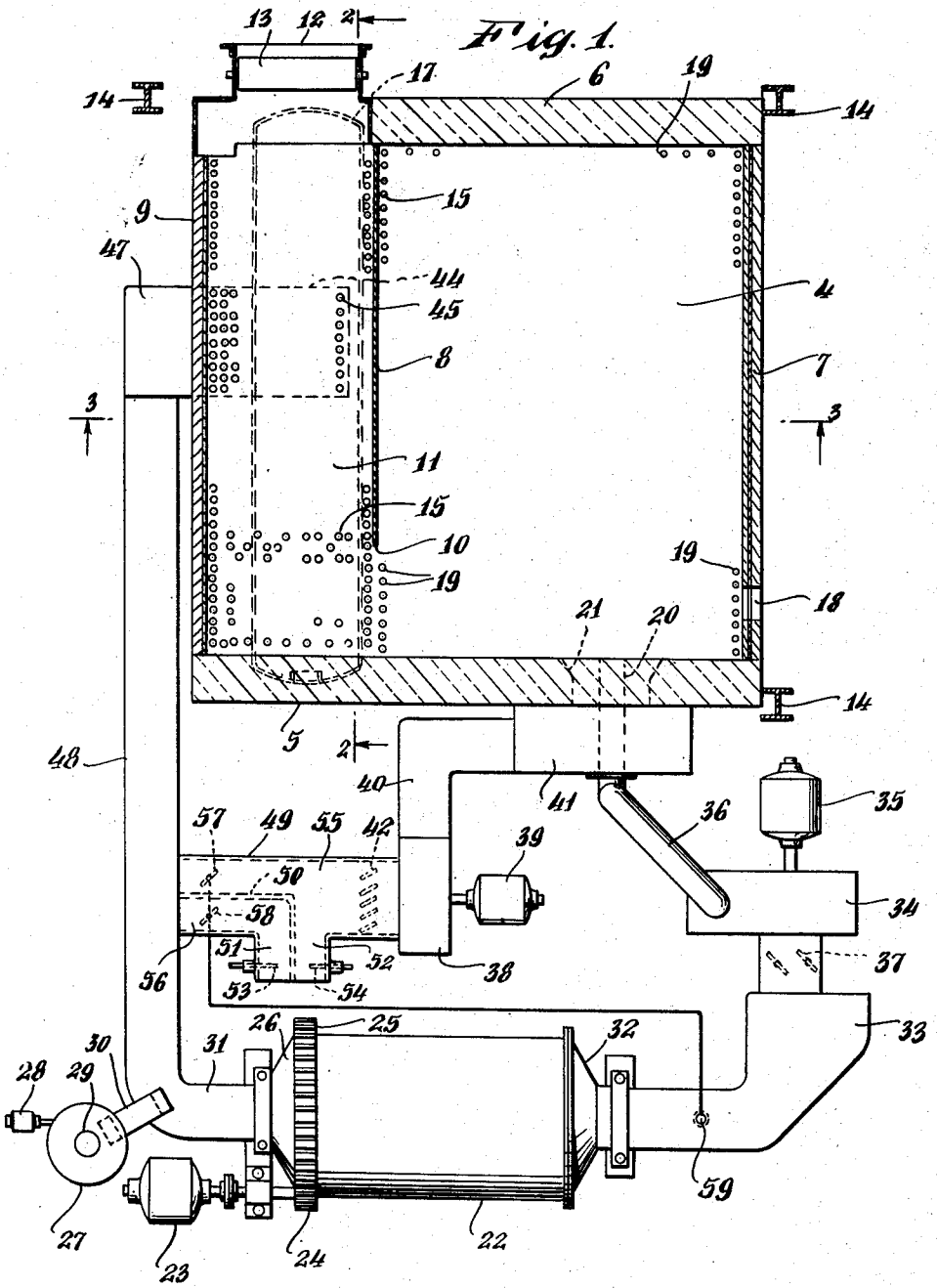
Oct. 13, 1953 F. FALLA 2,655,138

AIR HEATER MOUNTED IN THE CONVECTION SECTION OF FURNACES

Original Filed Nov. 29, 1948 4 Sheets-Sheet 1

Fig. 1.



