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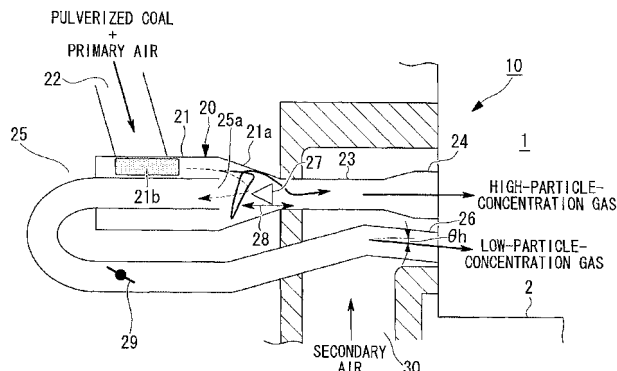
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(54) **Burner structure**

(57) To provide a low combustibility fuel firing burner that can ensure high ignition performance and combustion stability even if a gas flow rate is changed along with changes in boiler load or the like. A low combustibility fuel firing burner separates a pulverized low combustibility fuel supplied together with an air with a separator, distributing the separated fuel to a rich portion nozzle and a lean portion nozzle provided in a furnace, and burning

the fuel, in which a variable control part such as a core or a flow adjusting/blocking valve is provided in at least one of a high-particle-concentration gas pipe extending from a downstream side of the separator and communicating with the rich portion nozzle and a low-particle-concentration gas pipe extending from the downstream side of the separator and communicating with the lean portion nozzle.

FIG. 1



Description

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0001] The present invention relates to a low combustibility fuel firing burner applicable to various types of combustion apparatuses that burn a low combustibility fuel such as a pulverized coal boiler.

[0002] This application is based on Japanese Patent Application No. 2006-286692, the content of which is incorporated herein by reference.

2. DESCRIPTION OF RELATED ART

[0003] Hitherto, a low combustibility fuel firing burner that burns a pulverized low combustibility fuel (hereinafter referred to as "burner") has been used in pulverized coal boilers fired with a low combustibility fuel such as anthracite or petroleum coke in a fine powder form.

[0004] For example, as shown in Figs. 4 and 5, a burner 10A of the related art, which burns a fuel that is pulverized coal obtained by pulverizing anthracite in a furnace 1 of a boiler is composed of a pulverized coal-air mixture system provided in the burner center and supplying a mixture of pulverized coal and a primary air set to about 100°C, and a secondary air system provided around the pulverized coal-air mixture system and supplying a secondary air set to about 300 to 350°C.

[0005] The primary air system includes a separator 20A provided upstream of a burner portion for the purpose of improving an ignition performance. The separator 20A is based on the principle of a cyclone. Thus, a portion with many fuel particles (rich portion) and a portion with few fuel particles (lean portion) can be obtained.

[0006] On the downstream side of the separator, the primary air system is branched to a rich portion nozzle 24 for introducing and burning a high-particle-concentration gas containing fuel particles in a high concentration and a lean portion nozzle 26 for introducing and burning a low-particle-concentration gas containing fuel particles in a low concentration. In general, in the case of using a low combustibility fuel, the whole burner 10A is inclined downwardly to improve the ignition performance.

[0007] Further, the lean portion nozzle 26 is provided on the side of a furnace wall 2 that forms a furnace 1 and is thus put under an oxygen atmosphere to prevent slagging.

[0008] In Figs. 4 and 5, reference numeral 23 denotes a high-particle-concentration gas pipe for introducing a high-particle-concentration gas to the rich portion nozzle 24; and 25 from the separator 20A, a low-particle-concentration gas pipe for introducing a low-particle-concentration gas to the lean portion nozzle 26 from the separator 20A (see Japanese Unexamined Patent Application, Publication No. Hei 8-178210 (Fig. 5), for instance).

[0009] However, according to the above related art,

when a gas flow rate is changed along with change in boiler load or the like, an ignition performance or combustion stability might be affected thereby. In particular, in the case of using a low combustibility fuel, an ignition performance or combustion stability is affected also by interference of flames of adjacent nozzles.

[0010] To be specific, a distribution rate of fuel particles is determined in accordance with a separation efficiency of the separator 20A. Thus, during partial load operations that cause reduction in gas supply, the separation efficiency of the separator 20A is accordingly lowered due to a decrease in centrifugal force. Therefore, it is difficult to attain a desired distribution rate for the rich portion nozzle 24 and the lean portion nozzle 26.

