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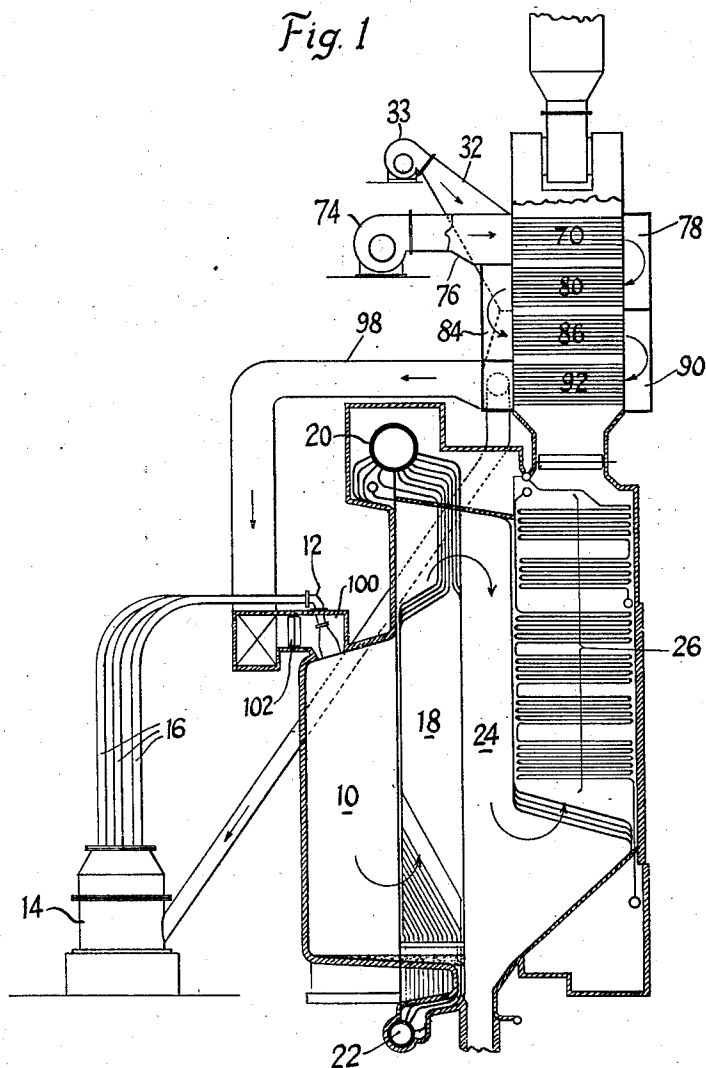
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AIR HEATER

