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(54) SOLID FUEL BURNER

FESTBRENNSTOFF-BRENNER

BRÛLEUR À COMBUSTIBLE SOLIDE

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(73) Proprietor: **Mitsubishi Hitachi Power Systems, Ltd.**
Yokohama 220-8401 (JP)

(72) Inventors:
- **MINE, Toshihiko**
  Kure-shi
  Hiroshima 737-8508 (JP)
- **KURAMASHI, Kouji**
  Kure-shi
  Hiroshima 737-8508 (JP)
- **OCHI, Kenichi**
  Kure-shi
  Hiroshima 737-8508 (JP)
- **OCHI, Yusuke**
  Kure-shi
  Hiroshima 737-8508 (JP)
- **SHIMOGORI, Miki**
  Kure-shi
  Hiroshima 737-8508 (JP)
- **OHYATSU, Noriyuki**
  Kure-shi
  Hiroshima 737-8508 (JP)
- **TADAKUMA, Satoshi**
  Kure-shi
  Hiroshima 737-8508 (JP)

(74) Representative: **TBK**
Bavariaring 4-6
80336 München (DE)

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Description

TECHNICAL FIELD

[0001] The present invention relates to a solid fuel burner for burning a solid fuel such as coal.

BACKGROUND ART

[0002] For a burner structure for burning a solid fuel such as coal in a boiler furnace used in a thermal power plant or the like, various structures have been proposed for the purpose of stabilizing flame, reducing unburnt carbon from the fuel, reducing nitrogen oxides in the exhaust gas or the like.

[0003] In a burner structure disclosed in Japanese Patent No. 3344694, a large circulating flow is formed between a mixture fluid of pulverized coal and carrier gas and secondary and tertiary air flows (combustion air flow) by ejecting the tertiary air flow outside the mixture fluid of pulverized coal and carrier gas and ejecting the secondary air flow outwardly beyond the tertiary air flow, whereby the mixing of the pulverized coal and the combustion air in the furnace in the vicinity of the burner outlet can be suppressed to effectively reduce the NOx generation and the unburned combustible contents in burnt ash, maintaining stable pulverized coal ignition and flame stability.

[0004] In a burner disclosed in Japanese Unexamined Patent Application Publication No. S61-72906, moreover, there is disclosed a structure in which, for the purpose of cooling a flame stabilizing ring disposed at an outlet of a primary sleeve through which a mixture fluid of pulverized coal and carrier gas flows, the flame stabilizing ring and a part of the primary sleeve connected to the flame stabilizing ring are both made into a two-tiered cooling sleeve, and a fin is provided in the cooling sleeve so that the flame stabilizing ring can be cooled by air flowing through the cooling sleeve.

[0005] In a burner disclosed in Japanese Unexamined Patent Application Publication No. 2004-101071, in which a pilot nozzle is provided at the center of a burner body and a plurality of main nozzles are arranged at intervals around the pilot nozzle so as to use a flame ejected from the pilot nozzle for ignition of a fuel ejected from the main nozzles, moreover, there is disclosed a structure in which a collar is provided at an end of a tapered part spreading in a radial fashion from an outlet of the pilot nozzle toward the main nozzles, thereby forming a flame stabilizing low speed flame zone (circulating flow) downstream of the collar. This publication discloses that since an air passage leading to the tapered part is provided in the collar opposed to the low speed flame zone, the collar can be cooled, and that since an air is ejected from the tapered part toward the main nozzles, the flashback of the flame can be prevented.

[0006] In a burner disclosed in Japanese Unexamined Patent Application Publication No. H11-148611, furthermore, an end of a gas nozzle has a cooling structure with an air cooling fin so as to prevent temperature from rising due to radiant heat from a furnace.

CITATION LIST

PATENT LITERATURE

[0007]

Patent Literature 1: Japanese Patent No. 3344694
Patent Literature 2: Japanese Unexamined Patent Application Publication No. S61-72906
Patent Literature 3: Japanese Unexamined Patent Application Publication No. 2004-101071
Patent Literature 4: Japanese Unexamined Patent Application Publication No. H11-148611

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0008] In the solid fuel burner of Patent Literature 1, as a means for controlling the jet direction of the secondary air flow, a guide plate for making the jet angle of the secondary air flow larger than the jet angle of the tertiary air flow is provided at an end of a partition between a pulverized coal nozzle and a secondary air nozzle. However, since the guide plate directly receives radiation from the furnace, it may be burnt.

[0009] In the structure of Patent Literature 2, in which the flame stabilizing ring is cooled by the air flowing through the cooling sleeve of the solid fuel burner, meanwhile, since the fin is also provided in the cooling sleeve, the flame stabilizing ring can be effectively cooled. However, the cooling air ejected into the furnace from the flame stabilizing ring may interfere with the formation of the circulating flow composed of hot air and pulverized coal in the vicinity of the flame stabilizing ring and downstream of the flame stabilizing ring.

[0010] Furthermore, although the burner disclosed in Patent Literature 3 is a gas turbine burner, the flame reducing zone (circulating flow) for stabilizing flame is formed downstream of the collar disposed at the end of the tapered part spreading in a radial fashion from the outlet of the pilot nozzle toward the main nozzles, and moreover, the air passage leading to the tapered part is provided in the collar so as to cool the collar. However, since it is intended for gas combustion, the circulation zone downstream of the collar is made large without consideration of deposition of ash. Therefore, ash may easily deposit on the collar when the burner structure is employed for a solid fuel such as coal. In addition, since the solid fuel ignites slower than a gas fuel, employing the above burner structure may result in retarding the ignition.

[0011] In the solid fuel burner disclosed in Patent Literature 4, which has a cooling device between a second-

ary air and a tertiary air, meanwhile, slugs are cracked and removed by thermal shock not only with a cooling air flowing through a slit provided at an end of the cooling device but also with different materials used for the members located inside and outside the slit. In this structure, since the cooling air coming out of the slit is ejected toward the center axis (fuel jet side) and its flow is obstructed by the secondary air flow, it is estimated that a sufficient amount of secondary air necessary for cooling cannot flow. Therefore, presumably, the deposited slugs have to be cracked by using the different materials. In burners not having a large cooling device like this burner, moreover, the flow from the slit and the secondary air flow (or fuel jet) may interfere with each other to make unstable the ignition of the burner and the flame.

[0012] It is an object of the present invention to provide a solid fuel burner capable of preventing a member located at a burner outlet from being burnt by radiation from a furnace, preventing deposition of ash on this member, and maintaining stable solid fuel ignition and flame stability without disturbing formation of a hot circulating flow at the burner outlet.

SOLUTION TO PROBLEM

[0013] In order to attain the above-mentioned object, the present invention adopts the following solutions.