[0011] Further, if a burner is not used during partial load operations or a spare burner is used, there is a fear of backflow of a gas from the lean nozzle pipe 25 to a direction of the separator 20A due to a negative pressure.

[0012] The above change in distribution rate and gas backflow, or the interference of flames of adjacent nozzles affects the ignition performance or combustion stability of the low combustibility fuel firing burner 10A designed to distribute particles of a low combustibility fuel with the separator 20A, so there is an increasing demand to develop a low combustibility fuel firing burner that overcomes the above problems.

BRIEF SUMMARY OF THE INVENTION

[0013] The present invention has been accomplished in view of the above circumstances, and it is an object of the present invention to provide a low combustibility fuel firing burner that can ensure high ignition performance and combustion stability even if a gas flow rate is changed along with changes in boiler load or the like.

[0014] The present invention adopts the following solutions with a view to attaining the above object.

[0015] A low combustibility fuel firing burner according to an aspect of the present invention separates a pulverized low combustibility fuel supplied together with an air with a separator, distributes the separated fuel to a rich portion nozzle and a lean portion nozzle provided in a furnace, and burns the fuel, wherein a variable control part for changing a flow path sectional area is provided in at least one of a gas flow path extending from a downstream side of the separator and communicating with the rich portion nozzle and a gas flow path extending from the downstream side of the separator and communicating with the lean portion nozzle.

[0016] According to the low combustibility fuel firing burner of the present invention, the variable control part for changing a flow path sectional area is provided in at least one of the gas flow path communicating with the rich portion nozzle and the gas flow path communicating with the lean portion nozzle. Hence, a sectional area of a gas flow path is appropriately changed and adjusted to the optimum value in accordance with operation conditions such as partial load operations.

[0017] In the low combustibility fuel firing burner, it is preferred that the variable control part be a movable resistor provided in a gas flow path for supplying a high-particle-concentration gas from the separator to the rich portion nozzle. Thus, a sectional area of a gas flow path for supplying a high-particle-concentration gas to the rich portion nozzle can be changed as appropriate. Hence, a gas flow rate in the gas flow path for supplying a high-particle-concentration gas is adjusted in accordance with operation conditions, and a separation efficiency of the separator can be optimized in accordance with operation conditions such as partial load operations.

[0018] In the low combustibility fuel firing burner, it is preferred that the variable control part be a flow adjusting/blocking valve provided in a gas flow path for supplying a low-particle-concentration gas from the separator to the lean portion nozzle. Thus, a sectional area of a gas flow path for supplying a low-particle-concentration gas to the lean portion nozzle can be changed from a full-open position to a totally-closed position as appropriate. Hence, a gas flow rate in the gas flow path for supplying a low-particle-concentration gas can be adjusted in accordance with operation conditions, or the gas flow path can be closed when the burner is not used.

[0019] In the low combustibility fuel firing burner, it is preferred that a wall against which a low combustibility fuel supplied into the separator collides be given a hard-wearing finish. Thus, a wear resistance of the wall against which slag, melted ash, and unburnt carbon collide is improved.

[0020] A low combustibility fuel firing burner according to another aspect of the present invention separates a pulverized low combustibility fuel supplied together with an air with a separator, distributes the separated fuel to a rich portion nozzle and a lean portion nozzle provided in a furnace, and burns the fuel, wherein a blowoff angle of the rich portion nozzle and a blowoff angle of the lean portion nozzle are offset in a vertical direction.

[0021] According to the low combustibility fuel firing burner, a blowoff angle of the rich portion nozzle and a blowoff angle of the lean portion nozzle are offset in a vertical direction, so interference of flames of nozzles can be prevented.

[0022] A low combustibility fuel firing burner according to another aspect of the present invention separates a pulverized low combustibility fuel supplied together with an air with a separator, distributes the separated fuel to a rich portion nozzle and a lean portion nozzle provided in a furnace, and burns the fuel, wherein a blowoff angle of the lean portion nozzle is offset to a furnace wall side in a horizontal direction.

[0023] According to the low combustibility fuel firing burner, a blowoff angle of the lean portion nozzle is offset to a furnace wall side in a horizontal direction, so it is possible to prevent slagging on a furnace wall as well as interference of flames of nozzles.

[0024] According to the present invention, in the low combustibility fuel firing burner structured to distribute

fuel particles of a low combustibility fuel with a separator, it is possible to prevent changes in distribution rate in accordance with operation conditions or gas backflow, so high ignition performance and combustion stability can be ensured.

[0025] Further, high ignition performance and combustion stability can be ensured by preventing interference of flames of adjacent nozzles as well.

