Jan. 24, 1939. C. P. BUTLER 2,144,792

WATER TUBE BOILER

Filed May 11, 1936 5 Sheets-Sheet 1

Fig. 1

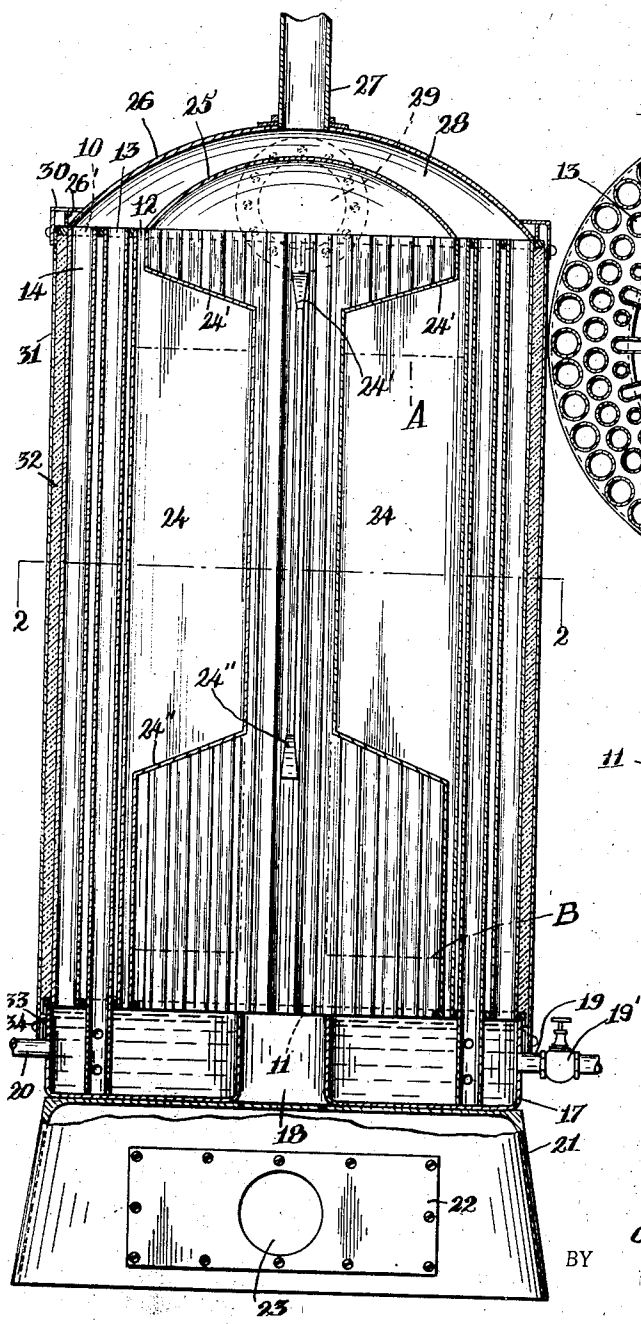


Fig. 2

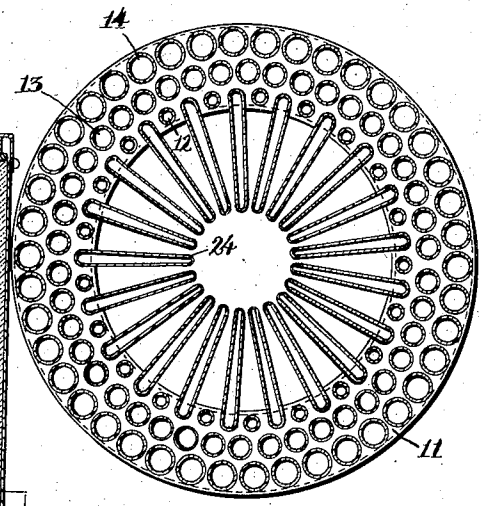
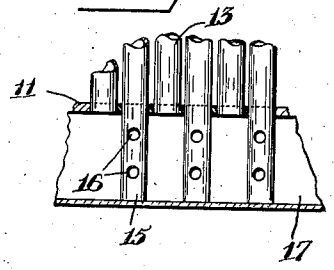


