May 24, 1932. P. WRIGHT 1,859,858

BOILER

Filed Oct. 28, 1929 3 Sheets-Sheet 1

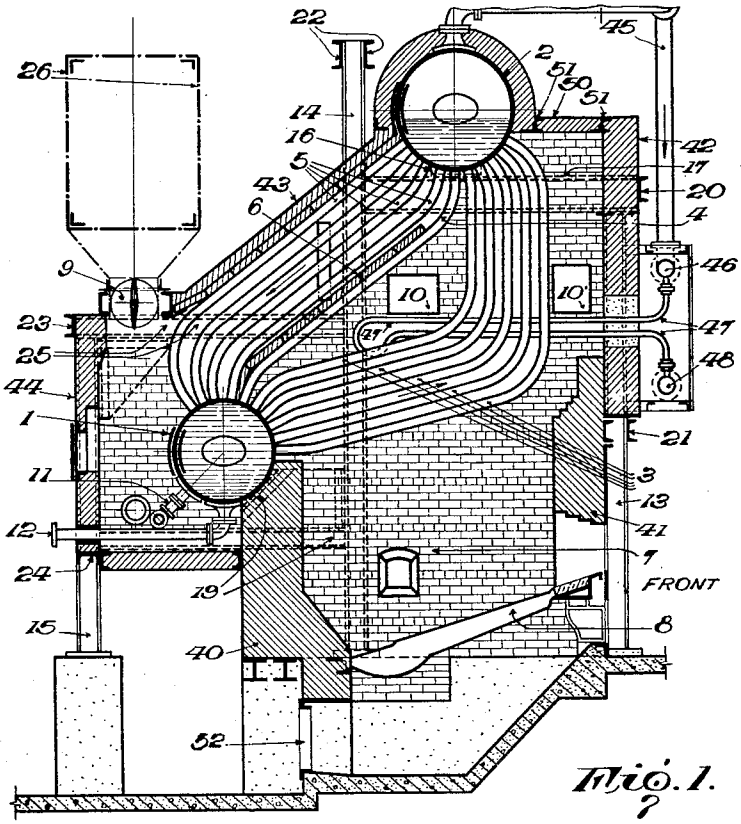


Fig. 1.

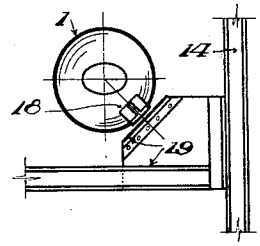


Fig. 2.

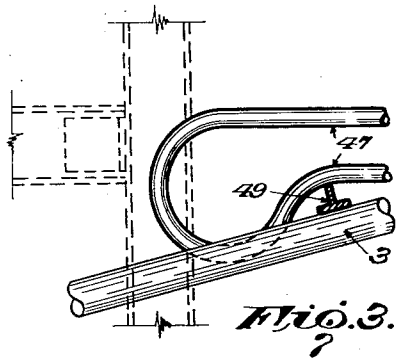


Fig. 3.

WITNESSES

T. H. Whitfield

Edw. C. Dienne.

INVENTOR.

Paul Wright

BY

Cameron, Kerkam & Sutton.

ATTORNEYS.

May 24, 1932. P. WRIGHT 1,859,858

BOILER

Filed Oct. 28, 1929 3 Sheets-Sheet 2

FIG. 5.

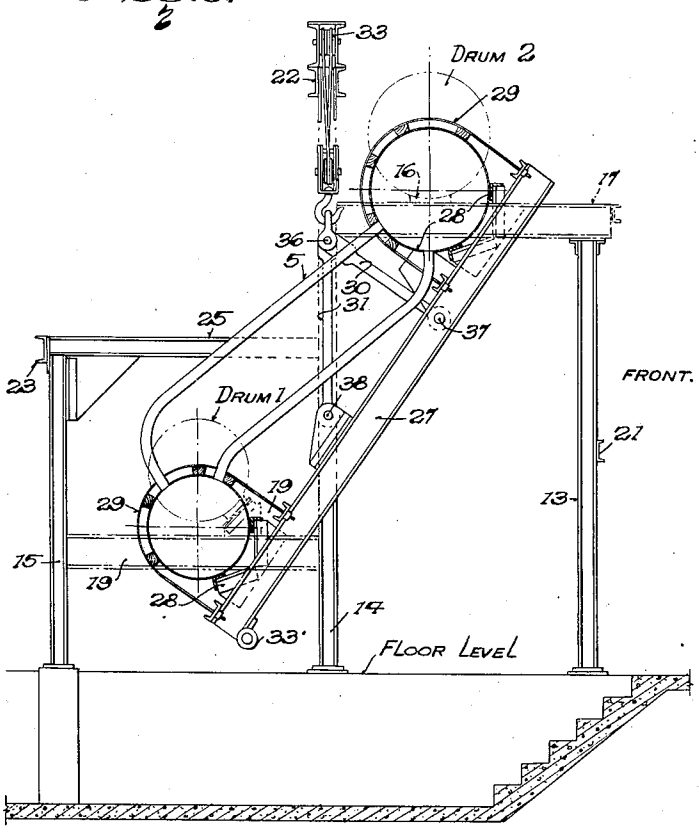


FIG. 6.

