Oct. 17, 1933. T. E. MURRAY 1,930,688

BOILER

Original Filed July 21, 1927 3 Sheets-Sheet 1

Fig. 1.

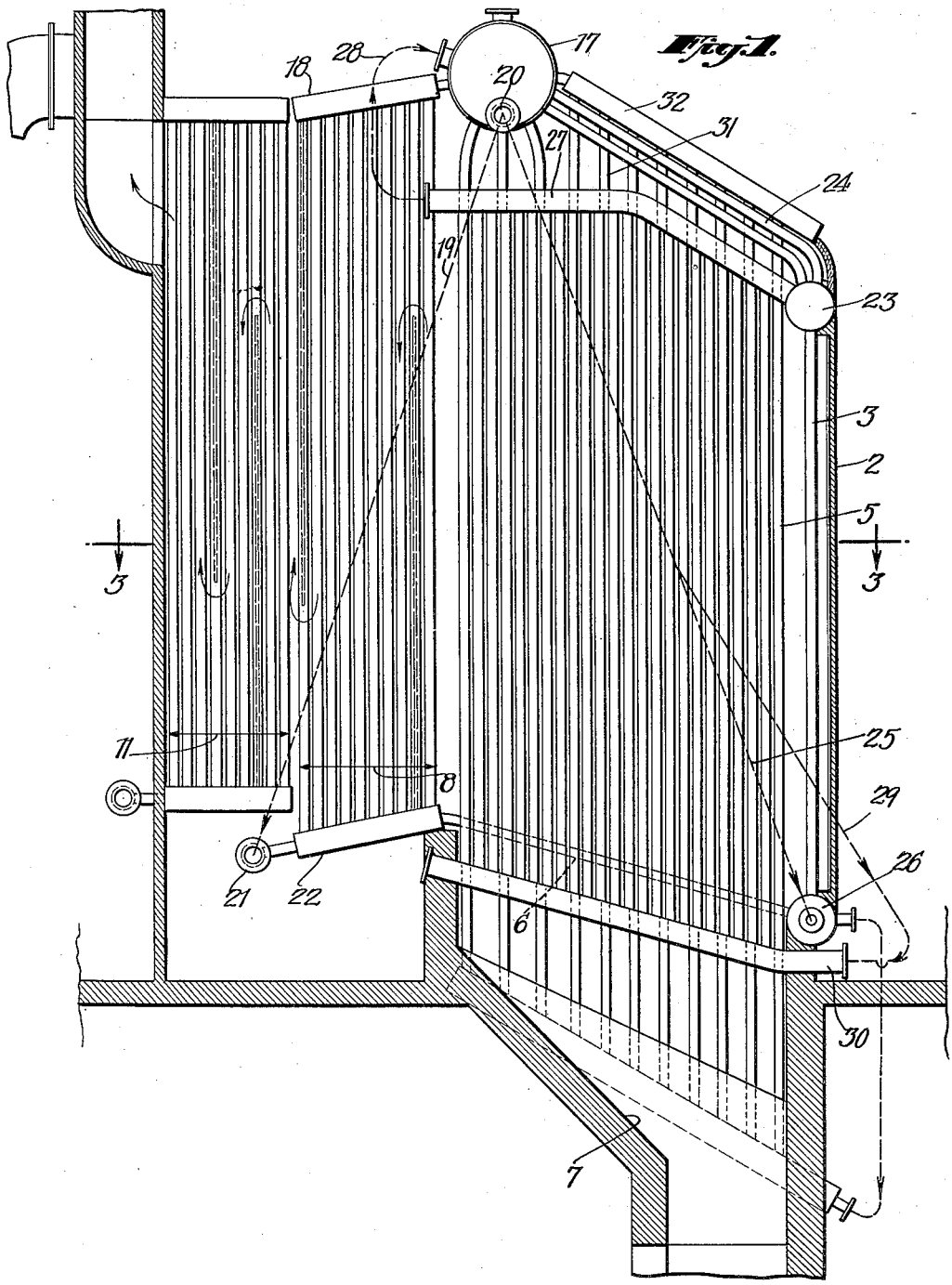

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Fig. 2.

