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(54) **COMBUSTION DEVICE**

VERBRENNUNGSVORRICHTUNG

DISPOSITIF DE COMBUSTION

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EP 2 679 899 B1

Description

TECHNICAL FIELD

[0001] The present invention relates to a combustion device such as a pulverized coal burning boiler having a pulverized coal burner.

BACKGROUND ART

[0002] As a combustion method using a pulverized coal burner of a pulverized coal burning boiler, there is adopted a two-stage combustion method that combusts a fuel in an air insufficient state and then complete burning air is supplied from an after air port in order to reduce an emission rate of a nitride oxide (which will be referred to as NOx hereinafter) in a combustion exhaust gas.

[0003] To further reduce NOx concentration in the exhaust gas at a boiler furnace outlet, the following means can be used.

(1) An after-air port is installed to a high position of a furnace, and a detention time of a combustion gas to reach a NOx reduction region between the burner and the after-air port is increased.
(2) An excess air ratio (an input air capacity/a theoretical air capacity) is lowered as much as possible, and thermal NOx is reduced beyond those in conventional examples.

[0004] However, a complete combustion region shifts to a downstream region (an upper portion of a furnace) according to the technology of (1), a combustion temperature rises as getting closer to the theoretical air capacity according to the technology of (2), and hence an exhaust gas temperature at an outlet of the furnace is increased. Therefore, a steam temperature and a metal temperature on a rear heat transfer surface of the boiler rise, and a possibility of occurrence of tube leak increases in design that a heat transfer surface material, arrangement of the heat transfer surface, and others are unchanged from the conventional examples. Therefore, a design temperature of the rear heat transfer surface must be increased to be higher than those in the conventional examples, and there is a problem that quality of the material must be enhanced in terms of strength and heat resistant properties.

[0005] To increase a detention time of the combustion gas to reach the NOx reduction region in the furnace of the after-air port from the burner or to equalize a design temperature of the rear heat transfer surface to a conventional examples while adopting an NOx reduction countermeasure for reducing the air excess ratio (the input air capacity /the theoretical air capacity) to be lower than those in the conventional examples, changing a direction of flames of the burner to an upward or downward direction of the furnace in accordance with combustion conditions such as a load can be considered. That is, when a direction of burner flames is set to a downward direction and a detention time of the combustion gas in the NOx reduction region between the burner and the after-air port is increased, the furnace installing position of the after-air port may be the same as that in the conventional example, this position is provided on a lower (upstream) side in the furnace as compared with the conventional examples even if a combustion temperature of the burner flames becomes high, and hence an exhaust gas temperature at the outlet of the furnace can be the same as that in the conventional examples.

[0006] Japanese Unexamined Patent Application Publication No. 2008-121924 discloses a burner having a movable nozzle. When the nozzle is movable in a portion that faces a furnace and has high radiant heat, consideration must be given to damage due to falling of clinkers adhering to the inside of the furnace or securement of movability.

[0007] Moreover, Japanese Unexamined Patent Application Publication No. 2002-147713, Japanese Unexamined Patent Application Publication No. S54 3924 A, EP 2 273 193 A1 or Japanese Unexamined Utility Model Application Publication No. S61 101226 U 27 disclose a burner that changes a direction of flames (a combustion region) by deviating an air flow rate in a circumferential direction of a burner.

[0008] In case of the burner provided with a combustion air nozzle having at least two or more air inflow directions, to connect respective combustion air flow paths of a plurality of burners through a duct on outer wall of a furnace and to provide a common wind box, arrangement of the duct is complicated.

PRIOR ART DOCUMENT

PATENT DOCUMENTS

[0009]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2008-121924
Patent Literature 2: Japanese Unexamined Patent Application Publication No. 2002-147713
Patent Literature 3: Japanese Unexamined Patent Application Publication No. S54 3924 A
Patent Literature 4: EP 2 273 193 A1
Patent Literature 5: Japanese Unexamined Utility Model Application Publication No. S61 101226 U 27

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0010] As described above, in case of using a burner having a movable nozzle disclosed in Japanese Unexamined Patent Application Publication No. 2008-121924, when the nozzle is movable in the portion that faces the furnace and has large radiant heat, consideration must be given to damage due to falling of clinkers adhering to the inside of the furnace or securement of movability.