10 BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0026]

15 Fig. 1 is a cross-sectional view of a low combustibility fuel firing burner according to an embodiment of the present invention;

20 Fig. 2 is a longitudinal sectional view of a structural example of a separator and a primary air pipe of Fig. 1;

25 Fig. 3 is a longitudinal sectional view showing an example of a blowoff angle of a rich portion nozzle and a lean portion nozzle;

Fig. 4 is a cross-sectional view of a low combustibility fuel firing burner of the related art; and

Fig. 5 is a longitudinal sectional view showing a blow-off angle of a rich portion nozzle and a lean portion nozzle of Fig. 4.

30 DETAILED DESCRIPTION OF THE INVENTION

[0027] Hereinafter, an embodiment of a low combustibility fuel firing burner according to the present invention will be described with reference to the accompanying drawings.

35 **[0028]** A low combustibility fuel firing burner (hereinafter simply referred to as "burner") 10 of Figs. 1 to 3 is provided in, for example, a furnace 1 of a pulverized coal boiler or the like. The burner 10 burns a powder (fine powder) of a low combustibility fuel supplied together with an air in the furnace 1. Specific examples of the low combustibility fuel include anthracite and petroleum coke.

[0029] The following description is directed to the burner 10 supplied with a fuel that is pulverized coal obtained by pulverizing anthracite as a low combustibility fuel.

[0030] The burner 10 is composed of a pulverized coal supply system supplied with pulverized coal together with a primary air at a relatively low temperature, about 100°C, and a secondary air system supplied with a secondary air at a relatively high temperature, about 300 to 350°C.

45 **[0031]** The pulverized coal supply system is positioned at almost the center of the burner 10 and provided with a separator 20 for distributing a mixture of a primary air and pulverized coal to a rich portion and a lean portion as described later for the purpose of improving an ignition performance. The separator 20 has a cyclone structure that is based on centrifugal separation. A primary air pipe 50 22 for supplying a mixed gas from a tangent line direction

is connected to a side wall of an external cylinder 21. A high-particle-concentration gas pipe 23 is connected to a small diameter portion 21a obtained by tapering the external cylinder 21 into a cone shape, and a rich portion nozzle 24 that is open to the furnace 1 is provided at its tip end.

[0032] Further, a low-particle-concentration gas pipe 25 is concentrically inserted into the external cylinder 21. The low-particle-concentration gas pipe 25 extends from the external cylinder 21 to the opposite side to the high-particle-concentration gas pipe 23 and makes a U-turn. A lean nozzle 26 is provided adjacent to the rich portion nozzle 24 at substantially the same level, at a tip end of the low-particle-concentration gas pipe 25. Incidentally, an opening 25a of the low-particle-concentration gas pipe 25 is positioned on the downstream side (rich portion nozzle 24 side) of a joint of the primary air pipe 22 in a flow direction of the mixed gas.

[0033] As for a positional relationship between the rich portion nozzle 24 and the lean portion nozzle 26, the lean portion nozzle 26 for burning a low-particle-concentration gas is provided on the side of a furnace wall 2 that forms the furnace 1.

[0034] A variable control part for changing a flow path sectional area is provided in at least one of a gas flow path communicating with the rich portion nozzle 24 and a gas flow path communication with the lean portion nozzle 26 on the downstream side of the separator 20.

[0035] In the illustrated structure, a core 27 that is, for example, triangular in section is provided as a movable resistor that can reciprocate in a gas flow direction, in the small diameter portion 21a connected to the high-particle-concentration gas pipe 23 for supplying a high-particle-concentration gas from the separator 20 to the rich portion nozzle 24. Along with movement of the core 27 in the small diameter portion 21a in an axial direction as indicated by an arrow 28, a sectional area of a flow path extending from the separator 20 to the high-particle-concentration gas pipe 23 is changed. In other words, a sectional area of a flow path of the high-particle-concentration gas pipe 23 is substantially changed.

[0036] Incidentally, the movable resistor is not limited to the illustrated core 27. For example, a butterfly valve or other such members capable of changing a sectional area of a flow path of the high-particle-concentration gas pipe 23 can be used.

[0037] In a gas flow path for supplying a low-particle-concentration gas from the separator 20 to the lean portion nozzle 26, that is, in an appropriate position in the low-particle-concentration gas pipe 25, a flow adjusting/blocking valve 29 such as a butterfly valve is provided as the variable control part. The flow adjusting/blocking valve 29 changes a valve member position from a totally-closed position to a full-open position to thereby adjust a sectional area of a flow path extending from the separator 20 to the low-particle-concentration gas pipe 25. Further, the flow adjusting/blocking valve 29 can totally close the low-particle-concentration gas pipe 25 (flow

path sectional area=0) if necessary.

