In a coal burning boiler apparatus, temperature of the pulverized coal to be fed to the boiler can be set depending on the property of the combustion coal, so that stable ignition and combustion can be made regardless of the property of the combustion coal fed.

Provided are a coal burning boiler 1, a coal pulverizer 2 for pulverizing massive coal 6 into fine powder, a temperature sensor 18 for detecting temperature of the primary air 35 for entraining the pulverized coal to the coal burning boiler, regulators 9, 12, 13 and 14 for regulating the temperature of the primary air and a controller for controlling the primary air temperature regulators on the basis of detected result of the temperature sensor so as to make the primary air have a given temperature.
FIG. 2

[Diagram of signal processing system, showing connections between various parts labeled with numbers.]
COAL BURNING BOILER APPARATUS

TECHNICAL FIELD

[0001] The present invention relates to a coal burning boiler apparatus using coal as fuel and particularly to a coal burning boiler apparatus which can realize proper combustion regardless amount of volatile portions of the coal.

BACKGROUND ART

[0002] In a coal burning boiler apparatus, massive coal is pulverized by a coal pulverizer into fine powder which is fed together with combustion air into a combustion furnace where it is ignited and burned. The ignition and combustion of the pulverized coal fed to the furnace are processed such that at first volatile portions produced by heating the pulverized coal is ignited and then the pulverized coal itself is ignited.

[0003] Conventionally used in a coal burning boiler apparatus is bituminous coal, which has much volatile portions, is readily ignited and is stable in flame. In a coal burning boiler using bituminous coal as fuel, combustion air (primary air) entraining pulverized coal is heated by exhaust gas from a boiler, the pulverized coal being heated by the primary air into a predetermined temperature. As to the heating of the pulverized coal, the temperature of the primary air is set to be substantially 80° C, for stable ignition and combustion and for prevention of spontaneous ignition during the entraining.

[0004] However, recent demand is to use inexpensive low-quality coal with less volatile portions such as anthracite or semi-anthracite coal or oil coke. Pulverized coal with less volatile portions such as anthracite or semi-anthracite coal or oil coke has difficulty in ignition and is unstable in combustion. In order to overcome such drawbacks and ignite the pulverized coal with less volatile portions for stable self-standing combustion, required is feeding of the pulverized coal under high-temperature status which enables ignition even with such less volatile portions.

[0005] A conventional coal burning boiler, which has no means for conducting heating depending on property of coal fuel, requires selection of coal fuel used depending on the coal burning boiler system. Or, in order to comply with changed fuel property, substantial changes in the system are required.

[0006] [Patent Literature 1] JP7-167426A

SUMMARY OF INVENTION

Technical Problems

[0007] In view of the above, the invention has its object to make it possible to set temperature of pulverized coal to be fed to a boiler depending on property of combustion coal, thereby enabling stable ignition and combustion regardless of the property of the combustion coal.

Solution to Problems

[0008] The invention is directed to a coal burning boiler apparatus comprising a coal burning boiler, a coal pulverizer for pulverizing massive coal into pulverized coal, a temperature sensor for detecting temperature of primary air entraining the pulverized coal to said coal burning boiler, means for regulating temperature of said primary air and a controller for controlling said regulating means on the basis of a detected result from said temperature sensor so as to make said primary air have a given temperature.

[0009] The invention is also directed to a coal burning boiler apparatus wherein said primary air temperature regulating means comprises a primary air feed pipe passing through an air preheater heated by exhaust gas from the boiler, a primary air bypass pipe bypassing said air preheater and joining into said primary air feed pipe, a first flow rate regulating damper arranged in said primary air feed pipe and a second flow rate regulating damper arranged in said primary air bypass pipe, said first and second flow rate regulating dampers being flow-rate controlled by said controller.

[0010] The invention is also directed to a coal burning boiler apparatus wherein said controller may have data on properties of coals and data on spontaneous ignition temperatures corresponding to said properties of the coals, spontaneous ignition temperature corresponding to a property of the coal supplied being calculated on the basis of said data on the properties of the coals and said data on the spontaneous ignition temperatures, temperature of the primary air being set on the basis of a result of the calculation. The invention is also directed to a coal burning boiler apparatus wherein said data on the properties of the coals may include data of volatile portion, fuel ratio and total moisture content. The invention is also directed to a coal burning boiler apparatus wherein said data on temperature of the primary air is temperature on the outlet side of said coal pulverizer and set to be lower than a corresponding ignition temperature by 20° C. The invention is also directed to a coal burning boiler apparatus wherein a further temperature sensor is provided on the inlet side of said coal pulverizer to conduct monitor for prevention of the temperature of the primary air flowing into said coal pulverizer from being higher than the given temperature.