[0011] Additionally, as to the burner provided with the combustion air nozzle having at least two air inflow directions disclosed in Japanese Unexamined Patent Application Publication No. 2002-147713, to connect the respective combustion air flow paths of the plurality of burners through the common dust on the outer wall of the furnace, the arrangement of the duct becomes complicated.

[0012] It is an object of the present invention to provide a combustion device that can change a direction of flames of a burner to upward and downward directions in a furnace in accordance with combustion conditions such as a load and equalize a design temperature of a rear heat transfer surface to that in conventional examples.

MEANS FOR SOLVING PROBLEM

[0013] The above-described object can be achieved by the following solving means.

[0014] A first aspect of the present invention provides a combustion device comprising a plurality of burners 19 arranged on a furnace wall 10 of a furnace 18, each burner 19 comprising: a cylindrical fuel nozzle 3 that injects a mixture of a fuel and a carrier gas therefor into the furnace 18; one or more cylindrical combustion gas nozzles 8, 11 that are provided on the outer circumference of the fuel nozzle 3 and inject a combustion gas into the furnace 18; and a wind box 12 that supplies the combustion gas to the combustion gas nozzles 8, 11, wherein the wind box 12 has a combustion gas inflow opening portion 12a, 12b into which the combustion gas flows from one direction, vertical to the axial direction of the burner 19 and is partitioned to form a plurality of parallel flow paths through which the combustion gas flows in from the combustion gas inflow opening portion 12a, 12b, wherein

one duct 16 through which the combustion gas is collectively supplied to the plurality of wind boxes 12 from the outside of the furnace 18, which is installed on the outer side of the furnace wall 10 on which the wind boxes 12 are installed, wherein the plurality of wind boxes 12 are aligned and installed entirely inside the one duct 16 such that the combustion gas flows into the combustion gas inflow opening portion 12a, 12b from one direction common to all burners 19, and wherein some of the plurality of flow paths in the wind box 12 are connected to an upper side of the combustion gas nozzles 8, 11, the other flow paths are connected to a lower side of the combustion gas nozzles 8, 11, and first flow rate adjusting means 15 for adjusting a flow rate of the combustion gas is independently provided to each of the plurality of flow paths in the wind box 12.

[0015] A second aspect of the present invention provides the combustion device according to the first aspect, wherein second flow rate adjusting means 17 for adjusting a flow rate of the combustion gas that flows into each burner 19 on the upstream side of the first flow rate adjusting means 15 is provided in each wind box 12.

[0016] In the combustion device according to the present invention, since the first flow rate adjusting means 15 for adjusting a combustion gas flow rate is provided to each of the plurality of combustion gas nozzles 8 and 11, when an opening degree of the first flow rate adjusting means 15 is adjusted, a momentum of the combustion gas injected into the furnace from the burner 19 can be independently adjusted on each of upper and lower sides. For example, when the first flow rate adjusting means 15 is adjusted to increase an air flow rate injected into the furnace 18 from the combustion gas nozzle 8 or 11 so that a momentum (an air injection flow rate) of the air flow rate from the lower side can be higher than that from the upper side of the burner 19, flames can be deflected to a downward direction. When the flames are deflected to the downward direction, the maximum thermal load region in the furnace 18 shifts to the lower side, thermal absorption of the furnace 18 increases, and an exhaust gas temperature at an outlet of the furnace can be reduced. Further, when the flames are deflected to the lower side of the burner 19 to shift the combustion region of the burner 19 to the lower side, a detention time of the NOx reduction region in the furnace 18 between the burner 19 and the after-air port 24 provided on the furnace wall 10 on the downstream side of the burner 19 becomes longer than that in a case where an injecting direction of flames is parallel, and the NOx concentration in the exhaust gas is reduced to be lower than that provided by the conventional technology.

