Jan. 14, 1936. C. S. TURNER 2,027,495

BOILER TUBE CLEANING CONSTRUCTION

Filed April 3, 1933 5 Sheets-Sheet 1

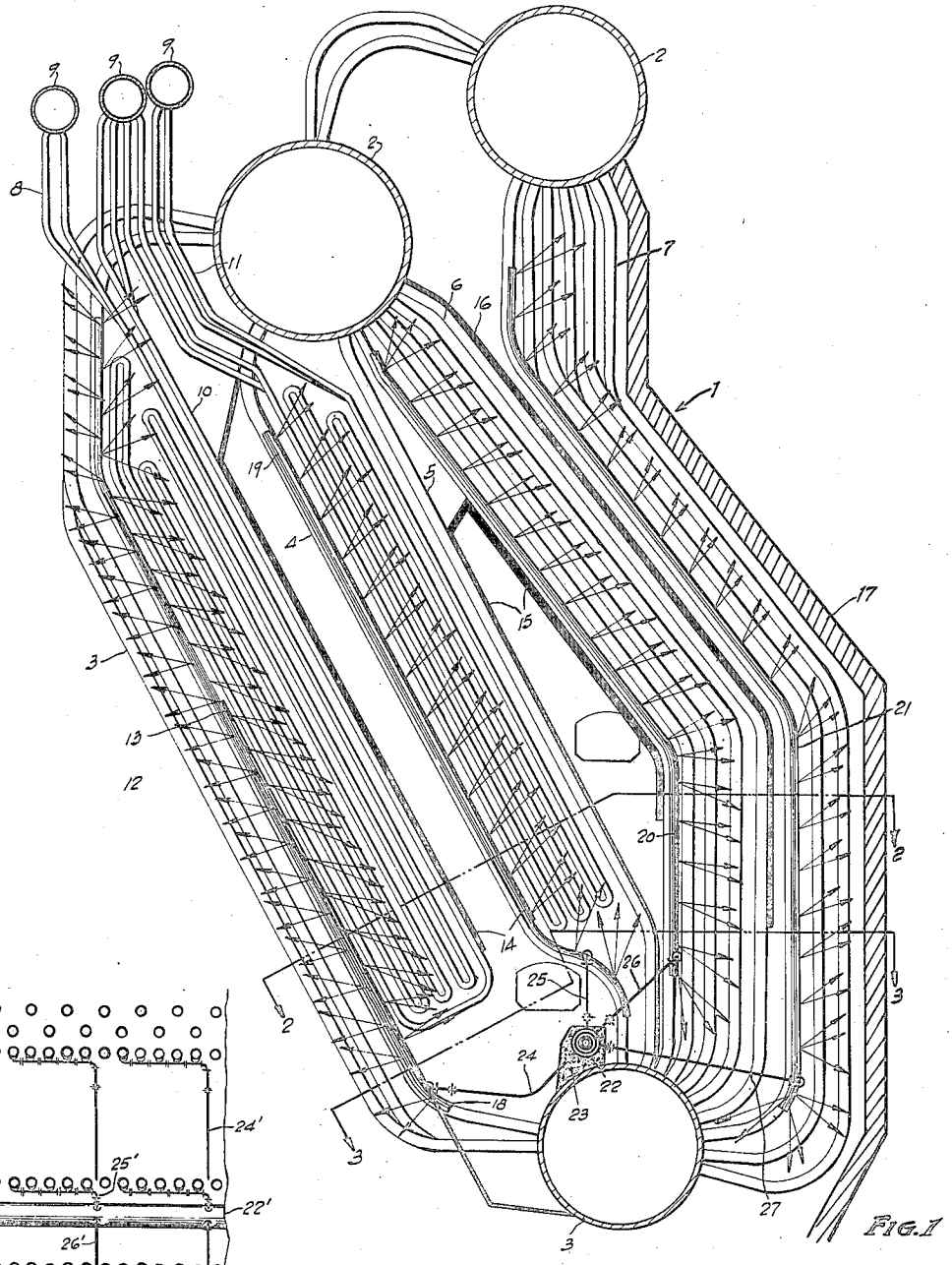


FIG. 1

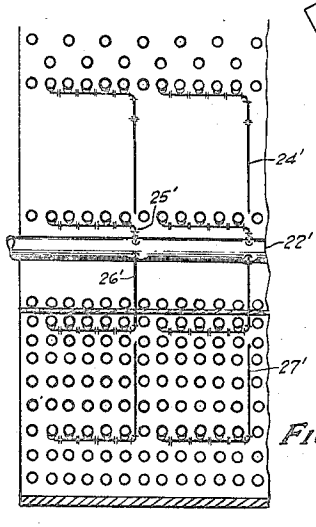


FIG. 4

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BOILER TUBE CLEANING CONSTRUCTION