[0038] A secondary air supply path (secondary air pipe) 30 that communicates with the furnace 1 is provided around the rich portion nozzle 24 and the lean portion nozzle 26 so as to surround the two nozzles. Here, the secondary air supply path 30 serves as a secondary air system provided for supplying an air at relatively high temperatures to the both of the nozzles 24 and 26.

[0039] In the above separator 20, a mixed gas supplied from the primary air pipe 22 flows while whirling around the low-particle-concentration gas pipe 25 in the external cylinder 21 to thereby centrifuge the mixture to a peripheral rich portion and a central lean portion. As a result, a high-particle-concentration gas containing pulverized coal in a high particle concentration flows in a gas flow direction while whirling around the low-particle-concentration gas pipe 25, and is guided to the rich portion nozzle 24 through the small diameter portion 21a and the high-particle-concentration gas pipe 23. On the other hand, a low-particle-concentration gas containing pulverized coal in a low particle concentration flows in a gas flow direction while whirling around the low-particle-concentration gas pipe 25 and then makes a U-turn to the opening 25a of the low-particle-concentration gas pipe 25, and is guided to the lean portion nozzle 26 through the low-particle-concentration gas pipe 25.

[0040] With regard to a distribution rate of fuel particles suitable in the case of using pulverized coal obtained by pulverizing anthracite as a fuel, that is, a distribution rate of fuel particles suitable to keep high ignition performance and combustion stability, about 93% of pulverized coal and about 50% of air in the total amount of mixed gas are distributed to the rich portion nozzle 24, and about 7% of pulverized coal and 50% of air in the total amount of mixed gas are distributed to the lean portion nozzle 26.

[0041] In the thus-structured nozzle 10, if a mixed gas supply is changed along with changes in boiler load or the like, the distribution rate of fuel particles is changed, so a predetermined distribution rate of fuel particles is kept by adjusting the core 27 position.

[0042] To be specific, the opening 25a of the low-particle-concentration gas pipe 25 is designed to obtain a desired distribution rate of fuel particles with an amount of mixed gas supplied under predetermined operation conditions such as rated operations. Thus, if a supply of the mixed gas is decreased, an amount of pulverized coal distributed to the high-particle-concentration gas side tends to decrease due to reduction in centrifugal force. To that end, the core 27 is moved in the arrow 28 direction in accordance with the decrease in mixed gas supply to thereby increase a sectional area of a flow path communicating with the high-particle-concentration gas pipe 23 from the separator 20. As a result, a resistance of the flow path extending to the rich portion nozzle 24 is lowered, and an amount of pulverized coal distributed to the rich portion nozzle 24 side is increased. Hence, a distribution rate of pulverized coal is adjusted to a predetermined value.

[0043] On the other hand, if a supply of mixed gas is increased, an amount of pulverized coal distributed to the high-particle-concentration gas side tends to increase due to an increase in centrifugal force. To that end, the core 27 is moved in the arrow 28 direction in accordance with an increase in mixed gas supply to thereby decrease a sectional area of a flow path communicating with the high-particle-concentration gas pipe 23 from the separator 20. As a result, a resistance of a flow path extending to the rich portion nozzle 24 is increased and an amount of pulverized coal distributed to the rich portion nozzle 24 side is decreased. In this case as well, a distribution rate of pulverized coal is adjusted to a predetermined value.

[0044] Further, the distribution rate can be adjusted by controlling the flow adjusting/blocking valve 29 provided in the low-particle-concentration gas pipe 25.

[0045] To be specific, if the mixed gas supply is decreased, the flow adjusting/blocking valve 29 is closed in accordance with the decrease in mixed gas supply to thereby reduce a sectional area of a flow path of the low-particle-concentration gas pipe 25. As a result, a resistance of a flow path extending to the lean portion nozzle 26 is increased, while a resistance of a flow path extending to the rich portion nozzle 24 is relatively decreased, so an amount of pulverized coal distributed to the rich portion nozzle 24 side is increased, and a distribution rate of pulverized coal is adjusted to a predetermined value.

[0046] On the other hand, if the mixed gas supply is increased, the flow adjusting/blocking valve 29 is opened in accordance with the increase in mixed gas supply to thereby increase a sectional area of a flow path of the low-particle-concentration gas pipe 25. As a result, a resistance of a flow path extending to the lean portion nozzle 26 is decreased, while a resistance of a flow path extending to the rich portion nozzle 24 is relatively increased, so an amount of pulverized coal distributed to the rich portion nozzle 24 side is decreased, and a distribution rate of pulverized coal is adjusted to a predetermined value.

