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COMBUSTION CHAMBER WITH COMBINED PULVERIZED FUEL AND GAS FIRING

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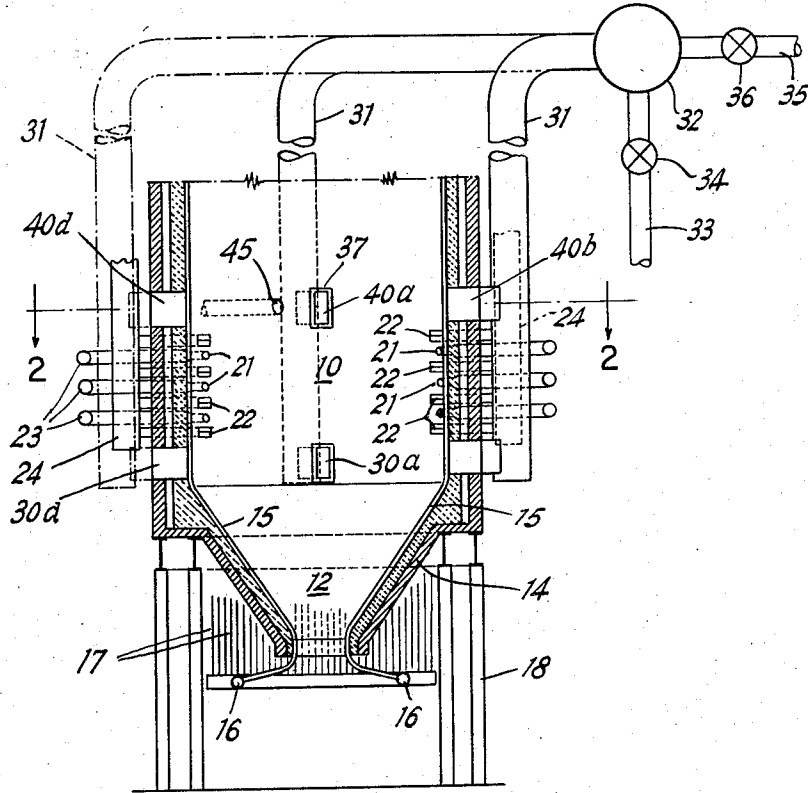


FIG. 1

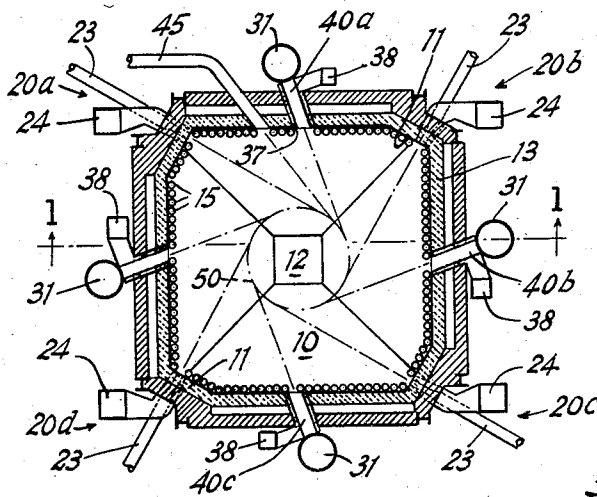


FIG. 2

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1

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2 Claims. (Cl. 110—22)

This invention relates to the firing of furnaces or combustion chambers by two or more independent sets or groups of burners involving a novel positional relationship of the two groups of burners whereby the burners of each group can have their combustible mixtures delivered therefrom at the particular optimum rate and without the firing rate of either group of burners deleteriously affecting that of the other. In a more specific aspect of the invention, each group of burners is supplied with a different type of fuel, such as pulverized fuel for one group and fuel gas for the other.

In the firing of furnaces with a combination of pulverized fuel burners and gas burners, a known arrangement is to arrange all the burners in the corners of the furnace with the pulverized fuel-air nozzles and gas burners being superposed in alternating sets with secondary air admission nozzles disposed between adjacent sets. This arrangement is designed to secure mixing of the pulverized fuel flames and the gas flames on the theory that such mixing would provide optimum combustion and heat release conditions.