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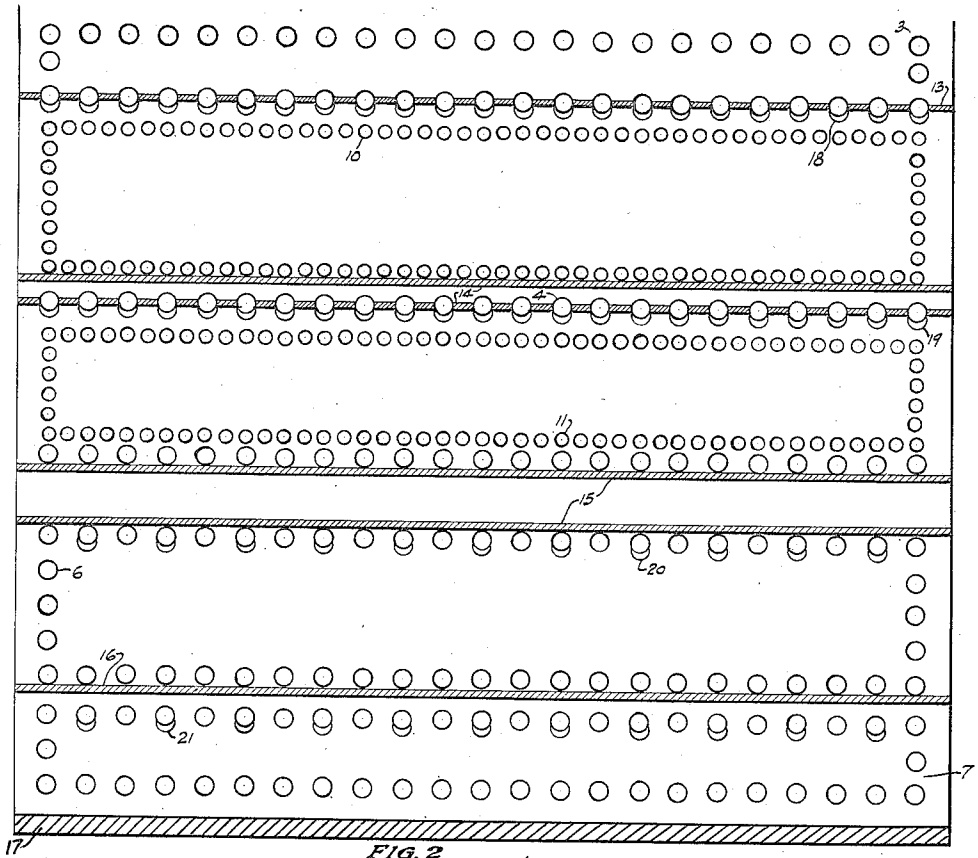


FIG. 2

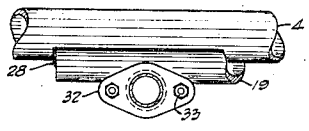


FIG. 6

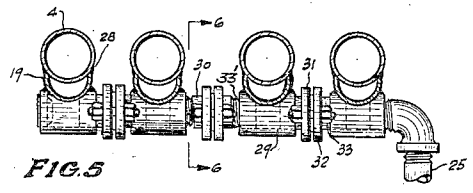


FIG. 5

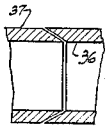


FIG. 8

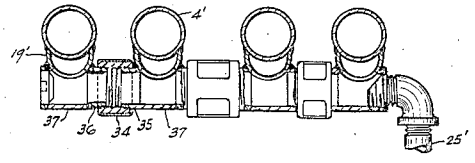


FIG. 7

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BOILER TUBE CLEANING CONSTRUCTION

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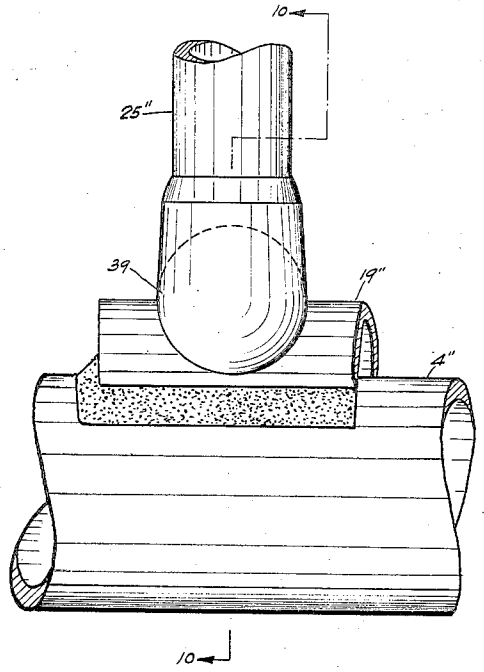