[0017] Furthermore, when the second flow rate adjusting means 17 is provided on the upstream side of the first flow rate adjusting means 15, an air capacity supplied to each burner 19 can be adjusted.

EFFECT OF THE INVENTION

[0018] According to the invention of the first aspect, when the momentum of the combustion gas injected into the furnace 18 from the burner 19 is deviated depending on each of the upper and lower sides, the flames can be deflected, and the thermal absorption of the furnace can be controlled. As a result, a temperature controller on the rear heat transfer surface of the furnace 18 can be eliminated. Additionally, in case of modifying an existing combustion device, the NOx reduction technology based on the change in the after-air port installing position and the air excess ratio can be applied without changing a steam temperature and a metal temperature of the rear heat transfer surface in the conventional example. Further, when the flames are deflected toward the lower side in the furnace 18, the combustion region of the burner 19 can be shifted to the lower side, the detention time of the NOx reduction region between the burner 19 and the after-air port 24 can be increased to be longer than that in a case where the injecting direction of the flames is horizontal, and the NOx concentration in the exhaust gas can be reduced as compared with the conventional example.

[0019] According to the invention of the first aspect, the combustion gas supplied to the wind box 12 provided on the outer side of one furnace wall surface 10 can be collectively supplied from one duct 16, and the combustion gas supply system for the plurality of burners 19 can have a simple configuration.

[0020] According to the invention of the first aspect, since the plurality of wind boxes 12 are aligned and installed on the outer side of the furnace wall 10 inside the one duct 16, construction of the plurality of wind boxes 12 and the duct 16 can be facilitated.

[0021] According to the invention of the second aspect, in addition to the effect of the invention of first aspects, the first flow rate adjusting means 15 provided to one wind box 12 can deviate the momentum of the combustion gas on each of the upper and lower sides of the burner 19, and providing the second flow rate adjusting means 17 on the upstream side of the first flow rate adjusting means 15 enables facilitating adjustment of an amount of the combustion gas supplied to each burner 19.

BRIEF DESCRIPTION OF DRAWINGS

[0022]

FIG. 1 is a schematic view showing a pulverized coal boiler system according to the present invention;

FIG. 2 is a cross-sectional view of a pulverized coal burner according to an embodiment of the present invention;

FIG. 3 is a perspective view (FIG. 3(a)) of a wind box and a view (FIG. 3(b)) showing a wind tunnel test result concerning the wind box according to an embodiment of the present invention;

FIG. 4 shows an example of the wind box in the form of a cross-sectional view (FIG. 4(a)) taken along a line A-A in FIG. 2 and a cross-sectional view (FIG. 4(b)) taken along a line B-B in FIG. 2;

FIG. 5 shows an example of the wind box in the form of a cross-sectional view (FIG. 5(a)) taken along a line A-A in FIG. 2 and a cross-sectional view (FIG. 5(b)) taken along a line B-B in FIG. 2;

FIG. 6 is a view showing a method for connecting each wind box with a combustion gas carrying duct and supplying combustion air according to an explanatory example not according to the invention;

FIG. 7 is a view showing a method for installing each wind box in the combustion gas carrying duct and supplying the combustion air according to an embodiment of the present invention;

FIG. 8 shows an example of the wind box in the form of a cross-sectional view taken along the line A-A in FIG. 2;

FIG. 9 shows an example of the wind box in the form of a cross-sectional view taken along the line A-A in FIG. 2;

FIG. 10 is a view showing a method for connecting each wind box with the combustion gas carrying duct and supplying the combustion air according to an explanatory example not according to the invention;

FIG. 11 is a view showing a method for installing each wind box in the combustion gas carrying duct and supplying the combustion air according to an embodiment of the present invention;

