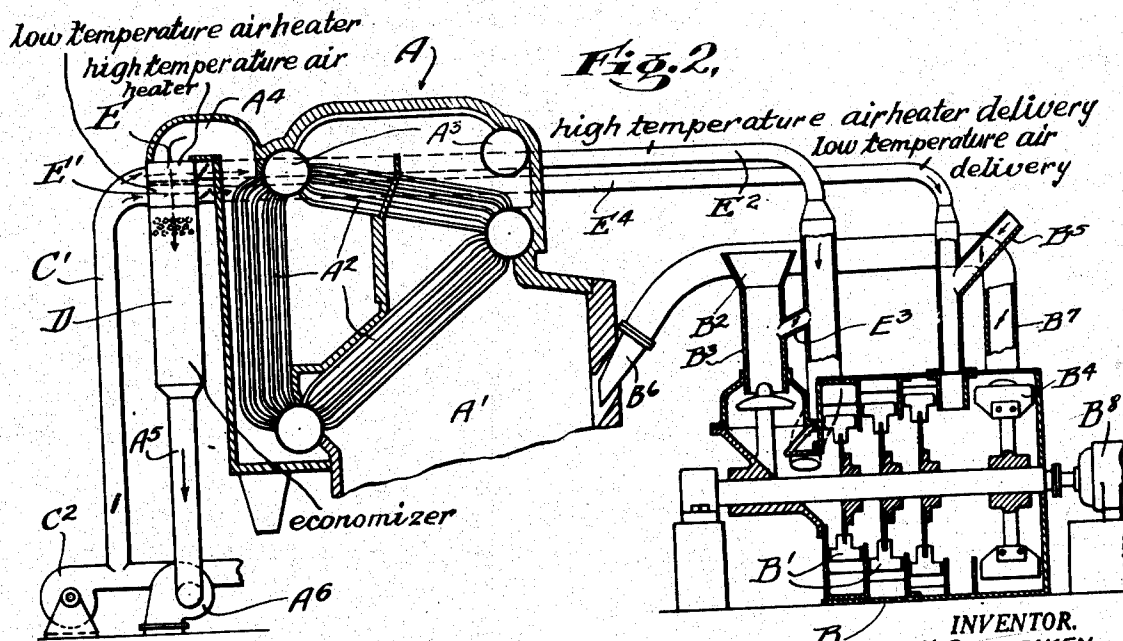
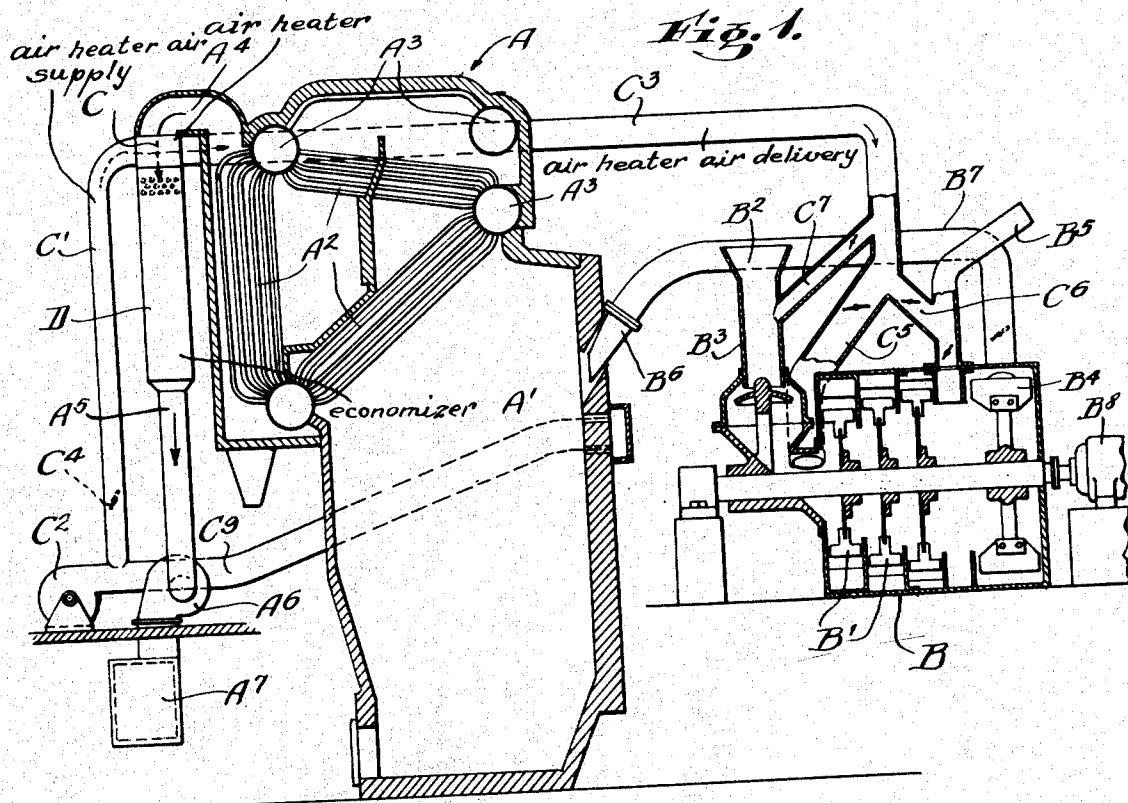