FIG. 9

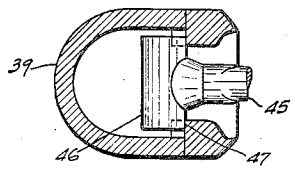


FIG. 11

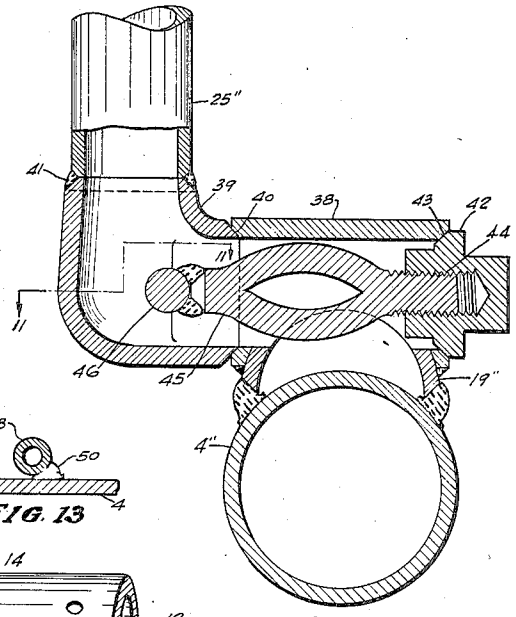


FIG. 10

FIG. 13

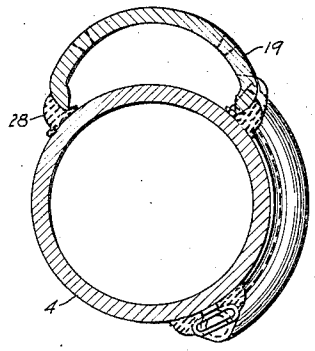


FIG. 14

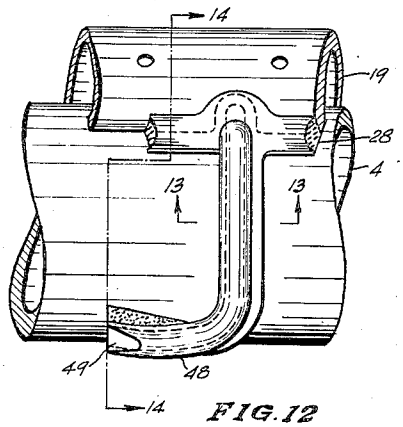


FIG. 12

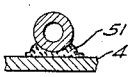


FIG. 15

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BOILER TUBE CLEANING CONSTRUCTION

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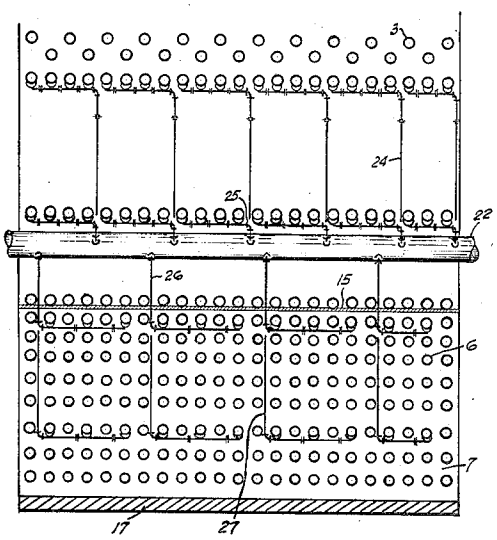


FIG. 3

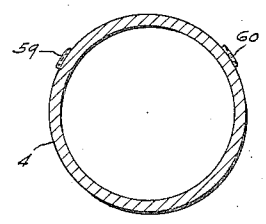


FIG. 18

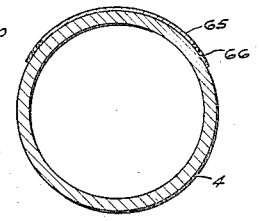


FIG. 20

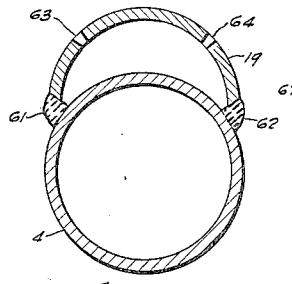


FIG. 19

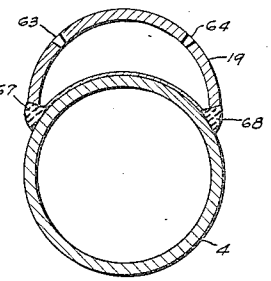


FIG. 21

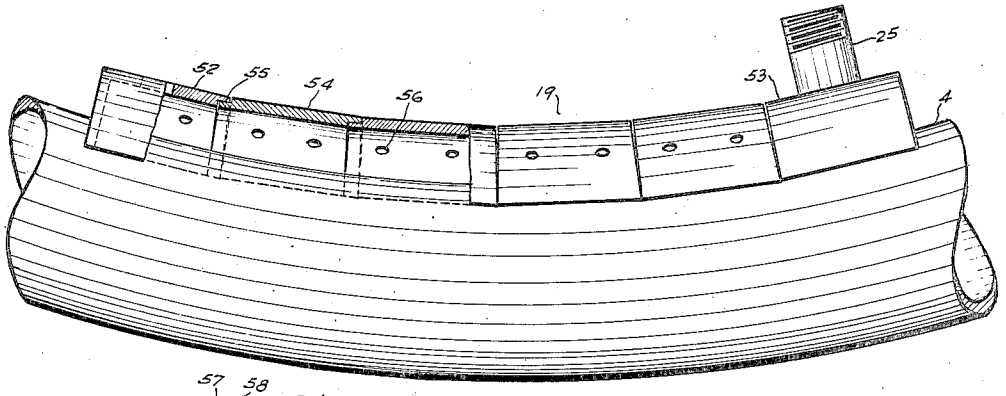


FIG. 16

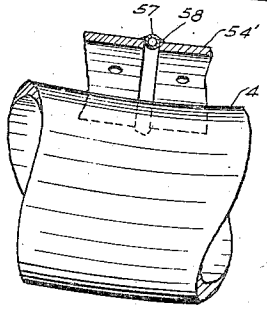


FIG. 17

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BOILER TUBE CLEANING CONSTRUCTION