[0014] A first aspect of the present invention provides a solid fuel burner comprises a fuel nozzle (11) for ejecting a mixture fluid of a solid fuel and a carrier gas, a secondary combustion gas nozzle (13) concentrically disposed around the fuel nozzle (11) for permitting passage of a secondary combustion gas, a tertiary combustion gas nozzle (14) concentrically disposed around the secondary combustion gas nozzle (13) for permitting passage of a tertiary combustion gas, and a guide sleeve (25) disposed at an outlet end of the secondary combustion gas nozzle (13) for guiding a tertiary combustion gas flow (18) radially outwardly from a burner center axis, the solid fuel burner characterized by comprising a flame stabilizer (23) disposed at the outer end of an inner circumferential wall (29) of the secondary combustion gas nozzle (13) for guiding a secondary combustion gas flow (17) radially outwardly from the secondary combustion gas nozzle (13), a plurality of fin members (36) secured on an outer circumferential surface of the flame stabilizer (23) and intended to be cooled by the secondary combustion gas flow (17), a first guide member (34) secured to the end of the flame stabilizer (23) for guiding the secondary combustion gas flow (17) outwardly from the burner center axis, and a second guide member (35) secured to the end of the fin member (36) and located at a distance from the first guide member (34), upstream of the secondary combustion gas flow (17) from the first guide member (34) for guiding the secondary combustion gas flow (17) outwardly from the burner center axis, wherein a gap for permitting passage of a part (17b) of the secondary combustion gas flow (17) is formed between the outer circumferential surface of the flame stabilizer (23), which extends to the first guide member (34), and the second guide member (35) so as to separate the secondary combustion gas flow (17) into the front side flow (17b) and the rear side flow (17a) of a furnace at the second guide member (35), and each outward angle of the first guide member (34) and the second guide member (35) with respect to the burner center axis is larger than an outward angle of the guide sleeve (25) with respect to the burner center axis.

[0015] A second aspect of the present invention provides a solid fuel burner comprises a fuel nozzle (11) for ejecting a mixture fluid of a solid fuel and a carrier gas, a secondary combustion gas nozzle (13) concentrically disposed around the fuel nozzle (11) for permitting passage of a secondary combustion gas, a tertiary combustion gas nozzle (14) concentrically disposed around the secondary combustion gas nozzle (13) for permitting passage of a tertiary combustion gas, and a guide sleeve (25) disposed at an outlet end of the secondary combustion gas nozzle (13) for guiding a tertiary combustion gas flow (18) radially outwardly from a burner center axis, the solid fuel burner characterized by comprising a first guide member (34) disposed at the outer end of an inner circumferential wall (29) of the secondary combustion gas nozzle (13) for guiding a secondary combustion gas flow (17) outwardly from the burner central axis, a plurality of fin members (36) secured on the outer side of the inner circumferential wall (29) of the secondary combustion gas nozzle (13) and intended to be cooled by the secondary combustion gas flow (17), and a second guide member (35) secured to the end of the fin member (36) and located at a distance from the first guide member (34), upstream of the secondary combustion gas flow (17) from the first guide member (34) for guiding the secondary combustion gas flow (17) outwardly from the burner center axis, wherein a gap for permitting passage of a part (17b) of the secondary combustion gas flow (17) is formed between the inner circumferential wall (29) of the secondary combustion gas nozzle (13), which extends to the first guide member (34), and the second guide member (35) so as to separate the secondary combustion gas flow (17) into the front side flow (17b) and the rear side flow (17a) of the furnace at the second guide member (35), and each outward angle of the first guide member (34) and the second guide member (35) with respect to the burner center axis is larger than an outward angle of the guide sleeve (25) with respect to the burner center axis.

[0016] A preferential embodiment provides a solid fuel burner according to the first or second aspect of the present invention, characterized in that the second guide member (35) has an inner diameter which is smaller than an outer diameter of the first guide member (34) and an outer diameter which is larger than the outer diameter of the first guide member (34).

ADVANTAGEOUS EFFECTS OF INVENTION

[0017] According to the first aspect of the present invention, the flow 17b of the secondary combustion gas flow 17 at the furnace-facing front side of the second guide member 35, which is a part of the secondary combustion gas flow 17 rectified by the fin members 36, is ejected along the flame stabilizing sleeve 23b, and the first guide member 34 is disposed at the end of the flame stabilizing sleeve 23b, so that the front side of the second guide member 35 can be cooled by the secondary combustion gas flow 17b, rectified by the fin member 36, flowing toward the front side (furnace side) of the second guide member 35 through the gap between the second guide member 35 and the flame stabilizer 23, which also prevents deposition of ash and the like on the second guide member 35.

[0018] Moreover, a relatively small circulating flow 19b can be formed downstream of the second guide member 35 to draw in a hot gas from the furnace, while a relatively large circulating flow 19a can be formed at the front side (furnace-facing side) of the first and the second guide members 34, 35, wherein these circulating flows 19a, 19b may draw in a hot gas from the furnace, so that the fuel ignition and flaming stability can be maintained to effectively reduce the NO_X concentration and the unburned combustible contents in burnt ash.

[0019] Furthermore, since the outward angles of the first guide member 34 and the second guide member 35 with respect to the burner center axis are larger than the outward angle of the guide sleeve 25 with respect to the burner center axis, the secondary combustion gas flow 17 and the tertiary combustion gas flow 18 intersect each other at the burner outlet, which facilitates formation of the circulating flows 19a, 19b.

[0020] The second aspect of the present invention has the same effects as the first aspect of the invention except for the effect due to the flame stabilizer 23 according to the first aspect of the present invention.

[0021] According to a preferential embodiment the inner diameter of the second guide member 35 is smaller than the outer diameter of the first guide member 34, while the outer diameter of the second guide member 35 is larger than the outer diameter of the first guide member 34, whereby the secondary combustion gas flows 17a, 17b separated into two parts at the second guide member 35 can be ejected perpendicularly with respect to the burner center axis in the furnace 41, so that the passage for the secondary combustion gas at the rear side of the furnace of the second guide member 35, along which the secondary combustion gas flow 17a flows, becomes sufficiently long to prevent the flow 17b at the front side of the furnace of the second guide member 35 from causing deposition of ash on the front side of the first guide member 34 or prevent damage due to radiant heat from the furnace 41.

BRIEF DESCRIPTION OF DRAWINGS

[0022]

Fig. 1 is a drawing showing how guide members are disposed in a solid fuel burner structure according to a first embodiment of the present invention.

Fig. 2 is a sectional view showing the solid fuel burner structure according to Embodiment 1.

Fig. 3 is a drawing showing gas flows when the first and the second guide members according to Embodiment 1 have the same outer diameters.

Fig. 4 is a drawing showing gas flows when the first guide member does not exist as a comparative example of Embodiment 1.

Fig. 5 is a sectional view showing a solid fuel burner structure according to Embodiment 2 of the present invention.

Fig. 6 is a drawing showing how guide members are disposed in the solid fuel burner structure according to Embodiment 2.

DESCRIPTION OF EMBODIMENTS

[0023] Hereinbelow, embodiments of the present invention will be described with reference to the drawings.

EMBODIMENT 1

[0024] Fig. 1 is an enlarged view of a part where guide members are disposed in a solid fuel burner illustrated in Fig. 2, and Fig. 2 is a sectional view of the solid fuel burner according to the present embodiment.

