

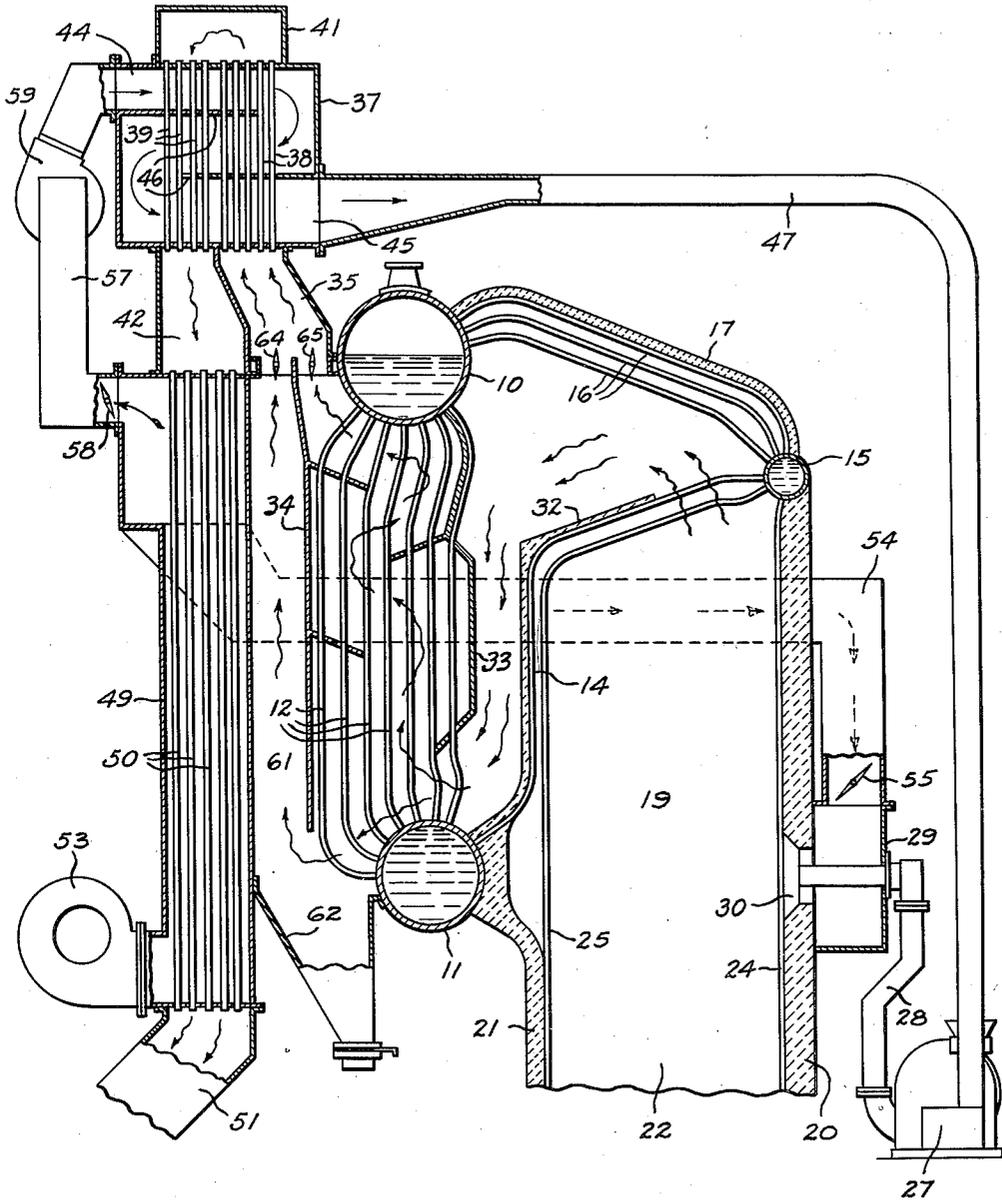
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TEMPERATURE REGULATION OF AIR HEATERS

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## TEMPERATURE REGULATION OF AIR HEATERS

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This invention relates to vapor generators, and more particularly to vapor generators of the type having a combustion chamber or furnace fired with pulverized fuel, the fuel being burned in suspension.

In such apparatus it is a common practice to provide a pulverizer to prepare the fuel, which is conveyed to the furnace by a current of so-called "primary" air. Additional or so-called "secondary" air is supplied to the furnace at the rate required to complete the combustion of the fuel. It is also customary to utilize the flue gases which leave the heating surfaces of the vapor generator to raise the temperature of an air stream, and to use this air stream to supply both the primary air and the secondary air requirements. The heated secondary air improves the combustion conditions, and the heated primary air is of great assistance in drying the fuel and in facilitating the pulverization thereof.

In installations which burn fuels of unusually high moisture content, the prior arrangements are not entirely satisfactory. In such installations it is desirable to heat the primary air to considerably higher temperatures than the secondary air. Furthermore, in the case of steam generators operating at comparatively low pressures the flue gases are relatively cool, and it may be desirable to heat the primary air to a temperature exceeding the normal temperature of the flue gases. This is not possible with apparatus as ordinarily constructed heretofore.