Fig. 3



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WATER TUBE BOILER

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Fig. 4

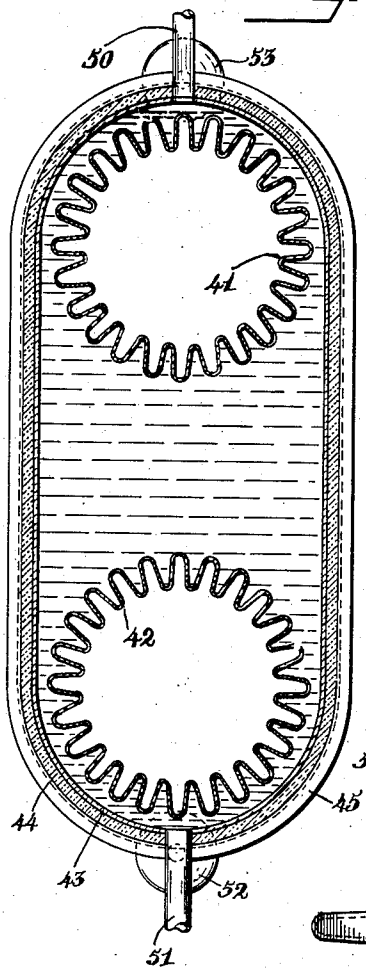


Fig. 5

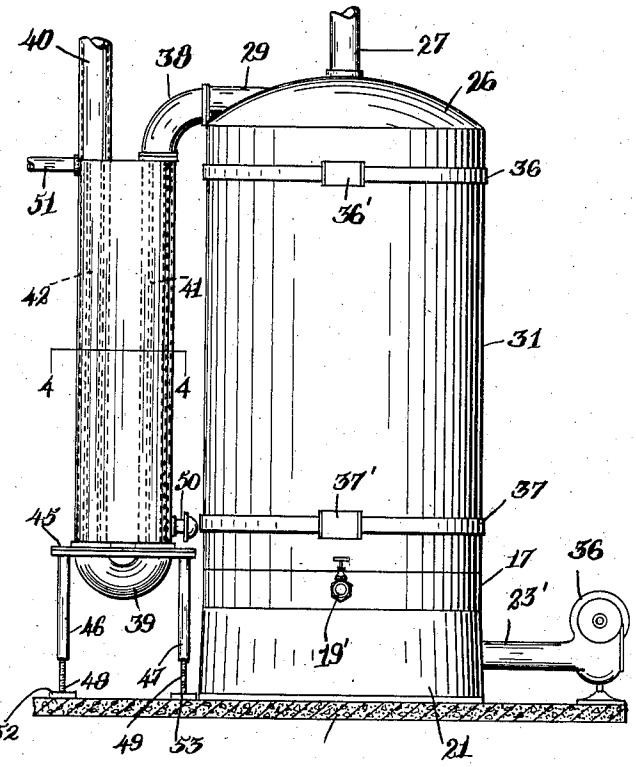


Fig. 6

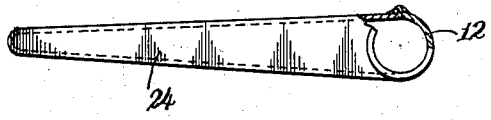
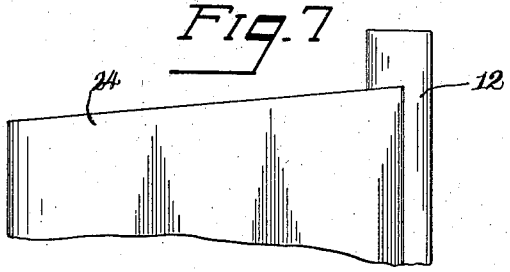


Fig. 7



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Jan. 24, 1939. C. P. BUTLER 2,144,792