[0025] The solid fuel burner is inserted in a burner throat 30 of a furnace wall provided with water pipes 31 and has a combustion-assisting oil gun 24 at its center axis and a fuel ejecting nozzle, i.e., a fuel nozzle 11 for ejecting a mixture fluid of a fuel and a carrier gas around the combustion-assisting oil gun 24. The combustion-assisting oil gun 24 passing through the fuel nozzle 11 along the center axis is used for ignition of the fuel at start-up of the solid fuel burner.

[0026] In the fuel nozzle 11, moreover, a condenser (obstacle) 33 is disposed around the oil gun 24, and a passage contracting member (venturi) 32 is disposed upstream of the condenser 33. With these obstacles 32, 33, a flow of the mixture fluid 16 can be deflected along the direction indicated by arrows to increase the density of solid fuel particles inside the inner circumferential wall 29 of the fuel nozzle 11, which facilitates ignition of the solid fuel at the outlet of the fuel nozzle 11.

[0027] Outside the fuel nozzle 11, the furnace wall is provided with a wind box 26 into which a combustion air is introduced, and in the wind box 26, outer air nozzles concentric with the fuel nozzle 11, i.e., a secondary air nozzle 13 and a tertiary air nozzle 14 are provided for ejecting air. The tertiary air nozzle 14 is provided with a swirler 28 for swirling air. Since a tertiary air ejected from

the tertiary air nozzle 14 is swirled by the swirler 28, a flow is induced at the burner outlet, between the fuel jet from the fuel nozzle 11, i.e., the flow of the mixture fluid of the fuel and its carrier gas 16 and the combustion air flows such as a secondary air flow 17 ejected from the secondary air nozzle 13 and a tertiary air flow 18 ejected from the tertiary air nozzle 14, in the direction reverse to the flow of the mixture fluid 16 and the tertiary air flow 18.

[0028] This reverse flow is called a circulating flow 19. The circulating flow 19 comprises a circulating flow 19a formed downstream of a flame stabilizer 23 and a circulating flow 19b formed downstream of a first guide member 34. A hot gas generated by combustion of the fuel flows into these two circulating flows 19a, 19b from a downstream zone in the furnace 41 and stays there. The ignition occurs such that the hot gas is mixed with the fuel particles in the flow of the mixture fluid 16 at the outlet of the solid fuel burner and then the temperature of the fuel particles is raised by radiant heat from the furnace 41.

[0029] A guide sleeve 25 for ejecting the tertiary air toward the outside of the solid fuel jet is provided at the end part (furnace-side outlet part) of an inner circumferential wall 38 of the tertiary air nozzle 14.

[0030] Outside the partition 29 between the fuel nozzle 11 and the secondary air nozzle 13 (i.e., the inner circumferential wall of the secondary air nozzle 13), the flame stabilizer 23 composed of a flame stabilizing base member 23a and a flame stabilizing sleeve 23b is provided for radially outwardly narrowing and converging the flow of the mixture fluid 16 ejected from the fuel nozzle 11, which is composed of the solid fuel and its carrier gas, and the secondary air flow 17 ejected from the secondary nozzle 13, and the two guide members 34, 35 are provided for ejecting the secondary air flow 17 into the furnace 41 outwardly beyond the tertiary air flow 18.

[0031] The first guide member 34 and the second guide member 35 are provided at a distance from each other in the flow direction of the combustion air. The first guide member 34 is located at the end of the flame stabilizing sleeve 23b and disposed such that the jet angle of the secondary air flow 17, which is deflected by the first guide member 34 and then ejected into the furnace 41, with respect to the burner center axis is larger than the jet angle of the tertiary air flow 18 with respect to the burner center axis.

[0032] Specifically, as shown in the encircled diagram at the upper side of Fig. 1, when the outward angles which the first guide member 34, the second guide member 35 and the guide sleeve 25 make with the oil gun 24 equivalent to the burner center axis are θ_{A1}, θ_{A2} and θ_B, respectively, they satisfy:

$$\theta_{A1} > \theta_B, \quad \theta_{A2} > \theta_B.$$

[0033] Since the outward angles of the first guide member 34 and the second guide member 35 with respect to the burner center axis are larger than the outward angle of the guide sleeve 25 with respect to the burner center axis, the secondary air flow 17 and the tertiary air flow 18 intersect each other at the burner outlet, which facilitates formation of the circulating flows 19a, 19b.

[0034] The second guide member 35 is placed in the same direction as the first guide member 34 with respect to the burner center axis, but upstream of the first guide member 34 in the burner. In addition, a gap is formed between the second guide member 35 and the flame stabilizing sleeve 23b.

[0035] The distance between the first guide member 34 and the second guide member 35 is equal to the distance between the second guide member 35 and the flame stabilizer 23. The secondary air flow 17 comprises a secondary air jet 17a ejected into the furnace 41 through the gap between the guide sleeve 25 and the second guide member 35 and a secondary air jet 17b ejected into the furnace 41 through the gap between the second guide member 35 and the first guide member 34, and the secondary air jets 17a, 17b are ejected outwardly with respect to the burner center axis beyond the tertiary air flow 18.

[0036] A fin member 36 connects to the second guide member 35, and the fin member 36 is attached in an upright position to the outer circumferential wall of the flame stabilizer 23 along the gas flow direction. A plurality of the fin members 36 are arranged at a pitch of 30 to 50 mm uniformly in the circumferential direction of the flame stabilizer 23 and radially. With the plurality of fin members 36 arranged at small intervals, the secondary air jets 17a, 17b can be rectified.

[0037] Since the second guide member 35 is provided at the end of the fin member 36, moreover, the secondary air jet 17a rectified with the fin members 36 can be ejected into the furnace 41 along the second guide member 35 perpendicularly outwardly with respect to the burner center axis. With this flow, the flame stabilizer 23 and the second guide member 35 can be cooled to prevent the burning of the burner due to radiant heat from the furnace 41.

[0038] Since the gap is formed between the second guide member 35 and the flame stabilizing sleeve 23b, the secondary air jet 17b rectified with the fin members 36, which is a part of the secondary air flow 17, can be ejected along the flame stabilizing sleeve 23b.

[0039] Since the first guide member 34 is provided at the end of the flame stabilizing sleeve 23b, furthermore, the secondary air jet 17b rectified with the fin members 36 can be ejected along the first guide member 34 perpendicularly with respect to the burner center axis. This jet 17b flows the gap between the first guide member 34 and the second guide member 35, so that a flow is formed along the surface of the second guide member 35 directed toward the furnace 41.

[0040] The relatively small circulating flow 19b formed downstream of the second guide member 35 may draw in a hot gas from the furnace. This may cause the burning

of the second guide member 35 or the deposition of ash on the second guide member 35, but the deposition of ash on the second guide member 35 can be prevented by the secondary air jet 17b coming out of the gap between the first and the second guide members 34, 35.

[0041] When the inner diameter of the second guide member 35 is smaller than the outer diameter of the first guide member 34 and the outer diameter of the second guide member 35 is larger than the outer diameter of the first guide member 34, the secondary air jet 17b can be ejected perpendicularly with respect to the burner center axis to prevent the deposition of ash on the surface of the second guide member 35.

