

Jan. 30, 1934.

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1,945,349

BOILER CONSTRUCTION

Filed April 1, 1931

3 Sheets-Sheet 1

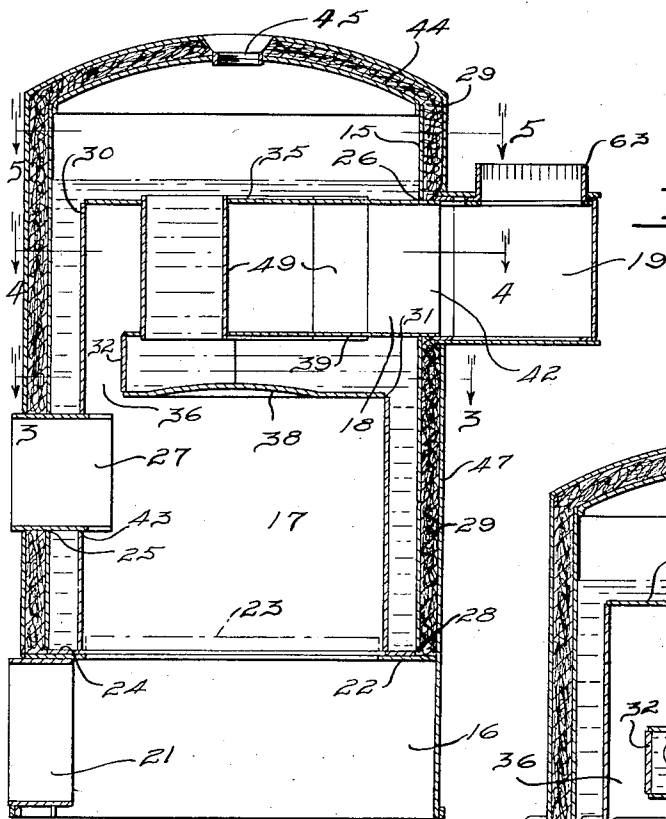


FIG. 1.

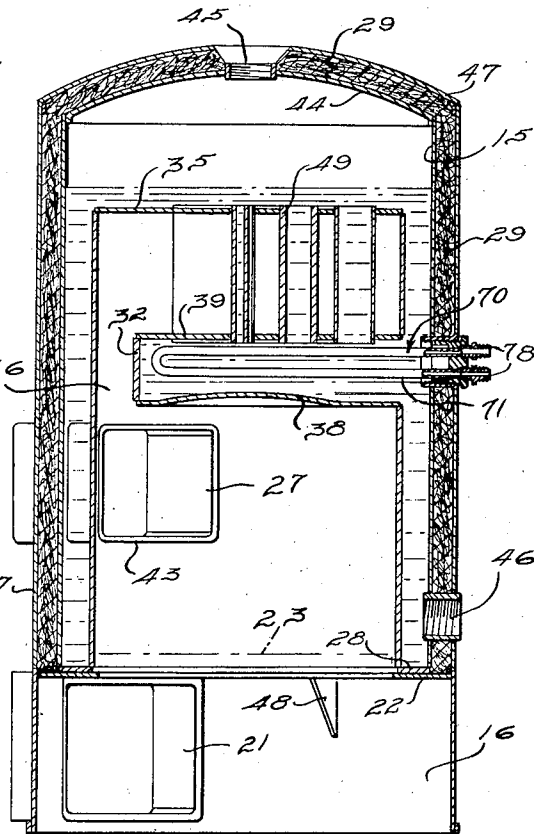


FIG. 2.

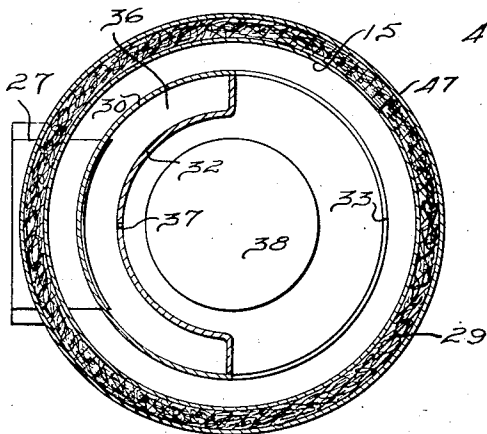


FIG. 3.