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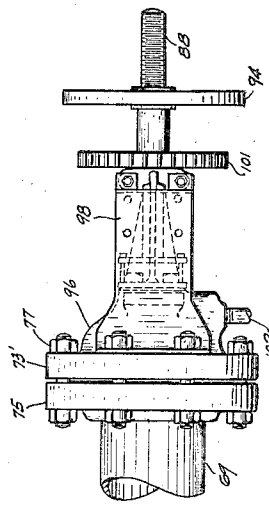


FIG. 24

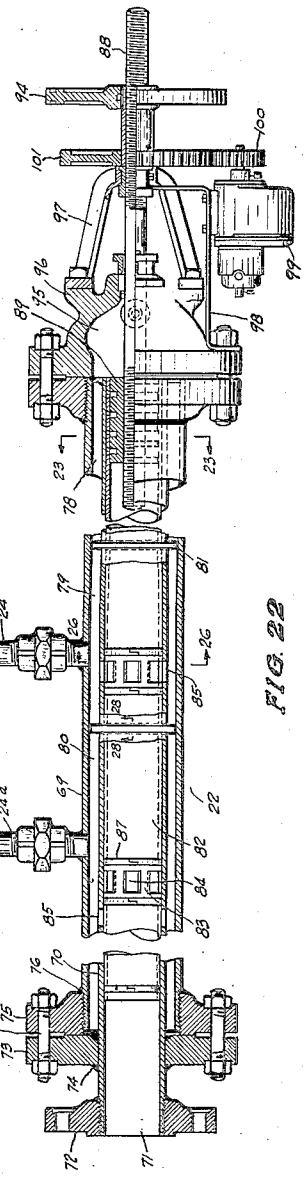


FIG. 22

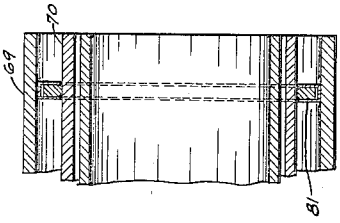


FIG. 26

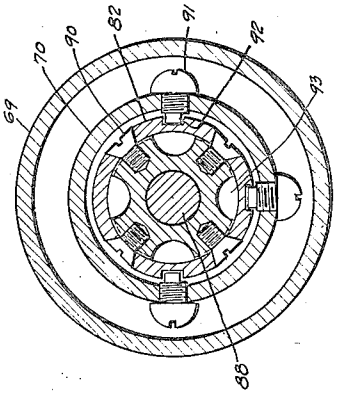


FIG. 23

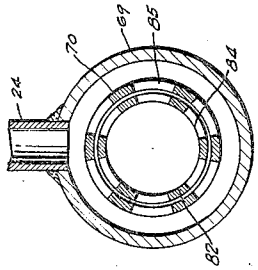


FIG. 28

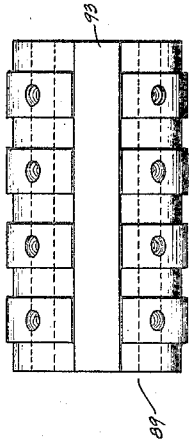


FIG. 25

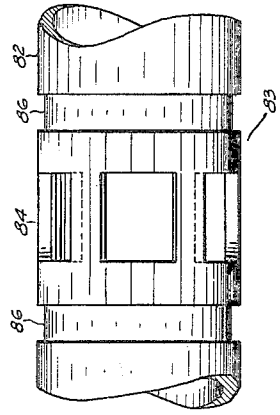


FIG. 27

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Patented Jan. 14, 1936 2,027,495

UNITED STATES PATENT OFFICE

2,027,495

BOILER TUBE CLEANING CONSTRUCTION

Charles S. Turner, Detroit, Mich., assignor, by mesne assignments, to Diamond Power Specialty Corporation, Detroit, Mich., a corporation of Michigan

Application April 3, 1933, Serial No. 664,273

7 Claims. (Cl. 122—392)

The invention is directed to an improvement in boiler cleaners, particularly of that type of cleaner wherein jets of cleaning fluid are discharged adjacent the heating surfaces of the boiler to be cleaned. More particularly, the type of cleaner is that comprising nozzle members mounted within the boiler setting together with the necessary cleaning fluid supply lines therefor.

More specifically the invention is an improvement on the construction and method shown in my co-pending applications Serial No. 428,721, filed February 15, 1930, and Serial No. 545,885, filed June 22, 1931.

The present invention comprehends certain improvements in the application of a nozzled cleaner element to the boiler heating surfaces, in the method of connecting the cleaning fluid supply lines to the elements and in the provision of a novel cleaning fluid control means.

Further features of the invention and the advantages thereof will be evident as the description proceeds, reference being had to the accompanying drawings, wherein:

Figure 1 is a side elevation, partly diagrammatic and partly in section, showing the invention applied to a boiler of the vertical bent tube type, the boiler baffles being shown in solid to distinguish from the boiler tubes and the cleaner elements;

Figure 2 is a diagrammatic plan view, partly in section, taken substantially on the line 2—2 of Figure 1;

Figure 3 is a diagrammatic plan view, taken substantially on the line 3—3 of Figure 1;

Figure 4 is a partial diagrammatic plan view, similar to Figure 3, but showing a modified arrangement of elements and supply lines therefor;

Figure 5 is a detail showing one method of connecting a cleaning fluid supply line to the cleaner element;

Figure 6 is a section taken on line 6—6 of Figure 5;

Figure 7 is a view similar to Figure 5, but showing a modification;