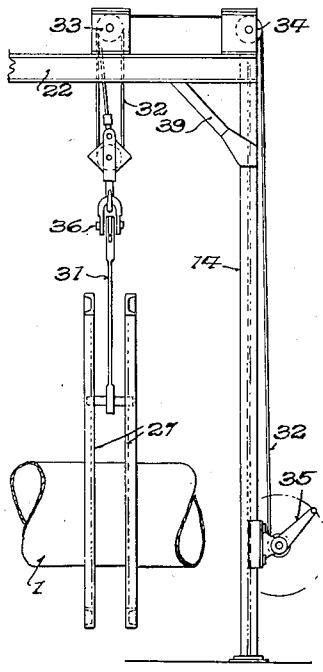
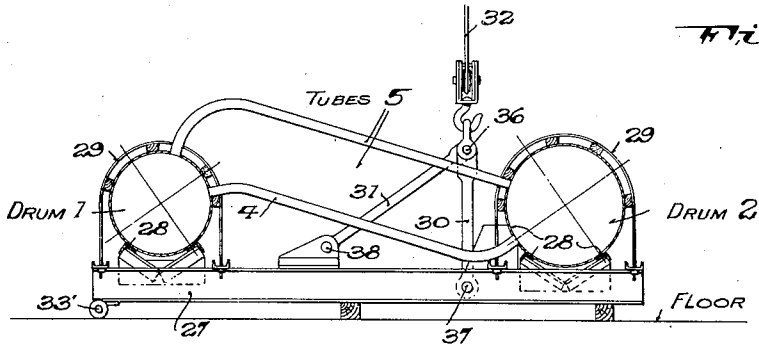


FIG. 4.



INVENTOR

Paul Wright

BY

Cameron, Kerkam & Sutton.

ATTORNEYS

May 24, 1932. P. WRIGHT 1,859,858

BOILER

Filed Oct. 28, 1929 3 Sheets-Sheet 3

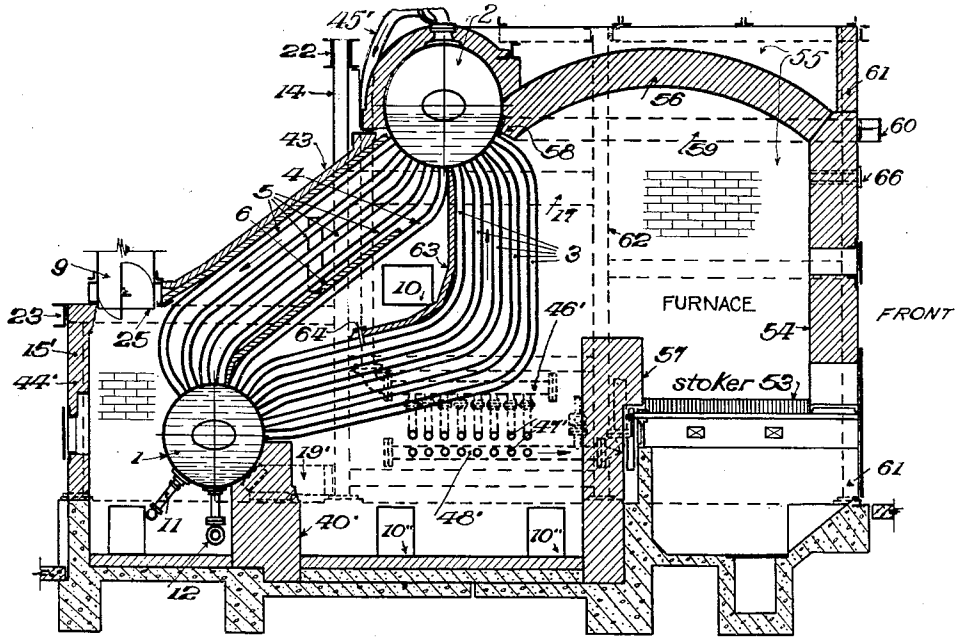


Fig. 7.

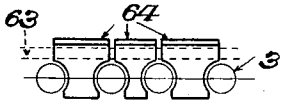


Fig. 8a

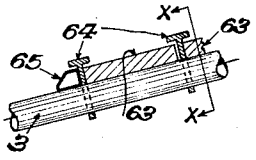


Fig. 8.

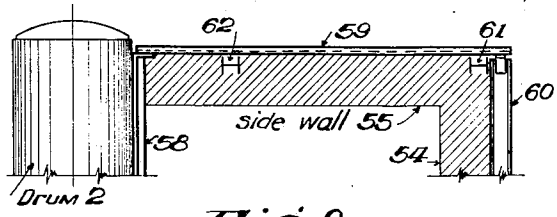


Fig. 9.

WITNESSES

T. H. Whitfield

Edw. C. Dennie

INVENTOR.

Paul Wright

BY

Cameron, Kerkam & Sutton.

ATTORNEYS.

Patented May 24, 1932 1,859,858

UNITED STATES PATENT OFFICE

PAUL WRIGHT, OF BIRMINGHAM, ALABAMA

BOILER

Application filed October 28, 1929. Serial No. 403,048.

This invention relates to boilers and has for its objects to secure an efficient generation of steam and its separation from the water; to provide a compact association of the component parts of the boiler; to effect economies in the construction of the boiler shell or pressure parts, in the erection of the boiler, in the space occupied by the setting, and in the construction of the furnace and boiler setting.

