HOT WATER BOILER FOR CENTRAL HEATING SYSTEMS

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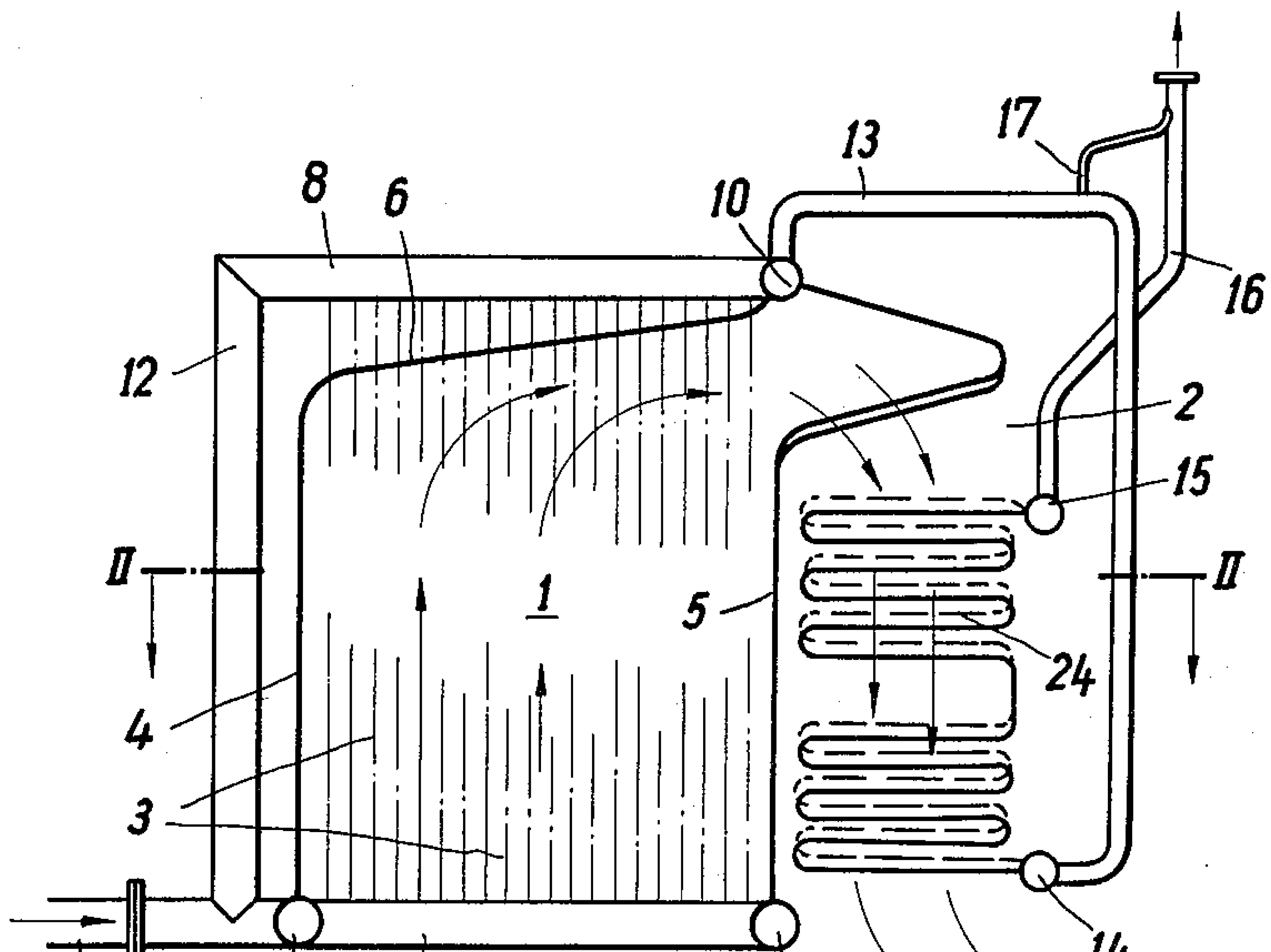