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3 Sheets-Sheet 2

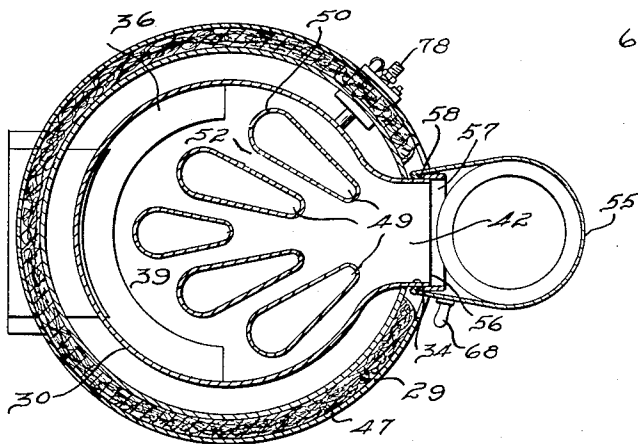


FIG. 4.

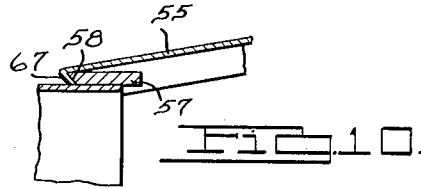
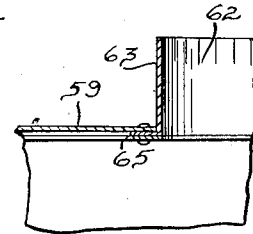


FIG. 5.

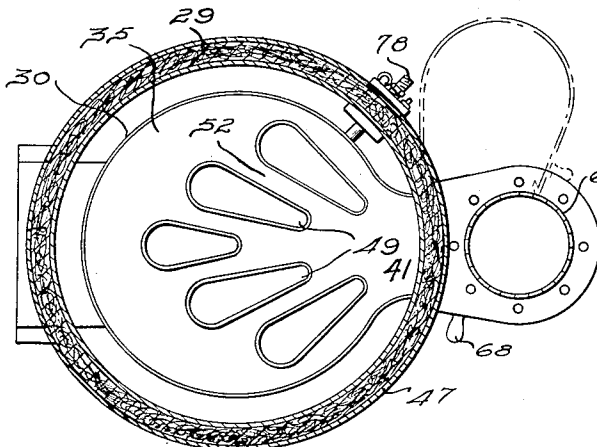


FIG. 6.

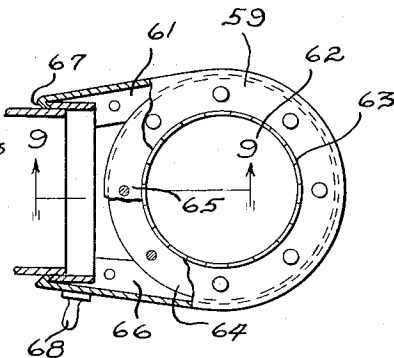


FIG. 7.

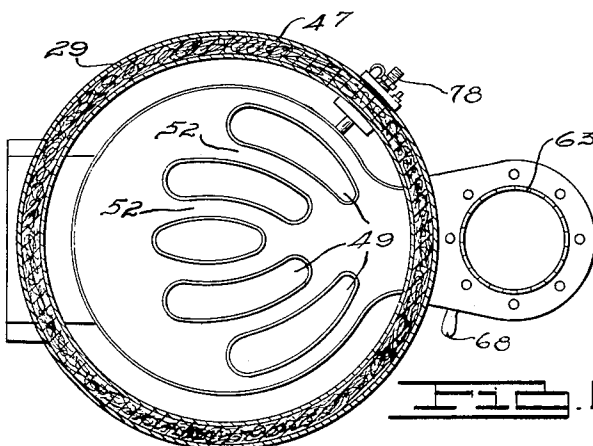


FIG. 8.

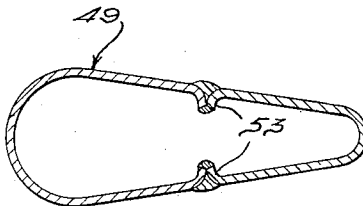


FIG. 9.

