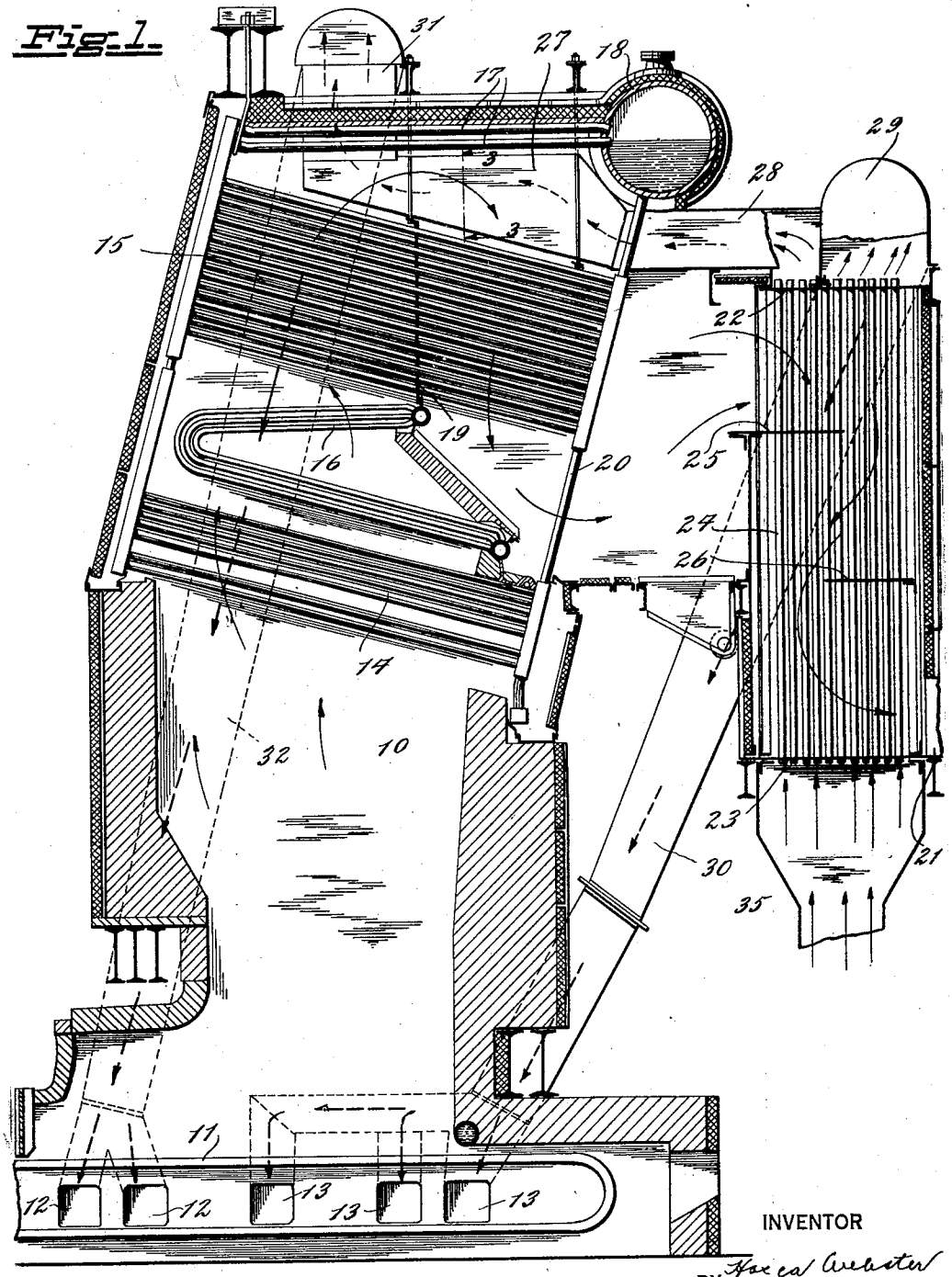
Dec. 1, 1931. H. WEBSTER 1,834,261

STEAM BOILER AND METHOD OF OPERATING THE SAME

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Fig. 1.



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Fig. 2.

