July 22, 1952 H. D. COULBOURN 2,604,082

BOILER

Filed May 18, 1950 2 SHEETS--SHEET 1

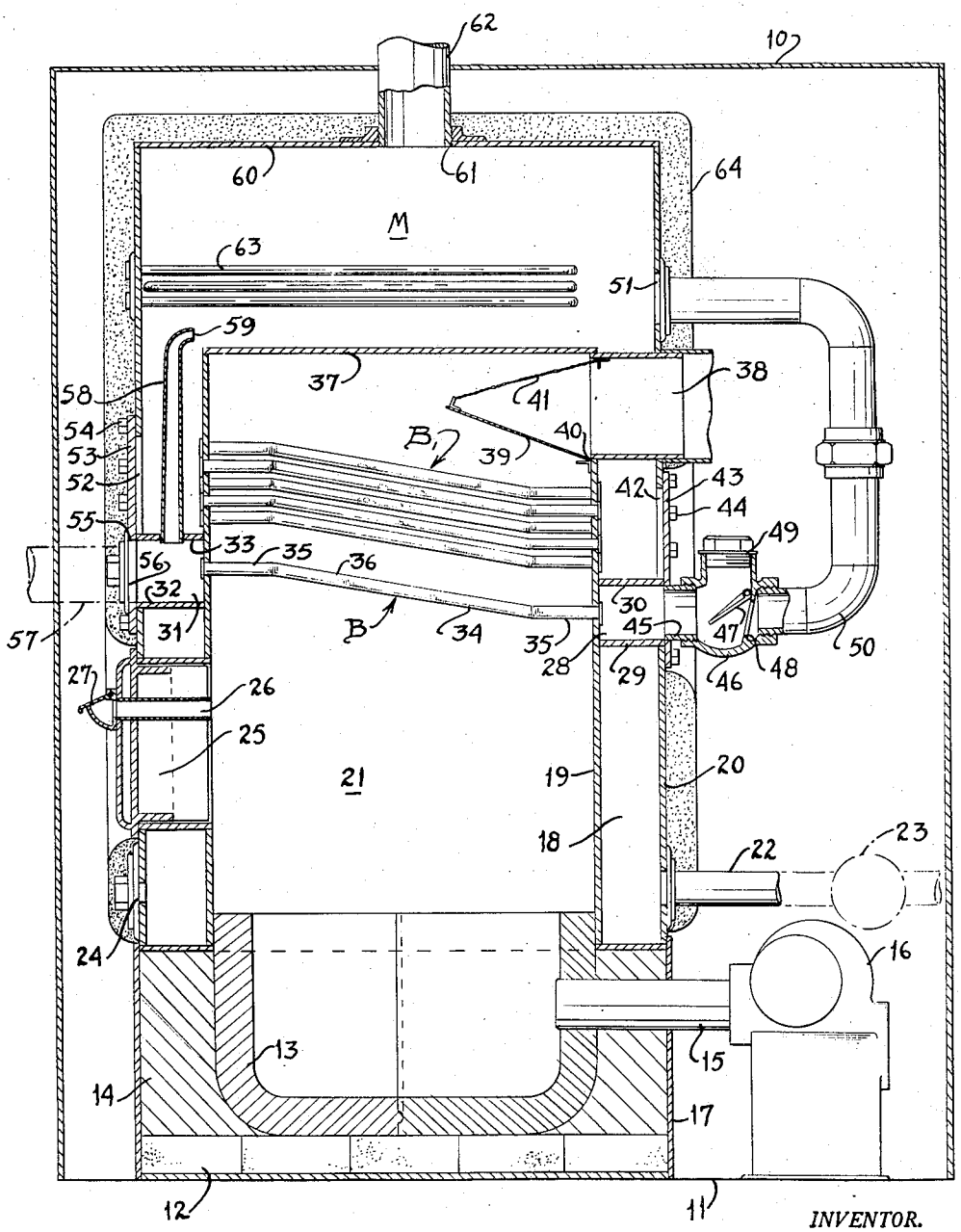


FIG. 1

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BOILER

Filed May 18, 1950 2 SHEETS—SHEET 2

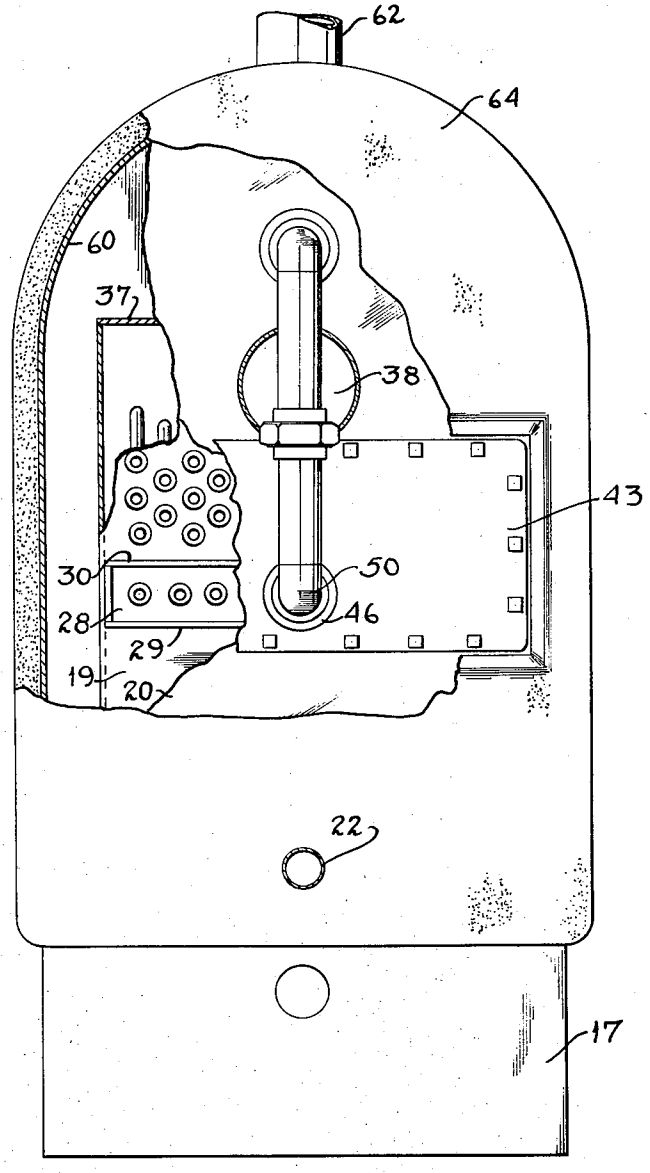


FIG. 2

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2,604,082

BOILER

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5 Claims. (Cl. 122—177)

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The present invention relates to boilers and is concerned primarily with a boiler that is designed for use with either hot-water or steam-heating systems and which is peculiarly effective for quickly getting hot water into the hot-water heating system or the flash generation of steam for a steam-heating system.

At the present time a hot-water boiler includes a large mass of water which must be heated in order to get hot water moving to the hot-water heating system. Likewise, a steam boiler includes a large mass of water which must be heated before steam will be generated. It has been recognized that this large mass of water must be heated as quickly as possible in order to render the heating systems effective. But, most of the efforts directed to the end of quickly heating a large mass of water are predicated on the theory of retarding or holding back the flow of flue gases through the boiler. While such methods may result in advantages to a certain degree, it is believed that they are in no way comparable to the arrangement provided by the present invention.

The present invention is founded on the belief that a large mass of water may be more quickly heated if it is, in effect, broken up into a number of smaller masses and these smaller masses, one at a time, subjected to the most intense heat of the boiler. When a small amount of water is subject to such intense heat it is quickly heated and due to the thermal action starts circulating with the result that the entire mass is circulated in the boiler so that the smaller portions thereof are successively subjected to this intense heat. With this arrangement hot water is quickly supplied to the heating system or steam is quickly generated and supplied to a steam-heating system.

An important object of the invention is to provide a boiler which operates on the principles above noted. In attaining this object the boiler is provided with two banks of tubes. One of these banks includes a comparatively small number of tubes and is located at the zone of greatest heat. The other bank includes a larger number of tubes and is positioned above the first bank where it receives heat from the gases of combustion after the latter have passed the first bank of tubes. From the foregoing it is apparent that the first bank of tubes contains a relatively small amount of water which is subjected to the most intense heat of the boiler.