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3 Sheets-Sheet 3

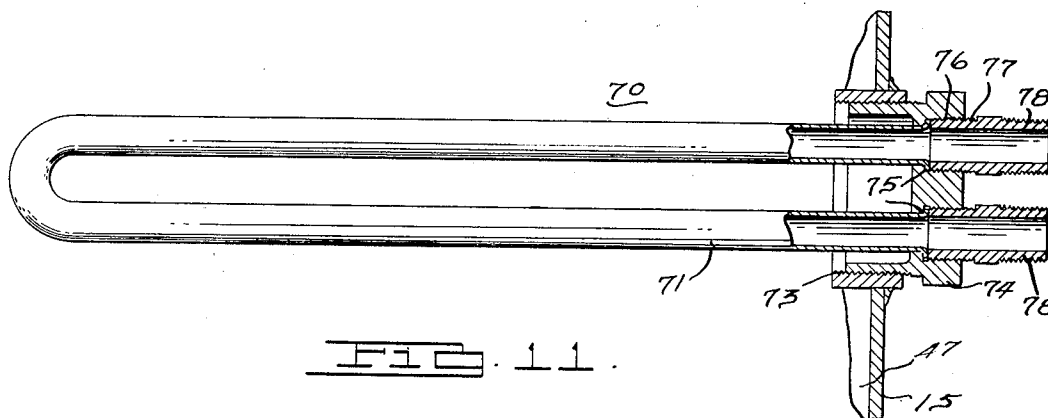


FIG. 11.

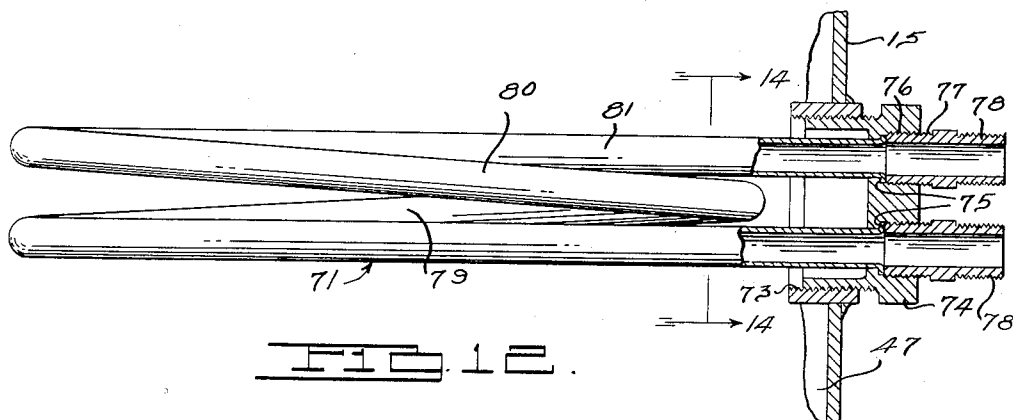


FIG. 12.

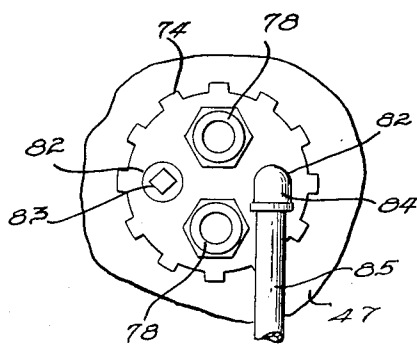


FIG. 13.

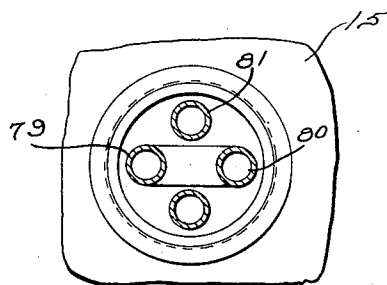


FIG. 14.

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UNITED STATES PATENT OFFICE

1,945,349

BOILER CONSTRUCTION

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Application April 1, 1931. Serial No. 526,965

8 Claims. (Cl. 122—166)

The present invention relates to furnaces of the type adapted for use in connection with the heating of residences and like structures, and the principal object is to provide a furnace of this type that is simple in construction, economical in operation, and that will have a relatively long life.

