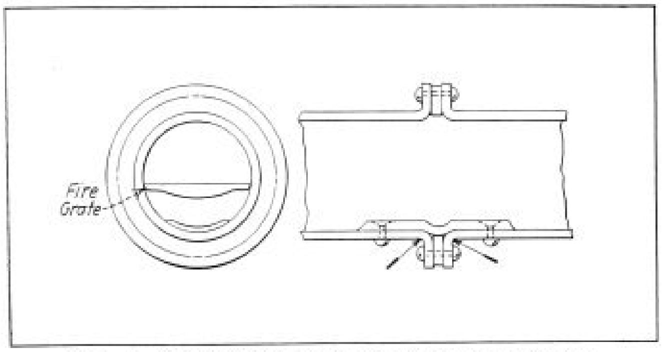


Fig. 2.—Method of Repairing Adamson Furnace

policy, even where only one knuckle was cracked to extend the patch over both knuckles, as shown, the cutting away of the material not being considered necessary as being below the fire line. These patches have given good service.

Lorain, Ohio. JOSEPH SMITH.

Trouble with Saw Mill Boilers

I HAVE had an extensive opportunity of inspecting saw mill and threshing machine boilers and it certainly is a very interesting experience. The conditions under which some of these boilers operate without having an explosion is miraculous.

I have found the staybolts removed and gas pipe plugs installed. Others have machine bolts with rubber or copper packing to take up the leaks; the fusible plugs removed and gas pipe plugs inserted. The gage cocks have no wheels or handles and, in many cases, the water glass is missing and has been broken for some time. They never blow off the boiler to help remove the settlings and mud that is bound to form in all boilers and allow the area around the front handhole plate in the smokebox to become covered with corrosion and wet ashes which, in a very short time, necessitates patching.

In installing flues it matters not to them whether the flue comes through the flue sheet or whether it projects ½ inch beyond. It is never beaded as required and in a very short time burns the ends off. The blow-off pipe is never protected from fire and gives a wonderful opportunity to burn off.

I have in numerous instances found the crown sheet covered with scale and mud about ¼ of an inch deep and some of the most wonderful bags and buckles. The staybolts have also been found to have been attacked by corrosion so that they were about ⅓ their original size. A circumstance which puzzles me at times is why the pitting in many cases attacks the staybolts only, the crown sheet, or the inside firebox sheet or outside wrapper sheet, for it is never alike in any two boilers in the same locality.

Port Dickinson, N. Y. INSPECTOR.

Simplified Practice

(*Continued from page 286*)

goods and services we might all enjoy, if we were more efficient, is the lack of standardization. The Committee urged a nation-wide program of industrial standardization be developed through co-operation between the Department of Commerce and Industry. As a part of that program, our Division of Simplified Practice is working with several different industries in their efforts to reduce waste by applying simplification and standardization.

These are not new subjects but it seems that the possibilities in them for savings, economies, and greater profits, are fast becoming better understood and appreciated. Although some of our industrial and technical organizations have accomplished much through a wise use of these principles, there are still many opportunities for further application in their respective fields.

When the American Society of Mechanical Engineers sent in its report, through the American Engineering Standards Committee, to Secretary Hoover, it cited over 1,000 opportunities for simplification. Some suggestions touch on boilers, valves, pipes, fittings, gages, pumps, injectors, etc.

Recently, the National Association of Sheet and Tin Plate Manufacturers began a survey of existing variety in thicknesses or gages of its products, also of the sizes of sheet in which each is made, and the relative demand for each size in terms of tons rolled per year by association members.

Another interesting suggestion relates to the present non-interchangeability of the many types of grate-shaker bars used on locomotives. The Interstate Commerce Commission's Bureau of Locomotive Inspection reports that more accidents have occurred around engine terminals from the lack of standardization in this one detail than from any other cause.

Simplified Practice is not necessarily standardization, though it may well, be the fore-runner of standardization, insofar as it clears away the superfluous and the unnecessary variations, and thus helps make standardization more effective. Simplified Practice means the reduction of variety in sizes, dimensions and immaterial differences of everyday commodities as a means of eliminating waste, decreasing costs and increasing profits and values in Production, Distribution and Consumption.

More and more of our industries are recognizing the fact that too many varieties is the mother of excessive investment, greater "cost-to-carry," slow turnover, rapid obsolescence, decreased profits and economic waste. More and more of our managers and our engineers are considering ways and means to stop these losses at their source.

Our part in this work is purely co-operative. We are not experts in any field. The only experts we know are the men in the industry. Neither are we Government investigators. There is nothing in our service which savors of interference, restriction, regulation or control. Our whole job is to help the industries to help themselves.

The first step in our service is to tell the story; then we co-operate in obtaining the facts on which to base the recommendations. When all the facts are in hand, we help arrange a general conference of all interests to consider the survey, make final recommendations, appoint a standing committee to foster the project, and watch over its progress.

We supplement that committee's effort by broadcasting the story and obtaining acceptance of the recommendations.

This acceptance is the pledge of each branch of the industry to use its best effort in securing general adoption of the simplified list as the only varieties to be recognized in future production, sale and purchase of the commodity covered.

The industry develops the standards—we help "sell" them. So long as "standards" are merely something printed on a page in a handbook, they don't mean much. The benefits come only through actual application and use of the standards. When the acceptances received represent an adequate majority of the interests, we endorse the recommendations and publish them in our elimination of waste series, and give them wide distribution.

The moment of opportunity is now! Through Secretary Hoover, the Department of Commerce invites you to take your full part in the nation. Our hope is expressed in Hoover's invitation to all business men, "Come down to Washington and show us what we can do to help you."

Making your contacts through our service in Simplified Practice, we are confident you will not only secure some of these immediate advantages we have attempted to outline in our story,—but vastly more significant, we believe you will gain new vision of cooperative democracy, of your part in the nation's affairs—that you will develop new influence in legislative investigations, in all the multifarious undertakings of government—that you will, in short, renew the responsible privilege of your citizenship and so insure the safety of our direction.

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—George Uhler, Washington, D. C.

Deputy Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law Society

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—John A. Stevens, Lowell, Mass.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 West 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—J. F. Scott, Trenton, N. J.

Secretary-Treasurer—C. O. Myers, State House, Columbus, Ohio.

Vice-Chairman—R. L. Hemingway, San Francisco, Cal.

Statistician—E. W. Farmer, Rhode Island.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

J. A. Franklin, International President, suite 522, Brotherhood Block, Kansas City, Kansas.

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, suite 524, Brotherhood Block, Kansas City, Kansas.

H. J. Norton, International Vice-President, Alcazar Hotel, San Francisco, Calif.

International Vice-Presidents—Thomas Nolan, 700 Court St., Portsmouth, Va.; John Coots, 344 North Spring St., St. Louis, Mo.; M. A. Maher, 2001-20th St., Portsmouth, Ohio; E. J. Sheehan, 7826 South Shore Drive, Chicago, Ill.; John J. Dowd, 953 Avenue C, Bayonne, N. J.; R. C. McCutcheon, 15 La Salle Block, Winnipeg, Man., Can.; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; John F. Schmitt, 605 East 11th Ave., Columbus, Ohio.

Master Boiler Makers' Association

President—Frank Gray, tank foreman, C. & A. R. R., Bloomington, Ill.

First Vice-President—Thomas F. Powers, assistant general foreman, boiler department, C. & N. W. R. R., Oak Park, Ill.

Second Vice-President—John F. Raps, general boiler inspector, I. C. R. R., Chicago, Ill.

Third Vice-President—W. J. Murphy, general foreman boiler maker, Penn System, Fort Wayne Shops, Allegheny, Pa.

Fourth Vice-President—L. M. Stewart, general boiler inspector, Atlantic Coast Lines, Waycross, Ga.

Fifth Vice-President—S. M. Carroll, general master boiler maker, C. & O. R. R., Richmond, Va.

Secretary—H. D. Vought, 26 Cortlandt Street, New York.

Treasurer—W. H. Laughridge, G. F. B. M., Hocking Valley R. R., 537 Linwood Avenue, Columbus, Ohio.

Executive Board—E. J. Reardon, Locomotive Firebox Company, 632 Marquette Building, Chicago, Ill., chairman; H. J. Raps, G. F. B. M., I. C. R. R., 7224 Woodlawn Avenue, Chicago, Ill., secretary.

Boiler Makers' Supply Men's Association

President—J. P. Moses, Jos. T. Ryerson & Son, Chicago, Ill.; Vice-President—F. H. McCabe, McCabe Manufacturing Co., Lawrence, Mass.; Secretary—W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

American Boiler Manufacturers' Association

President—E. R. Fish, Heine Boiler Company, St. Louis, Mo.

Vice-President—E. C. Fisher, The Wickes Boiler Company, Saginaw, Mich.

Secretary-Treasurer—H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

Executive Committee—George W. Bach, Union Iron Works, Erie, Pa.; G. S. Barnum, The Bigelow Company, New Haven, Conn.; F. G. Cox, Edge Moor Iron Company, Edge Moor, Del.; W. C. Connelly, D. Connelly Boiler Company, Cleveland, O.; W. A. Drake, The Brownell Company, Dayton, O.; A. R. Goldie, Goldie-McCulloch Company, Galt, Ont., Can.; J. F. Johnston, Johnston Brothers, Ferrysburg, Mich.; M. F. Moore, Kewanee Boiler Works, Kewanee, Ill., and A. G. Pratt, The Babcock & Wilcox Company, New York.

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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

TRADE PUBLICATIONS

Die Heads.—Land-Matic die head installation views are featured in a 12-page booklet recently issued by the Landis Machine Company, Waynesboro, Pa.

Exhaust Fans.—Bulletin No. 1650 prepared by the Diehl Manufacturing Company, Elizabeth, N. J., describes motor driven exhaust fans for direct and alternating currents in various types and sizes.

Portable Air Power.—Under the title of "One Hundred and One Ways to Save Money with Portable Air Power," the Ingersoll-Rand Company, 11 Broadway, New York, has prepared a most attractive catalogue showing compressed air tool operation as applied to various industries together with details of many of the products of the company.

Better Foundry Practice.—The Policy Holders' Service Bureau, Group Insurance Division, Metropolitan Life Insurance Company, New York, has issued Bulletin Number Three on the subject of foundry practice. This bulletin takes up the planning and controlling of production in a foundry with a special explanation of the methods necessary in getting castings out according to schedule.

Feed Water Heaters.—A 20-inch by 43½-inch chart, illustrating through colors the principle of utilizing waste heat for preheating boiler feedwater through the medium of the Elesco non-contact feed water heater, has been issued by the Superheater Company, New York. A facsimile of the chart also is shown on Folder A. Two other folders, B and C, discuss in concise form the advantages of heating boiler feed water and illustrate units of Elesco equipment and various installations.

Electric Fans.—A comprehensive review of the use of electric fans for blowing, exhausting, ventilating, cooling and drying is contained in a 16-page booklet just issued by the Buffalo Forge Company, Buffalo, N. Y. The subject matter is confined to direct connected units, including descriptions of small disk or propeller fans, multiblade type fans for heating and ventilating, stoker units, pressure blowers, mill exhausters and electric forge blowers, and is amply illustrated with views of installations in various industries.

Pneumatic Tool Repair Parts.—A complete repair part catalogue showing each part that enters into the construction of Thor pneumatic tools and the interchangeability of parts from one tool to another, has been published by the Independent Pneumatic Tool Company, Chicago. Considerable tabulated matter, giving symbol numbers, name and description of part, and showing the different sizes of Thor tools on which parts interchange, has been compiled in order to give the pneumatic tool user a better understanding of the parts in the various tools and thus enable him to keep a tool in service that might otherwise have to lie idle awaiting repair parts from the factory.

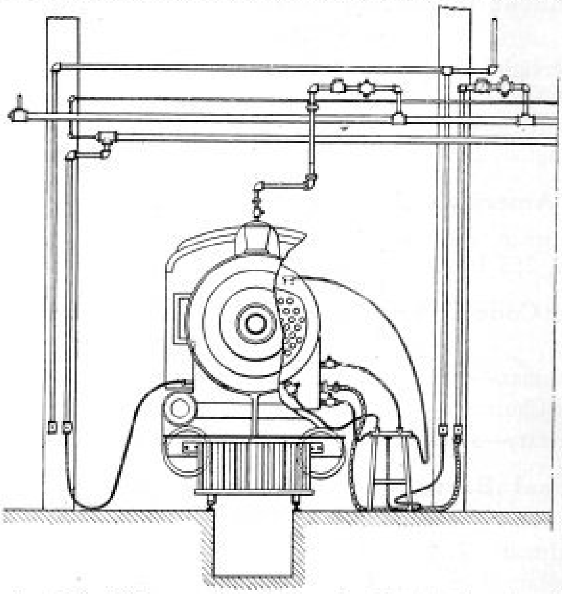
Electrical Equipment.—"Electrical Equipment for Railroad Shops" is the title of publication No. C-1661, which is being issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. It contains pertinent information and general principles, serving as a guide in the selection of electrical equipment for engine and car shops, engine terminals, freight terminals and passenger stations. The results of the application of individual motor drive and the extensive use made of magnetic control, both automatic and semi-automatic, in railway shops are described in detail and by illusrtations. A description of the arc welding process and its uses in track reclamation is also given.

SELECTED BOILER PATENTS

Compiled by
DWIGHT B. GALT, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

1,480,737. METHOD OF AND SYSTEM FOR WASHING OUT BOILERS. SPENCER OTIS, OF CHICAGO, ILL.

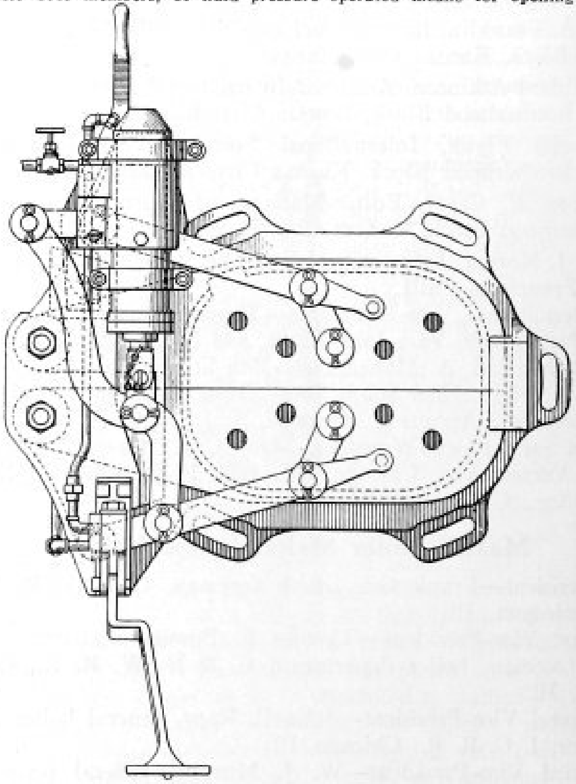
Claim.—The improvement in the art of washing out steam boilers while under pressure, which consists in delivering into the boiler, under a pressure sufficient to overcome the pressure of the boiler and causing to rise through



the water of the boiler a gas that is non-absorbing in the water, thereby bringing the sediment to a state of suspension in the water, collecting the added gas under pressure in the steam space of the boiler and evacuating the resultant water and sediment by pressure within the boiler. Seventeen claims.

1,492,896. FIRE DOOR FOR FURNACES. JAY G. ROBINSON, OF CHICAGO, ILLINOIS.

Claim 1.—In a device of the character described, the combination with movable door members, of fluid pressure operated means for opening and



closing the same, said means being adapted to hold said door members in closed position, means for releasing said holding means and manually operated means for moving said door members to open position. Seven claims.

THE BOILER MAKER

NOVEMBER, 1924

Brotan Boiler Applied to Hungarian Locomotives

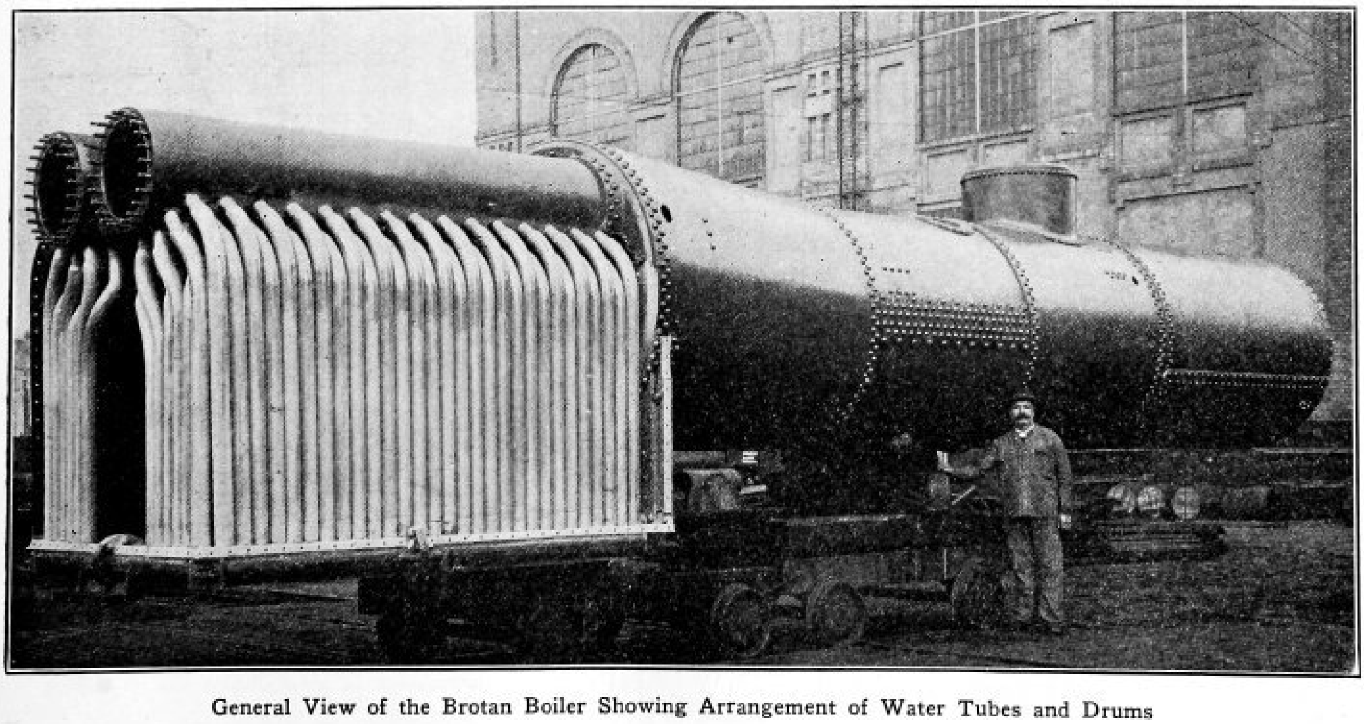
Combined Water and Firetube Boiler Adopted Because of Successful Operation in Bad Water Districts

THE Hungarian State Railways had handled practically all of its heavy express and passenger trains on the Fiume-Moravica section of the Budapest-Fiume line with locomotives of the 2-4-4-0 type, and the freight trains with 0-6-6-0 type locomotives until about 1914. Increased traffic conditions since that time created the necessity of developing a locomotive of greater power and capacity. The locomotive illustrated and described in this article was designed to handle traffic in the above-mentioned territory and was the first one of its type to be built in the shops of the state railways of Budapest.

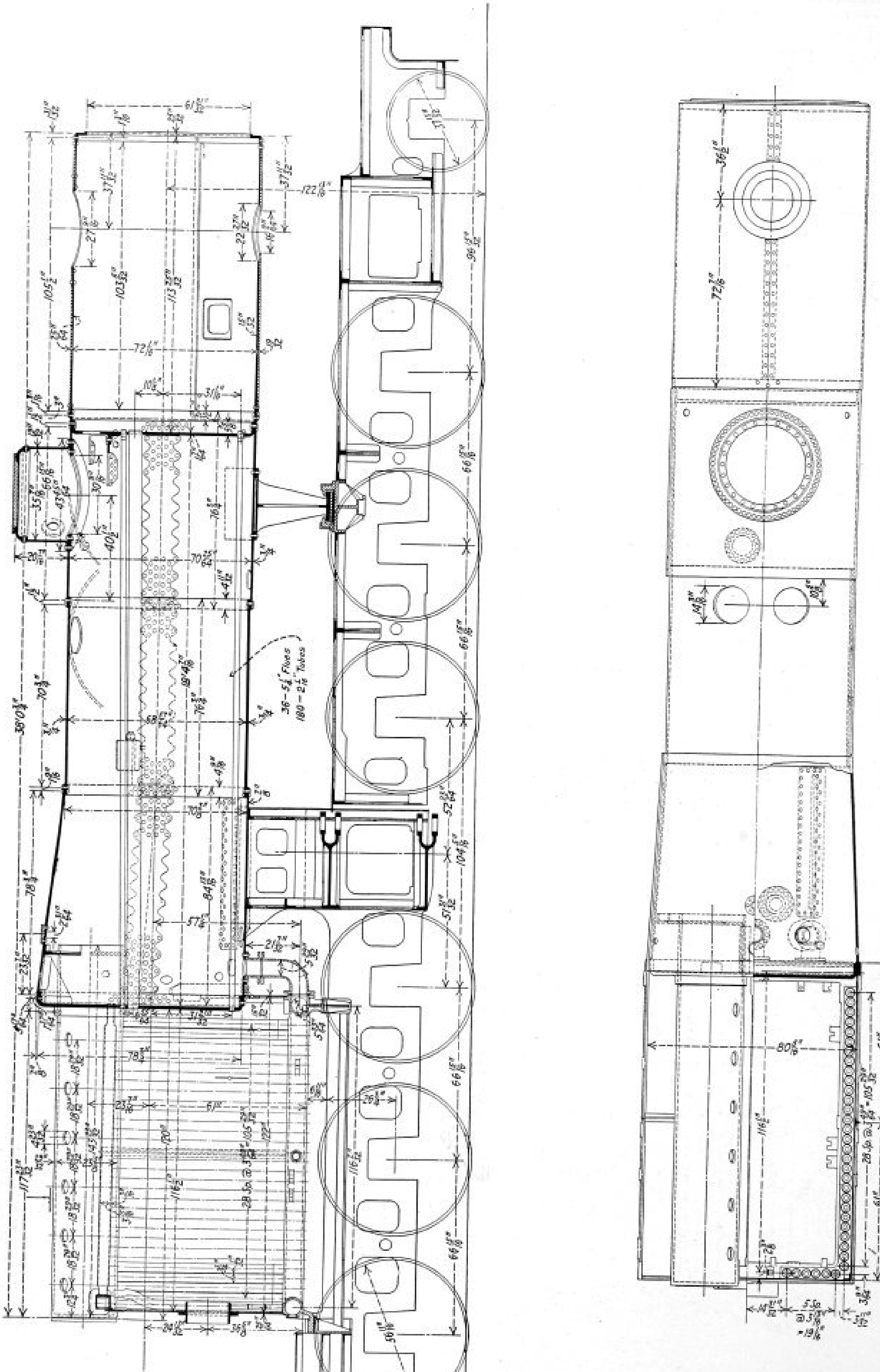
Difficulties had been experienced with the boilers on locomotives previously used in this district because of hard water and because of the highly satisfactory service which the Brotan boiler had rendered on some express locomotives, it was decided to embody it in the design of this new Mallet. Since this first locomotive was constructed, 59 more of the same design have been built and placed in service.

This particular design of the Brotan firebox boiler has a greater heating surface than is usually found in European locomotive boilers. The barrel of the boiler is in three sections; the middle section has a diameter of 68 29/32 inches and the plates are ¾ inch thick, while the rear section is conical with a maximum diameter of 78¾ inches, the plates being ⅞ inch thick. The circumferential seams of the boiler are lapped and double riveted; the longitudinal seams have double straps of unequal width and are triple riveted. The copper tube sheet of the firebox is 1 3/16 inches thick, the front tube sheet is of iron 1 7/64 inches thick. The steam dome is 20 7/16 inches high and has a diameter of 35 7/16 inches; it consists of two parts; viz., the flanged shell which is 19/32 inch thick, and the dome which is ⅞ inch thick and which has a cover 25 9/16 inches in diameter. The smokebox is built up of two plates and has a door consisting of two dished plates which is held against the cast steel door frame by 12 clamps. Connecting with the stack, which is not continued down inside the smokebox, is a conical, tiltable spark arrester extending down to the exhaust pipe which ends on a level with the center of the boiler. Behind the opening for the stack is fitted a half conical smoke duct.

The throttle valve on the steam dome is a double disk gate valve; two safety valves of four inches diameter, with a high lift, are fitted on a special pad back of the dome. On account of the size of the boiler two strainers, each with six



General View of the Brotan Boiler Showing Arrangement of Water Tubes and Drums



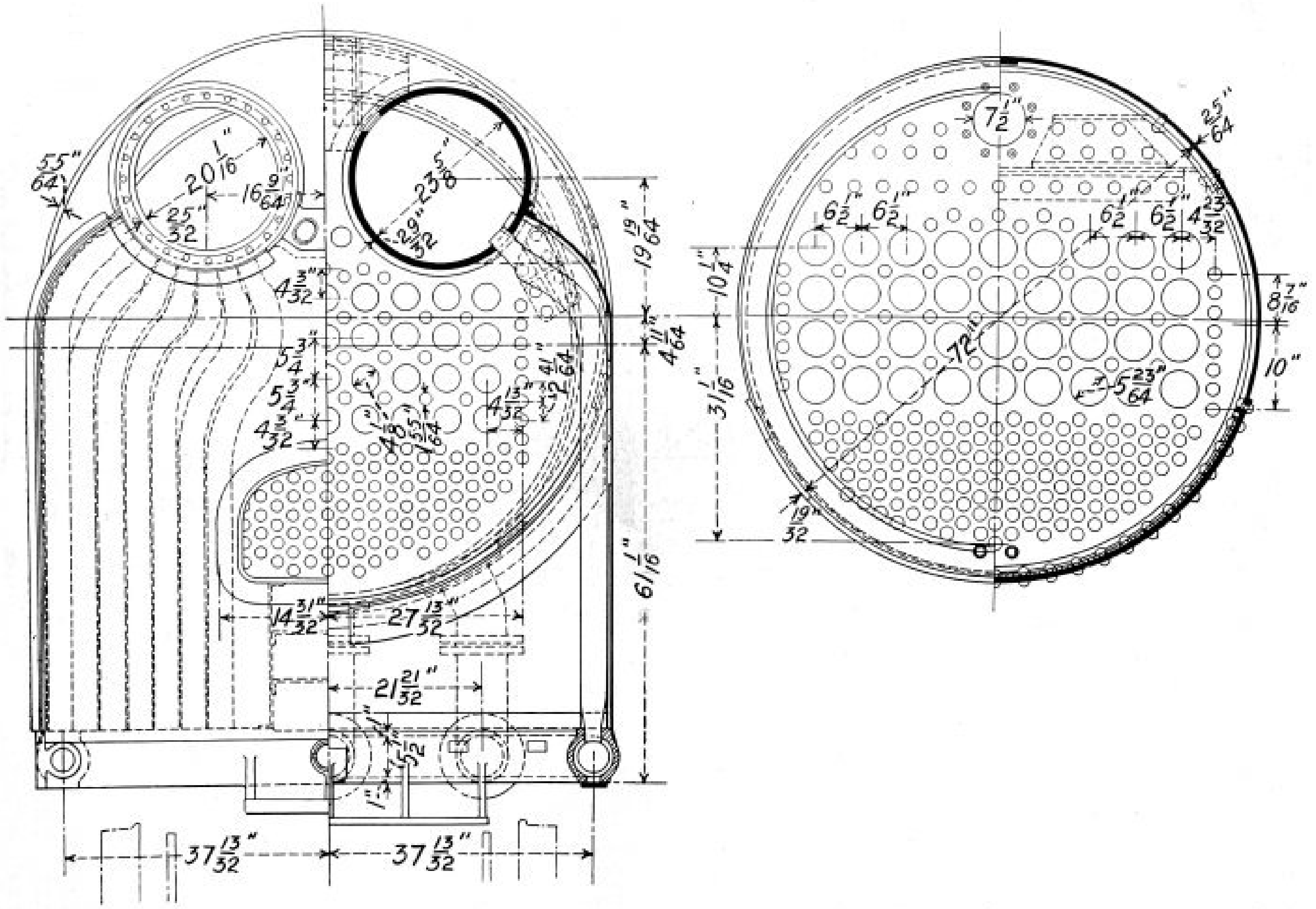
Elevation and Plan View of Mallet Locomotive on Hungarian State Railway cells of 21⅝ inches diameter, were fitted, the feedwater being led to these through a feed-head by means of a non-suction steam jet pump.

The Schmidt type superheater has 36 units in four rows of nine each. The Brotan type firebox, the largest of its kind, is 122 inches long between protecting plates and 79½ inches wide. The cast steel base frame is built up in four sections with flanged joints and its front end is connected to the boiler by three elbows. In later construction the base frame is in one piece. The side walls of the firebox are formed by seamless drawn wrought iron watertubes which end in two separate headers, and are connected with each other at the rear by a coupling piece. To insure tightness the headers project into the boiler for a distance of 22 9/16 inches and are there supported by heavy angle bars. Furthermore, to better shut off the gases of combustion toward the top, two cast steel girder having an inside riveted connection with the boiler at the top and resting at the bottom on bushed guides. Two coupled plate springs 70⅞ inches long, having 3 15/16 inches side play bring the forward truck back to the mid position.

The ashpan has a horizontal bottom divided into two sections by a recess for the middle axle of the rear truck; each of the sections has two trap doors in the bottom which can be operated from the cab. A branch line from the left pressure pipe of the steam jet pump serves for sprinkling the coal while one from the right serves the same purpose for the ashpan.

Circulation in Brotan Boiler

As noted above, the boiler barrel has a tapered section next to the firebox and the watertubes in the firebox, arranged in



Cross Section of Brotan Boiler on Hungarian Mallet Locomotive

more horizontal watertubes were built in between the two headers, reaching from the rear coupling piece to the tube sheet. The rear wall of the firebox is formed by six watertubes on each side, while forward a fireproof wall completes the enclosure. The fire door is a sliding door in halves, the opening being formed by a cast steel frame; combustion with but little smoke formation is attained by a long fire dome; a tilting grate serves readily to remove the slag formed by inferior coal.

The saddle connecting the cylinders of the rear truck is 59 inches deep and is rigidly riveted to the last boiler section. Thus secured, the boiler rests by means of a front and rear sliding surface of the base frame on the tie girders of the trucks, the last one of which is provided with a brass liner. Ahead of the middle axle of the forward truck is located a two vertical groups on each side, connect with horizontal drums which extend the entire length of the firebox. A hollow steel casting forms the under side of the firebox. A means of connection between this casting and the upper drums is provided by the watertubes. The upper drums are sometimes designated the "primary" boilers. The lower hollow steel casting, or foundation ring, is connected to the under side of the boiler barrel by a series of elbows. This system is arranged to create a vigorous circulation of water through the firebox.

In the latest type of Brotan boiler used on the locomotives of the Hungarian State Railway, two flanged connections are formed on the upper portion of the copper firebox tube plate of the boiler. The longitudinal drums are inserted in the openings thus formed. At the extreme forward ends they are riveted to the boiler barrel stiffening plates about 2 feet ahead of the copper tube plate inside the tapered section. In this way, the support of the drums is largely taken by the stiffening plate within the boiler and not by the tube plate alone as was formerly the case.

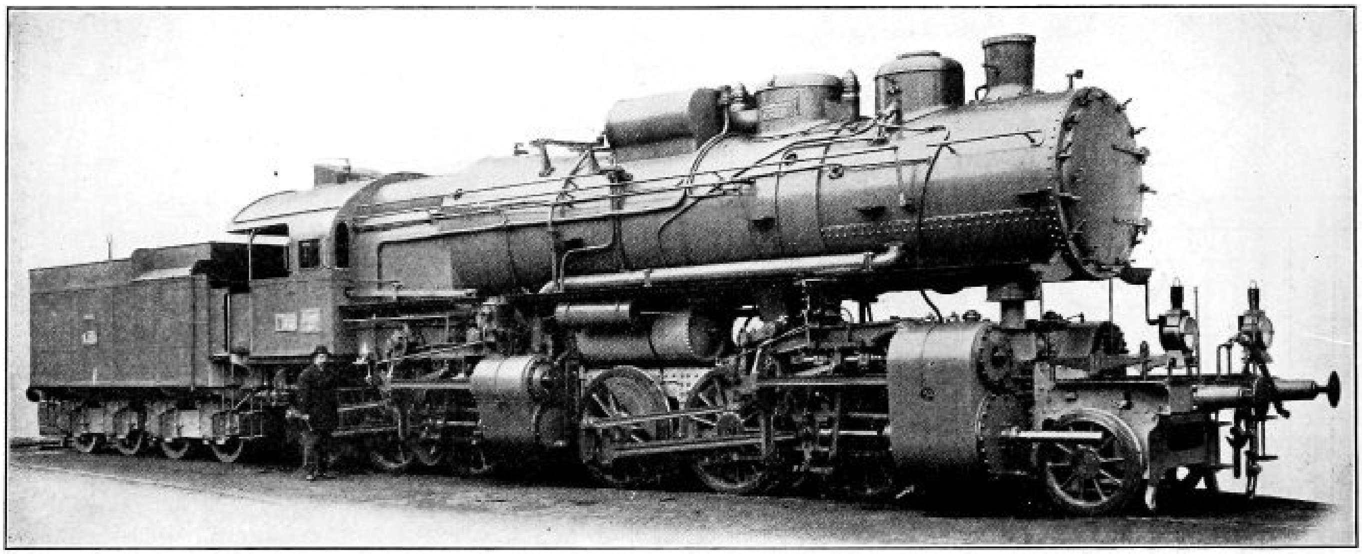
The Brotan tubes which are placed close together form the side walls of the firebox and are, of course, directly exposed on the inner sides to the heat. The outer sides of the tubes are protected against heat losses by means of a cover of non-conducting material sheathed with a light gage metal. The steam dome is located on the forward boiler ring and contains a balanced regulator valve and water-intercepting device, the latter being constructed on the Stein principle with centrifugal action. More than 600 locomotives of the Hungarian State Railways are equipped with this device which was first designed by the deputy manager of the State Locomotive Works. It depends for its function on the fact that the steam is caused to change its direction of flow suddenly when passing the regulator and the water intercepted reaches the water space of the boiler through a syphonic tube.

On the second ring of the boiler two feed water purifiers are mounted, the valves and piping of which are so arranged that the feed water is distributed to both purifiers equally under all conditions. Blow-off cocks are fitted to the boiler and foundation ring in such places that accumulation of scale is prevented at points where the circulation is slightest. This arrangement serves generally to purify the feed water so that reheating occurs to a considerable degree accompanied by the precipitation of the scale-building salts. In this way the deposits of sediment are considerably diminished and are of such a character that they can readily be moved. The water delivery to boilers equipped with this device can only be effected through the water purifying apparatus.

The safety valves are of the directly loaded "pop" type, three in number, mounted upon the steam dome. Each valve has a diameter of 4 inches which affords ample area of escape for an excess pressure of steam. The supply of water to the boiler is controlled by two-restarting injectors of the Friedmann type. The locomotives are fitted with smoke consuming mechanism, there being numerous tunnels on the roof while the character of the fuel is such as to give off light quantities of smoke during combustion. Gearing is provided for the purpose of shaking the grate bars. The smokebox contains a cone-shaped spark arrester.

The cab has sliding windows at the sides, a ventilating hood and an acetylene ceiling lamp. Each header on the boiler is equipped with a water gage; gage cocks are not provided.

The tender has four wheel trucks which are equipped with the same brakes as the locomotive.



Mallet Locomotive with Brotan Boiler Built for Heavy Freight Service

TABLE OF DIMENSIONS, WEIGHTS AND PROPORTIONS

H. P. cylinders, diameter	20.47 in.
L. P. cylinders, diameter	33.46 in.
Stroke	25.98 in.
H. P. piston valves, diameter	9.84 in.
L. P. piston valves, diameter	13.39 in.
Weights in working order:	
On drivers	214,000 lb.
On front truck	27,000 lb.
Total engine	241,000 lb.
Tender	126,000 lb.
Wheel bases:	
Driving	27 ft. 8 5/8 in.
Rigid	11 ft. 1 7/8 in.
Total engine	39 ft. 0 1/2 in.
Total engine and tender	63 ft. 0 in.
Wheels, diameter outside tires:	
Driving	56.69 in.
Front truck	37.40 in.
Boiler:	
Steam pressure	220 lb.
Diameter, first ring, inside	68.9 in.
Firebox, length and width	122 in. by 79 1/2 in.
Tubes, number and diameter	180—2 1/16 in.
Flues, number and diameter	36—5 1/4 in.
Watertubes	70—3 3/4 in.
Length over tube sheets	16 ft.—6 3/4 in.
Grate area	54.7 sq. ft.
Heating surfaces:	
Firebox and watertubes	247 sq. ft.
Tubes and flues	2,671 sq. ft.
Total evaporative	2,918 sq. ft.
Superheating	857 sq. ft.
Comb. evaporative and superheating	3,775 sq. ft.
Tender:	
Water capacity	6,800 gal.
Fuel capacity	8.8 tons
Rated tractive force, 75 percent	61,500 lb.
Weight proportions:	
Weight on drivers ÷ tractive force	3.48
Total weight engine ÷ comb. heating surface	63.9
Boiler proportions:	
Tractive force ÷ comb. heating surface	16.3
Tractive force × dia. drivers ÷ comb. heating surface	9.45
Firebox heating surface, percent. of evap. heating surface	9.3
Superheat. surface, percent. of evap. heating surface	32.0

NUMBER OF THREE-CYLINDER LOCOMOTIVES INCREASING.—An order has recently been placed by the Lehigh Valley with the American Locomotive Company for five three-cylinder locomotives, duplicates of the original No. 5000 type, which was on exhibition at the Atlantic City convention of the American Railway Association.

Applying the Thermic Syphon to Locomotive Boilers*

Boiler Makers Discuss Effect of Syphons on Life of Firebox Sheets and Flues

AFTER giving all data received careful consideration, the chairman gives as his version of the committee's findings, that the application of thermic syphons increases the life of firebox sheets and flues.

Our belief is founded on the following facts: By the application and use of thermic syphons a very active circulation of the boiler water is set up and maintained.

The circulation sweeping all parts of the boiler tends to equalize or reduce the range of temperatures of the boiler parts which would be exposed without thermic syphons. This in turn reduces the stresses and strains that are accountable for cracks, leaks and heavy maintenance expenses.

The committee received many reports showing a noted reduction in boiler work in general repairs, when the locomotive was syphon equipped, as compared with non-syphon equipped locomotives of the same class and service. The committee is of the opinion that the maintenance expense of locomotives can better be taken upon the floor of the convention, and therefore has not included any of these in its report.

