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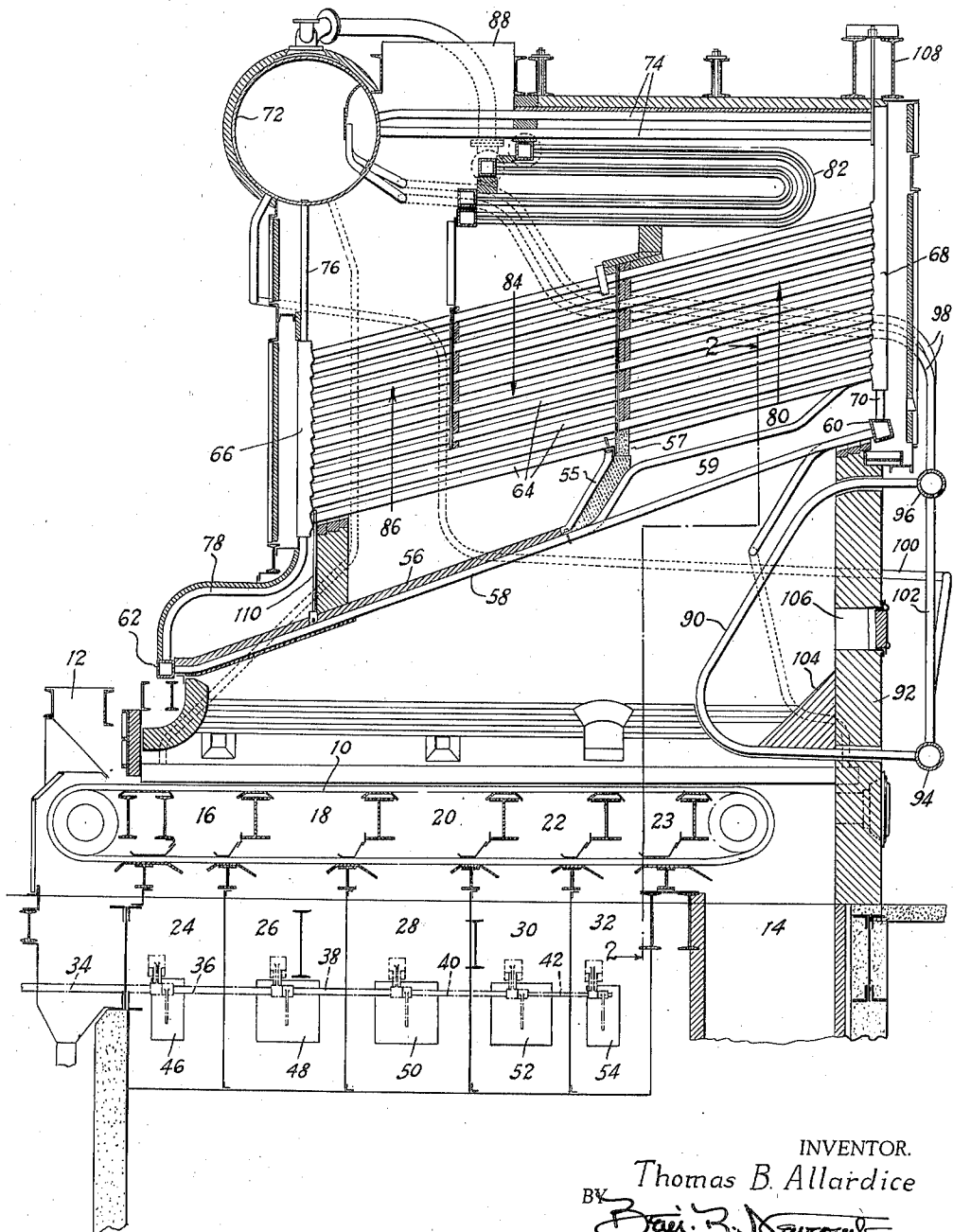
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2,238,205