With these objects in view the invention consists of a novel arrangement of drums, boiler tubes, structural supporting frame and their combination with each other and with the furnace, together with a system of baffling for directing the heated gases over and around said tubes. One form which the invention may assume is shown in the accompanying drawings, but it is to be expressly understood that these drawings are for the purpose of illustration only and are not intended to define the limits of the invention, reference being made to the appended claims for this purpose.

In the drawings, in which similar reference characters designate corresponding parts,

Fig. 1 is a vertical longitudinal section of a boiler embodying the invention;

Fig. 2 is an end view of the bottom drum yieldingly supported;

Fig. 3 is an enlarged view showing the method of supporting superheater tubes;

Fig. 4 is an erection assembly of the boiler drums and rear bank of tubes,—all resting on its erection cradle preparatory to being hoisted into position;

Fig. 5 is a side view of the supporting frame utilized with an erection cradle for hoisting the partial boiler assembly shown in Fig. 4;

Fig. 6 is a transverse view partially showing the supporting frame and the erection cradle with its hoisting arrangement;

Fig. 7 shows in longitudinal section another form of the boiler's setting and superheater arrangement;

Fig. 8 shows an enlarged detail of the baffling support; Fig. 8*a* is a cross section on the line X—X of Fig. 8; and

Fig. 9 shows the method of supporting the arch over the furnace indicated in Fig. 7.

Referring particularly to Figs. 1 and 2, the boiler proper comprises a yieldingly supported bottom or water drum 1, and a rigidly supported top or steam drum 2, in the relation that the top drum is above and forward of the bottom drum. These drums are connected by two principal banks of tubes. The first bank 3 connects the upper right-hand quadrant of drum 1, with the lower right-hand quadrant of drum 2, the tube bank being upwardly inclined from drum 1, for a portion of its length and thence changing direction to ascend vertically (or approximately so) to connect with drum 2. The second bank of tubes 5 and the tubes 4 connect the lower left-hand quadrant of drum 2, with that upper portion of drum 1 that is adjacent to and rearward of bank 3. The first tube bank 3 usually has the same number of tubes as the second tube bank although not necessarily. The inclination of the portion of tubes 3 extending forward from drum 1 over the furnace is at an angle of about 15 degrees from the horizontal, although this angle of inclination may be varied somewhat to meet different requirements. The boiler tubes have the usual bends to accommodate the radial entrances into their respective drums and also to permit yielding to compensate for the contraction and expansion caused by variation in temperature.

This two-drum boiler provides a construction of a smaller size of boiler than would be practicable in a similar small size boiler of the three-drum type shown in my Patent No. 1,437,790, thereby effecting an economy for small boilers in the material required for boiler drums. Furthermore, the bottom or mud drum and the top or steam drum, for either the two-drum or three-drum boiler, may be made interchangeable by omitting the drilling of certain tube holes. This feature is valuable in reducing the number and expense of drums that need be built in advance of sale, for stock or future sale.

The triangular shape formed by the front bank of tubes 3, with the rear bank 5 and tubes 4 and all tubes connected to the two drums, further provides a construction compensating any expansion or contraction

forces by reason of the quite flexible shape of tubes 3, which have a principal bend between the inclined portion and the approximately vertical portion. Thus a tendency to leak at tube ends is eliminated, although the degree of expansion in the front and the rear tube banks be different. This triangular shape eliminates distorting or buckling of the tubes exposed to the hottest portion of the furnace.

This relation of drums and banks of tubes lends itself to an improvement in baffling that forms a part of the present invention. Referring to Fig. 1, the principal baffle 6 is supported beneath the bank of tubes 5, on the row of tubes 4, and directs the furnace gases successively around the entire tube heating surface of the boiler from the furnace 7 to the gas exit 9. The inclined position of baffles 6, usually made of refractory tile or other heat resisting material, assures that they will unfailingly remain tight and be clean of flying cinder and dust deposits. By varying the opening between the upper end of baffle 6 and drum 2, the volume and velocity of the heating gases may be so controlled as to secure the best heat transfer advantages under the varying temperature of said gases in transit.

The furnace grates 8 (Fig. 1), may be inclined approximately parallel to the lower portion of tubes 3. This affords an advantage in furnace design, as it ensures an approximately equal length of flame travel from different portions of grates 8 to tubes 3, since the grates and tubes are positioned at about the same inclination. This promotes a more complete combustion of gases from the fuel before they pass over the tubes, due to the advantageous length of flame travel. Since there is only one abrupt change in the direction of the gas flow through this boiler setting, the resistance to the flow of the heating gases is reduced to a minimum. Hence the draft loss is relatively low and the expense of a boiler stack is reduced.

The shape of tube bank 3, with reference to tube bank 5 and the tubes 4, provides room for an access door 10, in either or both sides of the boiler setting, thereby permitting all baffle tiles to be inspected, altered to suit operating changes and readily handled in or out of the setting. This opening likewise facilitates handling of tubes during erection and affords an easy cleaning of the tubes' exterior. A similar access door 10′ located as shown in Fig. 1, facilitates access to tubes 3 from the front side so that entering either door 10 or 10′, any tube may be reached at arm's length.