The committee is also of the opinion that the thermic syphons will be a great help to the crown sheet as they cause a fountain action of the water on this sheet and prevent it becoming overheated. Fig. 1 is an illustration of the water circulation in a boiler equipped with thermic syphons.

Thermic syphons being of more recent origin and occupying a field entirely their own and no other appliance in use tending to serve the same purpose, the committee believes it may speak without prejudice regarding their use. The committee has in mind, and would like to bring before the convention, that the thermic syphon also acts as a substantial support for the crown sheet in cases of emergency. Syphon equipped locomotives have successfully passed through low water accidents, as an example of which we show Fig. 2, where it will be noted that the low water line is six inches below the top of crown sheet. The unusual shape of the overheated area (shaded) clearly proves that the water continued to flow over the crown sheet after other water protection had ceased. This proves that there is a fountain action of the water at the crown sheet in thermic syphon equipped locomotives.

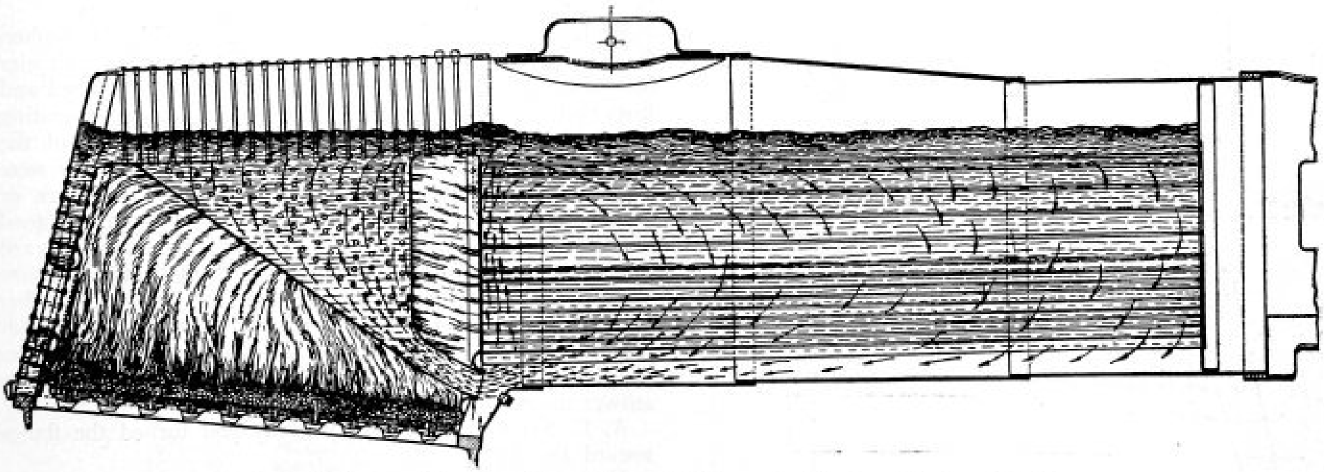


Fig. 1.—Diagram Showing Circulation of Water in Syphon Equipped Boiler

In order to give the members more proof on the above, we reprint a part of circular No. 260 of December 12, 1923, issued by A. G. Pack of the Interstate Commerce Commission, Bureau of Locomotive Inspection, Washington, D. C.

"We are receiving many alteration reports from a number of different carriers showing the application of thermic syphons and, so far as it has been brought to my attention, there has nothing yet been developed which would indicate a reason why their use should not be extended. They add materially to the direct or firebox heating surface and improve water circulation, which is essential to economical and successful boiler operation, and will deliver a certain amount of water to the crown sheet after it has become below this level, which may obviate what otherwise might become a serious explosion with fatal results.

"Syphons also add some beam and brace support to the crown sheet—they being attached to the crown sheet and at the throat sheet—which may prevent the crown sheet from coming down with a crash in case of low water."

Discussion

H. J. Raps: When I was Chairman of the Topic Committee of this section I had this subject put in as a topic for the purpose of bringing out the points in regard to what experience they had had with syphons and the prolonging of the life of the firebox. We have some locomotives with a very tall firebox, placed about seventeen inches from the grates. We were only getting twenty to thirty thousand miles from the flues, when it would be necessary to put in other flues. We would run along for a while when we would have to put in another flue. Our fireboxes in those engines were not lasting over eighteen months, and in two years we were taking them out.

We were advised of this application and took an engine and applied one. Up to the present time we have not had any trouble and I don't think they have ever removed a flue from the engine. On the strength of that we have received 110 Mikados. We built 24, applying two syphons to each one. It is our intention to apply the syphons to all the

*This report was read at the annual meeting of the Master Boiler Makers' Association. It was prepared by a committee composed of A. F. Stiglmeier, Chairman; H. J. Raps, J. J. Keogh, H. J. Wandberg and A. C. Dittrich.

engine. We have had great satisfaction with these and I would like to hear from others. We have it arranged with a vibrator to keep the scale out and we have not had any diaphragm plates break. At first we only welded the syphon into the box, then we conceived the idea of flanging the sheets. They have the flange enter under the flue sheet. This is quite an idea, there is about fourteen inches of welding and it does away with a great deal of trouble. If it increases the thickness of your flange they have it so arranged to take a three-eighths inch giving you one-half inch across. We have not had one crack and have experienced no trouble.

H. J. WANDBERG: While I am a member of this committee, I would like to say a few words in behalf of the syphon. I claim the honor, gentlemen, of helping to work out the Nicholson syphon. Mr. Nicholson came to me with a little copper device and said "Can this be made out of boiler

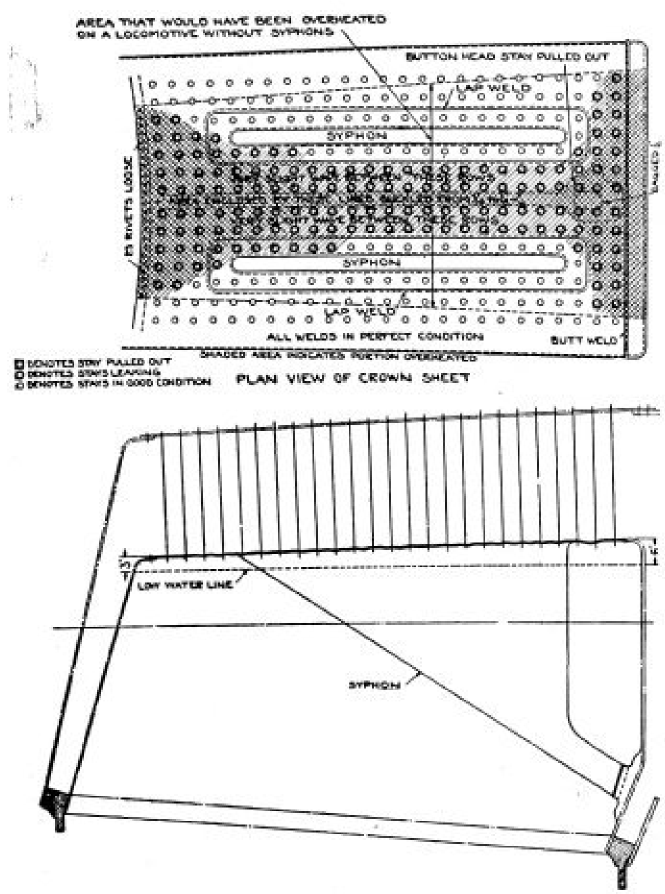


Fig. 2.—Action of Syphon in Case of Low Water

steel?" I said, "yes"—so we developed the syphon. The next thing was to secure an engine for this to be applied to. The Chicago, Milwaukee and St. Paul engine 7615 was the one, that was in 1918 we applied this, and I want to say it has been in constant service ever since. There was no trouble with the inspection when this was first made, and they insisted on the neck of the flange being 3½ inches and the flange being stacked on a ⅜ inch sheet. Although I could not get the part I wanted I got the next best thing and welded it in. It was in service five months when it cracked. We had to provide every means to check it. I made a collar out of five inch steel, cut the collar out of the flue sheet, I had to separate them in two square flanges. I paid no particular attention to expansion and contraction, just covered it up while I got a full installation in the throat sheet of the boiler.

I know the heat in the head of the boiler does not allow for a great deal of expansion before they heat the head. I allowed about ⅜ inch for expansion and contraction. This is over five years ago and the same connection is made to that flue sheet, and there has been no trouble. There have been no leaks, perhaps, this is because we have had diaphragms applied and the cracking taken care of by this contraction and expansion. The longer we work at the thing the more we learn, and have overcome great difficulties. As for the prolonging of the firebox by the application of the syphon, I would like to see every member get up and express himself.

L. M. STEWART: On the Atlantic Coast Line, we installed syphons, three or four years ago. As far as having trouble from leaking we have had none. We have spent considerable money, but as to saving of coal we were unable to determine. We are anxious to know about the improvement. We do not condemn the syphon, we want to find out the results. We want to know what results the members are getting.

L. R. PORTER: I am not in a position to tell you whether it will increase the life of the firebox. We applied them two two years ago and so far we have had no maintenance cost whatever. We have one that has gone seventy-five thousand miles, it has gone in good and bad water districts. I am not in a position to give you a prepared test.

E. J. REARDON: I have been working with the syphon for about a year. We have all heard what Mr. Stiglmeier has said about the syphon installation. I have inspected and inspected, and I did not find a syphon that stopped operating unless there was some foreign matter in it. Some of the diaphragm plates crack and we study that out. They were putting in diaphragm and running the metal structure or grain cross ways. We are running it up and down. Instead of having the grate flange out into the fire we turn it toward the boiler. That eliminates a great deal of trouble. There are a great many people here and they can tell you whether or not they have had plates crack, we have had a number crack and we are getting to that as soon as we can. If there are any questions you would like to ask I would be glad to answer them.

A. F. STIGLMEIER: Did you say you turned the flange toward the fire?

E. J. REARDON: I did say we turned it to the fire.

B. C. KING: We have only one difficulty and that is in getting the scale out in the bad water district. We bob the syphon when it shows honeycomb. We bob them every time there is any scale. We do have scale in bad water districts. As to the difficulty of the syphon; in making a test, we found that is about the same as the action in the firebox top. We can get the engine hot quicker in the house, if we could get at the syphon and clean it. We would like to know how to get at this, as the scale sticks to them.

J. G. REESE: We have five Nicholson syphons and they have been installed about a year. So far they have given us first class satisfaction, but prior to these five engines being equipped we had one locomotive that had been equipped four or five years and the only trouble was this syphon cracked on the inside of the throat sheet around the collar. This was welded several times before it was made tight, it was sometime before it was tightened and I cannot give you any recommendations at this time as to whether it is going to be a success.

T. F. POWERS: I have been waiting to hear somebody who has had a lot of trouble with syphons. I want to give you our experience on the Northwestern. We applied two in September 1922. The first went in service on what is known as the Fish run, running from then until late in the fall of 1922, and there was absolutely no maintenance cost, just a few ordinary things. We then sent the engine to our Dakota district, where there is very bad water, there is as much as eight to nine pounds of solid matter in a thousand to eighteen hundred gallons of water. They have a record there for not running over eight months. We then took it to the Wyoming shops for repairs, and the ordinary routine would be to take out the flues on account of the bad water, we inspected it and found there was very little scale.

We sent her back to the Eish run, put in a new diaphragm, the syphon on this first engine had cracked, but we have not had a syphon maintenance cost to exceed $25.00. I don't believe anything is more economical than the syphon. There are defects, of course, but you cannot expect to get anything that is one hundred percent perfect, there is nothing on the locomotive that is. Since then we have equipped twelve new Pacific type engines and we do not expect to have much maintenance cost, I think we will realize a saving of five to ten percent.

A. F. Stiglmeier: We have forty Mikado type equipped with syphons and also a Pacific type. When we first got them they gave us considerable trouble due to a congestion approximately 24 to 30 inches back from the flue sheet. We discovered that this was principally due to pure white lead and oil clogged in the syphon when they were applied, also we found numbers of pieces of wool which were evidently

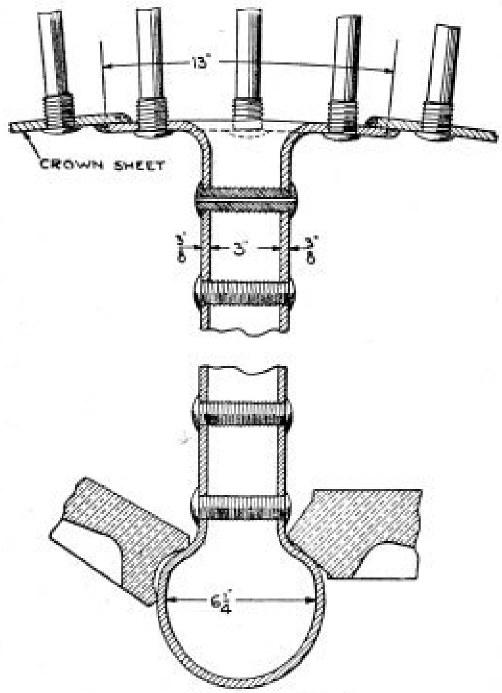


Fig. 3.—Section of Syphon

used by the builders when they were being welded in. Since then we have not had any trouble on this territory. We had one of the Mikado type, with the hole cut right in the flue sheet. On the Pacific we have the flange and it is giving good service now, and we are having no trouble.

A. G. Pack: The question of effect on life of boilers cannot be answered yet. The syphon has only been used for five or six years and you are asking these gentlemen to express an opinion, and it cannot be done because syphons have not been in use long enough. It is the scale in the syphon you have to deal with. Is a syphon harder to keep clean than the side sheet? Wont they crack if you allow the scale to collect? This is particularly true in the bad water district. There has never been an improvement, which has been perfect. There is nothing that has not been criticised, the arch tube was seriously criticised, and still 58 percent of your locomotives are carrying arch tubes. You have to keep them clean if you don't want them to crack. You have to keep your firebox clean.

I have had some reports of syphons cracking, I have had reports of fireboxes cracking. I am a crank on keeping the boiler clean. Lengthening the life of the firebox is a question all over the country. I happen to be in a position to see these things, and I happen to be where I can exert some influence. I have frequently said, we come here to profit by the experience of others. If the men always tell the good points we do not benefit much, it is by telling your troubles we profit. Tell your troubles, let's try to help one another in our troubles. Let's try to do what we can to improve this thing. If a condition is 100 percent perfect there is nothing to do with it. You tell your good points, but you do not tell your bad ones.

I would like to explain just a little for fear my remarks might be misunderstood. I am going to say that the Nicholson syphon has not been used long enough to definitely state that it is going to preserve the life of the firebox. I don't want anyone to feel I have spoken in a spirit of criticism. Everyone who knows me knows I have the interest and benefit of this association at heart and am anxious to see the locomotive conditions improved. We cannot stand still, and that is not criticism.

Eye Accidents in New York State Reported for Year

Injuries to the eyes of workers cost employers in New York State more than a million dollars during the year ending June 30, 1923, the last year for which statistics are available. This is revealed in an analysis of workmen's compensation cases received by the National Committee for the Prevention of Blindness from the State Department of Labor.

The report shows that there were 602 cases of permanent injuries to the eyes of employees; that these injuries resulted in 54,000 weeks of disability; and that $992,705 in compensation was paid to the victims. In addition there were 12 cases of combined eye injuries and face disfigurement which resulted in 1,439 weeks of disability and for which $27,855 compensation was paid. More than 800 additional cases of injuries to the eyes resulted in temporary disability and the payment of compensation for lost time. The compensation paid for permanent eye injuries in New York State, according to this analysis, is approximately one-eighth of the total amount of compensation paid for all non-fatal injuries in the industries of the state.

In commenting on the analysis, Lewis H. Carris, Managing Director of the National Committee said:

"The New York State report is another confirmation of the statement made by the National Committee for the Prevention of Blindness in its recent report of a two-year study of the eye hazards in industrial occupations that 'Even when we put aside all social, humanitarian, or other considerations, and look at the problem purely from the economic point of view, the eye hazard in industrial occupations still ranks second only to death in seriousness.'

"The million dollars paid as compensation for eye injuries by the employers of New York represents only a small part of the economic loss suffered by employers and employees and does not, of course, begin to pay for the human suffering resulting from such injuries. The law provides for a maximum compensation of $20 a week which in nearly all cases represents only a fraction of the injured employees' wage. The employers on the other hand lose, in addition to the million dollars paid in compensation, thousands upon thousands of dollars in lowered plant morale which is the aftermath of every serious industrial accident. Every serious accident also necessitates the replacement of an old, and often skilled employee with a new worker whose hire, education and supervision in the aggregate costs employers annually many thousands of dollars.

"The situation in the industrial establishments in New York State is, however, no worse than that in other industrial states." Mr. Carris said in part: "If anything, it is a little better than most, considering the size of New York's industries."

The National Committee's report on eye hazards in industrial occupations shows that of the 100,000 blind persons in the United States approximately 15,000 are the industrial blind; that there are approximately 200,000 industrial accidents resulting in injuries to the eyes each year; that a very large proportion of these accidents could be easily prevented on the one hand by employers through more thorough provision of safety devices, safety education and supervision of operations and on the other hand by employees through more conscientious use of the safeguards provided by progressive employers.

Mill Boilers Explode at Felixdorf, Austria

An Account of a Boiler Disaster That Occurred in a Country Which Prides Itself on Having Few Explosions

By Johann Jaschke

ON March 7 a boiler explosion occurred in the cotton mill at Felixdorf, Lower Austria. One of the two boilers exploded at 4:15 in the morning, some minutes before the fire was set on. It was a combined boiler of 1,940 square feet heating surface and a pressure of 170 pounds per square inch.

The boiler was built in 1899. The plates were rolled in the works of Withovice. The second boiler had only a heating surface of 1,610 square feet, but a pressure of 180 pounds per square inch and was built in 1902.

Both boilers have a superheater and are of the common construction with one steam space in the upper drum. The general setting and construction of the boilers is shown in Figs. 1 and 2.

The exploded boiler had an upper drum of a diameter of 6 feet 7 inches and a length of 13 feet 2 inches. There were 110 tubes 3½ inches in diameter outside. The plates have ¾ inch thickness and the dished head 15/16 inch thickness. The longitudinal seams are double butt strap and the round seams are double riveted laps.

A day before the explosion occurred the boilers had been under full load, the fires were extinguished at 6 p.m. Both firemen cleaned the tubes and covered the firebed with a layer of fresh coal, then they left the boiler room at 6:15 p.m.

On March 7 at 4 a.m. one of the firemen unlocked the boiler house for setting on the fire. At 4:05 a.m. he asked the fireman for electric power for the blowers of the furnace. The watchman overheard a whistling at 4:15 a.m. He left his room to look for it but the explosion occurred in this very moment. The watchman of the weaving mill, about 1,950 feet away gave the same story.

The effect of the explosion was very disastrous as shown in the accompanying illustrations.

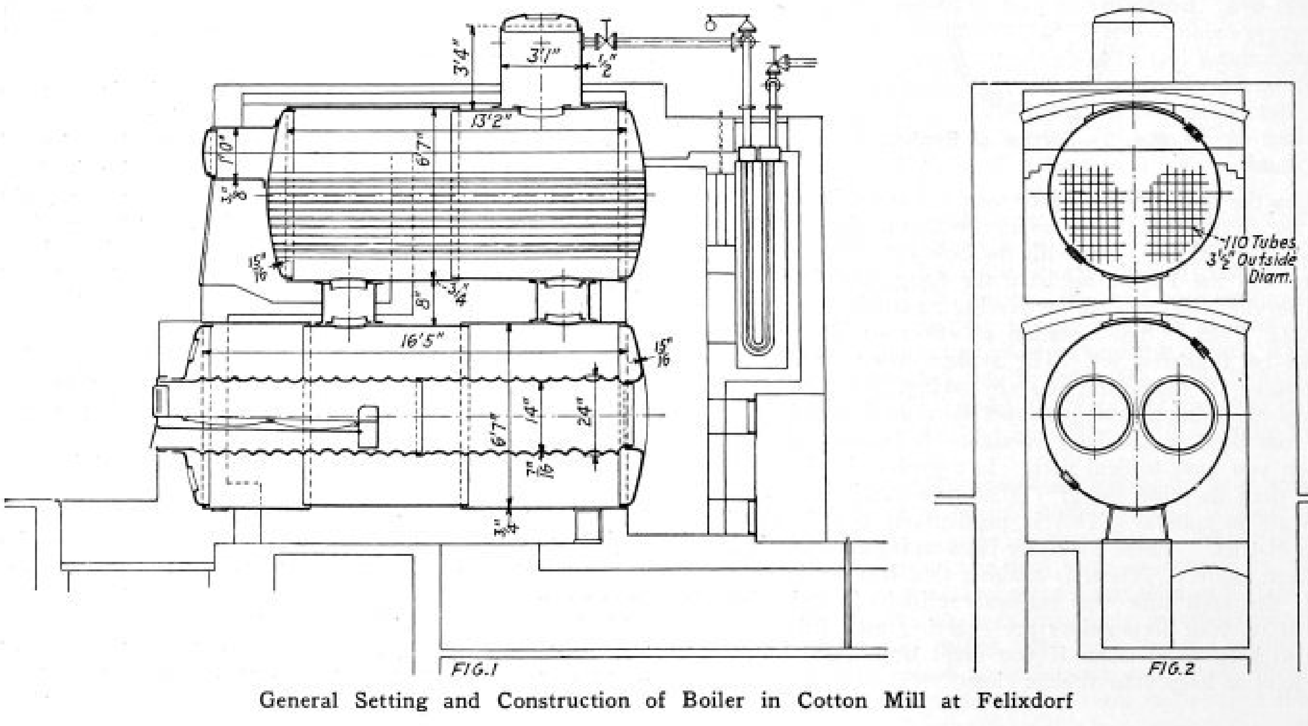
The upper drum burst its whole length and was unrolled. The front head burst in three places. The rear head remained intact. All tubes except five were spread and pulled out of the heads.

The fireman was killed and thrown some distance. His body was found on the shed of the spinning mill. His head was found in a little woods 400 feet from the boiler house.

One of the steam valves was found at the shed of the spinning mill. The wheel of the other lay some distance further on; this valve was nearly closed, the first open.

The second boiler was blown away, about 3 feet and then tilted over, but not injured. No scale was found in this boiler nor in the exploded one.

The setting was destroyed and the boiler house and the engine room heavily injured, as shown in the illustrations.



General Setting and Construction of Boiler in Cotton Mill at Felixdorf

Views of the Mill After the Explosion

Boiler Inspecting in Afghanistan

Difficulties Encountered in Introducing and Successfully Operating Steam Power and Machinery in a Distant Part of the World

By George Cecil

AFGHANISTAN, that semi-savage and more or less inaccessible country bordering upon India, was for many years a thorn in the flesh of the Calcutta and Bombay engineering and machinery firms. Nothing would induce the rulers who flourished between the 'fifties and the 'eighties to despatch an order across the border for steam-driven appliances. The *Amir* of the moment received in audience the intrepid travelers who, riding through the wild Kyber Pass, and braving the enmity of a hostile race, endeavored to push their employers' interests. But he would not gladden the representative's heart by launching out in the hoped-for direction. Even Abdur Rahman, who was by way of being civilized, at first, drew the line at novelties. "Tell the white stranger to return whence he came," quoth the *Amir*, through an interpreter, "and to be thankful that we have in our clemency spared his life." The wondering and extremely alarmed traveler lost no time in obeying the command; disobedience would have resulted in a very different sort of journey—to the gallows. Abdur Rahman was not a man with whom it was wise to argue.

Forty years ago the highly-placed Afghan was the slave of custom. His predecessors had believed in hand-power, and he saw no good reason why steam-driven machinery should be introduced. To have sanctioned an innovation would have dishonored their memory, perhaps bringing ill-luck to Afghanistan. So the *Amir* of that unenlightened epoch did as his fathers had done before him; consigning the wonders of engineering science to *Tehunnam* (Hades), the contented monarch smoked his odoriferous *huquah* and permitted life to follow its tranquil course. Hand-power triumphed.

Steam Power Introduced

A decade later, the *Shahazadah* (heir-apparent), on returning from a tour of India, informed his august sire of the use to which the white conquerors had put steam-driven machinery. Despite the fact that the young man was considered half-witted, the Ruler bent a willing ear to his tale. Finally, a cloth mill was erected, the engine and machinery being imported from England, through a much-gratified Calcutta firm. A manager was procured from the British midlands and an engineer from Scotland, the *Amir* taking a personal interest in the undertaking, and, eventually, paying the staff out of his privy purse. Not, however, for some years could his highness be induced to foot the bill for the engine, machinery and boiler. The super-trusting consignors had to wait a long time for their money.

A small-arms factory also came into existence, as well as a flour mill and a mint run on modern lines. Thus the thin end of the wedge.

Inhospitable Inhabitants

At first there was much opposition to these schemes. The Potentate's Council, viewing with horror so daring an attempt to bring their cherished native land into line with civilized and down-to-date countries, muttered words of disapproval. The *Amir* dismissed the malcontents, depriving them of their pensions, and informed the newly-appointed Council that renewed muttering would carry with it an even heavier penalty. The colored operatives, professing themselves unable to discriminate between a driving-belt and a loom, went on strike. His highness, rising to the occasion, caused them to be flogged with a formidable whip resembling the three-thonged Russian *plet*, in order that the dullest wits might be sharpened. The boiler inspector, who had been brought to Cabul (the capital) from Bombay, complained that the Afghans to whom he was supposed to impart the necessary instruction, found themselves incapable of learning. The "Lord of All Light" and the "Fount of All Sweetness," as the *Amir* is known to his faithful (and sometimes attached) subjects, imprisoned the dullards for a week, ordering them to be fed once only in two days, and to be well beaten on quitting the jail. One of the students remaining obdurate, the "Fount of All Sweetness" clapped him into prison for six weary months. After serving his sentence he was employed in cleaning out the prisoners' cells, a degrading and most unpleasant task. The unhappy dunderhead finally took poison.

For some time the Europeans whose business it was to direct these enterprises went in daily fear of their lives. The Cabulees, terming the (so-called) intruders "Christian dogs" and "sons of an unclean animal," lost no opportunity of molesting the mill manager, the engineer and the boiler inspector. They stalked their hated prey on dark nights, savagely assailing them. Poison was introduced into the boiler inspector's food, and with all but fatal results, by a highly ambitious oiler, who hoped to succeed his teacher in a job about which he knew very little. When the staff took an evening walk outside the city walls, ruffians flourished knives in their faces, heaping upon the inoffensive pedestrians the basest of insults. On one unfortunate occasion a rifleman used the unsuspecting boiler inspector as a target; the victim was, like Achilles, wounded in the heel. The "faithful" rejoiced.

The *Amir*, as can well be imagined, became furious. Personally trying each delinquent, he rang the charges on the following gruesome punishments: Blinding with quick lime, torture followed by hanging, and the amputation of the right hand, the left foot, in aggravated cases, also being sacrificed. Cowed, by so unmistakable a hint, into leaving the interlopers to their own harmless devices, the townspeople dissembled their antipathy to the white strangers. But the gangs of highwaymen proved less amenable to discipline. They laid in wait for the caravans which conveyed mill stores from Peshawar, on the frontier, to the far north, murdering the mule drivers and those of the military escort who did not run away. Then, helping themselves to leather driving-belts, cotton waste, nails and other useful things, the rascals hid in the rocky passes until such time as they could get the booty across the border—or until the lynx-eyed police brought them to book. Many were handed over to the "Fount of All Sweetness," who exercised considerable ingenuity in punishing the murderous robbers. Each was hung, but not till fiendish torture had been applied.

A very distinguished English politician, who, a few years ago, was received by the present *Amir*, ventured to suggest to the "Lord of All Light" that the punishments inflicted by the penal code outraged humanity! "I have to deal with savage animals," returned the amused monarch, "not with humanity!"

Reform

When, in the late 'nineties, Sir Salter Pyne became resident chief engineer and workshop superintendent to the government of Afghanistan, he turned his attention to the boilers. Some of these, having been in charge of native inspectors who scamped their work, or who, being hopelessly incompetent, had failed to detect various defects, were in a hopeless state. Pyne immediately condemned them, insisted upon the *Amir* ordering others from Bombay, and pointed out to his patron that a European boiler inspector and a capable assistant should be procured from India. His Highness, though jibbing at the cost, fell in with the suggestion, and today the bursting of a boiler is as rare as an earthquake. A few years later the reformer founded a school of boiler inspectors, and with advantage to everyone concerned, for a proper scale of pay having been arranged, the right sort of men were secured, nor are their successors any less competent.

There probably are as many boiler inspectors as boilers in Afghanistan. Yet, work is found for them all, since each man is employed in other capacities, thus earning his salary and leading a busy life. Some act as storekeepers; others are assistant engineers; two, who are skilled in figures, keep the accounts at the cloth mill and at the small arms factory. Another member of the department is manager of a flourishing sawmill which is run by the government. The *Amir*, it may be noted, takes a special interest in the boiler inspectors, frequently bestowing upon them marks of his favor. He beseeches *Allah* ("than whom none are greater!") to bless their matrimonial unions; and, if the Most High grants the prayers, a gift from the royal treasure-chest gratifies the happy parents. Those who have thus benefited speak of His Highness as the "Stream of Kindness."

Provision is made for the boiler inspector's old age, a pension awaiting the man who has earned it. As a pensioner he is a person of importance, one to whom all social circles are open, for has not the recipient of bounty been a government servant? Long may Dost Mahomed be spared to receive the monthly bag of *rupees!*

A Short-Sighted Supplier

Defects sometimes exist; but the boiler inspector usually is blameless. Recently, for example, a boiler, incorrectly designed for a certain pressure, was delivered by an engineering firm of repute, a firm which had fifty-five years' successful trading to its credit. Three months after being placed in position the boiler burst, killing two bystanders and seriously damaging a highly-placed official of the Court who had been ordered by his royal master to familiarize himself with its working. A complaint was made to the makers, accompanied by a peremptory order to remove the offending boiler, to supply another—free of charge—in its place, and to compensate the damaged Afghans. The triple request fell upon deaf ears, the firm declaring that extra pressure must have been used and that the engineer alone was to blame. The *Amir* promptly cancelled a fifty thousand *rupee* order which was nearing completion.

A few days later it was found that two steam gages, supplied by a Bombay agent, were faulty, one being thirty-four pounds out and the other thirty-three. The error having been discovered by an alert boiler inspector, and verified by no less an authority than the European chief engineer and workshop superintendent, it naturally was presumed that the consignors would make all amends in their power. They, however, preferred to brazen it out, angrily disclaiming responsibility and rudely suggesting that His Highness did not know what he was talking about. The *Amir*, very properly, replied that the account would not be paid, and that the offending steam gages were lying on a scrap heap—at the firm's disposal, "should a representative be sent to remove them." Cabul being many days' journey from Bombay, the Ruler, it will be perceived, exhibited a sense of humor. 'Tis one of his agreeable *traits*.

At one time makers of boilers and their appliances found the Afghan government easier to deal with. But today the *Amir* has developed into a very hard nut; the supplier who hopes to get the better of him must rise very early in the morning. His Highness expects to receive the fullest value for money.

Steam Boiler Clauses in New British Factory Bill Severely Criticized

By G. P. Blackall

C. E. STROMEYER, chief engineer of the Manchester (Eng.) Steam Users' Association, has just issued his annual report covering the year 1923. The report is of great interest to boiler makers, as it consists of a memorandum dealing exclusively with the steam boiler clauses in the new Factory Bill. Mr. Stromeyer's criticism should be of great value to Americans interested in steam boiler legislation and should serve as a guide when necessary to frame new legislation. Having made a deep study of the causes of steam-pipe explosions, he unhesitatingly predicts that if a certain provision in the bill should become law, whereby factory owners would be compelled to alter their steam pipes at great expense, the result would be an annual crop of steam-pipe explosions, which might unfortunately be attended with fatal results.

Objection is taken to the retention of the undefined expression "competent person" where boiler inspector is meant, and more particularly as the Boiler Explosions Act of 1882 offers a far better definition, viz., "an engineer who is practically conversant with the manufacture and making of boilers."

The chief objection to the bill contained in Mr. Stromeyer's report is, however, that it unnecessarily complicates a simple subject and gives prominence to trivialities and avoids dangerous matters. But, while somewhat destructive in its criticism, the memorandum embodies constructive proposals in that it suggests that the 1901 provision should be adhered to, with the exception of replacing "competent person" by "an engineer," and giving factory owners some control in regard to the inspection of their boilers. Such control has been the secret of the success of the Manchester Steam Users' Association, and has been copied by all continental European countries.

Since 1882 there have been over 2,500 explosions on land and sea of boilers and other steam vessels. Among these were 157 explosions of land boilers, not a single one of which, however, stands against the name of the Manchester association. This must be regarded as excellent testimony to the efficacy of the system of inspection devised and used by the association and it is therefore contended that for English manufacturers to be forced to suffer the annoying experiences of Austria and France could not but have a crippling effect on British industry at a time when her engineers, unfettered by rules and regulations, were making important industrial strides.

There's Plenty of Business—

For the firm that does the best work.

For the man who is better informed on his line.

If we are prepared to give better service.

If we give the customer a little more than he expected.

When we keep our business methods above suspicion.

When the golden rule is most nearly practised.

Where the common good is esteemed higher than personal profit.

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

THIS is the eighth instalment of a series of questions on both mechanical and boiler subjects which are liable to occur in state or federal examination papers for boiler inspectors. The earlier instalments appeared on page 105 of the April issue, page 139 of the May issue, page 180 of the June issue, page 208 of the July issue, page 231 of the August issue, page 264 of the September issue and page 293 of the October issue of THE BOILER MAKER. *The material should prove of benefit to all those who contemplate taking the examinations. The author would like to have those interested in the subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.*

159—Q. Give a brief description of the Baker-Pilliod valve gear.

A. The Baker-Pilliod valve gear is an outside gear with an eccentric crank on the outer end of the main pin, an eccentric rod, lap and lead lever, union link, cross head arm, bell crank, reversing yoke, gear connection rod and radius bar; two reach rods are used with this type of gear one connected to the reverse lever and top arm of tumbling a short reach rod from the top tumbling shaft arm connects to and give movements to the reverse yoke for reversing the motion and changing the cut off.

160—Q. What are the principal parts of the electric head light?

A. A steam turbine, the dynamo electric generator and the arc lamp.

161—Q. At what speed should the headlight dynamo be run?

A. About 2,800 revolutions per minute.

162—Q. What care and attention should be given the commutator?

A. The commutator must be kept free from dirt and grease, and the mica cut down slightly below the face of the commutator bars.

163—Q. How often should the commutator be cleaned?

A. The commutator should be cleaned before each trip.

164—Q. How are brushes fitted to the commutator.

A. Have the dynamo idle, take a piece of No. 0 sand paper the width of the commutator, place the sand paper under the brush with the rough side up, draw the sand paper from right to left until the brush has a true smooth bearing, then trim about one-eighth of an inch off the front edge of the brush. The brushes should have a bearing on at least two and not more than three of the commutator bars.

165—Q. Why is sand paper used to fit commutator brushes and to smooth commutator?

A. If any other than sand paper was used particles might lodge in the grooves between the commutator bars and cause a short circuit.

166—Q. What is a short circuit?

A. A connection between the positive and negative wires.

167—Q. How does the dynamo act when short circuited?

A. It will run very slowly with a large volume of steam blowing at the exhaust, the head light and cab lights will only show a dull red light.

How a Locomotive Should Be Inspected

The inspector should start at the front end of the locomotive and inspect the pilot; also note the height of the coupler and pilot. Inspect the uncoupling lever and sill step hand holds, note condition of engine truck wheels and the lateral between fair of engine truck boxes and hub of wheels. Proceed to the right side of the engine, note the condition of piston rods; the cross head and guides for vertical and lateral motion. Examine the valve stem and valve rod, the rocker boxes, rocker arms, links, eccentric blades and straps, side and main rods to see that the bushings and braces fit the pins and rods properly. At the same time examine the driving wheels and tires for defects and the driving boxes for loose braces and lateral motion. The studs, seams, washout, and arch tube plugs, rivets, and studs in the boiler should be closely examined for defects. The valves in cab, steam and air gages, gage cocks and water should be tested, the injectors inspected, checks and piping inspected for leaks, air pump tested and the condition of air brake mechanism noted. The engine frame on both sides should be inspected for cracks or other defects.

Inspection and repair report cards should be consulted and the date of washout and previous hydrostatic tests noted. The draw bar, draw bar pins should be inspected and the tail bars or deck casting and frames inspected; spring rigging, driving box saddles and equalizers inspected. Ash pans and grate shaking post and levers inspected, safety chains between engine and tenders, hand holds, hand rails and steps on engine and tender apron between tender inspected. The tender truck wheels, springs, spring hangers, equalizers, tender truck frames, tender frame, water tender, rear coupler, rear uncoupling lever, steps and hand holds inspected. The inspector should proceed around the left side of the tender and engine and make inspections as made on the right side, then the interior of firebox, flues, arch tubes, crown sheet, flue sheet, side sheets, staybolts and fusible plugs should be inspected. The back head and side sheets should be examined for broken staybolts and cracks.

Typical Report of a Locomotive Boiler Explosion

The following is a report of an accident to boiler of locomotive No. 11 owned and operated by the Jamaica and Flushing Railroad, at Fresh Pond, Long Island, on June 25, 1922.

This boiler was an extended wagon top type with crown sheet supported by 40 transverse crown bars, carrying 180 pounds steam pressure, and built by the American Locomotive Company, May 16, 1902.

At the time of the accident the locomotive was standing at a water tank known as Snyders, the head brakeman, Albert Jenks, was taking water, the Fireman, Henry Tubbs, had just finished cleaning the fire, Engineer James Perry was keying up the back and main rod brasses on right side. Engineer James Perry was slightly scalded, Fireman Henry Tubbs was blown back into the coal space of the tender and his hands were slightly burned, Brakeman Albert Jenks jumped off the tank and was uninjured.

Inspection of the boiler showed that this accident was caused by a deposit of scale on top of the crown sheet. The scale on that part of the crown sheet which had not blown down was at least ½-inch thick between the crown bar braces and the space between the crown bar braces and crown sheet was completely filled up with a very hard flinty scale. A careful examination of the crown sheet showed no evidence of low water.

The crown sheet had torn away transversely along the line of the first row of crown bar bolts back of the flue sheet and had pulled away from the next row of crown bar bolts, and was bent down to an angle of 90 degrees with the crown sheet.

All appurtenances were removed, inspected and tested, the steam gage was compared with a dead weight tester and

*Locomotive Inspector, New York State Transit Commission.

found to be 3 pounds light at 50 pounds pressure and correct at 100 pounds also at 180 pounds pressure, and safety valves and injectors were tested out by applying them to another locomotive of the same type as locomotive No. 11 and found to be in good condition, the water gage cocks, water glass valves, and the check valves were inspected and the openings in same were clean and free from scale, the tank valves and tank hose and strainer were found to be in good working condition.