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AIR HEATER FOR PULVERIZERS

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AIR HEATER FOR PULVERIZERS

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The present invention relates to steam generator units in which powdered fuel is burned, generally in suspension, and in which pulverizer units reduce the fuel to a fineness permitting burning in suspension. In modern steam generators of this type it is customary to preheat all, or a major portion, of the air required for combustion in an air heater located in the outlet flue for the products of combustion. The air heater is normally positioned in the outlet flue in series with and after an economizer. With this arrangement the economizer receives the heating gases from the generator first and the air heater receives the gases after they have been partially cooled by their passage through the economizer. This arrangement has generally been considered to give the highest over-all efficiency inasmuch as both the air for combustion and feed water are heated to the desired temperatures with a minimum amount of draft loss.

Difficulty has been experienced in pulverizing coal having a moisture content of, for example, over 15%. The moisture content of such coal is often increased to 25% when exposed to snow and rain. Coal having a high moisture content has a tendency to pack in the pulverizer feed line and paddle chambers and materially increases the power requirements of the pulverizer. It is necessary in such cases to provide some method of or apparatus for drying the coal either before or during its passage through the pulverizer. One system heretofore proposed involved the heating of the air for drying the coal by passing it through one or more air cooled furnace walls. This system is impractical as the maximum temperature of the air attainable is about 250° F. which temperature with the amount of air available is not sufficient to dry coal having a moisture content sufficiently high to present pulverization difficulties. It has also been proposed that a portion of the air heated for combustion purposes be diverted to the pulverizer. Additional air heating surface is then required and the high air temperature necessary in the pulverizer results in a material increase in cost of the air heater and ducts and the corresponding high temperature of the air for combustion increases the temperature in the furnace chamber with a resulting increase in slagging troubles when coal of low ash fusing temperature is used. Provisions for protecting the furnace walls and eliminating slagging are necessary with a corresponding increase in cost.

The object of my present invention is to provide an improved construction and arrangement of the air heater, steam generator and pulverizer unit which is characterized by effective drying of the coal, reduction in power requirements of the pulverizer, and no increase in cost of furnace chamber construction. A further object

of my invention is to provide an easy and effective control of the amount of air heated and delivered to the pulverizer unit.

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, however, and the advantages possessed by it reference should be had to the accompanying drawing and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Of the drawing:

Fig. 1 is a diagrammatic view of one embodiment of the invention as assembled; and

Fig. 2 is a similar view of a modified arrangement.

In the drawing and particularly in Fig. 1 I have diagrammatically illustrated a power plant unit comprising a steam generator A having a furnace chamber A' in which powdered coal is adapted to be burned in suspension. The products of combustion or heating gases pass upwardly into contact with a plurality of banks of water tubes A² extending between spaced drums A³ and out of the generator through a passage A⁴ to a heating gas outlet flue A⁵. The gases are withdrawn from the furnace by an induced draft fan A⁶, which delivers the gases to a stack connection A⁷.