A material advantage is obtained in circulation and steam disengaging capacity of the boiler as a result of this definite relation of drums and banks of tubes, because the feed water enters through a pipe 11, into drum 1, where it is distributed and mixed with the heated water in circulation. This effects immediate separation and precipitaton of a large percentage of the scale-forming substances within this drum, so that these substances may be blown off through the blow-off pipe 12. The water in bank 3 is subject to the first or hottest passes of the furnace gases and steam forms rapidly and causes the water and steam to ascend in these tubes to drum 2. The shape and general direction of tubes in bank 3 prevent the formation of steam pockets and possible lodgment of scale in the drums. Practically the entire tube surface of bank 3 is subjected to radiant heat exposure to the furnace. This is advantageous since the transfer of heat by means of radiation is considered most effective. The combined length of tubes in bank 3 is greater than the combined length of tubes in the bank 5 and tubes 4, thereby assuring a positive tendency for the mixture of steam and water to flow upward from drum 1, to drum 2. However, tubes 4 are exposed to gases of approximately the same temperatures as the upper tubes 3 and therefore the flow of steam and water through tubes 4 is upward into drum 2. This being true, the ratio of heating surface exposed to the first pass of the furnace gases is approximately 65% of the total heating surface for the particular boiler as illustrated in Fig. 1. This larger proportion of heating surface in the up-cast tubes facilitates the imparting of a greater amount of heat thereto by the gases of combustion than would otherwise be the case and in consequence more steam per unit of boiler heating surface is produced. The water returns downward through tubes 5 to drum 1 and thereby a positive, vigorous, circuitous flow through all the tubes is obtained. This promotes a highly efficient, continuous rate of steam generation and gives a quick response to increased furnace firing to meet over-load demands. The boiler tubes are spaced in alternately wide and narrow rows in a well known manner, thereby permitting removal of any tubes without disturbing the others. All tubes, except those of the superheater, are bent to the same radius to simplify construction.

The relation and arrangement of drums and banks of tubes as previously described permits the use of an improved supporting frame, which also serves to greatly facilitate erection and reduces the time and expense of doing the work. The supporting frame, Fig. 1, consists essentially of two front columns 13, one on each side, two intermediate columns 14, one on each side, and two rear columns 15. The top or steam drum 2 is supported on a saddle 16, resting on beams 17 carried by columns 13 and 14, and by reference to Fig. 2 it will be seen that the bottom or water drum 1 is yieldingly supported by

an inclined bearing bracket 18, which rests on beam 19 provided with an inclined support to match. Transversely, the front columns are braced by members 20 and 21, or otherwise. The intermediate columns 14 have their bottom ends anchored to the setting foundation (as do the other columns) and the top ends are transversely secured by a combination hoisting girder and strut 22. The rear columns are braced by members 23 and 24, or otherwise. The two front columns 13, supporting beams 17, also serve as binders for the brick setting. Likewise the two rear columns 15 serve as binders for the brick setting at the rear corners and also furnish support for the smoke breeching 26, by means of transverse beams which rest on side beams 25 connected to these columns.

The supporting framing is thus designed so that the drums, tubes and principal parts of the boiler proper, may be erected independently of the brick furnace setting. Thus the work of bricking the setting need not be interfered with after the boiler is erected. This supporting frame advantageously compensates for the expansion of the boiler proper without producing expansive strains, since the top drum is fixed and the bottom drum is free to move on its inclined support, as before explained.

Another feature of the invention is the arrangement of the supporting frame with particular reference to the position of columns 14, together with hoisting girder 22, designed for erection purposes. By reference to Figs. 4. 5 and 6, together with Fig. 1, an improved plan of erection is disclosed. Fig. 4 shows an erection cradle 27, provided with special saddles 28 for holding drums 1 and 2 securely by means of strap bolts 29 attached to the cradle The drums 1 and 2 may previously have been assembled with the rear tube bank 5 and tubes 4 at the factory, thus avoiding the expense of doing such work at the erection site. Also this plan assures proper alignment of the parts at the factory, thus relieving the erector of aligning. In such case, the assembly of drums and tubes may be profitably shipped strapped on the cradle, ready to erect. If clearance limitations, such as an opening in the building housing the boiler, necessitated shipping drums and tubes "knocked down" then the cradle still would be advantageous in erecting, since the drums 1 and 2 with tubes 4 and 5 may be correctly assembled in exact position as indicated by match marks provided on the cradle and the assembly work would be handily done upon floor level. This method avoids the hazard and loss of time involved in hoisting drums singly and aligning them individually upon improvised scaffolding, and hence saves the expense of scaffolding.

Assuming, for example the drums and tubes already assembled as indicated in Fig. 4, the whole is ready to be hoisted. For this purpose, a hoist 35, (Fig. 6) securely fastened to one of the columns 14, raises or lowers the cradle by means of rope 32 passing over sheave 34 to hoisting tackle 33 supported on hoisting girder 22. As indicated by Fig. 5, the supporting members shown in full lines are first set up, all column bases being anchored in correct position and temporary guy lines provided to hold the columns steady, preparatory to later placing into position and fastening the beams 17 and 19 shown by dotted lines. The position of the cradle and its assembly is shown as a position of equilibrium, just prior to final hoisting for final placing. It is this position of equilibrium which determines the location of columns 14 with reference to their particular position between drums 1 and 2. At final hoisting, the drums 1 and 2 are raised above the position of their respective supporting beams 19 and 17 and these beams are next placed and secured in position preparatory to lowering the assembly in the permanent location indicated by dotted lines.