No record could be found where at any time the boiler inspector had made a report of the condition of this boiler, although this inspector had made two interior inspections of this boiler, one on May 1, 1921, and the last one on April 20, 1922, practically two months prior to the accident. It is unbelievable to think that this crown sheet should be covered with such a heavy coating of scale in such a short period of time.

Responsibility for this accident rests with the railroad company for not paying more attention to the condition of the interior of the boilers in operation on this line.

168—Q. What should be done in case the throttle stem or connections become disconnected while the valve is closed? If it becomes disconnected and leaves the valve open?

A. In case the throttle became disconnected when the valve was closed it would not be necessary to disconnect the engine. Leave the lubricator working so as to feed oil to valves and cylinders and have engine towed to shop.

Should the throttle be disconnected and the valve stuck open, reduce steam pressure, then the engine may be handled with reverse lever and brake.

169—Q. What effect will a leaky steam pipe have on the fire?

A. A bad leak in the back of a bottom joint will blow back through the tubes and reduce the draft on the fire.

170—Q. What is the difference between a mallet compound locomotive and a simple engine?

A. A simple engine has one set of cylinders and uses live steam direct from the boiler which after one expansion is exhausted to the atmosphere.

A mallet compound has two sets of cylinders, one set fixed to the boiler at the rear end and the other swinging from a center at the front end. The rear engine works steam at high pressure. The steam from this engine exhausts into a receiver pipe from which it passes to the forward engine which works the steam at low pressure, then exhausts the steam to the atmosphere.

171—Q. Describe the Walschaert valve gear.

A. The Walschaert valve gear receives movement from an eccentric crank or arm on the outer end of the main pin on each side of the engine. This eccentric serves for both forward and back motion as eccentric rod from the crank arm is fastened to the bottom end of a link which swings on a center trunnion. A link block slides in a curved shot in the link from one end of the link to the other to reverse the engine and moves toward the center to change the cut off. A radius or valve rod connects the link block to the valve stem.

In a Walschaert valve gear, the motion providing lap and lead to the valve is derived from the main pin through the lap and lead lever which is connected to the crosshead.

172—Q. Trace the flow of steam through the superheater.

A. When the throttle is open saturated steam passes through the dry pipe into the saturated steam passage of the header casting. From this passage it enters one end of the unit, passing backward toward the firebox, forward through one of the straight pipes and the front return bend, backward through the other straight pipe to the back return bend and forward through the bent pipe and upward into the superheater steam passage of the header, thence through the steam pipes to the steam chest.

173—Q. What is the limit of lateral and vertical play between cross heads and guides?

A. One-fourth inch vertical or 5/16 inch lateral play between crossheads and guides.

(To be continued)

Making the Most of the Small Shop*

THE small shop depends entirely for its existence on its service—which is a combination of the time and skill of men and machines. Everything in the shop must contribute to the even, continuous and balanced operation of men and machines. Jams, delays, break-downs, overloading, all undermine the profitable character of the enterprise.

The pace of the shop is determined by its slowest worker and its output regulated by the capacity of its most limited piece of equipment.

The small shop must sustain a reputation for living up to promises of delivery. It will not do to promise work in a week that facilities cannot possibly turn out in less than three.

Promptness in filling orders depends upon three things:

1. Knowledge of the capabilities of men and machines.
2. Knowledge of orders on hand.
3. Systematic assigning of order as received.

Information of the foregoing character will at once reveal machines which are overloaded and machines in need of work, and thus reveal the character of tasks the shop requires and which it would be profitable to go out and secure.

The small shop points to the great variety of jobs it must fashion—no two of them alike. At the root of this seeming dissimilarity are fundamental elements and operations, such as drilling holes, cutting metal, bending shapes, all of which can be profitably studied and upon all of which even the smallest shop possesses a mass of information.

On the basis of past experience for the small shop, and for the large on the basis of time studies, standard times may be established for the fundamental operations into which almost all jobs of the shop may be analyzed. As the wealth of experience develops, these standards may be corrected. In the meantime, they will accurately enough answer the question—"How long will this job take and what machines must be used on it?"

Working the Machine

There is a degree of latitude with which equipment may be employed in the small shop. The question of assigning machines should be influenced by the jobs ahead and on the degree the various machines are loaded.

Thus, we have first an analysis of orders into simple operations, and second, an assignment of such operations to machines best equipped to handle them by construction and amount of work ahead.

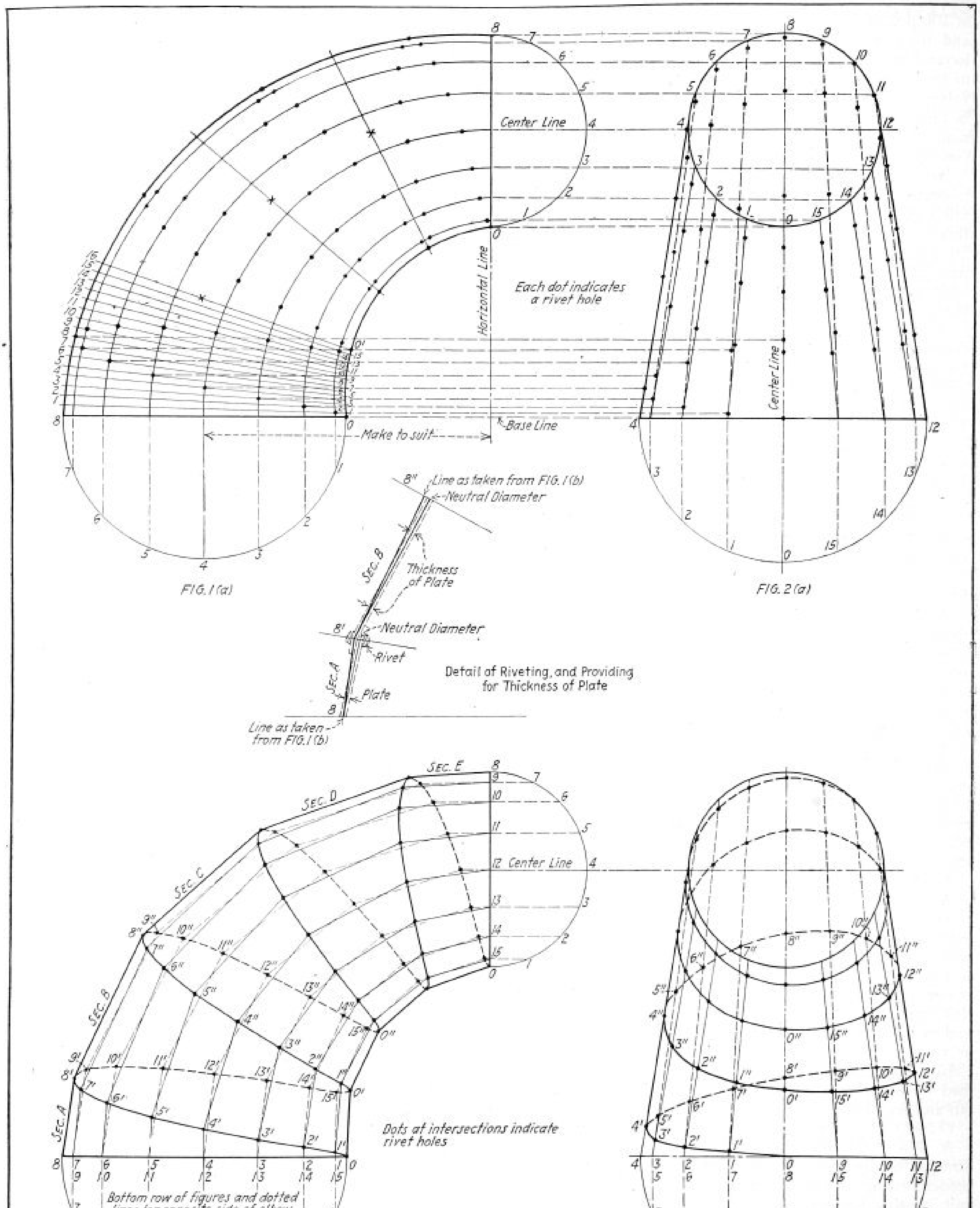
The assignment of operations to machines becomes a promise and it is well to check up all promises of this nature by the actual performances. Otherwise, all delivery dates may again become agog. Failures of performance should be called to the attention of the manager of the plant and discussed immediately with foremen involved, and all schedules promptly adjusted.

A Simple Production System

When standard times for elemental operations are developed on the basis of experience or time studies and orders are analyzed into such fundamental operations, when assignments are made to specific machines and a record and check

(Continued on page 328)

*Policyholders' Service Bureau, Metropolitan Life Insurance Company, New York.



Layout of a Tapering Elbow

Development of a Spiral Seam, Tapering Elbow

By C. A. Chincholl

NO doubt most of the readers of THE BOILER MAKER studied the details of the layout of a pattern for a tapering elbow built up in a helical form, which appeared in a previous issue of the magazine. At the time it was published, the writer stated he would willingly take care of any inquiries made by our readers regarding the layout of the elbow. Since that time, several such inquiries have been made, the answers to which follow. We hope that they will be satisfactory and beneficial, not only to those raising the questions but to other readers as well.

Regarding the manner in which Figs. 1 and 2 are laid out, we have in this article divided each sketch into two parts, thus making the lines of each sketch easier to follow. Starting with Fig. 1-A, the first step is to draw a base line; follow this by drawing a line perpendicular to the base line; this gives us a 90-degree angle. Now describe the center line, so marked in the sketch, using the diameter of the larger end of the elbow as the radius. This can be made to suit, depending on the size you wish to build the elbow. If the large end of the elbow is to be 12 inches in diameter, set your dividers at 6 inches and, with the intersection of the base line and the center line as the center point, describe the semi-circle, as shown on the bottom of the sketch. If the small end is to be made 8 inches, set the dividers at 4 inches and, with the intersection of the center line and the line horizontal to the base line as the center point, describe the semi-circle shown at the top.

The two semi-circles represent one-half of the circumference at each end. Next divide each semi-circle into eight equal parts. Project lines from each division point on each semi-circle to the diameter line at the large and small ends of the elbow, numbered from 0 to 8 on sketch. Now unite the division points on the diameter lines of the large and small end of the elbow with a solid line as shown, the radius of each connecting line being a different length. To obtain the radius of the circular line connecting 0 and 0, set your dividers, one point at 0 on the horizontal line and the other point at the intersection of the base and horizontal lines, with the same center as used in describing the center line of the elbow. Now swing the top point of the dividers to the base line and you will find it to over-reach 0 on the base line 2 inches. Split the difference which would be 1 inch by shortening the stretch of the dividers 1 inch. This gives us the exact radius. Now with one point of the dividers set at 0 on the base line describe a small arc. Change the point of the dividers to 0 on the horizontal line and intersect this arc and you have a point from which to describe an arc connecting points 0 and 0 Fig. 1-A.

The remaining lines connecting the division spaces of the large end with the division spaces of the small end of the elbow are all obtained in the same manner as in the case of 0 and 0. After all of the connecting lines have been placed, from 0 to 8, divide the elbow into four equal parts as shown in the sketch by lines marked *X*. We then divide each quarter part of the elbow into sixteen equal spaces as shown by numbers 0 to 16 in the lower portion of Fig. 1-A. At the intersection of line number 1 with the circular line number 1 make a dot; at the intersection of line number 2 with circular line number 2 make another dot. Continue this until you have arrived at the top. Then you will have all the rivet holes located, as each dot represents a rivet hole.

In laying out the end view of the elbow, shown as Fig. 2-A, start with the base line; square a line horizontal to the base line. This is the center line of Fig. 2-A. Projecting the center line from Fig. 1-A to intersect the center line of Fig. 2-A gives us our height. With the intersection of the two center lines as the center point and with a radius equal to the radius of the small semi-circle, Fig. 1-A, describe a complete circle. Divide this circle into sixteen equal spaces as 0 to 15. At the bottom describe a semi-circle as at the bottom of Fig. 1-A. Divide it into eight equal spaces and project them to the base line. Now connect these division points with straight lines as shown in Fig. 2-A. The solid lines indicate the front side and the dotted lines indicate the opposite side of the elbow. Now by projecting lines parallel with the base line, from each dot in Fig. 1-A and intersecting with the lines of the corresponding number in Fig. 2-A, you have the dots or rivet holes transferred to Fig. 2-A.

Now going to Fig. 1-B and Fig. 2-B, you will find that we have disregarded all lines shown in Fig. 1-A and Fig. 2-A that were used to locate the rivet holes. By connecting the rivet holes as shown by the spiral in Fig. 1-B and Fig 2-B, we have completed the seam for the elbow. The solid lines denote the front side and the dotted lines denote the opposite side of the elbow.

In order to make it more clear and show exactly how the thickness of the plate is taken into consideration, we have taken the slope or taper of sections *A* and *B*, as it appears in Fig. 1-B, and prepared a detail of the joint construction. By close study you will observe that instead of changing the diameter at the top and bottom of each revolution in the elbow, we simply step in the space equal to the thickness of metal, towards the center, as shown by the dotted lines in the plan view. This gives us the neutral diameter, by changing only the diameter at the top of each revolution.

SHAPING THE ELBOW

In answer to the best methods to follow in shaping up the elbow after the pattern has been sheared and punched ready for forming, we advise the following methods. For number eight gage and under, shape by hand over a mandrel or other round projection. Number eight gage up to ¼-inch plate, shape by means of handle fuller and sledge. Including ¼ inch plate and upwards work into shape while hot, taking one revolution at a heat.

October Locomotive Shipments

The Department of Commerce has announced October shipments of railroad locomotives, from the principal manufacturing plants, based on reports received from the individual establishments, as follows:

Year and Month	Locomotives Shipments			Unfilled orders		
1923	Total	Domestic	Foreign	Total	Domestic	Foreign
January	229	217	12	1,788	1,699	89
February	207	196	11	2,220	2,141	79
March	282	269	13	2,316	2,214	102
April	217	201	16	2,204	2,111	93
May	238	228	10	2,150	2,045	105
June	232	221	11	1,958	1,854	104
July	239	211	28	1,738	1,652	86
August	272	259	13	1,497	1,406	91
September	335	313	22	1,178	1,102	76
October	310	295	15	977	915	62
November	299	270	29	691	656	35
December	329	305	24	387	365	22
1924						
January	151	147	4	376	344	32
February	99	92	7	499	466	33
March	132	128	4	534	494	40
April	73	63	10	640	586	54
May	111	93	18	643	589	54
June	145	134	11	531	462	69
July	140	130	10	483	416	67
August	139	121	18	361	306	55
September	104	79	23	386	333	53
October	96	78	18	462	398	64

Transposing A. S. M. E. Boiler Code Formulas

Terms of Formulas Commonly Used in Boiler Work Explained and Their Use in Solving for Unknown Factors

By John E. Londregan

ONE of the most important necessities in designing a steam boiler to qualify for the A.S.M.E. inspection is the ability of the draftsman and the "layer-out" to transpose formulas. Through his ability to do this he is enabled to determine directly the value of whichever term in the formula he may need to know. After a boiler has been built and all the terms of the various formulas are known, it is a much simpler function to check up its construction than when certain factors are unknown.

With the aid of blue-prints, bills of material specifying plate thicknesses, the sizes of rivets and staybolts; the efficiency of the joints known; the pitch of rivets and staybolts determined and the factor of safety given it is a simple task to follow the formulas as given in the Code and prove whether or not, the boiler will sustain the pressure for which its construction was intended.

To the designer and "layer-out" the value of "P" (pressure) is a secondary consideration. Their initial interests lie in every other term of a formula necessary to equal that pressure selected to meet a specified requirement. The thickness of plate, the area of braces, the pitch of staybolts, etc., must all be known before the designer can begin to make his boiler suitable for a certain pressure.

To find those values the formulas, which in the Code are arranged for figuring the allowable pressure, must be transposed in accordance with certain simple rules. To think of these mathematical formulas at all times as equations which can be operated only in specific form, is the beginning of a scientific leaning toward a knowledge of them.

Analyzing Equations

As the word equation implies; it is an expression denoting the equality between two certain things. And the means we employ to portray the equality is called the formula.

Thus: $A = B + C$
$A - C = B$
$A - B = C$
$D = E \times F$
$D \div F = E$
$D \div E = F$

are all equations whose values are portrayed in formulas.

$50 = 40 + 10$
$50 - 40 = 10$

are also formulas denoting the equality of certain numbers, but as a general rule formulas are written with letters, each of which represents a certain numerical value.

It will be noted that each equation has two expressions, one on each side of an equality sign (=) and these two equations must at all times be equal to each other. It does not matter how they are changed about, if the operations are correctly done the expressions are always equal.

To keep the expressions equal, it is necessary when changing a term from one side of the equality sign to the other, to change the sign of the term. Plus (+) signs are changed to minus (—) signs and minus signs are changed to plus signs.

If a stack 50 feet long is made in two sections, 40 feet and 10 feet, its length can be expressed by 50 feet or by 40 feet + 10 feet. Since the sum of the two parts is equal to the total length of the stack, the length of any one part is equal to the total length minus the other part.

Thus 50 feet = 40 feet + 10 feet.
50 feet — 10 feet = 40 feet.
50 feet — 40 feet = 10 feet.

(Note here how the signs were changed from plus to minus.)

In formulas which involve the multiplication (×) sign and the division (÷) sign the procedure of operation is similar to that in which the plus and minus signs are involved.

When a term is changed from one side of an equation to the other the sign is also changed. The multiplication sign is changed to division and the division sign is changed to multiplication.

Thus $B = A \times C$
$B \div A = C$
$B \div C = A$

$P \times R \times FS = TS \times t \times E$ represents an equation between two different products. It must be borne in mind that all the terms of either one of the expressions in an equation are relative to each other and their relationship must not be destroyed.

In paragraph 180 the formula for determining the pressure of a vessel is written thus:

$$P = \frac{TS \times t \times E}{R \times FS}$$

If instead, we desired to find the value of t, t would be placed in the position P now holds as an unknown quantity but P would not occupy t's discarded position but would be returned to its relatives R and FS. Now transposing for all terms:

$$P = \frac{TS \times t \times E}{R \times FS}$$

$$R = \frac{TS \times t \times E}{P \times FS}$$

$$FS = \frac{TS \times t \times E}{P \times R}$$

$$TS = \frac{P \times R \times FS}{t \times E}$$

$$t = \frac{P \times R \times FS}{TS \times E}$$

$$E = \frac{P \times R \times FS}{t \times TS}$$

Par. 192. *Efficiency of Ligament.* When a shell or drum is drilling for tubes in a line parallel to the axis of the shells or drum, the efficiency of the ligament between the tube holes shall be determined as follows:

(*a*) When the pitch of the tube holes on every row is equal, the formula is:

$$\frac{p-d}{p} = \textit{efficiency of ligament}$$

where;

p = pitch of tube holes, inches.
d = diameter of tube holes, inches.

(*b*) When the pitch of tube holes on any one row is unequal, the formula is:

$$\frac{p-nd}{p} = \text{efficiency of ligament}$$

where;

p = unit length of ligament, inches.
n = number of tube holes in length, p.
d = diameter of tube holes, inches.

Paragraph 192 for determining the efficiency of a tube ligament is transposed as follows:

$$\frac{P-d}{P} = E \text{ or}$$

$$(P-d) \div P = E$$
$$(P-d) = P \times E$$
$$-d = (P \times E) - P$$
$$d = P - (P \times E)$$

Paragraph 192 (b).

$$\frac{P-nd}{P} = E \text{ or}$$

$$(P-nd) \div P = E$$
$$(P-nd) = P \times E$$
$$-nd = (P \times E) - P$$
$$nd = P - (P \times E)$$
$$d = P - (P \times E) \div n$$

Par. 195. *Convex Heads.* 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 following formula:

$$t = \frac{5.5 \times P \times L}{2 \times TS} + 1/8$$

where;

t = thickness of plate, inches.
P = maximum allowable working pressure, pounds per square inch.
TS = tensile strength, pounds per square inch.
L = radius to which the head is dished, inches.

Where two radii are used the longer shall be taken as the value of L in the formula.

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.

Paragraph 195. The equation and its transposed form:

$$(t - 1/8) \times 2 \times TS = 5.5 \times P \times L$$

$$t = \frac{5.5 \times P \times L}{2 \times TS} + 1/8$$

$$P = \frac{(2 \times TS)\,(t - 1/8)}{5.5 \times L}$$

$$L = \frac{(2 \times TS)\,(t - 1/8)}{5.5 \times P}$$

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

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

where;

P = maximum allowable working pressure, pounds per square inch.
T = thickness of plate in *sixteenths* of an inch.
p = maximum pitch measured between straight lines passing through the centers of the staybolts in the different rows, which lines may be horizontal, vertical or inclined, inches.

C = 112 for stays screwed through plates not over 7/16 inches thick with ends riveted over.
C = 120 for stays screwed through plates over 7/16 inches, thick with ends riveted over.
C = 135 for stays screwed through plates and fitted with single nuts outside of plate.
C = 150 for stays with heads not less than 1.3 times the diameter of the stays, screwed through plates or made a taper fit and having the heads formed on the stays before installing them and not riveted over, said heads being made to have a true bearing on the plate.
C = 175 for stays fitted with inside and outside nuts and outside washers where the diameter of washers is not less than $0.4p$ and thickness not less than T.

If a flat boiler plate not less than 3/8 inch thick is strengthened with a doubling plate covering the full area of the stayed surface and securely riveted thereto and having a thickness of not less than 2/3 T, then the value of T in the formula shall be three-quarters of the combined thickness of the boiler plate and doubling plate but not more than one and one-half times the thickness of the boiler plate, and the value of C given above may also be increased 15 percent.

When two sheets are connected by stays and but one of these sheets requires staying, the value of C is governed by the thickness of the sheet requiring staying.

Paragraph 199. The equation and transposition:

$$C \times T^2 = P \times p^2$$

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

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

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

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

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

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

According to paragraph 212d contained in the book of interpretations for the Code the pitch of staybolts, supporting a cylindrical furnace, may be increased over the pitch as given in table 4, as provided by the following formula:

$$P = \frac{C\,T^2}{p^2} + 250\frac{T}{R}$$

$$P - 250\frac{T}{R} = \frac{C\,T^2}{p^2} \text{ equation}$$

$$p^2 = \frac{C\,T^2}{P - 250} \times \frac{T}{R}$$

$$p = \sqrt{\frac{C\,T^2}{P-250} \times \frac{T}{R}} \text{ or}$$

$$p = \sqrt{\frac{RC\,T^2}{P \times R - (250\,T)}}$$

The transformation for this formula for determining the terms equal to T is one requiring a broader knowledge of algebra. Since T and T^2 are each a part of either side of the equation it would be necessary to first change all the terms to an equal power. But for information it may be stated that

$$T = \frac{125\,p}{C\,R}\left[\sqrt{\frac{P\,C\,R^2}{125^2} + p^2} - 1\right]$$

Par. 214. *Areas of Heads to be stayed.* The area of a segment of a head to be stayed shall be the area enclosed by lines drawn 2 inches from the tubes and at a distance d from the shell. The value of d used may be the larger of the following values:

(1) d = the outer radius of the flange, not exceeding 8 times the thickness of the head.

(2) $d = \frac{5 \times T}{\sqrt{P}}$

where d = unstayed distance from shell in inches.
T = thickness of head in sixteenths of an inch.
P = maximum allowable working pressure in pounds per square inch.

In watertube boilers, the tubes of which are connected to drum heads, the area to be stayed shall be taken as the total area of the head less the area of an annular ring of width d measured from the inner circumference of the drum shell.

Paragraph 214 regarding area of heads to be stayed:

$$d = \frac{5 \times T}{\sqrt{P}}$$

$$\sqrt{P} = \frac{5 \times T}{d}$$

$$P = \left(\frac{5 \times T}{d}\right)^2$$

$$T = \frac{\sqrt{P} \times d}{5}$$

Par. 221. *Stresses in Diagonal and Gusset Stays.* Multiply the area of a direct stay required to support the surface by the slant or diagonal length of the stay; divide this product by the length of a line drawn at right angles to surface supported to center of palm of diagonal stay. The quotient will be the required area of the diagonal stay.

$$A = \frac{a \times L}{l}$$

where: A = sectional area of diagonal stay, square inches.
a = sectional area of direct stay, square inches.
L = length of diagonal stay inches.
l = length of line drawn at right angles to boiler head or surface supported to center of palm of diagonal stay.

Paragraph 221—Diagonal stays:

$$A = \frac{a \times L}{l}$$

$$l = \frac{a \times L}{A}$$

$$a = \frac{A \times l}{L}$$

$$L = \frac{A \times l}{a}$$

Par. 239. *Plain Circular Furnaces.* Unstayed furnaces more than 12 inches diameter when riveted, of seamless construction, or when lap welded by the forging process, shall have walls not less than 5/16 inch thick. The maximum allowable working pressure for such furnaces, from 12 inches to 18 inches diameter inclusive, and of a length not more than four and one-half diameters; also for furnaces more than 18 inches diameter and not exceeding 38 inches diameter, shall be determined by one or the other of the following formulæ:

(*a*) Where the length does not exceed 120 times the thickness of the plate

$$P = \frac{51.5}{D}\left\{(18.75 \times T) - (1.03 \times L)\right\}$$

(b) Where the length exceeds 120 times the thickness of the plate

$$P = \frac{4{,}250 \times T^2}{L \times D}$$

where:
P = maximum allowable working pressure, pounds per square inch.
D = outside diameter of furnace, inches.
L = total length of furnace between centers of head rivet seams (not length of a section), inches.
T = thickness of furnace walls, in sixteenths of an inch.

In determining the maximum allowable working pressure for unstayed furnaces more than 18 inches diameter and not exceeding 38 inches diameter, if over six diameters in length, L in the formula shall be taken as six times the diameter.

Paragraph 239 a

$$P = \frac{51.5}{D} \times \left\{(18.75 \times T) - (1.03 \times L)\right\}$$

$$P \times D = 51.5 \times \left\{(18.75 \times T) - (1.03 \times L)\right\}$$

$$51.5 = \frac{P \times D}{(18.75 \times T) - (1.03 \times L)}$$

$$(18.75 \times T) - (1.03 \times L) = \frac{P \times D}{51.5}$$

$$(18.75) = \frac{P \times D}{51.5} + (1.03 \times L)$$

$$T = \frac{\frac{(P \times D)}{(51.5)} + (1.03 \times L)}{18.75}$$

$$D = \frac{51.5\left\{(18.75 \times T) - (1.03 \times L)\right\}}{P}$$

Paragraph 239 b

$$P = \frac{4250 \times T^2}{L \times D}$$

$$D = \frac{4250 \times T^2}{P \times L}$$

$$L = \frac{4250 \times T^2}{P \times D}$$

$$T = \sqrt{\frac{P \times L \times D}{4250}}$$

All formulas designed for the use of the mechanic can be very easily transposed by him for the equation of any one of the unknown terms by a little practice.

To get acquainted with a formula which looks complicated, it is fine practice to substitute numbers for the letters and solve the equation for any unknown number.

In this way you can prove for yourself if you have changed the signs as they should have been changed, and it will enable you to visualize the reasonableness of the transformation.

For example; in such a formula as:

$$A = \frac{C \times D}{E}$$

If we substitute numbers as: $16 = \frac{12 \times 8}{6}$ it is easier tc recognize their values and determine the position of the signs.

$$\begin{aligned} \text{Now—}16 \times 6 &= 12 \times 8 \quad \text{(Equation)} \\ 6 &= 12 \times 8 \div 16 \\ 16 &= 12 \times 8 \div 6 \\ 16 \times 6 \div 12 &= 8 \\ 16 \times 6 \div 8 &= 12 \end{aligned}$$

Here we have transformed the formula and proven the correctness of our alteration of the signs, for by actual operation the results of our calculations show the transformations to be correct.

It is well in every example for practice to write the equation after the formula is written thus:

$$A = \frac{B \times C}{D} \text{ (Formula)}$$

$$A \times D = B \times C \text{ (Equation)}$$

The transformations are then simple to perform.

For practice consider the formula $\frac{P - d}{P} = E$ in paragraph 192.

Substituting numbers for the letters we have the formula $\frac{12 - 6}{12} = .5.$

(Note the numbers selected should be figured out to balance the equation.)

$$\begin{aligned} \text{Next: } 12 - 6 &= 12 \times .5 \text{ (Equation)} \\ 12 - (12 \times .5) &= 6 \\ 12 - 6 \div 12 &= .5 \\ 12 - 6 \div .5 &= 12 \\ 12 - (12 \times .5) &= 6 \end{aligned}$$

In the first equation it will be seen that 12 is at the right of the equality sign and is therefore a plus quantity and becomes a minus quantity in the left of the equation and therefore the original sign of minus cannot be disturbed.

Study that over, it is important.

Paragraph 212 d

$$P = \frac{C\,T^2}{p^2} + 250\,\frac{T}{R}$$

$$\begin{aligned} \text{Let } P &= 100 \\ T &= 6 \\ R &= 25 \\ C &= 10 \\ p &= 3 \\ 250 &= 250 \end{aligned}$$

$$\text{Then, } 100 = \frac{10 \times 36}{9} + \frac{(250 \times 6)}{25} \text{ (Formula)}$$

$$100 - \frac{(250 \times 6)}{25} = \frac{10 \times 36}{9} \text{ (Equation)}$$

$$9 = \frac{10 \times 36}{100 - \frac{(250 \times 6)}{25}}$$

$$3 = \sqrt{\frac{10 \times 36}{100 - \frac{(250 \times 6)}{25}}}$$

Paragraph 239 covering Plain Cylindrical Furnaces:

$$P = \frac{51.5}{D} \times (18.75 \times T) - (1.03 \times L)$$

$$\begin{aligned} \text{Substituting: Let } P &= 120 \\ 51.5 &= 10 \\ D &= 5 \\ 18.75 &= 12 \\ T &= 6 \\ 1.03 &= 4 \\ L &= 3 \end{aligned}$$

$$\text{Then } 120 \times 5 = 10 \times [(12 \times 6) - (4 \times 3)]$$

$$10 = 120 \times 5 \div [(12 \times 6) - (4 \times 3)]$$

$$(12 \times 6) - (4 \times 3) = \frac{120 \times 5}{10}$$

$$(12 \times 6) = \frac{120 \times 5}{10} + (4 \times 3)$$

$$6 = \left\{\frac{120 \times 5}{10} + (4 \times 3)\right\} \div 12$$

$$3 = \left\{(12 \times 6) - \frac{120 \times 5}{10}\right\} \div 4$$

In formulas involving the square root sign ($\sqrt{}$) it is transposed with the exponent².

Thus $4^2 = 16$

$4 = \sqrt{16}$

With a few evenings' practice, substituting numbers for the letters in the equations, you should become proficient in transposing the formulas which enter into the daily requirements of your position.

But remember there is only one term in any of the formulas that is unknown, all others *must* be known before the unknown can be solved.

A Double Welding Repair*

By J. F. IRBY

EVERY shop in the country working with metals may not have among its equipment a punch press of such dimensions as the one illustrated here. Still there are few shop owners that are not faced, at one time or another, with the spectre of a shut-down because of damaged machinery. Thus the main point in the following incident should be interesting as typical of the wide variety of repair and reclamation work done by welding.

We may start with the statement that when broken equipment is carefully repaired with a reinforced oxy-acetylene weld it is stronger at the repaired section than it was origi-

*Allmetals Welding & Manufacturing Company, Baltimore, Md.

nally. Some skeptics might say, "Yes, probably," or "Undoubtedly, in laboratory tests, but does the same hold good in practice?"

It does! But to answer the question most satisfactorily is to prove it.

Fig. 1 shows a punch press frame, a gray iron casting weighing approximately two tons. A piece of metal too thick or too tough broke the casting square off at the level of the table. The frame was cracked through a hollow rectangular section 19 inches wide by 20 inches deep, 6 inches thick at the front, 1½ inches at the back and 2 inches thick at the sides.

After the edges were carefully veed and the frame accurately alined, it was preheated by gas burners and a good welding job done by competent oxy-acetylene operators. The casting was carefully covered to protect it from any draughts during welding, and this covering was left in place until the casting had cooled.

Fig. 1.—The First Repair on Frame

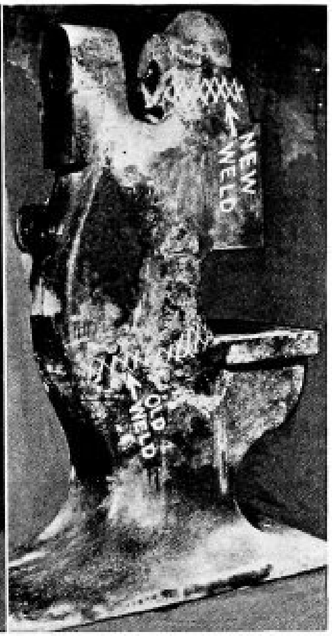


Fig. 2.—Ready for Service After Second Job

After proper annealing the punch press frame was put back in service and stood up under the work for a year. Then someone again fed it too big a bite and it went. Of course, the frame was sent to the same shop which had welded it after the first accident. It was again repaired and is shown in Fig. 2 ready for another term of service.

The point in this story is not that one good job deserves another, nor that the competent welder is an ever ready help in time of trouble, but that the second break did not run through the old weld. This was left unharmed. Nor was the new break within the region preheated for the old weld. It was in the crank bearing 4 feet away. This, then, demonstrates the original proposition, that a second break in a properly made weld need never be feared, because it holds.

Making the Most of the Small Shop

(Continued from page 321)

maintained of such assignments and finally, when all lapses are caught and rectified before there is a danger of them becoming serious, then we have a simple production system which should go far in enabling the proprietor of the small shop to make the most of his enterprise—to develop both a worthwhile service and a gratifying return on investment.

With this background, we come naturally to the essentials of a production sysetm designed and now in operation in a successful manufacturing concern. The plant is large, consisting of gray iron, steel and brass foundries, pattern shop, machine shops and pipe fabricating shop, but the essentials of the system employed may be readily adapted to the smallest enterprise. Even the forms are home-made and entail no heavy printing charges.

From the original order there is developed a Progress Sheet on which the original of the order is broken down to pieces and operations. The operations are assigned to the proper machines and the standard time of the operation is entered on the Progress Form. The number of pieces required is shown in red, which is indicated for our purpose by a dotted line. From this point the Progress Sheet is transmitted to the Planning Department.

The Planning Department has a simple graphical record arranged to show just what is ahead of each machine or department. From this simple graphical record the Planning Department is able to enter the shop's schedule date on the Progress Sheet for each operation. At this point the various operations are each given a specific operation order and a time card. The Progress Sheet is then filed and the factory orders placed upon a dispatching board. As the graphical record shows various machines or departments available for succeeding operations, the factory orders and cards are released to the shop. All finished orders and time cards come back through the Progress Clerk and are recorded on the Progress Sheet in black, in this way releasing the next succeeding operation.

Each day any operations becoming overdue are recorded for each department and all foremen report at a daily meeting operations overdue in their departments. This serves to minimize jobs from becoming overdue as a whole, for as soon as it is discovered that a specific operation is falling behind, an effort is made to take up the lag. All overdue jobs, distinct from overdue operations, are reported on a form, which likewise shows the routing for each unfinished operation. Such overdue jobs are reviewed at the daily meeting of the foremen.

In various departments of the plant a small dial contrivance is used for indicating upon the clock face when a job is started and the day and hour at which it should be completed, if on time. These dials are of assistance to the foreman in locating trouble encountered during production.

In discussing the producing system, the general manager of the plant states:

"We have no figures available on the percentage of overdue jobs before installing our new system, but we can say confidently that our factory conditions are very greatly improved, that we are able to handle a greater volume of business with less trouble and confusion, and have practically eliminated serious delays."

The Policyholders' Service Bureau maintains a production engineering section which is prepared to aid policyholders in establishing satisfactory production control. The production engineering section invites inquiries relative to machine arrangement, the distribution of work to departments and machines, dispatching boards, time studies and methods of wage payment.

Good Service Means—

Putting our best efforts into our work.

Being uncommonly courteous.

Treating the small customer as if he was a big one.

Making good on every advertisement or stopping it.

Being unhappy until the customer is pleased.

Keeping our promises regardless of profits.

Taking as much interest in the last order as in the first.

The Boiler Maker

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CONTENTS

At the annual meeting of the American Boiler Manufacturers' Association, held at Hot Springs, Va., last June, it was decided to create a section of the association to be called the Horizontal Return Tubular Boiler Division. The underlying idea for establishing this sub-division of the association was to take up the work of simplification and standardization of horizontal return tubular boilers as suggested by R. M. Hudson, assistant chief, Division of Simplified Practice, the United States Department of Commerce, Washington, D. C. In the address which Mr. Hudson made to the association at that time, he outlined the general purpose of simplification programs in industry and pointed out the value of the work in boiler construction.

Following the meeting, E. C. Fisher of the Wickes Boiler Company, Saginaw, Mich., was appointed to act as chairman of a committee to take up the subject of simplification and to conduct such meetings of the horizontal return tubular boiler division as might be found advisable. The first meeting was held in Chicago at the Auditorium Hotel on October 29. The main object of this meeting was to properly organize the section of the American Boiler Manufacturers' Association interested in the construction of horizontal return tubular boilers and to consider ways and means of introducing the work of standardization in accordance with the suggestions of the Division of Simplified Practice of the Department of Commerce.

As developed, it is the plan of the horizontal return tubular boiler manufacturers to eliminate obsolete sizes of boilers, to standardize dimensions and thicknesses of shells, to standardize working pressures, the number of tubes, braces, nozzles and also to deal with the simplification of settings of return tubular boilers.

This work was discussed throughout the entire day on which the meeting was held and the subject referred to the committee appointed last June to work up the matters under discussion. The report will be presented later at another meeting of the Horizontal Return Tubular Division of the A. B. M. A. After the entire work is completed, it will be presented to the entire membership of the A. B. M. A. for approval.

The requirements for welding apparatus for use in railroad shops, as recently outlined by the welding supervisor of one of the principal railway systems of the country, include a number of suggestions which are well worth considering when checking shop equipment.

Apparatus should be selected with a view towards efficiency of operation and safety and it should be modern in design. Only such apparatus should be chosen that is best adapted to meet special shop conditions. A careful study of the shop layout is necessary to determine the most advantageous arrangement of welding machines and these should be placed to facilitate the handling of material, reduce trucking and waits for crane service.

Oxy-acetylene welding and cutting torches, regulators, tanks, and the like, have reached a stage of development where they are absolutely safe if the ordinary precautions are followed. The hose used must be of the best grade obtainable, for the service demands safety and the ability to withstand wear. Gas lighters should be part of the welding equipment of every shop to avoid the necessity of lighting matches with the consequent fire hazard. Goggles, with proper ventilating features and colored lenses should be provided to protect the eyes of the operators.