FIG. 12 shows an example of the wind box in the form of a cross-sectional view taken along the line A-A in FIG. 2;

FIG. 13 shows an example of the wind box in the form of a cross-sectional view taken along the line A-A in FIG. 2;

FIG. 14 is a view showing a method for connecting each wind box with the combustion gas carrying duct and supplying the combustion air according to an explanatory example not according to the invention;

FIG. 15 is a view showing a method for installing each wind box in the combustion gas carrying duct and supplying the combustion air according to an embodiment of the present invention;

FIG. 16 shows an example of the wind box in the form of a cross-sectional view (FIG. 16(a)) taken along the line A-A in FIG. 2 and a cross-sectional view (FIG. 16(b)) taken along a line B-B in FIG. 2;

FIG. 17 shows an example of the wind box in the form of a cross-sectional view (FIG. 17(a)) taken along the line A-A in FIG. 2 and a cross-sectional view (FIG. 17(b)) taken along a line B-B in FIG. 2;

FIG. 18 is a view showing a method for installing each wind box in the combustion gas carrying duct and supplying the combustion air according to an embodiment of the present invention; and

FIG. 19 is a view showing a method for connecting each wind box with the combustion gas carrying duct and supplying the combustion air according to an explanatory example not according to the invention.

BEST MODE(S) FOR CARRYING OUT THE INVENTION

[0023] FIG. 1 shows a pulverized coal boiler system according to the present invention, FIG. 2 is a cross-sectional view of a pulverized coal burner 19 concerning the pulverized coal boiler system in FIG. 1, and FIG. 3 is a perspective view (FIG. 3(a)) of a wind box 12 of the pulverized coal burner 19 and a view (FIG. 3(b)) showing a wind tunnel test result concerning the wind box 12.

[0024] It is to be noted that a fuel in the present invention is not restricted to pulverized coal, and a solid fuel pulverized so that it can be carried using an air current can be used without regard to its type or composition. Further, although a description will be given on a situation where air is mainly used as a fuel carrying gas and a combustion gas, the present invention is not necessarily restricted to air alone, and it is possible to adopt any gas that can be used as the fuel carrying gas and the combustion gas for a combustion device such as a boiler, e.g., a combustion exhaust gas or a mixed gas of air or oxygen and the combustion exhaust gas without regard to its type or composition.

[0025] In the pulverized coal boiler system shown in FIG. 1, pulverized coal and combustion air are supplied to burners 19 provided on a plurality of stages on a furnace wall 10 of a boiler furnace 18, the pulverized coal is combusted, and a non-illustrated water wall constituting the furnace wall 10 and a heat exchanger such as a non-illustrated superheater provided in the furnace are heated, thereby generating water vapor.

[0026] The pulverized coal supplied to each burner 19 is obtained by pulverizing coal in a bunker 20 with use of a mill 21, and the pulverized coal is carried on an air current and supplied to each burner 19 by using a blower 23. Further, the combustion air supplied to each burner 19 and each after-air port 24 is supplied through a duct 16 by a blower 25, and the combustion air is supplied to each pulverized coal burner 19 from each wind box 12 arranged on the outer side of the boiler furnace wall 10.

[0027] An oil spraying nozzle 7 is arranged at a central axis of the pulverized coal burner 19, a fuel nozzle 3 through which a gas-particle flow 1 of the pulverized coal and the carrying air is arranged at an outer periphery of the oil spraying nozzle 7, and a secondary air nozzle 8 and a tertiary air nozzle 11 that inject the combustion air 2 are provided at an outer periphery of the fuel nozzle 3. As shown in FIG. 2, an outer peripheral wall of the tertiary air nozzle 11 is formed of the wind box 12.