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Fig. 8

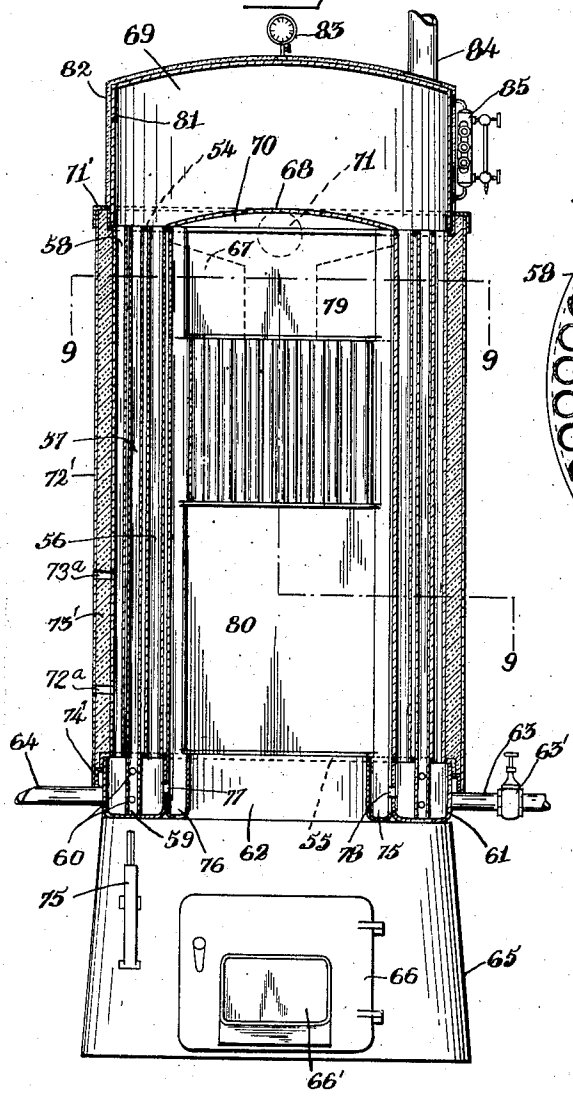

Fig. 9

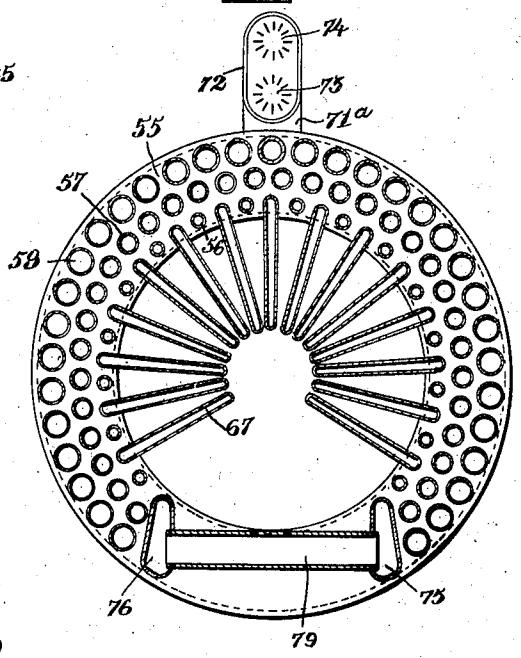

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Fig. 10

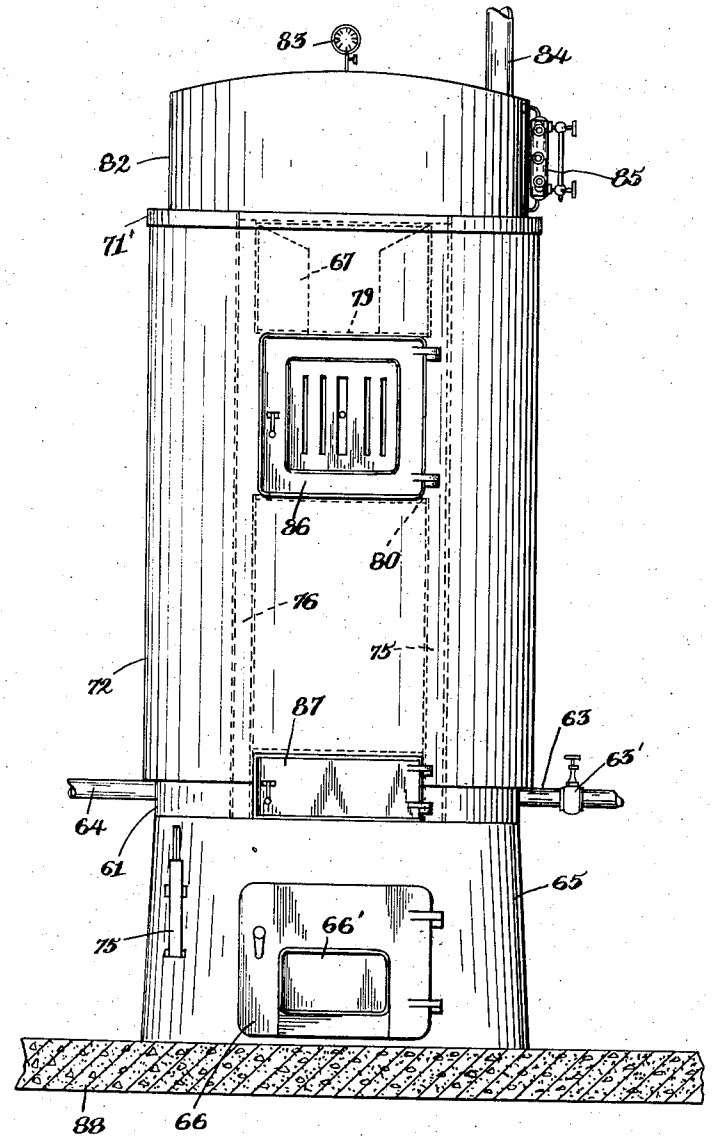

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Fig. 11

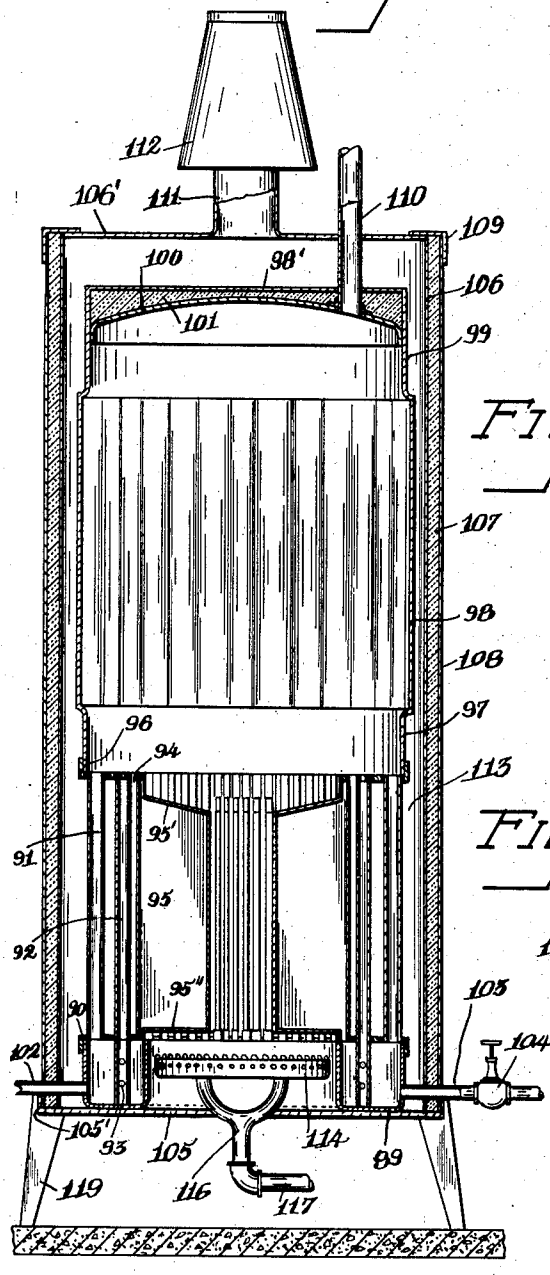