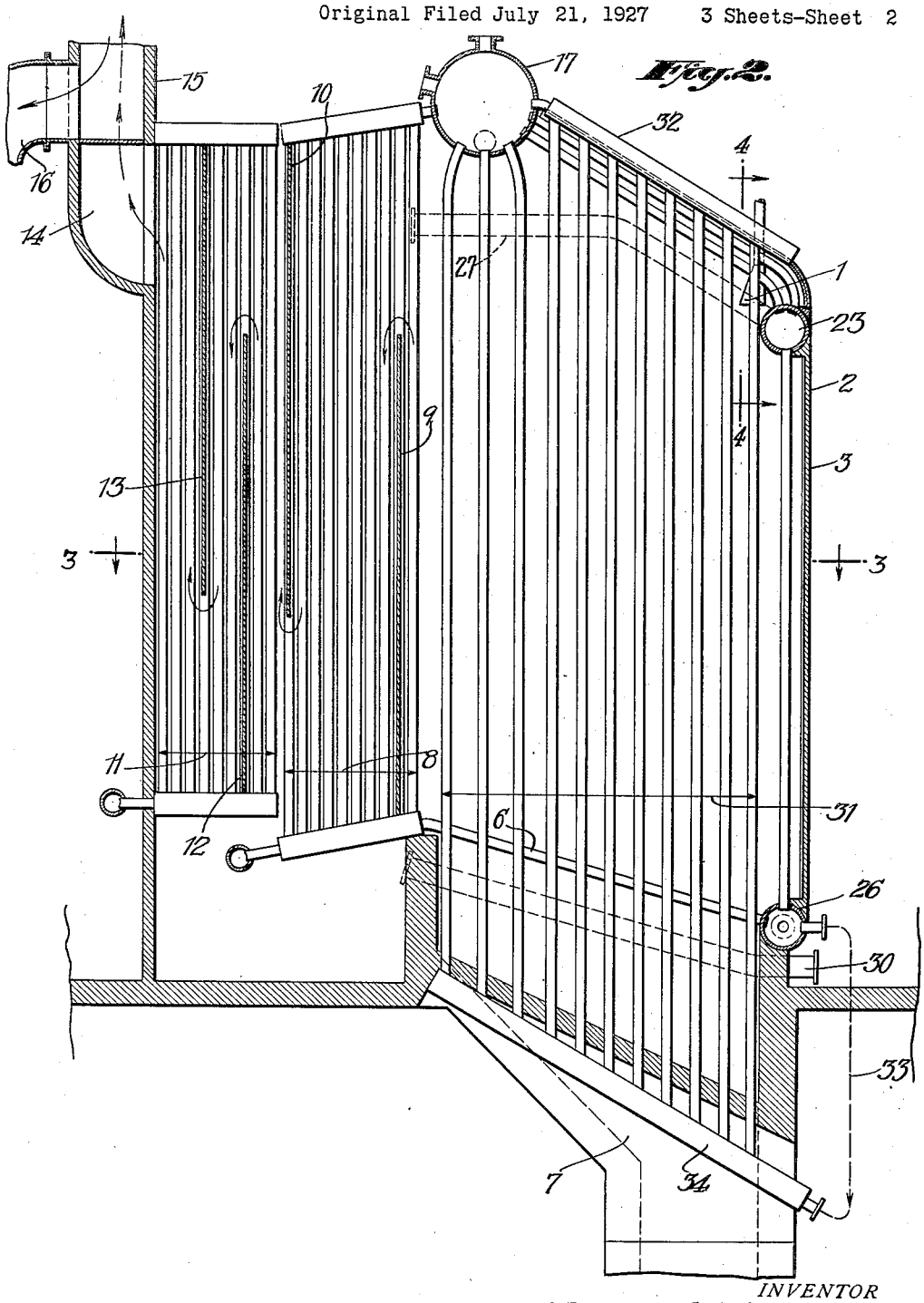

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Fig. 3.

