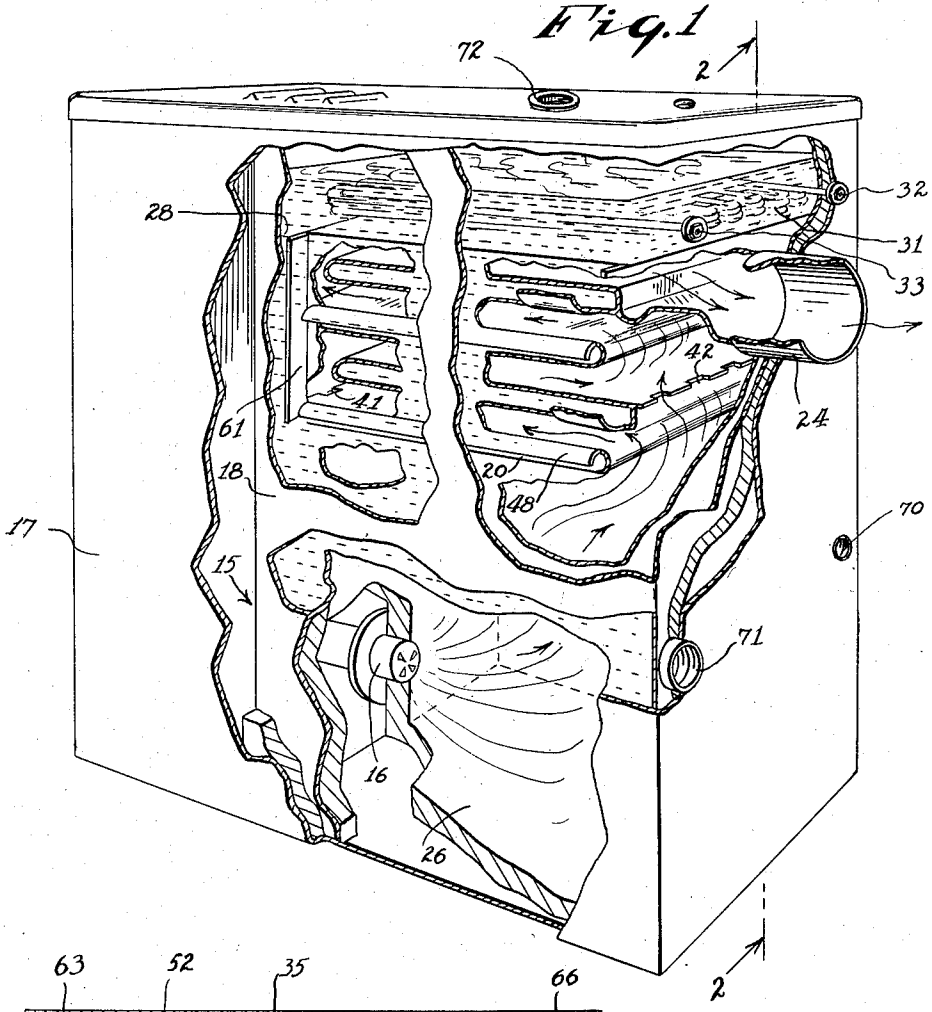
March 11, 1958 B. W. MANDELBURG 2,826,182