[0047] In this way, the distribution rate of pulverized coal can be adjusted by moving the core 27 or opening/closing the flow adjusting/blocking valve 29, so at least one of the core 27 and the flow adjusting/blocking valve 29 has only to be provided. However, both of the core 27 and the flow adjusting/blocking valve 29 may be moved at the same time to adjust the rate.

[0048] Further, if the flow adjusting/blocking valve 29 is totally closed, the low-particle-concentration gas pipe 25 can be blocked. Hence, it is possible to prevent back-flow from the lean portion nozzle 26 to the separator 20 side, for example, if the burner 10 is not used.

[0049] Incidentally, the external cylinder 21 of the separator 20 has an area against which pulverized particles flowing therein from the primary air pipe 22 at high speeds collide. To that end, on an inner wall of the area, a wear-resistant wall 21b that is optionally given a hardwearing

finish is formed as shown in Fig. 2.

[0050] To elaborate, conceivable examples of the hardwearing finish include bonding with a ceramic material or wear-resistant hardfacing (25Cr cast iron, CHR-3, etc.). A wear resistance is improved by forming the wear-resistant wall 21b, so even if pulverized coal particles collide against the cylinder, the cylinder does not thin out at an early stage, and a durability of the separator 20 can be improved.

[0051] Further, as for the positional relationship between the rich portion nozzle 24 and the lean portion nozzle 26, the lean portion nozzle 26 is provided close to the furnace wall 2 side. In addition, the lean portion nozzle 26 is preferably attached with an offset relative to the furnace wall 2 side in a horizontal direction. That is, as shown in the plane view of Fig. 1, a blowoff angle of the lean portion nozzle 26 is offset from that of the rich portion nozzle 24 that ejects a gas in a direction parallel to the furnace wall 2 as viewed in the horizontal direction of Fig. 1, and an ejection direction of the lean portion nozzle 26 is directed toward the furnace wall 2 side. In this case, a preferred blowoff angle θ_h is about 10 degrees; the blowoff angle θ_h is an angle offset from the rich portion nozzle 24 toward the furnace wall 2 side with respect to the horizontal direction.

[0052] As described above, if the blowoff angle of the lean portion nozzle 26 is offset to the furnace wall 2 side in the horizontal direction, it is possible to prevent interference of flames of the adjacent rich portion nozzle 24 and lean portion nozzle 26, and a fuel can be continuously burned under satisfactory conditions with a small loss. In addition, an ignition performance can be improved. Moreover, the ejection direction of the lean portion nozzle 26 is directed to the furnace wall 2 side due to the offset, so slagging as adherence of foreign materials such as coal ash to the furnace 1 wall can be suppressed.

[0053] Further, as for the positional relationship between the rich portion nozzle 24 and the lean portion nozzle 26, the lean portion nozzle 26 is provided close to the furnace wall 2 side. In addition, as shown in Fig. 3, the lean portion nozzle 26 is preferably attached with an offset between the blowoff angle of the rich portion nozzle 24 and the blowoff angle of the lean portion nozzle 26 in the vertical direction. More specifically, it is preferred to set the ejection direction of the lean portion nozzle 26 to a horizontal direction, and to tilt the rich portion nozzle 24 downwardly by a predetermined blowoff angle θ_v . In this case, a preferred inclination angle θ_v of the rich portion nozzle 24 is approximately -10 degrees to 30 degrees, most preferably, 30 degrees on the provision that an angle increases (+) as a distance from the horizontal position as a reference position increases. This is because if the inclination angle θ_v is larger than 30 degrees, interference of flames of adjacent upper and lower nozzles 24 occurs this time.

[0054] An offset is set between the blowoff angles of the rich portion nozzle 24 and the lean portion nozzle 26 in the vertical direction as described above, making it

possible to prevent interference of flames of the adjacent rich portion nozzle 24 and lean portion nozzle 26. Hence, a fuel can be continuously burned under satisfactory conditions with a small loss, and an ignition performance can be improved.

[0055] Incidentally, if the blowoff angles of the rich portion nozzle 24 and the lean portion nozzle 26 have offsets in vertical and horizontal directions, interference of flames can be prevented more easily.