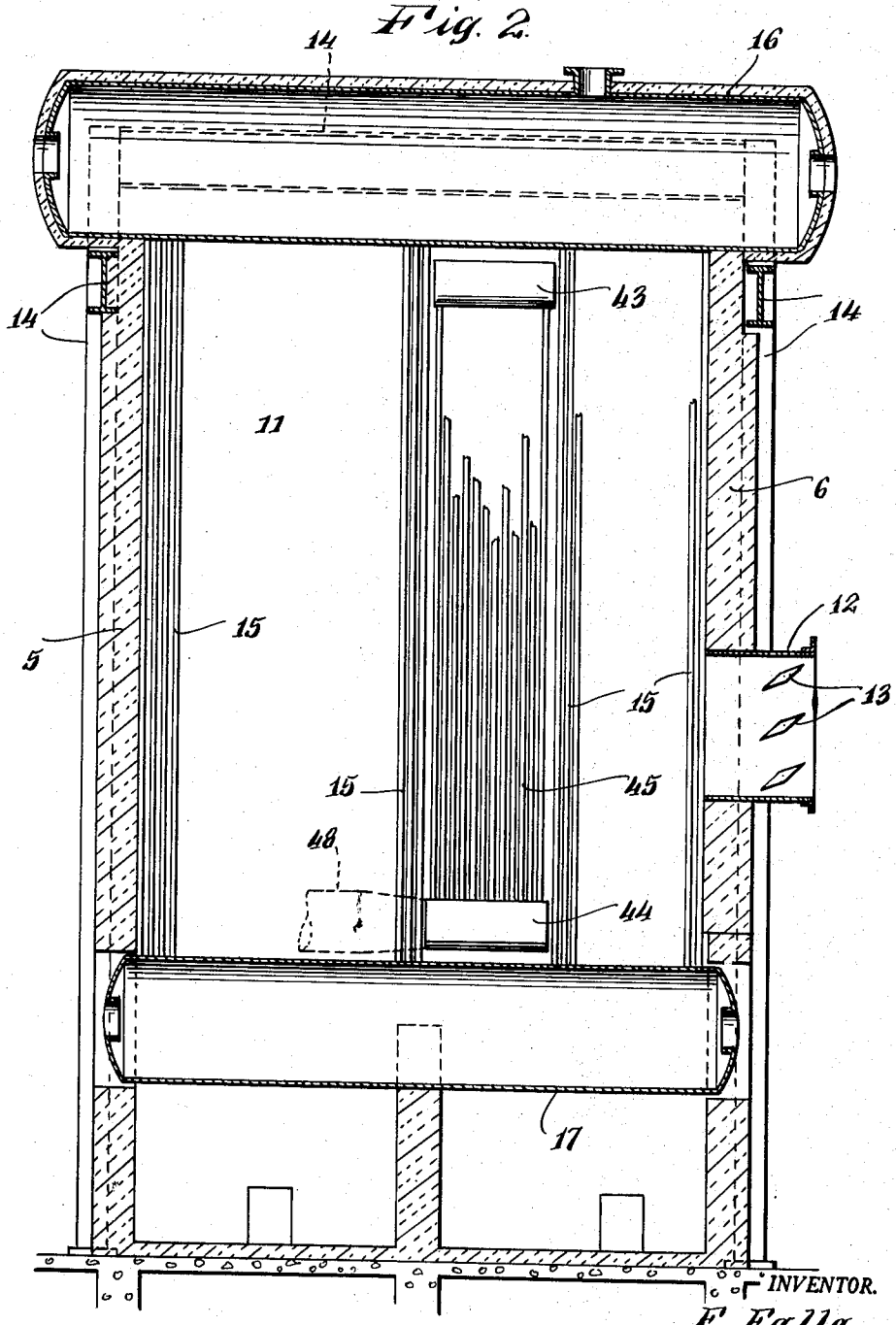
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AIR HEATER MOUNTED IN THE CONVECTION SECTION OF FURNACES

Original Filed Nov. 29, 1948 4 Sheets-Sheet 2

Fig. 2.