Figure 8 is an enlarged detail, in section, of a portion of the connection shown in Figure 7;

Figure 9 is an enlarged detail of a further modified method of connecting a cleaning fluid supply line to a cleaner element;

Figure 10 is a section taken on line 10—10 of Figure 9;

Figure 11 is a section taken on line 11—11 of Figure 10;

Figure 12 is an enlarged detail showing a method of applying one type of cleaner element to a boiler tube;

Figure 13 is a section taken on line 13—13 of Figure 12;

Figure 14 is a section taken on line 14—14 of Figure 12;

Figure 15 is a view similar to Figure 13, but showing a slight modification;

Figure 16 is a view partly in elevation, and partly in section, showing a method of fitting a cleaner element to the bent portion of a boiler tube;

Figure 17 is a fragmentary view similar to Figure 16, showing a modification;

Figure 18 is a sectional view of a boiler tube, prepared for attachment of a cleaner element thereto;

Figure 19 is a sectional view of a boiler tube, with the cleaner element attached thereto;

Figure 20 is a view similar to Figure 18, showing a modification;

Figure 21 is a view similar to Figure 19, showing a modification;

Figure 22 is a plan view, partly in section, and with certain portions broken away, of the cleaning fluid supply header and control means;

Figure 23 is an enlarged section on line 23—23 of Figure 22;

Figure 24 is a detail, in elevation, of the operating end of the control means, viewed at right angles to the position indicated in Figure 22;

Figure 25 is a detail of the traveling nut, constituting a portion of the control operating means;

Figure 26 is an enlarged section taken on the line 26—26 of Figure 22;

Figure 27 is a fragmentary detail of one of the valve members; and

Figure 28 is an enlarged section taken on line 28—28 of Figure 22.

In my prior mentioned co-pending patent applications, particularly Serial No. 428,721, there is disclosed and described a nozzled cleaner element integrally united to a portion of the boiler heating surface, such as a boiler tube. As there disclosed, the elements conveniently extend longitudinally of the boiler tube and are united thereto as by welding. So far as concerns the basic principle and the construction of the cleaner element itself, the present invention utilizes essentially the cleaner element of the former application.

Referring, first of all, to Figures 1, 2, and 3, 1 designates generally a boiler of the vertical bent tube type. Banks of tubes connect the

steam and water drums 2 with the mud drum 3. A superheater designated generally at 8 may be provided, comprising two banks of tubes 10 and 11 located in different portions of the boiler. These tubes are connected to drums 9 as indicated.

As is usual practice the boiler is divided by baffles of the conventional construction into passes to insure that the heating gases from furnace 12 will contact all of the boiler tubes as they pass through the boiler.

Baffles 13, 14, 15, 16 and back wall 17, as shown, divide the boiler into five passes, each pass comprising a bank of tubes. The tubes of the first bank are designated generally at 3 and, as will be noted, are boiler tubes. The second pass comprises essentially the first section of the superheater designated at 10; the third pass comprises the boiler tubes 4 and 5 with the second section of the superheater designated at 11; tubes 6 constitute the fourth pass and tubes 7 the fifth pass of the boiler.

Fixed to selected ones of the boiler tubes are the integral welded elements of the type hereinbefore pointed out. These are fixed to tubes as will be noted from Figures 2 and 3 extending across the width of the boiler and are represented by the designations 18, 19, 20 and 21. It will be noted that one group of such elements is provided for each pass of the boiler, the first element designated at 18 discharging both into the first and second passes of the boiler. The first baffle 13 may be provided with holes (not shown) to permit the discharge of cleaning fluid from the lower portion of the element 18 into both passes of the boiler, as desired.

A cleaning fluid supply header and control means designated generally at 22 is located inside the boiler and extends across the width of the boiler. This may be located adjacent the mud drum 3 and may be surrounded by a protective cement designated at 23, this serving to protect the header and control means from impingement by the boiler gases and is preferably of a relatively high conductivity so that any heat absorbed by the structure may be conveyed to the mud drum 3. Depending from this header and control means is the supply line 24 leading to the group of elements 18, the supply line 25 leading to the group of elements 19, the supply line 26 leading to the group of elements 20 and the supply line 27 leading to the group of elements 21.

As indicated particularly in Figure 2, various groupings or arrangement of the integral elements with respect to the boiler tubes may be employed. Thus, as indicated in that figure, the elements 18 are fixed to all of the boiler tubes of the third row since cleaning conditions are much more difficult in the first passes of the boiler due to the greater liability to here accumulate slag. The same is true of the elements 19 affixed to tubes 4. In the later passes of the boiler, as in the fourth and fifth passes, the integral elements 20 and 21 may, as shown, be attached to every other tube of the groups 6 and 7 respectively.