STEAM GENERATOR

Original Filed April 30, 1936 2 Sheets-Sheet 1

Fig. 1



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Fig. 2

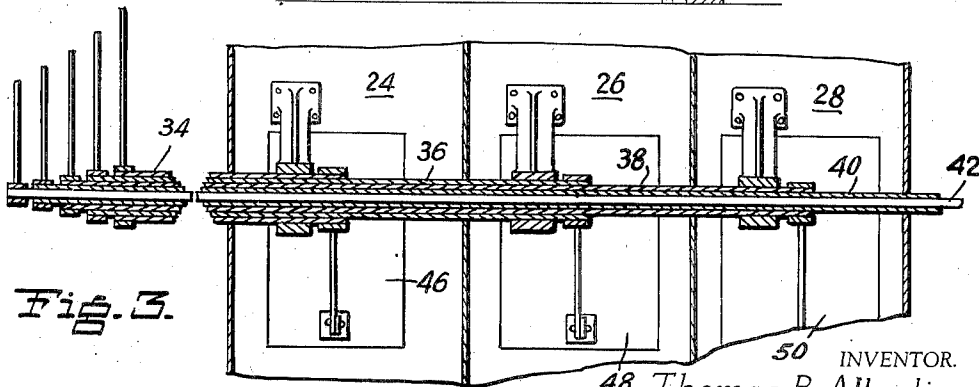
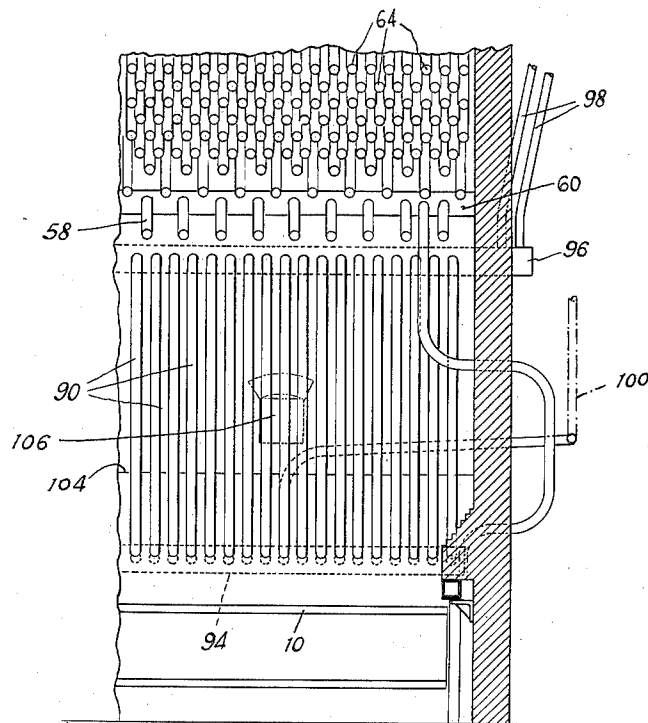


Fig. 3.

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UNITED STATES PATENT OFFICE

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STEAM GENERATOR

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4 Claims. (Cl. 122—235)

This invention relates to furnaces, and more particularly to furnaces which are adapted for use with steam boilers. It comprehends improvements in a steam boiler furnace burning solid fuel on a mechanical stoker having the combustion air supplied under pressure.

An object of the invention is to provide a stoker fired steam boiler furnace in which the discharge end of the stoker will not be injured by reason of overheating when that end of the stoker is exposed to the heat of the furnace.

A further object of the invention is to protect a rear wall of a stoker fired boiler furnace from excessive damage by overheating and fusion.

Another object of the invention is to provide an improved low-head boiler utilizing stoker firing, the point of release of volatile hydrocarbons being remote from the gas outlet of the furnace.

Still another object of the invention is to promote mixing of the combustible gases from the feed end of a stoker with excess air from the discharge end by creating a turbulent condition and a subdivision of one with reference to the other.

Other objects of the invention will appear as the accompanying description proceeds.

The invention will be best understood from the description and the annexed drawings showing an illustrative embodiment of the invention.

In the drawings:

Fig. 1 is a view in the nature of a vertical section of a stoker fired steam boiler furnace embodying the invention.

Fig. 2 is a partial view in the nature of a vertical section taken on the line 2—2 of Fig. 1 and looking in the direction of the arrows.

Referring to Fig. 1 of the drawings, there is shown a chain grate stoker 10 which receives fuel from the hopper 12 and carries the fuel through the combustion chamber toward the ash pit 14. As the fuel is moved along it is caused to be burned by combustion air supplied under pressure through the ducts 16—23. The air in the ducts may be maintained at different and desired pressures by control mechanism in the chambers 24—32 below the ducts to supply more air where the volatile is distilling and less where coke is burning out at the ash pit end of the stoker. As shown, this control mechanism includes a series of independently operable telescoping shafts 34—42 which are connected respectively to the dampers 46—54.