Another highly important object of the invention is to provide, in a boiler of the character indicated, a mixing chamber which is preferably

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located in the upper portion of the boiler. One end of this mixing chamber is in direct communication with the upper or discharge end of the first bank of tubes. That is, it receives hot water which is literally injected thereinto from this bank of tubes which contains the small mass of water that is subjected to the intense heat of the combustion chamber. The other end of the mixing chamber communicates both with the entrance end of the second bank of tubes and also, through the medium of a by-pass pipe, with the entrance end of the first bank of tubes. The second bank of tubes also communicates with the mixing chamber at its discharge end. Thus, as water is started in circulation due to the flash heating of the small volume of water in the bank of tubes that is subject to the intense heat some of the water is delivered from the mixing chamber back to the first bank and some to the second bank. Moreover, water is delivered from the discharge end of both banks of tubes to the mixing chamber.

Another highly important object of the invention is to provide, in a boiler of the type indicated, a one-way check valve which is positioned in said by-pass pipe where the latter is connected to the manifold at the end of said first bank of tubes. This valve is of extreme importance because it prevents any return of water from the bank of tubes containing the small volume of water and insures that all the water moves out through the discharge end of this bank and is delivered either to the heating system or to the proper end of the mixing chamber.

Another highly important object is to provide, in a boiler of the type noted, a water leg which preferably extends entirely around the boiler and which receives at its lower end either the water that is returned from a hot-water heating system or steam condensate from a steam-heating system. The upper portion of this water leg communicates with the upper bank of tubes and also with the mixing chamber.

Yet, another object of the invention is to provide, in a boiler of the character aforesaid, a manifold which communicates with the discharge end of the lower bank of tubes and which manifold is provided with an outlet which may either be closed when the boiler is used with a steam-heating system or placed in communication with a hot-water heating system. Extending upwardly from this manifold is a jet member which discharges into the mixing chamber. When the outlet for the manifold is closed as when the boiler is used for a steam-heating system, this jet member receives the water that is flash-heated from

the lower bank of tubes and ejects it into the mixing chamber with a jet-like action.

Still another object of the invention is to provide, in a boiler of the type indicated, a mixing chamber which includes an outlet at the top thereof. This outlet is closed when the boiler is used with a hot-water heating system but is placed in communication with the steam-heating system when the boiler is used with such a steam system. Thus, it is through this outlet that the steam which is generated by the boiler is delivered to the steam-heating system.

Yet, another highly important object of the invention is to provide, in a boiler of the type indicated, a mixing chamber in which is positioned the tubes of a domestic hot-water heater. The hot water which is required for domestic household purposes is heated in these tubes by the boiler and the arrangement of the boiler heretofore described is particularly adapted to the heating of this water even when the hot-water heating system for the premises has its circulation stopped.

Various other more detailed objects and advantages of the invention such as arise in connection with carrying out the above noted ideas in a practical embodiment will, in part become apparent, and in part be hereinafter stated as the description of the invention proceeds.

The invention, therefore, comprises a boiler that is adapted for use with either a hot-water heating system or a steam-heating system and which boiler is characterized by the presence of a lower bank of tubes small in number, located in the zone of most intense heat in the boiler, and an upper bank of tubes greater in number which are subjected to the effect of the gases of combustion after they pass the lower bank together with a mixing chamber, a water leg, a by-pass pipe, including a one-way check valve, and outlets for the discharge end of the lower bank of tubes and mixing chamber respectively, and which outlets may be optionally closed depending on the type of heating system with which the boiler is used.

The water leg receives the water that is returned from a hot-water heating system or the steam condensate of a steam-heating system and provides for the circulation of such water through the two banks of tubes in such a manner as to provide for the flash or instantaneous heating thereof.

For a full and more complete understanding of the invention, reference may be had to the following description and accompanying drawings wherein:

Figure 1 is a view taken as a vertical section through a boiler that is designed in accordance with the precepts of this invention; and

Figure 2 is a view in front elevation with parts broken away.

Referring now to the drawings wherein like reference characters denote corresponding parts and first more particularly to Figure 1, the boiler of this invention is shown as being enclosed within an outer casing designated 10. This casing preferably rests on a floor such as represented by the line at 11. Located at an appropriate point on the floor 11 within the casing 10 is a layer of bricks 12. These bricks may be of any type commonly employed in furnace constructions.

Supported on the bricks 12 is a fire pot made up of an inner lining 13 of appropriate refractory material and an outer wall structure 14 which also is of an appropriate refractory. Extending through the outer wall 14 and lining 13 is a conduit 15 which communicates at its inner end with the fire pot and at its outer end with an oil burner represented diagrammatically at 16. In its preferred embodiment the boiler of this invention is intended to be heated by an oil burner as illustrated in the drawings. However, it is to be understood that the invention is not to be limited in this respect. Gas, coal, or other fuel may be employed as the heating means without departing from the spirit of the invention.