RECIRCULATING SQUARE BOILER

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Fig. 1



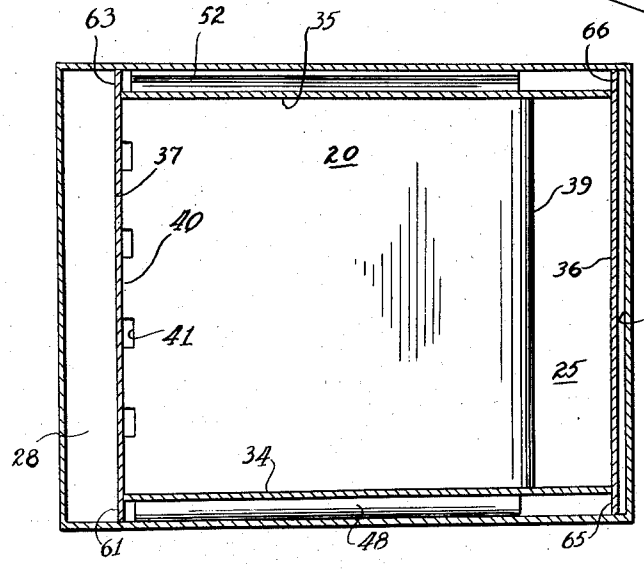


Fig. 9

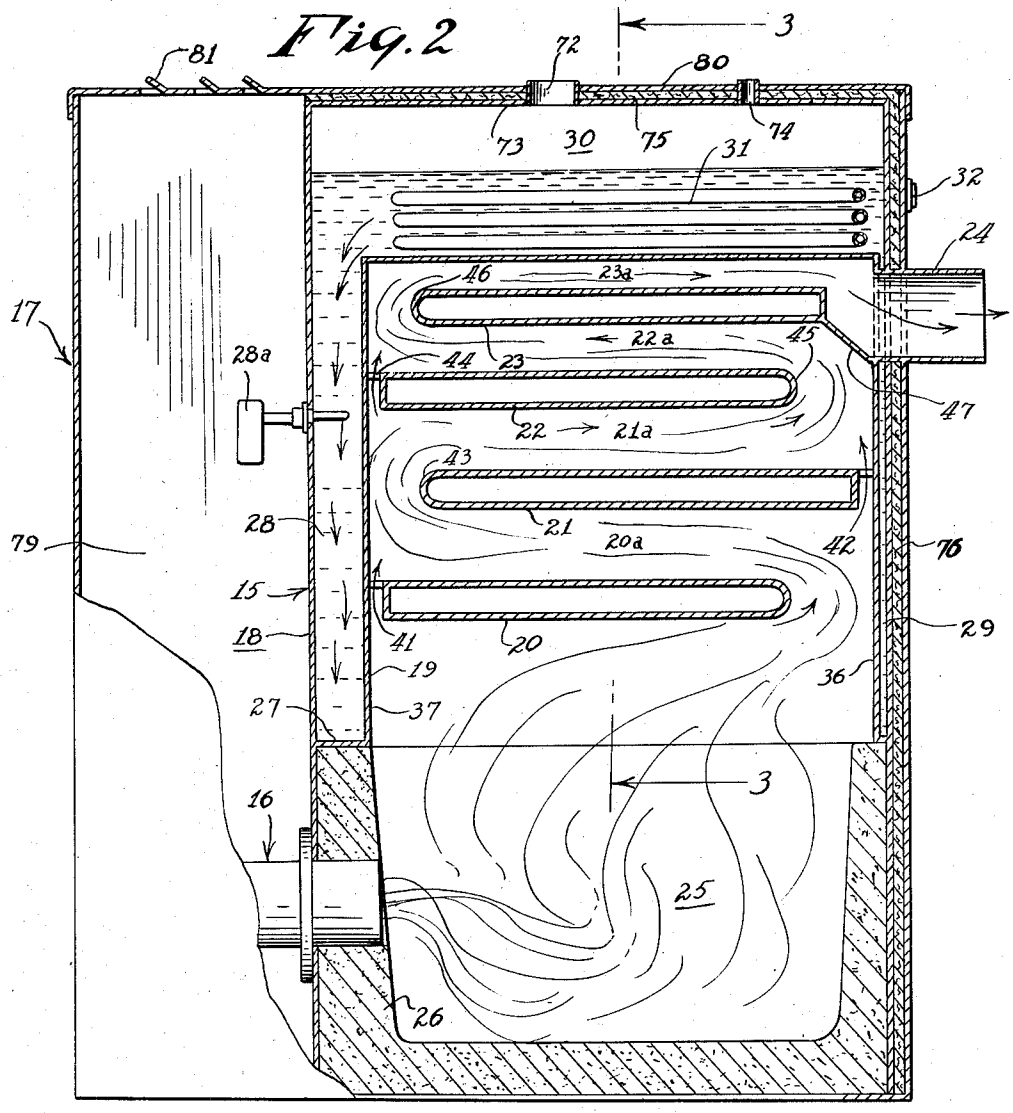
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Fig. 2



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Fig. 3

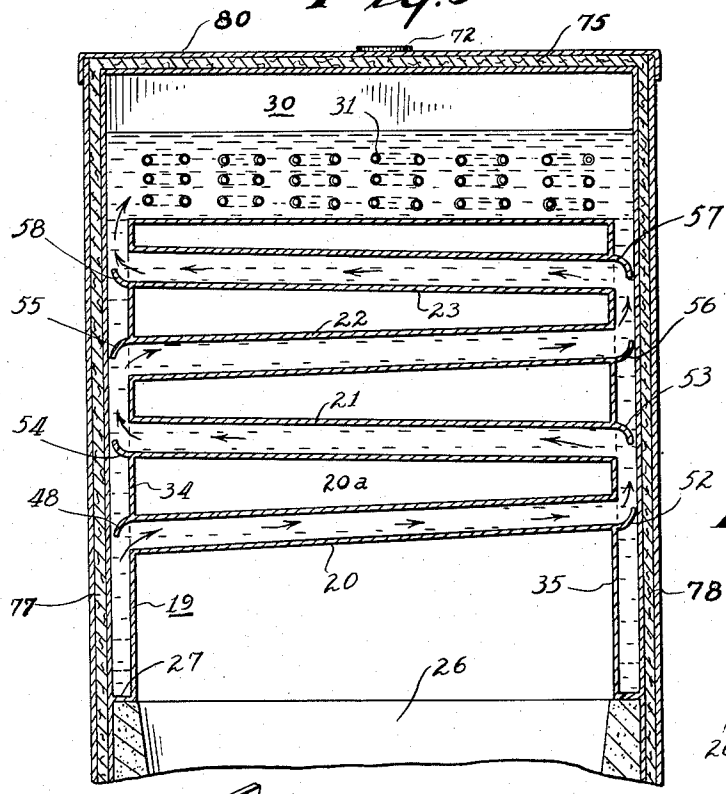
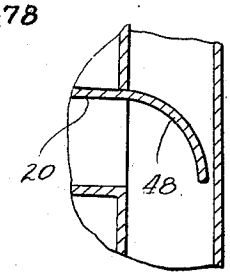