Fig. 1

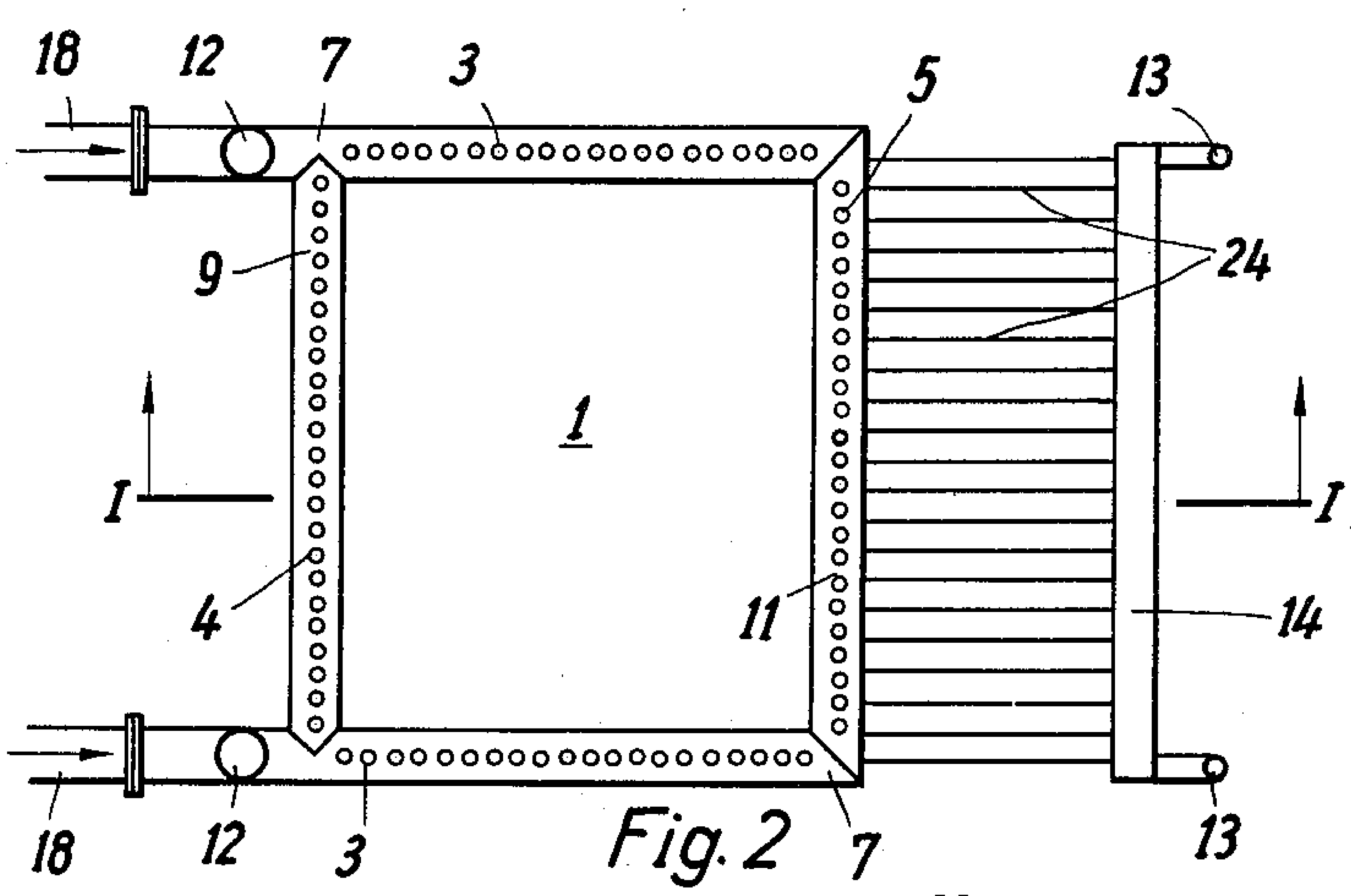

Fig. 2

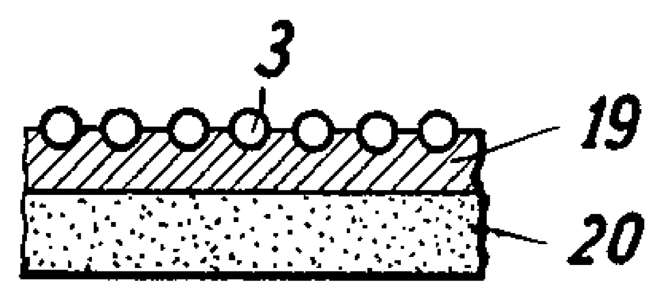

Fig. 3

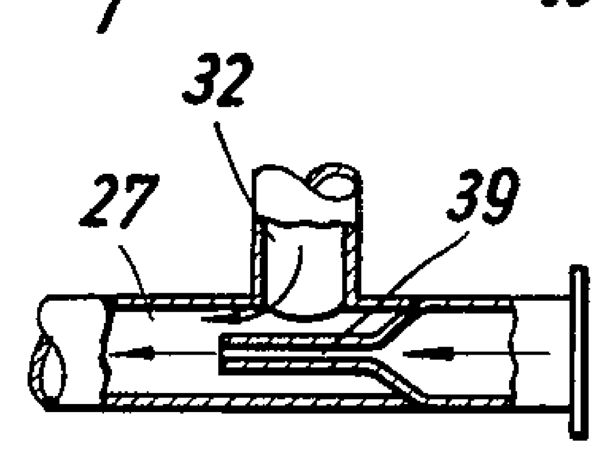

Fig. 6

Inventor:
HEINRICH VORKAUF