The refractory material of the arch 56 above the stoker is supported by the horizontally inclined tubes 58, stiffened centrally by bars 55,

and connected through the headers 60 and 62 into the circulation of the boiler. This arch, which radiates heat to the fuel bed to promote ignition, extends to the baffle 57, which protects the bars 55, and it is arranged so as to provide a furnace outlet 59, at a point relatively remote from the point of distillation of the volatile hydrocarbons. This insures a long path of travel for these furnace gases and provides time for air mixing and the completion of combustion before the gases contact with the convection heating surface of the boiler. The tubes 58 extend across the furnace outlet as slag screen tubes, being there widely spaced apart vertically and horizontally to so function, and to provide adequate gas flue area between them.

The circulatory system of the boiler includes a bank of horizontally inclined steam generating tubes 64 connected at their lower ends to down-take headers 66 and at their upper ends to uptake headers 68. The latter are connected at their lower ends to the header 60 by members 70, and at their upper ends they are connected to the steam water drum 72 by the horizontal circulators 74. Leading downward from the water space of the drum 72 are downtake members 76 connected to the upper ends of the header 66. The lower ends of these latter headers are connected to the header 62 by the tubes 78.

As fuel is burned on and above the stoker, the furnace gases pass upwardly through the first gas pass as indicated by the arrow 80. They contact with a superheater 82 at the top of this gas pass, and then turn and pass downwardly through a second gas pass as indicated by the arrow 84. At the bottom of the latter gas pass the gases again reverse their direction and proceed upwardly as indicated by the arrow 86 to the flue 88.

Above the ash pit 14 there is an open arch radiant heat screen and gas mixer consisting of a row of spaced water cooled tubes 90. These tubes have their ends extending through the rear wall 92. Their lower ends are connected to the header 94 as shown and their upper ends to the header 96, which, in turn, communicates by means of the uptake tubes 98 with the steam water drum 72. In order that adequate water for circulation through the screen be provided, the header 94 is directly connected with the water space of the drum 72 by means of the tube 100. Also, the headers 94 and 96 may be directly connected by recirculators 102. Above the lower horizontal positions of the tubes 90, and set against the wall 92, is a triangular ledge

shield 104, preferably constructed of light weight refractory material. This ledge shield extends over the ash pit opening so as to minimize the transmission of radiant heat from the combustion chamber toward the right hand end of the stoker and the clinker pit, and also to discharge solid matter that may fall onto it, toward the rear end of the chain grate instead of allowing it to fall directly into the ash pit.

Due to the use of the above described screen in front of the rear wall there is a cooling effect and a gas mixing effect, both of which are advantageous.

In the operation of chain grate stoker furnaces the volatile of the coal is distilled near the feed end of the stoker after the fuel bed has been heated by radiation from above, and this volatile matter requires considerable air to complete its combustion. At its opposite end, the stoker discharges ash into the pit, and it is important that the last residue of coke be burned out of the ash before this occurs. To insure the complete combustion of the last of the coke in the ash, it is necessary that air be supplied to the discharge end of the stoker, and, as the particles of coke are scattered in the ash, excess air passes up through this part of the stoker. In order that the total excess air be kept at a minimum, the volatile distilling zone is given less air than is locally required for complete combustion, and the gases from this zone which contain unburned gaseous combustible must be mixed with the gases from the ash end of the stoker which contains an excess of air. A thorough mixing of these gases is accomplished by the illustrative apparatus, and such thorough mixing is based upon the recognition of the fact that two large and smooth flowing streams of gas mix slowly even when brought into contact, but when either one is sub-divided into many small streams, especially when they are agitated, the desired mixing is promoted and the flame length is shortened.

Some of the gases rising from the rear end of the stoker, and having an excess of air, pass between the screen tubes 90 as they rise. These gases then emerge from positions between the tubes as a series of narrow streams having a vibratory motion. They contact with the stream of gases with unburned combustible outside of the screen. This promotes a thorough mixing, and further mixing is produced by the action of the remainder of the gases rising from the rear end of the stoker. They strike the bottom bends of the open arch screen tubes 90 and are deflected toward the main stream as a series of separate streams which penetrate, and mix with, the gases of the main stream. Thus the screen tubes 90 have two different, and supplementary, mixing actions.

At the ash end of the stoker, solid matter comprising particles of ash and coke may be blown upward by the flow of air and gas from the chain grate, and the construction of the tube screen and its relation to the ledge 104 is such that such particles of ash and coke will be deflected by the screen tubes and caused to return to the chain grate instead of being blown upward to the tube bank, or dropping into the ash pit. This promotes complete combustion of the coke, minimizes the loss of coke in the pit ash, and reduces the amount of fly ash in and beyond the furnace.