[0042] Fig. 3 shows the secondary air jets 17a, 17b and the circulating flows 19a, 19b in a case where the first guide member 34 and the second guide member 35 have almost the same outer diameter. The second guide member 35 can be cooled by the secondary air jet 17b flowing through the gap between the first guide member 34 and the second guide member 35. However, the small circulating flow 19b formed downstream of the second guide member 35 may cause the burning of the second guide member 35 or the deposition of ash on it.

[0043] As a comparative example of the present invention, Fig. 4 shows the secondary air jets 17a, 17b in a case where the first guide member 34 does not exist virtually.

[0044] When the first guide member 34 does not exist, the secondary air flow 17b being a part of the secondary air flow 17 jets out along the burner center axis. Therefore, the cooling air does not flow along the front side (furnace side) of the second guide member 35, and the small circulating flow 19b due to the second guide member 35 is formed on the surface side of the second guide member 35. In this case, the ash-containing hot gas in the furnace 41 may be brought into contact with the surface of the second guide member 35 to cause the burning or the deposition of ash. Therefore, the first guide member 34 is effective in preventing the deposition of ash or the burning when it is shorter than the second guide member 35.

[0045] In the solid fuel burner shown in Fig. 1, since the secondary air flow 17 is ejected into the furnace 41 outwardly beyond the tertiary air flow 18 with the first and the second guide members 34, 35, it can be accompanied with the jet of the tertiary air flow 18 without disturbing the zone of the circulating flow 19 formed by the flame stabilizer 23. Moreover, since the deposition of ash on the two guide members 34, 35 can also be prevented, it is also possible to prevent the zones of the circulating flows 19a, 19b from being disturbed by ash deposited on the two guide members 34, 35. Therefore, the solid fuel ignition and flaming stability can be maintained to enable stable combustion, which effectively reduces the NO_X concentration and the unburned combustible contents in burnt ash.

[0046] Moreover, although the invention disclosed in Japanese Unexamined Patent Application Publication No. S61-072906 describes an embodiment in which the flame stabilizer is provided with the fin member, the present embodiment, in which the second guide member 35 is provided at the end of the fin member 36, has an effect significantly different from the effect of the fin member according to the above-mentioned publication. Since the gap is formed between the second guide member 35 provided at the end of the fin member 36 and the flame stabilizing sleeve 23b, the secondary air flow 17 can be separated into the jet 17a flowing along the inner side of the second guide member 35 and the jet 17b flowing through the gap between the second guide member 35 and the flame stabilizing sleeve 23b. The jet 17a can cool the second guide member 35 from the inner side, while the jet 17b can prevent the deposition of ash on the surface of the second guide member 35 because it flows toward the tertiary air nozzle 14 along the second guide member 35 owing to the first guide member 34.

[0047] Thus, the secondary air jet 17b not only prevents the burning of the flame stabilizer 23 and the second guide member 35 by cooling but also prevents the deposition of ash on the flame stabilizer 23 and the second guide member 35, improving the solid fuel ignition and flaming stability more than before.

[0048] In the present embodiment, the two guide members: the first guide member 34 and the second guide member 35 are provided because when the major second guide member 35 is provided on the fin member 36, the temperature around these two guide members 34, 35 can be lowered by 250°C as compared with the case where a single guide member is provided, which prevents the burning of the first and the second guide members 34, 35.

EMBODIMENT 2

[0049] Fig. 5 shows a sectional view showing the structure of a solid fuel burner according to Embodiment 2 of the present invention, and Fig. 6 shows an enlarged view of its major part. The present embodiment is configured such that the part corresponding to the flame stabilizer 23 in the first embodiment is removed from the outward end of the partition between the fuel nozzle 11 and the secondary air nozzle 13 (the inner circumferential wall 29 of the secondary air nozzle 13).

[0050] Specifically, the first guide member 34 for guiding the secondary air flow 17 outwardly from the burner center axis is provided at the outward end of the inner circumferential wall 29 of the secondary air gas nozzle 13, a plurality of the fin members 36 to be cooled by the secondary air flow 17 are attached to the outside of the inner circumferential wall 29 of the secondary air nozzle 13, and moreover, the second guide member 35 for guiding the secondary air flow 17 outwardly from the burner center axis is provided at the end of the fin member 36 at a distance from the first guide member 34, upstream of the secondary air flow 17 from the first guide member 34. Furthermore, it is configured such that the gap for

permitting passage of a part of the secondary air flow 17 is formed between the inner circumferential wall 29 of the secondary air nozzle 13, which extends to the first guide member 34, and the second guide member 35 so as to separate the secondary air flow 17 into the furnace front side flow (the jet 17b) and the rear side flow (the jet 17a) at the second guide member 35.

[0051] Also in the present embodiment, the relatively small circulating flow 19b can be formed downstream of the second guide member 35 and may draw in a hot gas from the furnace. This may cause the burning of the second guide member 35 or the deposition of ash on the second guide member 35, but the deposition of ash and the like on the second guide member 35 can be prevented by the secondary air jet 17b coming out of the gap between the first and the second guide members 34, 35.

[0052] When the inner diameter of the second guide member 35 is smaller than the outer diameter of the first guide member 34 and the outer diameter of the second guide member 35 is larger than the outer diameter of the first guide member 34, moreover, the secondary air jet 17b can be ejected perpendicularly with respect to the burner center axis to prevent the deposition of ash on the surface of the second guide member 35.

[0053] Furthermore, since the outward angles of the first guide member 34 and the second guide member 35 with respect to the burner center axis are larger than the outward angle of the guide sleeve 25 with respect to the burner center axis, the secondary air flow 17 and the tertiary air flow 18 intersect each other at the burner outlet, which facilitates formation of the circulating flow 19b.

[0054] It should be noted that in the foregoing description, although at the side of the burner's outlet end, the fin member 36 terminates at the rear side of the second guide member 35 (the boiler's interior side is called as the front side) in the illustrated example, it may extend to the rear side of the first guide member 34, for example, without being limited to the height in the radial direction of the burner, the length in the axial direction or the shape shown in the burner's side view of Fig. 1, etc.

[0055] Specifically, the fin member 36 is acceptable as long as it is cooled by the secondary air flow 17, it retains the second guide member 35 and the gap is formed between the second guide member 35 and the inner circumferential wall 29 of the secondary air nozzle, which extends continuously from the fuel nozzle 11 to the first guide member 34, so as to separate the secondary air flow 17 into the front side flow and the rear side flow with the second guide member 35.

[0056] Moreover, although the solid fuel burner has been described with reference to a burner in which pulverized coal prepared by pulverizing coal is employed as the fuel and air is employed as the combustion gas, the present invention should not be construed as limited by the type of fuel or the composition of the combustion gas.

[0057] As the solid fuel, all the solid fuels such as brown coal or various biomasses can be employed in addition to the coal, while as the combustion gas, a recirculated exhaust gas, a mixed gas of air or oxygen and exhaust gas or the like can be employed.