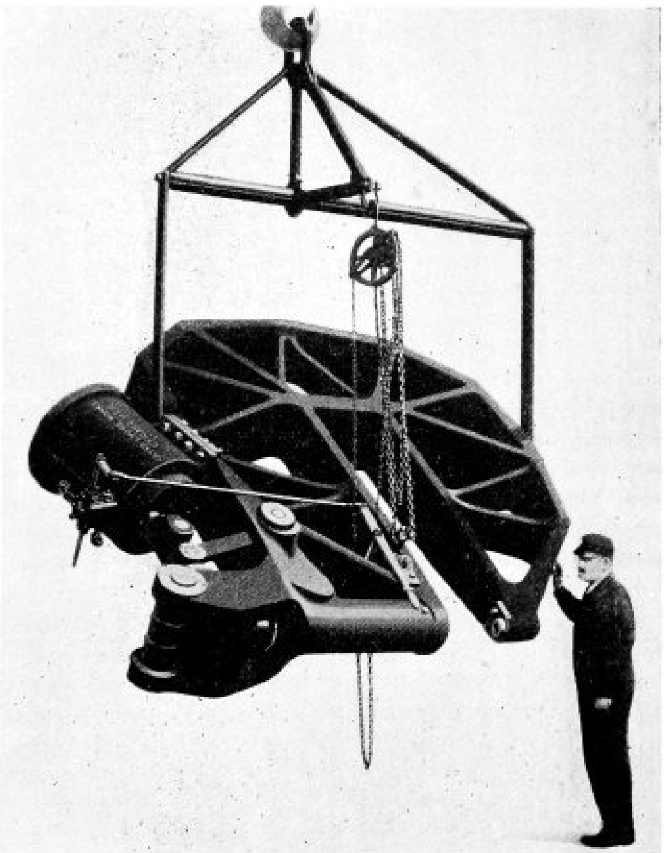
The selection of portable or stationary arc welding equipment depends on the size of the shops and its requirements. Apparatus to meet practically every need in this direction is commercially available, the important consideration being its arrangement in the shop. Electric flue welding apparatus is being used to a greater extent every year and shows many advantages in speeding up flue work. Sand blasting apparatus is an important adjunct to the equipment. Clean surfaces are absolutely essential to the making of good welds. The sand blast has been found the fastest and most effective means for accomplishing this result.

Engineering Specialties for Boiler Making

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

Portable Hanna Riveter for Large Work

A NEW large portable riveter has recently been designed and manufactured by the Hanna Engineering Works, 1765 Elston Avenue, Chicago. The reach is 75 inches and the gap is 18 inches. It is equipped with a cylinder, the diameter of which is 22 inches, and is capable of exerting 150 tons on the dies at 100 pounds air pressure. It is also equipped with a special suspension and bale by manipulation of which the riveter may be suspended in two



Method of Suspending Portable Riveter

positions (or any position intermediate). Its net weight (including bale) is 17,150 pounds. It is specially adaptable to gas holder bottom courses, to large standpipes, storage tanks, blast furnace stoves and the like. As the position of suspension approaches the "horizontal plane of symmetry" it is easier to raise or lower the die axis for riveting vertical seams by means of the bale than by raising or lowering the entire machine. Herein lies the utility of the special bale suspension.

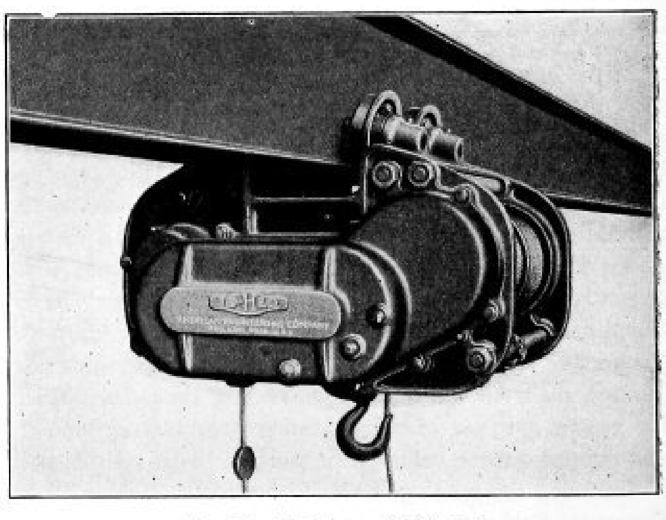
Incorporated in the bale is a hand operated triplex chain block that establishes a third point of riveter suspension, and by which change of position is obtained. The frame itself is one-piece steel casting of true truss design, with no central web. By this construction all members of the frame are loaded concentrically. The load on each member is known accurately. Casting strains that are unknown quantities are reduced to the minimum by making all members of substantially equal cross section thickness.

In this machine is incorporated the Hanna patented mechanism, which is a combination of toggles merging into a lever action, which develops a known and predetermined maximum uniform pressure during the last half of the piston stroke or what amounts to about the last half inch of die travel. This assures of absolutely tight rivets being driven with each and every stroke of the piston without any adjustment of the die screw being necessary to overcome the ordinary variations in lengths of rivets, thicknesses of plates, diameter of holes, etc. The Hanna type of mechanism eliminates the necessity of making two or three adjustments and a like number of blows on a single rivet to set same properly, as it automatically applies sufficient pressure and follows up the shrink of the rivet under full pressure until it is sufficiently cool and has taken its set.

Electric Monorail Hoist

A NEW electric monorail hoist designed to operate in a minimum headroom is being placed on the market by the American Engineering Company, of Philadelphia, in half-ton and one-ton sizes. This hoist retains many of the features that distinguish the other "Lo-Hed" hoists made by the same company, but is smaller and is intended for general utility use where a light, handy electric hoist is needed.

Like all the "Lo-Hed" line, this hoist is able to draw the load hook up until it almost touches the rail, which makes it available for use in places where, because of low headroom, no other hoist could be used. It gives additional clearance and safety for bulky loads and makes it possible to pile materials higher than could be done by any other means,



"Lo-Hed" Monorail Hoist

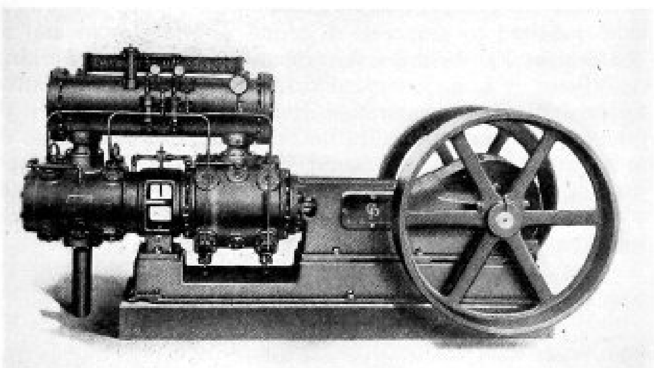
thus increasing the capacity of storage spaces by utilizing the space almost up to the ceiling.

Automatic holding and lowering brakes are provided and a safety device checks the hoist at the upper limit of travel and throws off the current. High duty roller bearings and automatic lubrication give a high efficiency. A factor of safety of at least five makes overloads possible in emergency.

These hoists are furnished for either direct or alternating current. All working parts are completely accessible and the motor can be removed for repairs in a few minutes without touching the load on the hook.

Straight Line Two Stage Compressor

IN order to meet the requirements of low power consumption per cubic foot of air delivery and the favorable physical condition of air resulting from two stage compression, the Chicago Pneumatic Tool Company, Chicago, Ill., has developed a straight line two stage belt or motor driven air compressor, designated as Class N-CTB. Operating at 275 revolutions per minute, this compressor has a piston displacement of 360 cubic feet of free air per minute with air pressures ranging up to 125 pounds. It is adapted to be driven by a belt or by synchronous motor with the rotor mounted directly on the compressor crank shaft.



Chicago Pneumatic Two Stage Compressor

Tandem construction is used in this unit in which the low pressure cylinder is placed next to the frame and the high pressure cylinder is connected to the low pressure cylinder by means of a tandem piece through which the piston-rod stuffing boxes are easily accessible. The intercooler is rigidly mounted above the two cylinders in which location it is convenient for cleaning, which may be done from either end. The whole unit is mounted upon a substantial subbase which gives the rigidity so desirable in a machine of this class. Perfect alinement of the machine is assured, resulting in maintained high mechanical efficiency and consequently prolonged life. This feature also gives the unit a degree of portability not realized in duplex construction and for this reason it will appeal to those compressed air users who frequently employ semi-permanent installations.

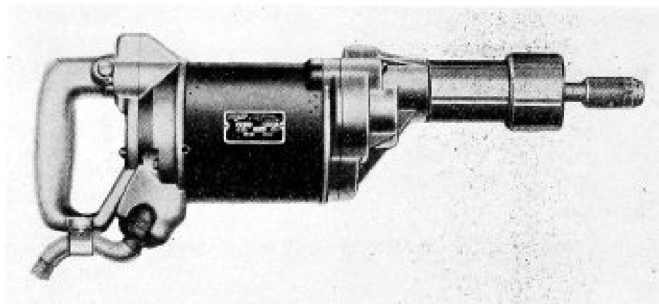
Simplate Air Valves are used throughout assuring high efficiency and trouble-proof operation of the most vital part of the compressor.

Automatic operation is attained in a high degree. A splash and flood system of lubrication is employed for all bearings while the cylinders may be lubricated by the standard sight-feed lubricator, by a pneumatically operated force-feed lubricator or by a mechanically driven force-feed lubricator.

Regulation of the volume of air and its pressure is entirely automatic and can be furnished to conform to the special conditions of the demand for air. Three step capacity regulation is regularly furnished in which two differential unloaders operating automatic unloading simplate inlet valves cause the compressor to operate at full, half, and no load according to the air demand with maximum efficiency and evenly distributed crank-shaft torque. Such operation results in excellent load characteristics for the driving motor since the steps are clearly defined in loading and unloading obviating any surges in the power line that would otherwise result.

Electric Screw Driver Equipped with Friction Head

A FRICTION head electric screw driver, which is being placed on the market by the Hisey-Wolf Machine Company, Cincinnati, O., is designed with a practical disk type friction clutch which is automatically adjusted according to the pressure applied by the operator. The screw driver is equipped with ball bearings throughout and fitted with a Hisey universal motor for operation on direct current and single phase alternating current of the same voltage and for any frequency from 25 to 60 cycles. The motor and frame unit of this screw driver is of the same design as that in the Hisey all-ball-bearing equipped electric drill. The clutch casing is of convenient size and serves as a hand grip when the work requires. Screws up to No. 14 x 2½ inches long can be driven in soft solid wood. When suitable lead holes are provided, larger wood screws and lag screws up to 5/16 inch diameter by 4 inches long can be driven. These machines are equally as practical for setting nuts up to ⅜ inch in metal and wood construction work as the friction clutch with its slipping feature when nut is driven home prevents undue strain on the operator. Standard nut sockets are carried in stock in ¼, 5/16 and ⅜ inch sizes for U. S. S. Square and Hexagon nuts and are recessed for bolt clearance to a depth equal to twice the bolt diameter.



New Hisey-Wolf Electric Screw Driver

This machine is designed with the same exclusive features so prominent in Hisey electric drills. The quick-cable connector is a most important feature. This new external cable connector permits cable repairs and renewals without dismantling the machine, thereby eliminating loss of time and inconvenience. The Hisey (patented) switch is conveniently fitted in grip handle.

Each machine is supplied with 10 feet all rubber conductor cable fitted with suitable attaching plug and two screw driving bits.

The screw slot finding attachment shown fitted to machine is supplied to special order only. It is a convenient accessory and obviates the driving bit from slipping out of the screw slot and marring the surface of the work. These are made in 3 sizes with bits 5/16, ⅜ and 7/16 inch diameter.

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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.*

Test for Determining Boiler Horsepower

Q.—At a local plant, a test was run recently on a new type stoker firing a Scotch marine boiler rated at 225 horsepower. A 2-inch pipe discharged directly into the atmosphere and for an approximation they used the following formula:

$$\frac{P \times A}{70} = \text{steam discharged per second.}$$

P = gage pressure = 90 pounds.
A = area of pipe which was 2 inches or 3.14 square inches.

Therefore:

$$\frac{P \times A}{70} \times 360 \text{ (seconds per hour)} =$$

$$\frac{90 \times 3.14 \times 360}{70} = 14{,}400 \text{ pounds steam per hour discharged.}$$

Therefore:

$$\frac{14{,}400}{34} = 423 \text{ horsepower developed approximately.}$$

F. S. L.

A.—Steam flowing from an unobstructed nozzle expands to the external pressure and to the volume due to this pressure so long as it is not less than 58 percent of the initial pressure.

Napier's formula $W = \frac{PA}{70}$ may be used in determining the evaporation when the final pressure is not less than 58 percent of the initial pressure, in which

W = maximum weight of steam discharged in pounds per second.
P = absolute initial pressure in pounds per square inch.
A = area of nozzle, square inches.

The *absolute pressure* is equal to the gage pressure plus the pressure of the atmosphere. Therefore for any given pressure the absolute pressure depends on the atmospheric pressure.

In your example, the gage pressure is given at 90 pounds per square inch, hence the absolute pressure equals at sea level 90 + 14.7 = 104.7 pounds. This value should be used in the solution of your example.

The unit boiler power is the evaporation of 34.5 pounds of water per hour from and at 212 degrees F. and the power of any boiler is found by dividing the equivalent evaporation from and at 212 degrees F. by 34.5.

Example.—A boiler at sea level evaporates 14,000 pounds of water per hour, when the temperature of the feedwater is 80 degrees F. and the pressure is 90 pounds per square inch, determine the horsepower.

Solution.—The absolute pressure for this case is 90 + 14.7 = 104.7 pounds. The total heat in the steam above 32 degrees F. at this pressure is 1,182 B. t. u. The equivalent evaporation is

$$\frac{14{,}000\ (1{,}182\text{-}80 + 32)}{965.8} = 15{,}510 \text{ pounds per hour.}$$

The horsepower equals 15,510 ÷ 34.5 = 449.

In the foregoing calculation the value 965.8 is the heat units required to evaporate 1 pound of water from and at 212 degrees F. In order to compare boilers under working conditions, it is necessary to reduce the actual evaporation to the equivalent evaporation from and at 212 degrees F. per pound of combustible in the fuel burned. The values of properties of steam are found in tables of saturated and superheated steam. This is an extensive subject, and I would advise that you obtain a treatise covering both saturated and superheated steam.

Dished Head Calculations

Q.—Would you please show me how to find the strength and the area of dished head shown in sketch with "*r*" equal to the diameter of the head. T. R. B.

A.—The A. S. M. E. Code gives the following formula for determining the thickness of a convex head:

$$t = \frac{5.5 \times P \times L}{2 \times TS} + \tfrac{1}{8}$$

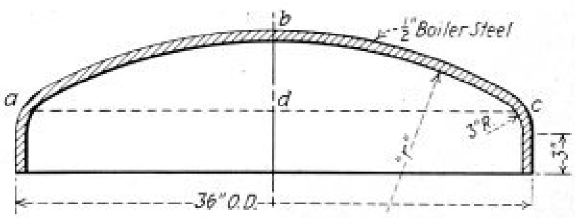


Diagram for Finding Strength of Dished Head

in which, t = thickness of plate, inches.
P = maximum allowable working pressure, pounds per square inch.
TS = tensile strength of plate, pounds per square inch.
L = radius to which the head is dished, inches.

By changing the above formula to find the allowable working pressure on a course head when the plate thickness and radius to which it is bumped are given, we have:

$$P = \frac{(t - \tfrac{1}{8})\ 2 \times TS}{5.5 \times L}$$

The section *a—b—c* of a sphere is known as a *zone.* The area of a zone is equal to the circumference of the sphere (taken through its diameter) times the altitude of the zone. Expressed as a formula:

$A = 2 \times 3.1416 \times r \times h.$

in which,

A = area of zone, square inches.
r = radius of sphere, inches.
h = height of zone, inches.

Riveted Joints and Tractive Power of Locomotives

Q.—Through the columns of The Boiler Maker I wish you would answer these two questions:

(1) Kindly inform me as to the formula to determine the efficiency or strength of a butt strap, whose tensile strength is 50,000 pounds per square inch, made of ¾-inch rivets spaced 3 inches apart in outer strap and four rows of same. Rivets spaced 7 inches in under strap only and one top and one bottom row of same. Diameter of rivets, 13/16 inch. I understand in the case of a lap seam you would express it mathematically thus:

Pitch minus diameter of rivet hole = net section. Net section divided by the pitch would determine strength, thus:

1-inch rivet, spaced 4 inches apart = 3-inch net section =
$3 \div 4 \times 100 = 75$ percent.

(2) To determine the tractive effort of an engine whose cylinder in diameter is 21 inches; length of stroke, 28 inches; diameter of driving wheel, 72 inches with a steam pressure per square inch of 200 pounds.

Some men maintain in determining the above that one should only use 0.85 percent of steam pressure.—W. E.

A.—In figuring the strength of a riveted joint it is necessary to determine first the different ways in which the joint may fail. From the strength of the weakest section, the strength of the joint is based. To answer your first question it is necessary to know the type of joint and arrangement of rivets. If you will supply a sketch we will give the necessary information.

The strength of the net section of plate in a lap joint may be figured as you state, but this calculation does not show the strength of the rivet section which must be found, then the weakest part of the joint is its strength.

The following formula, used by the American Locomotive Company, gives the tractive power of locomotives:

$$T = \frac{d^2S \ .85P}{W}$$

in which,

T = tractive power.
d = diameter of cylinder in inches.
S = length of stroke in inches.
P = boiler pressure in pounds per square inch.
W = diameter of driving wheels in inches.

In this country 85 percent of the boiler pressure is considered available, whereas in Europe as low as 60 percent of the boiler pressure is used instead of 85 percent as in the above formula.

Vacuum and Deflection Calculations

Q.—I wish to thank you very much for your letter of the 12th which reached me today. After reading your letter I saw where I made the mistake in the vacuum problem. In my marine service I have been accustomed to vacuum readings as so many inches of vacuum, usually 26 inches to 28 inches and when working out the problem, that was in my mind, not inches of mercury, which accounts for my mistake. It has been my experience both in naval and mercantile marine service for vacua to be spoken of as so many inches of vacuum, so I was caught napping when it was referred to as so many inches of mercury. Referring to your first paragraph, the formula you gave as

$$f = Kr^4 \frac{p}{t^3} E \quad \text{I see should read}$$

$$f = \frac{Kr^4 \dfrac{p}{t^3}}{E}$$

but I am afraid there is still something wrong somewhere as I applied it to a gasoline storage tank 48 inches diameter made of 3/16-inch steel. Using the formula as corrected by you with the quantities originally given, gave me a deflection of 4 inches which is about 10 times too much. If there is no mistake in my arithmetic which I hardly think is likely as I have checked over it a couple of times, I think this is caused by a cypher being missed out, in other words the constant K should be 0.05 instead of 0.5 as printed in The Boiler Maker. Referring back I found in the issue of The Boiler Maker, April, 1924, a formula to find deflection on a tank head with fixed edges which reads:

$$f = \frac{P \times R^4}{6Et^3}$$

P = pressure, pounds per square inch.
R = radius, plate.
E = modulus of elasticity.
t = plate thickness, inches.

Using this formula to the problem gave me a deflection of nearly ¾ inch which seems excessive and which is not borne out by practice.

As I have these problems practically every day I am anxious to find a reliable formula applicable to the case and should be extremely obliged for your co-operation if you will be so kind. I am seriously thinking of making a series of deflection tests later on but just at present I am too busy to do so.

I wish to thank you very much for the trouble you have taken to make these problems clear and thanking you in anticipation of a reply to the above queries. J. W.

A.—The formula given for problems of this kind are empirical but give results very close to conditions. The value of K as given is for light gages of material. For cast iron, the value ranges from 0.17 to 0.6; for boiler steel, values from .05 to .50 are used.

After you have made your deflection tests, we would be pleased to hear of the results and publish accounts of them for our readers.

Stay Calculations

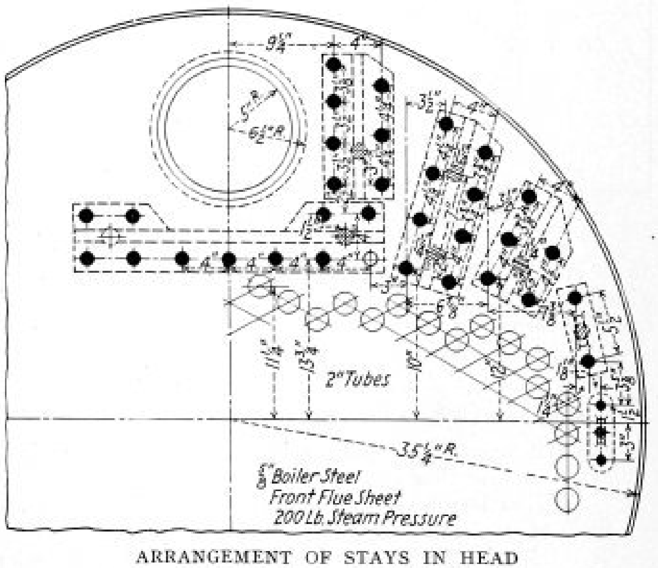
Q.—I am a constant reader of your questions and answers in The Boiler Maker, and find them very useful. May I submit this one:

The Interstate Commerce Commission has raised the permissible stress on boiler stays to 9,000 pounds per square inch. If the pressure of a boiler, being constructed before this went into effect, were to be raised, I mean the size of stays, to meet this, how would one find the stress on each stay so that the size of the stay could be computed?

I inclose sketch showing braces under discussion.

Will you please give me all the information you can on the subject. C. E. S.

A.—The A. S. M. E. Code requires the area of the head, as shown within the shaded section of Fig. 1 to be stayed. This section of the segment is inclosed by lines drawn 3



ARRANGEMENT OF STAYS IN HEAD

inches from the shell and 2 inches from the top of the tubes.

The area to be stayed is found from the following formula:

$$A = \frac{4\,(H-5)^2}{3} \sqrt{\frac{2\,(R-3)}{(H-5)} - 0.608}$$

in which;

A = area of segment, square inches.
H = distance from tubes to shell, inches.
R = radius of boiler head, inches.

To find the required number of *through braces*, that is, *end to end* stays assume, for example, that the area of the segment equals 800 square inches and that the maximum working pressure is 200 pounds per square inch. The total pressure on the segment equals 800 × 200 = 160,000. Since the permissible stress allowed on the stay equals 9,000 pounds per square inch and assuming that the sectional area

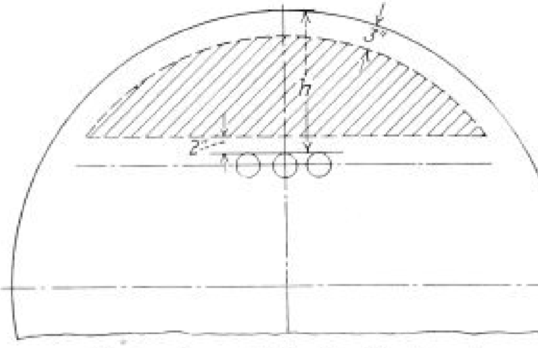


Fig. 1.—Area of Head to Be Stayed

of the stay is 1 square inch, then the number of stays required equals 160,000 ÷ 9,000 = 17 7/9 or 18 braces. Stays should always be so arranged that each stay carries the same load. In this case where 18 stays are used each stay would support an area of 800 ÷ 18 = 44 4/9 square inches.

If diagonal stays or gusset braces are used, the sectional area of each stay must be larger than that as figured for a

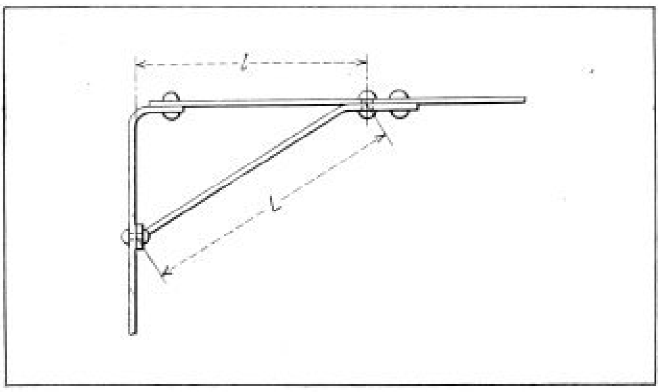


Fig. 2.—Dimensions of Stay

direct stay. This is due to the angle that such stays make with the head. The required sectional area may be found from the formula:

$$A = \frac{a \times L}{l}$$

in which A = sectional area of diagonal stay, square inches.
a = sectional area of direct stay, square inches.
L = length of diagonal stay measured as shown in Fig. 2, inches.
l = length between inside surface of head to palm of diagonal stay as shown in Fig. 2, inches.

Petticoat Pipe

Q.—I would be pleased to see in THE BOILER MAKER, of which I am a reader, the correct method of laying out irregular pieces, such as some call "*petticoat pipes*" of which you will find a rough sketch inclosed. W. A. J.

A.—The solution of this problem is shown in Fig. 1. A full view of the plan and elevation is given which shows the petticoat pipe to be made up of a cylinder *A* and a frustum of a cone *B*. The conical section is laid off so that the outer element *c*—*b* is extended to intersect the vertical axis *a*—*a*. With *a* as a center and *a*—*b* and *a*—*c* as radii describe the two concentric arcs for the top and bottom curves of the pattern. On these arcs lay off the stretchout or circumference around the top and bottom of the frustum. These lengths can be laid off by means of the traveling wheel. In this case one-half pattern of the frustum is shown. Allow for the laps as required for a single riveted lap joint. In case that you do not have a traveling wheel divide the quadrant or

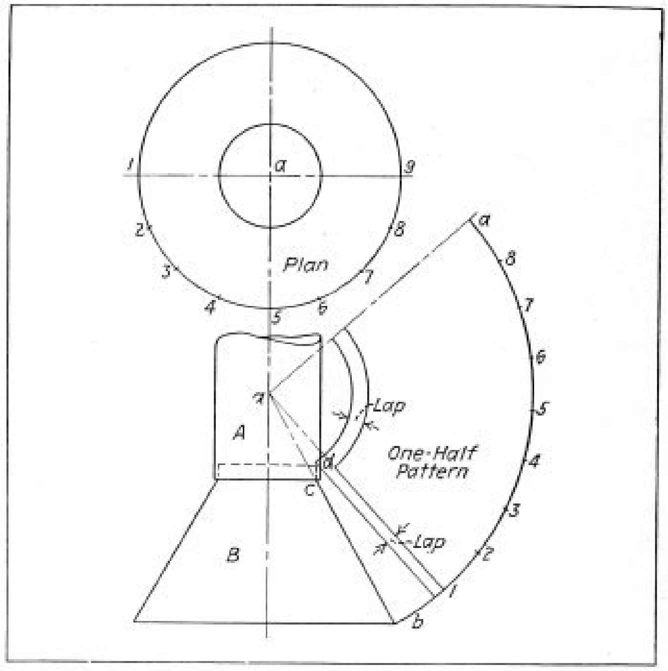


Fig. 1.—Plan and Elevation of Petticoat Pipe

semi-circle into a number of equal parts as shown in the plan. Make the lengths *1* to *9* of the pattern equal to the corresponding lengths of the plan.

TRADE PUBLICATIONS

ELECTRODE BOOKLET.—A 12-page booklet bearing the designation Y-2019 describes the new Type A General Electric welding electrode. Details are given on electrode construction and characteristics. Results of tests on welded cast iron specimens and deposited metal specimens are described, and oscillograms demonstrating arc stability are reproduced. Instructions for use of the electrode are supplied and specifications of the standard sizes given.

ALLOY STEELS.—A 48-page, illustrated handbook covering Agathon alloy steels and containing a number of tables of data of interest to metallurgists and engineers, has been issued by the Central Steel Company, Massillon, Ohio.

CHAIN GRATE STOKERS.—A complete discussion of both the Type A (natural draft) and Type G (forced draft) Illinois chain grate stokers is given in a 62-page catalogue recently issued by the Illinois Stoker Company, Alton, Ill. An array of blueprint drawings illustrates the use of both the forced and the natural draft chain grate stokers in connection with all of the principal types and makes of boilers.

SAFETY VALVES.—Sectional drawings, showing the construction and operation of automatic cushioned altitude valves for maintaining a uniform water level in tanks, standpipes and reservoirs, regardless of climatic conditions, are shown in print No. 801, recently issued by the Golden-Anderson Valve Specialty Company, Pittsburgh, Pa. Other types of Golden-Anderson safety valves are illustrated in a 16-page booklet.

Letters from Practical Boiler Makers

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

Who Should Make Shop Inspections on New Boilers?

THE time has come when the issue should be raised as to who is eligible to make shop inspections of new boilers that are being built and constructed according to the A. S. M. E. and state Codes.

At the present time the Codes allow anyone who holds a certificate of competency to pass on the shop work and methods; this I would not term good practice, for there are many, yes, very many inspectors in the field today who are entirely incompetent for such inspection.

What should be the requirements or qualifications of a shop inspector on new construction? Giving you my ideas of what the necessary requirements are, I would say, he should have served an apprenticeship as a boiler maker and have had 5 years' practical experience as a journeyman aside from his apprenticeship training and should also be able to convince the examining board of his fitness and eligibility.

Now, of course, the engineers will flare right up and try to say how eligible they are, but, in my estimation, and anyone else who makes a thorough study of the general conditions, they will decide that an engineer is not fully qualified to make the shop inspection. Why? Because there are many points and kinks in the proper heating, annealing and fitting of sheets and braces which only come through years of trial and experience and cannot be obtained from book learning. A real boiler maker (I do not refer to McAdoo mechanics) can pull over many stunts on an inspector, who, if he is not well versed, will allow the same to pass unheeded.

Another thing, the present inspectors in these boiler manufacturing plants are insurance inspectors with very little training in any line, and from the appearance of some of the boilers turned out today and stamped A. S. M. E. and National Board, it certainly shows inexperience or else the inspector is very careless and should have his certificate revoked. With the insurance company it is a business proposition. They get so much per boiler and seem to be afraid to be strict for fear the manufacturer will secure some other company who is not quite so strict. I expect to create antagonism, and that is not justified. I am stating true facts which cannot be denied.

We have the understanding that when we buy a boiler stamped A. S. M. E., National Board or any state standard that we are getting the best there is in boiler construction; but are we? No, we are not, and the workmanship shows it. Can my argument be backed, well I'll say it can, and I will give you a few cases that have come to my attention wherein if the boiler had been properly inspected during construction, the owner would have been better satisfied and the building of Code boilers more justified.

A recent case occurred where a boiler had been in operation for only three years. Considerable trouble had been experienced during this time in leakage about the firedoor, so as a final measure we decided to cut out the rivets and U the cracks for welding. After cutting out the rivet heads, we noticed that the rivets would not back out and finally, on getting one out, we discovered a collar on the rivets where the two sheets come together. The construction of the fire door was an ogee flange and, when the work was being done, the two sheets were not properly laid up and bolted together, thereby the cause of the leakage was ascertained. The same condition existed at the flue sheet and mud ring.

Another firm has been turning out boilers with several defects which could be remedied. Girth seams at the base of the boiler leaking about the first day of operation, leaky rivets and staybolts, staybolts with insufficient threads to make good heads and also insufficient heads on rivets. In flanging their domes for locomotive type boilers, they have a bulge form directly above the flange where the dome rests on the boiler. This is caused by improper flanging of the base and, although it might not cause any serious damage, it certainly is not good workmanship.

The average manufacturer today is not looking for good construction; he is looking for production, and production he must have. His supervising force is told we must have the output, and therefore you have a reason for the workmanship as outlined above.

What is the remedy for the situation? Well, I will give my idea, and if anyone has a better one or any criticism to offer come forward and speak their piece. Provide the shop where new boilers are manufactured with inspectors holding certificates of competency who have served the apprenticeship of boiler maker and had five years of experience as journeymen. Give him the proper backing of the chief inspector who issued the said certificate and not allow politics or any other means to influence his position. See that the inspector has backbone and grit to back his statements, and that he takes his stand and holds it when he knows the material and workmanship is not up to the standard. Remove the insurance inspector from the shop and install first class boiler inspectors.

Let all interested parties come on with their criticism. I am ready to back my statements and accusations.

Port Dickinson, N. Y. CHAS. W. CARTER, JR.

Be Cautious About Buying Welded Pressure Tanks

I DO not want to create the impression that all welded pressure tanks are not good. They are good when the welding is done properly—by individuals or concerns who understand the welding business and who do it as it should be done.

A number of serious failures of welded pressure tanks have occurred, making it evident that considerable care must be exercised to be certain that the work is well done, when welding tanks for carrying high pressure. Welding of this important nature must not be entrusted to an unskilled welder. The purchaser should be certain that he is buying from a responsible concern—a concern that will not tolerate slip-shod welding. To weld with a modern welding outfit appears to be a comparatively easy matter and many unskilled men, after making a few welds, are liable to consider themselves so expert that they will undertake any kind of work. However, correct welding is a science in itself, requiring considerable study and experience.

For example, during the welding process, internal stresses are liable to be set up due to the fact that at the weld seam a very high temperature is created during the welding act. Then after the weld has cooled down the metal shrinks and as a result there is bound to be an internal stress of some kind. This internal stress should be relieved by annealing, but since annealing means additional expense irresponsible concerns are liable to skip this operation, whereas the best concerns insist on it in spite of the greater cost of the completed vessel. The best concerns also insist on the most capable welders obtainable so as to reduce the "personal equation" to the minimum.

The use of welded tanks has increased a great deal during recent years and the science of welding has advanced to a gratifying degree. The writer is in favor of continued advancement. There is no better way to make tanks tight against leakage than by welding. There is no reason why welded tanks should not be just as strong, or stronger, than riveted tanks. When correctly done they are stronger. However, when investing, be cautious.

Newark, N. J. W. F. SCHAPHORST.

Laying Out a Distributor Pipe

A READER and student of the layout problems given in the pages of THE BOILER MAKER has been puzzled by the difficulty he has encountered in bringing the various sections of a five-pronged distributor pipe together so as to fit properly. Upon examination of his layout and the sections, we find that there was not a clear understanding of the shape each section should assume at the joint line.

Where an irregular article is to be constructed, it is necessary to construct a profile of the joint lines and the use of the profile will greatly help in shaping up the article. Without going into details of the layout, the elevation and base plan of one prong is shown at Fig. 1. The joint or seam line is shown by *A-1-2-3*.

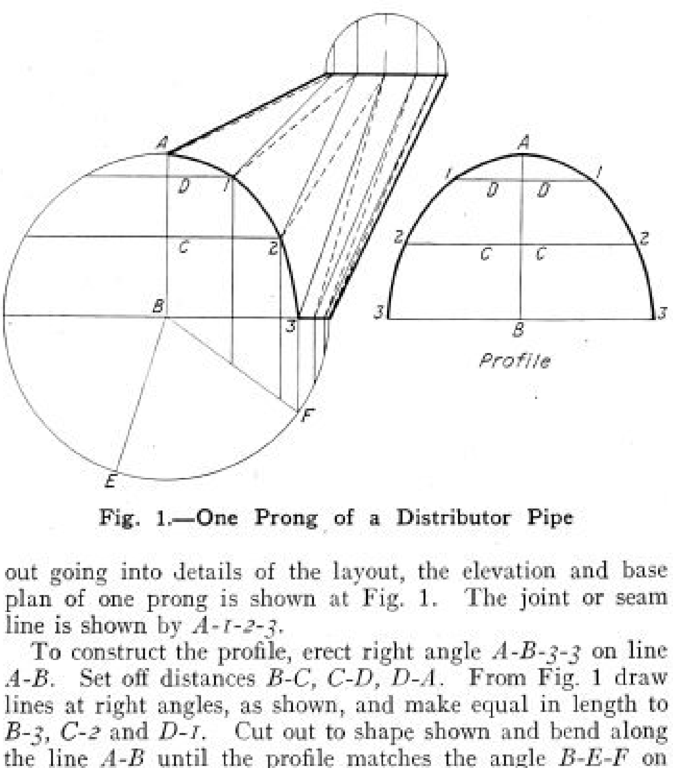


Fig. 1.—One Prong of a Distributor Pipe

To construct the profile, erect right angle *A-B-3-3* on line *A-B*. Set off distances *B-C, C-D, D-A*. From Fig. 1 draw lines at right angles, as shown, and make equal in length to *B-3, C-2* and *D-1*. Cut out to shape shown and bend along the line *A-B* until the profile matches the angle *B-E-F* on base plan. The use of the pattern will help in shaping up the article at the joint line.

In many articles of sheet metal work, the shape of the joint line does not follow any definite rule and a good deal is left to the judgment of the layerout. One of the most valuable assets along this line is for the student or worker to cultivate what is known as the "eye of the mind" or, to more clearly explain, whenever one sees an unusual piece of sheet metal work, try and figure out in your mind what the shape of the sheet would be before being bent to the shape of the article; thus he would acquire what all the books in the world on sheet metal cannot teach him.

Lorain, Ohio. JOSEPH SMITH.

BUSINESS NOTES

R. C. Broach has been appointed southeastern district manager for the Heine Boiler Company with offices at 709 Glenn Building, Atlanta. His territory includes eastern Tennessee, North and South Carolina, Alabama, Georgia and Florida. Mr. Broach, a native of Atlanta, has previously been employed in the General Sales Department of the Heine Boiler Company at St. Louis.

The Chicago Pneumatic Tool Company announces the appointment of H. E. Byer as manager of condenser and vacuum pump sales with headquarters in New York.

Howard J. Wittman, 632 Nasby Building, Toledo, Ohio, has been appointed district representative of the Kuhlman Electric Company of Bay City, Michigan. Mr. Wittman will have Northwestern Ohio as his territory.

The Globe Electric Supply Company, 1843 Wazee Street, Denver, Colorado, has been appointed district representative for the Kuhlman Electric Company of Bay City, Michigan. The territory involved includes the states of Wyoming, Colorado and New Mexico.

H. W. Thompson, formerly sales manager for Bardons and Oliver, has been elected a vice president of the George T. Trundle Engineering Company, Cleveland, Ohio, in charge of promotion. He will assume his duties with that company on December 1.

The stockholders of Joseph T. Ryerson & Son, Inc., have purchased a substantial interest in the Reed-Smith Company at 19th and South Canal Streets, Milwaukee. The Reed-Smith Company is a successful independent steel warehousing company, serving the industry in that section of the country. It has a large and varied line of finished steel products in stock, with ample facilities for quick shipment. Under the new plan the officers of the Reed-Smith Company of Milwaukee are: D. M. Ryerson, president; George W. Smith, vice president and general manager; E. L. Hartig, treasurer; Carl Gallauer, secretary.