Fig. 5



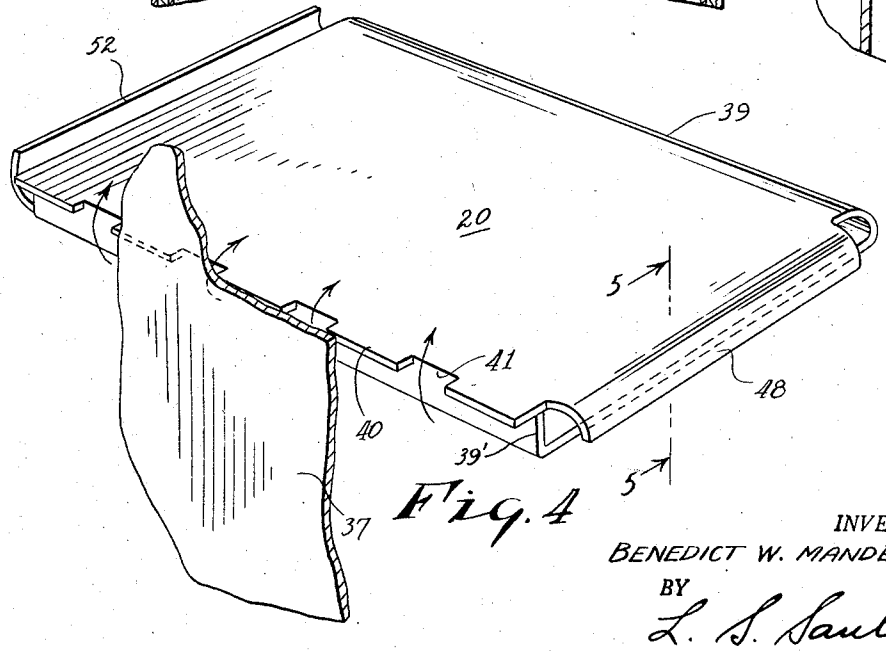


Fig. 4

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Fig. 6

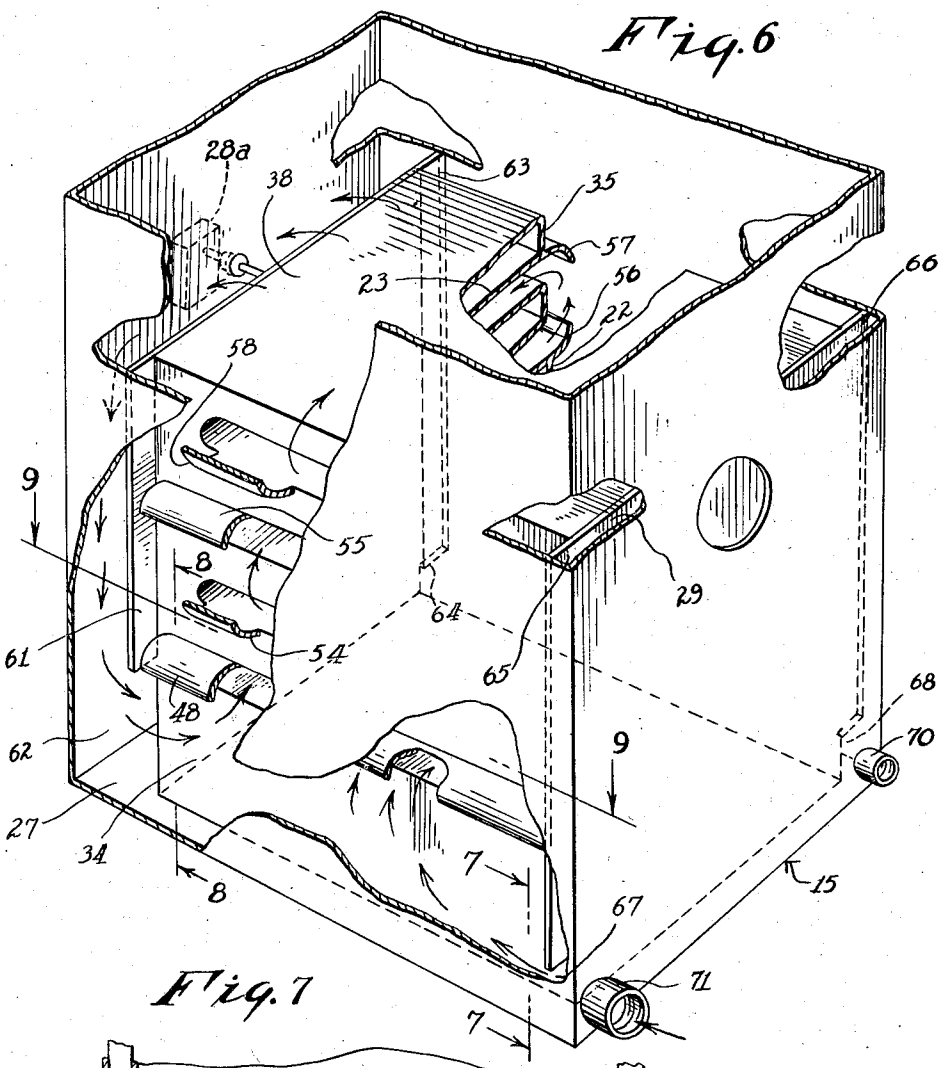


Fig. 7

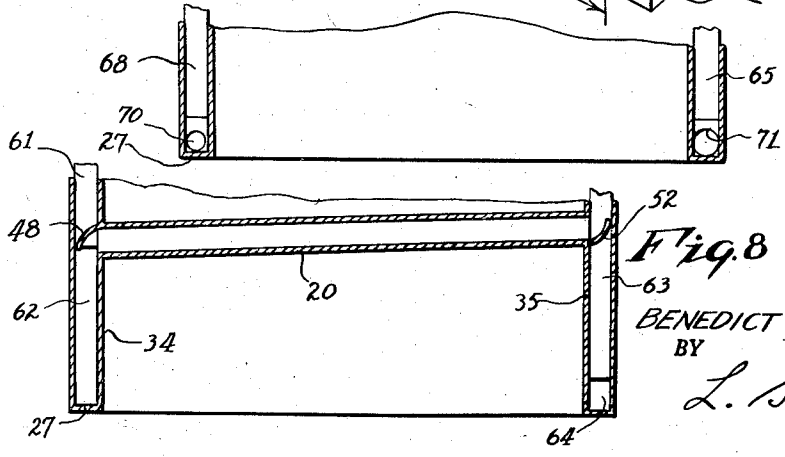


Fig. 8

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United States Patent Office 2,826,182 Patented Mar. 11, 1958

2,826,182

RECIRCULATING SQUARE BOILER

Benedict W. Mandelburg, Scarsdale, N. Y., assignor to Manville Boiler Co., New York, N. Y., a corporation of New York

Application December 4, 1952, Serial No. 324,040

5 Claims. (Cl. 122—155)

This invention relates to a tubeless recirculating water heating boiler construction.

It is an object of the present invention to provide a tubeless recirculating water boiler construction wherein the boiler will have high recirculating action causing instant and forceful water movement from the bottom in one path of flow to the top of the boiler and returning from the top of the boiler to the point of beginning through another path of flow, and wherein the lower recirculating compartment takes in the cooled water from the top of the boiler from a non-restricted passage downwardly along the front of the boiler and from the radiator return pipe so as to start circulation together within the boiler at a definite starting point and induce the water to flow in a continuous one-direction path only throughout the boiler.

It is another object of the invention to provide in a tubeless recirculating water heating boiler a long gas flue travel of constantly lessening size with the sectional area being large at the start and smaller as the gases progress through the flue travel, and with the smallest area being at the point of exit of the gases to the chimney fitting and without having any large top chamber or any other section of the flue travel of greater space than required, and wherein the flue travel will have at least a plurality of serpentine flue passages which allow for high absorption of the heat by the scrubbing effect of hot gases after leaving the fire chamber and as they pass through the properly proportioned and constantly diminishing sectional area of the flue travel.

It is another object of the invention to provide a tubeless recirculating water heating boiler wherein the gases are allowed to by-pass in small quantities the passages to eliminate any tendency of the gases to stratify in the flue travel and to eliminate any possibility of back pressure in the fire box and flue.

It is another object of the invention to provide a tubeless recirculating water heating boiler which allows for full expansion of the flame and gases and has effective scrubbing and wiping action over all of the heat-absorbing surfaces and whereby a smooth and quiet flow of gases through the boiler is had.