Fig. 12

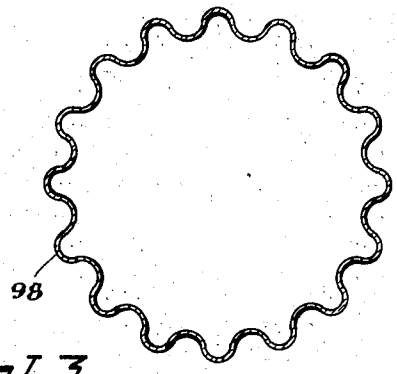


Fig. 13

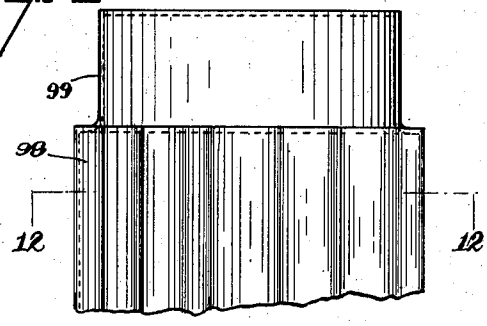
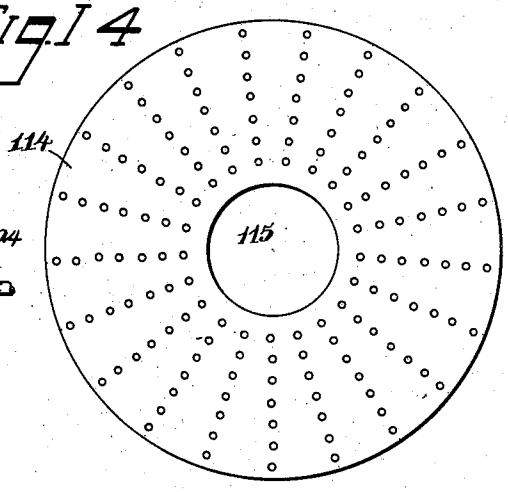


Fig. 14



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Patented Jan. 24, 1939 2,144,792

UNITED STATES PATENT OFFICE

2,144,792

WATER-TUBE BOILER

Carl Post Butler, New York, N. Y.