Again referring to Fig. 4, the cradle may preferably be equipped with a roller 33′ to facilitate first sliding it into postion preparatory to hoisting. The line of lift through link 30 first elevates drum 2 end of cradle and roller 33′ is useful for the cradle to drag easily into its equilibrium position. As the cradle rises, the links 30 and 31 take the load until link 31 attains a vertical position and holds all the load, as seen in Fig. 5. To avoid thrust in the links, a slotted connection may be made if desired in both links for the pin 36 holding the shackle. Also provision is made for adjusting the position of pins 37 and 38 to suit a change in weight of tubes or drums for boilers of the same type or pattern but of various pressures.

After erection, pin 36 is withdrawn. Straps 29 are loosed and the cradle is let down and may be thus returned to the factory with its hoist 35 and tackle 33 and 34 to be again used, thereby effecting an economy in erection expense.

Having erected drums 1 and 2 with tubes 4 and 5, tubes of bank 3 may next be more quickly erected and very easily lined up in the proper planes with tubes in the rear bank, already in place. The proper tube alignment is necessary to provide for boiler tube removal and replacement, also to readily accommodate the superheater elements in the spaces between sections of tubes.

Another advantage of the shape of this boiler and the design of its supporting frame, is the minimum clearance required for both the erection operation and the completed boiler. Thus the hoisting girder 22 need be no higher than the top of steam nozzle on drum 2. This limited height of girder 22 however renders possible the use of a trans-

verse knee brace 39 which braces column 14 and the brace properly clears the inclined edge of the setting below.

A smoke breeching 26, Fig. 1, is mounted in a vertical position immediately over a chamber defined by rear wall 44. This breeching does not extend rearward of said wall 44, nor vertically higher than girder 22. This construction effects economy of space and permits dust to fall from the breeching directly into the chamber below. The clearance between the rear wall 44 and the drum 1 is such as to afford ample space for cleaning out and for access to tubes 5 for removal or replacement.

This arrangement of drums and tubes with relation to each other and the boiler setting, provides a very advantageous arrangement of superheater. By reference to Fig. 1, the furnace is seen to be enclosed by a rear or bridge wall 40, a lower front wall 41, and an upper front wall 42, supported on transverse framing member 21. This provides a lap joint for accommodating expansion between the lower wall 41 and upper wall 42. The furnace is further inclosed by the side walls. The superheater comprises a saturated steam header 46 receiving the steam from drum 2 by means of pipes 45. Saturated steam passes thence through superheater tubes 47 to superheated steam header 48 for service. For construction purposes, the header 48 may be connected as saturated header if desired and the superheated steam would be drawn from header 46. This superheater arrangement affords an advantageous position of its tubes with reference to the gas passage and the means of support and location of headers. The heating gases reach the superheater tubes at a suitable temperature for efficient and successful heat transfer, since they have previously passed partially through tube bank 3, which serves to reduce the temperature of the gases, thereby preventing the superheater tubes from possible overheating. The headers are supported exterior to the front wall as shown in Fig. 1 and are so positioned that the superheater tubes are detachable and removable. The furnace or loop end of the superheater would tend to sag under service, were it not supported. Fig. 3 shows an enlarged view of the loop end supported by a cross member 49 that rests on upper tubes 3. The loop is so postioned as to rest on and hold in place, the T-bar member 49 without need of fastening. This T-bar made of cast iron would last satisfactorily since the heating gases previously pass over about five tubes 3 as shown, thus reducing the heat in said gases so as to afford no difficulty. This method of support also responds to any needed movement of either boiler or superheater tubes due to expansion and the support is simple nd economical in cost.

The location of headers 46 and 48 exterior to the furnace provides for easy inspection for maintenance and facilitates the connection by pipes 45 with the steam drum, so that said pipes 45 properly take up expansion or contraction strains within a very limited space over and alongside of the setting.

This design of setting and supporting frame affords an advantageous arrangement of gas exit, with regard to protecting the rear boiler tubes from possible corrosion externally. If a stack be used instead of the breeching 26 shown in Fig. 1, the stack would be supported on framing 25. Usually stacks admit rain water to fall through and settle below. It will be seen that the position of gas exit in such case would prevent the adjacent boiler tubes from being wetted by rain water. It is well known that sulphurous gases (from the fuel burned having some sulphur content) are absorbed by water in contact and form a corrosive fluid which will attack steel. My design prevents such wetting and the resultant corrosion of these rear tubes.

The rear of the setting, has the inclined covering 43, of refractory materials, either resting on tubes 5 as shown or supported independently of the tubes by suitable framing. It is apparent that the saving in side walls, above and to the left of the rear inclined bank of tubes 5, and likewise in the low rear wall 44, is effected without being detrimental to the design or function of the furnace chamber, furnace gas passages or rear dust chamber.

The relatively small space required in front of the boiler for removing or replacing a boiler tube, is an improvement in the boiler setting. By reference to Fig. 1, the upper portion of furnace chamber in front of tubes 3 is bounded by the upper front wall 42, the two side walls and a top covering 50. This top covering may be of refractory tile with a combination of insulation above and so constructed as to be supported on the transverse lintels 51 and thereby be removable. Therefore by removing a portion of covering 50, an opening is conveniently provided for taking in or out any tube. Thus tube 3 may be passed upward and over drum 2 in a manner requiring only limited clearance for removal. The clearance between upper portion of lower front wall 41 and adjacent tubes provides for tube 3 removal clearance. By comparison with boilers having straight tubes for example, this saving in space is appreciated. In the straight tube boiler, clearance approximating the length of the straight tube must be provided beyond the setting. In my setting such clearance is considerably less.