[0058] Furthermore, although the first guide member 34, the second guide member 35, the fin member 36 and the fuel nozzle 11 have been described as independent members for the convenience of description, even when a few of them or all of them are produced by casting or the like into an integral continuous member, they fall within the scope of the present invention.

REFERENCE SIGNS LIST

[0059]

11	Fuel Nozzle
13	Secondary Air Nozzle
14	Tertiary Air Nozzle
16	Flow of Mixture Fluid of Fuel and Carrier Gas
17	Secondary Air Flow
17a	Secondary Air Flow (Main Stream)
17b	Secondary Air Flow (Side Stream)
18	Tertiary Air Flow
19a	Circulating Flow
19b	Circulating Flow due to Guide Member
23	Flame Stabilizer
23a	Flame Stabilizing Base Member
23b	Flame Stabilizing Sleeve
24	Oil Gun
25	Guide Sleeve
26	Wind Box
28	Swirler
29	Inner Circumferential Wall of Secondary Air Nozzle
30	Burner Throat
31	Water Pipe
32	Passage Contracting Member (Venturi)
33	Obstacle (Condenser)
34	First Guide Member
35	Second Guide Member
36	Fin Member
38	Inner Circumferential Wall of Tertiary Air Nozzle
41	Furnace

Claims

1. A solid fuel burner comprising a fuel nozzle (11) for ejecting a mixture fluid of a solid fuel and a carrier gas, a secondary combustion gas nozzle (13) concentrically disposed around the fuel nozzle (11) for permitting passage of a secondary combustion gas, a tertiary combustion gas nozzle (14) concentrically disposed around the secondary combustion gas nozzle (13) for permitting passage of a tertiary combustion gas, and a guide sleeve (25) disposed at the outlet end of the secondary combustion gas nozzle (13) for guiding a tertiary combustion gas flow (18)

radially outwardly from a burner center axis,
the solid fuel burner **characterized by** comprising a flame stabilizer (23) disposed at the outer end of an inner circumferential wall (29) of the secondary combustion gas nozzle (13) for guiding a secondary combustion gas flow (17) radially outwardly from the secondary combustion gas nozzle (13),
a plurality of fin members (36) secured on an outer circumferential surface of the flame stabilizer (23) and intended to be cooled by the secondary combustion gas flow (17),
a first guide member (34) secured to the end of the flame stabilizer (23) for guiding the secondary combustion gas flow (17) outwardly from the burner center axis, and
a second guide member (35) secured to the end of at least one of the fin members (36) and located at a distance from the first guide member (34), upstream of the secondary combustion gas flow (17) from the first guide member (34) for guiding the secondary combustion gas flow (17) outwardly from the burner center axis,
wherein a gap for permitting passage of a part (17b) of the secondary combustion gas flow (17) is formed between the outer circumferential surface of the flame stabilizer (23), which extends to the first guide member (34), and the second guide member (35) so as to separate the secondary combustion gas flow (17) into the front side flow (17b) and the rear side flow (17a) of a furnace at the second guide member (35), and
each outward angle of the first guide member (34) and the second guide member (35) with respect to the burner center axis is larger than an outward angle of the guide sleeve (25) with respect to the burner center axis.

2. A solid fuel burner comprising a fuel nozzle (11) for ejecting a mixture fluid of a solid fuel and a carrier gas, a secondary combustion gas nozzle (13) concentrically disposed around the fuel nozzle (11) for permitting passage of a secondary combustion gas, a tertiary combustion gas nozzle (14) concentrically disposed around the secondary combustion gas nozzle (13) for permitting passage of a tertiary combustion gas, and a guide sleeve (25) disposed at an outlet end of the secondary combustion gas nozzle (13) for guiding a tertiary combustion gas flow (18) radially outwardly from a burner center axis,
the solid fuel burner **characterized by** comprising a first guide member (34) disposed at the outer end of an inner circumferential wall (29) of the secondary combustion gas nozzle (13) for guiding a secondary combustion gas flow (17) outwardly from the burner central axis,
a plurality of fin members (36) secured on the outer side of the inner circumferential wall (29) of the secondary combustion gas nozzle (13) and intended to be cooled by the secondary combustion gas flow (17), and
a second guide member (35) secured to the end of at least one of the fin members (36) and located at a distance from the first guide member (34), upstream of the secondary combustion gas flow (17) from the first guide member (34) for guiding the secondary combustion gas flow (17) outwardly from the burner center axis,
wherein a gap for permitting passage of a part (17b) of the secondary combustion gas flow (17) is formed between the inner circumferential wall (29) of the secondary combustion gas nozzle (13), which extends to the first guide member (34), and the second guide member (35) so as to separate the secondary combustion gas flow (17) into the front side flow (17b) and the rear side flow (17a) of the furnace at the second guide member (35), and each outward angle of the first guide member (34) and the second guide member (35) with respect to the burner center axis is larger than an outward angle of the guide sleeve (25) with respect to the burner center axis.

3. A solid fuel burner according to Claim 1 or 2, **characterized in that** the second guide member (35) has an inner diameter which is smaller than an outer diameter of the first guide member (34) and an outer diameter which is larger than the outer diameter of the first guide member (34).

Patentansprüche

1. Festbrennstoff-Brenner mit einer Brennstoffdüse (11) zum Ausstoßen einer Fluidmischung aus einem Festbrennstoff und einem Trägergas, einer konzentrisch um die Brennstoffdüse (11) herum angeordnete sekundären Verbrennungsgasdüse (13), um einen Durchtritt eines sekundären Verbrennungsgases zuzulassen, einer konzentrisch um die sekundären Verbrennungsgasdüse (13) herum angeordnete tertiären Verbrennungsgasdüse (14), um einen Durchtritt eines tertiären Verbrennungsgases zuzulassen, und einer am Auslassende der sekundären Verbrennungsgasdüse(13) angeordnete Führungshülsen (25), um einen tertiären Verbrennungsgasstrom (18) von einer Brenner-Zentrumsachse aus radial nach außen zu führen,
wobei der Festbrennstoff-Brenner gekennzeichnet ist, dass er einen an einem Auslassende von einer innen umlaufenden Wand (29) der sekundären Verbrennungsgasdüse (13) angebrachten Flammenstabilisator (23), um einen sekundären Verbrennungsgasstrom (17) von der sekundären Verbrennungsgasdüse (13) aus radial nach außen zu führen, eine Vielzahl von Lamellenelementen (36), die an einer außen umlaufenden Fläche des Flammenstabilisators (23) gesichert sind und zur Kühlung durch

den sekundären Verbrennungsgasstrom (17) gedacht sind,
ein erstes Führungselement (34), das am Ende des Flammenstabilisators (23) gesichert ist, um den sekundären Verbrennungsgasstrom (17) von der Brenner-Zentrumsachse aus nach außen zu führen, und ein zweites Führungselement (35) aufweist, das am Ende von mindestens einem der Lamellenelemente (36) gesichert ist und mit einem Abstand zum ersten Führungselement (34) stromaufwärts des sekundären Verbrennungsgasstroms (17) von dem ersten Führungselement (34)liegt um den sekundären Verbrennungsgasstrom (17) von der Brenner-Zentrumsachse aus nach außen zu führen,
wobei ein Spalt zwischen der äußeren umlaufenden Fläche des Flammenstabilisators (23), die sich zum ersten Führungselement (34) erstreckt, und dem zweiten Führungselement (35) gebildet ist, um einen Durchtritt von einem Teil (17b) des sekundären Verbrennungsgasstroms (17) zuzulassen, sodass der sekundäre Verbrennungsgasstrom (17) in den Vorderseitenstrom (17b) und den Rückseitenstrom (17a) eines Brennofens am zweiten Führungselement (35) aufgetrennt wird, und
jeder in Bezug auf die Brenner-Zentrumsachse nach außen gerichtete Winkel des ersten Führungselementes (34) und des zweiten Führungselementes (35) größer, als ein in Bezug auf die Brenner-Zentrumsachse nach außen gerichteter Winkel der Führungshülse (25) ist.