Other objects of the invention are to provide a tubeless recirculating heating boiler having the above objects in mind, which is of simple construction, welded into one piece, is without tubes to clog, clean or replace, has a minimum number of parts, inexpensive to manufacture, compact, durable, easy to install, low chimney temperature, low fuel consumption, fast heating economy, and efficient in operation.

For other objects and for a better understanding of the invention, reference may be had to the following detailed description, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a perspective view of the boiler with the burner and outer casing or jacket attached and with portions of the outer casing and of the boiler broken away in several places to show the interior construction thereof;

Figure 2 is a vertical sectional view taken generally on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary vertical sectional view taken on line 3—3 of Fig. 2;

Fig. 4 is a perspective view of one of the transverse water-containing flue baffles and showing notches cut away to allow for the by-pass of small quantities of the fire flame and gases in order to disturb and prevent stratification of the gases as they pass through the flue and to relieve pressures that may develop in the flue or fire chamber resulting from varying draft conditions;

Fig. 5 is a fragmentary sectional view showing a water deflecting portion on one of the water baffles and as viewed on line 5—5 of Fig. 4;

Fig. 6 is a fragmentary perspective view of the boiler structure with the top and other portions broken away to show the interior construction thereof and the manner in which the water passes upwardly through water-containing flue baffles and returns to the bottom of the boiler;

Fig. 7 is a fragmentary vertical sectional view taken generally on line 7—7 of Fig. 6;

Fig. 8 is a fragmentary vertical sectional view taken generally on line 8—8 of Fig. 6;

Fig. 9 is a horizontal sectional view taken generally on line 9—9 of Fig. 6.

Referring to the figures, 15 represents the boiler structure which embodies the features of the present invention and to which there is connected a fuel burner 16. This burner extends through the side of the boiler structure at the bottom thereof and delivers the flame to the boiler structure. Surrounding the boiler structure 15 and the burner 16 is an outer casing or jacket 17.

The boiler structure 15 comprises generally an outer shell 18, an inner shell 19 inwardly spaced from the outer shell to provide a water space between the shells, transverse flat water-containing flue baffles 20, 21, 22 and 23 connected between the sides of the inner shell for the passage of water therethrough, and a chimney outlet fitting 24. In the bottom of the boiler structure is a fire chamber 25 lined with fire clay 26 lying both in the bottom and in the side walls of the fire chamber. This fire clay is sufficiently thick to withstand the heavy heat concentration generated by the burner flame. The flame and the gases resulting therefrom rise upwardly and pass through the boiler structure in a serpentine manner, making several passes between the transverse water jackets and the top of the inner shell in order to reach the chimney outlet 24. The passages narrow as the heat is absorbed from the gases so that the full scrubbing action of the passing gases is effected. The gases contract as they give up their heat and require less conducting space as they near the outlet. Should any part of the flue travel space be greater than necessary to contain the reduced volume of the gases, the heat transfer of the remaining gases would be lessened and the efficiency of the boiler at that point is proportionately decreased. Metal in the boiler which is not effectively absorbing heat is wasted material. There is no large chamber near the chimney outlet in the present construction. The chimney outlet 24 extends from the inner shell 19 and is an integral part of the boiler structure.

While the outer shell 18 extends the full height of the boiler in order to include the fire chamber, the inner shell 19 extends upwardly from the top of the fire clay 26 of the fire chamber. A bottom piece 27 closes off water chamber space 28 lying between the two shells 18 and 19. On the front of the boiler structure there is water space 28 which is wider than at the back and other sides of the boiler so that natural and unrestricted flow of the water

on returning to the bottom of the boiler structure is effected. On the rear of the boiler there is a narrow and restricted film of water as indicated at 29 through which little, if any water can circulate, either upwardly or downwardly. The water maintained in this space is merely for the purpose of preventing the burning of the inner and outer shells and is an expansion space, if required. At the top of the boiler structure 15 is a relatively large water expansion space 30 in which all of the water is directed. A domestic hot water coil 31 is located in this high temperature water zone. This water coil has inlet and outlet fittings 32 and 33.

The inner shell 19 comprises two side plates 34 and 35 between which the water-containing flue baffles 20, 21, 22 and 23 extend and which are vertically spaced with respect to each other. These side plates are connected together at the front of the boiler by a front plate 36 and at the rear of the boiler by a rear plate 37. The top of the inner shell 19 is closed by a top plate 38. The lower transverse water baffle 20 is shaped as shown in Fig. 4 and can be made from one piece or from parts welded together. It is open at the ends and extends through openings in the side plates 34 and 35 to the edges of which it is welded in a watertight manner. The transverse baffle 20 is rounded at the rear edge as indicated at 39 and is made from flat stock bent and rolled, and the forward edge of the transverse baffle is made by turning up one end of the plate, as at 39' and overlapping the other end of the plate to provide a notched projection 40 having notches or openings 41 therein. The notches 41 provide an escape for a small stream of flame and gases so as to disturb stratification of the gases as they pass through the main flue travel space about the baffle 20 as at 20*a*. The greater portion of the flame and gases will surround the rounded end 39 of the baffle 20 to start their serpentine passage through the boiler. A small part of the flame will pass through the notches 41 of the baffle 20. The baffle 20 is tilted upwardly and transversely of the boiler from the water starting point.