by Walter S. Bleston
ATTORNEY

HOT WATER BOILER FOR CENTRAL HEATING SYSTEMS

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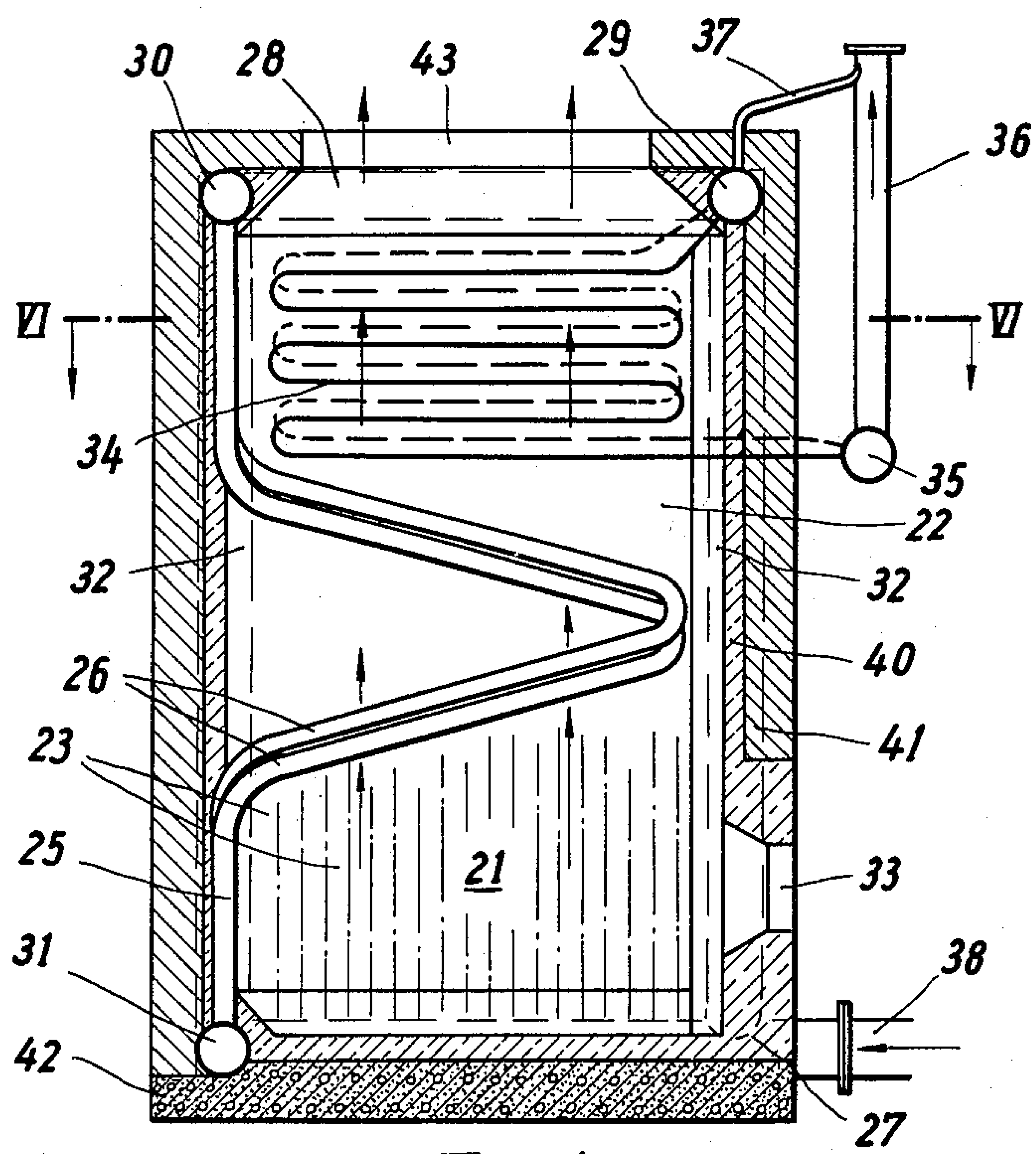