The Falls Hollow Staybolt Company, Cuyahoga Falls, Ohio, has made radical changes in its plant in following out a program of improvement in the production of hollow staybolt iron. The most important change made is the installation of a new automatic mill which eliminates much of the manual labor and controls the evolution of the bar automatically. The results claimed for the new process are that the bar is rolled more economically and, at the same time, more uniformly having a rounder gage, a rounder hole and is split-proof in the arrangement of the fibrous amalgamation.

The Gibb Instrument Company of Bay City, Mich., manufacturers of electric welding and electric heating equipment, announces the appointment of H. V. Beronius to represent the company in Iowa, Kansas, Nebraska, Oklahoma and northwestern Missouri. Mr. Beronius' headquarters will be 33 Linwood Terrace, Kansas City, Mo.

The Marion Machine, Foundry & Supply Company, Marion, Ind., has opened an office at 116 West 39th street, New York city, for the handling of sales and service in the metropolitan district. This office will be under the management of W. H. Caldwell.

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—George Uhler, Washington, D. C.

Deputy Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law Society

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—John A. Stevens, Lowell, Mass.

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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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

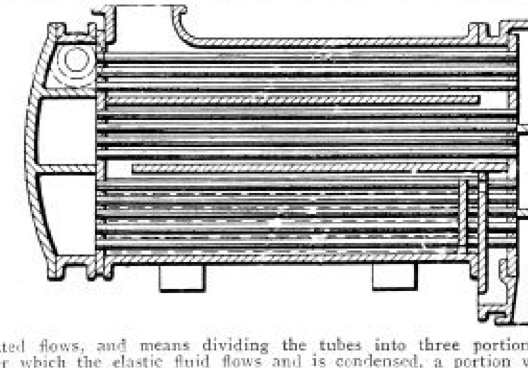
Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

SELECTED BOILER PATENTS

Compiled by
DWIGHT B. GALT, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

1,509,782. FEED-WATER HEATER. FREDERICK SAMUELSON, OF RUGBY, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

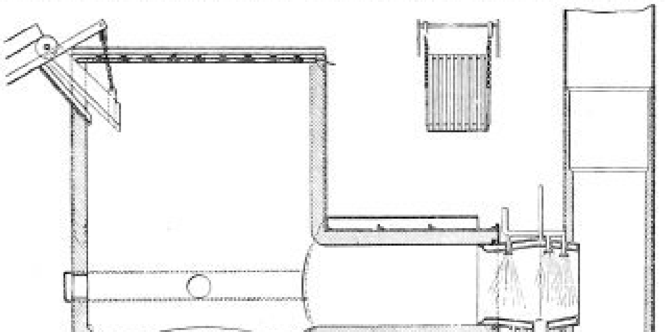
Claim 1.—A feed water heater comprising a casing, tubes in the casing over which heating elastic fluid flows and through which feed water to be



heated flows, and means dividing the tubes into three portions, a portion over which the elastic fluid flows and is condensed, a portion which is surrounded by condensed elastic fluid, and a portion over which the air and non-condensable gases flow. Four claims.

1,509,475. WOOD-REFUSE DESTROYER. CHARLES HARRISON, OF VANCOUVER, BRITISH COLUMBIA, CANADA.

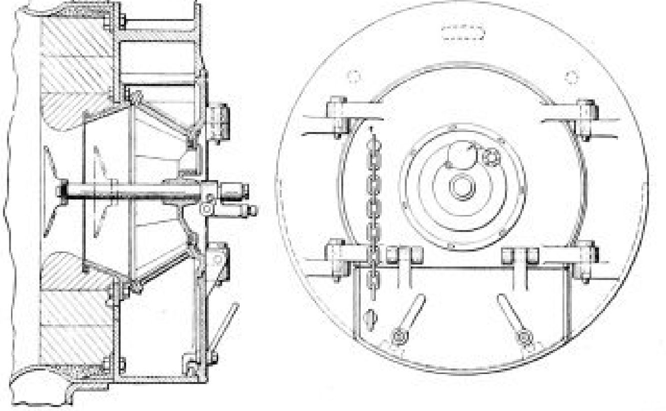
Claim 1.—A refuse burner comprising in combination a cylindrical chamber having a closed top and grates in the bottom, means for delivering air for combustion to the grates, means for delivering the material to be burned



into the upper part of the chamber, a cylindrical duct delivering the products of combustion from the lower part of the chamber to the smoke stack, said duct having a length the bottom of which drains to an outlet intermediate its ends, and means for delivering a spray of water across the area of said length of the duct. Six claims.

1,508,719. FURNACE FRONT. ERNEST H. PEABODY, OF PELHAM MANOR, NEW YORK.

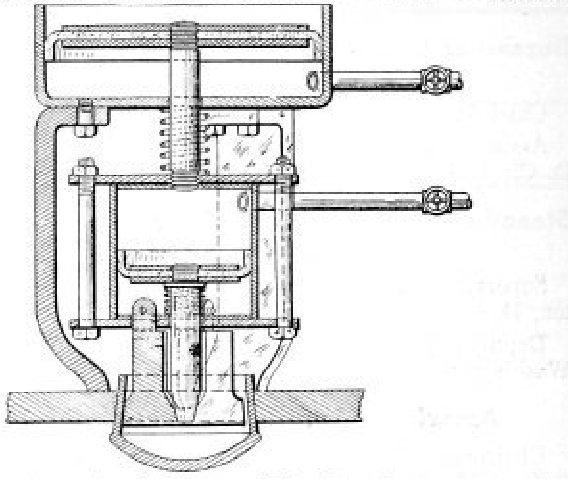
Claim 1.—A furnace front comprising a ring like member adapted to fit into an opening in a furnace, an annular air register supported by the front



by hinge joints enabling it to swing to either side, and means carried by said register and engaging the ring like member to automatically center the air register when it is swung to operative position. Seven claims.

1,506,948. TOOL FOR INSTALLING BOILER HANDHOLE CAPS. WALTER SIEGERIST, OF ST. LOUIS, MISSOURI, ASSIGNOR TO HEINE BOILER COMPANY, OF ST. LOUIS, MISSOURI.

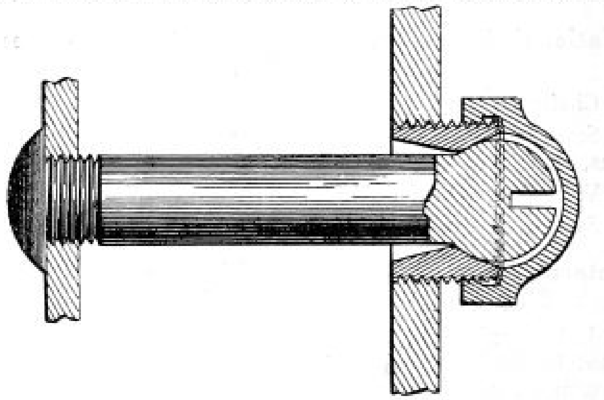
Claim 1.—A tool for the purpose described, comprising jaws adapted to be introduced into a hollow article and thereafter moved into engagement



with said article, a piston for moving said jaws in a direction to cause them to exert pressure on said hollow article and shift it relatively to a part in which it is positioned, a cylinder in which said piston is reciprocatingly mounted, and means for supplying an operating medium to said cylinder. Eight claims.

1,507,841. STAY-BOLT STRUCTURE. FREDERICK K. LANDGRAF, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO FLANNERY BOLT COMPANY, OF PITTSBURGH, PENNSYLVANIA.

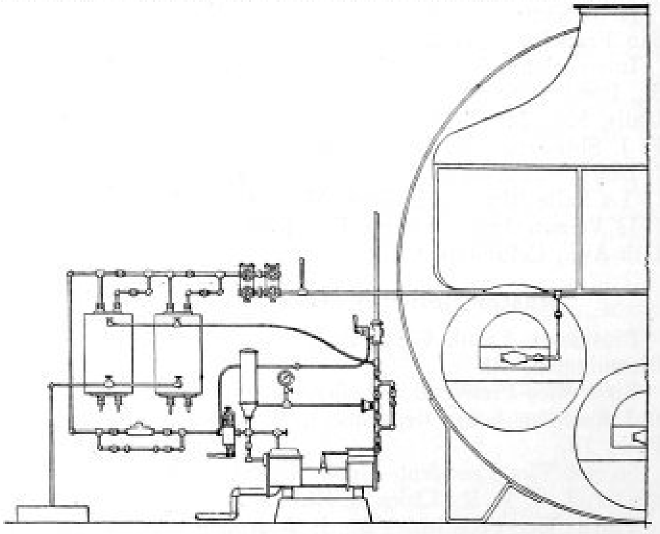
Claim 1.—The combination with a hollow member having an internally threaded portion and also an internal annular shoulder adjacent to the inner



end of the threaded portion, of a metal gasket lying flatly against said shoulder and having its peripheral portion extending radially past the free edge of the threads of the threaded portion of said member, whereby said gasket is prevented from escape from said hollow member. Three claims.

1,502,564. STEAM BOILER PLANT. FREDERICK HEATH, OF BELLINGHAM, WASHINGTON.

Claim 1.—The combination of an oil burner, a pump, an oil line connecting the pump with the burner whereby oil under pressure will be



supplied to the burner, and an oil-control valve interposed in the oil line, said valve closing upon reduction of pressure in the oil line whereby to cut off the further flow of oil. Four claims.

THE BOILER MAKER

DECEMBER, 1924

Special Shop Equipment Aids Production

Boiler Shop Tools Developed as a Result of Investigating the Needs of a Locomotive Repair Plant

By H. A. Lacerda

THE road with which I am connected realizing the importance of developing shop production by every means possible, and being a progressive organization has, among other means for attaining this end, established a piece work system and employed a special investigator for developing short cuts and efficiency methods. This position the writer has the privilege of holding. In the course of this work a number of shop-made devices have been designed that are intended to lighten labor, effect economies and speed up production generally. With the thought in mind that some of these devices may prove helpful to others of the boiler making fraternity, sketches and brief descriptions of them are given below.

That the use of labor-saving equipment and special studies of operations will speed up work is apparent from the results accomplished in our shop. For example, in removing the largest firebox going into the shop, containing 1,400 staybolts, three men do the work in 75 man-hours. In removing mud ring rivets we cut and take out two hundred and five ⅞-inch rivets in 3½ to 4 hours with two men doing the work. Formerly two days was required with four men working. All rigid staybolts are double-gunned—two men doing 850 in 8 hours, which means 1,700 staybolt ends. By employing a spring dolly bar, designed and patented by the writer, the men are able to drive 6 flexible staybolts per minute.

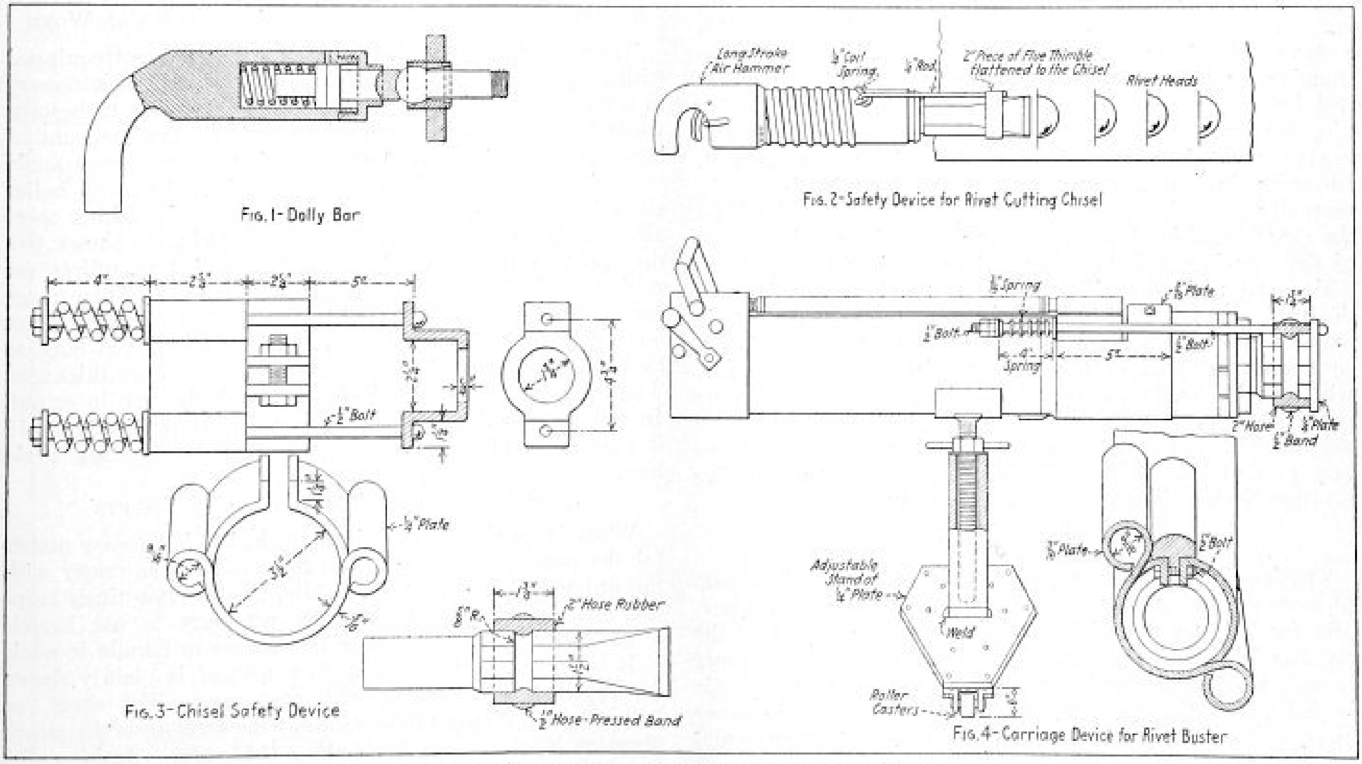


Fig. 1—Dolly Bar

Fig. 2—Safety Device for Rivet Cutting Chisel

Fig. 3—Chisel Safety Device

Fig. 4—Carriage Device for Rivet Buster

Devices That Will Be Found Useful in the Shop

Dolly Bar for Mounting Flexible Staybolts

In the construction and repair of fireboxes for locomotive engines, and the like, it is essential when securing a staybolt in position that care be taken to prevent flattening or deformation of the head of the bolt, which would otherwise disrupt or injure the bushing in which the head is mounted and thus affect the proper expansion and contraction of the firebox walls. Two methods have heretofore been employed in the mounting of flexible staybolts. First, it has been a common practice to shear off the closed end of a nut or cap which is ordinarily threaded on the bushing after a staybolt has been secured in position. The sheared nut is first threaded on the bushing, after which a sledge is engaged with the flat surface of the nut formed by the sheared end and held in engagement thereafter while the automatic hammer is being used to head the other end of the bolt. It thus becomes necessary to remove the sheared nut and replace it with another of the same type which has not been sheared.

The second method is similar to this in that a tool is utilized including a body portion which must be threaded upon the bushing during the process of securing the staybolt in place. After which the body portion must be removed from the bushing and a nut like the last one mentioned threaded upon it.

The present method, employing a tool simple and efficient in construction, overcomes the objections to the above methods by making it necessary to thread any element onto the bushing before securing the bolt in place and removing this element subsequent to the securing operation.

The tool consists of a body portion which may be made of any desirable material, such as machine steel, having a reduced curved end providing a handle, utilized to facilitate the handling of the tool when in use. The body portion is provided with a chamber extending longitudinally over a considerable portion of its length and communicating at its open end with the end of the body portion opposite the handle. The open end of the body portion is reduced and externally screw threaded to receive a cap having a central opening which communicates with the chamber. The head is mounted in the chamber; and is fitted at its inner end with a flange of substantially the same diameter as that of the chamber, so that the upward movement of the head is limited by contact of the flange with the cap. The centering pin, having a flange or head engagable with this flange, is also mounted so that it is allowed longitudinal movement. In order that an upward pressure upon the head may be normally exerted, a compression spring is disposed within the chamber which has one end engaged with the inner end of the chamber and the other end engaged with the flange. This spring also provides a shock absorbing cushion for the head as it is forced inward by the action of the automatic hammer against the staybolt. The reaction of the spring is such that the head of the staybolt will be unaffected and will readily enable the user to hold the tool in its proper position. The outer extremity of the head is convex and shaped to conform to the contour of the head end of the staybolt so that the tool may be held in the proper operative position during the operation of the automatic hammer.

Keeping Down Accidents

One of the greatest causes for accidents in a boiler shop of more or less serious nature is the system employed generally for holding rivet dies and chisels in the barrel of the riveting hammer. If by accident the trigger of the hammer is pressed when the die is not engaged with the work, the die is shot out of the machine with considerable force, in many cases striking other workers that are nearby. Manufacturers have not corrected this trouble to any great extent. In Fig. 2 is shown a simple means for holding chisels and dies in long-stroke hammers. The device consists of a piece of 2-inch flue flattened against the chisel. This ring must be fitted in each case because of the impossibility of making a standard size to fit all chisel shanks after they have been redressed by the blacksmith. The spring which is fastened around the barrel of the hammer is out of the operator's way, but it is very easy to detach the hook when necessary to remove the chisel for repairs.

There may be boiler makers in some shops who are more or less afraid to use these guns in cutting off tank rivets because of the lack of a safety device for holding large chisels in the gun. In other words, they much prefer the old way of cutting them out by hand with a side chisel and sledge, but there is absolutely no reason for doing this when the easy method can also be made a safe one.

In Fig. 3 is shown a safety device for holding the chisel in the barrel of a rivet buster for use in cutting out mud ring rivets. This is probably the most powerful and productive pneumatic buster in use. As noted above, we can very easily cut and back out 205 mud ring rivets on an average of between 3½ to 4 hours. Speed is only one factor here, safety being the most important, it having required much time and study to develop the method so that the operation can be carried out without danger.

A carriage device for handling this rivet buster is shown in Fig. 4. The operators are practically relieved of all weight in handling the device and are given to feel that they have a rapid firing gun instead of a rivet buster to handle. A side view of the rivet buster as it is mounted on the carriage indicates the manner in which the chisel is held from flying out.

A detail drawing is also shown of the strap which is made of 3/16-inch plate fitted around the barrel of the gun. Two 1-inch rods project through the side of this strap with a compression spring at the back end. Chisels that are to be used in the rivet buster are fitted with a rubber hose band compressed into the groove and held tightly in place by a hose clamp. This arrangement has been successful in preventing accidents caused by the chisel leaving the barrel of the gun.

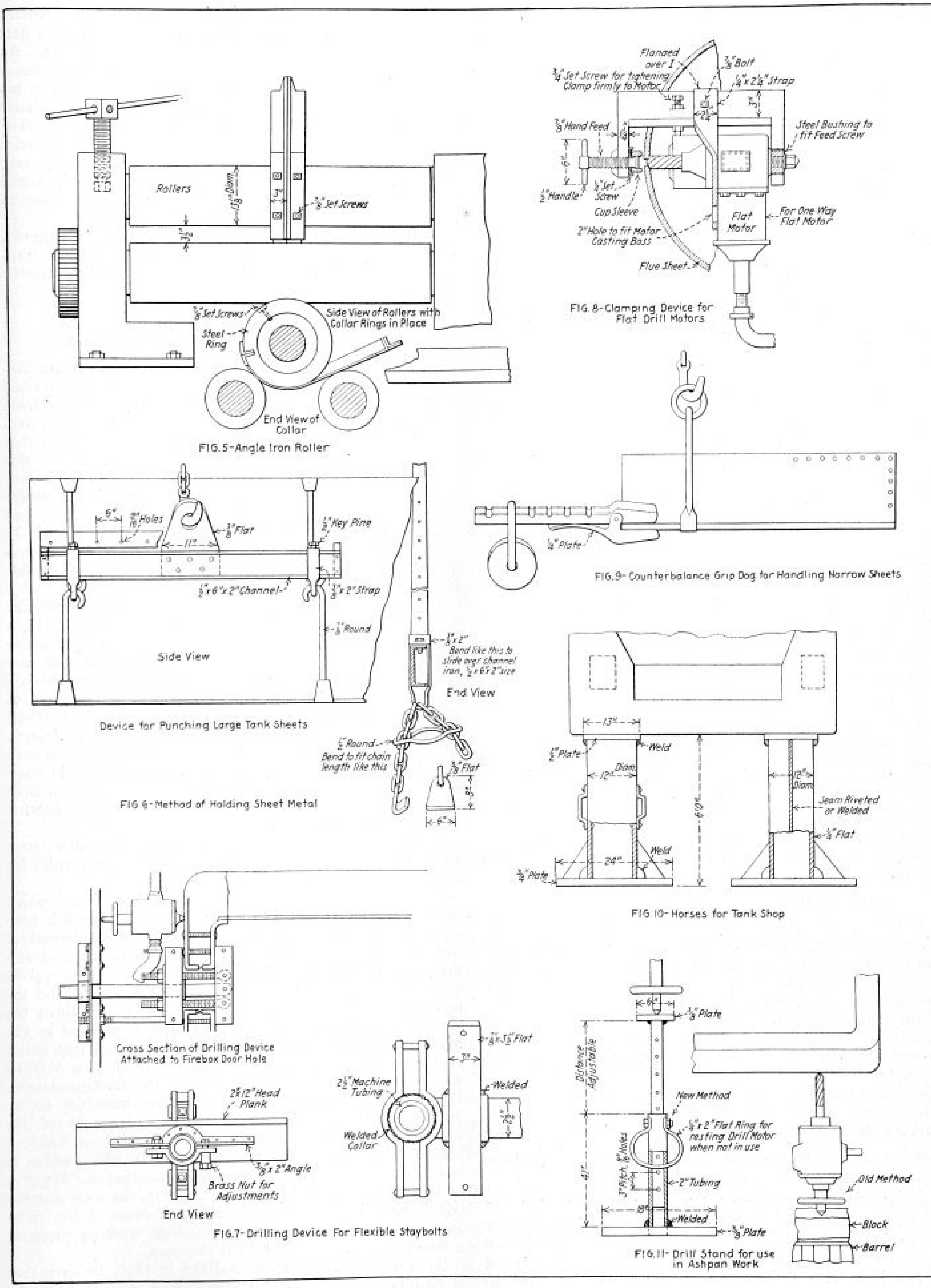
Rolling Angle Iron Cold for Tank and Cab Work

There may be a number of shops that are not equipped with a special angle iron roller so that when it is necessary to bend angle iron for tank and cab work it has to be bent while hot. In other places where only a small amount of bending is required the cost of casting the necessary angle iron service block is hardly worth while. In every boiler shop, however, there is some form of plate roller either operated by hand or power. The sketch, Fig. 5, shows two detachable collar rings that can be applied to rollers for rolling angle iron cold to any desired radius. These rings are fastened to the rollers with four ¾-inch submerged set screws. For rolling the iron two angles are placed back to back on the rolls and the collar set to the proper thickness. The angles can thus be rolled either with the web in or out. In rolling with the web out, a few bolts are required to hold it together. This is a real time saver for bending angle iron.

Punching Large Tank and Cab Sheets

When large sheets are being punched it is no easy matter for the punch operator to raise the sheet in the center with the ordinary hooks provided while, at the same time, keeping the sheet level. It is often necessary to use barrels to support the sheet or utilize two cranes to handle it while it is being punched. In Fig. 6, a method is plainly shown for handling large sheets with one crane. The sheet can be picked up at any place, while at the same time the punch operator is enabled to work along the center. Incidentally, the device makes it possible to do the work without the aid of a helper. Another advantage of the device is that the sheet does not jump while it is being punched, as it does when handled in the usual way.

The end view of the counterbalancing device shows another method of picking up the sheets with the chain hooks. The chains are fitted with a sliding oval ring which can be raised or lowered to tighten the strap hooks at the edge of the plate regardless of the length of chain that may be used. For example, if the chain is sufficiently long to pick up a



Additional Shop-made Boiler Equipment

plate 12 inches in width by moving the safety strap to the bottom, it will also pick up a plate 20 inches to 30 inches in width and, at the same time, hold the strap hooks tight against the edge of the plate so that there is no danger of their slipping out. This does away with the necessity of having many different lengths of lift hooks.

Drilling Staybolts When Removing Firebox Sheets

We have practically discontinued to drill staybolts, burning them out with the oxy-acetylene torch instead. However, when drilling the breakage zone for flexible staybolts, we use the device shown in Fig. 7. It was originally designed for the purpose of drilling all staybolts on the back head of the boiler, before we commenced burning them out. The advantage of this drilling device over the "old man" method of drilling is that it requires no stays or bolts. It fastens directly in the center of the firebox door hole as will be noted in the accompanying drawing, and once the 2-inch bolt with a spring back sliding sleeve is drawn up tight against the back head of the boiler a drilling post as rigid as that of any drill press is obtained. The one setting of this device will enable the operator to drill the entire back head of the boiler without changing the position of this equipment.

The back arm of the post upon which the motor feed rests is simply a 2-inch by 12-inch hard wood plank with a hole through it having a 3/8-inch by 2-inch angle iron fitted at the back to a ring shaped as noted in the back view shown on the drawing. A bottom strap also of the same diameter is fastened in place with a brass nut which adjusts it on the drilling post. The center post is made of 2½-inch diameter machine tubing fastened to a short strong back key pin extending through the center of the outside strong back, which is provided with a welded sleeve to keep the center post in line. We also have a drill device for taking care of the entire outside wrapper sheet in one setting. Four gangs can use it simultaneously.

Countersinking of Firebox Flange Sheets

It is well known that two men are usually required to countersink the rivet holes in flanged sheets—one to run the motor and the other to bear against the motor by means of a plank or leverage of some sort. This is generally done by the boiler maker and his helper. The drawing, Fig. 8, shows a clamping arrangement attached to an ordinary flat motor which will enable any unskilled boiler maker helper to do the work alone and countersink from 65 to 75 holes per hour.

Another Device for the Punch Operator

Fig. 9 shows a counterbalanced grip dog device for punching narrow sheets. It will be noticed how easily the operator can pick up the sheet at one end and punch the holes along the center while at the same time balancing the sheet under the punch at any desired height by moving the weight to different points along the handle. This dog device is very positive in its grip. No matter how the sheet is slung around, the grip will not let go the edge of the plate until the weight is removed. This does away with former methods of weighting down the top of the sheet at one end, which often caused injury by the weight sliding out of place and striking the operator.

Drilling Stay Holes for Ash Pan Casting Supports

The sketch, Fig. 11, shows a useful drilling stand for supporting the motor at any height for drilling stay holes in the bottom of the mud ring. The adjustment to height may be made to suit any length of drill that can be obtained from the tool rooms. In most shops when old stays need renewing or new holes have to be drilled, it is necessary to build up blocking to support the drill. The adjustable drill stand is always ready and can be raised or lowered to any desired height. The stand is made of machine tubing with a base welded to a plate 3/8 inch by 18 inches in diameter. An inner tube is adjustable inside the outer tube with a number of 9/16-inch holes drilled to take ½-inch bolts. The top of the inner tube, also of 3/8-inch plate, 6 inches in diameter, is welded in place as a rest for the motor feed. The ring strap shown on the stand is made of ¼-inch material 1½ inches wide with a diameter of 9 inches. This ring is fitted as a rest for the motor while it is not in use, instead of putting the motor on the floor when it is necessary to change the drills or to remove them for grinding.

Should further details of any of these devices be required, the writer will be pleased to furnish them through THE BOILER MAKER. Any communications to the author may be sent in care of the magazine.

Boiler Legislation in France

IN 1810 the danger of smoke being emitted by steam fire-engine boilers led to the passing of an act that prescribed that authorization for steam boilers had to be obtained. Thirteen years later the necessity for having safety valves on boilers had made itself felt, and a law was passed that each boiler must have a lock-up safety valve. About this time the first instructions to boiler attendants were issued. Three years later a law was passed prescribing a severe hydraulic test for all new boilers. At the same time, and again in 1830, rules for boiler dimensions were issued. In 1832 further rules were added, prescribing the diameters of safety valves and insisting on the installation of fusible plugs.

In 1839 a retrograde movement set in, and the hydraulic test pressure was reduced in severity, and then, in 1843, a very detailed boiler law came into force It was an improvement on the previous severe laws, but it bristled with new minute regulations, which seem to have grown in oppressiveness until, in 1865, they were swept away by a new law. About ten circulars were issued in the interval, the first one extending the scope of the act so as to include steam receivers. In 1847 three low-water indicators had to be fitted to each boiler. It was also stipulated that boilers must be laid down in certain directions, for it seemed to have been noticed that in cases of accident destruction of property was greatest at either end of a boiler.

In 1849 Bourdon's pressure gages, a new invention, were allowed to replace the mercurial ones, and in 1861 rules for the thickness of steel plates were issued.

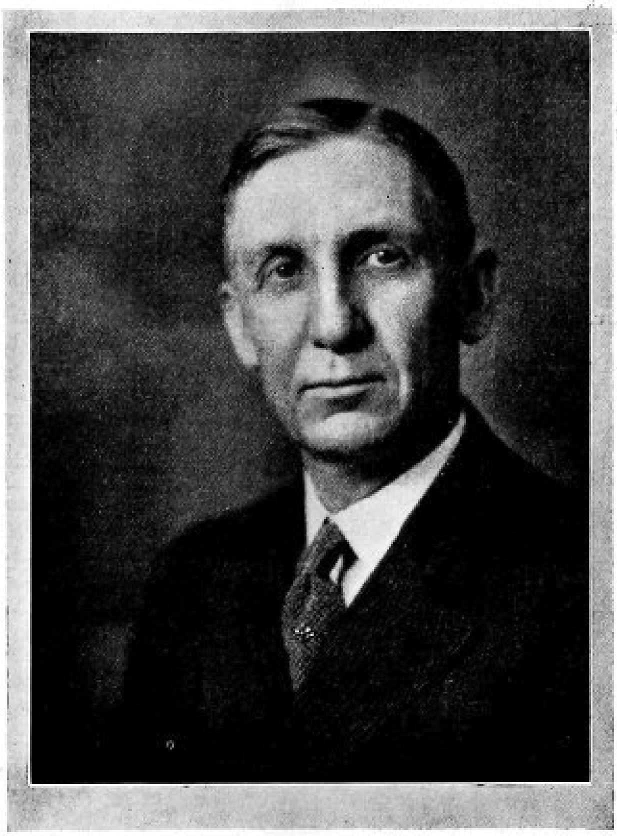
As already mentioned, in 1865 a law was passed which swept away many of the rules and regulations which government officials had been slowly building up. Boilermakers were now free to build boilers of any dimension and any thickness and place them in any direction; safety valves might be any size, steam receivers were not boilers, and the test pressures which had started at three or five times the working pressure were now reduced to those adopted by the Manchester Steam Users' Association. Inquiries into boiler explosions were ordered, and strange to say, the law of 1810 was revived by certain clauses against the smoke nuisance. Furnaces might smoke, but steam boilers must not do so. In 1880 this regulation was dropped. In some of the previous laws, but more particularly in that of 1865, a system of boiler classification was adopted, which seems to have been based on certain speculations—that the larger a boiler and the higher its working pressure, the more dangerous it must be. By multiplying the volume of the water contained in a boiler by the permissible working pressure, a figure was obtained that fixed the class.

This regulation had to be modified in 1880, for even then it had been found that high-pressure boilers were not so

(*Continued on page 364*)

Laying Out Locomotive Boilers

By W. E. Joynes



W. E. Joynes was born March 8, 1882, in Newport News, Va., and obtained his early education at French's private school and at the public schools of that place. Later he served as an apprentice in the ship fitting, mold loft and drafting departments of the Newport News Shipbuilding and Dry Dock Company. In all, he worked as a draftsman for this company for a period of six and a half years. During this time he attended Smith's elementary and applied mechanical evening class, later amplifying this education by outside study and private tutoring. Following this start in the shipbuilding industry, he was engaged for two years in Maine and Massachusetts shipyards. His first departure from ship work was in connection with steel building construction as a draftsman and in charge of outside work. For the past seventeen years Mr. Joynes has been connected with the American Locomotive Company, more than thirteen years of which time has been devoted to boiler design and plate development work. His first four years' experience in locomotive construction were in general design, drafting and in the manufacturing departments, as well as in practical shop experience. He has probably done more than any one connected with this company towards simplifying the methods of laying out locomotive boilers and is well qualified to present the results of his experience to our readers.

THE first of a series of articles under the above title will be published in the January issue of THE BOILER MAKER. The work has been developed by Mr. Joynes in an entirely new way and forms the only complete method of accurately laying out the sheets of a locomotive boiler so far published. Two boilers of different types will be described, in which are presented all the problems in plate development and layout design methods that occur in practically any boiler. In actual practice these same methods have enabled the locomotive builder and repair shop to completely develop all the sheets of the boiler on paper so that when they are laid out to full scale in the shop they are absolutely correct and require no adjusting to make them fit into place properly. It is hoped that all of our readers will find the articles both interesting and instructive as they represent the last word in boiler layout work.

Building a Straight Tube Watertube Boiler

Development of the Cammell-Laird Three-Drum Type Boiler and Practical Details of Its Construction

By F. G. Bailey

COMPARED with the "return tube circular" type boiler, a "3-drum" watertube boiler is a sharp contrast and, although this article is not the place to express a preference for either type, the watertube boiler, for mercantile or marine purposes or steam raising generally, merits the attention of all who need a simple, light, responsive, high powered unit.

Although it is of course widely known that the renewal of tubes in boilers of this type presents no particular difficulty in itself, engineers and superintendents realize that in order to readily replace tubes that are bent to a particular outline (as is usual in 3-drum watertube boilers) a large supply of spare tubes, each ready bent to suit its position must be kept on hand. This expensive bugbear has been overcome by the introduction of the "Cammell-Laird" boiler, which, among other important advantages, has eliminated this difficulty.

These improvements are summed up in the phrase of "straight tubes with round drums," and no further recommendation is really needed, the advantages are so obvious as compared with the former type of 3-drum boiler, with its "D" shaped water pockets of faulty design, which ultimately led to serious trouble.

Fig. 1 shows a sectional view of a very good and established type of 3-drum boiler with its wide variety of bent tubes, which are costly initially and in replacement.

Fig. 2 shows a corresponding view of a Cammell-Laird boiler and the comparative simplicity will at once be noted.

How the simplicity is attained and the combination of straght tubes with round drums achieved, will be seen by referring to Fig. 3 (a section of the Cammell-Laird patented water drum), and those to whom the matter is new, will readily appreciate this distinct advance in watertube boiler design. Of course Messrs. Cammell-Laird's boiler shops do not confine themselves to any one line of manufacture, but are capable of dealing with any kind of boiler work, and although the following description of construction applies to 3-drum boiler work generally, Babcock and Wilcox, Niclausse and Belleville boiler work is catered to.

Precision an Important Factor

From start to finish in this class of work precision of measurement and setting are paramount factors. The preliminary stages of the work follow the same lines as for ordinary boiler work generally. The drawing is issued to the shop. The "marker-off" lays the job down on the loft and makes the necessary templates. Even at this stage the simplicity of the "Cammell-Laird" type emphasizes itself, for with a bent tube boiler a host of accurately bent patterns and matrixes would be required, but with straight tubes they are entirely eliminated, and the work proceeds more rapidly.

As will be seen from the section view of drums, the tube plates must be most carefully made, and the plates instead of being rolled or gradually bent to shape are, while hot, pressed to shape by suitable blocks in the hydraulic press.

By means of the large edge-planing machines, and with the help of modern lathes, the plates are machined to reduce thicknesses where the rows of rivets are to be provided for. The greatest care is demanded in this work, to ensure against any slight longitudinal tool marks where the change of section takes place.

The wrapper plates (the thinner semi-circular portions of drums) are rolled to shape in either vertical or horizontal rollers, the plates being relatively thin. The dished ends are flanged and dished simultaneously in a 3-ram hydraulic press by means of blocks, and the butt straps by the same process as for those of circular boilers.

The rivet holes are not drilled until the drums are completely assembled, but the tube holes are immediately proceeded with and, in this, meticulous attention is given to produce each hole accurate in bore.

As will be seen in the illustrations, each tube-end, in addition to being expanded into the plates is bell-mouthed, which entails specially machining away of the tube plate. This is done by special cutters carried on the spindles of drilling machines.

Heavy cast iron jigs are used as guides in drilling the tube holes and large multi-spindled machines are employed which drill as many as six holes at once with a minimum of superintendence.

Drilling the Tube Holes

When the tube holes are drilled in the steam drum plate, the whole drum is assembled and the rivet holes drilled, this drilling being done by a battery of radial drills co-operating to deal speedily with the work. After dismantling them and the removing of the burrs from the rivet holes, the steam drums are rebuilt and riveted. Usually one end and the strapped seams are riveted by the hydraulic machine and the other end by hand.

The foregoing descriptive matter applies fairly closely to the water drums, but these latter are not riveted up at this stage, the bottom plates being removed and left off until after the boiler is tubed.

The tubes, all of the finest steel, are seamless, being "solid-drawn" and cold finished. As an aid to examination, the tubes are usually electro-plated with zinc, which gives a surface that readily throws up a defect into sharp relief; and an extensive electro zincing plant is an integral part of the boiler works plant. It is adjacent to the cutting off machines and the tube testing set.

Prior to tubing, the 3 drums are built up in correct relative positions in special cradles and the boiler is kept sufficiently high to enable the tubes to be passed upward through holes in the water drum tube plates, which are slightly larger than the holes in the steam drum. The tube ends are now roller expanded with a special self-feeding expander that also performs the bell-mouthing or, alternatively the bell mouth is formed by the use of a specially coned drift.

The metal at each end of the tube is rounded by a small tool arranged on the cutting-off machine, used to cut the tubes to length prior to fitting in place. Tubing done, the bottom plates are placed in position on water drums and calked where hand riveted, the "generator" is ready for its water pressure test. The "light" or casing work is an important item in watertube boilers and the tools, dies, etc., which are used for various parts have helped to render this work very accurate. The marking off of this work is highly onerous.

The firebrick work is another big item in this type of boiler, but there is not sufficient space here to enlarge upon matters of this kind.