However, in practice it has been shown that such mixing of the two types of flames results in disadvantages outweighing any possible advantages therefrom. For example, such mixing of the flames requires that the gas be delivered to the furnace at the same rate as the pulverized fuel-air stream is delivered. However, this gas delivery rate is unnecessarily high for pulverized fuel firing. Moreover, the more rapidly burning gas robs oxygen from the pulverized fuel-air mixture so that the slower burning pulverized fuel remains in an oxygen-deficient atmosphere and thus burns too slowly.

While the invention principles are applicable to the firing of two or more groups of burners with the same fuel, the invention will be described with particular reference to combined firing with gas burners and pulverized fuel burners. Thus, in accordance with the present invention, a combined pulverized-fuel and gas firing arrangement for furnaces is provided in which the flames from the two types of burners do not interfere with each other's burning, and the two sets of flames admix only adjacent the exit of the active combustion zone. Preferably, the pulverized fuel burners are arranged in one vertical zone of the furnace with one set of gas burners beneath the pulverized fuel burners and another set of gas burners above the pulverized fuel burners. The pulverized fuel burners are desirably mounted in the corners of the furnace and the gas burners in the lateral walls of the furnace at a substantial lateral spacing from the pulverized fuel burners.

The burners are arranged to fire the furnace tangentially, the firing axes of all the burners being tangential to the same theoretical vertical cylinder. The tangential firing of all the burners is preferably in the same direction, as firing in opposite tangential directions favors premature mixing of the burning fuel and air streams flowing from burners delivering fuels of different characteristics, with the aforementioned disadvantages.

2

With the foregoing burner arrangement, should it be desired to fire the furnace with only one of the groups of burners, the inactive burners are exposed to heat radiation from the flames provided from the active burners.

5 In accordance with the invention, undue heating and harmful effects due to such radiation are avoided by cooling the inactive burners by utilizing the latter to introduce cooled flue gases, preferably from the outlet flue or stack, into the furnace.

10 This recirculated gas directed into the furnace forms a blanket surrounding the flame and thus protects the inactive sets of burners as well as reducing radiation from the flame to the cooling tube walls of the furnace. In the burning of pulverized fuel alone, the enveloping of the flame by the recirculated gases, with consequent diminished radiant heat transfer to the wall tubes, results in at least partial compensation for the decrease in steam temperature normally to be expected for pulverized fuel operation as compared to gas operation. By proper regulation of the injection of cooled flue gases, it is possible to maintain the steam temperature substantially unchanged.

15 In many installations, it is desirable to fuse the fly ash, from the discharge flues, by reintroducing it into the furnace so that it is clinkered and discharged through the ash hopper. In accordance with the present invention, an air stream carrying the fly ash is directed into the furnace or combustion chamber tangentially to the same theoretical cylinder to which the burner axes are tangential. The flame heated ash becomes pasty, forms lumps, and, by virtue of its weight, is quickly carried by centrifugal force to the cooling tube walls, where it solidifies or is clinkered and falls into the ash hopper.

20 For an understanding of the invention principles, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawing.

In the drawing:

25 Fig. 1 is a longitudinal sectional view through a combustion chamber embodying the invention, taken along line 1—1 of Fig. 2; and

Fig. 2 is a transverse sectional view of Fig. 1 on the line 2—2 of the latter.

30 Referring to the drawing the combustion chamber 10 is illustrated as having a substantially symmetrical polygonal cross-section with beveled corners as indicated at 11. The lower end of the chamber is formed as an ash hopper 12 having a bottom outlet which may lead to a suitable ash disposal arrangement. The furnace gases flow upwardly through furnace or chamber 10 and may be utilized to heat a steam generator (not shown).

35 The side walls 13 of combustion chamber 10, and the walls 14 of hopper 12, desirably have their inner surfaces lined with a radiant heat absorbing arrangement comprising fluid cooled wall protecting tubes 15 which are connected into a lower header 16 to which are connected other fluid conveying tubes 17. The tubes which generate steam are connected at their upper ends to the steam and water drum of the generator and receive water through connections (not shown) between the water space of the drum and lower headers such as 16. The furnace may be suitably supported on a structural framework indicated generally at 18.