By reference to Figure 3 it will be noted that a plurality of supply lines across the width of the boiler is provided for the elements of each set. Thus, as indicated in Figure 3, six supply lines 24 are provided for the elements 18 and a like number for the elements 19. Four supply lines, 26 and 27, are provided for the groups of elements in the back of the boiler. It will be observed from the description of the header and control member 22, to be hereinafter described in detail, this control member is divided up into chambers so that cleaning fluid may be supplied progressively to the various supply lines for a given set of units across the width of the boiler. This feature constitutes an essential and very important element of the present invention. It obviously permits, in effect, the dividing of the boiler into zones across its width and the progressive, successive or selective blowing of these zones, as may be desired. It will be further noted particularly that these zones extend substantially from the front to the rear of the boiler so that, in effect, the entire boiler is divided into slices, so to speak, across its width and each of these slices may be blown one at a time. The effect of this, of course, is to decrease the size of the cleaning fluid supply line required in that it divides, for example, the elements of the first and second groups into six different lots. A particularly important feature of the invention, however, is the setting up of a disturbance throughout the entire passage of the gas through the boiler from front to back over a selected portion or zone across the width of the boiler. This produces an extremely effective cleaning arrangement due to the progressive disturbance of the gas set-up and the building up of this disturbance as successive elements discharge into the path of the gas flow. The zoning arrangement minimizes the disturbance in the operation of the boiler in that only one section or slice of the boiler is blown at a time.

As indicated in Figure 4, the number of elements and the grouping of the supply pipes may be identical for the elements of all groups taken from front to back of the boiler. Thus the supply line 24' serves exactly the same number of elements as the supply line 25' which, in turn, is identical with the number of elements supplied by each of the lines 26' and 27'. Thus, an exact partitioning of the control member 22' may be afforded and a more close and exact definition of the zones blown across the width of the boiler. Either the arrangement shown in Figure 3 or Figure 4 may be applied as desired depending upon conditions.

A further feature of the invention consists in the construction of the supply lines between the headers and the elements of heat resisting material. This is particularly applicable in the hotter portions of the boiler. The elements in view of their integral joining to the boiler tubes may ordinarily be of plain steel construction and the supply header, in view of the location of same adjacent the mud drum and the protection afforded by the heat conductive cement thereabout, may also be of plain steel material. There is thus afforded, by the combination of these elements as recited, a complete boiler cleaner construction adapted to adequately resist the most severe conditions encountered in the boiler setting.

In Figures 5 and 6 one method of attaching the cleaning fluid supply line, designated at 25, to the integral nozzled elements 19 is shown. These integral nozzled elements 19 may be welded at 28 to the boiler tube 4, there being provided one such element for each boiler tube in the particular arrangement shown in Figure 5. A fitting 29 recessed to receive the element 19 and provided with an opening thereto, not shown, may be welded to the element as indicated.

Nipples 33' extending from this fitting are provided with flanges 32 which may be drawn together by bolts 33 to provide a steam-tight joint.

A modification is shown in Figures 7 and 8 in which the coupling 34 is provided with right and left hand threads at its opposite ends. The fitting 37 welded to the element 19' is provided with a beveled edge as indicated in Figure 8, against which abuts a beveled edge on the nipple 36, fixed to the coupling 34. Obviously, turning of the coupling 34 will force the respective nipples 35 and 36 with their bevelled edges against the abutting fittings 37. Since considerable pressure can, if desired, be applied, a substantially steam-tight joint is obtained by this arrangement.

In Figures 9 to 11 is shown a still further method of joining a cleaning fluid supply line to an integral element. The boiler tube is designated at 4'', the element at 19'' and the cleaning fluid supply line at 25''. Fitting 38 may be welded as indicated to the element 19'', the connection from supply line 25'' being made to this fitting by means of the elbow 39 through the beveled friction joint 40 and the welded joint 41. Both ends of the fitting 38 are open, a plug 42 being provided at the end opposite from the elbow 39, this plug engaging fitting 38 through the tapered friction joint 43. The plug 42 is threaded at 44 to receive the bolt 45 which is welded to the transverse pin 46. The bolt, it will be noted, is of special design to provide flexibility to take care of expansion and contraction effects and to provide a spring effect to insure the tightness of the friction joints 40 and 43 under all conditions of temperature. The elbow 39 is provided with the shoulders 47 against which the pin 46 is adapted to abut so that as the nut 42 is turned the joint will be tightly assembled. As observed in Figure 10 the bolt 45 with the transverse pin 46 may be inserted with the pin 46 vertically whereupon the assembly may be turned through 90 degrees as in the case of a bayonet slot construction to bring the ends of the pin 46 into engagement with the shoulders 47 whereupon the nut 42 may be applied to the threaded end of the bolt 45 and the nut tightened up to assemble the joint.

In Figures 12 and 13 is indicated one method of attaching to a boiler tube an integral element of the type described particularly in my co-pending application Serial No. 545,885. The integral element is attached preferably to the rear or leeward side of the boiler tube, the element 19 being fixed to tube 4 by weld 28. A small tube 48 is provided leading around to the front of the boiler tube 4 and provided with the nozzle 49 for discharge adjacent the front side of the boiler tube. This nozzle, as indicated in Figure 14 may, if desired, be fan shape. As indicated in Figure 13 the attachment of this supplementary nozzle tube 48 may be effected by providing a weld 50 on one side of the tube only. This may be directly applied after the nozzle tube 48 is in place or a welded pad may first be built up on the boiler tube, the nozzle tube 48 applied thereto and joined to the pad by welding. In Figure 15 an alternate form is shown in which both sides of the tube 48 are welded to the tube 4, the joints being indicated at 51.

In Figure 16 is indicated a method of attaching the integral element to a boiler tube, particularly applicable to the curved portion of the tube. The integral element is indicated generally by the reference character 19 and is attached as by welding to the tube 4 in the usual manner. The element in this case is made up of the end section 52 with intermediate sections 54 and section 53 to which the supply line 25 may be fitted. It will be understood that further sections may be joined to section 53 to constitute the entire element, these being of the conventional construction and extending over the relatively straight portion of the boiler tube not shown.