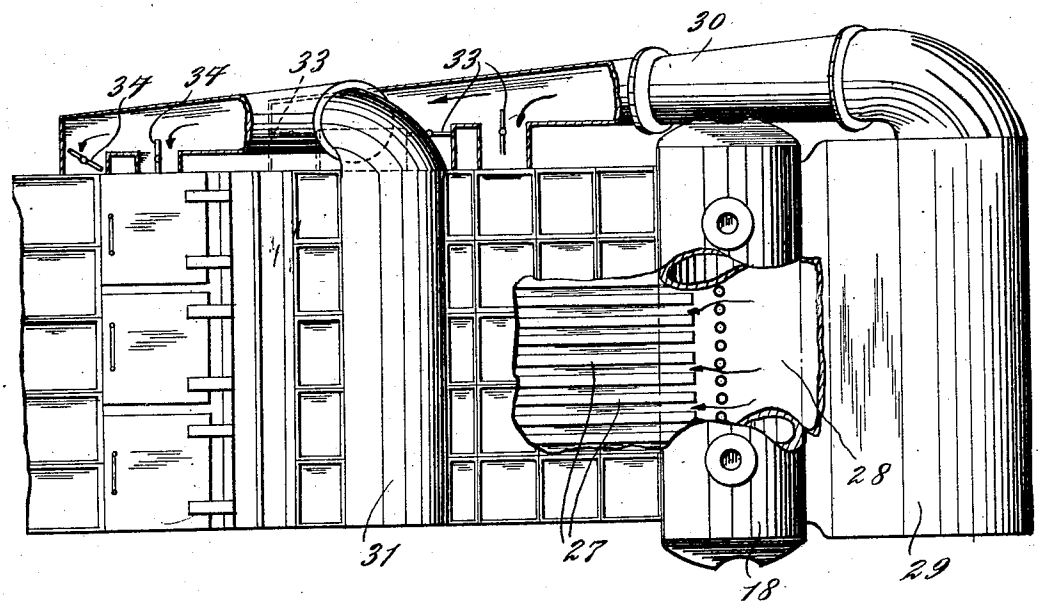
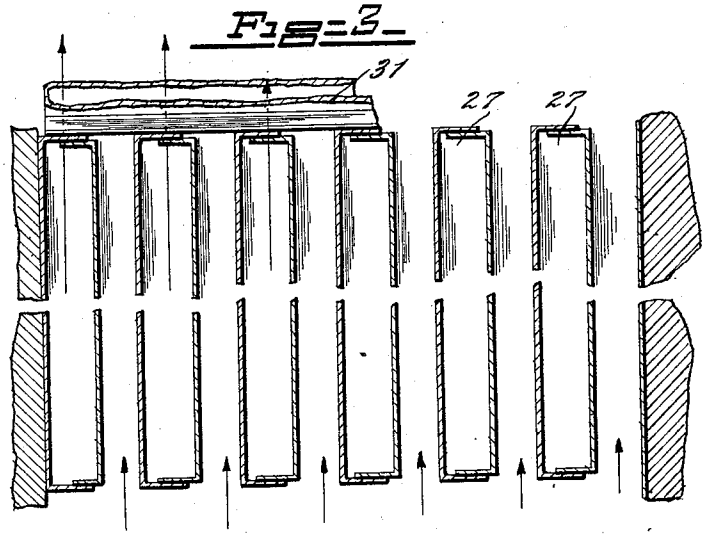


Fig. 3.



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UNITED STATES PATENT OFFICE

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STEAM BOILER AND METHOD OF OPERATING THE SAME

Application filed February 12, 1925. Serial No. 8,625.

My present invention relates to steam boilers and their operation and particularly such boilers in which the combustion air is preheated before being supplied to the fuel.

My invention will be best understood from the following description and the annexed drawings, in which Fig. 1 is a sectional elevation of one form of water tube boiler which I have chosen for purposes of illustration and embodying my invention; Fig. 2 is a plan view of the same, with some of the parts broken away, and Fig. 3 is a section on the line 3—3 of Fig. 1.

Like reference characters indicate like parts in the different views.

Referring to Fig. 1, 10 is a furnace chamber, being provided, in the illustrative arrangement, with a chain grate stoker 11 shown diagrammatically, air being supplied to the upper run of the grate through the ports 12, 12, at the front end of the stoker and the ports 13, 13, at the middle and rear end of the stoker, it being understood that the fuel bed is carried from the left to the right in Fig. 1.