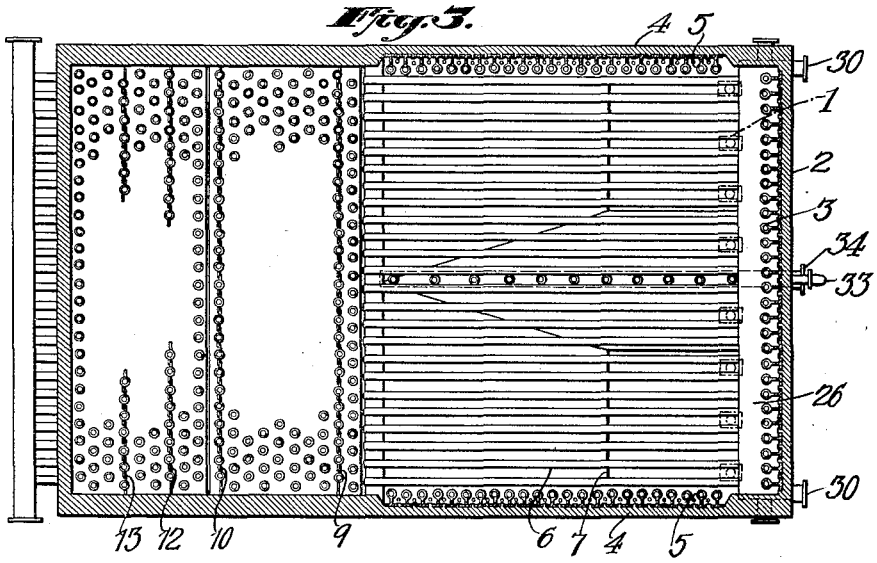


Fig. 4.

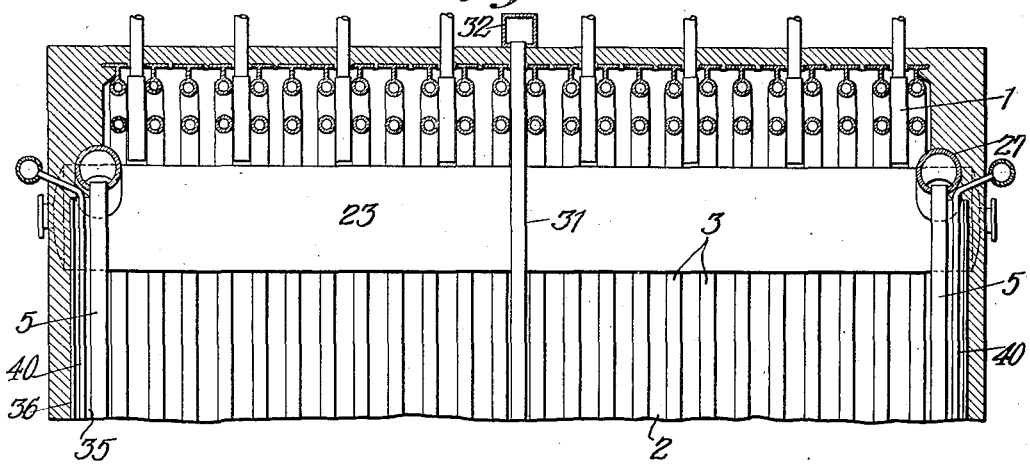
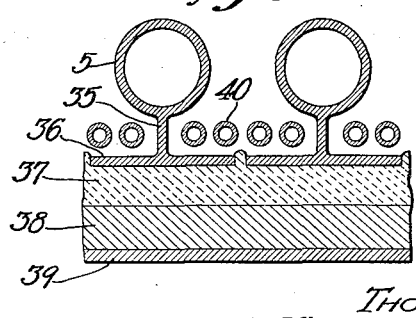


Fig. 5.



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UNITED STATES PATENT OFFICE

1,930,688

BOILER

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Application July 21, 1927, Serial No. 207,377
Renewed June 9, 1932

11 Claims. (Cl. 122—235)

In certain previous applications, I have described boilers having furnace walls made of or lined with water tubes which are exposed to the direct radiant heat of the burning fuel, whereby the capacity of the boilers is very greatly increased.

The present invention is based on the provision of tubes in the furnace arranged in such a way as to utilize the radiant heat in a similar way.

The accompanying drawings illustrate embodiments of the invention.

Fig. 1 is a side elevation of a boiler with the near side wall removed so as to show the tubing within;

Fig. 2 is a central vertical section;

Fig. 3 is a horizontal section substantially on the lines 3—3 of Figs. 1 and 2;

Fig. 4 is a transverse vertical section substantially on the line 4—4 of Fig. 2;

Fig. 5 is a detail in horizontal section.

The space at the right may be called the furnace, being an open chamber in which combustion of the fuel takes place. The fuel may be pulverized coal, oil, gas or the like introduced in jets through burners 1 projecting downward in the top of the combustion chamber near the front wall, which is composed of an outer shell 2 and a lining of vertical tubes 3 exposed to the burning fuel. The sides of the furnace are similarly formed with an outer shell 4 (Fig. 3) and a lining of vertical water tubes 5 exposed to the flame. At the bottom of the combustion chamber there is a water screen of inclined pipes 6 extending downward from back to front and located over the ash pit 7.