The flue baffle 21 is formed similar to the baffle 20, but is reversely mounted so that its notches as indicated at 42 will lie at the rear of the boiler to permit some escape of the gases at the location through the baffle 21 and without having to follow the main path forwardly under the baffle 21 and about its end 43 to create a turbulence and disturb the stratification of the gases. The gases on passing about the end 43 of the baffle 21 will pass over the top of the baffle 21 and through space 21*a*, but some will escape through notches 44 in the baffle 22 spaced above the baffle 21. The baffle 21 is tilted upward and transversely of the boiler from the opposite side of the boiler. The baffle 22 is tilted transversely and in the same manner as baffle 20 is tilted. Escape of the gases through the notches 41, 42 and 44 will prevent stratification of the gases within the boiler and will relieve back pressure throughout the boiler. The gases on rounding the point 43 of the baffle 21 will travel rearwardly through flue travel space 21*a* and will turn and move upwardly over rounded portion 45 of the baffle 22 and forwardly over the top thereof and through space 22*a*. The gases will move about rounded end 46 of the transverse water baffle 23 and will move over the top thereof through a narrow top space 23*a* and rearwardly to the chimney outlet 24. A deflecting baffle plate 47 is inclined downwardly from the rear edge of the transverse baffle 23 so as to prevent any escape of gases directly to the chimney outlet 24 from space 22*a* without rounding the rounded end 46 of the transverse water baffle 23. The water baffle 23 is tilted transversely and in the same manner as baffle 21.

The transverse water baffles 21 and 22 are constructed similarly to the transverse water baffle 20 as shown in Fig. 4, but are mounted alternately within shell 19. The flue travel spaces 20*a*, 21*a*, 22*a* and 23*a* make up a serpentine path for the upward and outward travel toward the chimney outlet 24. These spaces are of diminishing size from the fire chamber 25 to the outlet 24 for the purpose above set forth and to avoid pockets and dead spaces that otherwise prevent gas flow over the full extent of the flue travel surfaces. The vertical heights of the spaces are different as will be noted in Fig. 2.

The space 20*a* is of greater height than the height of the upper space 23*a*. Because the baffles are tilted from side to side, as the gases travel through the flue spaces from the front to the rear and from the rear to the front and so on until they reach the chimney outlet, they will also sweep diagonally from side to side while continuing forwardly and backwardly through the flue passages, thus increasing the length and time of travel of the bulk of the gases and effectiveness of the scrubbing action of the gases upon the heat absorbing surfaces in the flue travel spaces.

The transverse baffle 20 has a downwardly curved water deflecting portion 48 for directing the water from the starting point at one side of the boiler into the space within the water baffle 20. This water passes transversely through the baffle 20 and upwardly as the baffle 20 is inclined in this manner, as shown in Fig. 3, and upon reaching the end of the baffle 20 is directed upwardly by an upwardly curved deflecting portion 52 into the water space at the opposite side of the boiler. The water travel then is directed upwardly until it reaches a downwardly curved deflecting portion 53 of the water baffle 21. Thereafter, the water passes through the transverse baffle 21 which is inclined in the reverse direction from the baffle 20, as shown in Fig. 3. On the opposite end of the transverse baffle 21 is an upwardly curved deflecting portion 54 which causes the water to move upwardly through the water space at that side of the boiler. This water will upon moving upwardly be again deflected by a downwardly curved deflecting portion 55 of the transverse baffle 22 which is inclined similar to the lower baffle 20 so that the water will pass through the baffle 22 and upwardly to the opposite side of the boiler where it will again be directed upwardly by an upwardly curved deflecting portion 56. The water then moves upwardly again at that side of the boiler and will engage a deflecting portion 57 of a transverse water baffle 23 which is inclined similar to the transverse baffle 21. The water then passes through this transverse baffle 23 until it reaches the opposite end thereof where it will be deflected again upwardly by a deflecting portion 58 thereof and into the water expansion space 30 which contains the domestic hot water coil 31. As the water in this space 30 is chilled by the use of the domestic hot water coil and passes forwardly over the top plate 38 of the inner shell structure 19, the cooled water will then pass downwardly as shown by arrows in Fig. 6 into the space 28 at the front of the boiler. This space 28 is large and unrestricted, and accordingly the bulk of the cooled water will fall in this direction and pass by an aquastat 28*a* which is an electrical control to start the burner 16 to reheat the water for recirculation. There will still remain some water in the small narrow and restricted space 29 in order to prevent burning of the shell plates.