Between each adjacent section is provided the mortised joint 55, this providing for relative expansion of the boiler tube as the same is heated and cooled in service. The various sections may be provided with the nozzle 56 as shown. The small amount of steam leak which will exist at the mortised joint 55 will be immaterial in view of the fact that this will be exceedingly small in amount and will merely pass harmlessly into the boiler setting. A flexible joint is thus provided at the bent portion of a tube which is obviously subjected to the greatest expansion and contraction strains as the same is subjected to temperature variations in service.

If an absolutely steam tight joint is desired between the various sections, the construction shown in Figure 17 may be employed. This consists essentially of a small tube 57 inserted as indicated between the respective sections 54' to which it is welded as at 58. This small tube obviously affords flexibility between the various sections permitting the element to accommodate itself to movements of the bent portion of the boiler tube. In Figure 18 pads 59 and 60 may be welded to the tube 4, to which, as shown in Figure 19, the element 19 may be affixed by welds 61 and 62. This element may be provided, as indicated with the nozzles 63 and 64. The building up of these pads on the boiler tube before welding of the element 19 thereto provides a method of attaching the integral element which minimizes the heat applied to the boiler tube. Obviously these pads can be applied with much less temperature than would be required to weld the entire integral element structure 19 to the boiler tube. When the element is welded it is applied to the pads so that these are heated to a higher degree than the boiler tube, the concrete result of the whole method being that less heat or burning of the boiler tube is necessary to attach the integral element in this manner.

In Figure 20 a thin sheet of metal indicated at 65 may be welded at its ends as at 66 through the boiler tube 4. As shown in Figure 21, to these welded ends of the thin sheet 65 may be attached the element 19 by welds 67 and 68. The advantage of this construction is essentially the same as that pointed out for the form shown in Figures 18 and 19 as regards the heat applied to the boiler tubes to provide for welding of the integral element thereto. It, furthermore, provides a sheet or plate protecting the boiler tube from erosion of the steam in its passage through the element structure.

Figures 22 to 28 inclusive show the cleaning fluid supply header and control means designated generally by the reference character 22 and to which reference has hereinbefore been made. This comprises essentially an outer tube 69 to which the cleaning fluid supply branch lines 24 and 24a are connected in the manner shown. An inner tube 70 located inside the tube 69, is connected at its open end 71 through flange 72 to a suitable source of cleaning fluid supply. Flange 73 is fixed as by welding at 74 to tube

70, flange 73 being, in turn, connected by bolts 77 to flange 75, welded at 76 to the outer tube 69. A unitary assembly is thus obtained. At the opposite end of the header a similar flange 75 attached to the outer tube 69 is bolted to flange 73' formed as a part of the housing 96 to which reference will hereinafter be made.

Between tube 69 and tube 70 a space is provided divided by partitions 81 into sections 78, 79, and 80. As will be noted, these spaces form, in effect, separate chambers each of which communicates with a cleaning fluid supply line, such as 24 and 24a, leading to a group of integral elements.

To control the supply of cleaning fluid entering at 71 successively to the various chambers, a longitudinally travelling inner tube 82 is provided. This tube is provided in each chamber with a valve construction designated generally at 83. This consists of ports 84 cut into tube 82 and grooves 86 on opposite sides of the ports into which piston rings 87 are fitted to secure steam tightness. Ports 84 are adapted to register in certain positions of the inner longitudinally travelling tube with ports 85 cut in tube 70, it being obvious that when these ports are in registry cleaning fluid will pass from inside of tube 82 to one of the chambers inside tube 69 and thence through the cleaning fluid supply line to the respective group of integral elements. The registration of the ports is best shown in Figure 26. As indicated in Figure 22 the ports 85 are so arranged with respect to the ports 84 in the valve portion 83 as to successively or progressively provide registration of the ports in the inner and outer tubes, whereby cleaning fluid may be supplied successively or progressively to the various chambers. The inner or valving tube 82 is caused to move longitudinally by rotating the screw 88 through suitable means to be hereinafter described. This screw engages the traveling nut 89 which is fixed as by screws 90 to the inner tube 82 and travels therewith. Rotary movement of the traveling nut 89 is prevented by engagement of the pins 91 threaded into the fixed tube 70 and adapted to engage grooves 92 in the traveling nut 89. Rotation of shaft 88 is thus seen to induce longitudinal movement of the traveling nut 89 and with it the inner or valving tube 82 to which it is fixed. To provide for easy movement of this assembly the traveling nut is provided with slots 93 which permit steam pressure inside the tube 82 to pass through these grooves into the space 95 in the housing 96, thus balancing the pressure on both sides of the traveling nut and eliminating the steam thrust on this nut. Drain line 102 which may be provided with a suitable valve, not shown, serves to relieve the space 95 of condensate as may be required.

Rotation of screw 88 may be produced by hand wheel 94 which is fitted to the screw 88 by means of a feathered key. Alternatively, the motor 99 fixed to bracket 98 in turn fixed to housing 96 may be provided. This motor is adapted to rotate pinion 100 and, in turn, the large gear 101 which is also fitted as by a feathered key, not shown, to the rotary screw 88. Thus, rotation of the hand wheel 94 or the gear 101 serves to rotate the screw 88, thus traversing the traveling nut 89 and with it the inner valving tube 82.