Enclosing the outer fire pot wall 14 and bricks 12 is a metallic jacket 17 which is also formed with an opening to accommodate the conduit 15.

Supported on the upper surface of the wall structure 14 is the structure which provides a water leg 18. This water leg extends entirely around the boiler and is defined by an inner wall 19 and an outer wall 20. The inner wall 19 encloses a chamber 21 through which the gases of combustion from the fire pot pass.

Communicating with the water leg 18 at the lower end thereof is a pipe 22 which is intended to be connected to the return side of a heating system with which the boiler is used. Thus, if this heating system is a hot-water system the pipe 22 is the return side of such a system. When the boiler is used with the steam-heating system the pipe 22 receives the steam condensate from such a system and delivers it to the water leg 18.

All hot-water heating systems ordinarily include a pump for circulating water therethrough and such a pump is indicated diagrammatically at 23.

Clean-out plugs for cleaning out the water leg 18 are shown at 24. These plugs are ordinarily closed during the normal use of the boiler.

In order to provide access to the boiler chamber 21 a door represented at 25 is included in the construction of the walls 19 and 20 that define the water leg. This door is also normally closed during the operation of the boiler. A tube 26 extends through the door 25 and its outer end is normally closed by a hingedly mounted puff gate 27. If pressures within the chamber 21 become excessive this gate 27 will open to relieve them in a well known manner.

Mounted between the walls 19 and 20 but not in communication with the water leg 18 is an entrance manifold 28. This manifold is defined by a lower cross plate 29 and an upper cross plate 30. Also mounted between the walls 19 and 20 and not communicating directly with the water leg 18 is a discharge manifold 31 that is defined by a lower plate 32 and an upper plate 33. Extending between the manifolds 28 and 31 is a lower bank of tubes designated B. The bank B comprises a single layer of individual tubes 34 with the lower end of each tube communicating with the manifold 28 and the upper end of each tube with the manifold 31. It will be noted that each tube 34 has straight or horizontal end portions 35 and an inclined intermediate main body portion 36. This construction of the tubes actually functions as an expansion joint which accommodates contraction and expansion due to thermal changes.

Positioned above the bank B of tubes is a second bank B1. The bank B1 includes a plurality of tubes of the same general character as the tubes 34, but there are several layers of these tubes and they are of greater number. The first

or lower layer of tubes in the bank B1 are staggered relative to the tubes in the bank B and tubes in the layers above the lowermost layer are also staggered. Thus the gases of combustion are caused to travel in a tortuous path which is most efficient to their giving up heat. The lower ends of the tubes of the bank B1 communicate with the water leg 18 at one side which functions as a header and the upper ends of the tubes of the bank B1 communicate with the water leg 18 at the opposite side.

The chamber 21 is closed at the top by a top wall 37 which also constitutes the bottom of a mixing chamber designated M. The flue outlet is shown at 38 as extending through the walls 19 and 20 immediately beneath the top wall 37, and extending inwardly into the chamber 21 from the wall 19 at the inner end of the flue outlet 38 is a baffle plate or diffuser 39 which is hingedly mounted along its lower edge as indicated at 40 and normally supported in effective position by chains shown at 41.

The outer wall 20 is cut away opposite to the manifold 28 and the lower ends of the bank of tubes B1 to form an opening 42 that is normally closed by a header plate 43. The latter is normally secured in position by the screw bolts shown at 44. Carried by the header plate 43 is a short tube 45, the inner end of which communicates with the manifold 28. Mounted on the outer end of the tube 45 is a valve casing 46 which houses a one-way check valve 47 that is adapted to cooperate with a valve seat 48 that is formed as a part of the casing 46. A plug shown at 49 is mounted in the casing 46 and may be removed to provide access to the valve 47 when occasion demands.

Connected to the valve casing 46 is one end of a by-pass pipe 50. The other end of the by-pass pipe 50 communicates with the mixing chamber M and is represented at 51. It is evident that hot water may pass from the mixing chamber M through the by-pass pipe 50 and past the valve 47 to the manifold 28 and thence to the lower bank of tubes B; but, the one-way check valve 47 prevents return movement of the water in the opposite direction.

