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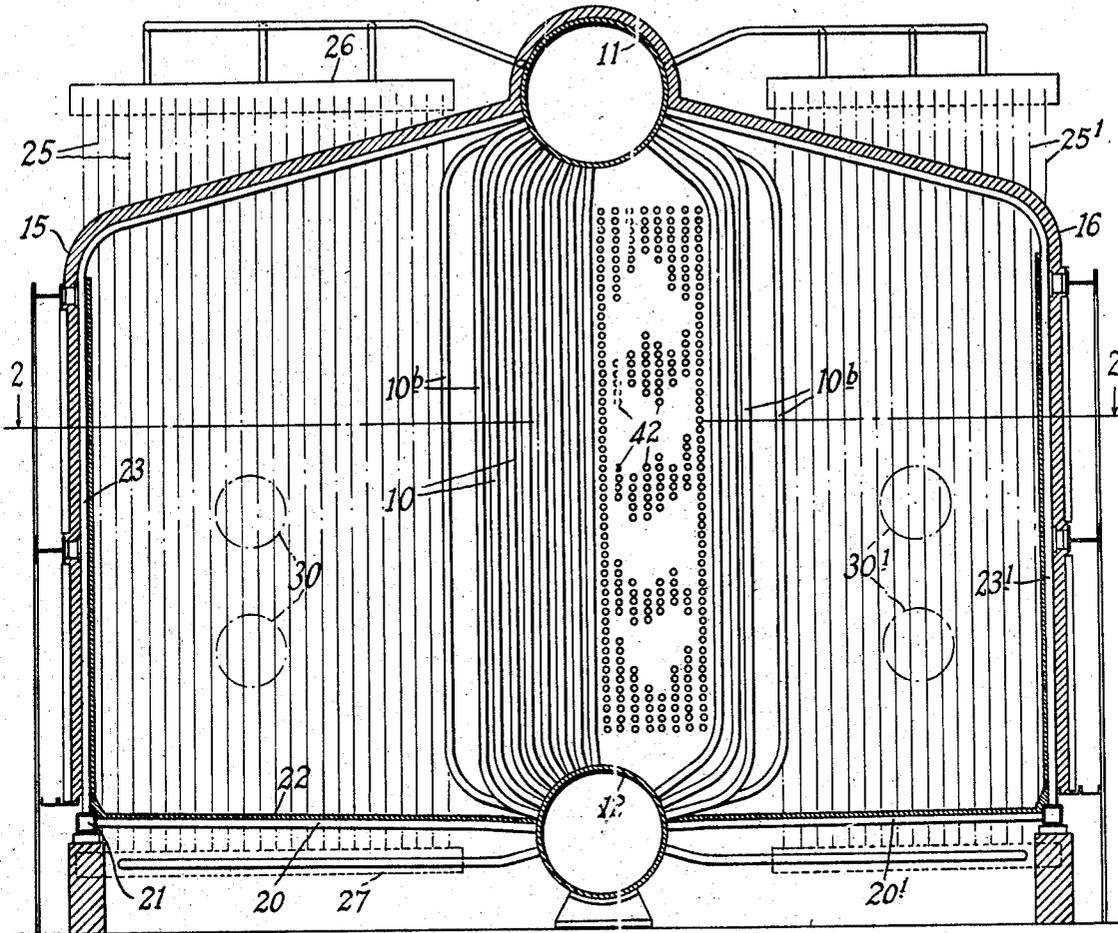
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STEAM GENERATOR