At the back of the combustion chamber there are additional banks of vertical tubes for utilizing by convection the hot gases which pass off from the combustion chamber. A group 8 of such tubes corresponds to the usual overhead tubing of water tube boilers, in which the steam is generated. Baffles 9 and 10 serve to direct the hot gas.

A second group 11, of vertical tubes, is placed beyond the steam generating tubes 8 in the path of the gases and is provided with baffles 12 and 13 which direct the gas to the discharge flue 14. The bank 11 of tubes may be used as an economizer to preheat the feed water of the boiler. Gases may be passed from the flue 14 to an air preheater 15 of any usual or suitable design with alternate passages for the hot gases upward and for the air downward and to the air outlet 16.

The main steam drum 17 collects steam from all the generating tubes. The tubes 8 connect at their upper ends with inclined headers 18 which lead to the upper part of the drum. Downgoing pipes are indicated by the line 19 (Fig. 1) leading from openings 20 near the bottom of the ends of the drum and conveying water to a transverse header 21 which communicates with longitudinal headers 22 leading into the lower ends of the tubes 8.

For the front tubes 3 the circulation is as follows. They lead at their upper ends into a transverse header 23 which leads through branches 24 to the steam drum 17. From openings 20 in the opposite ends of this drum return pipes 25 convey water down to the opposite ends of a transverse drum 26 which communicates with the lower ends of the vertical tubes 3.

The circulation of the side tubes 5 is as follows: Their upper ends lead into longitudinally extending drums 27 one at each side of the furnace, which communicate through pipes indicated by the lines 28 with the steam drum. From the openings 20 in the ends of the latter downgoing pipes 29 lead into the front ends of headers 30 which convey the water to the lower ends of the vertical tubes 5. The steam drums 27 at the top of these tubes may communicate at their front ends with the headers 23 so as to provide an additional path for circulation of the front tubes 3. Likewise the tubes 6 of the water screen may communicate at their lower front ends with the water header 26 and at their rear ends with the several headers 22. Various other circulating arrangements may be provided for all the different groups of tubes in the boiler, those indicated being chiefly diagrammatic.

To provide an increased heating surface subject to the direct radiant heat of the burning fuel, I arrange within the combustion chamber one or more curtain walls or screens of tubes extending vertically, or so nearly vertically as to permit a very rapid circulation and thus cooperate in maintaining the large capacity desired. The drawings show a single screen of this sort, but more than one screen may be used and the screen or screens may be differently arranged according to the design and desired capacity of the boiler.

This screen consists of a line of vertical water tubes 31 extending longitudinally, that is, from front to back across the combustion chamber. The flame is on both sides of the line of tubes by reason of the location of nozzles. Preferably the tubes are spaced apart to permit free circulation of the gases from one side of the furnace to the other. The tubes illustrated are plain, they may be provided with fins, flanges or other

external projections to increase the surface area exposed to the flame. Such flanged tubes are illustrated in connection with the side walls, and various alternative designs are illustrated in other applications. The circulation for these tubes will, of course, depend on their number and arrangement. In the case illustrated, the three tubes at the rear lead directly into the steam drum. The others lead into an upper header 32 which is inclined upward and communicates with the steam drum. A water connection indicated at 33 leads from the header 26 to the lower end of the inclined header 34 which communicates with the lower ends of the tubes 31.

The side and front walls of the furnace are preferably of the cross-section indicated at Fig. 5. The water tubes 5 are provided with rearward projections comprising a web 35 and flanges 36 forming radiating or radiation receiving surfaces. On the outer faces of the flanges are layers 37 and 38 of any usual or suitable refractory and insulating materials, and outside of these is a steel shell 39. The flanges 36 of the adjacent tubes are nearly in contact with their edges so as to protect the insulating material on their outside. Within the spaces between the steam generating tubes, I may place tubes 40 forming part of a steam superheater and connected in any desired way with the steam circulating system. Such superheater tubes are exposed to the radiant heat of the fire like the steam generating tubes 5 but not to quite the same extent, being partly shielded by the latter.

The same construction of furnace walls is shown in application Ser. No. 177,534, filed March 23, 1927, but is not claimed therein except in connection with other features of improvement.