The coal to be burned is comminuted in a pulverizer unit B located at one end of the generator and comprising a plurality of chambers in series in which the coal is reduced to the desired size by successive impacts with paddles B' mounted in the chambers and rotated by an electric motor or steam turbine B⁸. The supply of unpulverized coal is continuously delivered through a chute to a hopper B², from which it passes through a feed pipe B³ connected to the inlet end of the pulverizer. A fan B⁴ is positioned on the paddle shaft at the discharge end of the pulverizer for inducing a current of air through the pulverizer upon which the fuel in the course of treatment is borne successively from one paddle chamber to the next and when pulverized to the desired degree of fineness is mixed with additional air for combustion entering the pulverizer through a conduit B⁵ open to atmosphere. The air upon which the pulverized fuel is borne is known as "carrier" air. The combustible mixture is passed to one or more powdered coal burners B⁶ through a pipe B⁷ connected to the fan discharge.

In carrying out my invention I provide an air heater C in the gas outlet flue A⁵ adjacent the outlet passage A⁴. Air is delivered to the heater through a damper controlled conduit C' at room temperature from a forced draft fan C². The air heater is so proportioned that only a relatively small quantity of air is subjected to the furnace

gases in the high temperature end of the conduit A⁵. The heater is much smaller in size than those ordinarily used for preheating all or a major portion of the air for combustion delivered to furnace chambers and the air exit temperature from the heater C is proportionally higher, normally ranging from 450° to 550° F. The heated air passes out through a conduit C³ connected to the pulverizer unit. The supply of air to the heater can be regulated either by controlling the speed of the fan C² or changing the position of the conduit damper or both.

At the pulverizer end, the heated air conduit C³ is divided into branch conduits C⁵ and C⁶, each of which is controlled by a damper positioned therein. The conduit C⁵ is shown as connected to the inlet end of the pulverizer and the conduit C⁶ to the discharge end of the pulverizer. The heated air from the conduit C⁵ comes into intimate contact with the coal entering the paddle chambers and thoroughly dries it. This air is also used as the "carrier" air and carries the finely divided coal through the paddle chambers. As shown the conduit C⁶ is connected to the conduit B⁵ adjacent the connection of the latter to the fan chamber. A third conduit branch C⁷ connects the conduit C³ with the coal feed pipe B³ at a point above the connection of the latter with the pulverizer. The flow of air through the main conduit and each of the branch conduits being controllable by adjustment of the corresponding dampers, a close regulation of the amounts of air supplied to the different points in the pulverizer unit is possible.

An essential feature of the present invention is the delivery of a sufficient quantity of air at high temperature to the inlet or feed end of the pulverizer. This air contacts with the coal before and during its passage through the pulverizer. When this is sufficient to dry the coal, the branch conduits C⁶ and C⁷ remain closed. In practice the amount of air heated and supplied to the inlet end of the pulverizer varies from 1 to 1½ lbs. per lb. of coal. This amount of air is not sufficient for efficient combustion of the powdered coal and an auxiliary supply of atmospheric air is drawn into the pulverizer through the conduit B⁵ by the fan. This air for combustion is not preheated but is at room temperature. If additional air is necessary, it is delivered by the fan C² through the conduit C² to the furnace chamber at room temperature. The amount of heated air delivered to the furnace chamber with the coal is relatively small in proportion to the air for combustion at room temperature and no measurable increase in furnace temperature results. The furnace chamber construction need therefore be no more expensive than in furnaces not utilizing preheated air.

The overall efficiency of the generator unit may be improved by the installation of heat absorbing surface, such as a standard economizer D in the gas flue A⁵ below the air heater C. The usual pipe connections to the economizer and from the economizer to the circulating system of the generator are provided. While the temperature of the heating gases when they reach the economizer is less than in installations where the economizer is placed before the air heater, the exit temperature of the feed water is quite high and the use of such an economizer highly desirable.