It is accordingly one object of the present invention to provide a vapor generator fired with pulverized fuel and particularly adapted for operation with high moisture fuel.

It is a further object of the invention to provide a steam generator fired with pulverized fuel and capable of operating satisfactorily with high moisture fuel even when generating steam at relatively low pressures.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

Referring to the drawings illustrating one embodiment of the invention, and in which like reference numerals indicate like parts, the single figure is a vertical longitudinal section through a steam generator arranged for pulverized fuel firing.

The embodiment illustrated comprises a transverse steam-and-water drum 10, a transverse water drum 11 therebeneath, and a bank of up-

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right water tubes 12 connecting the drums. A row of water tubes 14 extends upwardly from the front portion of the lower drum 11 and then forwardly to a small transverse drum or header

15. Water tubes 16 extend rearwardly from the front drum 15 to the steam-and-water drum 10, these tubes serving to support the roof 17 of the boiler setting. A furnace or combustion chamber 19 is located in front of the lower drum 11, this furnace having a front wall 20 extending upwardly to the front drum 15, a rear wall 21 extending upwardly to the lower drum 11, and two side walls 22 (one only being shown). Water wall tubes 24 are associated with the front wall 20 and are connected at their upper ends to the front drum 15. Water wall tubes 25 are associated with the rear wall 21, and the upper portions of these tubes are bent forwardly to connect with the front drum 15. A suitable pulverizer 27 delivers pulverized fuel through a pipe 28 to a burner 29 mounted adjacent an opening 30 in the front wall 20.

The gaseous products of combustion from the furnace 19 are guided in a proper course through the boiler by means of suitable baffles. As shown, a baffle 32 extends upwardly from the lower drum 11 along the tubes 14 to direct the gases upwardly between the front portions of the tubes 14 and 25, adjacent the front drum 15. A baffle 33 extends downwardly from the steam-and-water drum 10 along the front portion of the tube bank 12, so that the gases are directed downwardly between the baffles 32 and 33 and into the lower portion of the tube bank. An upright baffle 34 is located directly behind the tube bank to cooperate with the baffle 33 in defining a passage through which the gases may flow upwardly in contact with the tubes 12 and thence into a passage 35.

Somewhat above and to the rear of the steam-and-water drum 10 there is provided a primary air heater comprising a casing 37, a front bank of upright tubes 38 extending through the casing, and a rear bank of upright tubes 39 extending through the casing. The gas passage 35 leads directly to the lower ends of the front tubes 38. At the top of the casing 37 there is provided a box 41 which serves to direct the gases from the upper ends of the front tubes 38 into the upper ends of the rear tubes 39. After flowing downwardly through the rear tubes, the gases enter a passage 42 behind the passage 35. The casing 37 has an air inlet 44, an air outlet 45 and two staggered horizontal baffles 46 to direct air in three passes across the tubes 38 and 39. The out-

let 45 is connected by a duct 47 to the fuel pulverizer 27. Beneath the primary air heater 37 there is provided a secondary air heater comprising a casing 49 through which there extends a bank of vertical tubes 50 with their upper ends in communication with the passage 42 and their lower ends in communication with a passage 51. This passage 51 may lead to an induced draft fan or stack (not shown). Air is delivered to the lower end of the casing 49 by a forced draft fan 53, and the heated air may escape from the upper end of the casing 49 to the burner 29 through a duct 54 provided with a damper 55. Heated air may also escape from the upper end of the casing 49 through a duct 57 provided with a damper 58 and leading to a fan 59, the latter serving to discharge the air through the inlet 44 of the primary air heater.

In some installations utilizing high moisture fuel, and particularly with steam generators operating at low pressures, the flue gases which have traveled upwardly in contact with the water tubes 12 may be at a temperature lower than that which is desirable for the primary air. In order that the primary air may be heated sufficiently, means is provided to by-pass a controlled portion of the flue gases, out of contact with the water tubes. For this purpose the secondary air heater casing 49 is spaced rearwardly from the baffle 34 to provide a vertical passage 61 connected at its upper end with the passage 35. Gases may enter the lower end of the passage 61 by flowing rearwardly directly across the lower portions of the water tubes 12 and beneath the lower edge of the baffle 34, which is spaced from the water drum 11. A hopper 62 is provided behind the drum 11 to collect any fly-ash which is discharged from the gases as they enter the passage 61. Dampers 64 and 65 are provided in the lower portion of the passage 35 and located respectively behind and in front of the baffle 34, to control the proportionate flow of gases on opposite sides of this baffle.