The cleaning fluid supply header and control means just described is thus seen to provide means for successively or progressively connecting the cleaning fluid supply lines 24 and 24a to the source of steam supply. This, in turn, permits the supply of the cleaning fluid to the integral elements disposed in zones or slices across the width of the boiler, as hereinbefore pointed out.

As an illustrative example of the manner in which the blower elements and their supply pipes may be connected to the distributor 22, reference may be made to Figure 3 of the drawings. When the blower elements are arranged in the manner illustrated in this figure there may be connected to the first chamber 79 of the distributor two feed lines 24, two feed lines 25, one feed line 26, and one feed line 27 with the result that a portion only of the width of the boiler will be cleaned when cleaning fluid is supplied to this chamber. It is to be understood, however, that the blower elements and their supply pipes may be connected to the distributor in any manner desired insofar as provision is made whereby cleaning fluid will be discharged in a zone which includes a plurality of the boiler passes, but occupies a portion only of the width of the boiler.

It might be noted further that the term "width" as utilized in the specification and claims is to be construed as that dimension of the boiler which is substantially normal to the general direction of gas flow through the boiler. In most installations this dimension will be completely normal to the direction of gas flow, but in certain installations the width may be construed as a dimension angularly disposed with reference to the normal direction of gas flow.

It is obvious that the tube 82, with its associated valving arrangements, may be readily traversed in either direction, thus affording selective supply of the cleaning fluid to the various groups of integral elements, as desired. A hand operated valve, not shown, may be provided in the cleaning fluid supply line connected to the header at 71, the operation of this valve, in conjunction with the header control valve, permitting any range of selective action desired.

For the sake of convenience the invention has been described as being embodied in a device for cleaning boilers. It will be apparent, however, that the inventive principles disclosed may be embodied in devices for cleaning apparatuses similar to boilers and it is to be therefore understood that the term "boiler" whenever used throughout the specification and claims is to be construed as meaning a fluid heater or heat transfer apparatus of any character and that the term "boiler cleaner" is to be construed as meaning a cleaner for any such apparatus.

While several embodiments of the inventive idea have been described and disclosed in considerable detail, it is to be understood that the description is for the purpose of illustration only. The right is, therefore, reserved to make such changes in the details of construction and arrangement of parts as will fall within the purview of the attached claims.

What I claim is:

1. In combination, a boiler having a plurality of boiler tubes, a plurality of blower elements extending in rows across the width of the boiler, there being a plurality of said rows of blower elements between the gas inlet and the gas outlet of the boiler and each row being divided into sections with each section occupying a portion only of the width of the boiler and corresponding sections in said rows being in substantial alignment from the gas inlet to the gas outlet of the boiler, a header, and means including

connections between said sections and said header providing for the simultaneous supplying of cleaning fluid to all of the sections occupying any desired portion of the width of the boiler.

2. In combination, a boiler divided into a plurality of passes from the gas inlet to the gas outlet thereof, a row of blower elements in each pass, each row being divided into sections with each section occupying a portion only of the width of the boiler and corresponding sections in adjacent passes being in substantial alignment from the gas inlet to the gas outlet of the boiler, a header, and means including connections between said sections and said header providing for the simultaneous supply of cleaning fluid to the sections in all of the passes occupying any desired portion of the width of the boiler.

3. In combination, a boiler divided into a plurality of passes, a row of blower elements in each pass, each row being divided into sections with each section occupying a portion only of the width of the boiler and corresponding sections in adjacent passes being in substantial alignment from the gas inlet to the gas outlet of the boiler, a header, connections between said sections and said header, and control means associated with said header for controlling the flow of cleaning fluid therefrom through said connections, said control means providing for a simultaneous supply of cleaning fluid to all of the sections occupying any desired portion of the width of the boiler.

4. In combination, a boiler divided into a plurality of passes, a row of blower elements in each pass, each row being divided into sections with each section occupying a portion only of the width of the boiler and corresponding sections in adjacent passes being in substantial alignment from the gas inlet to the gas outlet of the boiler, a header, means dividing said header into a plurality of compartments, connections between said sections and the compartments in said header, all of the connections leading to corresponding sections in adjacent passes being connected into the same compartment, and means for admitting cleaning fluid to the compartments in said header according to a desired sequence of said compartments.

5. In combination, a boiler, means dividing the boiler in the direction of gas flow therethrough into a plurality of passes, a plurality of blower elements located at spaced points both across the width of the boiler and in the direction of gas flow therethrough for discharging cleaning fluid into said passes, said blower elements being divided into sections with each section occupying a portion only of the width of the boiler and corresponding sections in adjacent passes being in substantial alignment, a header, and means including connections between said sections and said header providing for the simultaneous supplying of cleaning fluid to all of the sections occupying any desired portion of the width of the boiler.

6. That step in the method of cleaning a boiler which is divided into passes in the direction of gas flow which consists in discharging cleaning fluid in a zone which includes a plurality of the boiler passes but occupies a portion only of the width of the boiler.

7. That step in the method of cleaning a boiler which is divided into passes in the direction of gas flow which consists in discharging cleaning fluid in a zone which includes all of the boiler passes but occupies a portion only of the width of the boiler.

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