ADVANTAGEOUS EFFECTS OF INVENTION

[0011] Excellent effects and advantages can be obtained in the invention. According to the invention, which comprises a coal burning boiler, a coal pulverizer for pulverizing massive coal into pulverized coal, a temperature sensor for detecting temperature of primary air entraining the pulverized coal to said coal burning boiler, means for regulating temperature of said primary air and a controller for controlling said regulating means on the basis of a detected result from said temperature sensor so as to make said primary air have a given temperature, the temperature of the primary air can be made suited for the property of the coal to obtain optimum combustion status regardless of the property of the coal. Thus, a low-quality coal may be used to decrease the running cost.

[0012] According to the invention, said primary air temperature regulating means may comprise a primary air feed pipe passing through an air preheater heated by exhaust gas from the boiler, a primary air bypass pipe bypassing said air preheater and joining into said primary air feed pipe, a first flow rate regulating damper arranged in said primary air feed pipe and a second flow rate regulating damper arranged in said primary air bypass pipe, said first and second flow rate regulating dampers being flow-rate controlled by said controller, which makes it possible to regulate the temperature of the primary air by means of the simple structure.

[0013] According to the invention, said controller may have data on properties of coals and data on spontaneous ignition temperatures corresponding to said properties of the coals, spontaneous ignition temperature corresponding to a property of the coal supplied being calculated on the basis of said data on the properties of the coals and said data on the spontaneous ignition temperatures, temperature of the primary air...
being set on the basis of a result of the calculation, which makes it possible to obtain optimum combustion status regardless of the property of the coal. Thus, low-quality coal may be used to decrease the running cost.

According to the invention, a further temperature sensor may be arranged on the inlet side of the coal pulverizer to conduct monitor for prevention of the temperature of the primary air flowing into said coal pulverizer from being higher than the given temperature.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a system diagram for a coal burning boiler apparatus according to an embodiment of the invention;

FIG. 2 is a block diagram on a controller of the coal burning boiler apparatus; and

FIG. 3 is a diagram illustrating flow of data processing in the coal burning boiler apparatus.

REFERENCE SIGNS LIST

1 coal burning boiler
2 coal pulverizer
3 air preheater
6 massive coal
8 forced draft fan
9 primary air feed pipe
10 secondary air feed pipe
12 primary air bypass pipe
13 first flow rate regulating damper
14 second flow rate regulating damper
15 primary air amount regulating damper
16 flow rate sensor
17 first temperature sensor
18 second temperature sensor
20 oxygen amount sensor
21 signal processing part
22 main controlling part
23 display part

DESCRIPTION OF EMBODIMENT

An embodiment of the invention will be described in conjunction with the drawings.

First of all, the embodiment of a coal burning boiler apparatus according to the invention will be described with reference to FIG. 1.

In FIG. 1, reference numeral 1 denotes a coal burning boiler in a coal burning boiler apparatus, for example, for power generation or industrial purposes; 2, a coal pulverizer (mill) for pulverizing massive coal into fine powder; and 3, an air preheater for heating combustion air through exhaust heat.

Arranged on a wall of the coal burning boiler 1 are a required number of pulverized coal burners 4 connected via a pulverized coal feed pipe 5 to the coal pulverizer 2 which is supplied with the massive coal 6.

Combustion air to be fed to the coal burning boiler 1 is sucked from an air aspirator pipe 7 by a forced draft fan 8. The pipe is branched at a discharge side of the forced draft fan 8 into primary and secondary air feed pipes 9 and 10, respectively, connected to the air preheater 3. The primary and secondary air feed pipes 9 and 10 having passed through the air preheater 3 are connected to the coal pulverizer 2 and to the pulverized coal burners 4, respectively.

A primary air bypass pipe 12 is provided for intercommunication of portions of the primary air feed pipe 9 upstream and downstream of the air preheater 3. The portion of the primary air feed pipe 9 upstream of the air preheater is provided with a first flow rate regulating damper 13; the primary air bypass pipe 12 is provided with a second flow rate regulating damper 14; a portion of the primary air feed pipe 9 upstream of the coal pulverizer 2 is provided with a primary air amount regulating damper 15.

Exhaust gas produced in the coal burning boiler 1 is discharged via an exhaust duct 19 provided with a sensor 21 for detecting an amount of oxygen remaining in the exhaust gas as well as the air preheater 3 downstream of the sensor 21. The exhaust gas thus guided by the exhaust duct 19 is discharged to the atmosphere via an exhaust gas processing unit (not shown) including for example a dust collector and/or a desulfurizer.

FIG. 2 shows a controller 23 of the coal burning boiler apparatus.

Flow rate of the primary air detected by the flow rate sensor 16, temperature of the primary air on the inlet side of the pulverizer 2 detected by the first temperature sensor 17, temperature of the primary air on the outlet side of the pulverizer 2 detected by the second temperature sensor 18, amount of oxygen remaining in the exhaust gas detected by the oxygen amount sensor 21 undergo required signal processings such as amplification processing and A/D conversion processing in a signal processing part 24 and are input into a main controlling part 25.