[0056] According to the present invention, in the burner 10 structured to distribute fuel particles of a low combustibility fuel with the separator 20, the core 27 or the flow adjusting/blocking valve 29 is moved to prevent changes in distribution rate in accordance with operation conditions and gas backflow, so high ignition performance and combustion stability can be ensured. Further, an offset is set between ejection directions of the rich portion nozzle 24 and the lean portion nozzle 26 to prevent interference of flames of adjacent nozzles to thereby ensure high ignition performance and combustion stability.

[0057] The present invention is not limited to the above-described embodiment and might be modified as appropriate without departing from the scope of the present invention.

Claims

1. A low combustibility fuel firing burner for separating a pulverized low combustibility fuel supplied together with an air with a separator, distributing the separated fuel to a rich portion nozzle and a lean portion nozzle provided in a furnace, and burning the fuel, wherein a variable control part for changing a flow path sectional area is provided in at least one of a gas flow path extending from a downstream side of the separator and communicating with the rich portion nozzle and a gas flow path extending from the downstream side of the separator and communicating with the lean portion nozzle.
2. The low combustibility fuel firing burner according to claim 1, wherein the variable control part is a movable resistor provided in a gas flow path for supplying a high-particle-concentration gas from the separator to the rich portion nozzle.
3. The low combustibility fuel firing burner according to claim 1, wherein the variable control part is a flow adjusting/blocking valve provided in a gas flow path for supplying a low-particle-concentration gas from the separator to the lean portion nozzle.
4. The low combustibility fuel firing burner according to any one of claims 1 to 3, wherein a wall against which a low combustibility fuel supplied into the separator collides is given a hardwearing finish.

5. A low combustibility fuel firing burner for separating a pulverized low combustibility fuel supplied together with an air with a separator, distributing the separated fuel to a rich portion nozzle and a lean portion nozzle provided in a furnace, and burning the fuel, wherein a blowoff angle of the rich portion nozzle and a blowoff angle of the lean portion nozzle are offset in a vertical direction.
6. A low combustibility fuel firing burner for separating a pulverized low combustibility fuel supplied together with an air with a separator, distributing the separated fuel to a rich portion nozzle and a lean portion nozzle provided in a furnace, and burning the fuel, wherein a blowoff angle of the lean portion nozzle is offset to a furnace wall side in a horizontal direction.