The outer wall 20 is also cut away opposite to the manifold 31 and the upper ends of the tubes in the bank B1 to provide an opening 52 which is normally closed by a header plate 53. The latter is normally secured in closed position by screw bolts shown at 54. This header plate 53 is formed with an outlet opening 55 that communicates with the manifold 31. This opening 55 is closed by a plug shown at 56 when the boiler is used with a steam-heating system but communicates with the conduit shown in broken lines and designated 57 when the boiler is used with a hot-water heating system. The pipe 57 is effective to deliver water that is heated in the tubes in the bank B directly to such a hot-water heating system.

Extending upwardly from the plate 33 in which it is mounted is a jet tube 58. This tube 58 extends upwardly through the water jacket 18 and has a discharge mouth at 59 that opens into the mixing chamber M.

The mixing chamber M is closed at the top by a top wall 60 that is formed with a steam outlet 61. A conduit 62 is connected to this outlet 61 in a well known manner and communicates with the steam-heating system when the boiler is used with such a system. When the boiler is used with a hot-water heating system the outlet 61 is closed by a plug.

Tubes for a domestic hot-water heater are shown at 63. These tubes are intended to receive the water that is to be heated for domestic use by the boiler and this water is not a part of either the hot-water heating system or the steam-heating system.

Except for the places where the clean-out plug 24, access door 25, and header plates 43 and 53 are located, the outer wall 20 is covered by an appropriate heat insulating material such as represented at 64 and which may be of a magnesia composition.

Operation with a hot-water heating system

When the boiler above described is used in conjunction with a hot-water heating system the steam outlet at 61 is closed by a plug and the plug 56 removed with the conduit 57 connecting the manifold 31 to the delivery side of such a hot-water system. The conduit 22 is connected to the return side of the hot-water heating system which it will be recalled will include a circulating pump 23.

The oil burner 16 or other heating means is employed to deliver hot gases of combustion to the chamber 21. The lower bank of tubes B is located at the zone of the most intense heat and this bank includes only a comparatively small proportion of the water which is contained within the boiler. This water is quickly heated and due to the tendency of the hot water to move upwardly it will so move through the tubes of the bank B to the manifold 31. As a matter of fact, any movement in the opposite direction is positively prevented by the check valve 47.

From the manifold 31 some of the hot water will pass up through the jet tube 58 to start the water moving in the mixing chamber M. The remainder of the hot water in the manifold 31 is delivered by the conduit 57 to the hot-water heating system. Thus, it is apparent that almost immediately some of the hot water is delivered to the hot-water heating system.

Water from the mixing chamber is conducted down through the water leg 18 to the entrance side of the tubes of the bank B1 and other water is conducted by the by-pass pipe 50 back to the manifold 28. Thus, the water in the boiler is circulated through the tubes in the banks B and B1, mixing chamber M, and by-pass pipe 50. Moreover, the pump P causes the water to circulate through the heating system so that after it has given up its heat the cooled water will be returned to the water leg 18 by the return pipe 22.

Should the thermostat control discontinue operation of the pump P, due to the fact that the premises being heaed having reached a predetermined temperature, water will continue to circulate through the boiler itself so that domestic hot water in the tube 63 will be heated as its use is required.

Operation with a steam-heating system

When the boiler is used with a steam-heating system the outlet 55 in the mainifold 31 is closed by the plug 56 and the conduit 62 connected to the steam outlet 61 and to the delivery side of the steam-heating system. The pipe 22 will still serve to return steam condensate from the steam-heating system.

As above explained there is only a comparatively small mass of water in the tubes of the bank B and as these tubes are located at the zone of most intense heat the water is heated almost instantaneously. This heated water moves upwardly through the jet tube 58 and is

discharged at the mouth 59 in the form of a jet. This starts the water in the mixing chamber M into circulation. Some of the water is delivered back to the lower bank B through the by-pass 50 and manifold 26 while the remainder of the water is delivered by the water leg 18 to the entrance side of the tubes in the bank B1.

Thus, the water is started into circulation almost instantaneously and is quickly heated by the gases of combustion in the chamber 21 to the point where steam is generated. This steam is delivered by the conduit 62 to the steam-heating system. Obviously the water for domestic purposes is also heated by the tubes 63 located in the mixing chamber M.