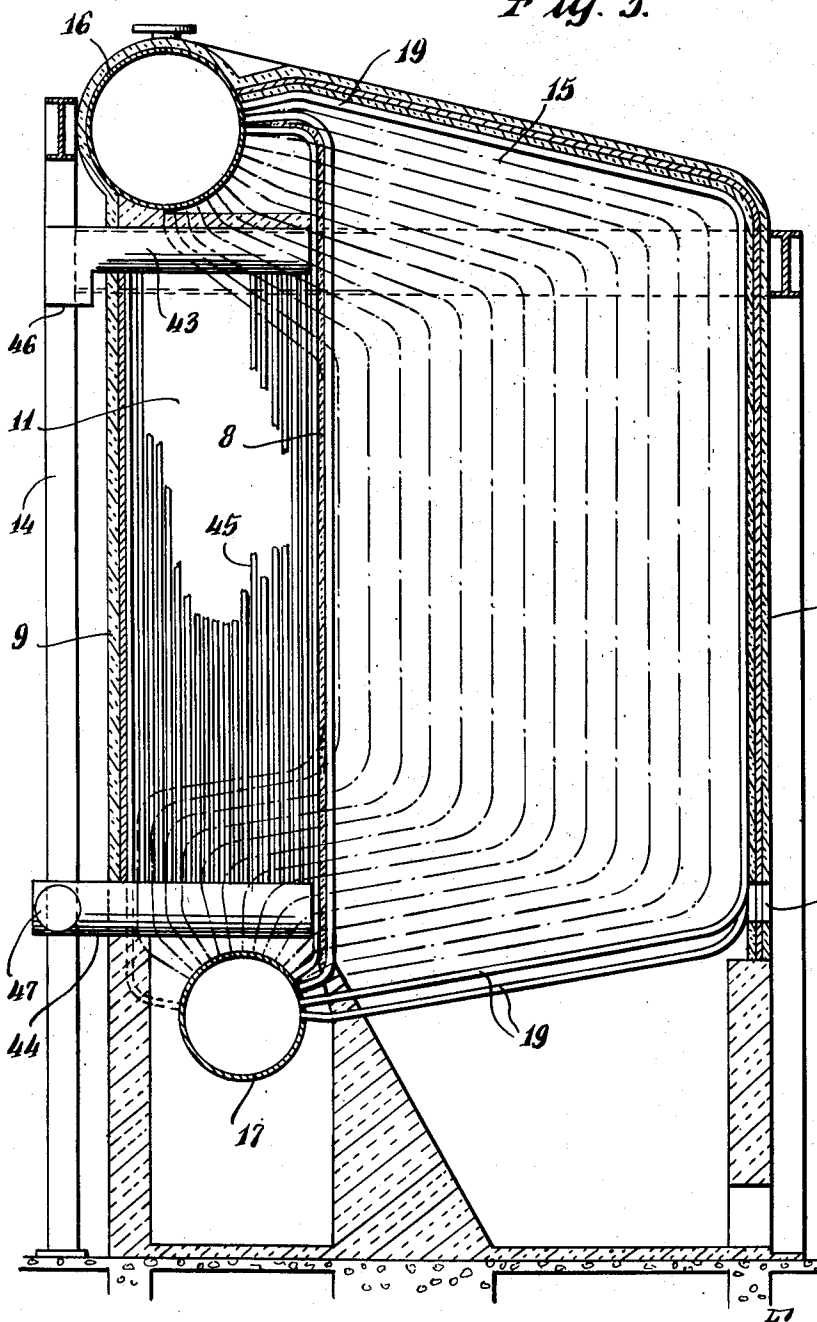
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Fig. 3.