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2 Sheets-Sheet 1

Fig. 1



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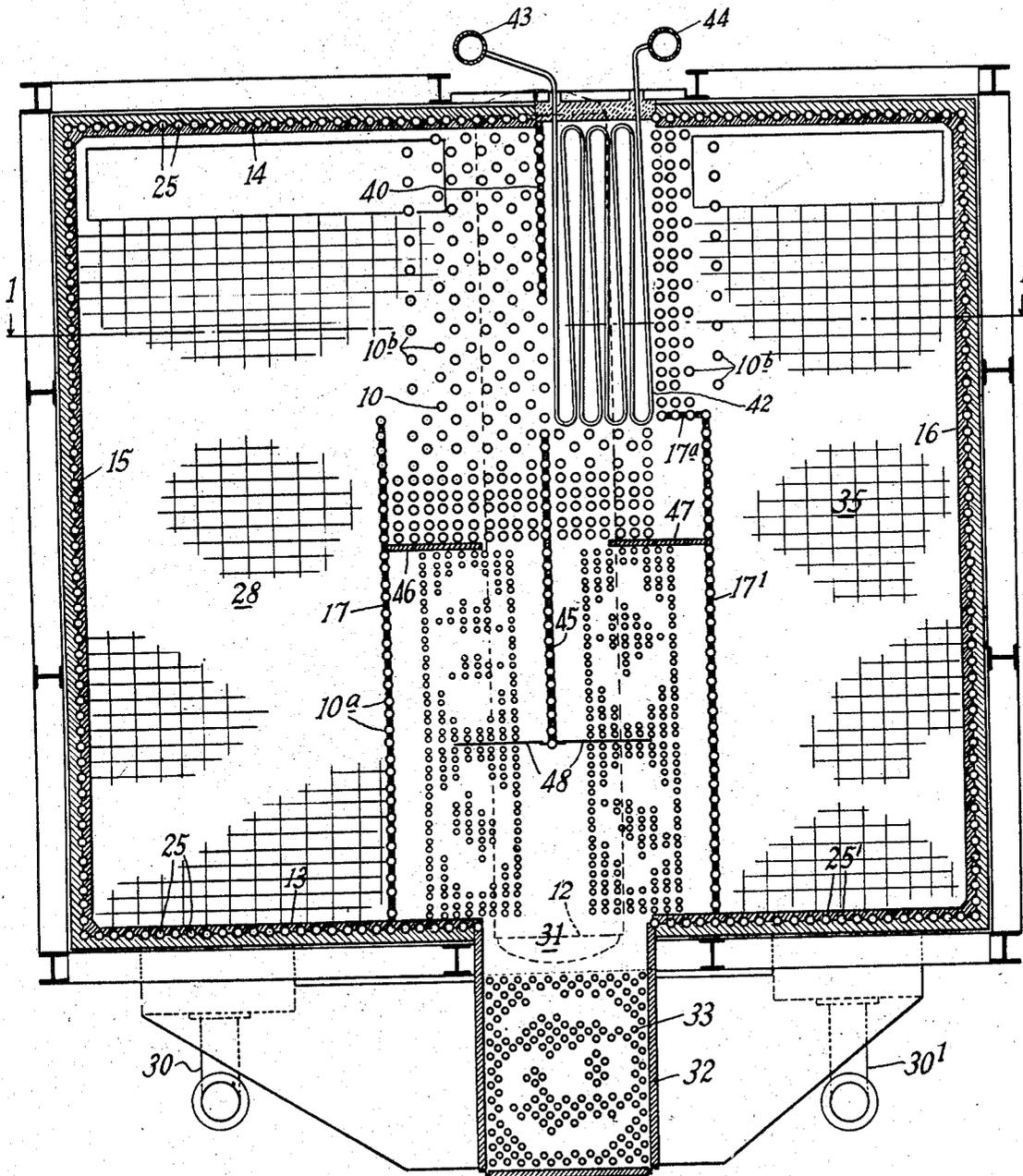
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Fig 2



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UNITED STATES PATENT OFFICE

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STEAM GENERATOR

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a corporation of New Jersey

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4 Claims. (Cl. 122-336)

The present invention relates to the construction and operation of vapor generating units of moderate capacity which are particularly characterized by their small floor space and low head room requirements, and more particularly to a water tube steam boiler of the two-drum type having a single bank of generating tubes connecting the drums and a furnace chamber laterally adjoining the space occupied by the tube bank and connected thereto at only one end.

The main object of my invention is the provision in a vapor generating unit of the character described of an improved location and arrangement of the vapor superheating surface, and of means for regulably controlling the degree of superheat effected over a relatively wide range of operating conditions.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of my invention.

Of the drawings:

Fig. 1 is a sectional elevation taken on the line 1-1 of Fig. 2; and

Fig. 2 is a horizontal section taken on the line 2-2 of Fig. 1.

In the steam boiler unit illustrated in the drawings a vertically disposed bank of steam generating tubes 10 is arranged between and connected to a pair of horizontally extending upper and lower drums 11 and 12 respectively. The tube bank is arranged along the central portion of and enclosed by a setting of rectangular shape including a front wall 13, rear wall 14, and side walls 15 and 16, constructed as hereinafter described. Tubes 10* in the outermost row of the tube bank at the side adjacent the side wall 15 are spaced a substantial distance from the remaining portion of the tube bank, with the inter-tube spaces closed by refractory material or other suitable provisions, to form a vertically extending fluid cooled partition 17 extending from the front wall 13 rearwardly for a substantial distance along the tube bank leaving a space between its rear end and the rear wall.