Fig. 4

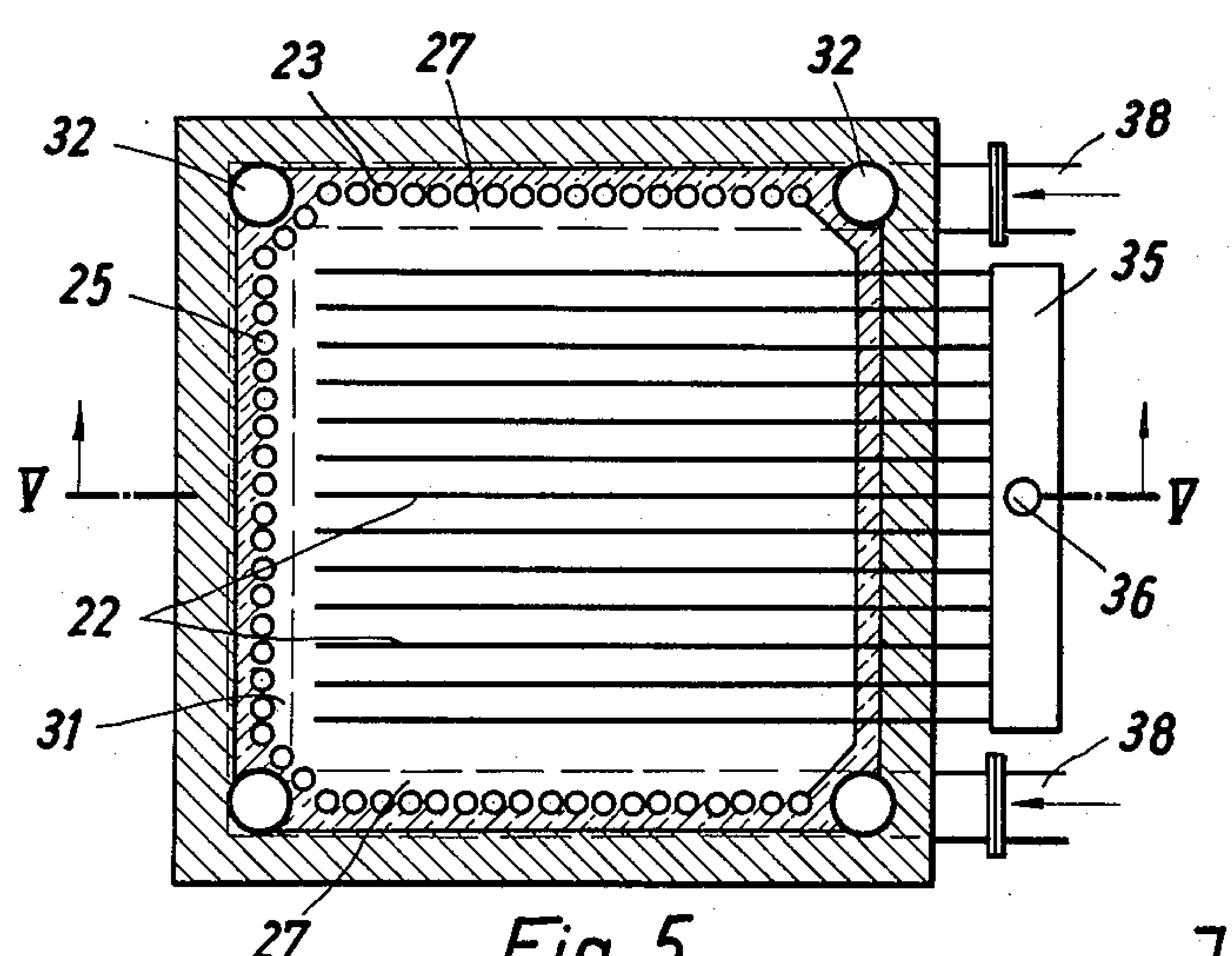

Fig. 5

Inventor:
HEINRICH VORKAUF
by Walter S. Bleston
ATTORNEY

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HOT WATER BOILER FOR CENTRAL HEATING SYSTEMS

Heinrich Vorkauf, Davoser Strasse 2b, Berlin-Schmargendorf, Germany

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The invention relates to hot water boilers for central heating systems with one heating surface part of the boiler exposed to radiation and another part exposed to convection of the combustion gases.

Conventionally, in such boilers the water returning from the heating system is forced to pass through a convection heating surface in which the cooled water is preheated, and then conducted to a radiation heating surface in which the water is brought up to the desired discharge temperature.

It is well known that the presence of sulfur in the combustion gases of a furnace raises the dew point of the gases. The dew point limits the temperature to which the combustion gases can be cooled and thus limits the efficiency of the boiler. Furthermore sulfur causes corrosions in the cooler parts of the boiler plant. In consequence, a feeding of the cooled return water from the heating system into the convection heating surface can have for a result that the combustion gases which per se are there already cooled, become cooled below the dew point. Corrosion will then occur in the convection heating surface particularly in places where the flow velocity of the combustion gases is nil or only low, that means, in dead corners or where dust has been deposited.

It is the primary object of this invention to eliminate or to reduce the danger of cooling the combustion gases below their dew point and of the occurrence of corrosion.

With these and other objects in view, the invention proposes, in hot water boilers of the mentioned type, to feed the water returning from the central heating system first into distributors of the radiation heating surface, then to mix, in collectors located on top of the boiler, the water heated in that heating surface and, finally, to conduct the water from the collectors