Application May 11, 1936, Serial No. 78,999

4 Claims. (Cl. 122—333)

This invention relates generally to water-tube boilers, and more specifically to a water-tube boiler for domestic or industrial use and manufactured of drawn pure copper at all water contacting parts.

The main object of the invention resides in the provision of a water-tube boiler of approximately the same size as the old-fashioned cast iron water heater having from 8 to 9 feet of radiation surface in its fire box, and being approximately 66 inches in height; the difference between the old fashioned water-heater and the present construction however, residing in the increase of the radiation surface and increase in the strength of the construction to withstand a pressure several times that which the known heaters under normal conditions are called upon to withstand.

Another object of the invention resides in the provision of a construction which is convertible from a water boiler to a steam boiler by converting the top hot water chamber to a steam chamber.

Another object of the invention resides in the provision of a water-tube boiler which is capable of utilizing fuel oil, fuel gas and coal as the combustion element.

Another object of the invention resides in the production of a sturdy, compact and durable water-tube boiler, the parts of which are capable of testing before assemblage, and the parts of which are easily accessible for cleaning and repair purposes after assemblage.

These objects and other incidental ends and advantages of the invention will hereinafter be set forth in the progress of the disclosure and as pointed out in the appended claims.

Accompanying this specification are drawings showing a preferred form of the invention together with modifications thereof in the utilization of oil, gas and coal as fuel and in the conversion from a hot water boiler to a steam boiler, corresponding reference characters designating corresponding parts throughout the several views of the said drawings.

In accordance with the drawings:—

Figure 1 represents a central vertical section of a water-tube boiler adapted to utilize oil as fuel.

Figure 2 is a transverse section of Figure 1 along the plane 2—2 thereof, the batteries of pipes, fins and lower trough cover only being shown.

Figure 3 is a fragmentary sectional view through the lower trough, showing the extended legs of the intermediate battery of pipes.

Figure 4 is a transverse sectional view of Figure 5 through the plane 4—4 thereof, showing a smoke or flue pipe within a water jacket.

Figure 5 is a side elevation of Figure 1.

Figure 6 is a plan view of one of the fins shown in Figure 1, partly broken away.

Figure 7 is a fragmentary side elevation of the said fin as brazed to a tube of the innermost battery.

Figure 8 is a central vertical section of a steam boiler utilizing coal as fuel, and embodying the principles of the invention.

Figure 9 is a transverse sectional view of Figure 8 through the planes 9—9—9, not showing, however, the insulated shell therefor.

Figure 10 is a front elevational view of Figure 8.

Figure 11 is a central vertical section of a hot water boiler similar to Figure 1, except that the hot water chamber is in the form of a hot water tank and that the fuel utilized is gas.

Figure 12 is a transverse sectional view of the intermediate portion of the said tank showing vertically disposed corrugations.

Figure 13 is a fragmentary elevation of the upper portion of the said tank showing an uncorrugated reduced end thereof.

Figure 14 is a top plan view of the gas burner showing a series of radiating jets adapted to be in alignment with the bottom surfaces of the several fins within the boiler of Figure 11.

In accordance with the invention, Figures 1 to 7 inclusive, depict a preferred form of a water-tube boiler utilizing oil as fuel and adapted to function as a water heater. The said water-tube boiler may be utilized as a steam boiler by shortening the lower limits of fins **24** so that the distance from the combustion chamber or burner **23'** is increased to the point marked A on Figure 1, and in addition by enlarging the size of the hot water chamber **28** to that shown in Figure 8. Furthermore, the same construction for both hot water heating and steam generating purposes may be heated by gas fuel by lowering the lower wall of fins **24** to the level marked B on Figure 1. The construction of Figure 1 preferably has an approximate height of 66 inches. The cast iron base **21** is 12 inches in height, the intake water trough **17** is 6 inches in height, the batteries of water risers or pipes **12**, **13** and **14** are 36 inches in height, while the upper arch **26** forming the hot water or steam chamber, is 12 inches in height.

More specifically described, the water-tube

boiler comprises an upper and lower cover member 10 and 11 being in the form of a ring and preferably being made of ⅛ inch copper. Covers 10 and 11 are provided with aligned and concentrically arranged openings, into which are brazed 3 circular batteries of copper pipes 12, 13 and 14, respectively. The innermost battery of pipes or water risers 12 are preferably of the ½ inch standard size, the intermediate battery of pipes 13 are preferably of the ¾ inch standard size, while the outermost battery of pipes 14 are preferably of the 1 inch standard size. Each battery of pipes and the individual pipes are sufficiently spaced apart to allow for the insertion of a brush for cleaning the external surfaces of the said pipes. Pipes 12, 13 and 14 are preferably 36 inches long with the exception of preferably the alternate pipes of the intermediate battery 13, which are adapted to extend below cover member 11 as indicated by numeral 15 to the bottom of the water trough 17, the latter being preferably and approximately 6 inches in height. The extensions 15 are provided with orifices 16 to bring about a circulation of water with the water of trough 17, and serve as the supporting means for the water risers.

