

Sept. 3, 1940.

W. H. ARMACOST

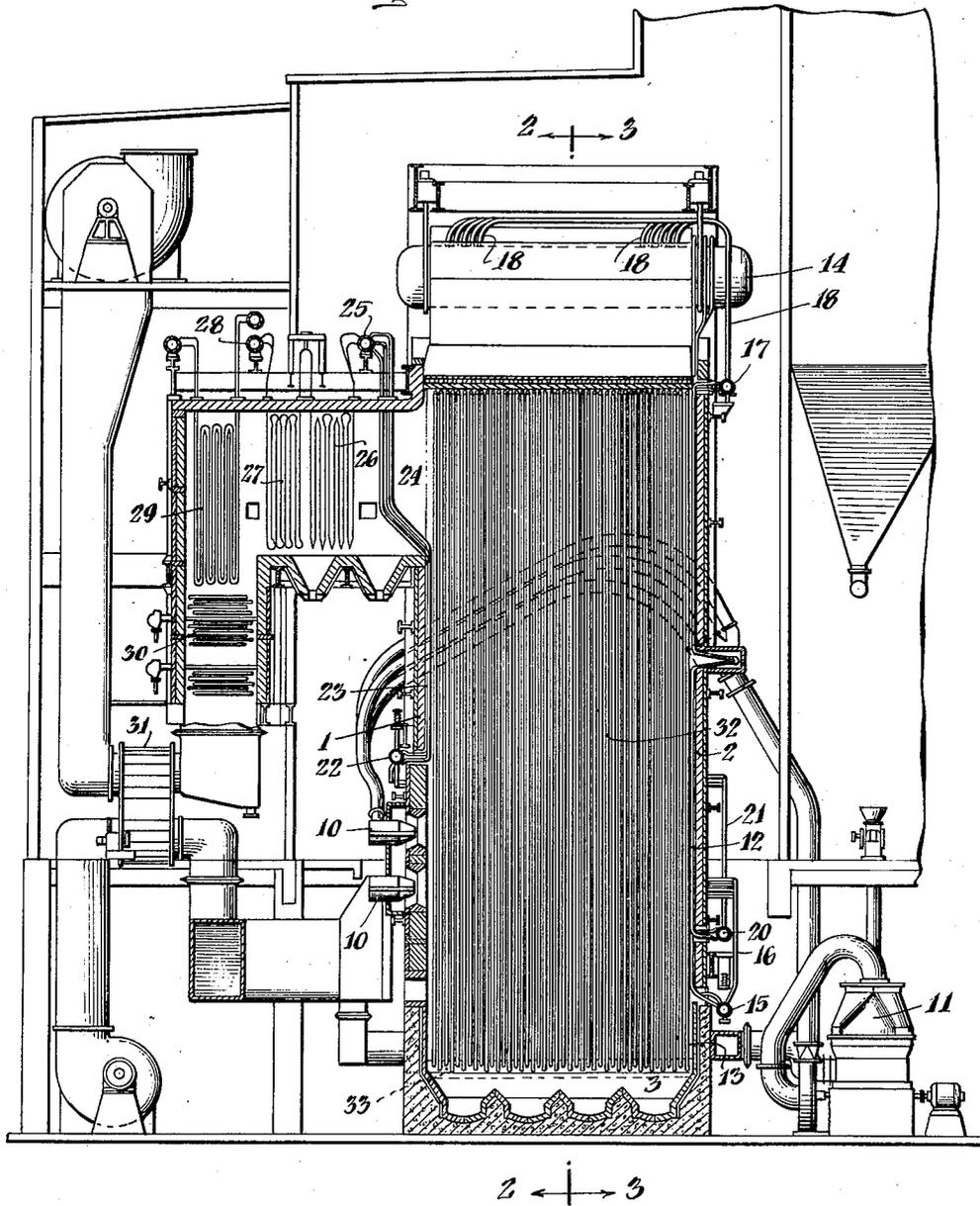
2,213,185

COMBINED RADIANT AND CONVECTION SUPERHEATER

Filed June 18, 1938

2 Sheets-Sheet 1

Fig. 1



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Fig. 2

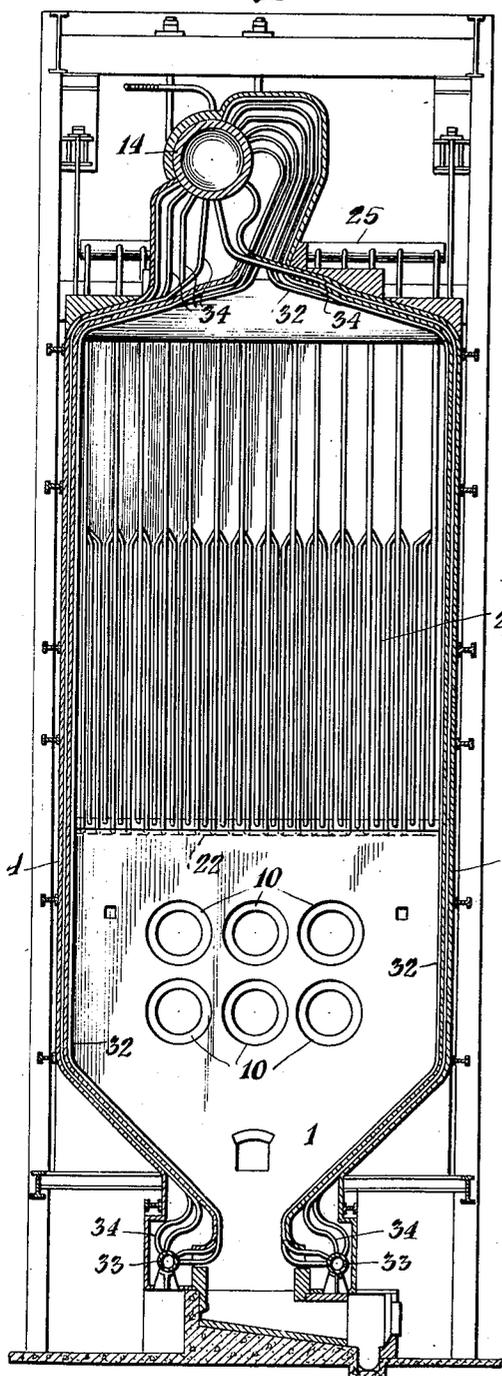
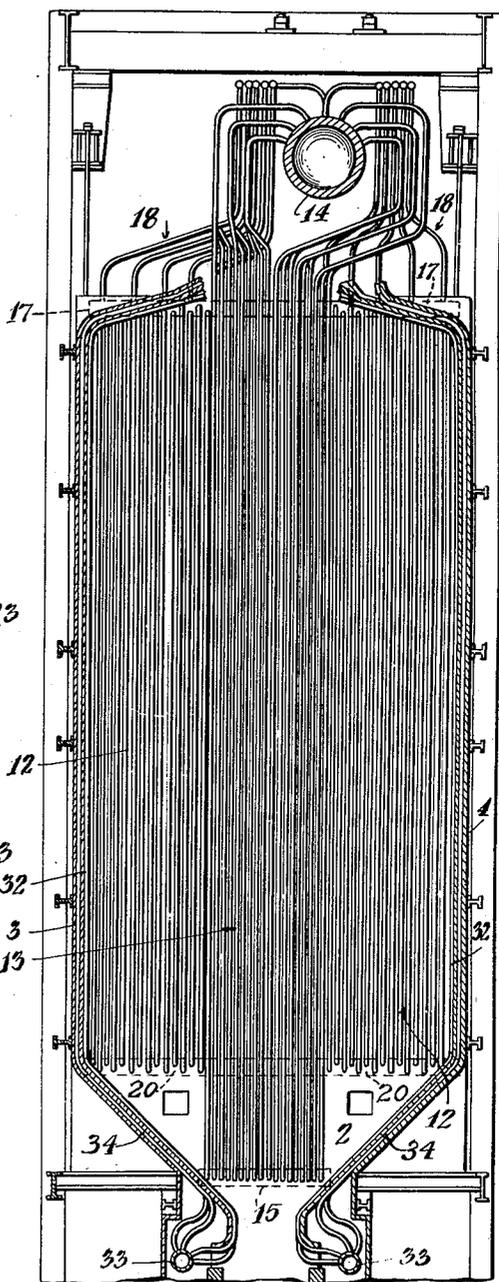


Fig. 3



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COMBINED RADIANT AND CONVECTION SUPERHEATER

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8 Claims. (Cl. 122-481)

This invention relates to boilers for high steam temperatures and pressures and particularly to an improved arrangement of the various heat absorbing surfaces thereof. In such boilers much of the heat absorbing surface is located within the furnace and it is an object of the present invention to provide a novel correlation of the water and steam heating surfaces in the furnace with respect to each other and the fuel burners and also with respect to convection heated surfaces located in the offtake from the furnace.