to the convection heating surface. In the radiation heating surface the gas temperatures are essentially higher than in the convection heating surface so that the cooled return water can cause less easily, or not at all, a condensation of sulfur acid at the outer walls of the tubes. The water heated in the radiation heating surface can, then, be conducted to the convection heating surfaces without endangering them, inasmuch as the combustion gases will not be cooled down so far that one had to be afraid of the combustion gas temperature falling below the dew point.

Furthermore, there do not exist in the radiation heating surface any dead corners in which the combustion gases are stagnant and which, as stated above, particularly favor the creation of corrosions, since the radiation heating surface generally consists merely of a row of tubes located at the walls and as the heating by the flame due to radiation spreads better onto all points of the radiation heating surface than where the heating takes place by convection.

It is another object of the invention further to increase the temperature of the return water by connecting the collectors located on top of the radiation heating surface with the distributors located at the bottom of the latter by non-heated by-pass tubes. Preferably the return water will be supplied to each distributor at its one end and the by-pass tube located at that end shall be vertical with respect to the distributor. Thereby a better mixture is obtained of the cold water coming from the central heating system with the water which flows back through the bypass tubes and which is already heated, inasmuch as the inflowing return water exercises a suction effect on the by-pass tubes. This suction effect can still be increased by a suction nozzle, a reduced cross-section or other suitable means. Preferably the tubes of the radiation heating surface are arranged closely to one another. Thereby only the heated side is exposed to the acidiferous gases whereas the nonheated side of the tubes is so covered by refractory or corrosion resistant materials that the gases cannot contact the walls.