The front plate 37 has a vertically extending side extension 61 which extends from the top edge of the front plate 37 down to the elevation of the curved deflecting portion 48 of the transverse baffle 20, leaving a space 62 thereunder through which the water can be directed toward the deflecting portion 48 to provide for recirculation of the chilled water and prevents the water from mixing with water in other spaces at that side of the boiler.

At the opposite side of the front plate 37 there is a vertically extending extension 63 which extends downwardly to a point near the bottom plate 27 of the boiler structure. This extension 63, Fig. 6, will prohibit any passage of water from the unrestricted space 28 at the front of the boiler toward the opposite side of the boiler. A small space 64 is left under the extension 63 to allow

for flushing all of the water from the boiler for draining purposes.

The rear plate 36 has side extensions 65 and 66 which extend downwardly to distances slightly above the bottom 27 of the boiler structure so as to allow for the passage and circulation of water through the narrow restricted space 29 at the rear of the boiler. These spaces under the extensions 65 and 66 are indicated at 67 and 68 respectively and are sufficient to allow water to pass through the boiler structure from within the boiler and to allow water to be drained from the boiler through a drain fitting 70. Cooled water from the expansion space 30 is prevented from passing down the sides of the boiler by the several deflecting portions 57, 58, and so forth, Fig. 3, on the several water baffles. The return water from the radiators returns to the boiler structure 15 through a return inlet fitting 71 at the rear of the boiler, Fig. 6, and at the starting side of the boiler for recirculation and heating within the boiler. An outlet fitting 72 is connected to top plate 73 of the outer shell. A safety valve or gauge fitting 74 is also connected to the top plate 73.

At the top of the outer shell is insulation 75 and at the rear of the outer shell is vertically-extending insulation 76. Similar insulation is provided on the opposite sides of the outer shell, as indicated at 77 and 78, Fig. 3. At the front of the boiler there is a large space 79 which houses the burner 16. The casing 17 includes a top cover plate 80 having ventilating openings 81.

It should now be apparent that there has been provided a tubeless recirculating water boiler wherein the water in passing through the boiler is caused to circulate in but one direction and to be returned to a single starting point. The water, starting from one side of the boiler, moves in and out through the water-containing flue baffles to and from the other side and upwardly to the expansion space in the top of the boiler and thereafter is returned by way of a free unrestricted passage at one end of the boiler to the starting point at the one side of the boiler. In order to confine this passage end extension baffles are provided between the inner and outer shells at the unrestricted end of the boiler, the baffle extension at the one side extending downwardly and allowing sufficient space for the water to flow freely thereunder to the starting point, and the baffle at the water restricted end of the boiler extending downwardly to allow only a slight space merely for the purpose of draining and cleaning the boiler. At the opposite end of the boiler, there is a small restricted space between the inner and outer shells merely for the purpose of containing water and preventing the burning of the boiler walls, and it should be understood that there is little, if any, circulation of water through this restricted space.

It will further be apparent that the baffles are arranged so as to obtain a serpentine flow of gases passing upwardly therethrough and that the baffles have openings for permitting the by-passing of the gases between the passages to disturb any stratification of the gases therein and to relieve any back pressure within the confines of the boiler's flue travel. The baffles are alternately spaced in opposite directions from side to side so that the water on traversing these baffles will be elevated slightly on passing through each baffle and wherein the flue gases will be caused to pass diagonally into the flue passages from one corner to the other and to thereby lengthen their travel and increase the scrubbing effect on the heating surfaces.

While various changes may be made in the detail construction, it shall be understood that such changes shall be within the spirit and scope of the present invention, as defined by the appended claims.

What is claimed is:

1. A boiler construction comprising an outer shell, an inner shell disposed within the outer shell, said inner shell having end walls and one of the operative end walls being sufficiently spaced from the outer shell to provide for an unrestricted water space for free flow of water downwardly therebetween the other of said end walls being spaced from the outer shell to provide a restricted water passage, said inner shell having side walls spaced from the side walls of the outer shell to provide side water spaces for an upward flow of water therebetween, water-containing flue baffles extending transversely of the border between the sides of the inner shell for lateral passage of water therebetween, and baffle extensions extending vertically between the sides of the inner shell and the outer shell adjacent the free unrestricted space at the end of the boiler to confine the water returning through the unrestricted space and to direct water to the bottom of the boiler and away from the sides of the inner shell and thereby to prohibit the mixing of the downwardly flowing water with the upward flow of water, said baffle extensions for the unrestricted water space running to a point spaced from the bottom of the unrestricted water space to provide openings through which the return water may pass at the bottom of the boiler to the side water spaces, and other baffle extensions extending vertically between the sides of the inner shell and the sides of the outer shell adjacent the restricted water passage extending downwardly from the top of the inner shell to locations near to the bottom of the boiler to provide openings through which any water passing to or from the restricted space may pass from or to the side water spaces whereby a small flow of water may be retained in the restricted water passage to prevent overheating of the boiler at that end thereof.