While preferred specific embodiments of the invention are hereinbefore set forth, it is to be clearly understood that the invention is not to be limited to the exact arrangements, mechanisms, and devices illustrated and described because various modifications of these details may be provided in putting the invention into practice within the purview of the appended claims.

What is claimed is:

1. In a boiler of the character described, a side wall structure including a water leg and enclosing a combustion chamber, a water mixing chamber above said combustion chamber and communicating with said water leg, a return inlet at the lower portion of said water leg for returning water from a heating system to said boiler, a first bank of tubes in said combustion chamber at the zone of most intense heat and having an inlet side and a discharge side, a second bank of tubes positioned in said combustion chamber above said first band with the opposite ends of the tubes therein communicating with said water leg, a by-pass connecting said mixing chamber to the inlet side of said first bank of tubes, a manifold included in said wall structure and communicating with the discharge side of said first bank of tubes, said manifold having an outlet that is adapted to be connected to a hot-water heating system, and a jet tube connected to the upper side of said manifold and extending upwardly through said water leg to said mixing chamber.

2. In a boiler of the character described, a wall structure including a water leg and enclosing a combustion chamber, means for introducing gases of combustion into said combustion chamber, an inlet for introducing water returned from a heating system into the lower portion of said water leg, a water mixing chamber above said combustion chamber and communicating with said water leg, an entrance manifold in said wall structure, a discharge manifold in said wall structure, a first bank of tubes extending across said combustion chamber with the ends of the tubes communicating with said manifolds, a second bank of tubes above said first bank with the opposite ends of the tubes communicating with said water leg, a by-pass extending from said mixing chamber to said entrance manifold, an outlet for said discharge manifold adapted to be connected with a hot-water heating system, and means for establishing communication between said discharge manifold and said mixing chamber.

3. In a boiler of the character described, a wall structure including a water leg and enclosing a combustion chamber, means for introducing gases of combustion into said combustion chamber, an inlet for introducing water returned from a heating system into the lower portion of said water leg, a water mixing chamber above said combustion chamber and communicating with said water leg, an entrance manifold in said wall structure, a discharge manifold in said wall structure, a first bank of tubes extending across said combustion chamber with the ends of the tubes communicating with said manifolds, a second bank of tubes above said first bank with the opposite ends of the tubes communicating with said water leg, a by-pass extending from said mixing chamber to said entrance manifold, a one-way check valve in said by-pass adjacent to said entrance manifold, an outlet for said discharge manifold adapted to be connected with a hot-water heating system, and means for establishing communication between said discharge manifold and said mixing chamber, there being a greater number of tubes in said second bank than in said first bank.

4. In a boiler of the character described, a wall structure including a water leg and enclosing a combustion chamber, means for introducing gases of combustion into said combustion chamber, an inlet for introducing water returned from a heating system into the lower portion of said water leg, a water mixing chamber above said combustion chamber and communicating with said water leg, and entrance manifold in said wall structure, a discharge manifold in said wall structure, a first bank of tubes extending across said combustion chamber with the ends of the tubes communicating with said manifolds, a second bank of tubes above said first bank with the opposite ends of the tubes communicating with said water leg, a one-way check valve in said by-pass adjacent to said entrance manifold, an outlet for said discharge manifold adapted to be connected with a hot-water heating system, and a jet tube positioned in said water leg and having its lower end connected to the upper side of said discharge manifold with its upper end opening into said water mixing chamber, there being a greater number of tubes in said second bank than in said first bank.

5. In a boiler of the character described, an inner side wall structure and an inner top wall which together enclose a combustion chamber, an outer side wall structure spaced from said inner side wall and cooperating therewith to define a water leg, an outer top wall spaced above said inner top wall and cooperating therewith to define a water mixing chamber, a water return conduit connected to the lower portion of said outer side wall, an entrance manifold positioned between said inner and outer side walls, a discharge manifold positioned between said inner and outer side walls, said discharge manifold being at a higher level than said entrance manifold, a first bank of tubes extending across said combustion chamber with the opposite ends of the tubes communicating with said manifolds, a second bank of tubes extending across said combustion chamber above said first bank with the opposite ends of the tubes therein communicating with said water leg, a by-pass communicating between the lower portion of said water mixing chamber and said entrance manifold, a jet tube connected to the upper side of said discharge manifold and extending upwardly between said inner and outer side walls to said water mixing chamber, and an outlet for said discharge manifold adapted to be connected to a hot-water heating system.

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