The furnace setting's bridge-wall 40, is especially arranged so as to maintain a close contact with drum 1. Any expansion movement of drum 1 is guided along the line of

its inclined support 19, Figs. 1 and 2. While a tight setting that prevents gas leakage is very desirable, this feature described has a special structural advantage, since a possible inclusion of furnace cinder or dust between drum 1 and wall 40 is obviated. If dust jambs between the drum and wall, the upper brick may be seriously loosened due to expansion or contraction movements of drum or wall. Asbestos or other packing is used between. If desired, the lower portion of the bridge-wall may be arranged with rear ash clean-out opening 52, as shown in Fig. 1. The position of transverse member 24 of the supporting frame affords ample headroom for access to opening 52.

In Fig. 7 is shown a modified form of the furnace and setting. A principal object of this modification is to furnish an extremely low setting of the entire boiler with its breeching, and at the same time provide ample furnace volume required for efficient combustion; also in manner similar to the arrangement in Fig. 1, to provide for exposure of tubes to the radiant heat of the furnace and first passes of the gases, by means of novel baffling, and provide an efficient superheater arrangement for the modification.

In the modification, Fig. 7, the furnace with its stoker 53 (or corresponding grates) below, is positioned forward of drums 1 and 2, and boiler tubes 3, 4 and 5, and is supported by the same style supporting frame embodying the construction features and erection advantages as previously described for Fig 1.

In the modified setting the furnace is bounded by a front wall 54, the two side walls 55, an arched roof 56, a fire wall 57, positioned at the rear of the stoker 53 and just back of which is located the boiler assembly. The furnace gases pass upward from stoker 53 over firewall 57 rearwardly, thence sweep the tubes by reason of being directed by baffle 63 around same, turning at its bottom position 64, thence sweeping tubes 4 upwardly to pass over the top of baffle 6 and downward over tubes 5 to the gas exit 9. The gases in passing from the furnace over tubes 3, partially sweep the superheater tubes 47' which are located transversely just below tubes 3, to the rear of fire wall 57.

It will be seen that the volume of the furnace may be approximately determined by its three average dimensions which comprise a depth from the inside of front wall 54, to the front or longest tube 3; a height from stoker level to the arch 56 above, this arch being definitely positioned with reference to drum 2 which serves as its support on one side; and a width between side walls of the furnace and setting. In the relation of boiler and furnace, the width of setting may be made a common factor governing boiler sizes. In such case, it is desirable to properly proportion the furnace volume and its related grate area for a unit of width and, correspondingly the boiler's generating capacity should be designed for this same unit of width. Thus from the same type of boiler, a range of boiler sizes may be had by varying the width of setting yet using the same pattern of drums and tubes which will be properly related to the stoker grate area and furnace volume.

This modified setting provides an unfailing support for arch 56 for the furnace roof. As was previously described, for a given type or pattern of boiler, the depth of furnace may be made of constant dimension, thus providing a desirable constant span of the arch from front wall support to rear support held by drum 2. Obviously an arch sprung between the two side walls would have variable dimensions of span for various sizes of furnace and this would be both objectionable and impractical. Fig. 7 shows a vertical longitudinal section of the setting and furnace arch. The arch is firmly supported by its front skew-back, being supported by transverse beam 60 secured to column 61. The end of beam 60 is rigidly connected horizontally by a longitudinal beam 59 (on both sides of setting) to the arch's rear skew-back support 58. Fig. 9 shows a partial sectional plan view of one side wall, the front arch support 60 and rear support 58, with the connecting framing. Support 58 may be of angle cross-section, one leg of the angle being fastened to drum shell 2, with the other leg of angle positioned so as to clear tubes 3. Thus the thrust of the arch (at the rear) is borne practically against the rigid water cooled drum shell and there is no interference with tubes 3 for removal or replacement, and an unfailing rigid support is provided for the arch. Side column 62 serves to support beam 17 and is connected to other members as shown, so as to act as a binder member for the setting.

For various intensities of firing, my furnace presents the advantage that fire-wall 57 may be varied in height, between a level of the stoker and the arch above. In this manner, the area of the direct exposure af vertical portions of tubes 3, to the impinging gases or to the radiant furnace heat, may be varied to suit firing conditions.

One feature of the furnace, is the method by which air may be admitted over the fire, to assist combustion and thereby reduce smoke. This is done by admitting air through the upper portion of the front wall 54, beneath arch 56, by means of inlet passages 66, shown in Fig. 7. In case of extremely high temperatures, air thus admitted through passages 66 would advantageously cool arch 56 above and thereby promote greater heat release within the furnace. The position of passages 66 pre-

vents their being stopped or choked by slagging, since the furnace gases sweep away from this portion of the furnace.