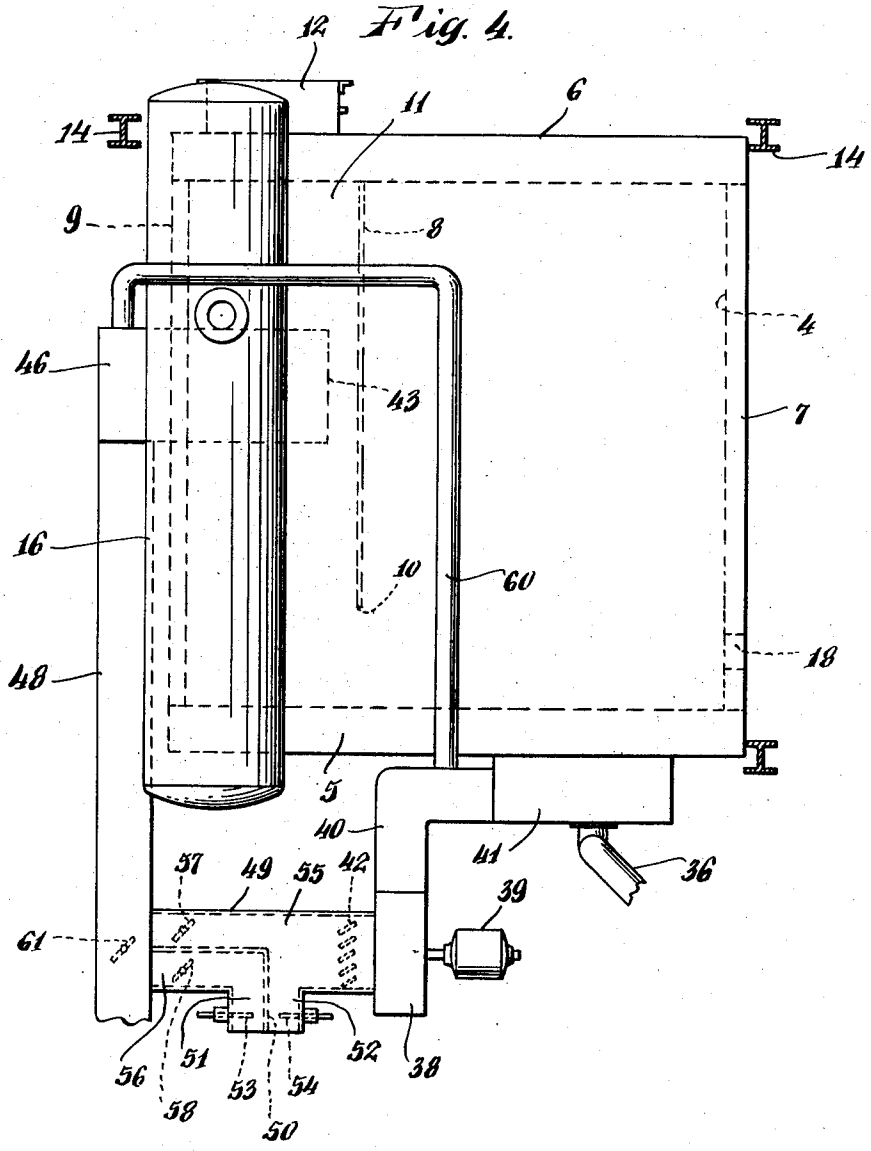
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Fig. 4.



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AIR HEATER MOUNTED IN THE CONVECTION SECTION OF FURNACES

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Original application November 29, 1948, Serial No. 62,525. Divided and this application November 9, 1950, Serial No. 194,750

1 Claim. (Cl. 122—336)

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This invention relates to the treatment of coal while being pulverized for delivery in an air stream to a burner in the combustion chamber of a furnace. The present application is a division of my co-pending application, Serial No. 62,525, filed November 29, 1948.

It is an object of the invention to adapt the use of pulverized coal for firing small furnaces by maintaining a desired moisture content in the pulverized coal.

It is another object of the invention to maintain the desired moisture content of the pulverized coal by an air heater removably and selectively mounted in the furnace to receive heat from the gases of combustion.

A further object of the invention is to create a flow of air through the air heater which will not affect the feed of coal to the pulverizer.

Other objects and advantages of the invention will be hereinafter described.