The trough 17 is preferably made of ⅛ inch copper U-shaped in profile and preferably hammered out of a 4 inch pipe, the said trough 17 having a central opening or flue passage 18, and being about 6 inches in height.

Numerals 19 and 20 represent 1½ inch water pipes preferably made of brass for supplying and draining the water in the trough 17, while 19' represents a valve to control the flow of water through the inlet pipe 19 to the trough 17.

The water-tube boiler base 21 is made of cast-iron of standard design and is provided with a rectangular plate 22 having an opening therein 23 for the insertion of an oil burner 23' from feed 36. Within the interior of base 21 is the combustion chamber which communicates with the flue chamber 18 formed by the inner walls of trough 17. Trough 17 rests on base 21, while extensions 15 rest on the bottom wall of trough 17. Thus a firm support is given to the superposing structure.

The inner battery of pipes 12 are provided with vertically extending copper water chambers or fins 24. These fins 24 preferably communicate with alternate pipes of the innermost battery 12 extending forwardly and radially to form a circular and vertical flue chamber at their inner edges as best shown in Figure 2. The top walls 24' of fins 24 incline upwardly from their forward edges while the lower walls 24'' thereof incline downwardly from their forward edges, the said fins diverging outwardly from their inner edges.

The upper walls of fins 24 are spaced slightly below the upper cover member 10 while the lower walls 24'' are spaced substantially above cover member 11.

25 represents a dish-shaped dome preferably made of ⅛ inch sheet copper and connected as by brazing to the inner periphery of upper cover member 10. Spaced from dome 25 is an outer dome 26 connected as by brazing to the outer periphery of upper cover member 10, the intervening space between domes 25 and 26 affording a hot water or steam chamber 28. Extending rearwardly from dome 25 and penetrating chamber 28 and dome 26 is a flue pipe 29 which is adapted to be connected to a flue elbow outlet 38 while a brass 1½ inch outlet water pipe 27 leads to a copper lined hot water tank.

The outer battery of pipes 14 is provided with a metallic shell 31 having a non-conducting lining 32, the said shell being suspended from the dome member 26 by means of an angle iron hoop 30 supported at the lower edges thereof. Another angle iron hoop 33, if preferred, surrounds water trough 17 above aligned pipes 19 and 20, the said shell 31 being affixed thereto at the lower edges by means of rivets 34.

The outer shell 31 may have securing bands 36 and 37 therearound as shown in Figure 5 with standard tightening buckles 36' and 37'. Thus shell 31 along its vertical seam may be opened and closed for cleaning the water risers and fins.

It will be seen that the radiation or heat transfer surface is vertically disposed thereby lessening the extent of flue deposits thereon and that the amount of heat transfer surface is of a magnitude several fold that of the standard boilers of even greater size.

From flue 29 an elbow 38 leads to a water heating twin smoke pipe comprised of 2 corrugated copper pipes 41 and 42. These copper pipes are enclosed within a copper metallic jacket 43 having an outer non-conducting lining 44. Jacket 43 is provided with a top and bottom wall, a water inlet 50 and a water outlet 51. The outlet pipe 42 is connected by means of smoke pipe 40 at the top wall of jacket 43, and proceeds to the chimney. Jacket 43 is mounted on an angle iron stand 45 having transverse supports between pipes 41 and 42, the said supports not being shown in the drawings. Connected to the pipes 41 and 42 at the bottom wall of jacket 43 is a U-shaped sheet iron elbow 39. Angle iron stand 45 is provided with legs 46 and 47, the said legs threadedly engaging with threaded posts 47 and 48, the latter being affixed to the base by means of securing plates 53 and 52. The water risers, fins, trough and hot water chamber are tested to withstand at least 300 pounds working pressure. Water jacket 43 is adapted to heat water independently of the water-tube boiler.

As has before been mentioned, by raising the lower walls of fins 24 to the level marked A on Figure 1 and increasing the size of chamber 28, the water-tube boiler above described can be converted to a steam generating boiler. By lowering the walls of fins 24 to the level marked B on Figure 1 and keeping them on the plane of the horizontal, the hot water boiler may utilize gas as a fuel.