FIG. 1

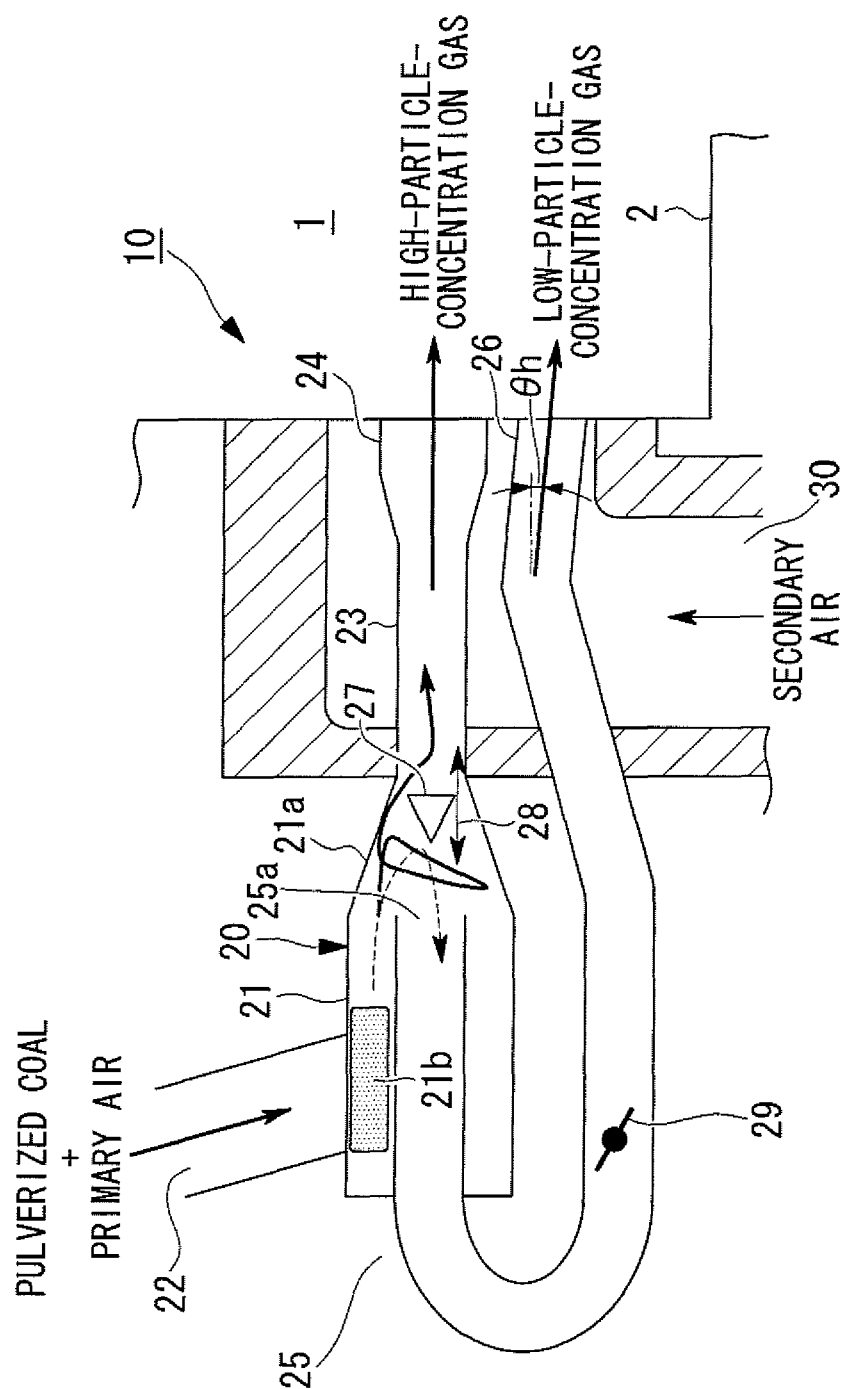


FIG. 2

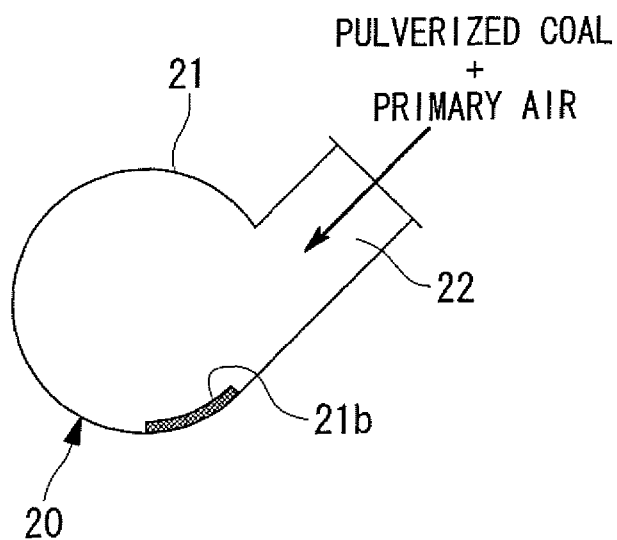


FIG. 3

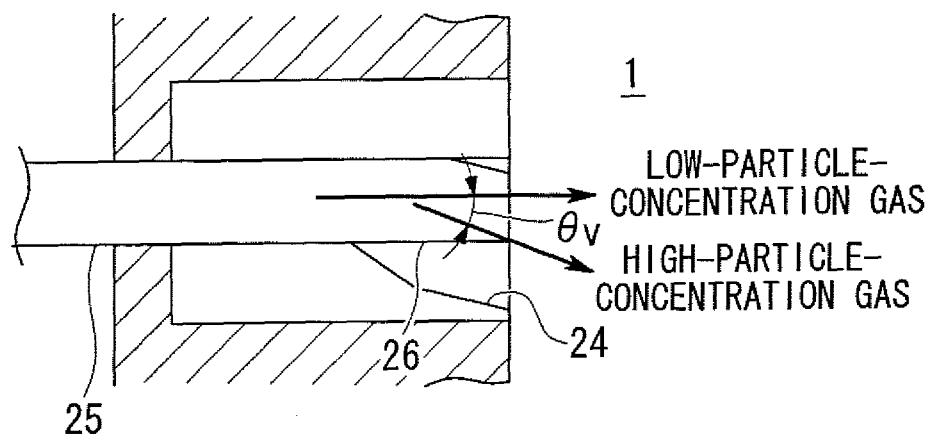


FIG. 4