Further objects and details of the invention will be apparent from the description given hereinafter and the accompanying drawing illustrating two embodiments thereof by way of example. In the drawing:

FIG. 1 shows a boiler of the invention in fragmentary side-elevational section on the line I—I of FIG. 2;

FIG. 2 illustrates the boiler in section on the line II—II of FIG. 1;

FIG. 3 shows a detail of the boiler of FIG. 1 in section;

FIG. 4 shows another embodiment of a boiler of the invention in elevational section on the line V—V of FIG. 5;

FIG. 5 is a plan section on the line VI—VI of FIG. 4; and

FIG. 6 is an elevation partly in section of a detail of the boiler of FIG. 4.

Referring now to the drawing and initially to FIGS. 1 and 2, there is seen the water tube system of a hot water boiler in elevation and in plan section respectively. The outer thermally insulating envelope of the boiler and the oil or gas burner have not been illustrated in order not to crowd the drawing, but the direction of flow of the combustion gases is indicated by arrows.

The boiler comprises a radiation heating surface part **1** and a convection heating surface formed of banks of tubes **24** in the flue **2**. The radiation heating surface is composed of the side wall tubes **3**, front wall tubes **4**, and rear wall tubes **5**. The front wall tubes are bent to form also the ceiling tubes **6**.

The side wall tubes **3** of each side wall are arranged in parallel between a lower distributor **7** and an upper collector **8**. The two distributors **7** are connected by two transverse distributors **9** and **11** arranged in line with the ends of the side walls, and the two longitudinal collectors **8** are joined by a transverse collector **10** in line with the furnace rear wall.

The front wall tubes **4** extend upwardly from the transverse distributor **9** and their extensions which form the ceiling tubes **6** open into the transverse collector **10**. The rear wall tubes **5** rise upwards from the transverse distributor **11** which is connected to the longitudinal distributors **7**. The tubes **5** extend with their upper portion outwardly towards the flue **2** where they are staggered so as to lie alternatingly in two planes and to permit passage of combustion gases from the furnace **1** into the flue **2**. They are finally joined to the transverse collector **10**.

The front ends of the collectors **8** are joined with the front ends of respective distributors **7** by two vertical by-pass pipes **12** which are protected from the heat radiated by the hot gases in the furnace **1** by the interposed front wall tubes **4** and may be further protected by thermal insulation (not shown).

Two connecting pipes **13** extend from the transverse collector **10** to the two ends of a lower distributor **14** of the convection heating surfact **24** consisting of several banks of spaced tubes the upper ends of which are joined to a collector **15**. The discharge pipe **16** leading to the heating system which is to be supplied with hot water by the boiler extends from the collector **15** rather high above the boiler structure.

The highest point of the boiler tube system located in the pipe **13** is connected to the discharge pipe **16** by a deaerating pipe **17**.

Water is circulated through the boiler from the return lines 18 of the heating system to the distributors 7 which receive the water at its lowest temperature and partly pass it to the transverse distributors 9 and 11. The water rises through the tubes 3, 4, 5 and 6 where it is exposed to the radiant heat of the combustion gases. The heated water is collected in the collectors 8 and 10 in which the streams coming from the individual tubes at different temperatures are mixed. One portion of the mixed water passes through the connecting pipes 13 and the distributor 14 into the convection heating surface 24 where it is further heated whereupon it finally leaves the boiler through the discharge pipe 16.

Another portion of the water heated in the furnace 1 is returned through the by-pass pipes 12 to the feed end of the distributors 7 where it is mixed with the cold water entering into the pipes 18. The downward flow of the heated water in the vertical by-pass pipes is intensified by the strong suction exerted at the T-junction between the by-pass pipes 12 and the distributors 7 by the return water entering through pipe 18.

FIG. 3 shows a portion of a side wall of the boiler of FIG. 1 in plan section and illustrates the fire resistant thermally insulating material which backs the tube system of the boiler and has been omitted from FIGS. 1 and 2.

The tubes 3 are embedded to approximately one half of their circumference in refractory or corrosion-resistant material 19. By this arrangement, only those portions of the tubes 3 which are accessible to the direct radiation are exposed to the effect of the acidiferous combustion gases whereas those portions of the tubes which are facing away from the source of radiant heat and which are heated not at all or only weakly are withdrawn from the corroding effect. The refractory material is backed by a layer of thermal insulating material 20.