2. A boiler construction comprising an outer shell having front, side and back walls, an inner shell fitted within the outer shell and spaced from the walls thereof, said inner shell having a front wall spaced from the front wall of the outer shell to provide an unrestricted water space for the free flow of water returning from the top of the boiler to the bottom thereof, a water expansion chamber above said inner shell, water-containing flue baffles extending between the sides of the inner shell and communicating with the side water spaces between the sides of the inner shell and the side walls of the outer shell, said water-containing baffles lying one above the other and vertically spaced from each other, each of said water flue baffles having deflecting portions for directing water inwardly into the baffle and for directing water outwardly and upwardly from the baffle, said deflecting portions extending into the side water spaces between the sides of the inner shell and of the outer shell whereby to cause a serpentine flow of water through the inner shell, and baffle extensions from the end wall of the inner shell and aligned with the ends of the deflecting portions to prevent the flow of return water from the water expansion chamber at the top of the boiler from entering directly the side water spaces between the sides of the inner shell and the side walls of the outer shell, said vertical baffle extensions running to a point spaced from the bottom of the unrestricted water space to provide openings through which the return water may pass at the bottom of the boiler to the side water spaces.

3. A boiler construction, as defined in claim 2, and the wall of the inner shell opposite from the unrestricted end of the boiler being spaced from the opposite end of the boiler providing a restricted flow of water therebetween, baffle extensions extending between the sides of the inner shell and the side walls of the boiler adjacent the restricted space and extending downwardly to a location close to the bottom of the boiler whereby to restrict the flow of water into and between said restricted space and a return flow inlet pipe disposed at the one side of the boiler for return water to the entering space for the water returning from the top of the boiler downwardly through the unrestricted space.

4. A boiler construction comprising an outer shell, an

inner shell disposed within the outer shell and closed at the top to provide a water expansion space thereover, said inner shell having one of its end walls sufficiently spaced from the outer shell and having smooth surfaces thereon to provide for an unrestricted water space for full downward flow of return water within the boiler, said inner shell having side walls spaced from the sides of the outer shell to provide side water spaces for the upward flow of water therebetween, a plurality of water containing flue baffles extending transversely between the side walls of the inner shell for the flow of water between the side water spaces and through the interior of the boiler, said hollow water containing flue baffles being vertically spaced from one another in heights diminishing in amount from between the lower baffles and the baffles thereabove and between the upper baffles and the top of the inner shell, a chimney opening extending from the inner shell adjacent to the minimum height spacing between the upper baffle and the top of the inner shell, the sides of said baffles being alternately spaced from the opposite ends of the inner shell whereby to provide for a serpentine and diminishing cross section area flow of the gases upwardly through the inner shell to the chimney opening, and said water containing baffles being spaced slightly from the end of the inner shell at the sides thereof opposite from the sides permitting the main flow of the gases into the spaces between the baffles and notched baffle extensions extending between these sides to permit a restricted flow of gases between the gas traversing spaces whereby to prevent stratification of the gases traversing these spaces.

5. A boiler construction comprising an outer shell, an inner shell disposed within the outer shell and closed at the top to provide a water expansion space thereover, said inner shell having one of its end walls sufficiently spaced from the outer shell and having smooth surfaces thereon to provide for an unrestricted water space for full downward flow of return water within the boiler, said

inner shell having side walls spaced from the sides of the outer shell to provide side water spaces for the upward flow of water therebetween, a plurality of water containing flue baffles extending transversely between the side walls of the inner shell for the flow of water between the side water spaces and through the interior of the boiler, said hollow water-containing flue baffles being vertically spaced from one another in heights diminishing in amount from between the lower baffles and the baffles thereabove and between the upper baffles and the top of the inner shell, a chimney opening extending from the inner shell adjacent to the minimum height spacing between the upper baffle and the top of the inner shell, the sides of said baffles being alternately spaced from the opposite ends of the inner shell whereby to provide for a serpentine and diminishing cross section area flow of the gases upwardly through the inner shell to the chimney opening, said baffles being tilted from one side of the inner wall to the other side of the inner wall and on each side of said inner wall said baffles are alternately spaced different distances from one another whereby to cause the gases to pass diagonally over the water-containing baffles in passing from side to side and to increase the length and time of travel of the bulk of the gases and the effectiveness of their scrubbing action.

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