The bare tubes of the open arch screen serve to cool the furnace in addition to promoting

complete combustion, with a minimum of excess air, and a minimum of flame shortening action. They also protect the ash end of the stoker and protect the ash in the pit from such overheating as might result in the formation of excessive amounts of clinker and slag. At the same time, they cool the rear wall of the furnace so that fly ash contacting with that wall cannot flux with the refractory and damage the wall. Slagging of the side walls of the furnace and of the boiler tubes is reduced, and experience with the described stoker has indicated that there is very little bridging of slag across the screen tubes 90. Any slag which cools upon these tubes may be periodically removed with a water lance, operating the latter through the access opening 106 in the wall 92.

A characteristic feature of the present installation involves the chain grate stoker arrangement wherein the fuel inlet is located at the lower front end of the combustion chamber while the gas outlet is positioned at its upper rear end. The boiler is thereby of advantageous construction where headroom is limited. The furnace gases travel in a path which approaches the horizontal, as contrasted with the gas travel in the usual chain grate stoker installation. The latter is close to the vertical.

In the illustrative boiler the general movement of gases from the fuel bed is diagonally and rearwardly through the furnace, and the zone of highest gas velocity before reaching the slag screen tubes 58 which extend across the furnace gas outlet 59 is immediately below the tubes 58. Slagging at the entrance of the first gas pass 80 is not only minimized by these tubes, but also by the cooling effect of the open arch screen tubes 90 which face the furnace and the slag screen tubes and cool both the gases approaching those tubes and any slag which may accumulate on those tubes and at the furnace gas outlet.

The rear arch formed by the tubes 90 offers no appreciable restriction of the combustion chamber throat, and the gases arising from the grate section above the duct 23 can pass directly upwardly. Also, the upper ends of the tubes 90 are so spaced from the entrance to the first boiler gas pass that there is no appreciable restriction of gas flow.

The boiler is preferably of top hung construction, the uptake headers being supported from the beam 108 and the downtake header 66 being supported from the drum 72. The arch 56 may be partly supported by hangers 110 which are connected at their lower ends to the tubes 58 and at their upper ends to the lowermost tubes of the steam generating bank 64.

Whereas, the invention has been illustrated and described with reference to one particular embodiment of the invention, it is to be appreciated that this embodiment is merely illustrative. It is not intended as any limitation of the invention. It should be further understood that some of the features of the invention may be used independently of others.

I claim:

1. In combination with a steam boiler, a furnace having a bridge wall at one end, a stoker advancing a fuel bed through the furnace and toward the bridge wall, means forming a clinker pit adjacent the bridge wall and below the discharge end of the stoker, fluid cooled screen tubes extending from the bridge wall to a position above the discharge end of the stoker wherein

they contact with combustion products of the fuel bed, said screen tubes extending from the fuel bed upwardly and rearwardly, means for connecting the screen tubes into the circulation in the boiler, and a shield consisting of non-metallic refractory material and disposed on the lower ends of the screen tubes above the clinker pit, said shield having a surface sloping downwardly away from the bridge wall and toward the discharge end of the stoker so as to cause any cooled ash or similar combustion products cooled by the screen tubes to pass downwardly to the discharge end of the stoker.

2. In a vapor generating installation, a furnace, fluid heating tubes exposed to heat from the furnace gases, a stoker, means including a bridge wall and forming an ash pit at the discharge end of the stoker, excess air supply means and means for preventing the escape of unburned carbon; said means including a fluid cooled screen and a refractory shield at the discharge end of the stoker and beyond the range of the excess air supply means, the shield presenting a surface inclined downwardly from the bridge wall toward a position substantially above the discharge end of the stoker.

3. In fluid heat exchange apparatus, a furnace,

fluid heat exchange tubes exposed to heat from the furnace gases, a stoker, means forming an ash pit at the discharge end of the stoker, means for supplying a part of the stoker near the discharge end with a considerable excess of air so that unburned carbon particles are lifted from the stoker bed, a fluid cooled screen comprising spaced tubes extending across the path of movement of the excess air with the unburned carbon particles suspended therein, and means for returning the ash formed by the burning of said particles to the stoker bed at a position beyond the point of application of the excess air.

4. In fluid heat exchange apparatus, a furnace, fluid heat exchange tubes exposed to heat from the furnace gases, means forming an ash pit, a forced draft stoker for the progressive burning and feeding of fuel toward the ash pit, fluid cooled screen tubes projecting over the discharge end of the stoker and promoting the mixture of air and particles floated from the stoker bed by the air blast near the discharge end of the stoker, and means including a shield for returning separated non-combusted particles to the rear portion of the traveling grate of the stoker, said shield being disposed beyond the range of the air blast.

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