2. Festbrennstoff-Brenner mit einer Brennstoffdüse (11) zum Ausstoßen einer Fluidmischung aus einem Festbrennstoff und einem Trägergas, einer konzentrisch um die Brennstoffdüse (11) herum angeordnete sekundären Verbrennungsgasdüse (13), um einen Durchtritt eines sekundären Verbrennungsgases zuzulassen, einer konzentrisch um die sekundären Verbrennungsgasdüse (13) herum angeordnete tertiären Verbrennungsgasdüse (14), um einen Durchtritt eines tertiären Verbrennungsgases zuzulassen, und einer am Auslassende der sekundären Verbrennungsgasdüse(13) angeordnete Führungshülsen (25), um einen tertiären Verbrennungsgasstrom (18) von einer Brenner-Zentrumsachse aus radial nach außen zu führen,
wobei der Festbrennstoff-Brenner **dadurch gekennzeichnet ist, dass** er ein erstes Führungselement (34), das an dem äußeren Ende von einer innen umlaufenden Wand (29) der sekundären Verbrennungsgasdüse (13) angebracht ist, um einen sekundären Verbrennungsgasstrom (17) von der Brenner-Zentrumsachse aus nach außen zu führen,
eine Vielzahl von Lammellenelementen (36), die an der Außenseite der innen umlaufenden Wand (29) der sekundären Verbrennungsgasdüse (13) gesichert sind und zur Kühlung durch den sekundären Verbrennungsgasstrom (17) gedacht sind, und
ein zweites Führungselement (35) aufweist, das am Ende von mindestens einem der Lamellenelemente (36) gesichert ist und mit einem Abstand zum ersten Führungselement (34) stromaufwärts des sekundären Verbrennungsgasstroms (17) von dem ersten Führungselement (34) liegt um den sekundären Verbrennungsgasstrom (17) von der Brenner-Zentrumsachse aus nach außen zu führen,
wobei ein Spalt, zwischen der innen umlaufenden Wand (29) der sekundären Verbrennungsgasdüse (13), die sich zum ersten Führungselement (34) erstreckt, und dem sekundären Führungselement (35) gebildet ist, um einen Durchtritt von einem Teil (17b) des sekundären Verbrennungsgasstromes (17) zuzulassen, sodass der sekundäre Verbrennungsgasstrom (17) in den Vorderseitenstrom (17b) und den Rückseitenstrom (17a) des Brennofens am zweiten Führungselement (35) aufgetrennt wird, und jeder in Bezug auf die Brenner-Zentrumsachse nach außen gerichtete Winkel des ersten Führungselementes (34) und des zweiten Führungselementes (35) größer als ein in Bezug auf die Brenner-Zentrumsachse nach außen gerichteter Winkel der Führungshülse (25) ist.

3. Festbrennstoff-Brenner nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das zweite Führungselement (35) einen inneren Durchmesser, der kleiner als ein äußerer Durchmesser des ersten Führungselementes (34) ist, und einen äußeren Durchmesser hat, der größer als der äußere Durchmesser des ersten Führungselementes (34) ist.

Revendications

1. Brûleur à combustible solide comprenant une buse de combustible (11) pour éjecter un fluide de mélange composé d'un combustible solide et d'un gaz porteur, une buse de gaz de combustion secondaire (13) disposée de manière concentrique autour de la buse de combustible (11) pour permettre le passage d'un gaz de combustion secondaire, une buse de gaz de combustion tertiaire (14) disposée de manière concentrique autour de la buse de gaz de combustion secondaire (13) pour permettre le passage d'un gaz de combustion tertiaire, et un manchon de guidage (25) disposé au niveau de l'extrémité de sortie de la buse de gaz de combustion secondaire (13) pour guider un écoulement de gaz de combustion tertiaire (18) radialement vers l'extérieur à partir d'un axe central de brûleur,
le brûleur à combustible solide étant **caractérisé en ce qu'**il comprend un stabilisateur de flamme (23) disposé au niveau de l'extrémité externe d'une paroi circonférentielle interne (29) de la buse de gaz de combustion secondaire (13) pour guider un écoulement de gaz de combustion secondaire (17) radia-

lement vers l'extérieur à partir de la buse de gaz de combustion secondaire (13),
une pluralité d'éléments d'ailette (36) fixés sur une surface circonférentielle externe du stabilisateur de flamme (23) et prévus pour être refroidis par l'écoulement de gaz de combustion secondaire (17),
un premier élément de guidage (34) fixé sur l'extrémité du stabilisateur de flamme (23) pour guider l'écoulement de gaz de combustion secondaire (17) vers l'extérieur à partir de l'axe central de brûleur, et
un second élément de guidage (35) fixé sur l'extrémité d'au moins l'un des éléments d'ailettes (36) et positionné à une distance du premier élément de guidage (34), en amont de l'écoulement de gaz de combustion secondaire (17) à partir du premier élément de guidage (34) pour guider l'écoulement de gaz de combustion secondaire (17) vers l'extérieur à partir de l'axe central de brûleur,
dans lequel un espace pour permettre le passage d'une partie (17b) de l'écoulement de gaz de combustion secondaire (17) est formé entre la surface circonférentielle externe du stabilisateur de flamme (23), qui s'étend jusqu'au premier élément de guidage (34) et au second élément de guidage (35) afin de séparer l'écoulement de gaz de combustion secondaire (17) en un écoulement du côté avant (17b) et un écoulement du côté arrière (17a) d'un four au niveau du second élément de guidage (35), et
chaque angle externe du premier élément de guidage (34) et du second élément de guidage (35) par rapport à l'axe central de brûleur est supérieur à un angle externe du manchon de guidage (25) par rapport à l'axe central du brûleur.