The baffle arrangement for the modified boiler setting is shown in Figs. 7 and 8. Baffle tiles 63 are supported on and attached to one row of tubes 3 by T shaped cast baffle clamps 64. The boiler tubes having been erected in permanent place, the clamps may first be erected by projecting them partly between the tubes, then turning same at right angles so that the rounded notches engage the tubes as a fastening, see Fig. 8*a*. Standard refractory tiles may thus be clamped in position to form a baffle of any desired size. To prevent the bottom section of such a baffle 63 and its clamps 64, from sliding along tubes 3, metal stops 65 are welded to the boiler tubes in the position shown in Fig. 8. Baffle 63 (and its component parts) is employed with baffle 6 (previously described with Fig. 1) for directing the passage of the heating gases successively over tubes 3, thence over tubes 4 and tubes 5, to the gas exit 9. A feature of the baffles is their position so as to shed dust or flying cinder in a manner that prevents lodgment on the boiler tubes. For example, baffle 63, for the main portion, is about vertical, whereas the lower inclined portion may lodge some dirt below the position adjacent to door 10 in Fig. 7, but the tube surface would remain clean of dirt and from access door 10, the baffle could be cleaned. Also baffle 6, being inclined, will not lodge dirt. The sweep of the heating gases, tends to dislodge dirt therefrom keeping tubes 5 clean. The areas of the gas passages between the baffles and limiting surfaces confining the gases, may be changed readily. This is quickly done by altering the number of baffle tiles used, all of which may be handled through access door 10. This is a distinct advantage over plastic construction molded cross-wise the tubes in a permanent position, and which cannot be changed without destroying the baffle.

In the superheater arrangement shown in the modification, Fig. 7, saturated steam from the boiler passes through connecting pipe 45′, to saturated steam header 46′ where it is distributed to flow through superheater tubes 47′ and is thus superheated. Thence the superheated steam passes through header 48′, outward for service. The headers 46′ and 48′ are located on the exterior of the side wall in a manner similar to the arrangement on the exterior of front wall as previously described for Fig. 1.

This superheater location in the modified setting is advantageous for properly exposing the superheater tubes to the heating gases of a desired temperature that is fairly definite. This temperature of the heating gases may be approximately controlled at the superheater position in two principal ways: First, the height of fire wall 57 may be such as to direct the furnace heating gases in more or less degree over tubes 3 and thereby reduce the temperature of said gases at the superheater location; and second, by the vertically up or down positioning of the superheater tubes with reference to placing them more or less in the direct sweep of the passing heating gases, below the inclined position of tubes 3 as shown in Fig. 7. The location is further advantageous, since tubes 47′ are in a position to be free of dirt lodgment, as such dirt would settle in the chamber below. The tubes are accessible from within the setting by means of access doors 10″ located below.

What is claimed is:—

1. In a boiler, the combination of a water drum arranged at the rear of the fire grate, a steam drum arranged above and forward of the water drum, a bank of tubes extending at an acute angle upward and forward from the water drum and then approximately vertically upward to the steam drum, a second bank of tubes extending from the lower rear portion of the steam drum to the water drum, and a baffle supported beneath and adjacent to said second bank and extending from the water drum along said second bank and toward but not to the steam drum.

2. In a boiler setting, the combination of a water drum horizontally disposed adjacent to a wall of the furnace, a steam drum arranged above the furnace and approximately parallel to the water drum, a front bank of tubes leading from the water drum and sloping upward over the frunace and thence curving and extending upward to the steam drum, a second bank of tubes inclining downward from the steam drum to the water drum, a single baffle supported within said second bank of tubes and extending from the water drum toward but not to the steam drum.

3. In a boiler, the combination of a water drum arranged at the rear of the fire grate, a steam drum arranged approximately parallel to above and forward of the water drum, a bank of tubes extending at an acute angle upward and forward from the water drum and then approximately vertically upward to the steam drum, a second bank of tubes extending from the lower rear portion of said steam drum to the water drum, and a single baffle supported within said second bank and extending from the water drum toward but not to the steam drum, whereby the first tube bank and the lower tubes of the second bank beneath the baffle are exposed to the radiant heat of the furnace.

4. In a boiler setting, the combination of a water drum horizontally disposed adjacent to a wall of the furnace, a steam drum arranged above the furnace and approximately parallel to the water drum, a front bank of tubes leading from the water drum and sloping upward over the furnace and thence

curving and extending upward to the steam drum, a second bank of tubes inclining downward from the steam drum to the water drum, an intermediate set of tubes disposed between the two banks of tubes and connecting the said drums, and a single inclined baffle extending along said intermediate tubes from the water drum toward but not to the steam drum, whereby the furnace gases are directed successively over the front and second banks of tubes.

5. In a boiler assembly the combination of a water drum horizontally disposed adjacent to a wall of the furnace, a steam drum arranged transversely above the furnace and approximately parallel to the water drum, a front bank of tubes leading from the water drum and sloping upward over the furnace and thence curving and extending upward to the steam drum, a second bank of tubes inclining downward from the steam drum to the water drum, an intermediate single set of tubes disposed between the two banks of tubes and connecting the drums, and a single inclined baffle supported by said single set of tubes and extending from the water drum toward but not to the steam drum, whereby the direction of flow of the steam and liquid content is upward from the water drum to the steam drum in both the front bank and intermediate set of tubes, and downward in the second bank.

6. The combination of a water drum, a steam drum, a front bank of tubes inclined forward and upward at an acute angle from the water drum and then approximately vertically upward to said steam drum, a rear bank of tubes connecting said steam and water drums, a saturated steam header and a superheated steam header exterior to the boiler setting, steam pipes leading from the saturated steam header to the superheated steam header, said pipes passing through a wall of the setting and between the tubes of the front bank of tubes at approximately the base of the perpendicular portion thereof and into the space between said two banks of tubes, said pipes at the interior loop portions being curved downward, a bar resting on the interior line of said front bank of tubes and supporting the steam pipes connecting said header, and piping connecting the steam drum and the saturated steam header.