Other objects of the invention are to provide a furnace of the residential heating type constructed substantially entirely of sheet metal; to provide a furnace of this type having a novel construction of combustion and heat interchange chambers; to provide a furnace of the type described having a lower water header connected to the main water header by water passages of novel form; to provide water passages in the heat interchange chamber of such form and so arranged as to extract a maximum amount of heat from the products of combustion during passage through the heat interchange chamber; and to provide such water passages of elongated sections and so arranged that the side walls are in generally radial disposition with respect to the outlet opening of the heat interchange chamber.

Other objects are to provide water passages of novel form for the heat interchange chamber of a furnace; and to provide a novel form of construction for such passages.

The above being among the objects of the present invention, the same consists in certain features of construction and combinations of parts to be hereafter described with reference to the accompanying drawings, and then claimed, having the above and other objects in view.

In the accompanying drawings which illustrate suitable embodiments of the present invention, and in which like numerals refer to like parts throughout the several different views—

Figure 1 is a sectional view of a boiler embodying features of my invention,

Figure 2 is a sectional view of a boiler similar to that shown in Figure 1, taken on an angle thereof and illustrating a modified form of my invention,

Figure 3 is a sectional view of the structure shown in Figure 1 taken on the line 3—3 thereof,

Figure 4 is a sectional view of the structure shown in Figure 1, taken on the line 4—4 thereof,

Figure 5 is a sectional view of the structure shown in Figure 1, taken on the line 5—5 thereof,

Figure 6 is a view similar to that of the structure shown in Figure 5, illustrating a modified form of my invention,

Figure 7 is an enlarged sectional view, in elevation, of the interchanger shown in Figure 4 illustrating a modified form thereof,

Figure 8 is an enlarged plan view of the smoke box shown in Figures 1, 4, 5 and 6,

Figure 9 is a sectional view of the structure shown in Figure 8, taken on the line 9—9 thereof,

Figure 10 is a broken enlarged view of a section of the structure shown in Figure 4,

Figure 11 is an enlarged broken sectional view of a separate fluid conductor illustrated in Figure 2,

Figure 12 is a view of the structure similar to that shown in Figure 11 illustrating a modified form which the structure may assume,

Figure 13 is an end view of the structure shown in Figures 11 and 12, illustrating the method of attaching the separate conductors thereto, and

Figure 14 is a view of the structure shown in Figure 12 taken on the line 14—14 thereof.

While the present invention may be adapted to either hot air, steam or water furnaces for residential uses, I have designed it particularly for use in connection with steam or hot water installations, and consequently the specific embodiments of the invention disclosed in the drawings are illustrated as of the latter type. Furthermore, while the design of the furnace is adapted particularly to fabrication from sheet metal, boiler plate or the like, it will be apparent in the following specification that as far as many of the main features of construction are concerned, such features may be incorporated in a furnace which may be constructed in whole or in part of cast metal.

Referring to the accompanying drawings, I show my furnace as being provided with a circular base 16 forming an ash box. The front wall of the base 16 is provided with an opening in which a square frame 21 is received, and to which a door (not shown) may be secured where coal is to be employed in the furnace, or through which an oil burner may be inserted when oil burners of the type which are introduced into the ash pit are to be employed.

The upper end of the base 16 is provided with an inwardly extending annular member 22 suitably welded thereto and forming a seat for receiving the boiler portion of the furnace. The boiler includes an outer cylindrical shell 15 preferably formed from sheet metal and suitably welded together, and an inner concentric shell 30 spaced from the outer shell 15 and preferably formed from sheet metal suitably welded together. The lower end of the shells 15 and 30 are secured and sealed together by an annular sheet member

24 welded thereto. The upper end of the shell 15 is provided with an upwardly curved head 44 suitably welded thereto and which, in turn, is provided with a relatively large central opening in which the threaded collar 45 is welded for receiving the steam or water outlet pipe of the furnace. The shells 15 and 30 are provided at their front with aligned openings 25 and 43 respectively, in which is received a door frame 27 which is secured and sealed thereto by a suitable welding operation.