The front and rear wall tubes 4, 5 and the ceiling tubes 6 may be similarly embedded. The tubes may also be arranged side by side in abutting contact and those portions which face away from the flame and the hot gases may be embedded substantially as shown in FIG. 3.

The embodiment of the invention illustrated in FIGS. 4 and 5 differs from that shown in FIGS. 1 and 2 mainly by the fact that it is of the single flue type.

The furnace section 21 of the boiler illustrated in FIGS. 4 and 5 is enclosed by walls on three sides, the walls being formed by side wall tubes 23, rear wall tubes 25 and ceiling tubes 26 integral with the rear wall tubes. The side wall and rear wall tubes of this embodiment are placed closely to each other in a side-by-side abutting engagement. The side wall tubes 23 rise from the two lower longitudinal distributors 27 to two upper collectors 28. The distributors 27 are connected along the rear wall of the boiler by a transverse distributor 31 from which the rear wall tubes 25 rise. The upper collectors 28 are joined along the rear wall of the boiler by a transverse collector 30 and along the front wall by a header 29 which serves as a distributor for the convection heating surface. Four non-heated by-pass pipes 32 along the vertical edges of the boiler connect the collectors 28 and 30 and the header 29 which jointly form a rectangularly bent closed conduit with a similar lower conduit having one open side and formed by the longitudinal distributors 27 and the transverse distributor 31. The collectors 28, 30, header 29, by-pass pipe 32 and distributors 27 and 31 form the boiler frame work which carries the heating surface.

The integral rear wall tubes 25 and ceiling tubes 26 provide paths of water flow which extend upward along the boiler rear wall to the top of the furnace 21, thence obliquely across the upward gas flow toward the boiler front wall and equally back to the rear wall, and again upward along the rear wall to the transverse collector 30 at the top of the boiler. The tubes 25 along the rear wall of the boiler are so closely juxtaposed as to be substantially in side-by-side abutting engagement. The ceiling tubes 26 which lead the water from the rear wall toward the front wall and back are alternatingly displaced upward and downward so as to permit upward flow of combustion gases from the furnace 21 into the flue 22 which is separated from the furnace by the tubes 26. The side wall tubes 23 rise straight from the lower distributors 27 to the collectors 28.

The convection heating surface 34 located above the tubes 26 consists of serpentine tubes which extend from the header 29 and open into a collector 35 outside of and parallel to the boiler front wall. The discharge pipe 36 for connection to the central heating system extends from the collector 35. A deaerating pipe 37 of small diameter connects the header pipe 29 with the discharge pipe 36 to bleed any accumulated air from the boiler.

The boiler is lined with a layer 40 of corrosion-resistant refractory material in which the tubes of the water walls are embedded in the manner described in more detail in connection with FIG. 3. The layer 40 is backed by an outer envelope 41 of thermally insulating material which is not in contact with the corrosive combustion gases. The boiler stands on a foundation plate 42.

The front wall of the boiler has an inwardly flaring opening 33 for a burner and the boiler top has a central opening 43 for the escape of the combustion gases.

It has been stated that the downflow of the heated water through the by-pass pipes and its mixture with the cooled return water is favored or induced by the suction effect occurring when those pipes are vertically connected to the entrance end of the distributors of the radiation heating surface, and that this effect can be further intensified by suitable means, such as a constriction of the distributor cross-section, the application of a suction nozzle and the like. Such a means is shown in FIG. 6 where the bypass tube 32 extends vertically from the distributor 27 in the entrance end of which a nozzle like structure 39 is provided. The return water from the heating system flows through that structure and, thus, exerts an increased suction effect on the already heated water supplied through pipe 32. Thereby the mixture of the two flows of water of different temperatures will be favored, the circulation becomes livelier and a sufficient supply of heated water to the cooled water is ensured. It will be understood that similar suction nozzles may be applied to the entrance ends of the distributors 7 of the boiler shown in FIGS. 1 and 2.