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3 Sheets-Sheet 1

Fig. 1



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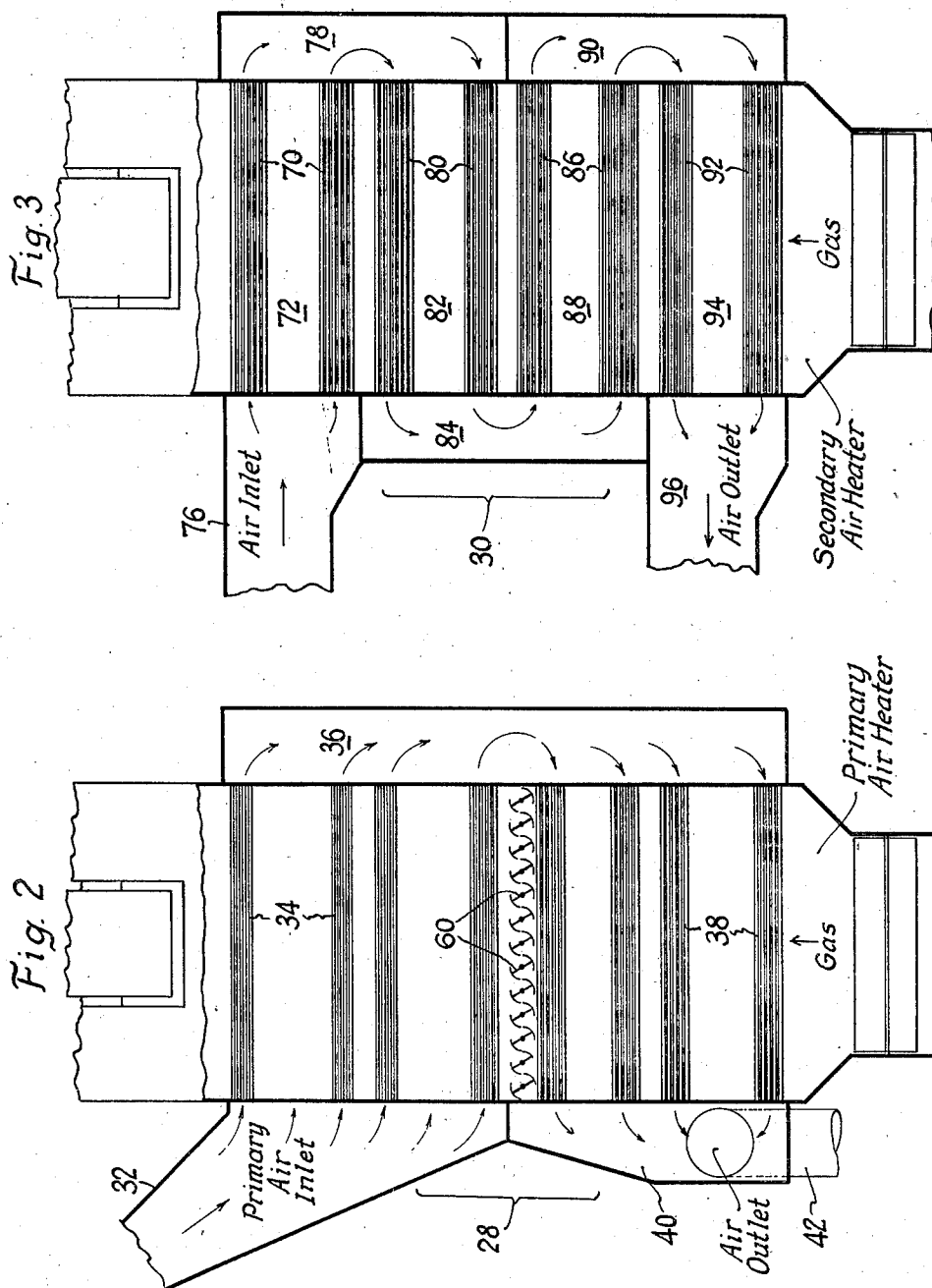
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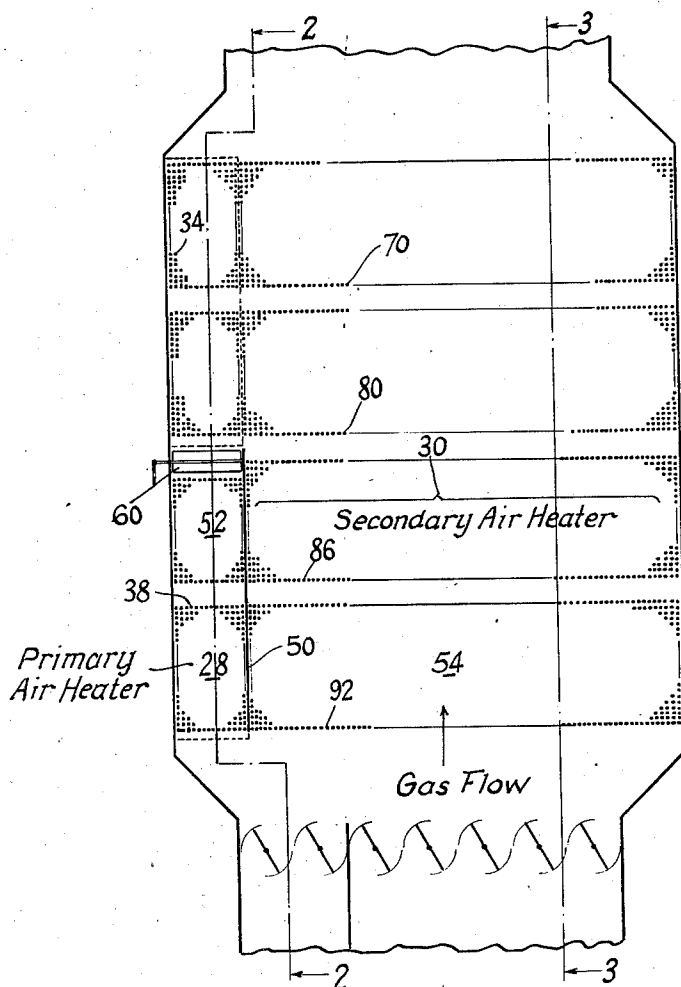
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Fig. 4



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AIR HEATER

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2 Claims. (Cl. 257-230)

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This invention relates to installations involving furnaces requiring a plurality of air supply systems subject to different requirements as to air temperatures, pressures, and volumes. The invention is particularly applicable to steam generator installations in which pulverized fuel is burned in suspension in air.