The inner shell 30 terminates at its upper end in downwardly spaced relation with respect to the upper end of the outer shell 15, and the rear wall of the outer shell 15 is provided with an opening 26, the upper edge of which is substantially flush with the upper edge of the inner shell 30. The upper end of the inner shell 30 is closed by a top header member 35 of the shape indicated in Figure 5 and which is of generally circular formation in plan view with the exception that it is provided at its back with an extending portion 41 of a width commensurate with the width of the opening 26 into which it projects and where it is welded to the outer shell 15.

Downwardly spaced from the upper header 35, is an intermediate header 39 of the same general shape as the upper header 35 with the exception, as illustrated in Figure 4, that it is cut back from contact with the inner shell 30 for approximately 180 degrees over its forward side. The rearwardly extending portion 42 of this intermediate header 39 extends into flush relationship with respect to the lower edge of the opening 26 and is welded to the outer shell 15 at that location. The side walls of the inner shell 30 between the headers 35 and 39 are slit centrally of the opening 26 and outwardly bent along the margins of the headers 35 and 39 to which they are suitably welded, and into contact with the sides of the opening 26 at which location the free ends of such portions are welded to the sides of the opening 26 in the outer shell 15. In the space thus formed between the upper and intermediate headers 35 and 39, and which is utilized as an interchange chamber, is arranged a plurality of vertically extending tubular members 49, which will be described later in detail, and which project through these headers to form a water passage therebetween and are suitably welded to each thereof.

Spaced a suitable distance below the intermediate header 39 is a lower header 38 which is of the same shape as the header 39 with the exception that it has no extension portion corresponding to the portion 41 of the header 39. The inner shell 30 is cut away over its rear half between the headers 38 and 39 for a distance of 180 degrees, and extending between the headers 38 and 39 from one side of the inner shell 30 to the opposite side, and following the contour of the front half of the headers 39 and 38 is a member 32 welded to the cooperating parts over its entire length. The lower header 38 is welded over the rear 180 degrees of its circumference to the inner shell 30 at the lower edge 31 of this cut out portion.

From the above it will be apparent that between the headers 38 and 39 a lower water header is provided which communicates with the upper water header, between the upper header 35 and the cover 44 for the outer shell 15, not only through the passages within the tubular members 49, but also between the outer shell 15 and the inner shell 30 for that portion of the rear 180 de-

grees of the furnace not occupied by the extensions 41 and 42 on the headers 35 and 39. It will also be apparent that a combustion chamber 17 is formed below the lower header 38 and communicates with the heat interchange chamber between the headers 35 and 39 through a semi-annular passage 36 formed between the member 32 and the inner shell 30 over the front half of the latter. It will also be apparent that the semi-annular shape of the passageway 36 between the combustion chamber 17 and the interchange chamber acts to spread the products of combustion, in passing from one to the other, into a relatively wide sheet conducive to optimum heat interchange conditions when properly taken advantage of.

The construction of the tubular members 49 to take proper advantage of the form in which the combustible mixture is introduced into the interchange chamber, will now be described. As best illustrated in Figures 4 and 5, the members 49 in section are elongated, and each are provided with one relatively wide rounded end and one relatively narrow rounded end. All of the members 49 are arranged in a fan-like or radial relation with respect to the outlet for the products of combustion from the furnace, and their relation of width to length is such, and their position in the heat interchange chamber is such, as to provide between them a plurality of relatively narrow passages 52, of substantially constant width, for the passage of products of combustion through the heat interchange chamber.

When the sides of the smoke box are removed in a manner which will be explained hereinafter, a brush or other cleaning instrument may be inserted between each pair of the tubes 49 and the inner surface of the heat interchanger to thereby reach and clean all points of the surfaces of the tubes and the inner surface of the interchanger. By removing all of the soot in this manner from the exchanging surfaces of the heat interchanger, the heat is thereby readily transferred through the walls of the tubes and interchanger, from the product of combustion flowing therethrough to the fluid passing within the tubes 49.

Referring particularly to Figs. 3 and 4, it will be noted that the passage 36 connecting the combustion chamber to the heat interchanger is arcuate in shape and encompasses the entire width of the combustion chamber 17 to enable the products of combustion to be delivered to the heat interchanger in such manner that the flow of the combustion particles therethrough to the outlet thereof, will be uniform between the passages provided by the spaced tubes 49. This uniform flow of the combustion particles across the elongated sides of the tubes 49, readily causes the heat remaining in the products of combustion to be conducted therefrom to the fluid to be heated, with a result that the stack temperature is retained below a value which would be effective for appreciably raising the temperature of the fluid, and this goes to increase the efficiency of my boiler.