2. Brûleur à combustible solide comprenant une buse de combustible (11) pour éjecter un fluide de mélange composé d'un combustible solide et d'un gaz porteur, une buse de gaz de combustion secondaire (13) disposée de manière concentrique autour de la buse de combustible (11) pour permettre le passage d'un gaz de combustion secondaire, une buse de gaz de combustion tertiaire (14) disposée de manière concentrique autour de la buse de gaz de combustion secondaire (13) pour permettre le passage d'un gaz de combustion tertiaire, et un manchon de guidage (25) disposé au niveau d'une extrémité de sortie de la buse de gaz de combustion secondaire (13) pour guider un écoulement de gaz de combustion tertiaire (18) radialement vers l'extérieur à partir d'un axe central de brûleur,
le brûleur à combustible solide étant **caractérisé en ce qu'**il comprend un premier élément de guidage (34) disposé au niveau de l'extrémité externe d'une paroi circonférentielle interne (29) de la buse de gaz de combustion secondaire (13) pour guider un écoulement de gaz de combustion secondaire (17) vers l'extérieur à partir de l'axe central de brûleur,
une pluralité d'éléments d'ailette (36) fixés sur le côté externe de la paroi circonférentielle interne (29) de la buse de gaz de combustion secondaire (13) et prévus pour être refroidis par l'écoulement de gaz de combustion secondaire (17), et
un second élément de guidage (35) fixé sur l'extrémité d'au moins l'un des éléments d'ailette (36) et positionné à une distance du premier élément de guidage (34), en amont de l'écoulement de gaz de combustion secondaire (17) à partir du premier élément de guidage (34) pour guider l'écoulement de gaz de combustion secondaire (17) vers l'extérieur à partir de l'axe central de brûleur,
dans lequel un espace pour permettre le passage d'une partie (17b) de l'écoulement de gaz de combustion secondaire (17) est formé entre la paroi circonférentielle interne (29) de la buse de gaz de combustion secondaire (13), qui s'étend jusqu'au premier élément de guidage (34) et au second élément de guidage (35) afin de séparer l'écoulement de gaz de combustion secondaire (17) en un écoulement du côté avant (17b) et un écoulement du côté arrière (17a) du four au niveau du second élément de guidage (35), et chaque angle externe du premier élément de guidage (34) et du second élément de guidage (35) par rapport à l'axe central de brûleur est supérieur à un angle externe du manchon de guidage (25) par rapport à l'axe central de brûleur.

3. Brûleur à combustible solide selon la revendication 1 ou 2, **caractérisé en ce que** le second élément de guidage (35) a un diamètre interne qui est inférieur à un diamètre externe du premier élément de guidage (34) et un diamètre externe qui est supérieur au diamètre externe du premier élément de guidage (34).

FIG. 1

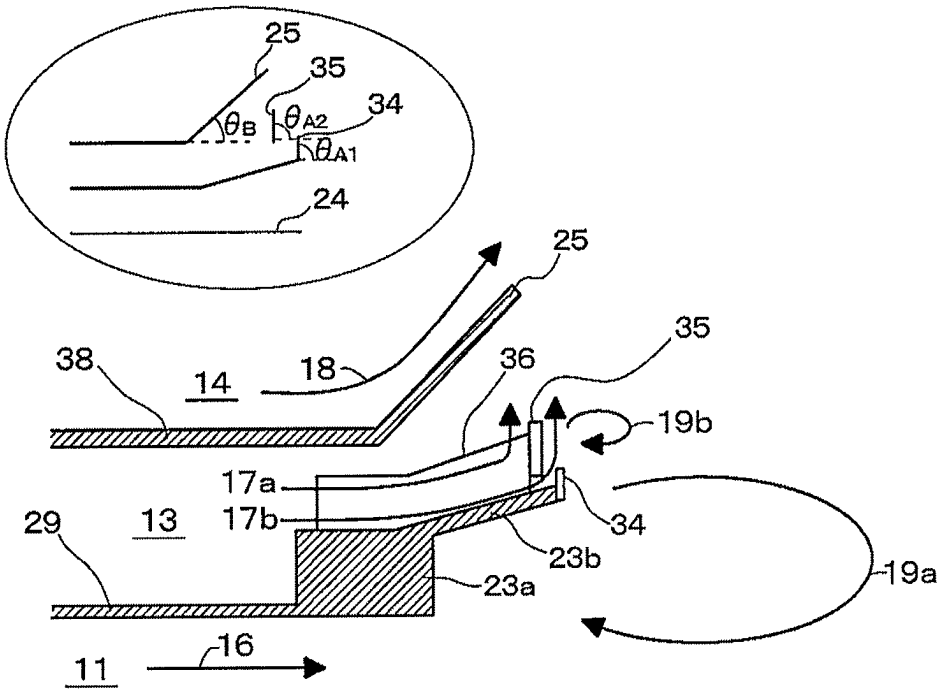

25
35
34
θ_B
θ_{A2}
θ_{A1}
24
25
35
38
14
18
36
19b
17a
17b
34
29
13
23b
19a
23a
16
11