In the drawings accompanying and forming a part of this application,

Figure 1 is a plan view of a furnace and a coal pulverizer having a pulverized coal discharge end connected to a burner mounted in a wall of the combustion chamber of the furnace with the furnace in section and showing an air heater mounted in the convection section of the furnace and connected to the coal receiving end of the pulverizer and to an auxiliary or secondary air supply to the burner.

Figure 2 is a sectional view, on an enlarged scale, of the furnace taken substantially on the line 2—2 of Figure 1 looking in the direction of the arrows to show the mounting of the air heater in the furnace.

Figure 3 is a sectional view, on an enlarged scale, of the furnace taken substantially on the line 3—3 of Figure 1 looking in the direction of the arrows, to show the atmospheric air inlet and heated air outlet portions of the air heater.

Figure 4 is a plan view similar to Figure 1 with the coal pulverizer omitted and showing an air connection between the secondary air supply and the air heater, and an additional damper in the connection between the heated air outlet of the air heater and the coal receiving end of the pulverizer.

In carrying out the invention, there is shown in the accompanying drawings a furnace having a combustion chamber 4 formed by a front wall 5, rear wall 6, a side wall 7 and a baffle wall 8. The baffle wall 8 extends from the rear wall 6 in parallel spaced relation to the other side wall 9 of the furnace and terminates in spaced relation to the front wall 5 to form a communication 10 between the combustion chamber 4 and an outlet passage 11 between the baffle wall 8 and the side wall 9 for the gases of combustion from the combustion chamber 4 to a smoke outlet 12 in the rear wall 6 arranged with dampers 13 operated by means of draft control apparatus (not shown) connected to a furnace draft connection 18 in the side wall 7 communicating with the combustion chamber 4. The front, rear and side walls of the furnace are supported by a steel framework, as indicated at 14.

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The outlet passage 11 is occupied by a convection section comprising water tubes 15 connected at the upper ends in communication with a water and steam drum 16 supported by the steel framework 14 and the water tubes are connected at the lower ends in communication with a water and mud drum 17 suspended freely from the drum 16, as shown in Figure 2.

Steam generating elements in the form of tubes 19 are arranged in the combustion chamber and connected at the opposite ends in communication with the drums 16 and 17, as shown in Figures 1 and 3.

Pulverized coal is fired in the combustion chamber 4 by a burner shown in a general way at 20 in Figure 1 as extended into an opening 21 in the front wall 5. Pulverized coal is pneumatically delivered to the burner 20 from a pulverizer shown as being a tube mill including a drum 22 rotated on its longitudinal axis by an electric motor 23 operatively connected to the drum by a gear 24 connected to the drive shaft of the motor 23 and meshing with an annular gear 25 secured on the drum. Unpulverized coal is delivered to one end of the drum, constituting the coal receiving end 26, by any suitable type of feeder and shown as consisting of a disk 27 rotated by an electric motor 28 and receiving coal from a hopper (not shown) through a delivery pipe 29 terminating centrally above the disk, as shown and described in Patent No. 1,764,108 issued June 17, 1930, to Joseph E. Kennedy. The coal is discharged from the feeder disk 27 by a chute 30 into a conduit 31 communicating with the inlet or receiving end of the tube mill drum 22. The coal delivered into the tube mill drum 22 through the end 26 is pulverized by the rotation of the drum and the action of attritive elements, such as balls or rods, in the drum. The pulverized coal is discharged from the drum through the opposite end thereof constituting the discharge end 32 and connected in communication with the inlet of a classifier 33 of any suit-

able structure having its outlet connected in communication with suction means in the form of a fan (not shown) mounted in a housing 34 and driven by an electric motor 35. The outlet of the fan housing 34 is connected in communication with the burner 20 by a conduit 36 to deliver classified pulverized coal suspended in an air stream induced to flow through the pulverizer drum 22 by the fan in housing 34. The communication between the classifier 33 and fan housing 34 is controlled by a register, as indicated in a general way at 37 in Figure 1, and which may be actuated by any combustion control to maintain steam pressure whereby the register is actuated to close position by an increase in the steam pressure and decrease the amount of pulverized coal delivered to the combustion chamber, and to open position by a drop in the steam pressure and increase the amount of pulverized coal delivered to the combustion chamber.