The tubes 49, when extended in dimensions to conform to the dimensions of larger furnaces, are subject to greater strains than in the case of smaller furnaces, and in order to guard against their collapse, I have shown in Fig. 6 the sides thereof as being of arcuate shape to increase their resistance to pressure. The dispositions of the sides relative to each other and to a point at the mouth of the interchanger has been retained, as will be noted from Fig. 6, to provide uniform

passages for the combustion gases which are readily accessible from the mouth of the interchanger.

In Fig. 7, I have illustrated another method for strengthening the sides 52 of the tubular member 49, that of constructing the tubular member in two sections having inturned flanges 53 thereon which are welded together at 54 to effect a unit tubular structure. The flanges and the welded joints brace the sides 52 to increase their resistance to pressure differences between the inner and outer fluid. A weld may also be provided on the inner abutting edges of the flanges 53 to increase the strength of the joint and to decrease the possibility of a fluid leaking therethrough.

In order to have the mouth of the interchanger readily accessible for cleaning purposes, I have constructed the smoke box 19 in such manner as to have the encompassing side wall 55 thereof readily removable. The ends 41 and 42 of the headers 35 and 39, and the outwardly bent portions of the inner shell 30 between them, project through the opening 26 as a substantially rectangular end frame 56 which is provided with a collar 57 which is slidable over the end 56 and which is provided with inwardly sloping surfaces 58 on its inner side edges. A pair of plates 59 are welded, or otherwise attached, to the top and bottom of the square collar 57 and a strap 61 is attached to the inner edge of the bottom plate 59 for effecting a shoulder inwardly of the edge of the plate.

The top plate 59 is provided with an opening 62 through which a smoke breaching 63 extends and is retained against the inner surface of the plate 59 by a ring 64 which is supported against a flange 65 of the smoke breaching 63 and the inner surface of the top plate 59 by rivets or other suitable means. The outer edge of the ring 64 forms a shoulder for the rear portion of the upper plate, and straps 66 are attached to the underside of the top plate in continuation of the ring 64 for effecting shoulders along its side edges. The shoulders effected by the ring 64 and the straps 66 are offset inwardly on the underside of the upper plate 59 in the same manner as the strap 61 is offset inwardly on the upper side of the bottom plate 59.

The shoulders thus effected on the plate 59, receive the encompassing member 55 which extends thereabout and which is provided with inturned flanges 67 on its ends for engaging the sloping surfaces 58 of the collar 57 for retaining the member 55 in sealed relation with the shoulders. A handle 68 is mounted on one side of the member 55 adjacent to a flange 67 for the purpose of effecting the release of the flange and therefore the entire encompassing member, as shown in Fig. 5 in dot and dash line, to have the discharge opening of the interchanger readily accessible to an operator.

After the walls of tubes 49 of the interchanger have been cleaned and the soot removed from the inner surface of the interchanger, the discharge opening therethrough is closed by engaging the flange 67 on one end of the encompassing member 55, with a surface 58 on the collar and drawing the member about the shoulders, effected by the strap 61, the ring 64 and the member 66, until the flange on the opposite end of the encompassing member engages the opposite surface 58 of the collar. By disassembling the sides of the smoke box in this manner, the mouth of the interchanger is made accessible to an operator and the cleaning tool may be swung through such an angle that all points of the inner surface of the

interchanger may be reached thereby. In Fig. 10, I have shown an enlarged view of the sloping surface 58 of the collar 57 which is engaged by the flange 67 of the encompassing member 55.

In connection with my furnace, it will, of course, be obvious that an insulating covering such as 29 may be provided for preventing a loss of heat from the furnace by transfer to the surrounding air, and that such insulation may be provided with a fabric or metal enclosure such as 47, if desired.

It will also be apparent that any suitable means may be provided for supporting grates when coal is to be used as fuel. As a means of illustration, I have shown grate supports 48 welded to the sides of the ash box 16, the grates being indicated by dotted lines at 23.