Connected to the main controlling part 25 is a memory part 26 such as a hard disk drive (HDD). Stored in the memory part 26 are required programs and data for operation of the coal burning boiler apparatus; the required programs are, for example, sequence program for driving and controlling the forced draft fan 8, the first and second flow rate regulating dampers 13 and 14 and the primary air amount regulating damper 15 and arithmetic program for calculating optimum combustion condition depending on property of fuel (coal) and the data are those on the properties of coals and those on spontaneous ignition temperatures.

The data on properties of coals and on spontaneous ignition temperatures are stored from the operating part 27 via the main controlling part 25 into the memory part 26. Input from the operating part 27 are various commands for driving the coal burning boiler apparatus.

In accordance with the sequence program and the calculated combustion conditions, the main controlling part 25 issues control signals for the forced draft fan 8, the first and second flow rate regulating dampers 13 and 14 and the primary air amount regulating damper 15 and, on the basis of the issued control signals, a fan controller 28, first and second flow rate regulating controllers 29 and 30 and a primary air amount regulating controller 31 drive and control the forced draft fan 8, the first and second flow rate regulating dampers 13 and 14 and the primary air amount regulating damper 15, respectively.

A display part 32 displays, for example, input situations from the operating part 27, the combustion conditions
and operating situations of the forced draft fan 8, the first and second flow rate regulating dampers 13 and 14 and the primary air amount regulating damper 15.

[0051] Next, mode of operation of the coal burning boiler apparatus will be described.

[0052] Combustion air for the boiler is sucked by the forced draft fan 8; the sucked air is branched by the primary and secondary air feed pipes 9 and 10 into the primary and secondary airs 35 and 36. The primary air 35 is further branched by the feed and bypass pipes 9 and 12 into branched primary air 35' and bypass flow 35''.

[0053] The branched primary air 35' and the secondary air 36 are passed through the air preheater 3 and are preheated by the exhaust gas, the preheated secondary air 36 being fed to the pulverized coal burners 4. The bypass flow 35'' bypasses the air preheater 3 and joins into the branched primary air 35', thereby providing the preheated primary air 35 which is sent to the coal pulverizer 2.

[0054] The pulverized coal pulverized and produced in the coal pulverizer 2 is fed by the primary air 35 to the pulverized coal burner 4. Temperature on the inlet side of the coal pulverizer 2 is detected by the first temperature sensor 17, temperature on the outlet side, i.e., temperature of the primary air 35 is detected by the second temperature sensor 18 as primary air temperature sensor. Detected results from the first and second temperature sensors 17 and 18 are respectively input via the signal processing part 24 into the main controlling part 25.

[0055] The temperature of the primary air 35 is set by regulation of flow rate ratio between the branched primary air 35' and the bypass flow 35''. The regulation of the flow rate ratio is conducted by the first and second flow rate regulating dampers 13 and 14. The primary air feed and bypass pipes 9 and 12 and the first and second flow rate regulating dampers 13 and 14 provide primary air temperature regulating means. There may be provided further means for feeding air, in a separate pathway, to the coal pulverizer 2 or to the primary air feed pipe 9 so as to regulate the temperature of the primary air 35.

[0056] Flow rate of the primary air 35 supplied is detected by the flow rate sensor 16 and the detected result is input to the controller 23 where via the main controlling part 25 and the primary air amount regulating controller 31, the flow rate of the primary air 35 is controlled by the primary air amount regulating damper 15 for proper combustion with no excess or deficiency depending on load.

[0057] The pulverized coal fed together with the primary air 35 to the pulverized coal burners 4 is burned further together with the secondary air 36. After the combustion, the exhaust gas is discharged via the exhaust duct 19.

[0058] The amount of oxygen remaining in the exhaust is detected by the oxygen amount sensor 21 and the detected result is sent to the controller 23 where the main controlling part 25 sets the forced draft amount for proper remaining oxygen amount suited for the fuel property to control the forced draft fan 8 via the fan controller 28.

[0059] Next, temperature regulation of the primary air 35 will be illustrated in conjunction with FIG. 3.

[0060] FIG. 3 illustrates flow of data processing relating to temperature regulation of the primary air 35. Data on properties of various kinds of coals usable for a coal burning boiler apparatus being obtained beforehand by means of analysis and the like. The data on the properties may include those of volatile portion, fuel ratio (fixed carbon/volatile portions), total moisture content in coals; data on spontaneous ignition temperatures of the respective coals with obtained property data are obtained through experiences, past performances and the like. The data on the properties of the respective coals are classified for the respective coals and are stored in the memory part 26 together with their classification codes; data on the spontaneous ignition temperatures of the respective coals are stored in the memory part 26 in association with the property data or with the classification codes.