Superheater tubes 40 may be also arranged on the front wall of the furnace if the design is such as to call for additional superheating. In that case they would be arranged like those against the side walls, exposed to the radiant heat but not to quite the same extent as the steam generating tubes.

Various modifications may be made by those skilled in the art without departing from the invention as defined in the following claims.

What I claim is:

1. A boiler of the type described which comprises a rear bank of vertical heat absorbing tubes and side rows and a front row of vertical water tubes and top and bottom water tubes forming with said side and front tubes and said rear bank of tubes a combustion chamber, a steam drum and connections for delivering water from said tubes to said drum and returning water from said drum to said tubes, an enclosing wall spaced from said side, top and front wall tubes, said tubes each having a rib extending from the outermost part of said tube towards said enclosing wall and thence in sidewise flanges to expose substantially the entire surface of said tubes except the outermost to direct radiation from said combustion chamber.

2. A boiler of the type described which comprises a combustion chamber having vertical side and front enclosing water tubes and a rear bank of heat absorbing water tubes, a steam drum receiving water from and delivering water to said tubes, an enclosing wall spaced from said side and front water tubes, a vertical row of partition water tubes extending from front to rear of said combustion chamber, downwardly directed fluid fuel burners at the upper forward part of said combustion chamber and on both sides of said row of partition water tubes, and said side, front and partition water tubes being freely exposed throughout substantially their entire surface to direct radiation from said combustion chamber, said enclosing walls being protected by vertical ribs connected to said side and front water tubes by a connecting rib.

3. The boiler of claim 2 having superheater tubes in the space between said side tube and said enclosing wall and partially exposed to radiation from said combustion chamber.

4. A boiler of the type described which comprises a combustion chamber enclosed by front and side walls of spaced vertical water tubes, an outer shell enclosing said water tubes, ribs extending from the outermost surface of said water tubes to said enclosing shell and extending in sidewise ribs at the surface of said shell.

5. A boiler of the type described which comprises a combustion chamber enclosed by front and side walls of spaced vertical water tubes, an outer shell enclosing said water tubes, ribs extending from the outermost surface of said water tubes to said enclosing shell and extending in sidewise ribs at the surface of said shell, and superheater tubes outwardly of said water tubes within said enclosing shell.

6. A boiler of the type described having a combustion chamber divided by a longitudinal row of vertical water tubes exposed to direct radiation in said combustion chamber, an enclosing side and front shell for said combustion chamber, spaced vertical water tubes within and surrounding the front and side parts of said combustion chamber within said shell and freely exposed to direct radiation from said combustion chamber, ribs extending from the outermost part of said side and front water tubes to said enclosing shell, radiating surfaces secured to said ribs at their outer edges, and a downwardly and rearwardly directed fluid fuel burner in the upper front part of said combustion chamber.

7. A boiler comprising a combustion chamber wall of spaced vertical water tubes, an outer wall enclosing said wall of water tubes, and ribs in a plane outside said water tubes and extending lengthwise of said outer wall between the water tubes and the said outer wall, and said ribs connected to said tubes at the tube surfaces facing said outer wall.

8. A boiler comprising a combustion chamber wall of spaced vertical steam generating water tubes, flanges extending laterally from said tubes and forming the back walls of spaces between them, and superheater tubes in the said spaces, the superheater tubes being located outwardly beyond the plane of the centers of the steam generating tubes.

9. A boiler comprising a combustion chamber wall of spaced vertical steam generating water tubes, flanges extending laterally from said tubes and forming the back walls of spaces between them, and superheater tubes in the said spaces, the superheater tubes being located outwardly beyond the plane of the centers of the steam generating tubes, said steam generating tubes and superheater tubes having their metallic faces exposed to the direct radiant heat of the burning fuel.

10. A boiler comprising a combustion chamber wall of spaced vertical steam generating water tubes, flanges extending laterally from said tubes in a plane located outside of said tubes, connections between said tubes and said flanges, and superheater tubes located in a plane between that

of the steam generating tubes and that of the flanges, and in the spaces between successive steam generating tubes.

11. A boiler comprising a combustion chamber wall of spaced vertical steam generating water tubes, flanges extending laterally from said tubes in a plane located outside of said tubes, connections between said tubes and said flanges and superheater tubes located in a plane between that of the steam generating tubes and that of the flanges, and in the spaces between successive steam generating tubes, said steam generating tubes and superheater tubes having their metallic faces exposed to the direct radiant heat of the burning fuel.

THOMAS E. MURRAY.