Referring to Fig. 2, I have shown a separate circulating system 70 provided in the boiler 20, the conducting tube 71 thereof forming a delivery and return circuit for a fluid to a vicinity above the lower header 38 and below the intermediate header 39, which area is the hottest part of the boiler. The purpose of the second fluid conducting circuit is to heat water which is to be employed for washing, bathing or other purposes, without requiring a second boiler or heating device.

I have shown the structure enlarged in Figs. 11 and 12 as including a third threaded aperture 73 through the side of the fluid container 15, in which a plug 74 is threaded for sealing the aperture against the egress of the fluid. A pair of shouldered apertures 75 are provided in the plugs 74, the shoulders of which engage the flanged ends of the tube 71. Outwardly from the shoulders, the aperture is threaded at 76, for engaging the thread 77 of a nipple 78 which is screwed therein with its inner end tightly engaging the flanged end of the tube 71 for the purpose of forming a seal therewith. In this construction the lower nipple 78 constitutes a conductor for the cold water which passes through the tube 71 within the boiler 20 and outwardly through the upper portion of the tube and the upper nipple 78 to be conducted to a hot water storage tank. It will be noted that the fluid in the separate circuit is conducted through the nipples 78 to and from the tube 71 independent of the plug 74. The plug is employed to removably support the circuit in the side of the boiler and to provide shouldered apertures in which the direct engagement between the nipples and the flanged ends of the tubes is effected.

In Fig. 12, I have shown the tube 71 as being bent back upon itself at 79 and reversely bent at 80 and then outwardly at 81 to thereby increase the length of the tube and decrease the amount of time that the water need be encompassed by the fluid of the boiler to raise its temperature a predetermined amount. The tubes are constructed to have an overall outside diameter which is less than the diameter of the aperture 73 in order that the tube may be inserted within the boiler along with the plug 74 which is threaded into aperture 73. In Fig. 14, I have shown a cross section of the tube which has been bent back upon itself as shown in Fig. 12 to disclose the relation of the various elements 79, 80 and 81 thereof when positioned within the confines of the aperture 73.

In Fig. 13, I have shown a pair of apertures 82 which are provided through the plug 74 along with the apertures 75 which receive the nipples 78. The aperture 82 on the left hand portion of

the plug is closed by a second plug 83, while the aperture 82 on the right hand side of the plug is provided with an elbow 84 to which a conductor 85 is connected. The elbow 84 directly communicates with the fluid within the boiler which may be conducted therefrom by the pipe 85 to provide a convectional flow of the fluid through the boiler, or for other purposes.

While I have described and illustrated several embodiments of my invention, it will be apparent to those skilled in the art that various changes, omissions, additions and substitutions may be made therein without departing from the spirit and scope of my invention, as set forth in the accompanying claims.

I claim as my invention:

1. A heat interchanger for a boiler including, in combination, an enclosure member having a chamber and being provided with a wide opening in one end, constituting a passage for the ingress of the combustible gases, and an oppositely disposed opening for the egress of the gases, hollow members extending through said enclosure member, having arcuate sides, the adjacent sides of adjacent members being struck from the same center and arranged to provide passages having uniform cross sections, the opposite sides of said adjacent members being struck from different centers to cause said passages to converge toward said second-named opening.

2. A heat interchanger for a boiler including, in combination, an enclosure member having a chamber and being provided with a relatively wide opening in one end constituting a passage for the ingress of the combustion gases and an oppositely disposed opening for the egress of said gases, hollow members extending through said enclosure member having arcuate sides, the adjacent sides of adjacent members being located about a common center to provide passages having uniform width and the center member being elliptical in cross section for effecting the converging of the passages toward said second-named opening.

3. A heat interchanger for a boiler including, in combination, an enclosure member of generally circular section provided with a chamber and having a narrow arcuate opening which encompasses substantially one half of the circumference of the chamber for constituting a passage for the ingress of the combustion gases, said enclosure being provided with a second opening oppositely disposed with respect to said first named opening for the egress of said gases, and tubular members extending through said enclosure member, said tubular members having flat converging sides with a side of each tubular member disposed in parallel relation to a side of an adjacent member for effecting passages therebetween, the passages converging radially toward said second opening.