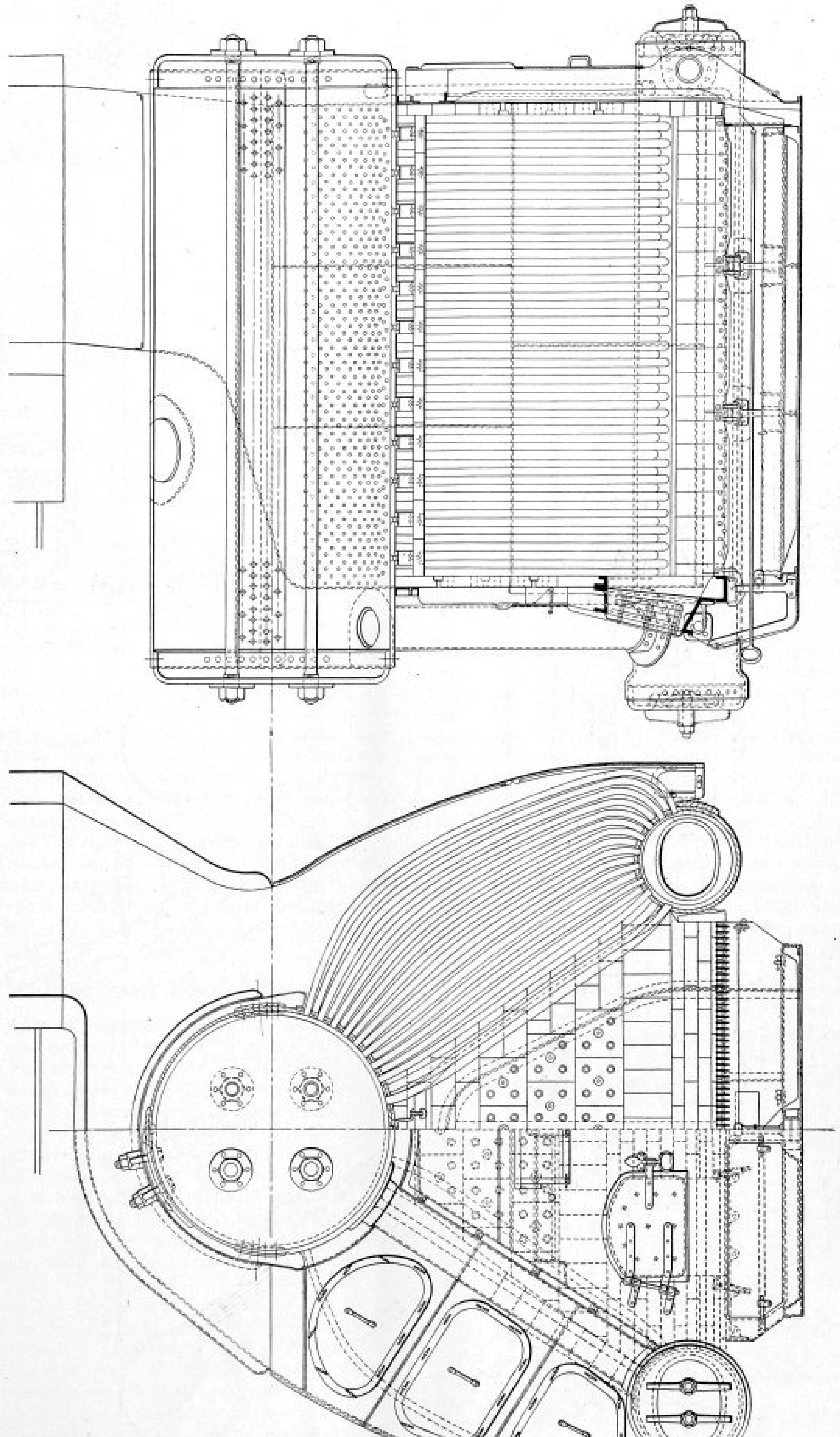
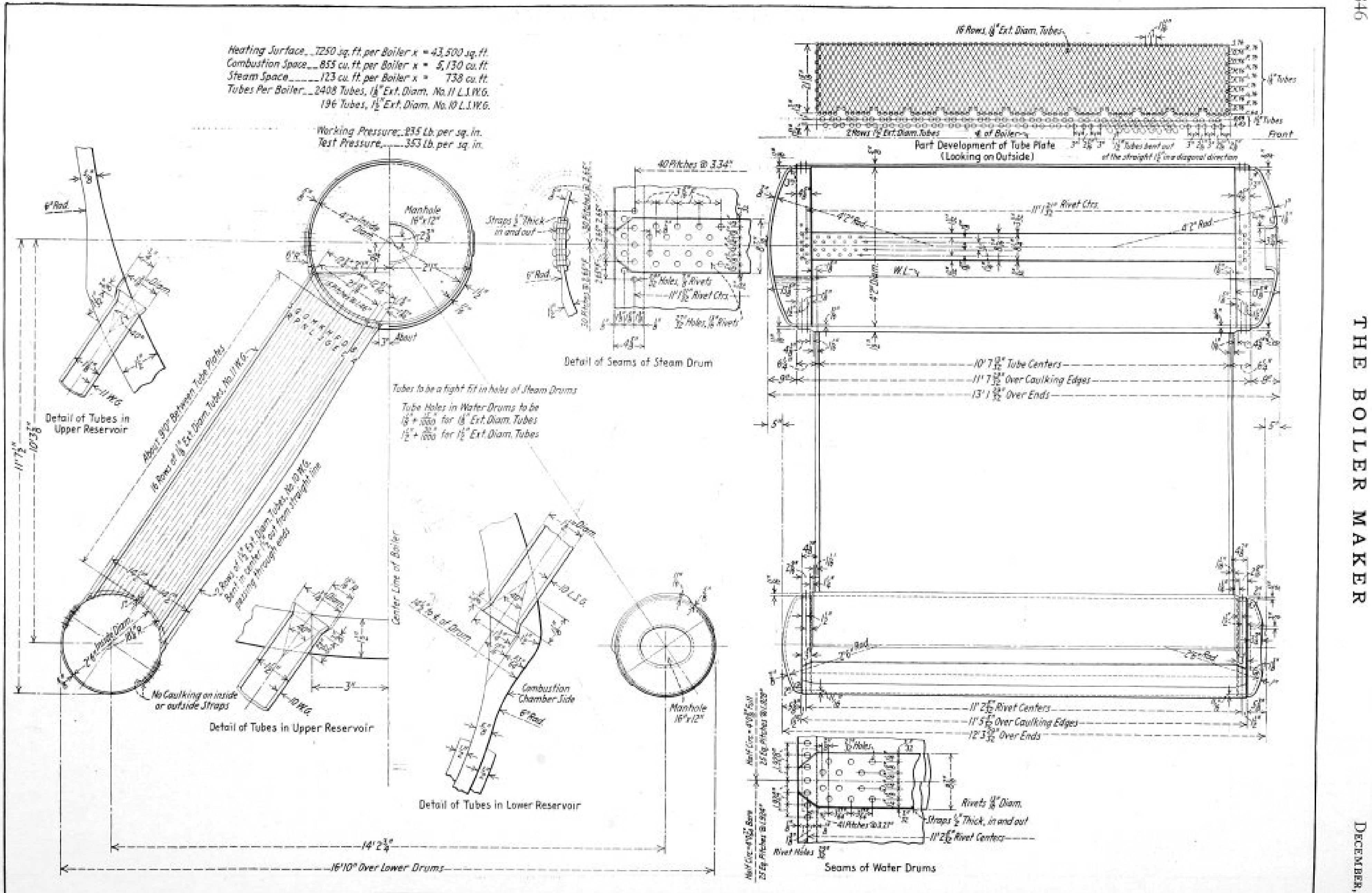


Fig. 1.—Bent Tube Type Watertube Boiler



Straight Tubes Are Used in the Cammell-Laird Boiler

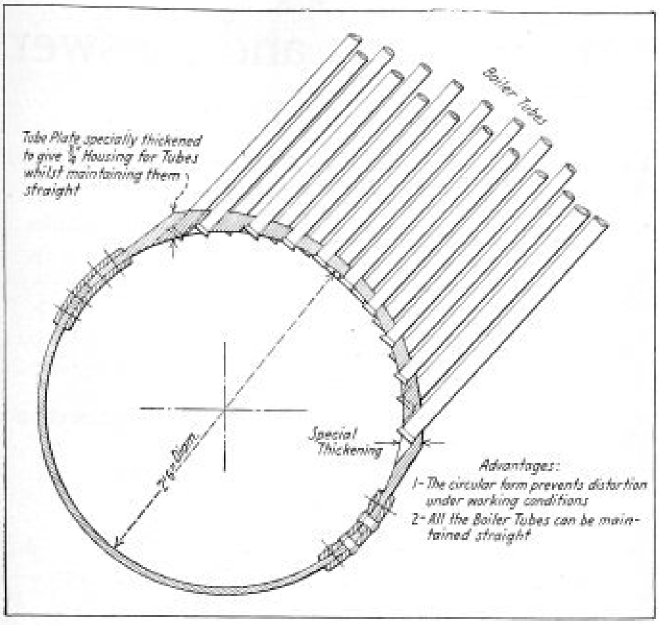


Fig. 3.—Section of the Cammell-Laird Water Drum

In the "Cammell-Laird" watertube type, the space occupied by the boilers could have been reduced by two-thirds: the boiler weights astonishingly reduced and the stokehold personnel correspondingly diminished.

To return to the subject of the Boiler shop—in these days a boiler shop that is well equipped employs separate electric drive for its various machines, has full outfits for oxy-acetylene burning and welding also electric welding, and the amount of work that is not actually boiler work is rapidly rivaling the latter in quantity. Giant rotary kilns, large insulators, steel plate condensers and turbine exhaust bends, tanks for rolling stock, feed tanks and reservoirs, digesters, tip buckets, etc., are taken as ordinary items of the shop's work and its versatility is an important asset.

From the above description the writer is indebted to Messrs. Cammell-Laird and Company, Limited, recognized in Great Britain as one of the leading authorities in the manufacture of the various types of boilers at present on the English market.

Safety Valves and Birds' Nests*

IT would naturally be supposed that when a man had reached the age necessary to have acquired sufficient knowledge and experience to enable him to qualify as a boiler inspector, the pleasures of boyhood days would be but memories of the dim past, never again to be revived. The exception which proves the rule, however, is forcibly illustrated by the following incident which occurred in the writer's experience about six years ago when making an external inspection of four horizontal tubular boilers.

On arrival at the plant, the inspector paid his customary social call at the office, where he was well acquainted, chatted for a few moments with the chief engineer in the engine room, and then proceeded to make the usual external inspection. He watched the fireman blow down the water column and operate the try cocks, and then asked to have the safety valves blown. The boilers were each equipped with one 4 inch pop type valve, the escape pipes being carried horizontally through the building wall and discharging outside. The fireman went up the ladder to blow the valves and the inspector went outside to observe the discharge from the escape pipes. The valve on boiler No. 1 was first blown and everything was satisfactory. When No. 2 was blown it was noted that something in the form of solid matter was ejected from the pipe and, striking a wall about 6 feet distant, fell to the ground. An examination of this object showed it to be a bird's nest battered out of shape and containing some eggs which had been smashed. The inspector was somewhat alarmed at this discovery for, while he realized that it was indeed the season of the year when as a boy he hunted birds' nests, he remembered that they were usually found in hedges and trees and in some cases in the grass, but never had he found or heard of one being found in a piece of iron pipe, especially a pipe that at one end was connected to a boiler carrying 140 pounds steam pressure.

The valve on boiler No. 3 was next blown and another bird's nest was ejected. This one, like the first, was battered out of shape by the impact against the wall. Unlike the other, however, it contained no eggs but instead there were three fledglings which had just been hatched out and which, of course, had been scalded to death by the escaping steam. The valve on boiler No. 4 was next blown and, like No. 1, was found free and clear of obstructions.

The inspector again sought the chief engineer and asked him how often the valves were blown. He replied, "Every morning, regularly." Asked if he personally saw them blown, he stated that he did not but he stood in the engine room and heard them blown one after another each morning. The subject was changed by the inspector and the fine weather being experienced just then was commented on, the inspector intimating that it must be about time for the birds to be building their nests. He then asked the chief about how long it would take a bird to build its nest and hatch out the eggs. The chief replied that he was not very well posted in such matters but presumed that it would take several weeks. He was then invited outside and shown the nests, and, on being informed where they came from, expressed surprise and indignation. Inquiry of the fireman brought forth the assertion that all valves were blown every day, but, on being confronted with the evidence of failure to blow Nos. 2 and 3, he admitted his neglect. When the time arrived each morning to try the valves, he blew the valve on one boiler only, blowing it four times and allowing a liberal interval between blows to give the impression that all four had been blown. This practice was alternated weekly between boilers Nos. 1 and 4. The reason assigned for not blowing boilers Nos. 2 and 3 was that there were too many pipes to climb between to reach them. After explaining the seriousness of this practice, the inspector left with an assurance that the valves would be properly blown in the future.

About three months afterwards the inspector again visited this plant for the purpose of inspecting one of the boilers internally. On entering the combustion chamber, he observed a bundle of straw in one corner which, on investigation, was found to be a creditable imitation of a bird's nest on a large scale and containing one dozen fresh hen fruit just off the farm. Fearing that, should someone neglect to remove them before the boiler was fired up, they might, if not hatched out, be somewhat overcooked, the Inspector transferred them to his grip and later found that, with a few rashers of bacon, they made excellent breakfast food.

* From an article by Robert P. Guy, Assistant Chief Inspector, New York Department, Hartford Steam Boiler Inspection and Insurance Company, appearing in *The Locomotive*.

WE DO NOT MAKE PROGRESS—

If we get new customers and don't hold the old ones.

Unless the public gets better service as we get better profits.

Until we do our work a little better than the rest.

Just because we become busier.

When the ethics of our business are sacrificed for dividends.

After we think our methods are good enough.

By calling all our critics unreasonable.

Boiler Inspectors' Examination Questions and Answers

By A. J. O'Neil*

THIS is the ninth and last instalment of a series of questions on both mechanical and boiler subjects which are liable to occur in state or federal examination papers for boiler inspectors. The earlier instalments appeared on page 105 of the April issue, page 139 of the May issue, page 180 of the June issue, page 208 of the July issue, page 231 of the August issue, page 264 of the September issue, page 293 of the October issue and page 320 of the November issue of THE BOILER MAKER. *The material should prove of benefit to all those who contemplate taking the examinations. The author would like to have those interested in the subject comment on the value of the information. Any questions which require a further explanation will be amplified at the request of any reader.*

REPORT OF A LOCOMOTIVE BOILER EXPLOSION

The following is a report of an accident to boiler of locomotive number 6, owned and operated by the Camden and Astoria Railroad, at Freehold, New Jersey, on May 1, 1920.

This boiler was a semi-wide, radial stayed type, with crown sheet supported by 22 transverse rows and 12 longitudinal rows of button head stays, spaced 4 by 4 inches, carrying 200 pounds steam pressure, and built by the Rome Locomotive Works, June 4, 1906.

At the time of the accident, the locomotive was standing on the ash pit, having returned from a trip to Camden. In the cab of the locomotive, at the time when the accident occurred, were the engineer, the fireman, engine hostler and fire cleaner. The fireman and engine hostler were instantly killed, the engineer and fire cleaner were rather seriously injured.

Inspection of the boiler showed that this accident was due to low water. The water line showed very plainly along the full length of the crown sheet on both sides and was found to be five inches below the highest part of the crown sheet.

The crown sheet and both side sheets of one piece construction, had torn away from the flue sheet, and pulled away from eight transverse rows of radial stays, and had torn away from the left side sheet for a distance of 52 inches and from the right side sheet for a distance of 50 inches back from the flue sheet.

All appurtenances were removed, inspected and tested, the steam gage was compared with a dead weight tester and found to be correct, the safety valves and injectors were placed on another locomotive and found to be in good working condition; the gage cocks were found to be clean; the tank valves and tank hose were in good condition; the check valves and openings were clean and in serviceable condition; the water-glass cocks were examined and it was found that, in the bottom cock, the gasket had been squeezed past and over the end of the tubular glass, greatly restricting if not entirely preventing proper circulation of water in the water glass.

Examination of the work reports showed that this defective water glass had been reported four times previous to accident, no record was found to show that repairs had been made.

While low water was the cause of this accident, it is believed that the defective water glass was a strong contributory cause of this crown-sheet failure.

Responsibility for this accident rests with the railroad company for not making repairs as reported and also for not inspecting the water-glass valves and gage cocks before the locomotive left the terminal.

*Locomotive Inspector, New York State Transit Commission.

FORMULAE FOR STRESSES ON SPECIFICATION CARDS

$$\text{Staybolts} = \frac{P \times a \times b}{(A\text{-}c)} \qquad \text{Crown stays} = \frac{P \times a \times b}{A}$$

P = Boiler pressure
a = Horizontal pitch
b = Vertical pitch
A = Area at root of thread or smallest section
c = Area of telltale hole.

$$\text{Braces} = \frac{\textit{Area Supported} \times \textit{Boiler Pressure}}{\textit{Total Area of Braces}}$$

$$\text{Rivets} = \frac{P \times D \times p}{2 \times a \times n} \qquad \text{Efficiency of seam} = \frac{p\text{-}d}{p}$$

$$\text{Tension on plate} = \frac{P \times D \times p}{2 \times t \times (p\text{-}d)}$$

P = Boiler pressure
D = Diameter of boiler
p = Pitch of unit section of seam
a = Area of rivet hole
d = Diameter of rivet hole
n = Number of rivet sections
t = Thickness of plate

$$\text{Safe working pressure} = \frac{T \times t \times E}{R \times F}$$

T = Tensile strength of shell sheets (See Rule 4)
t = Thickness of shell sheets
E = Efficiency of seam
R = Radius of boiler
F = Factor of Safety (Not less than 4)

EXAMPLES OF BOILER STRESSES WORKED OUT

$$\text{Stress on staybolts} = \frac{P \times a \times b}{(A\text{-}c)}$$

$$\text{At root of thread} = \frac{200 \times 4 \times 4}{0.547} =$$

5,850 pounds per square inch.

$$\text{At reduced section} = \frac{200 \times 4 \times 4}{0.519} =$$

6,170 pounds per square inch.

$$\text{Stress on crown stays} = \frac{P \times a \times b}{A}$$

$$\text{At root of thread} = \frac{200 \times 4 \times 4}{0.691} =$$

4,530 pounds per square inch.

$$\text{At smallest section} = \frac{200 \times 4 \times 4}{0.736} =$$

4,350 pounds per square inch.

$$\text{Tension on rivets} = \frac{P \times D \times p}{2 \times a \times n} =$$

$$\frac{200 \times 79.625 \times 9}{2 \times 1.108 \times 9} = 7{,}190 \text{ pounds per square inch.}$$

Efficiency of seam $= \dfrac{P \times d}{P} = \dfrac{9 - 1.1875}{9} = \dfrac{7.8125}{9} = 86.75$ percent.

Tension on plate $= \dfrac{P \times D \times p}{2 \times t \times (p\text{-}d)} = \dfrac{200 \times 79.625 \times 9}{2 \times 0.8125 \times 7.8125} = 11{,}280$ pounds per square inch.

Safe working pressure $= \dfrac{T \times t \times E}{R \times F}$

$$= \frac{55{,}200 \times 0.8125 \times 0.8675}{39.86 \times 4}$$

$= 240$ pounds

Bursting pressure $= \dfrac{T \times t \times E}{R}$

$$= \frac{55{,}200 \times 0.8125 \times 0.8675}{39.86}$$

$= 960$ pounds.

Area of Crown Stays at Root of Thread $= \dfrac{P \times a \times b}{A}$

Size of crown stay, Inches	*Area of stay at root of thread*
7/8	0.419
15/16	0.494
1	0.575
1 1/16	0.662
1 1/8	0.755
1 1/4	0.960

Rivets $= \dfrac{P \times D \times p}{2 \times a \times n}$

Suggested Allowable Stresses.

Staybolts, Crownbar bolts, Crown stays: 7,500 pounds

Round and Rect. braces, Gusset braces: 9,000 pounds

Iron rivets—shear 9,500 pounds.

Steel rivets—shear 11,000 pounds.

Net section of plate 12,500 pounds.

Factor of safety, 4 for boiler and 6 for firebox.

AREAS IN SQUARE INCHES TO BE USED IN CALCULATING STRESSES

Stress on staybolts $= \dfrac{P \times a \times b}{A - c}$

Size of staybolt, inches	$(A - c)$
3/4	0.261
13/16	0.324
7/8	0.392
15/16	0.467
1	0.547
1 1/16	0.635
1 1/8	0.728

Stress on crown bar bolts $= \dfrac{P \times a \times b}{A}$

Size of bolt, inches	(A)
3/4	0.302
7/8	0.420
1	0.550
1 1/8	0.694
1 1/4	0.893

To Find Depth of Thread;

U. S. $= P \times 0.6495$

V thd. $= P \times 0.8660$

Whitworth $= P \times 0.6403$

To Find Diameter at Root of Thread;

Dia. at root of V thd. = dia. bolt — $(1.732 \div P) = D - 0.1443$.

Dia. at root Whitworth thd. $= (1.299 \div P) = D - 0.1082$.

DATA ON BOILER STAYS—12 THREADS PER INCH

Diameter over thread	Diameter at root of thread: "V" thread	Diameter at root of thread: U. S. thread	Diameter at root of thread: Whitworth thread	Area in sq. in. at root of thread: "V" thread	Area in sq. in. at root of thread: U.S. thread	Area in sq. in. at root of thread: Whitworth thread	Depth of Thread: "V" thread	Depth of Thread: U.S. thread	Depth of Thread: Whitworth thread	Area at reduced section: 1/8" less in diam.	Area at reduced section: 3/16" less in diam.	Area at Body of American Staybolt 3/16" less in diam.
3/4"	.7306	.7668	.7633	.4193	.4618	.4637	.072127	.05412	.05336	.4418	.3712	Not Made
13/16"	.7932	.8293	.8308	.4941	.5401	.5421	.072127	.05412	.05336	.5185	.4418	.4418
1"	.8557	.8918	.8933	.5750	.6246	.6267	.072127	.05412	.05336	.6013	.5185	.5185
1 1/16"	.9182	.9543	.9558	.6622	.7152	.7175	.072127	.05412	.05336	.6903	.6013	.6013
1 1/8"	.9807	1.0168	1.0183	.7558	.8120	.8144	.072127	.05412	.05336	.7854	.6903	.6903
1 3/16"	1.0432	1.0793	1.0808	.8547	.9148	.9173	.072127	.05412	.05336	.8866	.7854	.7854

Size of rivet, inches	*Area of rivet hole, square inches*
11/16	0.371
3/4	0.442
13/16	0.518
7/8	0.601
15/16	0.690
1	0.785
1 1/16	0.887
1 1/8	0.994
1 5/32	1.050
1 3/16	1.108
1 1/4	1.227
1 5/16	1.353

Plate $= \dfrac{P \times D \times p}{2 \times t \times (p\text{-}d)}$

Dia. at root of U. S. thd. $= (1.2807 \div P) = D - 0.1067$.

Locomotive Inspection Report of the I. C. C.

The Interstate Commerce Commission's monthly report to the President on the condition of railway equipment shows that during October, 5,898 locomotives were inspected by the Bureau of Locomotive Inspection, of which 2,847 were found defective, or 48 percent, and 341 were ordered out of service. The Bureau of Safety during the month inspected 104,515 freight cars, of which 4,347 were found defective, and 1,413 passenger cars, of which 23 were found defective. Fourteen cases involving 33 violations of the safety appliance acts were transmitted to various United States attorneys during the month for prosecution.

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, C. W. Obert, 29 West 39th Street, 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.

Case No. 446. *Inquiry:* Is it permissible, under the requirements of the Low-Pressure Heating Boiler Section of the Code, to apply crown bar reinforcement to an oval or arched furnace crown sheet by the use of crown bars welded along their lower edges to the upper surface of the crown sheet? If not, what form of crown bar reinforcement is permissible under the Heating Boiler Section of the Code, and under what rule may such construction be calculated?

Reply: It is the opinion of the Committee that the construction described will be acceptable for steam heating boilers at pressures not exceeding 15 pounds and for water boilers for any pressure not exceeding 160 pounds where the strength of the crown bars, as calculated in Par. P-230*a* is shown to be sufficient, assuming in the formula that p, the pitch of supporting bolts, is equal to the distance between the crown bars from center to center, and C is equal to 12,000.

Case No. 454. *Inquiry: a* Must a water-relief valve be attached immediately to hot water boilers; if so, would a nipple and coupling between the valve and the boiler be considered as immediately attached?

b Would a valve with a rubber diaphragm be acceptable?

c Would a valve with a rubber seat disk be acceptable?

d Would a valve with a water-way through a number of smaller openings in the aggregate which are equivalent to the required area be acceptable?

Reply: a A connection not exceeding 6 inches in length and having a minimum cross-section not less than the nominal area of the relief valve required, will be considered by the Committee as being connected "as closely as possible" as required in Pars. H-46 and H-99.

b and c It is the opinion of the Committee that while Par. H-44 states that the valve shall be of the diaphragm-operating type, the Committee undoubtedly felt that a diaphragm of rubber or composition that was liable to fail, due to deterioration or vulcanizing when subjected to highly heated water or steam, would not be used. That being the case, the Committee recommends that materials of this nature be not used, for the seat disk nor should they be used for the diaphragm in diaphragm-operated valves under such conditions, for example, where the steam or hot water passes under the diaphragm.

d It is the opinion of the Committee that a valve exceeding ½ inch nominal diameter may have multiple ports if such ports are each not of less area than a ½ inch valve.

Case No 455. *Inquiry:* Is it to be understood from Par. P-216, which states that the part of a tube sheet which comes between the tubes and shell of a boiler need not be stayed if the maximum pitch does not exceed 1½ times the maximum pitch of staybolts for the corresponding thickness and pressure given in Table P-6, that it can be interpreted to mean that 1½ times the pitch as determined by the formula given in Par. P-199 may be used, which will allow a much greater spacing when using heavy heads?

Reply: It is the opinion of the Committee that it will not be permissible, under Par. P-216, to determine the maximum pitch from the formula in Par. P-199, but that instead reference must be made to the maximum allowable pitches in Table P-6 and Par. P-204.

Case No. 456. *Inquiry:* Is it necessary, under the requirements of Par. P-324, to so locate the supporting lugs of horizontal return tubular boilers when they are of pressed steel construction and of a triangular form, that the adjacent corners are not over 2 inches apart, whereas due to the triangular form it would be impossible to locate the edges of the bearing surfaces 2 inches apart?

Reply: It is the opinion of the Committee that the requirement of Par. P-324 will be met if lugs of the form described are so located on the boiler shell that their adjacent corners are not over 2 inches apart.

Case No. 457. *Inquiry:* Will it not be permissible, in the construction of dry-back Scotch-type boilers to locate the fusible plug at a lesser distance than 2 inches above the upper row of tubes where the distance between the uppermost line of tubes and the top of the steam space is 13 inches or less, as is provided for horizontal return tubular and economic-type boilers in Pars. A-21*a* and A-21*r*?

Reply: In applying Par. A-21*q*, it is the opinion of the Committee that where the size of the boiler is such that the distance between the top line of tubes and the top of the steam space is not over 13 inches, the same provisions as given for horizontal return tubular boilers in Par. 21*a* may be allowed.

Case No. 458. *Inquiry:* Inquiry is made as to whether, under the requirement of Par. P-277 of the Code, it is permissible to connect both the steam delivery pipes and the safety valve to the boiler through the customary four-way or "niggerhead" fitting as is used in oil country practice?

Reply: It is the opinion of the Committee that under the requirements of Par. P-277, it will be necessary to attach the safety valve or valves to the boiler through an entirely independent connection from that used for the steam delivery connection.

Case No. 459. *Inquiry:* An interpretation is requested as to the requirements of the Boiler Code for longitudinal joints of Adamson-type furnaces, as the Code apparently specifies the types of longitudinal joints for use in plain furnaces only.

Reply: Attention is called to the fact that Pars. P-239 and P-240 apply to *all* types of unstayed furnaces, so that the provisions therein for the construction of longitudinal joints of such unstayed furnaces apply generally to the Adamson type as well as to all other types of unstayed furnaces, whether vertical or horizontal.

Case No. 460. *Inquiry: a* If safety valves in sizes 3 inches or less for boilers operating at a working pressure of more than 15 pounds and not more than 125 pounds are provided with flanged inlets, must these flanges be extra-heavy, or can they be standard dimensions and standard drilling?

b If two safety valves in sizes 3 inches or less are mounted on a Y base, must the inlet flange of the Y base be of extra-heavy, or can it be standard dimension where the working pressure does not exceed 125 pounds?

Reply: a Under Par. P-286, if the safety valves are of 3 inches or less in size, standard dimensions and standard drilling, may be used.

b The outlet flanges on a Y base for connection to safety valves 3 inches or less in size, may be of standard dimensions and standard drilling, but if the base flange of the Y is over 3 inches in diameter it would be necessary to make it extra-heavy as provided for in Par. P-286.

Economizers and Their Place in Boiler Work

How Economizers Are Built—The Theory of Operation—and Methods Used in Their Repair

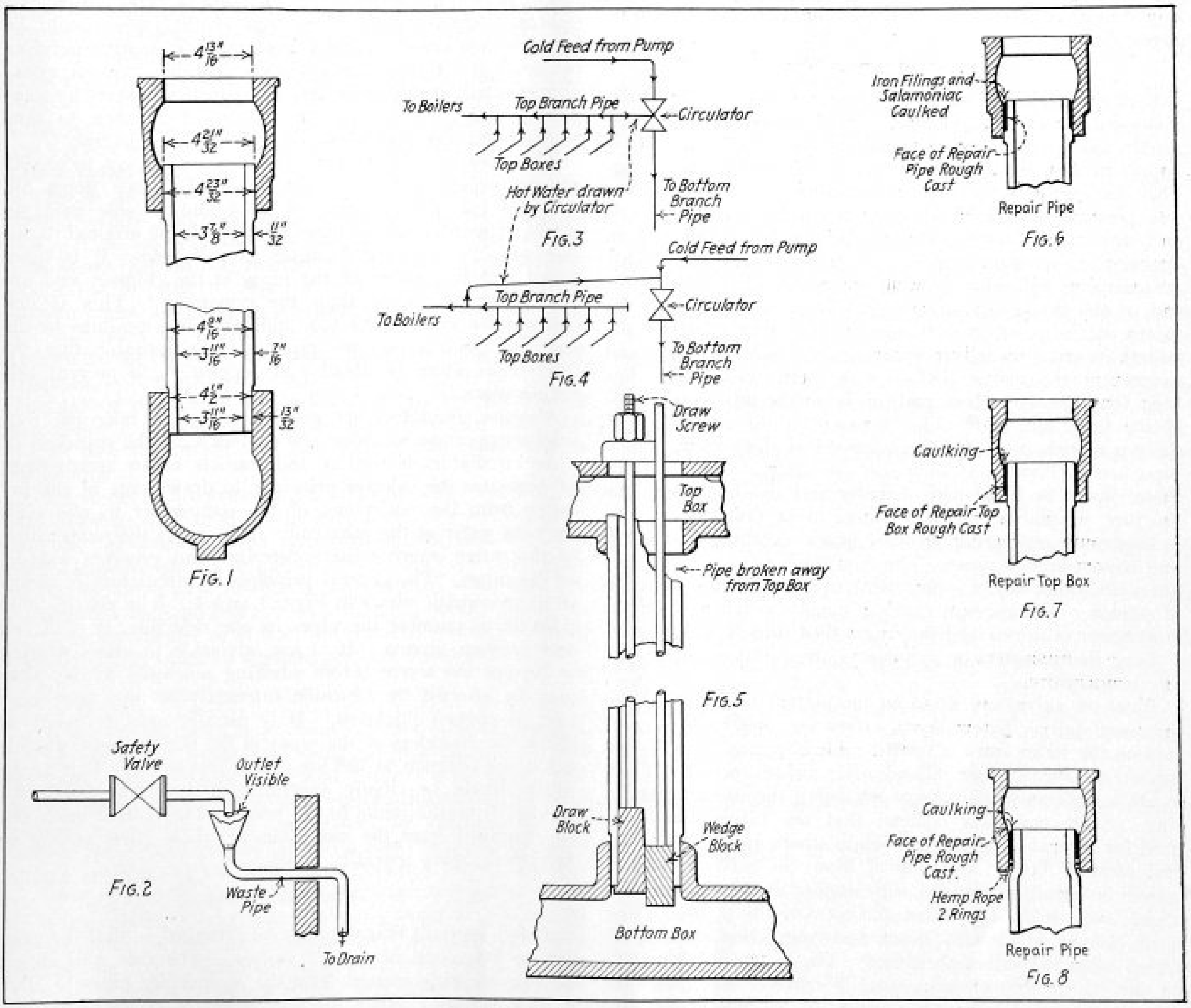
By "Boilers"

MOST large boiler plants are now fitted with economizers to heat up the feedwater by utilizing waste flue gases and thus effect a saving in fuel and obtaining a higher boiler efficiency. The types principally used in England are Greens, Goodbrands and Babcock and Wilcox economizers. The two former are cast iron and similar in construction. The latter is a steel economizer used in conjunction with the Babcock and Wilcox watertube boiler.

Several years ago, various types of economizers were on the market, the principal difference being in the method of circulating the water through the vertical pipes. Some older types of economizers were so constructed that the feedwater was compelled to travel up one section and down another before the boiler feed pipe was reached, but now the sections are all connected by top and bottom branch pipes and circulation takes place from the bottom boxes to the top boxes and to the boiler. Greens and Goodbrands economizers embody this principle.

Path of Circulation

The course of the feedwater is from the pump to the bottom branch pipe, to the bottom boxes, up the vertical pipes, in the top boxes and to the top branch pipe connected to the boiler feed pipe. The gases pass through the vertical pipes in the opposite direction to the water causing the hottest gases to come in contact with the hottest water. The temperature of the feed is raised through about 200 degrees F. in passing through the economizer pipes. It is necessary to continually clear away the sooty deposit from the pipes to ensure good results and therefore scrapers are fitted to each pipe and operated up and down by suitable gear. This



Details of Economizer Fittings

gear changes direction when the scrapers reach the top or bottom of the pipes, thus continually clearing away the non-conducting sooty deposit.

Details of Construction

The vertical pipes are cast in vertical molds, care being taken to ensure that the core is central to give an even thickness of pipe. The various dimensions of the standard economizer pipes are shown on Fig. 1. The top and bottom of the pipes are accurately machined to enable a proper fit to be made in the boxes. They are pressed in position, the joints being metal to metal. Accuracy of fit between the pipes and the boxes is relied on to make a watertight joint. The top openings are closed with internal lids fitting in a taper hole. One hole in each section is made larger to permit the other lids being withdrawn and is called the master lid. If this requires renewing it is necessary to remove the top branch pipe. The lids are drawn up by bolt and cross bar, the bolt being fitted into an elongated hole in the lid. Internal pressure keeps the lid in position and makes a tight joint.

The holes in the bottom boxes are closed by external caps and bolts.

The economizer sections are made 6, 8, 10 or 12 pipes wide and can be placed together to form groups. Groups usually consist of 8 sections and have a bend or expansion pipe between the top and bottom branch pipes of the groups. Any number of groups can be placed together to suit requirements.

Types of Fittings Used

Each economizer is fitted with safety valves usually of the enclosed lever and weight type. Small economizers have one safety valve but large economizers have several. It is important that the safety valve waste pipe outlet can be seen when testing the valve or when the valve is blowing from excess pressure. Usually this pipe is carried through a wall and outside to a suitable drain. Where this is the case an arrangement as shown in Fig. 2 should be adopted. This arrangement will also prevent danger should the extreme end of the waste pipe freeze up. It is necessary that the safety valves be set at a higher pressure than those on the boilers in order to deliver water against boiler pressure and to prevent the valves lifting from pump shocks. It has been found that the best position is on the top branch pipe at the feed inlet end. Thermometers at the outlet end of the top branch pipe and the inlet end of the bottom branch pipe are necessary to determine efficiency. The cups for these should be filled with mercury and should project into the pipe to enable correct readings to be taken.

Maximum registering pressure gages are fitted on the top and bottom branch pipes. Those on the bottom branch pipes are often found out of order owing to vibration due to action of pumps. A maximum reading should be taken when the economizer is at rest and the finger then turned back to zero.

Long thermometers or pyrometers are useful to obtain flue gas temperature.

Blow off valves are fitted on the bottom branch pipe and are used daily. Screw down valves are preferable to plug taps as the latter cause a considerable shock to the cast iron pipes and boxes when closed after being opened. There exists a difference of opinion regarding the use of this fitting. Some engineers contend that the valves should be used for several minutes daily while others use them for several seconds daily. Opening of blow out valves of economizers is certainly attended with danger due to lowering the water level in the top boxes and tops of the pipes. These parts become filled with steam and contraction stresses are set up when the valves are closed. The blow off valve being on the bottom branch pipe usually opposite the feed inlet pipe insures that very little sediment is drawn from the economizer when the valve is opened, as the water from the pump will take the least line of resistance and pass to the blow out valve, drawing only a small percentage of sediment from the bottom boxes. The position of the blow out valve should be such that it is accessible and safe to use having a suitable waste pipe connected and fitted with a locking device to prevent the box key being removed when the valve is in the open position.

The inlet valve to the economizer should be in a position where it can be readily operated, care being taken that this valve is open before the pumps are started. A relief valve on the feed pipe between the pumps and the economizer will prevent damage in the event of the pumps being started and the inlet valve being inadvertently closed. The economizer safety valves will prevent excess of pressure if the outlet valve to the boilers is closed or the boiler check valves unduly throttled.

Cleaning and Inspection

It is necessary to periodically open up the pipes and bottom boxes to clean away scale and sediment and to allow the pipes to be inspected internally. A spring scraper is used for clearing and is passed down each pipe to clear away soft scale. Power boring tools are necessary when the scale is thick and hard. This tool consists of a number of circular scraper wheels of various diameters the largest being slightly smaller than the internal diameter of the pipes.

The pipes are inspected by passing a light down and sighting from the ends. The tops of the pipes should be tested with a chisel to detect any graphitic wasting peculiar to cast iron. If the wasting is considerable internal measurements will enable inspectors to estimate its extent by comparing with outside diameters, care being taken to note whether the pipe has been cast with the core central.

The flues and pipes should be cleaned of soot to enable proper inspection to be made. Suitable access doors are provided for this purpose. A good and reliable guide to extent of wasting of the pipes is to check the original diameter with the existing diameter as calipered. It is often found that the bottom of the pipes at the chimney end are more severely wasted than the remainder. This is due to the inlet water being too cold, allowing moisture in the gases to condense on the pipes. It is desirable that the inlet temperature be about 120 degrees F. to prevent this taking place.

Various circulators are on the market to raise the feed inlet temperature to about 120 degrees F. The principle of these circulators is similar and consists of an arrangement of cones on the injector principle to draw some of the hot water from the outlet end of the economizer to mix with the cold water at the inlet end. This raises the temperature of the water entering the economizer and prevents wasting of the pipes. The general principle of circulators is shown in diagrammatic views in Figs. 3 and 4. It is usually only possible to examine the pipes in one side flue, at each end and between groups. It is not advisable to allow wasting to become too severe before advising renewals, as the pipes may be affected by corrosion internally or may have been cast of uneven thickness. It is usually only necessary to check the diameters of the pipes at the bottom ends, wasting not being common at the top of the pipes. The tops of the pipes should be closely examined, however, to detect any leakage from the joints to top boxes. The bottom boxes can be examined from the soot chamber, those parts resting on brickwork being specially noted.