A row of outwardly inclined tubes 20 extends from the lower drum 12 to a box header 21 extending along the bottom of the side wall 15. The spaces between the tubes 20 are closed by refrac-

tory material or metallic blocks 22 to form a floor. A row of tubes 23 extends upwardly from the header 21 in the side wall 15, with their upper portions inclined and connected to the drum 11. The spaces between the inclined portions of the tubes 23 are closed in any suitable manner to form a roof. The front and rear walls are also water cooled by vertically disposed tubes 25, connected at their upper and lower ends to external headers 26 and 27 respectively, which in turn are connected into the adjacent drums. A fluid cooled furnace chamber 28 is thus formed laterally adjoining the space containing the tube bank 10 and opening thereto at its rear end.

One or more fuel burners 30 are arranged to discharge a stream of fluid fuel, such as pulverized coal, oil or gas, substantially horizontally through the front wall 13 into the furnace chamber 28. With this arrangement the burning fuel and heating gases travel rearwardly in the furnace chamber 28. The furnace is designed to effect complete combustion of the fuel therein and the heating gases pass around the rear end of the partition 17 and forwardly in contact with the tubes of the main generating bank. After traveling across the tube bank as hereinafter described, the heating gases exit through an outlet 31 in the front wall 13 into a vertical flue 32 in which is arranged an air heater 33 for effecting heat transfer between the exiting heating gases and the air subsequently supplied for combustion purposes to the unit.

Steam generating units of the general type heretofore described have gone into extensive use in recent years. Steam superheating surface is usually incorporated in such units in association with the main tube bank. Such superheaters however, have been usually arranged so that the superheater surface is normally contacted by substantially all of the heating gases passing through the unit and-consequently the final superheat temperatures will normally fluctuate over a relatively wide range in operation. In accordance with the present invention, superheating surface is incorporated in the unit in a location where it is adequately protected from excessive temperature conditions and also where, in association with an auxiliary furnace, the final superheat can be readily controlled over a wide range of operating conditions. A constant final superheat temperature or different final superheat temperatures can be effected as desired. For this purpose the unit also comprises an auxiliary furnace chamber 35 laterally adjoining the space containing the main tube bank 10 at its side opposite the fur-

nace chamber 28. The furnace chamber 35 is similar in construction but of narrower width than the furnace chamber 28, being defined by floor tubes 20', side wall tubes 23', end wall tubes 25', and a fluid cooled partition 17' similar to the partition 17 but having an inwardly projecting section 17^a at its rear end. Tubes 10^b in the outermost rows at opposite sides of the main bank between the rear end of the partitions 17 and 17' and the rear wall 14 are spaced to form a slag screen preventing slagging of the more closely spaced generating and superheating tubes subsequently contacted by the gases, when a slag-forming fuel is burned. A central partition 40 extends forwardly from the rear wall 14 for a short distance, being preferably formed by closing the corresponding intertube spaces of one row of tubes with refractory. A number of tube rows are omitted in the portion of the main tube bank between the rear wall and the ends of the partitions 17, 17' at the auxiliary furnace side of the partition 40. A group of multiple-looped horizontally arranged superheater tubes 42 are arranged in this space with their ends connected to external vertical inlet and outlet headers 43 and 44 respectively. With this arrangement the superheater will be self-draining. The superheater tubes 42 will be mainly heated by the heating gases entering the tube bank from the auxiliary furnace 35. The superheater tubes may also receive a small amount of radiation from the auxiliary furnace, being protected from excessive temperatures by the portions of the tube bank between the superheater tubes and the two furnaces.

To provide effective heat transfer conditions through the tube bank a second central partition 45, formed by tubes and refractory, is arranged forwardly of and in line with the partition 40. The partitions are arranged with their adjacent ends spaced to provide a gas equalization passage therebetween. Transverse baffles 46 and 47 extend inwardly from the partitions 17 and 17' and transverse baffles 48 extending outwardly from the forward end of the partition 45 cooperate with the partitions in defining a sinuous horizontal flow path for the heating gases over most of the tube bank to the outlet 31. The gap between the partitions 40 and 45 permits equalization in the gas pressure conditions through the portions of the gas flow path at opposite sides of the partition 45, in the event that such differences would tend to exist due, for example, to a difference in the fuel burning rates or air supplies to the furnace chambers 28 and 35.