The operation of the invention will now be apparent from the above disclosure. Fuel and air will enter the furnace 19 through the opening 30, and combustion will take place, the gaseous products of combustion flowing upwardly across the front portions of the water tubes 14 and 25 and then rearwardly and downwardly between the baffles 32 and 33 to the lower portion of the water tube bank 12. Here the gases will divide in accordance with the relative adjustments of the dampers 64 and 65, a portion of the gases flowing upwardly in contact with the tubes 12 between the baffles 33 and 34 to enter the passage 35, and the remainder flowing upwardly through the by-pass 61 to enter the passage 35 and there mix with the first portion. Since the gases in the passage 61 have by-passed most of the heat-absorbing surface of the water tubes 12, these gases will be considerably hotter than the gases which flow upwardly in front of the baffle 34. Consequently the dampers 64 and 65 provide a means for varying the temperature of the mixed gases in the passage 35. All of these mixed gases flow upwardly through the tubes 38 to the box 41, thence downwardly through the tubes 39 to the passage 42, and downwardly through the tubes 50 to the passage 51. Steam will be generated in the various water tubes by reason of heat absorption from the gases, and this steam will be withdrawn from the upper drum 10 to a place of use.

The fan 53 will supply air to the lower end of

the casing 49, and this air will flow upwardly in contact with the tubes 50 and thus be heated in a desired manner. From the upper end of the casing 49 a part of the heated air will travel through the duct 54 to the burner 29, under control of the damper 55, and enter the furnace as secondary air for combustion purposes. The remainder of the heated air will flow past the damper 58 and through the duct 57 to the fan 59 and thence into the casing 37. This air will travel around the baffles 46, making three passes across the tubes 38 and 39, and then through the duct 47 to the pulverizer 27, where it will serve as primary air to dry the fuel and convey the same through the pipes 28 to the burner 29.

By adjustment of the dampers 64 and 65 the temperature of the mixed gases in the passage 35 may be varied as desired, and in this manner the temperature of the primary air entering the duct 47 may be controlled. If necessary, for example when burning very wet fuels, the primary air temperature can be made to exceed the temperature of the flue gases approaching the damper 65. The primary air fan 59 renders it unnecessary to maintain sufficient pressure in the secondary air supply to overcome the resistance of the primary air heater. Thus the load on the secondary air fan 53 may be appreciably decreased.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A vapor generator comprising liquid-containing elements, a primary air heater, a secondary air heater, means to supply air to the secondary air heater to be heated thereby, means to conduct part of the heated air from the secondary air heater to the primary air heater to be heated thereby, a passage through which hot gases may flow in contact with the said liquid-containing elements and thus be appreciably reduced in temperature, a by-pass for said passage through which hot gases may flow and be discharged at a temperature appreciably exceeding the temperature of the gases leaving the said passage, means to control the relative rates of gas flow in the passage and the by-pass, means to conduct all the gases from both the passage and the by-pass directly to the primary air heater, and means to conduct the gases from the primary air heater to the secondary air heater.

2. A vapor generator comprising a bank of substantially parallel liquid-containing tubes, a primary air heater, a secondary air heater, means to supply air to the secondary air heater to be heated thereby, means to conduct part of the heated air from the secondary air heater to the primary air heater to be heated thereby, a passage through which hot gases may flow along the tube bank in contact with the tubes and thus be appreciably reduced in temperature, a by-pass for the passage which hot gases may enter by flowing directly across one end of the tube bank without appreciable reduction in temperature, means to control the relative rates of gas flow in the passage and the by-pass, means to conduct all the gases from both the passages and the by-pass directly to the primary air heater, and means to conduct the gases from the primary air heater to the secondary air heater.

3. A vapor generator comprising a bank of upright liquid-containing tubes, a primary air heater, a secondary air heater, means to supply air to the secondary air heater to be heated

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thereby, means to conduct part of the heated air from the secondary air heater to the primary air heater to be heated thereby, means to deliver hot gases to the tube bank adjacent one end thereof, a passage through which a portion of the hot gases may flow along the tube bank in contact with the tubes and thus be appreciably reduced in temperature, a by-pass for the passage which a portion of the hot gases may enter by flowing directly across the said end of the tube bank without appreciable reduction in temperature, means to control the relative rates of gas flow in the passage and the by-pass, means to conduct all the gases from both the passage and the by-pass directly to the primary air heater, and means to conduct the gases from the primary air heater to the secondary air heater.

4. A vapor generator comprising a bank of upright liquid-containing tubes, a primary air heater, a secondary air heater, means to supply air to the secondary air heater to be heated thereby, means to conduct part of the heated air from the secondary air heater to the primary air heater to be heated thereby, means to deliver hot gases to the tube bank adjacent the lower end thereof, a passage through which a portion of the hot gases may flow upwardly along the tube bank in contact with the tubes and thus be ap-

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preciably reduced in temperature, a by-pass for the passage which a portion of the hot gases may enter by flowing directly across the lower end of the tube bank without appreciable reduction in temperature, means to control the relative rates of gas flow in the passage and the by-pass, means to conduct all the gases from both the passage and the by-pass directly to the primary air heater, and means to conduct the gases from the primary air heater to the secondary air heater.

CHARLES F. HAWLEY.

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