The boiler illustrated in FIGS. 4 and 5 operates in a manner similar to that of the boiler shown in FIGS. 1 and 2. Water is pre-heated by radiation in the furnace 21 in which its flow is parallel to the upward flow of the combustion gases. In the flue 22 the water flows in a downward direction while the combustion gases still flow upward and heat the water in the banks of the convection heating tubes 34. The water enters the bottom of the furnace at its lowest temperature and is discharged from the convection heating surface in the flue 22 at its highest temperature with which it is to be supplied to the central heating system. A portion of the pre-heated water is returned from the top of the tubes forming the walls of the furnace 21 to the distributors 27 and 31 to raise the minimum temperature of water in the furnace.

Thus the invention provides a hot water boiler for use with a central heating system wherein the cooled water from the system is charged into the radiation heating surface, and thence into the convection heating surface of the boiler from where the discharge pipe extends for connection to the inlet of the central heating system. Circulation of some of the water heated by radiation back to the distributors of the furnace wall tubes is rendered possible, so that the temperature of the water entering those tubes is already raised above that of the water supplied to the boiler. The invention avoids the occurrence of corrosion due to the sulfur contained in the combustion gases by preventing the latter from being cooled down below their dew point in any portion of the boiler.

It will be apparent to those skilled in the art that many modifications and alterations of the structure illustrated and described hereinbefore can be made without departure from the spirit and essence of the invention which for that reason shall not be limited but the scope of the appended claims.

I claim:

1. In a hot water boiler for a central heating system, a radiation heating surface including first distributing means, first collecting means, and radiation heated water-carrying tubes, said first distributing means being located at the bottom, said first collecting means being located on top of said radiation heating surface and said water-carrying tubes extending from said distributing means through at least part of their lengths in the vertical direction and opening into said collecting means, non-heated by-pass tubes connecting said first collecting means to said first distributing means, a convection heating surface including second distributing means, second collecting means and serpentine tubes connected between said second distributing means and second collecting means, said first distributing means having an inlet end for receiving return water from said heating system, a connection between said first collecting means and said second distributing means, and a discharge means for supplying heated water from said second collecting means to said heating system, said second collecting means being connected solely to said serpentine tubes and said discharge means, and said first distributing means being connected to said discharge means solely through said radiation heating surface and said convection heating surface.

2. A hot water boiler as in claim 1, said first distributing means including a horizontal distributor pipe provided with said inlet end, said first collecting means including a horizontal collector pipe above said distributor pipe, a portion of said water carrying tubes and one of said by-pass tubes extending straight vertically between said distributor pipe and said collector pipe, and said by-pass tube opening to said distributor pipe close to said inlet end whereby return water from said heating system charged into said inlet end causes a suction effect on the water in said by-pass tube.

3. A boiler as in claim 1 wherein said vertical portions of said water-carrying tubes are closely arranged side by

side and form walls of the boiler furnace, further comprising a first cover of corrosion-resistant material applied to that side of the vertical tubes which is not exposed to radiation, and a second cover of heat-insulating material applied to said first cover.

4. A boiler as in claim 1, said discharge means being a pipe extending from said second collector means upwards beyond the tops, respectively, of said radiation heating surface and said convection heating surface, and a deaerating tube connecting the topmost point of the tubular system of the boiler to said discharge pipe above the boiler structure.

5. In a hot water boiler of a single flue type for a central heating system, a radiation heating surface including side wall and rear wall tubes, median portions of said rear wall tubes being bent to form ceiling tubes, first horizontal interconnected distributor tubes and first horizontal interconnected collector tubes, a convection heating surface including serpentine tubes, a second distributor tube and a second collector tube, said convection heating surface being located between the level of said first collector tubes and said ceiling tubes, said second distributor tube being connected to and located on the level of said first collector tubes and the upper ends of said serpentine tubes being connected to said second distributor tube, said second collector tube being located on the level of and connected to the lower ends of said serpentine tubes, one of said first distributor tubes having an inlet end for the reception of cool return water from said system, and a discharge pipe for conducting heated feed water to said heating system, said discharge pipe extending from said second collector above the structure of said boiler.

References Cited in the file of this patent

UNITED STATES PATENTS

1,236,306	Jackson	Aug. 7, 1917
2,741,228	Vorkauf	Apr. 10, 1956
2,904,016	Durham	Sept. 15, 1959

FOREIGN PATENTS

555,279	Italy	Jan. 19, 1957
772,546	Great Britain	Apr. 17, 1957