Figures 8, 9 and 10 depict a steam-boiler operated by coal, utilizing at the same time the principles of the heat-transfer surface unit shown in Figures 1–7 inclusive. Numerals 54 and 55 represent the upper and lower cover members the forward segments thereof being perforated differently from cover members 10 and 11. The said segments are provided with spaced and irregularly shaped elliptic openings to accommodate frame water risers 75 and 76 in addition to the outwardly and rearwardly disposed batteries of pipes 56, 57 and 58 corresponding thereat to batteries 12, 13 and 14. The intermediate battery 57 is provided with extensions 59 having perforations 60 to communicate with the water trough 61. Water trough 61 is in the form of a horseshoe having its front opposing end walls juxtaposed and brazed to the outer lateral limits of frame water risers 75 and 76 as shown in Figure 8, risers 75 and 76 communicating with trough 61 by means of openings 78 and 77. Trough 61 and risers 75 and 76 are supported by a base 65 having the usual or standard swivel door 66 with the

automatic draft door 66' in the ash pit opening with the standard rocking grate and grate shaker 75. Numeral 62 represents an open space above the grate which is covered by a clinker door 87 mounted on the frame water risers 75 and 76. A copper water box 80 having open side walls and communicatively brazed to risers 75 and 76 extends from cover member 55 upwardly, the said water box being preferably of ⅛ inch copper 10½ inches wide, 16 inches high and 4 inches thick. Water box 80, it is seen, serves as a water riser, and is capable of withstanding a pressure of 150 pounds working pressure. Coal door 86 about 10 inches high and 10½ inches wide situated above the top wall of water box 80 is mounted on the frame water risers 75 and 76 in similar fashion to clinker door 87 as shown in Figure 10. Above the upper edge of coal door 86 is another water box 79 brazed into frame water risers 75 and 76, the said water box extending from below cover member 54.

The innermost battery of pipes 56 is alternately provided with fins 67 similar to fins 24 of Figure 1 except that the lower walls of said fins are flat and terminate at the level of the lower wall of water box 79 as shown in Figure 8.

Numerals 63 and 64 represent the corresponding inlet and drain pipes, 63' being a valve for the inlet pipe 63, while 68 is the inner dome exposed to the flue gases at 70 which together with outer dome 81 furnishes the steam chamber 69. Inner dome 68 is brazed to the inner periphery of cover member 54 while the outer dome 81 is brazed to the outer periphery of cover member 54. Pipe 71*a* represents the outlet for the flue gases and connects with the water jacket 72 through corrugated pipes 73 and 74 as heretofore described in connection with the structure shown in Figure 1. Numeral 83 represents a standard steam gauge, 85 a typical water gauge and 84 a steam outlet. An angle iron hoop 71' affixed to the lower limit of outer dome 81 carries a shell 72' having a non-conducting lining 73', the lower portion of the shell being affixed to an angle iron hoop 74' supported by aligned pipes 63 and 64. Outer dome 81 is provided with a non-conducting surface 82. The shell 72' and insulation 73' are preferably pierced with two 1 inch holes 72*a* and 73*a* at 18 inches from the bottom and 28 inches from the bottom in order to furnish enough air for the combustion of fuel when all the doors are shut.

It is to be observed that cover members 10 and 11 of Figure 1 and 54 and 55 of Figure 8 may have their inner and outer peripheries turned. Thus, the inner and outer peripheries of 10 and 54 are turned upwardly 90 degrees, while the peripheries of 11 and 55 are turned downwardly 90 degrees. Such conformation aids in the proper brazing of joints.

Figures 11, 12, 13 and 14 depict a water-tube boiler wherein the hot water chamber or steam chest is in the form of a storage tank, the said boiler being heated by gas fuel and wherein a flue jacket is provided instead of a narrow and vertical flue duct. Of course, the same construction is capable of utilizing oil as fuel by upwardly inclining and slightly raising the bottom walls of fins 95. In addition, the same construction is capable of acting with a smaller upper hot water chamber in conjunction with an external water tank.

In Figures 11–14, 96 and 90 are the cover members perforated as 10 and 11, while 91, 92 and 94 are the concentric batteries of pipes, 89 the lower water trough, 93 extensions of the intermediate battery of pipes with circulating holes therein, 95 the fins on the innermost battery of pipes having upper inclined walls 95' and lower straight walls 95'', the said lower walls being situated directly above cover member 90. 98 is a corrugated hot water tank having a lower and reduced non-corrugated portion 97 connected to the outer periphery of cover member 96 and an upper and reduced non-corrugated portion 99 connected to a dome member 101. Numerals 103, and 102 are the inlet and drain to trough 89 while 104 is a standard valve for inlet 103. 105 is a base plate supported by legs 119 on which trough 89 is supported and through which a gas burner 116 passes, the said gas burner having jets radially disposed as indicated by 114 in Figure 14 and having a central opening 115. The jets are adapted to lie along the lower walls 95'' of fins 95. Numeral 117 represents the feed for the gas burner, the gas burner being provided with regular safety controls and valves.