Flue Setting

It is important that the flues be arranged so that the gases can be by-passed in case of failure. The side wall should also be set wide enough from the economizer pipes to allow a man to pass. When the economizer is at work this passage is closed by deflectors which are operated from outside and which compel the gases to travel along the vertical pipes. Care should be taken that there are no sharp corners or pockets in the flues in which gas can accumulate. Flue gas explosions are not infrequent and are caused by trapped gas becoming ignited by a spark. Also it is usually found that air has been finding its way into the flues through faulty brickwork. These explosions usually cause considerable damage to brickwork, pipes and surroundings. Explosion doors and swivel dampers are to be preferred to slide arrangements as in the event of a flue gas explosion taking place the dampers and doors would open and release the force thus preventing damage to the flues and economizer pipes.

METHODS OF REPAIRING ECONOMIZERS

Repairs to economizers can be carried out with proper tools and methods. Sometimes it is required to renew a pipe or a bottom or top box. To renew a pipe the practice is to break away the old pipe from one side of the top box and draw the pipe out of the bottom box. This is done by means of a shaped block and wedge which are passed down the pipe to be removed so that the lip of the block engages with the underneath side of the pipe in the bottom box. The wedge is knocked into position and the pipe is withdrawn by screwing up the nut on the rod attached to the block. The drawing of the pipe may be facilitated by a light hammering on the bottom of the pipe while the drawing is in progress. The method and tools are shown in Fig. 5. After the defective pipe has been withdrawn a specially made repair pipe is fitted. This pipe is driven into the bottom box the joint being metal to metal. The joint between the pipe and the top box is made by filling in the cavity with iron filings and sal-ammoniac.

Figs. 6 and 8 show types of repair pipes and method of fitting. It is important that the pipe faces are rough as cast. It is not desirable that more than two pipes per section be renewed in this manner. When more pipes require renewal it is better to renew a section. When it is necessary to renew a top box it is a good plan to take the section out and press on a new top box. If it is not desired to remove the section from the group a specially made top box is supplied by the makers and is fitted as shown in Fig. 7. The method is to break off the defective box and after fixing the new one in position calk the space provided with iron filings and sal-ammoniac. The face of the repair box is rough cast.

Bottom boxes are renewed by breaking away the old box and drawing on a new box by means of bolts passing from the top box through holes, provided in the bottom of the repair bottom box. It is a good plan to allow the draw bolts to remain in position for about three months when they can be removed and the holes filled with plug studs. After repairs the economizer or at least the repaired section should be hydrostatically tested to working pressure and a half.

OPERATING THE ECONOMIZER

To ensure efficiency care must be exercised in working the economizer. Scale and sediment internally and soot externally greatly reduce the feed temperature. Losses due to air leakage through door and faulty brickwork reduce the temperature of the gases and lower the efficiency of the economizer. Care should be taken that the scrapers thoroughly clean the pipes from top to bottom. Sometimes it is found that the chains connecting the scraper gear to the drive have become lengthened, causing them to rest on the bottom boxes before the scrapers on the other side have reached the top. Again if the scraper gear chains are too short the scrapers on one side will bear against the top box before the scrapers on the opposite side have reached the bottom. Observation of the wheel pulleys when working will enable the attendant to determine whether the scrapers are acting properly or not. Any slipping of chains on the pulleys will indicate that some adjustment of the chains is required. Dampers should always be kept closed and gases by-passed when getting up steam and when steam is not being used, to avoid generation of steam in the economizer, and consequent risk of water hammer.

Extensive failures of economizer parts may cause serious explosions. Small failures sometimes only result in releasing a small amount of energy and are usually detected by racing of the feed pumps.

Used properly, economizers are worthy of their name and effect considerable saving in the fuel bill.

Repairing Vessels While Under Pressure

THE exceedingly dangerous practice of repairing boilers, pipe lines, and various pressure vessels while they are under pressure appears to be so generally followed that one is led to believe that the danger is not really appreciated. But knowing the inherent gambling instinct in man and how ready he is to take the "short cut," that Nemesis of safety, it ought not be difficult to admit that the prevalence of this practice is partly due to thoughtlessness or carelessness. To instruct the man who is willing to learn, and to continually admonish the thoughtless, it is our policy from time to time to point out some of the unfortunate results of such bad practice which come to our attention. In looking over the explosion list for the month of September of last year, there came to our attention no less than four clippings of accidents which it would appear resulted from attempts to repair steam containers while under pressure. We are reprinting five such clippings.

WALTER SEXTON SCALDED BY EXPLODING BOILER

Mr. Walter Sexton was badly scalded Monday about noon by the explosion of a boiler at the General Ice Company plant, on Deery Street. He was fixing to take the end out of the boiler to repair it when an explosion occurred, caused by the water running low in the boiler, and blew out the manhead, throwing hot water and steam on his left arm, shoulders and back, badly blistering the flesh. His injuries, though painful in the extreme, were not thought to be dangerous.—*Shelbyville, Tennessee, Times, August* 31, 1923.

[This appears to be a case of opening a warm boiler before it is entirely empty.—EDITOR.]

ACCIDENT MAY COST SIGHT OF DAIRYMAN

Physicians were fighting Saturday morning to save the eyesight of Walter Bowie, 40, 997 Jefferson Avenue, who was badly burned at 7:45 A.M., Saturday, by escaping steam.

Bowie, an employe of Reed Brothers' Dairy, 147 North Pauline Street, was attempting to put a wheel on a steam valve when the pressure in the boiler blew open the valve and a column of steam struck him in the face.

A. L. Reed, one of the owners of the dairy, rushed Bowie to the Baptist hospital.

Bowie's eyes were seared by the steam, but physicians hope to save his sight.—*The Memphis Press, September* 8, 1923.

TWO BURNED IN BOILER ACCIDENT AT MODESTO

Modesto, September 10th:—A. H. Pierce of Ripon, assistant foreman of the Sun Garden Canning Company, who was seriously burned about the head and body Saturday night when a boiler exploded, was declared out of danger at the Robertson Hospital here today. Oscar Studley was also badly burned. They were repairing the boiler when an

(*Continued on page* 364)

A.S.M.E. Boiler Construction Code

PREAMBLE

The object of the code covering the construction of Unfired Pressure Vessels is to provide a safe construction for the great variety of pressure containers now manufactured and used for innumerable purposes throughout the country and under an exceedingly wide range of conditions. The efforts to give publicity which have been made in order to obtain as wide a range of opinion as possible, has brought out views which were often times diametrically opposed. In such cases the attempt has been made to frame the rules in accordance with the greater weight of opinion.

It is believed that these rules will not work undue hardship on the manufacturing industries generally, and at the same time will result in the construction of reasonable safe pressure vessels, for it is undoubtedly true that many of the failures which take place are due to the lack of proper restrictions governing both material, workmanship, dimensions and supervision.

Rules for electric induction compression welding are in process of preparation and will be submitted later on for addenda to the Code.

The committee is composed of E. R. Fish, chairman; W. H. Boehm, C. E. Bronson, E. C. Fisher, S. F. Jeter, W. F. Kiesel, Jr., James Neil and H. V. Wille.

Section VIII

Report on Rules for the Construction of Unfired Pressure Vessels

These rules do not apply (a) to boilers and other pressure vessels which are subject to Federal inspection and control, (b) to locomotives of all types, (c) to vessels for containing only water under pressure for domestic supply, (d) to vessels subject to temperatures exceeding 750 degrees F.

U-1. The Rules in this Section apply to Unfired Pressure Vessels over 6 inches in diameter, more than 1.5 cubic feet in volume and carrying a pressure of over 30 pounds per square inch, constructed of steel or iron plates.

SAFETY APPLIANCES

U-2. All pressure vessels shall be protected by such safety and relief valves and indicating and controlling devices as will insure their safe operation. These devices shall be so constructed, located, and installed that they cannot readily be rendered inoperative. The relieving capacity of safety valves shall be such as to prevent a rise of pressure in the vessel of more than 10 percent above the maximum allowable working pressure, and their discharges shall be carried to a safe place.

U-3. Safety valves shall be of the direct spring-loaded type, with seat and bearing surface of the disk inclined at an angle of about 45 degrees, or about 90 degrees to the center line of the spindle; designed with a substantial lifting device so that the disk can be lifted from its seat with the spindle not less than one-eighth the diameter of the valve when the pressure on the tank is 75 percent of that at which the safety valve is set to blow.

U-4. Safety valves having either the seat or disk of cast iron shall not be used.

U-5. If more than one safety valve is used, the discharge capacity shall be taken as the combined capacity of all the valves.

U-6. Each safety valve shall have full-sized direct connection to the vessel. When an escape pipe is used, it shall be full-sized and fitted with an open drain, to prevent water from lodging in the upper part of the safety valve or escape pipe. When two or more safety valves are placed on one connection, this connection shall have a cross-sectional area equal to or greater than the combined area of these safety valves. No valve of any description shall be placed between the safety valve and the vessel, nor on the escape pipe between the safety valve and the atmosphere. When an elbow is placed on an escape pipe, it shall be located close to the safety valve outlet, or the escape pipe shall be securely anchored and supported.

U-7. Every safety valve which is exposed to a temperature of 32 degrees F., or less, shall have a drain at least ⅜ inch in diameter at the lowest point where water can collect, to prevent freezing.

U-8. Safety-valve springs shall not be adjusted to carry more than 10 percent greater pressure than that for which the springs were made.

U-9. Each safety valve shall be tested once every day, or oftener, by raising the disk from its seat.

U-10. Safety valves for compressed-air tanks shall not exceed 3 inches in diameter and shall be proportioned for the maximum number of cubic feet of free air that can be supplied per minute as shown in Table U-1.

U-11. Corrosive Chemicals. All pressure vessels which are to contain substances having a corrosive action upon the metal of which the vessel is constructed, shall be designed for the pressure they are to carry, and the thickness of all parts subject to corrosion should be increased by a uniform amount to safeguard against early rejection.

MATERIAL

U-12. Plates for any part of a riveted vessel required to resist stress produced by internal pressure, shall be of flange- or firebox-quality steel conforming with the Specifications for Boiler Plate Steel given in the Rules for Power Boilers, except as provided in Par. U-13.

U-13. Steel plates for any part of a pressure vessel which

TABLE U-1. MAXIMUM FREE AIR SUPPLIED IN CUBIC FEET PER MINUTE FOR DIFFERENT SIZES OF SAFETY VALVES AT STATED PRESSURES

Diameter of Valve	Gage Pressure (Pounds)														
(In.)	50	100	150	200	250	300	350	400	500	600	800	1,000	1,200	1,600	2,000	2,400
¼	...	...	...	...	...	...	...	53	61	70	84	97	109	128	147	160
½	20	32	42	51	59	67	74	111	129	147	177	205	230	270	304	330
¾	37	59	78	96	112	127	141	176	224	232	242	346	386	423	474	518
1	58	94	124	152	178	202	224	248	286	324	390	450	500	586	...	...
1¼	84	135	180	221	159	293	325	...	374	...	509	...	...	...	...	...
1½	114	186	248	302	354	400	444	...	472	...	634	...	...	...	...	...
2	189	306	410	501	592	668	741	...	...	...	...	...	...	...	...	...
2½	282	457	613	750	680	998	1,114	...	...	...	...	...	...	...	...	...
3	393	638	856	1,050	1,230	1,398	1,557	...	...	...	...	...	...	...	...	...

The foregoing table is based on the following formulas:

$$Q = 28\,PDl \text{ for 45-deg. bevel-seat valves}$$

and

$$Q = 40\,PDl \text{ for flat-seat valves}$$

where

Q = discharge in cubic feet of free air per minute.
P = absolute pressure at which the safety valve opens (gage pressure plus 14.7 lb. at sea level).
D = diameter, in inches, of the inside edge of the bearing surface between the disk and seat.
l = vertical lift of the safety-valve disk from its seat, in inches, representing the lift for minimum discharge capacity, for satisfactory operation of the valve.

is to be constructed with other than riveted joints, or with any combination of riveted and other joints herein considered, shall be of the quality specified for the particular kind of joint used.

U-14. In determining the maximum allowable working pressure, the maximum allowable working stress as herein provided shall be used in the computations.

U-15. For resistance to crushing of steel plate, the maximum allowable stress shall be 19,000 pounds per square inch of cross-sectional area.

U-16. In computing the maximum allowable stress on rivets in shear, the following values in pounds per square inch of the cross-sectional area of the rivet shank shall be used:

Iron rivets in single shear	7,600
Iron rivets in double shear	15,200
Steel rivets in single shear	8,800
Steel rivets in double shear	17,600

The cross-sectional area used in the computations shall be that of the rivet shank after driving.

CONSTRUCTION AND MAXIMUM ALLOWABLE WORKING PRESSURES

U-17. For all pressure vessels the minimum thicknesses of shell plates, heads and dome plates after flanging shall be as follows:

When the Diameter of Shell is

14 in. and under — 1/8 in.	Over 14 in. to 24 in. — 3/16 in.
Over 24 in. to 36 in. — 1/4 in.	Over 26 in. to 54 in. — 5/16 in.
Over 54 in. to 72 in. — 3/8 in.	Over 72 in. — 1/2 in.

except that for riveted construction the minimum thickness shall be 3/16 inch.

U-18. The minimum thicknesses of butt straps for double-strap riveted joints shall be as given in Table U-2. Intermediate values shall be determined by interpolation. For plate thicknesses exceeding $1\frac{1}{4}$ in. the thickness of the butt straps shall be not less than two-thirds of the thickness of the plate.

TABLE U-2—MINIMUM THICKNESS OF BUTT STRAPS

Thickness of shell plates, in.	Minimum thickness of butt straps, in.	Thickness of shell plates, in.	Minimum thickness of butt straps, in.
3/16	3/16	17/32	7/16
1/4	1/4	9/16	7/16
9/33	1/4	5/8	1/2
5/16	1/4	3/4	1/2
11/32	1/4	7/8	5/8
3/8	5/16	1	11/16
13/32	5/16	1 1/8	3/4
7/16	3/8	1 1/4	7/8
15/32	3/8	.....	.....
1/2	7/16	.....	.....

U-19. The maximum allowable working pressure is that at which a pressure vessel may be operated.

Where the term "maximum allowable working pressure" is used it refers to gage pressure, or the pressure above the atmosphere, in pounds per square inch.

U-20. For Internal Pressure. The maximum allowable working pressure on the shell of a pressure vessel shall be determined by the strength of the weakest course, computed from the thickness of the plate, the efficiency of the longitudinal joint, the inside diameter of the course, and the maximum allowable unit working stress.

$$\frac{S \times t \times E}{R} = \text{maximum allowable working pressure, pounds per square inch.}$$

where S = maximum allowable unit working stress in pounds per square inch.

= 11,000 pounds per square inch for steel plate stamped 55,000 pounds per square inch and 10,000 pounds per square inch for steel plate stamped less than 55,000 pounds per square inch and 9,000 pounds for material used in seamless shells.

t = minimum thickness of shell plates in weakest course, inches.

E = efficiency of riveted, longitudinal joint, percent.

R = inside radius of the weakest course of the shell, inches, 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 outside radius shall be used.

NOTE—When the safe working pressure for welded or brazed vessels is to be determined, E will be omitted from the formula, and the values for S in Pars. U-68, U-82, or U-94 will be substituted for the values given above. For seamless shells, E equals 100 percent.

JOINTS

U-21. The joints of pressure vessels, if of riveted construction, shall conform to the requirements of Pars. U-26 to U-35.

U-22. Pressure vessels may be fabricated by means of fusion or forge welding, or brazing, provided the rules governing the method adopted and as given in Pars. U-67 to U-96 of the Code are followed, except that base metal of flange or firebox qualities as given in the Rules for Power Boilers may be used.

U-23. Pressure vessels shall not be fabricated by means of fusion welding under the rules given in Pars. U-67 to U-79, inclusive, except:

a. Air tanks, when the diameter does not exceed 20 inches, the length does not exceed 3 times the diameter, and the working pressure does not exceed 100 pounds per square inch.

b. Other tanks, under these rules, in which the circumferential joints only may be welded, when the inside diameter does not exceed 48 inches.

U-24. Pressure vessels may be fabricated by means of forge welding when the rules given in Pars. U-80 to U-90 are followed.

U-25. Pressure vessels for use at any temperatures not exceeding 406 degrees F., may be fabricated by means of the brazing process when the rules given in Pars. U-91 to U-96 are followed.

RIVETED JOINTS

U-26. The efficiency of a joint is the ratio which the strength of the joint bears to the strength of a solid plate. In the case of a riveted joint this is determined by calculating the breaking strength of a unit section of the joint, considering each possible mode of failure separately, and dividing the lowest result by the breaking strength of a length of a solid plate equal to that of the section considered.

U-27. The distance between the center lines of any two adjacent rows of rivets, or the "back pitch" measured at right angles to the direction of the joint, shall have the following minimum values:

(*a*) If $\frac{P}{d}$ is 4 or less, the minimum values shall be $1\frac{3}{4}d$

(*b*) If $\frac{P}{d}$ is over 4, the minimum value shall be:

$$1\frac{3}{4}d + 0.1(P - 4d)$$

where P = pitch of rivets in outer row when a rivet in the inner row comes midway between two rivets in the outer row, inches.

= pitch of rivets in the outer row less pitch of rivets in the inner row when two rivets in the inner row come between two rivets in the outer row, inches. (It is here assumed that the joints are of the usual construction when the rivets are symmetrically spaced.)

d = diameter of the rivet holes, inches.

U-28. On longitudinal joints, 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 $1\frac{1}{2}$

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 top of the calking edge of the plate before calking. The corresponding distance for circumferential seams shall be not less than 1¼ times the diameter of the rivet holes.

U-29. *a.* The strength of circumferential joints of pressure vessels the heads of which are not stayed by tubes or through braces, shall be at least 50 percent of that required for the longitudinal joints of the same structure.

b. When 50 percent or more of the load which would act on unstayed solid head of the same diameter as the shell, is, in consequence of the holding power of the tubes and stays, relieved by the effect of through tubes or stays, the strength of the circumferential joints in the shell shall be at least 35 percent of that required for the longitudinal joints.

U-30. The riveted longitudinal joints of a shell or drum which exceeds 48 inches in diameter, shall be of butt-and-double-strap construction. This rule does not apply to the portion of a shell which is staybolted to the inner sheet.

U-31. The longitudinal joints of a shell or drum not more than 48 inches in diameter, may be of lap-riveted construction; but the maximum allowable working pressure of such construction shall not exceed 150 pounds per square inch, nor 200 pounds per square inch for tanks less than 24 inches in diameter.

U-32. Butt straps and the ends of shell plates forming the longitudinal joints shall be rolled or formed to the proper curvature by pressure and not by blows.

U-33. The longitudinal joint of a dome 24 inches or over in inside diameter shall be of butt-and-double-strap construction or made without a seam of one piece of steel pressed into shape, and its flange shall be double-riveted to the shell. In the case of a dome less than 24 inches in diameter, for which the product of the inside diameter and the maximum allowable working pressure does not exceed 4,000 inch-pounds, its flange may be single-riveted to the shell and the longitudinal joint may be of the lap type provided it is computed with a factor of safety not less than 8.

When shells are cut to apply domes or manholes the net area of metal, after rivet holes are deducted, in flange and liner, if used, must not be less than the area required by these rules for a length of shell equal to the length removed. A height of vertical flange equal to three times the thickness of the flange shall be included in the area of the flange.

U-34. Rivet and Staybolt Holes. All holes in braces, lugs and sheets for rivets or staybolts shall be drilled full size with plates, butt straps, and heads bolted up in position, or they may be drilled or punched not to exceed ¼ inch less than full size for plates over 5/16 inch in thickness and ⅛ inch less than full size for plates not exceeding 5/16 inch in thickness and then drilled or reamed to full size with plates, butt straps, and heads bolted up in position. The finished holes must be true, clean and concentric.

U-35. Rivets shall be of sufficient length to completely fill the rivet holes and form heads at least equal in strength to the bodies of the rivets. Forms of rivet heads that will be acceptable are shown in Fig. U-1.

Dished Heads

U-36. The thickness required in an unstayed dished head when it is a segment of a sphere shall be calculated as follows:

For $P \times L$ equal to or less than ½ S,

$$t = \frac{3PL}{4S} \text{ for pressure on concave side}$$

and

$$t = \frac{5PL}{4S} \text{ for pressure on convex side}$$

For $P \times L$ greater than ½ S,

$$t = \frac{PL}{2S} + \tfrac{1}{8} \text{ for pressure on concave side}$$

and

$$t = \frac{5PL}{6S} + 0.2 \text{ for pressure on convex side}$$

where t = thickness of plate, inches
P = maximum allowable working pressure, pounds per square inch
L = radius to which the head is dished, inches
S = maximum allowable unit working stress of 11,000 pounds per square inch for steel plate stamped 55,000 pounds per square inch, and 10,000 pounds per square inch for steel plate stamped less than 55,000 pounds per square inch.

Where two radii are used, the longer shall be taken as the value of L in the formula.

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.

When a dished head has a manhole opening, the thickness, as determined by these rules and formulas, shall be increased by not less than ⅛ inch.

U-37. When dished heads are of less thickness than determined by Par. U-36, they shall be stayed as flat surfaces, no allowance being made in such staying for the holding power due to the spherical form.

U-38. The corner radius of an unstayed dished head measured on the concave side of the head shall not be less than three times the plate thickness up to $t = 1$ inch, and not less than $3t^2$ for thicker plates.

U-39. A manhole opening in a dished head shall be flanged to a depth measured from the outside of not less than three times the required thickness of the head.

Braced and Stayed Surfaces

U-40. The maximum allowable working pressure for various thicknesses of braced and stayed flat plates and those which by these Rules require staying as flat surfaces with braces or staybolts of uniform diameter symmetrically spaced, shall be calculated by the formula:

$$P = C \times \frac{T^2}{p^2} \times \frac{S}{11{,}000}$$

where P = maximum allowable working pressure, pounds per square inch
T = thickness of plate in sixteenths of an inch
S = maximum allowable unit working stress, pounds per square inch
p = maximum pitch measured between straight lines passing through the centers of the staybolts in the different rows, which lines may be horizontal, vertical or inclined, inches
C = 112 for stays screwed through plates and not over 7/16 inch thick with ends riveted over
= 120 for stays screwed through plates over 7/16 inch thick with ends riveted over
= 135 for stays screwed through plates and fitted with single nuts outside of plate
= 150 for stays with heads not less than 1.3 times the diameter of the stays, screwed through plates or made taper fit and having the heads formed on the stays before installing them and not riveted over, said heads being made to have a true bearing on the plate

(*Continued on page* 364)

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CONTENTS

The annual index of THE BOILER MAKER for the year 1924 will be published separately from the magazine at the end of the year. As the complete index will be useful only to those of our subscribers 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 those who notify us at once 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 15.

The series of articles "Boiler Inspectors' Examination Questions and Answers" concludes in this issue. Many favorable comments have been received on the value of these articles to our readers as well as requests that they be made available in book form. In view of this demand, the complete series, together with the Rules of Inspection and Interpretations of the Bureau of Locomotive Inspection, useful tables, inspection and locomotive failure reports and other data valuable to inspectors and those who are studying for positions as inspectors will be published in book form and placed on sale early in the coming year.

Short methods and easily made equipment for speeding up shop production merit the closest attention of all those engaged in boiler work. The developments made in one shop will never be of assistance to those having to meet the same problems unless they are broadcasted in some way. THE BOILER MAKER attempts to serve the field to the best of its ability by acting as the medium through which shop kinks and practical methods may become general knowledge. In this issue, for example, a number of devices are described and the results accomplished by their use outlined. This is only one shop out of several hundred where boiler work is done—not one of which but has one or several devices that are used to help along the day's work.

The Master Boiler Makers' Association considered this subject of "shop kinks" sufficiently important to devote a portion of the 1924 convention to a discussion of devices that the men had developed. The only criticism that could be offered on the report presented was that not enough members of the association supplied the committee with details of equipment that they were using. The material obtained was excellent. Of course it could not be expected that a single report of the association or a single article in THE BOILER MAKER could tell all of the developments of even one progressive shop, yet it is not too much to expect that our readers supply more information on the methods that they are using and the home-made tools that they find helpful. In the coming year it is our intention to publish more material of this nature and so we request that the article this month be used by our readers as a sample of what is desirable in the way of shop articles and send in descriptions of their work.

After a great deal of study and discussion, Section VIII of the A. S. M. E. Boiler Construction Code, on "Rules for the Construction of Unfired Pressure Vessels" has been approved by the counsel of the Society and is being presented in its final form to the industry.

The object of the Code covering the construction of unfired pressure vessels is to provide a safe construction for the great number and variety of pressure containers now manufactured and used for many purposes in this country. Considerable publicity has been given to the Code in its original and revised forms in order that the committee might obtain as wide a range of opinion as possible. Views which have often been diametrically opposed have resulted in some cases. In such instances the attempt has been made to frame the rules in accordance with the greater weight of opinion. It is believed by the committee that these rules will not work undue hardship on the manufacturing industries generally and, at the same time, will result in the construction of reasonably safe pressure vessels. It is undoubtedly true that many of the failures which take place are due to the lack of proper restrictions governing both material, workmanship, dimensions and supervision. Any communications in connection with the Code for unfired pressure vessels may be sent to C. W. Obert, secretary of the Boiler Code Committee, at 29 West 39th street, New York.

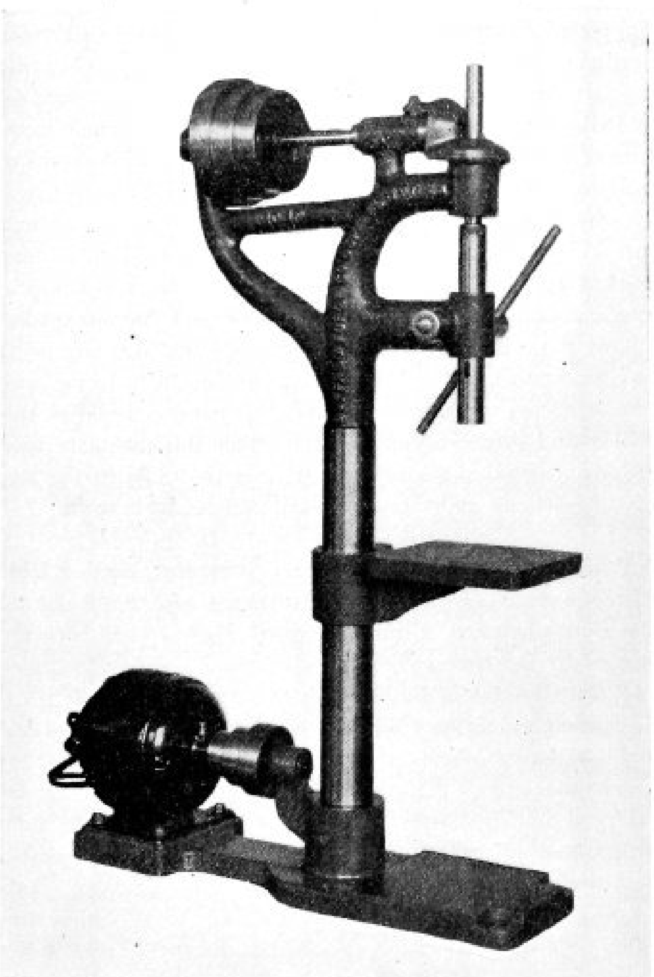
Engineering Specialties for Boiler Making

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

New Model Three Speed Bench Drill

A NEW model of the Buffalo 10-inch motor driven three speed bench drill, which will be of special interest where noiseless operation is desired, is being shown the trade by the Buffalo Forge Company, Buffalo, N. Y.

This model is a direct connected unit, without the intermediary of a standard pinion and gear. Step cone pulleys, keyed to the motor shaft as shown in the illustration, furnish



Ten-Inch Motor Drive Bench Drill

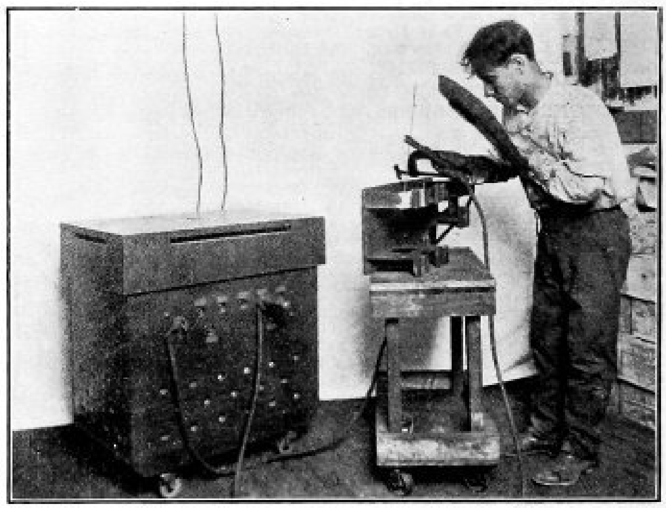
the three speeds. The motor speed is 1,750 revolutions per minute. The manufacturer claims operation of this drill to be without noise and without vibration. By changing the type of drive, it has been possible to shorten the length of the base on the new model, in addition to making it of one solid casting. The former insures more compactness of the unit, thereby cutting down space requirements.

The drill has a substantial one-piece frame insuring perfect alinement of the crown gears and shafts. All rotating parts are carefully machined and fitted. The upper cone pulley is supported between the bearings instead of being overhung, thereby eliminating unnecessary strains on the shaft. The feed lever and spindle furnished are held in position by means of a friction spring which automatically holds the spindle where it is placed.

The work table is adjustable both in a vertical and horizontal position. The base can be used as a table, if desired, as it is carefully and accurately planed and has countersunk bolt holes. The normal driving speed here is 750 revolution per minute, although it can be driven as high as 1,500 and still remain in perfect balance.

The Walters Electric Arc Welder

A READILY portable arc welding machine has been brought out by the Walters Arc Welding Corporation, New York. The machine is enclosed in a wooden box mounted on casters which makes it readily portable. The welding points are marked directly in amperes on the



Portable Electric Arc Welder Especially Adapted to Railway Practice

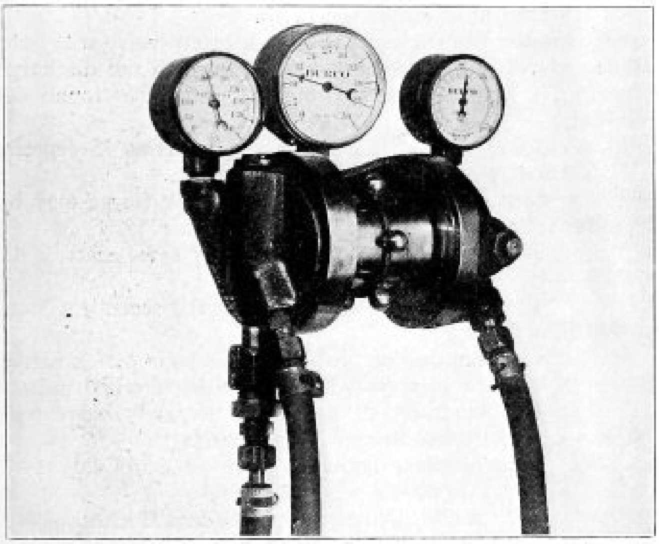
outside of the casing. This positive marking tends to insure against using the wrong amperage for different materials to be welded.

The maximum and minimum welding currents are 200 and 40 amperes respectively. The machine is, therefore, said to be capable of welding any job, without pre-heating, in cast and malleable iron or steel, from a locomotive frame to a No. 14 gage cab sheet. It is built on the transformer principle so that it will operate on single phase, two phase or three phase current, using 220, 440 and 550 volts, respectively. This makes it very convenient for railroad work. The danger from electric shock is reduced to a minimum as asbestos covered wire is used throughout.

The cooling is accomplished by natural ventilation thus eliminating the necessity of a fan. The machine is capable of standing continuous welding at 200 amperes. The current regulation is very close. On short circuit the welding current shows only 10 amperes higher than while the arc is in operation.

Automatic Equal Pressures Two Gas Regulator

WITH the idea of promoting safety in the use of oxy-acetylene cutting and welding equipment, the Burdett Oxygen & Hydrogen Co., Chicago, has developed the automatic, equal pressures, two gas regulator illustrated. There are three connections to this regulator



Burco Two Gas Regulator Which Maintains Equal Torch Hose Pressures Automatically

as indicated, that on the left being the acetylene tank connection, the middle the acetylene torch hose and the right the oxygen torch hose. By means of this regulator with a single adjusting wheel, equal pressures can be produced in the oxygen and acetylene hose lines leading from the regulator to the torch. The regulator is designed to prevent mixed gases in either hose length by producing equal pressures automatically, thus preventing hose fires, hose explosions, the burning out of regulator seats and the possibility of regulator explosions from flame propagation.

The single hand wheel controlling both gases in one regulator makes unnecessary numerous adjustments and re-adjustments of independent regulators on the oxygen and acetylene tanks. The center gage shows the torch pressure readings for both gases. The two gases flow independently until after they pass the valves in the torch and reach the point of mixture either in the handle, head, or tips.

The hand wheel when turned with an upward motion brings an equal pressure on the two controlling diaphragms by the compression of a single spring. The thrust of the hand wheel is against ball bearings which reduce the force necessary to turn the control to a minimum. Unequal oxygen and acetylene tank pressures are controlled by the gas flow areas and resistance. The regulator is designed to give ample volume of both gases for welding operations.

Duplex Spiral Fluted Staybolt Tap

A STAYBOLT tap which consists of two spirals, opposite in direction, has recently been placed on the market by the W. L. Brubaker Bros. Company, Millersburg, Pa., under the trade name of Brubaker duplex spiral fluted staybolt tap.

The tap is divided into five parts—the reamer, taper, thread and shank respectively. The advantage claimed for

New Duplex Tap

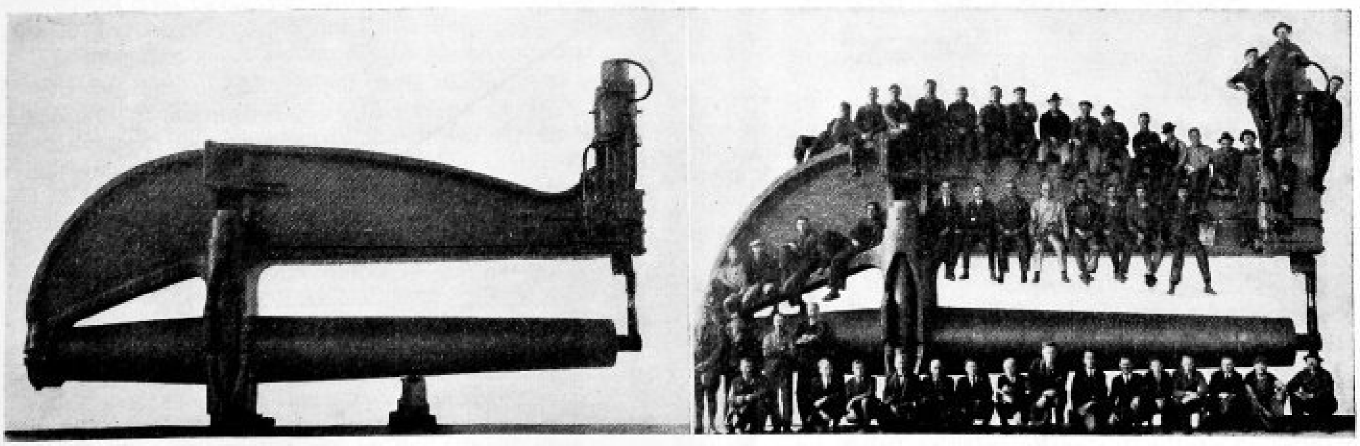
this tap is that the reamer portion of it is made with a right hand spiral, thus giving it the action of a drill and reamer combined, while the tap is a left hand spiral, which gives it the same action as when using the regular Brubaker left hand spiral tap.

Two Hundred Ton Hydraulic Riveter

SINCE the attention of the boiler manufacturing industry has been turned towards designs for high pressures, various supply manufacturers have developed heavy machinery to aid in the construction of such boilers. One of these, the R. D. Wood and Company, of Philadelphia, has built a 200-ton hydraulic 6-power riveter for the D. Connelly Boiler Company of Cleveland, Ohio.

The illustrations show this riveter which has a forged steel stake, a gap of 18 feet 6 inches and a daylight between the stakes of 30 inches at the riveter gap. The forged steel stake has a maximum diameter of 40 inches and carries on its upper end a special chrome nickel steel horn 9¾ inches in diameter which permits the riveting of boiler heads ranging from 40 inches to 72 inches in diameter into boiler drums of corresponding size through a standard manhole.

The outer stake and riveter head are made of cast open hearth steel and are connected by two combination bolts 12 inches in diameter located on either side of the riveter. The machine has an approximate length overall of 30 feet and weighs nearly 200,000 pounds.



Two Views of the Record Size Hydraulic Riveter

Questions and Answers for Boiler Makers

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

Conducted by C. B. Lindstrom

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 Ratings

Q.—As a subscriber to your magazine, I would appreciate your advising the percentage rating of a locomotive from the following data and the method used in arriving at same:

Drivers	56 inch diameter.
Weight on drivers	160,000 pounds.
Cylinder diameter	21 inches.
Stroke	26 inches.
Boiler pressure	180 pounds.

—A. McD.

A.—Your inquiry is not quite clear. We understand that you are referring to locomotive ratios. The American Locomotive Company give the following rules, based on cylinder area, boiler horsepower and on proper evaporating values of the heating surfaces of the boiler:

For saturated steam the locomotive horsepower calculation is as follows:

(1) $HP = 0.0212 \times P \times A$.

For superheated steam:

(2) $HP = 0.0229 \times P \times A$.

in which,

HP = horsepower.
P = boiler pressure, pounds per square inch.
A = area of one cylinder, square inch.

In these formulas the horsepower is based on piston speed, the stroke and diameter of wheels are omitted; no regard is given to the service of the locomotive, thus making this method of proportioning apply to both passenger and freight service.

Safety Valve Calculations

Q.—Please publish in The Boiler Maker soon as possible or send me formula as to how to find the outlet area of safety valves for locomotive boilers.—J. A. K.

A.—The Interstate Commerce Commission division of Locomotive Inspection stipulate as follows on safety valves:

Number and Capacity.—Every boiler shall be equipped with at least two safety valves, the capacity of which shall be sufficient to prevent, under any conditions of service, an accumulation of pressure more than 5 percent above the allowed steam pressure.

Setting of Safety Valves.—Safety valves shall be set to pop at pressures not exceeding 6 pounds above the working pressure.

The *A. S. M. E.* Code gives the following rules for calculating the discharge capacity:

Method of Computing Discharge Capacity.—The required discharge capacity of a safety valve or valves for a boiler may be based either on the heat units in the fuel consumed or on the amount of steam generated.

The number of heat units that each safety valve will handle for valves of the ordinary types, in which the discharge capacity is proportioned to the lift, may be found as follows:

$U = 161{,}000 \times P \times D \times L$ for bevel seats at 45 degrees.
$U = 227{,}500 \times P \times D \times L$ for flat seats.