Above the chamber 10 is a steam boiler which may be of any desired type but which, in the form illustrated, is of the horizontally inclined tube type having a set of tubes 14 spaced from a set of tubes 15 to form a superheater chamber in which is a superheater 16, the tubes 14 and 15 being connected to uptake and downtake headers in the usual manner with steam and water circulating tubes 17 connecting the uptake headers with the steam and water drum 18. A baffle 19 provides up and down passes for the gases across the bank of tubes 15, the gases passing into the waste gas flue between the nipples 20, from whence the gases pass back and forth through a primary air heater to the gas exit 21.

This primary air heater, in the illustrative form, is made up of a pair of heads 22, 23 through which extend the ends of tubes 24, baffles 25 and 26 being arranged to cause the waste gases to flow in the general direction indicated by the arrows on Fig. 1 as they pass to the exist 21.

The lower tubes 14 are exposed for their full length to the furnace and the gases first pass across these tubes and then the superheater 16 and the left-hand ends of the tubes 15, being turned by the furnace roof downward into the second pass at the right of the baffle 19 in Fig. 1.

In the triangular space formed between the tubes 15 and the circulators 17 is provided a secondary air heater which, in the form illustrated, is made up of plates to form alternate passages for the air and the furnace gases. The plates are arranged, as shown best in Fig. 3, to form a series of spaced apart ducts 27 of rectangular cross-section, these ducts being connected at their right-hand ends to a flue 28 which, in turn, is connected to the upper ends of some of the tubes 24 of the primary air heater, the remainder of such tubes 24 being connected to a duct 29 connected, in turn, to a duct 30 which leads to the air inlet ports 13 of the stoker.

Likewise the left-hand ends of the air heater ducts 27 of the secondary air heater are connected to a duct 31 discharging through the duct 32 to the ports 12, 12. Suitable dampers 33, 33, 33 and 34, 34 may be provided to control the passage of air through the several ports.

With the arrangement described, the combustion air enters through the duct 35 and passes upward through the tubes 24, the exteriors of which are swept by the waste gases. Some of the air thus heated is delivered directly to the ducts 29 and 30 and from thence to the air inlets 13 at the rear of the furnace chamber. The remainder of this combustion air which passes through the tubes 24 at the left in Fig. 1, is carried through the secondary air heater formed of the ducts 27 where it takes up heat from the hot furnace gases passing from the first to the second pass of the boiler and which, of course, are considerably hotter than the gases which sweep the tubes 24. This portion of the combustion air, therefore, is raised to a higher temperature than the portion supplied through the ports 13, and this high temperature air is delivered to the front part of the grate through the ports 12, where the

fuel is "green" and where a higher temperature is desirable in order to promote combustion. This high temperature gas is not desirable at the rear of the fuel bed, particularly when certain kinds of fuels are used.

By the arrangement described, it will be seen, therefore, that the combustion air is divided into two parts of different temperatures which may be supplied to different portions of the fuel bed as desired.

It will be understood that while I have shown my preferred arrangement, the application of my invention may be widely varied. For instance, if desired, all of the combustion air may be passed through the secondary air heater. It will also be obvious that while compactness is obtained by placing the secondary air heater in the triangular space above the tubes 15, such air heater may be placed in any other position within the boiler where it may be contacted with gases which are still passing through the boiler and which are, therefore, at a higher temperature than the gases in the waste gas flue.

It will also be understood that the form of air heaters may be widely varied and that my invention may be used with other forms of combustion apparatus and with finely pulverized or gaseous fuels as well as with solid fuels. While I have illustrated my arrangement in connection with a horizontal water tube boiler, it will also be understood that certain features of my invention may be applied to other types of boilers.

I claim:

1. In combination, a water tube boiler and a furnace, means for directing gases from said furnace across the tubes of said boiler in a plurality of passes, an air heater located between two of the passes whereby gases pass in succession over boiler tube heating surface, then over said air heater, and then over other boiler tube heating surface, and means for utilizing the air from said air heater for combustion purposes.