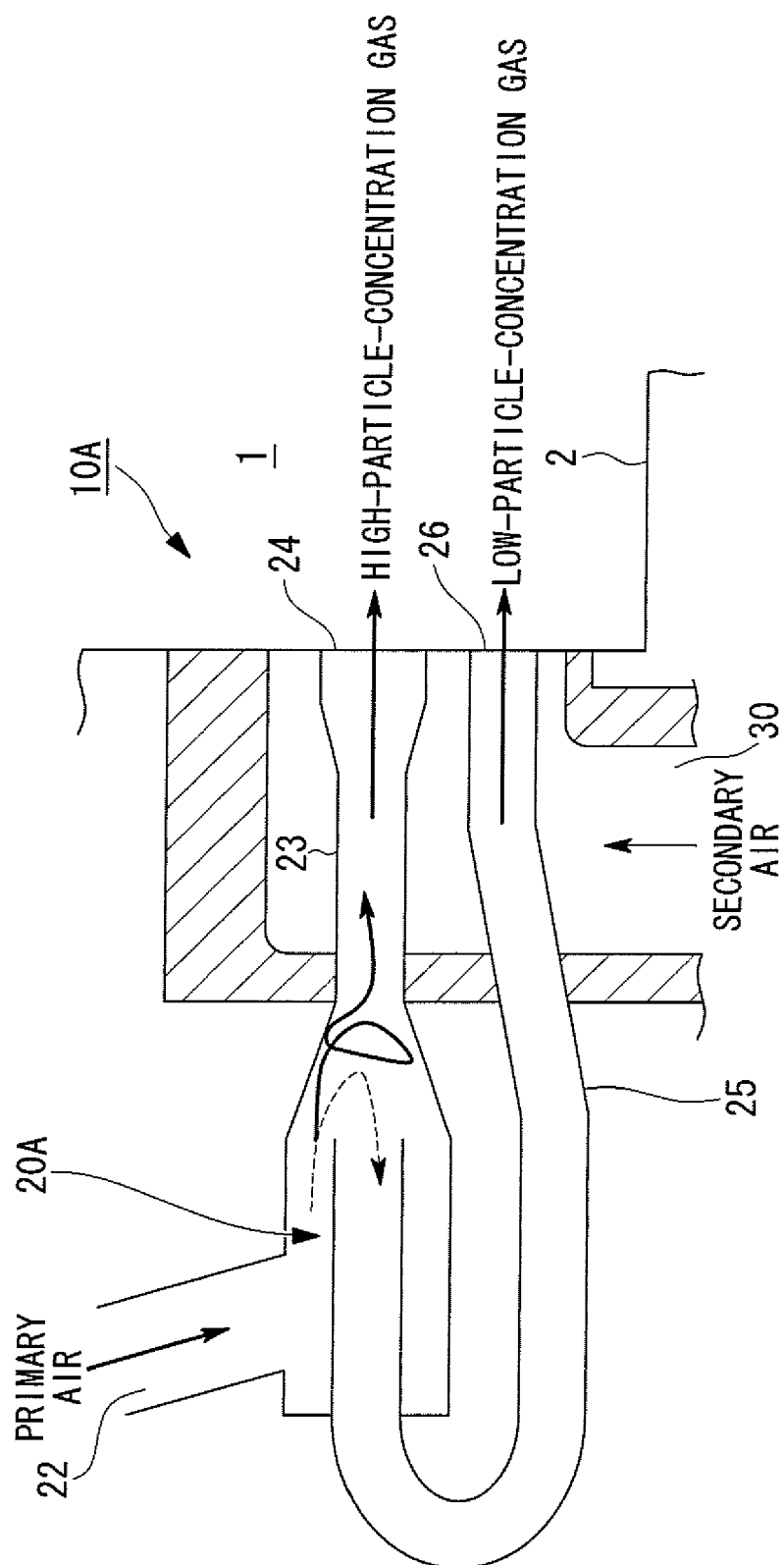
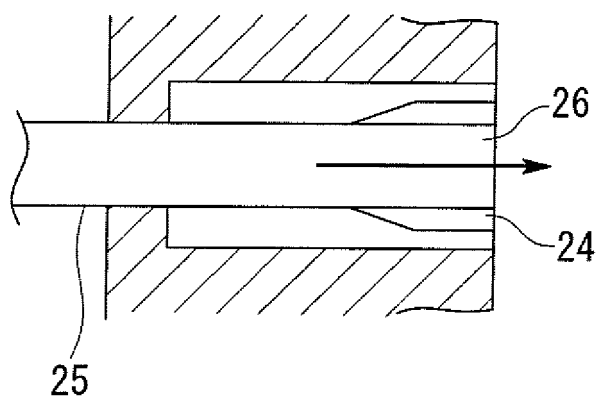


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006286692 A [0002]
- JP HEI8178210 A [0008]