In the directly fired type of furnace for such installations a current of air passes through the pulverizer to carry pulverized fuel in suspension to a burner and also afford part of the air required for the complete combustion of the fuel.

In addition to the primary air which passes through the pulverizer, such furnace installations also require a supply of preheated secondary air to complete the combustion of fuel. The temperature requirements of the two air supplies differ, the ratio of their volumes differs, and the total quantity of air varies with the amount of fuel burned, and with boiler load.

The primary air, passing through the pulverizer, is subject to greater flow resistance and the pressure at which it must be supplied, therefore, must be higher than the pressure of the secondary air which passes directly from the source of heat to the furnace.

The temperature and volume requirements for the primary air depend upon fuel condition, primarily the condition of the fuel as to moisture content. When the moisture content of the fuel is high, effective pulverizer operation requires higher temperatures of the primary air to reduce this moisture content. This condition is subject to change. An effective primary air supply system must therefore be subject to such control that the primary air will be of a temperature high enough to effect the desired drying action, but not so high as to cause excessive distillation of volatiles in the fuel, or high enough to cause the fuel to be ignited or to attain a sticky condition.

At the same time, the volume of secondary air supplied to such a furnace must be subject to such conditioning and control that the sum of the quantities of primary and secondary air is adjusted to the rate of fuel supply.

It is an object of the invention to provide a combustion system adapted to accomplish the above indicated results without the provision of separate air heaters at separate positions in the path of the furnace gases, and without excessive power consumption by the fans or other air impellers.

It is also an object of the invention to accomplish the above indicated results while main-

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taining stack gas temperatures at a desired minimum, and maintaining all air heater elements free from the corrosive effects of condensation thereon.

Another object of the invention is to effect the desired temperature and volume control of the primary air without bypassing, or the introduction of tempering air into the preheated primary air supply. The desired control of the primary air is thus effected with a minimum of cost as to ductwork and control elements, and without the reduction of the quantity of air flowing through the air heater. The tempering of the primary air at a position in advance of a pulverizer involves a reduction in the quantity of air flowing through the air heater and a consequent loss in absorption of heat from the flue gases. This condition causes a loss of overall thermal efficiency in the installation, and it is a characteristic which is avoided by the present invention.

The invention will be described with reference to the accompanying drawings in which an embodiment of the invention is illustrated.

In the drawings:

Fig. 1 is a diagrammatic view in the nature of a vertical section, illustrating a high pressure steam generator including the illustrative combustion system;

Fig. 2 is a vertical section of the primary air heater taken on the line 2-2 of Fig. 4;

Fig. 3 is a vertical section through the secondary air heater taken on the line 3-3 of Fig. 4; and

Fig. 4 is a vertical section of the air heater on a plane normal to the plane of Fig. 1.

The illustrative system includes the furnace 10 of the steam generator shown in Fig. 1. The furnace is fired by one or more pulverized fuel burners 12, supplied with pulverized fuel from a pulverizer 14 through one or more of the conduits 16.

Furnace gases pass from the bottom of the furnace into an open pass 18, the walls of the furnace and this open pass being defined by wall tubes connected into a boiler circulation system including the upper and lower headers 20 and 22.

The furnace gases pass from the top of the first open pass 18 and into the second open pass 24. They pass downwardly therethrough and then turn beneath the convection section 26 and pass upwardly over the fluid heating tubes of that section.

Above the convection section the furnace gases pass over the tubes of an air heater which is di-

vided into two sections. The first section constitutes a primary air heater 28, and the other section is a secondary air heater 30 as indicated in Figs. 2, 3, and 4 of the drawings.