The invention will be best understood upon consideration of the following detailed description of an illustrative embodiment thereof when read in conjunction with the accompanying drawings, in which:

Fig. 1 is an elevational view, partly in vertical section, of a boiler embodying the present invention; and

Figs. 2 and 3 are sectional views on the lines 2-2 and 3-3, respectively, in Fig. 1.

The furnace of the boiler shown in the drawings contains all of the steam generating elements of the boiler and part of the steam heating or superheating elements, all of the furnace walls being substantially completely faced or lined with heat absorbing elements except the wall 1 through which project the fuel burners 10 fed by the mill 11. The opposite wall 2 (Fig. 3) is located at such a distance from the wall 1 that the flames from the burners 10 do not impinge on the heat absorbing elements on this wall. The heat absorbing surfaces on the wall 2 comprise radiant superheater elements 12 covering the areas from each side edge of wall 2 part way toward the center thereof, the middle portion of the wall being lined with steam generating tubes 13. These tubes receive water from the steam and water drum 14 through the lower header 15 connected to the drum by downcomers 16 (Fig. 1).

The inlet headers 17 for the radiant superheater tubes 12 are connected to the steam space of drum 14 by pipes 18 and the outlet header 20 therefor is connected by pipes 21 to an inlet header 22 supplying radiant superheater tubes 23 covering the entire width of wall 1 (Fig. 2) above the burners 10. The upper portions of the superheater tubes 23 extend across the offtake 24 and are connected at their upper ends to the inlet header 25 of a convection superheater located in the offtake. Where they cross the offtake 24 the upper ends of the radiant superheater tubes are arranged to permit gases from the furnace to pass therebetween to impart heat to the elements 26, 27 of the convection superheater and

also act as a slag screen therefor. The outlet header for the convection superheater is designated by the numeral 28. A reheater 29, an economizer 30 and an air preheater 31 are also shown in the offtake 24 from the furnace.

As shown in Fig. 1, the side walls 3 and 4 are lined with steam generating tubes 32 connected at their upper ends to the steam space of drum 14 and receiving water from lower headers 33 connected to the water space of the drum 14 by downcomers 34 as shown in Fig. 2.

As mentioned above the wall 2 is located at such a distance from the wall 1 that the flames from the burners 10 therein do not impinge substantially on the heat absorbing elements on the wall 2. The flames and gases from the burners 10 are cooled substantially by the water cooled surfaces 32 on the side walls 3 and 4 before reaching a position in front of the radiant superheater elements 12 on the wall 2. Since the remaining radiant superheater elements 23 are located on the wall 1 above the burners 10 the flames are projected away from these elements, and the gases are cooled by the heat absorbing elements in the lower portion of the furnace before they rise to a position to impart heat to the elements 23. Therefore, in operation all of the radiant steam heating surface is substantially free from flame impingement and is located in zones of relatively low temperature so it will not suffer overheating. The flames issuing from the burners 10 are flanked on either side by water cooled surfaces 32 to which they rapidly give up much of their heat by radiation and since they do not retain their directional velocity because of the furnace depth, they do not impinge on that steam heating surface 12 on the wall 2 opposite to the burners. Upon turning upwardly, the flames are further cooled by the remaining water cooled surfaces and by the steam heating surface 23 until they have reached the opening of the furnace offtake, whereupon they have been cooled to such an extent that the cross flow of the gases over the upper portions of the steam heating tubes on the wall 1 and into the offtake as shown in Fig. 2, does not overheat said tubes.

The furnace leaving temperature may be varied by manipulating the burners to vary heat absorption in the furnace. In the embodiment shown the burners are so grouped that under reduced loads the flames may issue from the top burners, thereby avoiding cooling by the parts of the heat absorbing elements in the lower portion which results in a higher offtake temperature and consequent higher superheat. Alter-

natively, the flames may issue from the bottom burners with resultant lower offtake and superheat temperature. The flames may issue from the side or center burners which would influence the offtake or superheat temperatures by the greater or lower absorption, respectively, of the side water walls 32, or the flames may be projected to a greater or lesser distance across the furnace toward the water or steam heating surfaces of the wall in Fig. 3 and effect the superheat by such means of control.

Thus, according to the invention there is a cooperative relation between the location of the steam heating and the steam generating surfaces and the location of the burners with respect thereto which is particularly applicable to high pressure, high temperature steam conditions in that the steam heating tubes 12, 23 must be well guarded against over-exposure to heat impingement due to both their temperature and thickness. As a consequence of such guarding against flame impingement, a less costly alloy may be used. In a high pressure generator of the type all steam generating tubes are within the furnace which also contains an amount of steam heating surface to satisfy the relatively high steam temperature required. The arrangement of the radiant superheating elements 12 on the side portions of wall 2 with steam generating tubes 13 therebetween also permits a desired increase or decrease of the superheating effect by replacing generating tubes 13 with superheating elements 12, or vice versa, while still maintaining the protection afforded by the water cooled side walls 32 against overheating these radiant superheating elements.