Numeral 106 represents a shell spaced from tank 98 and trough 89 and serves as the outer limit of a flue chamber. The said shell rests on base plate 105 and has a top wall 106'. An external shell 108 with a non-conducting lining 107 is adapted to surround the inner shell 106, the latter being maintained in place by flange 105' at the periphery of base 105 and by a circular angle iron 109 at the upper edge, the said angle iron resting on top wall 106' of shell 106. Numeral 110 represents a distribution hot water pipe while 111 is a flue pipe having a conical draft diverter 112.

Thus the constructions shown in Figures 1–14 utilize a system of water risers having a maximum amount of a heat transfer surface for the size of the unit, the said amount approaching 80 square feet. The unit is compact, accessible for cleaning and repairs, durable and a fuel saver, the saving in the fuel being in the proportion to the increase of heat transfer surface.

I wish it understood that minor changes and variations in the size, shape, material, integration, location and subcombination of the several parts may all be resorted to without departing from the spirit of the invention and without departing from the scope of the appended claims.

I claim:

1. In a water-tube boiler having a combustion chamber base, an inlet water trough having a central opening, the said trough being proximate to and supported on the said combustion chamber base, a plurality of spaced vertically extending water-chambers communicating with the said inlet water trough, a perforated cover member for the said water trough to which the said water-chambers at their lower ends are affixed, certain water chambers extending through the said cover member and resting on the bottom of the water trough and being perforated within the region of the said trough, a duplicate upper perforated cover member to which the said water chambers at their upper ends are affixed, a hot water chamber mounted on the said upper cover and in communication with the said water chambers, a shell to prevent the escape and direct the flow of the hot flue gases.

2. A water-tube boiler set on a combustion chamber and having an inlet water trough having a central opening, the said trough being proximate to and supported by the said combustion chamber, a plurality of adjacent sets of water tubes concentrically arranged, the said

water-tubes being spaced and increasing in diameter from the innermost to the outermost set and communicating with the said inlet water trough, a perforated cover member for the said water trough to which the said water-tubes at their lower ends are affixed, tubes from an intermediate set extending through the said cover member and resting on the bottom of the water trough and being perforated within the region of the said trough, a duplicate upper perforated cover member to which the said water-tubes at their upper ends are affixed a hot water chamber mounted on the said upper cover and in communication with the said water tubes, and a shell surrounding the outermost set of water tubes.

3. A water-tube boiler having a combustion chamber, an inlet water trough having a central opening, the said trough being proximate to and supported by the said combustion chamber, a plurality of adjacent sets of water-tubes concentrically arranged, the said water-tubes being spaced and increasing in diameter from the innermost to the outermost set and communicating with the said inlet trough, a perforated cover member for the said water trough to which the said water tubes at their lower ends are affixed, tubes from an intermediate set extending through the said cover member and resting on the bottom of the water trough and being perforated within the region of the said trough, vertically extending water chambers radially disposed extending from and in communication with the innermost set of water tubes, a duplicate upper perforated cover member to which the said water-tubes at their upper ends are affixed, a hot water and steam chamber mounted on the said upper cover and in communication with the said water-tubes, and a shell surrounding the outermost set of water-tubes.

4. A water-tube boiler having a combustion chamber, an inlet water trough having a central opening, the said trough being proximate to and supported by the said combustion chamber, a plurality of adjacent sets of water-tubes substantially concentrically arranged, the said water-tubes being spaced and increasing in diameter from the innermost to the outermost set and communicating with the said inlet trough, a perforated cover member for the said water trough to which the said water-tubes at their lower ends are affixed, tubes from an intermediate set extending through the said cover member and resting on the bottom of the water trough and being perforated within the region of the said trough, vertically extending water chambers radially disposed extending from and in communication with the innermost set of water-tubes, a duplicate upper perforated cover member to which the said water-tubes at their upper ends are affixed, a set of supporting water tubes between and affixed to the cover members forwardly thereof and affixed to perforations thereat, spaced water chambers affixed to and communicating with the said supporting water-tubes, a hot water and steam chamber mounted on the said upper cover and in communication with the said water-tubes, and a shell extending from and to the peripheries of the cover members.

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