7. In a boiler setting, the combination of a water drum horizontally disposed adjacent to a furnace bridge wall, a steam drum arranged approximately parallel to above and forward of the water drum, a front bank of tubes leading from the water drum and sloping upward and thence curving and extending upward rearward of the furnace and to the steam drum, a primary baffle extending downward at the back of the front bank of tubes from the steam drum toward but not to the water drum, a second bank of tubes inclining downward from the steam drum and connecting to the water drum, an intermediate set of tubes disposed between the two banks of tubes and connecting the drums, and a second inclined baffle supported on said intermediate tubes and extending from the water drum toward but not to the steam drum, whereby the furnace gases are directed successively over the first and second banks of tubes.

8. The combination of a structure as defined in claim 7, with an arch over the furnace supported in part by the front wall thereof and means for admitting air to the furnace through the front wall beneath the point where the arch over the furnace rests on said wall.

9. In a boiler setting, the combination of a water drum horizontally disposed adjacent to a furnace bridge wall, a supporting frame having two pairs of side columns and each pair supporting a side beam extending between them, a steam drum arranged approximately parallel to above and forward of said water drum and supported by said side beams, a front bank of tubes leading from the water drum forward and upward to the steam drum, a second bank of tubes extending downward from the steam drum to the water drum, a primary baffle extending downward at the back of the front bank of tubes from the steam drum toward but not to the water drum, a secondary baffle supported within the second bank of tubes and extending from the water drum toward but not to the steam drum, and a furnace positioned forward of the assembly of drums and tubes, whereby the front bank of tubes is exposed to the radiant heat of the furnace.

10. The combination of a structure as defined in claim 9, with an arch over the furnace supported in part by the front wall thereof and means for admitting air to the furnace through the front wall beneath the point where the arch over the furnace rests on said wall.

11. The combination of a structure as defined in claim 9, with a transverse firewall projecting upward in the furnace and forward of the first tube bank but not to the level of the steam drum.

12. The combination of a pair of front columns, a pair of rear columns, a pair of intermediate columns, and a bridge wall extending transversely of the setting, with a water drum slidably supported to the rear of said bridge wall, a steam drum fixedly supported above and forward of said water drum by a beam extending between said front and intermediate columns, a front bank of tubes extending forwardly and upwardly from said water drum to said steam drum, a rear bank of tubes extending downward from said steam drum to said water drum, and an arch sprung over the furnace and supported

by the front wall of the furnace on one side of the arch and the steam drum on the other side thereof.

13. The combination of a structure as defined in claim 12 with means for admitting air to the furnace through the front wall thereof and just beneath the point where the arch rests on said wall.

14. The combination of a structure as defined in claim 12 with a baffle extending downward at the back of the front bank of tubes from the steam drum toward but not to the water drum and a second baffle extending upward at the front of the rear bank of tubes from the water drum towards but not to the steam drum.

15. The combination of a pair of front columns, a pair of rear columns, a pair of intermediate columns and a bridge wall extending transversely of the setting and between said rear and intermediate columns, with a water drum slidably supported to the rear of said bridge wall, a steam drum supported above and forward of said water drum by a pair of beams extending between said front and intermediate columns, a front bank of tubes extending forwardly and upwardly from said water drum to said steam drum, a rear bank of tubes extending downward from said steam drum to said water drum, and an arch sprung over the furnace and supported by the front wall of the furnace on one side of the arch and by the steam drum on the other side thereof.

16. The combination of a structure as defined in claim 15 with means admitting air to the furnace through the front wall thereof just beneath the point where the arch rests on said wall.

17. The combination of a structure as defined in claim 15 with a baffle extending downward at the back of the front bank of tubes from the steam drum toward but not to the water drum and a second baffle extending upward at the front of the rear bank of tubes from the water drum towards but not to the steam drum.

18. In a boiler setting, the combination of a water drum horizontally disposed adjacent to a furnace bridge wall, a steam drum arranged approximately parallel to above and forward of the water drum, a front bank of tubes leading from the water drum and sloping upward and thence curving and extending upward rearward of the furnace to the steam drum, a second bank of tubes inclining downward from the steam drum to the water drum, and a superheater having heating elements transversely disposed beneath the sloping portion of the first bank of tubes and between the bridge wall and the furnace, whereby the heating elements are maintained clear of dirt lodgment and are accessible and compactly connected to the boiler.

19. In a boiler setting, the combination of a water drum horizontally disposed adjacent to a furnace bridge wall, a steam drum arranged approximately parallel to above and forward of the water drum, a front bank of tubes sloping upward and forward from the water drum and thence curving and extending upward to the steam drum, a second bank of tubes inclining downward from the lower rear portion of said steam drum to the water drum, three columns opposite each other on each side of the setting, a pair of upper side beams extending between the forward and intermediate columns for supporting the steam drum and a pair of lower side beams extending between the rearward and intermediate columns for supporting the water drum, and a transverse girder supported by the two intermediate columns positioned approximately in vertical alignment with the center of gravity of the two drums and the second bank of tubes, whereby the assembly of said drums and second bank of tubes may be hoisted into permanent position preparatory to next erecting the front bank of tubes without necessity of drum alignment.

In testimony whereof I have signed this specification.

PAUL WRIGHT.