[0061] With respect to the spontaneous ignition temperatures corresponding to the properties of the coals, spontaneous ignition temperatures only for typical properties of coals may be obtained to analogize spontaneous ignition temperatures for any unknown properties of coals from the spontaneous ignition temperatures corresponding to the known properties.

[0062] When coal to be burned is determined, property analysis is conducted for the coal. The obtained coal property is input to the operating part 27. In this case, if the coal property is known one, a classification code corresponding to the known coal property is input. The main controlling part 25 starts the combustion condition arithmetic program to calculate spontaneous ignition temperature on the basis of the stored property data to thereby set the temperature of the primary air 35 on the outlet side of the coal pulverizer 2. The temperature is set to be lower than the spontaneous ignition temperature by a predetermined temperature, e.g., by a (approximately) 20°C as to prevent spontaneous ignition of the pulverized coal. For bituminous coal, the set temperature may be about 80°C; and for anthracite or semi-anthracite coal or oil coke, about 100°C.

[0063] After the temperature of the primary air 35 on the outlet side of the coal pulverizer 2 is set, degrees of valve openings of the first and second flow rate regulating dampers 13 and 14 are regulated on the basis of the set value. The temperature of the primary air 35 on the outlet side of the coal pulverizer 2 is fed back to the controller 23, so that flow rate regulation by the first and second flow rate regulating dampers 13 and 14 is conducted such that the temperature of the primary air 35 is maintained to the set value.

[0064] The temperature of the primary air 35 on the inlet side of the coal pulverizer 2 is detected by the first temperature sensor 17 to conduct monitor for prevention of the temperature of the primary air 35 fed to the coal pulverizer 2 from exceeding the spontaneous ignition temperature. If there is a possibility that the temperature of the primary air 35 may exceed the spontaneous ignition temperature, then the degree of opening of the second flow rate regulating damper 14 is urgently increased to increase the flow rate of the bypass flow 35'' thereby lowering the temperature of the primary air 35.

[0065] Thus, regardless of property of coal, the temperature of the primary air 35 is properly set and the pulverized coal heated by the primary air 35 is fed to the pulverized coal burners 4 for combustion, thereby obtaining stable ignition and combustion.

1. A coal burning boiler apparatus characterized in that it comprises a coal burning boiler, a coal pulverizer for pulverizing massive coal into pulverized coal, a temperature sensor for detecting temperature of primary air entraining the pulverized coal to said coal burning boiler, means for regulating temperature of said primary air and a controller for controlling said regulating means on the basis of a detected result from said temperature sensor so as to make said primary air have a given temperature.
2. A coal burning boiler apparatus as claimed in claim 1, wherein said primary air temperature regulating means comprises a primary air feed pipe passing through an air preheater heated by exhaust gas from the boiler, a primary air bypass pipe bypassing said air preheater and joining into said primary air feed pipe, a first flow rate regulating damper arranged in said primary air feed pipe and a second flow rate regulating damper arranged in said primary air bypass pipe, said first and second flow rate regulating dampers being flow-rate controlled by said controller.

3. A coal burning boiler apparatus as claimed in claim 1, wherein said controller has data on properties of coals and data on spontaneous ignition temperatures corresponding to said properties of the coals, spontaneous ignition temperature corresponding to a property of the coal supplied being calculated on the basis of said data on the properties of the coals and said data on the spontaneous ignition temperatures, temperature of the primary air being set on the basis of a result of the calculation.

4. A coal burning boiler apparatus as claimed in claim 2, wherein said controller has data on properties of coals and data on spontaneous ignition temperatures corresponding to said properties of the coals, spontaneous ignition temperature corresponding to a property of the coal supplied being calculated on the basis of said data on the coal properties and said data on the spontaneous ignition temperatures, temperature of the primary air being set on the basis of a result of the calculation.

5. A coal burning boiler apparatus as claimed in claim 3, wherein said data on the properties of the coals include data of volatile portion, fuel ratio and total moisture content.

6. A coal burning boiler apparatus as claimed in claim 4, wherein said data on the coal properties include data of volatile portion, fuel ratio and total moisture content.

7. A coal burning boiler apparatus as claimed in claim 3, wherein said temperature of the primary air is temperature on the outlet side of said coal pulverizer and set to be lower than a corresponding ignition temperature by 20°C.

8. A coal burning boiler apparatus as claimed in claim 4, wherein said temperature of the primary air is temperature on the outlet side of said coal pulverizer and set to be lower than a corresponding ignition temperature by 20°C.

9. A coal burning boiler apparatus as claimed in claim 1, wherein a further temperature sensor is provided on the inlet side of said coal pulverizer to conduct monitor for prevention of the temperature of the primary air flowing into said coal pulverizer from being higher than the given temperature.