FIG. 2

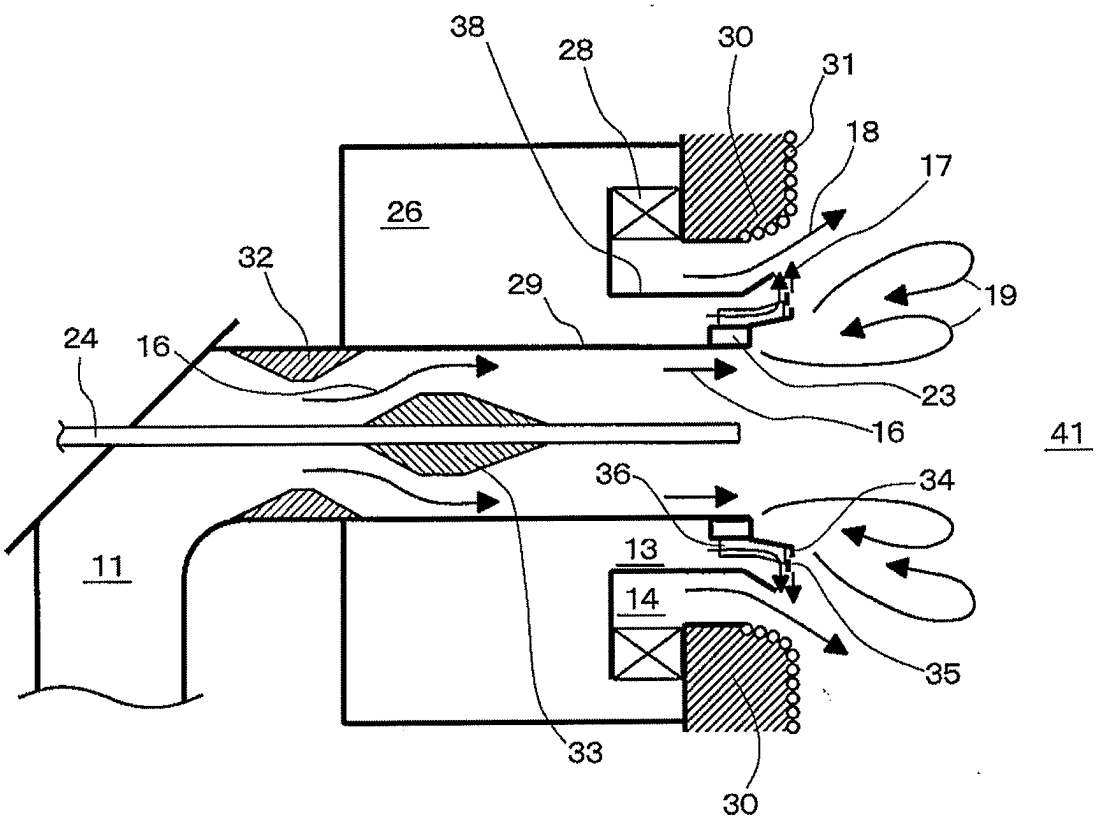


FIG. 3

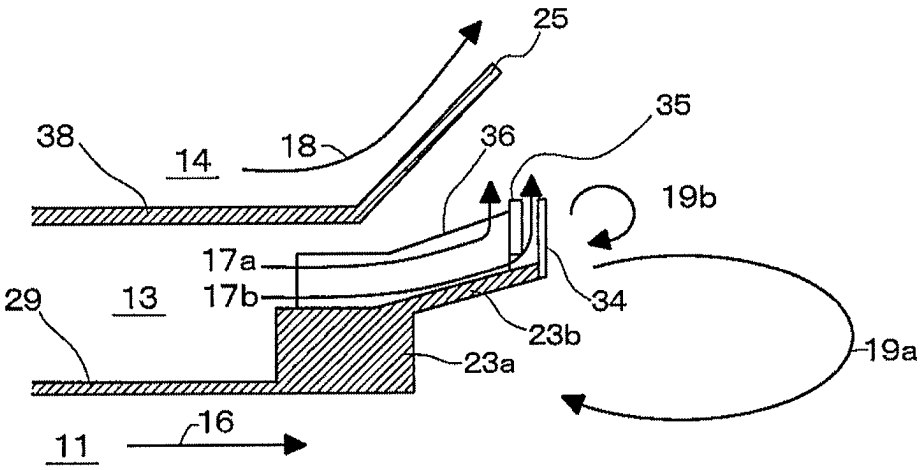


FIG. 4

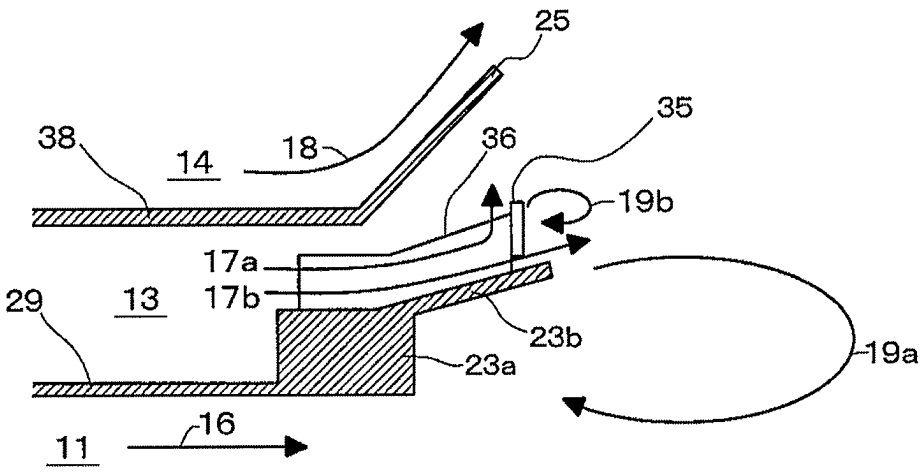


FIG. 5

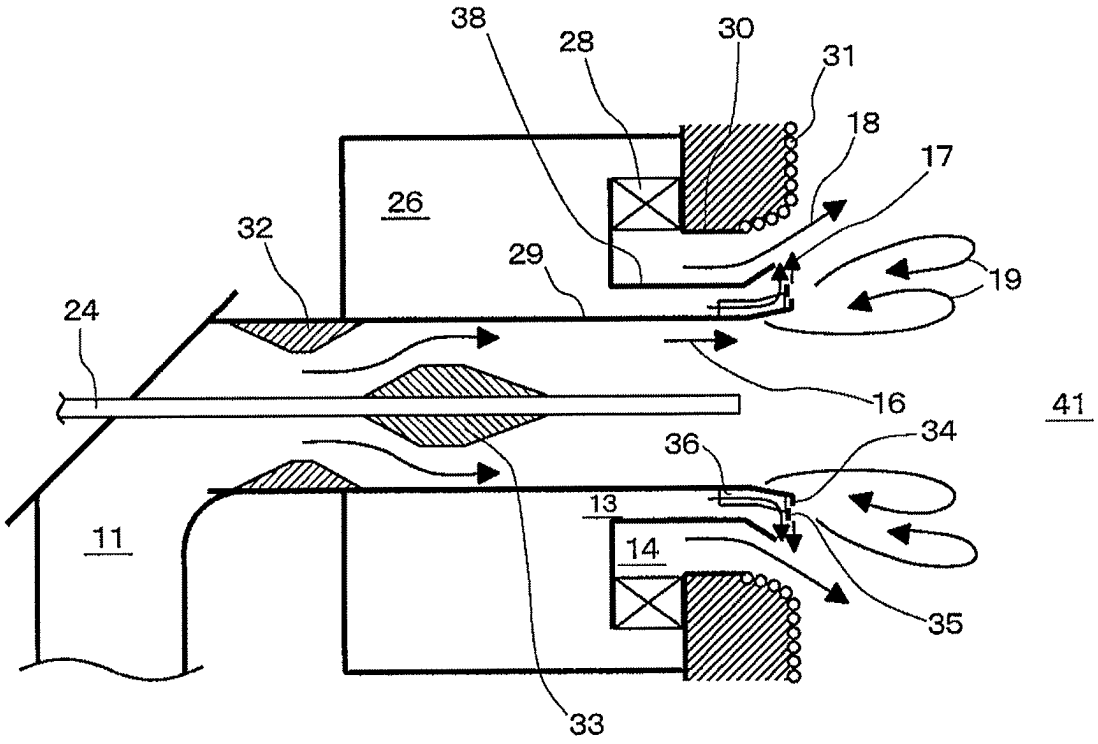
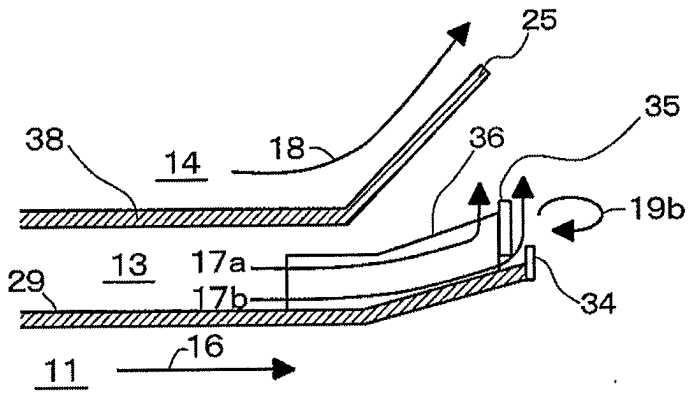


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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