To facilitate burning of the pulverized coal, auxiliary or secondary air is supplied to the combustion chamber 4 through the opening 21 by a fan (not shown) mounted in a housing 38 and driven by an electric motor 39. The air outlet of the fan housing 38 is connected in communication with the opening 21 and the combustion chamber 4 through a conduit 40 and an air box 41 encircling the burner 20 at the exterior of the furnace wall 5 and in communication with the opening 21. The air inlet to the fan housing 38 is controlled by adjustable vanes indicated in a general way 42 in Figure 1 and which also may be actuated by the combustion control actuating the register 37, whereby an increase in steam pressure will actuate the vanes to close position and decrease the amount of secondary air delivered to the air box 41 and burner 20 and a decrease in steam pressure will actuate the vanes to open position and increase the amount of secondary air delivered to the air box 41 and burner 20.

If the moisture content of the coal fed to the pulverizer drum 22 is high, the degree of pulverization and the combustion of the pulverized coal are adversely affected. To overcome this defect in the use of the usual type of commercial coal in which the moisture content varies, it is the principal object of the invention to provide an air heater particularly adapted for small furnaces of the type illustrated. The air heater is adapted to be mounted in the outlet passage 11 for the gases of combustion and to take the place of certain of the convection tubes 15 in said passage, whereby the heat of said gases are utilized by the air heater. The air heater comprises headers 43 and 44 connected in communication with each other by tubes 45. The height of the air heater is less than the height of the passage 11 to permit ready mounting of the air heater in said passage and removal of said air heater from the passage. Also the air heater may be mounted in any desired position in the passage 11 by replacing the tubes 15 with said heater. If it is desired to obtain the maximum heat from the gases of combustion the heater will be placed adjacent to the communication 10 to receive the unspent heat of the gases leaving the combustion chamber 4. The amount of heat taken-up by the heater will decrease proportionally to the distance it is spaced from the communication 10. In the position of the heater shown in the drawings, the heater obtains an intermediate amount of heat from the gases. The headers 43 and 44 have portions extending through the side wall 9 of the furnace with the extending portions supporting the heater from the furnace wall 9, as shown in Figure 3. The extending portion of the header 43 is arranged with an air inlet or intake 46, and the extending portion of the header 44 is arranged with a heated air outlet 47 connected in communication with the coal conveying conduit 31 and the air inlet to the fan housing 38 by a conduit 48 having one end connected to the heated air outlet 47 and the opposite end connected to the conduit 31. An intermediate portion of the conduit 48 communicates with the air inlet of the fan housing 38 through a conduit 49 communicating at the opposite ends with the conduit 48 and the air inlet of the fan housing 38, as shown in Figure 1. The vanes 42 are adjustably mounted in said conduit 49. The conduit 49 is arranged to provide atmospheric air inlets to the conduit 48 and the fan housing 38 to reduce the amount of heated air to said conduit and provide a supply of atmospheric air to the fan housing. This is accomplished by providing an angle shaped partition 50 extending from the juncture between the conduits 48 and 49 through a side wall of the conduit 49 and forming with lateral extensions of said side wall atmospheric air inlets 51 and 52. The areas of the inlets 51 and 52 are controlled by slidable gates or closures 53 and 54, respectively. The partition 50 forms in the conduit 49, a passage 55 leading from the conduit 48 to the air inlet of the fan housing 38 and atmospheric air inlet 52, and a passage 56 leading from the conduit 48 to the atmospheric air inlet 51. The heated air communications between the conduit 48 and passages 55 and 56 are controlled by dampers 57 and 58, respectively, adjusted by suitable means actuated by a temperature responsive element mounted at the pulverized coal discharge end of the pulverizer drum 22, as indicated in a general way at 59 in Figure 1, so that the dampers 57 and 58 are actuated to open position when the temperature of the pulverized coal is sufficient to dry the coal or indicates that the moisture content of the coal is low, whereby the heated air is directed from conduit 48 to the air box 41 through passage 55 by the suction of the fan in the housing 38 and atmospheric air is induced by the air flow through the pulverizer drum 22 to flow through the inlet 51 and passage 56 to the conduit 48 to intermingle with and reduce the temperature of the heated air to the conduit 31. In this open position of the dampers, the fan in housing 38 will maintain a flow of air through the heater 43—45 and prevent damage to the material of said heater by excessive temperature of the gases of combustion. Also in the open position of the damper 57, the temperature of the air entering the fan housing 38 may be varied by adjusting the closure 54. The dampers 57 and 58 are actuated to close position when the temperature of the pulverized coal is low to permit heated air to be delivered direct to the pulverizer by the suction of the fan in the housing 34.