In some cases it is advantageous to partially dry the coal while in the feed pipe B³ to improve the operation of the pulverizer feed mechanism. The damper in the conduit C⁷ is therefore opened

to permit a small portion of the preheated air to pass to the feed line. This air is almost negligible in amount, but produces a marked improvement in operation of the feed mechanism.

Where the coal moisture content is relatively low and it is desired to preheat a portion of the auxiliary air for combustion, the conduit C⁷ is closed and the supply of air to the heater increased. The preheated air, at a slightly lower temperature than heretofore described, is proportioned between the conduits C⁵ and C⁶. The preheated air from the conduit C⁶ mixes with the air in the conduit B⁵ and passes with the dried coal to the fuel burners.

In Fig. 2 I have illustrated a modified construction in which the air heater is divided into two sections E and E' having a common inlet connection from the fan C² and separate discharge connections. This arrangement provides two sources of hot air at different temperatures and is particularly useful in pulverizer installations where the air passing through the pulverizer with the coal is desirably at a higher temperature than the air supplied to the discharge end. In this arrangement a conduit E² connects the high temperature section E of the heater with the feed end of the pulverizer. A small branch conduit E³ connects the conduit E² and the coal feed pipe B³. A conduit E⁴ connects the low temperature heater section E' with the discharge end of the pulverizer through the auxiliary air conduit B⁵. The aggregate air heater surface in the arrangement shown in Fig. 2 is little, if any, greater than that of Fig. 1 and provides an effective distribution of the heated air when supplied to the three points indicated.

While in accordance with the provisions of the statutes, I have illustrated and described the best forms of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus embodying my invention without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

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

1. The combination with a steam generator having a furnace chamber in which powdered fuel is burned in suspension, of a pulverizer unit having means for pulverizing and delivering the fuel to be burned to said furnace chamber, and a sectional air heater exposed to the heating gases from said furnace chamber, the sections of said heater being exposed to heating gases at different temperatures and heating air to different temperatures, and separate discharge conduits for the different sections, said conduits being connected to different points in said pulverizer unit.

2. The method of conditioning and feeding fuel containing excess moisture to a furnace which comprises feeding the fuel to a pulverizer, causing a relatively small amount of carrier air at a temperature of over 300° F. to pass through said pulverizer, supplying a relatively large amount of air for combustion at a lower temperature than said carrier air to the outlet end of said pulverizer, and feeding the fuel by flotation on the combined air currents to the furnace, all of said air being substantially free from admixture with products of combustion.

3. The method of conditioning and feeding fuel containing excess moisture to a furnace which comprises feeding the fuel to a pulverizer, supplying a small amount of highly preheated air to said fuel while it is being fed to the pulverizer, causing a relatively small current of carrier air at a temperature of over 300° F. to pass through said pulverizer, supplying a relatively large amount of air for combustion at a lower temperature than said carrier air to the outlet end of said pulverizer, and feeding the fuel by flotation on the combined air currents to the furnace, all of said air being substantially free from admixture with products of combustion.
4. The method of conditioning and feeding fuel containing excess moisture to a furnace which comprises feeding the fuel to a pulverizer, causing a relatively small amount of carrier air at a temperature of over 300° F. to pass through said pulverizer, supplying a mixture consisting of a relatively small amount of preheated and a relatively large amount of unpreheated air for combustion to the outlet end of said pulverizer, said mixture being considerably larger in amount and at a lower temperature than said carrier air, and feeding the fuel by flotation on the combined air currents to the furnace, all of said air being substantially free from admixture with products of combustion.
5. The method of conditioning and preparing fuel containing excess moisture for burning in a furnace which comprises feeding the fuel to a pulverizer, supplying a definite amount of a gaseous heating medium to the inlet end of the pulverizer at a temperature above the melting point of the fuel, comminuting the fuel in the pulverizer, supplying a larger amount of a gaseous medium at a low temperature to the pulverizer at a point adjacent its discharge end to reduce the temperature at that point below the melting point of the fuel, and feeding the comminuted fuel by flotation on said gases to the furnace.
6. The method of conditioning and preparing fuel containing excess moisture for burning in a furnace which comprises feeding the fuel to a pulverizer, supplying a definite amount of a gaseous heating medium to the inlet end of the pulverizer at a temperature above the melting point of the fuel, comminuting the fuel in the pulverizer, supplying a larger amount of a gaseous medium at a low temperature to the pulverizer at a point adjacent its discharge end to reduce the temperature at that point below the melting point of the fuel, and feeding the comminuted fuel by flotation on said gases to the furnace.
7. The method of conditioning and preparing fuel containing excess moisture for burning in a furnace which comprises feeding the fuel to a pulverizer, supplying a definite amount of a gaseous heating medium to the inlet end of the pulverizer at a temperature above the melting point of the fuel, comminuting the fuel in the pulverizer, supplying a larger amount of a gaseous medium at a low temperature to the pulverizer at a point adjacent its discharge end to reduce the temperature at that point below the melting point of the fuel, feeding the comminuted fuel by flotation on said gases to the furnace, and regulating the temperature of the second mentioned gas in accordance with the excess moisture contained in the fuel.
8. The method of conditioning and preparing fuel containing excess moisture for burning in a furnace which comprises feeding the fuel to a