2. The method of operating a steam boiler and its setting which consists in feeding a fuel bed into the furnace, utilizing the heat of waste furnace gases after their passage over boiler heating surfaces to heat combustion air, passing said air through one portion of the fuel bed, and utilizing the heat both of waste furnace gases after their passage over boiler heating surfaces and the heat of gases at an intermediate stage in their flow across boiler heating surfaces to heat combustion air and passing the same through another portion of the fuel bed.

3. The method of operating a steam boiler and its setting which consists in feeding a fuel bed into the furnace, utilizing the heat of waste furnace gases after their passage over boiler heating surfaces to heat combustion air, passing said air through one portion of the fuel bed, and utilizing in succession the heat of gases from the furnace at an intermediate stage in their flow across boiler heating surfaces and the heat of waste furnace gases after passing over additional boiler heating surfaces to heat combustion air and passing the same through another portion of the fuel bed.

4. In a steam boiler and its furnace, means for feeding a fuel bed into the furnace, means for conducting heated gases from the furnace over boiler heating surfaces, a primary air heater, a secondary air heater, means for conducting said heated gases at an intermediate stage in their flow across the boiler heating surfaces into contact with said secondary air heater, means for conducting said gases after their passage across the entire boiler heating surface into contact with said primary air heater, means for conducting air from said primary air heater through one portion of the fuel bed to the furnace, and means for conducting air from said secondary air heater through another portion of said fuel bed to the furnace.

5. In a steam boiler and its furnace, means for feeding a fuel bed into the furnace, means for conducting heated gases from the furnace over boiler heating surfaces, a primary air heater, a secondary air heater, means for conducting said heated gases at an intermediate stage in their flow across the boiler heating surfaces into contact with said secondary air heater, means for conducting said gases after their passage across the entire boiler heating surface into contact with said primary air heater, means for conducting air from said secondary air heater through one portion of the fuel bed to the furnace, and means for conducting air from said primary air heater through another portion of said fuel bed to said furnace.

6. In a stream boiler and its furnace, means for feeding a fuel bed into the furnace, means for conducting heated gases from the furnace over boiler heating surfaces, a primary air heater, a secondary air heater, means for conducting said heated gases at an intermediate stage in their flow across the boiler heating surfaces into contact with said secondary air heater, means for conducting said gases after their passage across the entire boiler heating surface into contact with said primary air heater, means for conducting a portion of the air from said primary air heater through one portion of said fuel bed, means for conducting another portion of the air from said primary air heater to said secondary air heater, and means for conducting air from said secondary air heater through another portion of the fuel bed.

7. In a steam boiler and its furnace, means for feeding a fuel bed into the furnace, means for conducting heated gases from the furnace

over boiler heating surfaces, a primary air heater, a secondary air heater, means for conducting said heated gases at an intermediate stage in their flow across the boiler heating surfaces into contact with said secondary air heater, means for conducting said gases after their passage across the entire boiler heating surface into contact with said primary air heater, means for conducting air from said primary air heater through one portion of the fuel bed to the furnace, means for conducting air from the primary air heater to the secondary air heater, and means for conducting air from said secondary air heater through another portion only of said fuel bed.

8. In a steam boiler and its furnace, means for feeding a fuel bed into the furnace, means for conducting heated gases from the furnace over boiler heating surfaces, a primary air heater, a secondary air heater, means for conducting said heated gases at an intermediate stage in their flow across the boiler heating surfaces into contact with said secondary air heater, means for conducting said gases after their passage across further boiler heating surface into contact with said primary air heater, means for conducting air from said primary air heater through one portion of the fuel bed to the furnace, and means for conducting air from said secondary air heater through another portion of said fuel bed to the furnace.

9. In combination, a steam boiler and its furnace comprising a progressive feed grate, an air heater utilizing waste heat gases from the boiler, means for conducting air from said air heater beneath one portion of the fuel bed, a second air heater for raising air to a higher temperature than that of the first air heater, and means for conducting the air from the second air heater beneath another portion of the fuel bed.

10. In combination, a steam boiler and its furnace comprising a progressive feed grate, a first air heater utilizing waste heat gases from the boiler, a second air heater, means for conducting a portion of air from said first air heater through said second air heater and thence through one portion of the fuel bed, and means for conducting other air from the first air heater through another portion of said fuel bed.

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