In accordance with the structure and arrangement of parts hereinbefore disclosed and described, the atmospheric air is induced to enter the air intake 46 and travel through the header 43, tubes 45 and header 44 to the conduits 48, 49 and 31 by the action of either or both fans in the housings 34 and 38 when the register 37 and vanes 42 are open. When the dampers 57 and 58 are open, the flow of air through the heater is caused by the fans in housings 34 and

38 and when the dampers 57 and 58 are closed, the flow of air through the heater is caused by the fan in the housing 34. The closures 53 and 54 are adjusted to permit a desired or required amount of atmospheric air to enter the passages 55 and 56. When the damper 57 is closed, the secondary air is supplied through inlet 52.

In the air connections between the air heater 43—45 and the fan housing 38 and tube mill drum 22 shown in Figure 1, the inlet or coal receiving end 26 of the drum 22 has to stand the suction equivalent to the draft losses through the air heater 43—45 and conduits 48 and 31, so that sometimes there may be a suction large enough to affect the feed of the coal to the drum. Figure 4 shows an arrangement of parts to overcome this defect comprising an air conduit 60 connected at one end in communication with the conduit 40 to receive air from the fan housing 38 and the opposite end of the conduit 60 connected in communication with the air intake 46 of the air heater 43—45 to deliver air from the fan housing 38 to the air heater. A damper 61 is also mounted in the conduit 48 in alignment with the partition 50 so that the positioning of said damper to extend transversely of the conduit 48 will cause a circuitous flow of air through the fan housing 38, conduit 60, air heater 43—45, conduit 48 and passage 55 in conduit 49. The actuation of the damper may be effected by the impulses of the combustion control simultaneously and proportionally operating the register 37 and vanes 42. The adjustment of the damper 61 to various positions in the conduit 48 controls the flow of preheated primary air from the air heater 43—45 to the tube mill drum 22. When the suction at the coal receiving end 26 of the tube mill drum 22 is not too great, the arrangement of parts shown in Figure 1 would be used.

Since the heater 43—45 is small, it does not materially change the draft requirements of the furnace, and the furnace draft loss resulting from the use of the air heater is so low that an ordinary stack can draft the furnace in the normal way without additional drawing means.

The tubes 45 are mounted in the headers 43, 44 to conform to the spacing of the tubes 15, so

that soot blowers can be used to clean both tubes 15 and 45.

Having thus described my invention, I claim:

In combination with a furnace having a combustion chamber having a burner in one wall and steam generating elements lining the remaining walls including the roof and floor of the chamber, an outlet passage at one side of the combustion chamber and communicating with the combustion chamber at the wall arranged with the burner for the gases of combustion from the combustion chamber, a water and steam drum at the top and a water and mud drum at the bottom of the outlet passage connected to the steam generating elements of the combustion chamber and tubes connecting the drums and extending vertically of the passage to form a convection section of the furnace, the drums having corresponding portions free of the tubes to form a space between sections of the tubes, an air heater comprising a series of tubes connected at the opposite ends to headers and said tubes and headers mounted in the outlet passage in the space between sections of the convection tubes and the headers having portions extending exteriorly of the convection section of the furnace with one portion arranged with an air inlet to the heater and the other portion arranged for communication with a place of use of the heated air to deliver heated air from the heater to the place of use and the tubes of the heater being in vertical alignment with the tubes of the convection section to form a uniform convection surface gas passage between the drums.

FERNANDO FALLA.

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