What I claim is:

1. In a boiler having a furnace provided with burners introducing fuel through one wall thereof; steam generating surfaces lining the adjacent walls of the furnace; steam heating surfaces lining the wall opposite that in which said burners are located over areas extending part way from each outer edge of said opposite wall toward the center thereof, the width of said furnace being such that flames from said burners do not impinge on said opposite wall; and steam generating surfaces lining that portion of said opposite wall between the portions thereof that are lined by steam heating surfaces.

2. In a boiler having a furnace provided with burners introducing fuel through one wall thereof; steam generating surfaces lining the adjacent walls of the furnace; steam heating surfaces lining the wall opposite that in which said burners are located over areas extending part way from each outer edge of said opposite wall toward the center thereof, the width of said furnace being such that flames from said burners do not impinge on said opposite wall; an offtake for said furnace extending outwardly from the upper edge of the wall in which said burners are located; and steam heating surfaces lining the portion of the wall above said burners.

3. In a boiler having a furnace provided with burners introducing fuel through one wall thereof; steam generating surfaces lining the adjacent walls of the furnace; steam heating surfaces lining the wall opposite that in which said burners are located over areas extending part way from each outer edge of said opposite wall toward the center thereof, the width of said furnace being such that flames from said burners do not impinge on said opposite wall; an offtake for said furnace extending outwardly from the upper edge

of the wall in which said burners are located; and steam heating surfaces lining the portion of the wall above said burners; said steam heating tubes having spaced portions extending across said offtake; and steam heating surfaces located in said offtake at a point beyond the steam heating surface extending across the offtake.

4. In a boiler having a furnace provided with burners introducing fuel through one wall thereof; steam generating surfaces lining the adjacent walls of the furnace; steam heating surfaces lining the wall opposite that in which said burners are located over areas extending part way from each outer edge of said opposite wall toward the center thereof, the width of said furnace being such that flames from said burners do not impinge on said opposite wall; an offtake for said furnace extending outwardly from the upper edge of the wall in which said burners are located; steam heating surfaces lining the portion of the wall above said burners; said steam heating tubes having spaced portions extending across said offtake; and steam heating surfaces lining a portion of the wall in which said burners are located over an area above said burners, parts of said surfaces extending in spaced relation across said offtake in advance of said steam heating surfaces therein.

5. In a boiler having a furnace provided with burners introducing fuel through one wall thereof; steam generating surfaces lining the central portion of the furnace wall opposite that in which said burners are located; and steam heating surfaces lining the remainder of said opposite wall over areas extending from each outer edge thereof to the portion covered by said steam generating surfaces, said furnace being of a width such that flames from said burners do not impinge upon the heating surfaces on said wall.

6. In a boiler having a furnace provided with burners introducing fuel through one wall thereof; steam generating surfaces lining the central portion of the furnace wall opposite that in which said burners are located; steam heating surfaces lining the remainder of said opposite wall over areas extending from each outer edge thereof to the portion covered by said steam generating surfaces, said furnace being of a width such that flames from said burners do not impinge upon the heating surfaces on said wall; and steam generating surfaces lining the side walls of said furnace for cooling the gases from said burners before said gases impart heat to said steam heating surfaces on the wall opposite said burners.

7. In a furnace for a steam generating unit substantially fully cooled by heat absorbing surface facing the walls thereof including all of the steam generating heat absorbing surface for the unit and other steam heating radiant heat absorbing surface; burner means; an offtake for the products of combustion; and convection heat absorbing, steam heating surface in said offtake, some of said radiant steam heating surface extending across the opening of the offtake as a slag screen through which the products of combustion pass and being the only heating surface between the furnace and the convection steam heating surface within the offtake.

8. In a furnace for a steam generating unit substantially fully cooled by heat absorbing surface facing the walls thereof; fuel burners in a wall of said furnace; an offtake for the products of combustion extending from the wall in which said burners are located at a point above the lat-

ter; steam heating surface facing a wall area located above said burners and extending across the opening of the offtake as a screen through which the products of combustion pass; steam heating surface facing the wall opposite said burners, that portion directly opposite said burn-

ers being spaced therefrom a distance to avoid undesirable flame impingement; and steam generating surface facing the remaining walls of the furnace.

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