The primary air inlet 32 (Fig. 2) receives air from the forced draft fan 33. The air passes from the inlet 32 through the tubes 34 to an intermediate chamber 36 from the lower part of which the air moves through the tubes 38 of a return pass to the primary air outlet 40. From that outlet the primary air passes through the conduit 42 to the pulverizer 14, acting as carrier air to dry the pulverized fuel, classify it, and transport it from the pulverizer to the burner 12.

Fig. 4 shows a baffle 50 separating the tubes in the second pass of the primary air heater, from the adjacent tubes of the secondary air heater, the arrangement being such that the gas pass 52 of the primary air heater and the gas pass 54 of the secondary air heater have a common gas inlet and common gas outlet.

The baffle 50 terminates short of the second pass of the primary air heater in order that the low temperature tubes of the latter may be always subject to a flow of furnace gases at such temperatures that condensation and consequent corrosion will be minimized.

At the outlet of the gas pass 52 of the primary air heater the flow regulators 60 are provided so as to control the exit temperature of the primary air by varying the flow of the furnace gases.

Such control of the temperature of the primary air is to prevent any such high temperatures as might result in distillation of the volatiles of the fuel, while effecting adequate fuel drying action. Softening and ignition of the fuel externally of the furnace are also prevented.

The secondary air heater is arranged to supply a volume of air considerably greater than that supplied by the primary air. Furthermore, the temperature requirements of the secondary air are much higher than those of the primary air. Hence, the secondary air heater is divided into four passes as indicated in Fig. 3. Tubes 70 of the first pass 72 receive air from the forced draft fan 74 through the inlet 76. The air passes from the tubes 70 into a first intermediate chamber 78 and thence through the tubes 80 of the second pass 82 to a second intermediate chamber 84. From the latter the air passes through the tubes 86 of a third air pass 88 to a third intermediate chamber 90.

From the chamber 90 the air passes through the tubes 92 of a fourth air pass 94 to the secondary air outlet 96. From this outlet the air passes through a duct 98 to the burner casing 100 from which the air passes about the burners into the furnace 10.

The flow of heated secondary air into the furnace may be controlled by one or more regulators 102 disposed in the casing 100, and further control may be accomplished by regulating the speed of the forced draft fan 74. Similarly, the flow of primary air through the primary air heater and thence to the pulverizer 14 may be controlled by variation of the speed of the forced draft fan 33.

What is claimed is:

1. In apparatus of the class described; a primary air system including an air heater adapted to deliver heated carrier air to a fuel pulverizer; a secondary air supply system including an air

heater adapted to deliver heated secondary air to a pulverized fuel burner of a furnace; each air heater including a group of spaced tubes disposed transversely of heating gas flow with the groups disposed alongside each other in parallelism and in the same transverse zone of the gas pass; means causing primary air and secondary air to flow through said groups of tubes in a plurality of series connected passes with the primary air separated from the secondary air; a division wall extending into said gas pass between said heaters in the direction of gas flow and separating parallel sub-passes in which the high temperature sections of said air heaters are disposed; said division wall being disposed in parallelism to said groups of tubes and terminating forwardly of the low temperature sections of the air heaters (relative to gas flow); the low temperature section of the primary air heater being always subject to the flow of gases which have passed over the high temperature section of the secondary air heater; and damper means disposed across the flow of gases over the high temperature section of the primary air heater and regulating the exit temperature of the primary air by varying the amount of furnace gas flow over the high temperature section of the primary air heater without effecting the same variation of flow of gases over the low temperature section of the primary air heater; the damper means being also disposed at the downstream end of the division wall and between the high and low temperature sections of the primary air heater.

2. In an air heater, tube sheets forming opposite walls of a gas pass through which there is a unidirectional flow of heating gas, a group of spaced tubes having their opposite ends fixed to said tube sheets at openings therein and extending across the gas pass, a baffle between said tube sheets and extending from the gas inlet side of the heater part way only through the group of tubes, said baffle separating primary air heating metallic tubes from secondary air heating metallic tubes, gas flow control means disposed at the downstream end of said baffle and across the gas flow over said primary air heating tubes, primary air flow directing means disposed exteriorly of the tube sheets at opposites of the gas pass and causing primary air to flow across said pass in one direction on one side of said control means and to flow across said pass in a reverse direction beyond said control means in the low temperature section of the primary air heater, and secondary air flow directing means disposed alongside said first mentioned air flow directing means at opposite sides of the gas pass to direct secondary air flow through the remainder of said tubes in a plurality of passes.

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