pulverizer, supplying a definite amount of carrier air to the inlet end of the pulverizer at a temperature above the melting point of the fuel, comminuting the fuel in the pulverizer, supplying a larger amount of air at a lower temperature to the pulverizer at a point adjacent its discharge end to reduce the temperature at that point below the melting point of the fuel, and feeding the comminuted fuel by flotation on said air to the furnace.

9. The method of conditioning and preparing fuel containing excess moisture for burning in a furnace which comprises feeding the fuel to a pulverizer, supplying a definite amount of carrier air to the inlet end of the pulverizer at a temperature above the melting point of the fuel, comminuting the fuel in the pulverizer, supplying a larger amount of air at a lower temperature to the pulverizer at a point adjacent its discharge end to reduce the temperature at that point below the melting point of the fuel, feeding the comminuted fuel by flotation on said air to the furnace, and regulating the temperature of the last mentioned air supply in accordance with the amount of excess moisture present.

10. Apparatus for conditioning and feeding fuel containing excess moisture to a furnace which comprises a fuel pulverizer unit having a fuel inlet and a fuel outlet, means for passing a relatively small amount of carrier air at a relatively high temperature through said pulverizer, means for supplying a relatively large amount of low temperature air for combustion directly to the outlet end of said pulverizer, a furnace having provisions for burning pulverized fuel in suspension, and means for conveying the pulverized fuel to said furnace together with the air supplied to said pulverizer unit.

11. In apparatus for conditioning and feeding fuel containing moisture to a furnace, the combination with a fuel pulverizer unit having a fuel inlet and a fuel outlet spaced apart from said inlet, means for progressively advancing fuel along a path of travel from said inlet to said outlet and subjecting the fuel to repeated pulverizer actions as it moves along said path and two air inlets opening to said pulverizer at separated points along said path one of which is less remote than the other from said fuel inlet, and means for supplying preheated air at a relatively high temperature to the said air inlet less remote from said fuel inlet and for supplying preheated air at a temperature lower than the first mentioned temperature to the other air inlet.

12. In apparatus for conditioning and feeding fuel containing moisture to a furnace, the combination of a fuel pulverizer unit having a fuel inlet and a fuel outlet spaced apart from said inlet, means for progressively advancing fuel along a path of travel from said inlet to said outlet and subjecting the fuel to repeated pulverizer actions as it moves along said path, two air supply connections opening to said pulverizer at separated points along said path one of which is less remote than the other from said fuel inlet and means for supplying preheated air at a relatively high temperature to the said air inlet less remote from said fuel inlet and for supplying preheated air at a temperature lower than the first mentioned temperature to the other air inlet said means including regulable means for admixing air not preheated with preheated air passing to the last mentioned air inlet.

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