4. A furnace including a casing, a hollow wall intermediate the top and bottom of said casing dividing it into a lower combustion chamber and an upper heat interchanger chamber, a passage between said combustion chamber and one side only of said interchanger chamber, said interchanger chamber having a discharge opening on the side thereof opposite said passage, a second casing surrounding the first mentioned casing in generally spaced relation thereto and the space between said casings being connected to the interior of said hollow wall, and a plurality of separate hollow tubes extending between said top and said wall connecting the interior of said wall

with the space between said top and said second casing, each of said hollow tubes being elongated in transverse section in the direction of the flow of gases between said passage and opening, and the sides of adjacent tubes being so located relative to each other to form a plurality of relatively narrow separated passages elongated in said direction of flow for the passage of said gases.

5. A furnace including a casing, a hollow wall intermediate the top and bottom of said casing dividing it into a lower combustion chamber and an upper heat interchanger chamber, a passage between said combustion chamber and one side only of said interchanger chamber, said interchanger chamber having a discharge opening on the side thereof opposite said passage, a second casing surrounding the first mentioned casing in generally spaced relation thereto and the space between said casings being connected to the interior of said hollow wall, and a plurality of separate hollow tubes extending between said top and said wall connecting the interior of said wall with the space between said top and said second casing, each of said hollow tubes being elongated in transverse section in the direction of the flow of gases between said passage and opening, and the cross sectional width of said tubes measured in a direction perpendicular to said direction of flow decreasing toward the edge thereof closets to said discharge opening.

6. A furnace including a casing, a hollow wall intermediate the top and bottom of said casing dividing it into a lower combustion chamber and an upper heat interchanger chamber, a passage between said combustion chamber and one side only of said interchanger chamber, said interchanger chamber having a discharge opening on the side thereof opposite said passage, a second casing surrounding the first mentioned casing in generally spaced relation thereto and the space between said casings being connected to the interior of said hollow wall, and a plurality of separate hollow tubes extending between said top and said wall connecting the interior of said wall with the space between said top and said second casing, each of said hollow tubes being elongated in transverse section in the direction of the flow of gases between said passage and opening, the sides of adjacent tubes being so located relative to each other to form a plurality of relatively narrow separated passages elongated in said direction of flow for the passage of said gases, and the width of said tubes decreasing toward said opening whereby the thickness of the medium therein to be heated, measured in a direction perpendicular to said direction, varies in accordance with the decrease in heat content of the gases flowing through said elongated passages.

7. A furnace including a casing, a hollow wall intermediate the top and bottom of said casing dividing it into a lower combustion chamber and an upper heat interchanger chamber, a passage between said combustion chamber and one side only of said interchanger chamber, said interchanger chamber having a discharge opening on the side thereof opposite said passage, a second casing surrounding the first mentioned casing in generally spaced relation thereto and the space between said casings being connected to the interior of said hollow wall, and a plurality of separate hollow tubes extending between said top and said wall connecting the interior of said wall with the space between said top and said second casing, each of said hollow tubes being elongated in transverse section in the direction

of flow of gases between said passage and opening, and the sides of adjacent tubes being so located relative to each other to form a plurality of relatively narrow separated passages elongated in said direction of flow for the passage of said gases, some of said tubes being elongated in said transverse section to a greater extent than others of said tubes.

8. A furnace including a casing, a hollow wall intermediate the top and bottom of said casing dividing it into a lower combustion chamber and an upper heat interchanger chamber, a passage between said combustion chamber and one side only of said interchanger chamber, said interchanger chamber having a discharge opening on the side thereof opposite said passage, a second casing surrounding the first mentioned casing

in generally spaced relation thereto and the space between said casings being connected to the interior of said hollow wall, and a plurality of separate hollow tubes extending between said top and said wall connecting the interior of said wall with the space between said top and said second casing, each of said hollow tubes being elongated in transverse section in the direction of the flow of gases between said passage and opening, the sides of adjacent tubes being so located relative to each other to form a plurality of relatively narrow separated passages elongated in said direction of flow for the passage of said gases, and said tubes being arranged with the lengths of said sections in fan-like relation with respect to said opening.

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50	125
55	130
60	135
65	140
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75	150