40 The combustion chamber 10, in the specific example illustrated, is arranged for combined firing with pulverized fuel and with gas, or with either fuel singly. In accordance with the present invention, pulverized fuel burners 20a, 20b, 20c, and 20d are arranged each in a beveled corner 11 of furnace 10. Substantially in the center of each side wall 13, and in a plane below the zone of the pulverized burners, is a gas burner nozzle 30a, 30b, 30c, or 30d. A second set of gas burner noz-

3

zles, 40a, 40b, 40c, and 40d are each arranged substantially at the center of side walls 13 but in a plane above the zone of the pulverized fuel burners.

There are thus one set of gas burner nozzles 30 below the pulverized fuel burners 20 and one set of gas burner nozzles 40 above burners 20. Also, in horizontal plan (see Fig. 2) the gas burner nozzles and pulverized fuel burners are arranged in alternation around the horizontal periphery of chamber 10, the gas burner nozzles being substantially midway of each wall 13 and the pulverized fuel burners being located in the corners 11. All of the burners are so arranged as to fire, in the same direction, substantially tangentially to a theoretical cylinder 50.

Each pulverized fuel burner 20 comprises alternately arranged, vertically superposed, primary air and pulverized fuel nozzles 21 and secondary combustion air ports 22. Fuel-air nozzles 21 are supplied with primary air and fuel from supply pipes 23 leading from a suitable pulverizer or other source of pulverized fuel and primary air. Secondary combustion air ports 22 are connected to secondary air conduits 24 supplied, from a suitable source, with secondary air under a positive pressure.

Gas burner nozzles 30, 40 are connected to supply conduits 31 connected to a main 32. The latter is connected to a supply of fuel gas by a pipe or conduit 33 having a control valve 34 interposed therein. Main 32 may be supplied with cooled flue gas, for recirculation into chamber 10 through nozzles 30, 40, by a pipe or conduit 35 connected, preferably, to the flue gas outlet or stack. A control valve 36 is interposed in pipe 35. Additional combustion air for gas burners 30, 40, if needed, may be supplied through ports 37 supplied, from the source of secondary air under pressure, through conduits 38.

By selective operation of valves 34 and 36, nozzles 30, 40 may be supplied either with fuel gas or flue gas. If desired, similar means may be provided to selectively supply burners 20 either with pulverized fuel and air or with cooled flue gas from the stack.

Fly ash, collected from the gas passes and the stack, is re-directed into chamber 10 by a nozzle 45 arranged to direct the ash tangentially of cylinder 50 and in the same direction as the burner jets. The fly ash fuses together and the fused lumps are hurled, by centrifugal force, onto the wall cooling tubes where they solidify or clinker and fall into hopper 12.

In the operation of the described burner arrangement, the flames from burners 20, supplied with secondary air from nozzles 22, burn independently of the flames from burners 30 and 40. This is due to the vertical and lateral spacing of the one group of burners from the other group. The flames from the two groups of burners do not mix until adjacent the exit of the zone of active combustion

4

in chamber 10. Hence, the two groups of burners can be fired independently as to optimum firing rates for each, without either group of burners interfering with the firing of the other.

When firing with burners 20 alone, valve 34 is closed and valve 36 is opened to deliver cooled flue gas through the idle burners 30 and 40. This flue gas forms a blanket around the active combustion zone substantially reducing radiation to wall tubes 15. However, the ultimate steam temperature is not deleteriously affected as more heat is thus delivered to other heat exchange units in the flow path of the hot combustion gases.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. In a furnace arranged for combined firing with pulverized fuel and with gas and having side walls joined by beveled corners; sets of pulverized fuel burners and gas burners respectively arranged to deliver pulverized fuel-air mixtures and fuel gas into the furnace; the pulverized fuel burners being disposed in the bevelled corners of the furnace and the gas burners being disposed laterally substantially centrally of the furnace walls; the two types of burners being spaced from each other vertically of the furnace; all the burners firing the furnace tangentially to the same cylinder and in the same tangential direction.

2. In a furnace arranged for combined firing with pulverized fuel and with gas and having side walls joined by beveled corners; sets of pulverized fuel burners and gas burners respectively arranged to deliver pulverized fuel-air mixtures and fuel gas into the furnace; the pulverized fuel burners being disposed in the bevelled corners of the furnace and the gas burners being disposed laterally substantially centrally of the furnace walls; the two types of burners being spaced from each other vertically of the furnace; each pulverized fuel burner including alternately vertically superposed primary-air-and-fuel nozzles and secondary combustion air ports; all the burners firing the furnace tangentially to the same cylinder and in the same tangential direction.

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