With the described arrangement and the main furnace 28 alone in operation, the steam will be mainly generated in its furnace wall and partition tubes and the tubes in the rear and intermediate portions of the tube bank. The remaining tubes will act as downcomers. The steam generated passes into the upper drum 11 thence to the superheater header 43, and through the superheater tubes 42 to the outlet header 44. Only a low degree of superheat is attained with the main furnace alone in use by the heating of the portion of the superheater tubes forwardly of the partition 40 by gases passing through the equalization gap and over the auxiliary furnace side of the tube bank. When higher superheat temperatures and steam generating rates are desired the auxiliary burner 30' is operated, causing the superheater tubes to be heated over substantially their entire length,

and accordingly increasing the amount of heating gases contacting with the tubes in the adjacent portion of the tube bank. The fuel and air supplies to the auxiliary burners 30' are regulated by the valve and damper means customarily provided to control the heating effected thereby, and accordingly the superheat temperatures may be readily controlled over a wide range. The construction described depends only upon the control of combustion conditions in the auxiliary furnace for regulating the superheat temperatures, advantageously avoiding the use of any control dampers for regulating the amount of gases contacting with the superheater surface with the corresponding problem of damper maintenance, and also of any by-passing of gases around the superheater with a corresponding loss in heat transfer efficiency and expense for inactive heating surface.

While in accordance with the provisions of the statutes I have illustrated and described herein the best form of my invention now known to me, those skilled in the art will understand that changes may be made in the form of the apparatus disclosed without departing from the spirit of the invention covered by my claims, and that certain features of my invention may sometimes be used to advantage without a corresponding use of other features.

I claim:

1. A steam boiler having a pair of horizontally disposed upper and lower drums, a bank of vertically disposed water tubes connected to said drums along the length thereof, means forming a furnace chamber laterally adjoining the space containing said tube bank and communicating with one end thereof, means forming a second furnace chamber laterally adjoining the space containing said tube bank and communicating with the same end thereof, a central partition arranged to partly divide said tube space longitudinally thereof, means for burning fuel in and effecting a flow of heating gases longitudinally through each of said furnace chambers and then through said tube space, and a steam superheater arranged within said tube space between said central partition and said second furnace chamber and receiving heat mainly from said second furnace chamber.

2. A steam boiler having a pair of horizontally disposed upper and lower drums, a bank of vertically disposed water tubes connected to said drums along the length thereof, means forming a main furnace chamber laterally adjoining the space containing said tube bank and communicating with the rear end thereof, means forming an auxiliary furnace chamber laterally adjoining the space containing said tube bank and communicating with the rear end thereof, a vertical partition arranged to partly divide said tube space longitudinally thereof, means at the front end of each of said furnace chambers for burning fuel therein and effecting a flow of heating gases longitudinally through each of said furnace chambers and then through said tube space, and a steam superheater arranged within the rear portion of said tube space between said central partition and the rear end of said auxiliary furnace chamber and being heated mainly by the heating gases from said auxiliary furnace chamber.

3. A steam boiler having a pair of horizontally disposed upper and lower drums, a bank of vertically disposed water tubes connected to said drums along the length thereof, fluid cooled par-

5 titions forming the inner walls of separate furnace chambers laterally adjoining and at opposite sides of the space containing said tube bank and communicating with the rear end thereof, a central partition arranged to divide said tube space longitudinally thereof, transversely extending baffle means cooperating with said central partition to define a plurality of serially connected gas passes extending transversely of said tube space at each side of said central partition, means for burning pulverized fuel in and effecting a flow of heating gases through each of said furnace chambers and then through said serially connected gas passes, and a steam superheater arranged within the rear portion of said tube space and receiving heat mainly by convection.

10 4. A steam boiler having a pair of horizontally disposed upper and lower drums, a bank of vertically disposed water tubes connected to said drums along the length thereof, means including rows of partition-forming tubes connected to said drums forming separate fluid cooled furnace

chambers laterally adjoining and at opposite sides of the space containing said tube bank and communicating with the rear end thereof, a fluid cooled central partition arranged to divide said tube space longitudinally thereof, transversely extending baffle means cooperating with said central partition to define a plurality of serially connected gas passes extending transversely of said tube space at each side of said central partition, means at the front end of each of said furnace chambers for burning pulverized fuel therein and effecting a substantially horizontal flow of heating gases longitudinally through each of said furnace chambers and then through said serially connected transverse gas passes, and a steam superheater arranged within the rear portion of said tube space at one side of said central partition and receiving heat mainly by convection from the heating gases from only one of said furnace chambers.

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