The amount of steam that a valve will discharge may be found as follows:

$W = 110 \times P \times D \times L$ for bevel seats at 45 degrees.
$W = 155 \times P \times D \times L$ for flat seats.

in which,

U = number of heat units per hour that a safety valve will handle, British thermal units.
W = quantity of steam that a safety valve will handle per hour, pounds.
P = absolute boiler or gage pressure plus 14.7 pounds per square inch.
D = inside diameter of valve seat, inches.
L = vertical lift of valve disk, measured with a percent excess pressure, inches.

The maximum quantity of fuel that can be burned per hour at the time of maximum forcing is determined by a test. The weight of steam generated per hour is found by the formula:

$$W = \frac{C \times H \times 0.75}{1{,}100}$$

in which,

W = weight of steam generated per hour, pounds.
C = quantity of fuel burned, pounds.
H = heat value of fuel, B.t.u. per pound.

The *A. S. M. E.* give the following values of heats of combustion of different fuels:

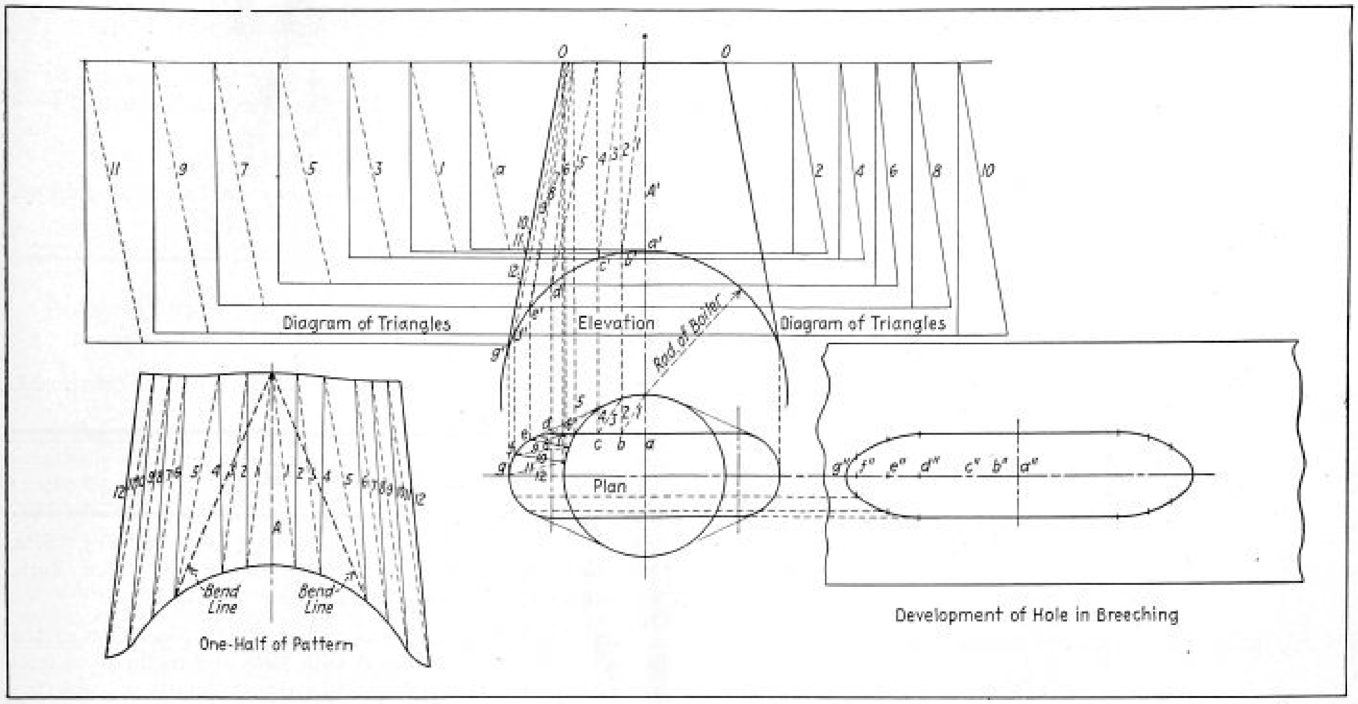
	B.t.u. per pound
Semi-bituminous	14,500
Anthracite	13,700
Screenings	12,500
Coke	13,500
Petroleum, crude oil, Penn.	20,700
Petroleum, crude oil, Texas	18,500

Refer to examples given in Par. 423 to 426 inclusive of the A. S. M. E. Boiler Code, which illustrate the use of the formula for the calculation of the weight of steam and size of safety valve. The manufacturers of safety valves give tables and other data on safety valve calculations. The A. S. M. E. Code gives a table on the size and lift of safety valves required. The size of the opening in the boiler is governed by the size of safety valve.

Smoke Stack Breeching

Q.—Will you kindly tell me how to lay out smoke stack breeching for boiler in one-piece.—E. H. S.

A.—The accompanying drawing illustrates a complete development of one-half of the pattern, the other half is



One Half Pattern of One Piece Breeching

exactly the same. Triangulation is used for this layout; it is necessary to draw only a quarter plan and half elevation of the transition piece. The construction lines are numbered in both views to correspond, thus making it much easier to follow the required layout of the triangles and their assembly in the pattern. Before the pattern can be laid off, the development of the hole in the shell of the boiler must be made. The arc lengths on this outline are used in making the layout of the large end of the breeching.

Stack Base and Elbows

Q.—Would you kindly enlighten me on how to layout the base of a bell shaped bottom of a self supporting stack 16 feet 9 inches diameter at the top, 23 feet diameter at bottom and 18 feet 6 inches high, to be made of ⅝-inch steel plates running vertically?

(2) How may I figure the rise or different lengths of lines in the stretch-out for an elbow pattern without the aid of a plan and elevation drawing? In other words, the way used in laying out large elbows and miter cuts for large work?

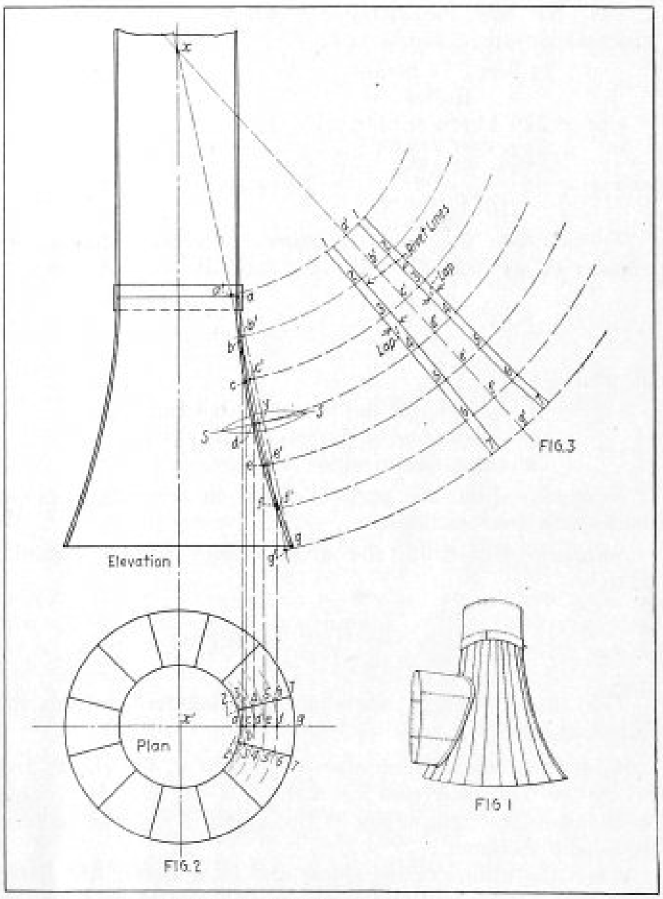
(3) How may I change a large miter so that it can be read to the part of a foot, as 9 5/32 inches to 12 inches?—C. H. H.

A.—(1) The perspective, Fig. 1, illustrates the form of the bell-shaped part of a self-supporting stack. This base is composed of vertical strips or segments alternating with inside and outside strips, which are joined together with single riveted lap seams. Around the top of the support is a ring that is riveted to the stack and base; this construction provides a good means for erection of the stack in the field.

The drawing, Fig. 2, shows one method of developing the strips or segments. A sectional view of the elevation and a plan are produced, showing in the elevation the form of the curved strips and plate thickness. From the center of the plate and through the extremities *a* and *g* draw the chord *a—g*. Divide the curve on the neutral line between points *a* and *g* into equal parts; and through the point *d* draw the line *s—s* perpendicular to the chord *a—g*. Bisect the distance between the chord *a—g* and point *d* on line *s—s*, thus locating point *y*. Through *y* and parallel with *a—g* draw a straight line to intersect the axis *x—x'* at point *x*.

In the plan, divide the circle representing one of the ends of the base into the required number of sections; in this example 12, of which one section is shown developed. Project the points *a, b, c, d,* etc., from the elevation to the center line *x'—g* in the plan. With *x'* as a center, draw arcs from points *a, b, c,* etc., to intersect the lines *1—7* of the segment. On the line *x—y* in the elevation and from the point *y* set off the arc lengths *d—c, c—a,* etc.

The pattern of one segment may now be laid off as indicated in Fig. 3. With *x* as a center and *x—a', x—b', x—c', x—e', x—d', x—f'* and *x—g'* as radii draw arcs of indefinite



Details of Self-Supporting Stack

length. In the pattern draw a straight line connecting point *x*. Transfer the arc lengths between points *a—1*, *b—2*, *c—3*, etc., of the plan and set them off from points *a'*, *b'*, *c'*, etc., in the pattern. Trace in the outline of the pattern through the points *1*, *2*, *3*, *4*, *5*, *6* and *7*, and allow for laps. Where heavy plate is used it is necessary to take into account the thickness of plate, which may be done by making the layout to the neutral axis or center of the plate thickness. Allow

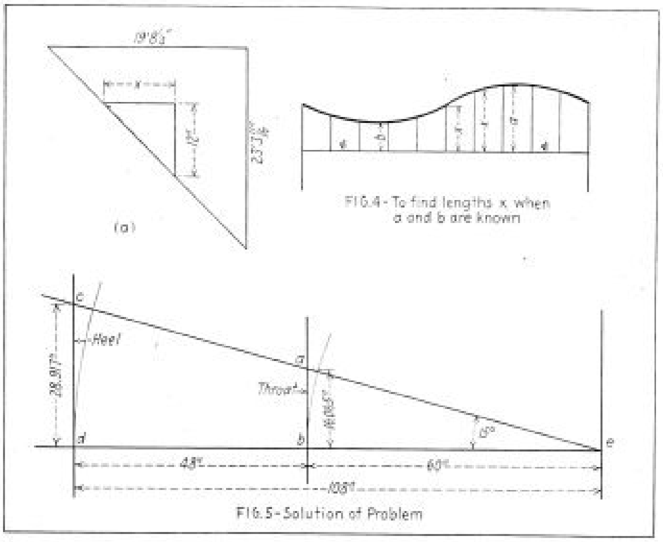


FIG.4-To find lengths x when a and b are known

FIG.5-Solution of Problem

Problem in Triangulation

for the laps. On account of the curvature in the base, each segment will require a slight raising or hammering to produce the double curvature.

(2) To find the distance *x* when the dimensions are given as shown in Fig. 4 (a):

x : 19 feet 8¼ inches : : 23 feet 3 11/16 inches : 12 inches

$x \times 279\ 11/16 = 236\frac{1}{4} \times 12$

$$\text{and } x = \frac{236\frac{1}{2} \times 12}{279\ 11/16} = 10.36 \text{ inches.}$$

To calculate the angle of miters in elbows having any number of sections, the following formula may be used:

$$A = \frac{N}{(2 \times n) - 2}$$

in which

A = angle for the rise on each joint, degrees.
N = Number of degrees in the elbow.
n = number of elbow sections.

Example.—Find the angle of miters in a 90-degree elbow made with four sections.

Solution.—Substitute the given values in the formula, then

$$A = \frac{90}{(2 \times 4) - 2} = 15 \text{ degrees. Ans.}$$

The angle between miters may be determined from the following rule:

Subtract 1 from the number of sections in the elbow, and divide the remainder into the number of degrees, comprising the whole elbow; the result is the angle in degrees between the elbow sections.

When the radius of the elbow and its diameter are given, the length of the heel and throat may be determined by calculation. Assume, for example, that a four-piece elbow 48 inches in diameter is to be constructed to a radius of 60 inches at the throat.

The rise on each joint is 15 degrees as explained. Refer to Fig. 5. The length *a—b* or throat equals the length *b—c* times the tangent 15 degrees. Then

$$60 \times 0.26795 = 16.065 \text{ inches.}$$

The length of the heel *c—d* may be found as follows, representing *c—d* by x:

$x : 108 : : 60 : 16.065$

or $x \times 60 = 108 \times 16.065$

$$\text{and } x = \frac{108 \times 16.065}{60} = 28.917 \text{ inches.}$$

Explain more fully the information required for question 3.

BOOK REVIEW

A STUDY OF THE LOCOMOTIVE BOILER. By Lawford H. Fry. Size, 6 by 9 inches. Pages, 157. Illustrations, 29. New York, 1924: Simmons-Boardman Publishing Company.

This volume is planned as a study of the operation of the locomotive boiler and to deal with tests and methods of testing. No particular attention is given to details of construction and familiarity with the general arrangement is assumed. Beginning with the experimental tests on locomotives of the Liverpool and Manchester Railway in 1834, the progress of testing methods is outlined down to the present time. The theory of combustion and the relation of various forms of fuel to the generation of steam in locomotive boilers are analyzed. In studying the operation of a locomotive boiler it is highly desirable to draw up a "heat balance"; that is to say, to ascertain how the heat available in the coal fired is distributed, to find what proportion is usefully employed in evaporation and how the remainder is divided among the various avenues of loss. Chapter III outlines the data necessary and the method developed for computing a heat balance. The chapter following offers for comparison a number of balances thus obtained. Chapter V deals with the detailed study of the processes by which the heat produced by combustion is taken up by the boiler heating surfaces. Two distinct and independent processes are involved; that of radiation from the fire to the firebox surface and that of transfer by contact of the heated gases with the cooler boiler heating surfaces. Equations are developed for carrying through the computations for both cases and typical examples given for applying these formulas. The following chapters deal with the transfer of heat from the gases to the flues with a consequent progressive fall of temperature of the gases as they pass through the flues and escape at the smokebox temperature. The general effect of the various conditions on the rate of heat transfer in flues is given with formulas from which the exact effect of these conditions can be computed. Tables to facilitate such computations are included.

A study of heat absorption as affected by the rate of operation and by the boiler dimensions and the methods of determining boiler efficiency constitute the final chapters in the book. Many useful tables, giving the results of tests, the proportions of boilers, combustion calculations, comparisons of calculated and test results and other data make up the final section in the book. For the designer, the railroad operator or student in locomotive design the information given in this book should prove of the utmost value as it is practically the only complete analysis of the physiology of the locomotive boiler; that is the problems of the boiler that enter into the production of steam through the medium of proper combustion and the absorption of the developed heat by the boiler surfaces.

Letters from Practical Boiler Makers

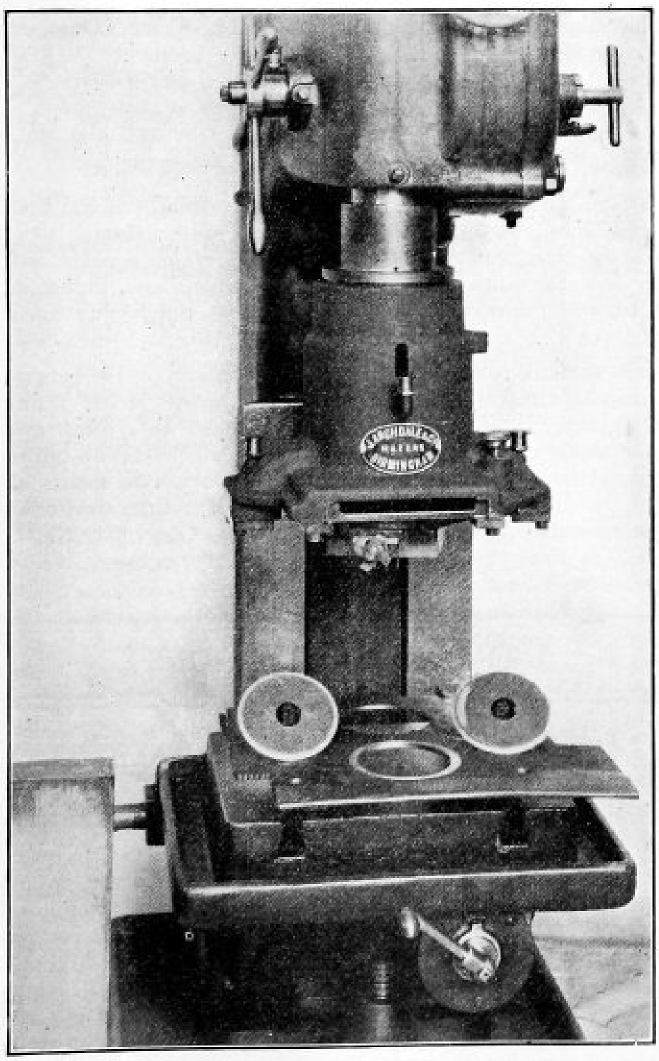
This Department Is Open to All Readers of the Magazine —All Letters Published Are Paid for at Regular Rates

New Oval Hole Cutting Attachment

A NEW invention recently introduced to the world of machine tools in England is an attachment especially designed for cutting oval holes in steel headers for watertube boilers. It is designed for use with a drilling machine (the accompanying illustration shows the attachment on a vertical drill), and is connected to the non-rotating spindle valve, no external connection being necessary to fix it in place.

The cutting tool is carried in a slide, the motion of which is controlled by an eccentric, the machine spindle, and an additional slide. The difference between the lengths of the major and minor axes of the ovals which can be cut is a fixed amount, and the oval may vary from 3⅝ inches by 4¼ inches to 4⅝ inches by 5¼ inches.

In addition to cutting an oval hole, by changing the tool and making a small adjustment the underside of the work for a width of about ⅜ inch may be faced, the feed being actuated by screw, star-wheel, and tappet.



Attachment Connected to Vertical Drill

On test, the larger sized oval hole was cut through a one-half inch steel plate in 2½ minutes.

The device, while introduced for the above-mentioned purpose, has proved itself equally suitable for similar operations where required in other parts.

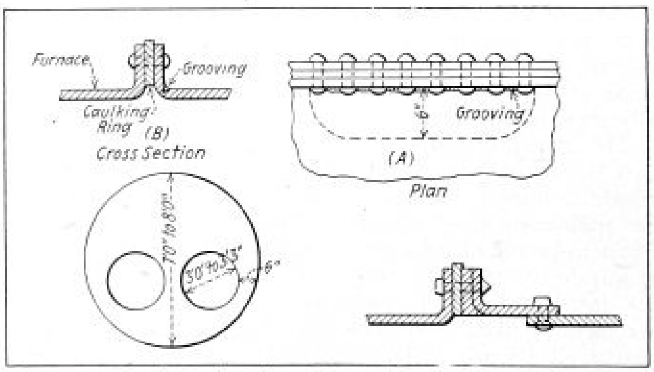
It is being manufactured by James Archdale & Co., Ltd., Birmingham, one of the ten concerns in the combine known as Associated British Machine Tool Makers, Ltd.

London, England. G. P. BLACKALL.

Repair to Adamson Ring in a Lancashire Boiler

OWING to bad circulation in the wings of a Lancashire boiler, corrosion takes place, the parts affected being the roots of the flanges of the Adamson joints, on the first three lengths in the boiler, where they are nearest the shell. The nature of the defect is grooving usually six inches or more in length in the position shown in the sketch, (*A*) being a plan and (*B*) a cross section. As this grooving considerably weakens the furnace, some form of repair is necessary.

The rivets which come in the grooving are removed by first cutting off the heads, drilling the shanks almost through



Grooving in a Lancashire Boiler

to the points then punching out. Space being limited the work is laborious, as will be seen from the sketch.

The grooving is now cut out with the acetylene torch including a portion of the furnace as shown in plan (*A*) with the dotted line. Holes are marked off on the body of the furnace, to the same pitch as the joint rivets and drilled. The patch is made to fit on the wet side as shown, marked off, drilled and planed to size.

Care should be taken that the root of the patch is tight down before marking off. As a rule the holes in the flange are given about ⅛ inch lift towards the lap. The holes in the furnace body are countersunk. The patch is bolted up leaving the flange bolts loose till the body rivets are driven, then tightening them with a box spanner while the patch is hot.

The flange rivets are driven, taking care that the holes are close in the root. After the burnt portion of the furnace is chipped, the calking ring is given a good punching up, then calked, the remainder of the calking following.

Hull, England. F. SNOWDEN.

A. S. M. E. Boiler Construction Code

(*Continued from page 356*)

= 175 for stays fitted with inside and outside nuts and outside washers where the diameter of washers is not less than T.

If a flat plate not less than 3/8 inch thick is strengthened with a securely riveted doubling plate covering the full area of the stayed surface and having a thickness of not less than 2/3 T, then the value of T in the formula shall be three-quarters of the combined thickness of the plate and doubling plate but not more than one and one-half times the thickness of the plate, and the value of C given above may also be increased 15 percent.

When two sheets are connected by stays and but one of these sheets requires staying, the value of C is governed by the thickness of the sheet requiring staying.

Acceptable proportions for the ends of through stays with washers are indicated in Fig. U-2.

(*To be continued*)

Boiler Legislation in France

(*Continued from page 342*)

destructive as low-pressure ones. This law, however, revived the old restrictions about the placing of boilers, but in a modified form. Boilers of the most destructive class were not to be placed nearer to a dwelling than 10 feet, and unless they were distant at least 33 feet a thick wall of 39 inches or more had to be interposed. This law is apparently still in force, and is inconvenient in so far that the owner of a boiler is forced to shift its position, or at least to build the protecting wall, if his neighbor erects a dwelling within a distance of 33 feet from the boiler. It is interesting to note that watertube boilers, because of their small water volume, belong to the less dangerous (French) classes, and being subjected to fewer restrictions in that country, naturally grew in favor.

The most important clause of this act is the one that says that steam users must not only see that their boilers are in a safe condition, but have them inspected at intervals that are sufficiently close together. Another clause provides that if an inspector of mines has reason to believe that a boiler is unsafe, he may have it tested, but if the boiler is under the inspection of an association, their certificate will be accepted as proof that the boiler is safe. By this means nearly all French boilers have been driven into the arms of the various Boiler Associations.—*From Report of C. E. Stromeyer, Chief Engineer of the Manchester Steam Users' Association, through the courtesy of Power.*

Repairing Vessels While Under Pressure

(*Continued from page 353*)

expansion joint became loose. A burst of steam knocked Pierce off the boiler. The joint was tightened and no damage to the cannery occurred.—*San Francisco Chronicle, September 11, 1923.*

BOILERMAKER IS BADLY SCALDED

C. P. Newby, a boilermaker working at the Missouri Pacific shops in Baring Cross and living at 2720 West Sixth Street, Little Rock, was slightly scalded about the right shoulder and right side of the face while at work in the boiler shop at the shops about 3 o'clock Sunday afternoon when a steam pipe on a locomotive burst and threw the boiling water over him.

He was taken to the emergency hospital at the shops where his injuries were dressed and then removed to his home. According to a statement he made to the attending doctor he was knocking rust out of a boiler pipe on the locomotive when a steam pipe burst and the scalding water flooded the boiler. It was reported at the shops Monday morning that he was only slightly hurt and would be able to return to his work in a few days.—*Arkansas Democrat, September 23, 1923.*

LOCOMOTIVE ENGINEER DIES FROM INJURIES

Little Rock, Ark., September 25th:—H. L. Hickman, Rock Island engineer, died last night as the result of injuries suffered yesterday morning when he, with Fireman W. E. Oden, was terribly scalded by a mixture of steam, boiling water and fuel oil. Oden's condition is said to be serious.

The fatal accident, it is reported, was caused by a leak in the crown sheet of an engine the men were repairing, which allowed the scalding water and vapor to gush upon them.—*Memphis News Scimitar, September 25, 1923.*

Reprinted from *The Locomotive.*

BUSINESS NOTES

The Southwark Foundry & Machine Co., Philadelphia, Pa., has discontinued its Cleveland office. This office is now located at 100 East South street, Akron, Ohio, in charge of F. H. Smith.

The Premier Staybolt Company, Pittsburgh, Pa., has opened a Chicago office in the Peoples Trust and Bank building, 30 North Michigan boulevard. L. W. Widmeier, assistant to the president, is in charge of this office.

Tom Moore, 811 Royster building, Norfolk, Va., has been appointed railroad sales agent in the southeastern district for the American Bolt Corporation, New York. He will conduct the sales activities in the railroad and industrial field. Mr. Moore was formerly general purchasing agent of the Virginian railway.

R. C. Broach of Atlanta, Ga., and formerly in the general sales department at St. Louis, Mo., of the Heine Boiler Company, St. Louis, has been appointed this company's southeastern district manager with office at 709 Glenn building, Atlanta, Ga. The southeastern territory consists of eastern Tennessee, North and South Carolina, Alabama, Georgia and Florida. S. B. Alexander, Charlotte, N. C., will continue as the company's special representative in North and South Carolina.

TRADE PUBLICATIONS

SWAGING MACHINES.—A 32-page booklet illustrating the modern art of swaging and swaging machines has been issued by the Torrington Company, Torrington, Conn. Dimensions and capacities of the Dayton swaging machines are also given.

FILE CHART.—A complete and ready reference to the various kinds, sizes, shapes and cuts of saw files, machinists' files, miscellaneous files and rasps and extra fine Swiss pattern files, has been prepared by the Nicholson File Company, Providence, R. I., in the form of a 54-inch by 27-inch hanger printed on heavy cloth-backed paper, with wood rollers at top and bottom. The chart is also printed on 27-inch by 12-inch cards, the surfaces of both styles being varnished to permit of washing.

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—George Uhler, Washington, D. C.

Deputy Supervising Inspector General—D. N. Hoover, Jr., Washington, D. C.

American Uniform Boiler Law Society

Chairman of the Administrative Council—Charles E. Gorton, 253 Broadway, New York.

Boiler Code Committee of the American Society of Mechanical Engineers

Chairman—John A. Stevens, Lowell, Mass.

Vice-Chairman—D. S. Jacobus, New York.

Secretary—C. W. Obert, 29 West 39th Street, New York.

National Board of Boiler and Pressure Vessel Inspectors

Chairman—J. F. Scott, Trenton, N. J.

Secretary-Treasurer—C. O. Myers, State House, Columbus, Ohio.

Vice-Chairman—R. L. Hemingway, San Francisco, Cal.

Statistician—E. W. Farmer, Rhode Island.

International Brotherhood of Boiler Makers, Iron Ship Builders and Helpers of America

J. A. Franklin, International President, suite 522, Brotherhood Block, Kansas City, Kansas.

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

Joseph Flynn, International Secretary-Treasurer, suite 504, Brotherhood Block, Kansas City, Kansas.

James B. Casey, Editor-Manager of Journal, suite 524, Brotherhood Block, Kansas City, Kansas.

H. J. Norton, International Vice-President, Alcazar Hotel, San Francisco, Calif.

International Vice-Presidents—Thomas Nolan, 700 Court St., Portsmouth, Va.; John Coots, 344 North Spring St., St. Louis, Mo.; M. A. Maher, 2001-20th St., Portsmouth, Ohio; E. J. Sheehan, 7826 South Shore Drive, Chicago, Ill.; John J. Dowd, 953 Avenue C, Bayonne, N. J.; R. C. McCutcheon, 15 La Salle Block, Winnipeg, Man., Can.; Joseph P. Ryan, 7533 Vernon Ave., Chicago, Ill.; John F. Schmitt, 605 East 11th Ave., Columbus, Ohio.

Master Boiler Makers' Association

President—Frank Gray, tank foreman, C. & A. R. R., Bloomington, Ill.

First Vice-President—Thomas F. Powers, assistant general foreman, boiler department, C. & N. W. R. R., Oak Park, Ill.

Second Vice-President—John F. Raps, general boiler inspector, I. C. R. R., Chicago, Ill.

Third Vice-President—W. J. Murphy, general foreman boiler maker, Penn System, Fort Wayne Shops, Allegheny, Pa.

Fourth Vice-President—L. M. Stewart, general boiler inspector, Atlantic Coast Lines, Waycross, Ga.

Fifth Vice-President—S. M. Carroll, general master boiler maker, C. & O. R. R., Richmond, Va.

Secretary—H. D. Vought, 26 Cortlandt Street, New York.

Treasurer—W. H. Laughridge, G. F. B. M., Hocking Valley R. R., 537 Linwood Avenue, Columbus, Ohio.

Executive Board—E. J. Reardon, Locomotive Firebox Company, 632 Marquette Building, Chicago, Ill., chairman; H. J. Raps, G. F. B. M., I. C. R. R., 7224 Woodlawn Avenue, Chicago, Ill., secretary.

Boiler Makers' Supply Men's Association

President—J. P. Moses, Jos. T. Ryerson & Son, Chicago, Ill.; Vice-President—F. H. McCabe, McCabe Manufacturing Co., Lawrence, Mass.; Secretary—W. H. Dangel, Lovejoy Tool Works, Chicago, Ill.

American Boiler Manufacturers' Association

President—E. R. Fish, Heine Boiler Company, St. Louis, Mo.

Vice-President—E. C. Fisher, The Wickes Boiler Company, Saginaw, Mich.

Secretary-Treasurer—H. N. Covell, Lidgerwood Manufacturing Company, Brooklyn, N. Y.

Executive Committee—George W. Bach, Union Iron Works, Erie, Pa.; G. S. Barnum, The Bigelow Company, New Haven, Conn.; F. G. Cox, Edge Moor Iron Company, Edge Moor, Del.; W. C. Connelly, D. Connelly Boiler Company, Cleveland, O.; W. A. Drake, The Brownell Company, Dayton, O.; A. R. Goldie, Goldie-McCulloch Company, Galt, Ont., Can.; J. F. Johnston, Johnston Brothers, Ferrysburg, Mich.; M. F. Moore, Kewanee Boiler Works, Kewanee, Ill., and A. G. Pratt, The Babcock & Wilcox Company, New York.

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	Allegheny County, Pa.

Cities

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

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

States

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

Cities

Chicago, Ill.	Nashville, Tenn.	St. Louis, Mo.
Kansas City, Mo.	Parkersburg, W. Va.	Seattle, Wash.

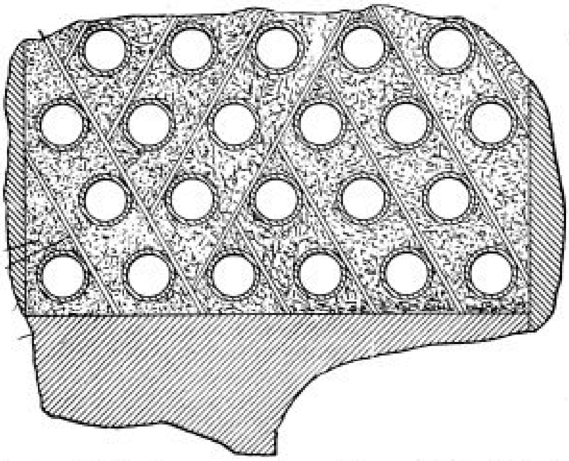
SELECTED BOILER PATENTS

Compiled by
DWIGHT B. GALT, Patent Attorney,
Washington Loan and Trust Building
Washington, D. C.

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

1,511,840. BOILER MOUNTING. JOSEPH W. PUTNAM, OF EAST ORANGE, NEW JERSEY.

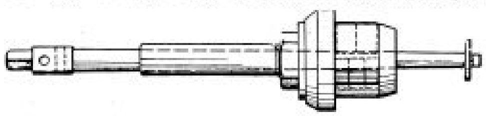
Claim 1.—The process of building a baffle wall, devoid of pre-formed bricks, for boiler tubes which consists in successively molding, in position with respect to the boiler tubes, independently removable wall sections of



refractory material having opposing faces with mutually interlocking indentations and projections, and in interlocking with each other said molded wall sections during and by the process of molding the same. Four claims.

1,507,846. TUBE EXPANDER. GRAVES R. MAUPIN, OF MOBERLY, MISSOURI, ASSIGNOR TO THE J. FAESSLER MANUFACTURING COMPANY, A COPARTNERSHIP COMPOSED OF JOHN W. FAESSLER, CHRISTINIA FAESSLER, LOUIS E. FAESSLER, AND GRAVES R. MAUPIN, ALL OF MOBERLY, MISSOURI.

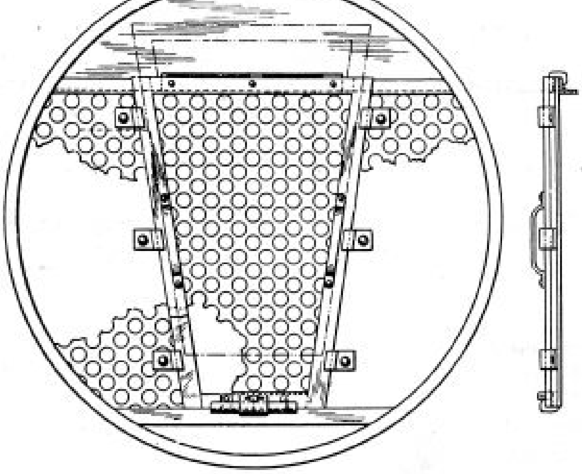
Claim 1.—A tube expander comprising a cage, a tapered mandrel extending through said cage, and a plurality of sectional rollers arranged in groups



varying in number of sections located in said cage, said rollers contacting with the mandrel and adapted to be projected beyond the periphery of said cage by the action of said mandrel. Four claims.

1,509,314. INSPECTION DOOR FOR LOCOMOTIVE FRONT ENDS. JOHN P. POWERS, OF ESCANABA, MICHIGAN, ASSIGNOR OF ONE-HALF TO THOMAS F. POWERS, OF CHICAGO, ILLINOIS.

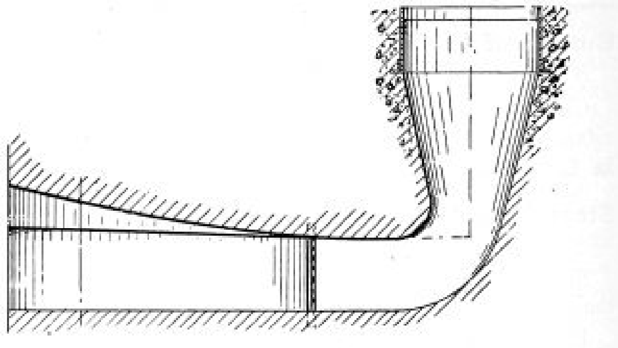
Claim 1.—In a device of the kind described, the combination of a spark screen having a door opening therein, an open frame fixed to said screen



about said opening, a perforated door having a frame with oppositely disposed, inclined side edges, and means spaced outwardly from the open frame providing guides arranged complemental to said inclined side edges of said door frame so that said door frame is removably held in place against said open frame under its own weight. Three claims.

1,511,364. DRAFT TUBE. HARRY E. POPP, OF CLEVELAND, OHIO, ASSIGNOR BY MESNE ASSIGNMENTS, TO NEWPORT NEWS SHIPBUILDING & DRY DOCK COMPANY, OF NEWPORT NEWS, VIRGINIA, A CORPORATION OF VIRGINIA.

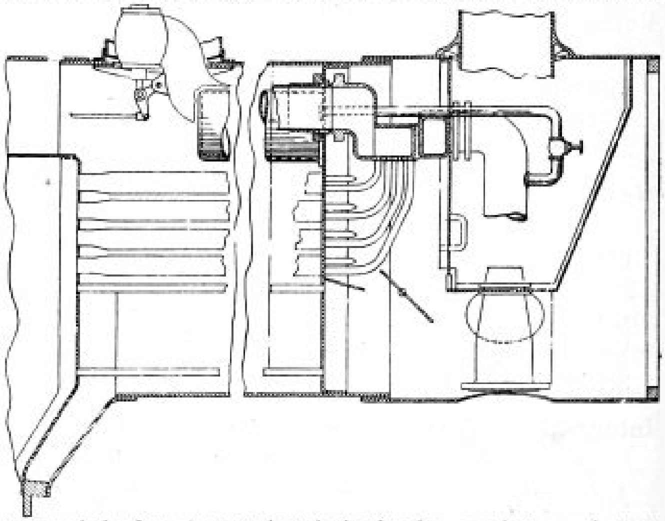
Claim 1.—A draft tube for a water turbine, shaped to convert the column



or stream of water leaving the runner and while substantially coaxial therewith into an elongated narrow sheet. Thirteen claims.

1,508,128. DRIFTING DEVICE. GILBERT E. RYDER, OF LEONIA, NEW JERSEY.

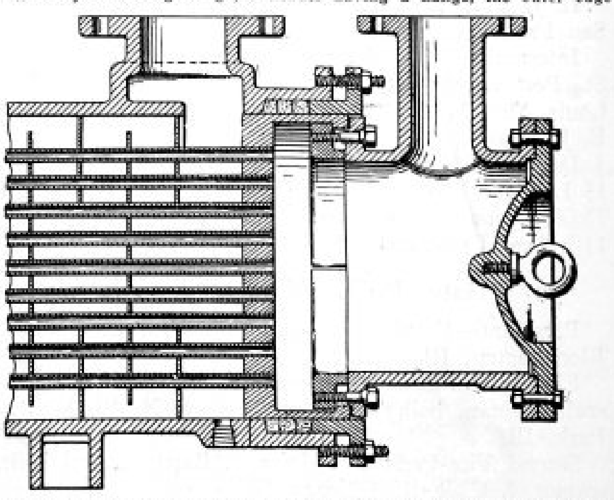
Claim 1. In a locomotive equipped with a superheater, the combination of the superheater; a dry-pipe to deliver steam from the boiler to the superheater; a steam-pipe to deliver steam from the superheater; throttling means



to control the flow of steam through the dry-pipe, superheater, and steam-pipe; a closed chamber whose outer surface is in contact with the boiler contents; and a pipe through which the interior of said chamber communicates with the steam-pipe beyond the throttling means. Six claims.

1,511,836. HEAT-EXCHANGE APPARATUS. KARL MUHLEISEN, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO SCHUTTE AND KOERTING COMPANY, OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

Claim 1.—In heat exchange apparatus, the combination of a tube-plate having a forwardly extending flange which terminates at its forward edge in an inwardly extending flange, a header having a flange, the outer edge



portion of which is adapted to contact with the forward edge of the first named flange, a clamping member comprising a plurality of sections, the outer edges of which are situated underneath the said inwardly extending flange, and means for clamping the latter flange between the said clamping member and the flange on said header. Seven claims.