[0028] Further, the oil spraying nozzle 7 is used for auxiliary combustion at the time of starting up or low-load combustion of each burner 19. A venturi tube 6 configured to narrow a nozzle inner diameter of the fuel nozzle 3 is arranged on an inner peripheral wall of the fuel nozzle 3, and a pulverized coal concentrator 5 is provided on the outer periphery of the oil spraying nozzle 7 near an outlet portion of the fuel nozzle 3. A flame stabilizer 4 is provided at an end of a partition wall (an outlet portion of each of the nozzles 3 and 8) that partitions the fuel nozzle 3 and the secondary air nozzle 8, and a guide sleeve 13 that directs a fluid toward a diffusing direction from the central axis of the burner 19 is provided at an end of a partition wall (an outlet portion of each of the nozzles 8 and 11) that partitions the secondary air nozzle 8 and the tertiary air nozzle 11.

[0029] As described above, in this embodiment, each burner 19 is formed of the oil spraying nozzle 7, the fuel nozzle 3, the secondary air nozzle 8, the tertiary air nozzle 11, and the wind box 12 constituting the outer peripheral wall of the tertiary air nozzle 11, and this burner 19 is installed on the furnace wall 10 of the furnace 18.

[0030] Although a description will be given with reference to the drawings, the present invention is not restricted to structures in the description.

EMBODIMENT 1

[0031] FIG. 3(a) shows a perspective view of the wind box 12 of the pulverized coal burner 19 according to this embodiment, and FIG. 4 shows a cross-sectional view (FIG. 4(a)) taken along a line A-A in FIG. 2 and a cross-sectional view (FIG. 4(b)) taken along a line B-B in FIG. 2. It is to be noted that each dark arrow shown in FIG. 4 and subsequent drawings represents an inflow direction of the combustion air.

[0032] Further, a heavy oil nozzle 7 and the pulverized coal nozzle 3 are not shown in FIG. 4, and the heavy oil nozzle 7 and the pulverized coal nozzle 3 are arranged in a cylindrical through hole of the wind box 12. A furnace wall of the through hole constitutes an outer wall of the secondary air nozzle 8.

[0033] As shown in FIG. 4, the wind box 12 having combustion air inlet openings 12a and 12b provided in a direction vertical to a central axis direction of the pulverized coal burner 19, and the secondary air nozzle 8 is arranged as if it is inserted in the through hole provided in the wind box 12.

[0034] Furthermore, the two combustion air inlet openings 12a and 12b are provided in the wind box 12, a partition plate 14 that partitions the two combustion air inlet openings (combustion gas opening portions) 12a and 12b is provided, and the partition plate 14 is connected to the outer side of a portion that divides the outer wall of the secondary air nozzle 8 constituting the through hole of the wind box 12 into two parts.

[0035] Upper and lower dampers 15a and 15b, each of which has a rotary shaft in a direction cutting across a flow of the combustion air introduced into the wind box and changes an area through which the combustion air flows, are provided near the combustion air inlet openings 12a and 12b in the wind box 12 divided into upper and lower parts by the partition plate 14, and separately adjusting respective rotation angles of the two dampers 15a and 15b enables deviating a momentum of the combustion air injected from the pulverized coal burner 19 depending on each of upper and lower sides in the wind box 12.

[0036] For example, when the upper damper 15a is closed and the lower damper 15b is opened, an injection amount of the combustion air on the lower side of the burner 19 increases, and the momentum of the combustion air on the lower side of the burner 19 increases, whereby flames in the boiler furnace 18 can be deflected to a downward direction.

[0037] It is to be noted that, in a state that planes of the dampers 15a and 15b are arranged in a direction parallel to a flow of the combustion air, each of the dampers 15a and 15b is arranged in the wind box 12 to be retracted by a length L1 from the inlet opening portion of the wind box 12.

[0038] FIG. 3 (b) shows a result of a tertiary air flow path outlet velocity distribution at the time of flame downward deflection realized by conducting a test for deviating a momentum of tertiary air injected from the tertiary air nozzle 11 into the furnace depending on each of the upper and lower sides of the burner 19 based on the wind tunnel test. It was confirmed from this wind tunnel test that the momentum of the combustion air on the lower side of the burner 19 can be increased by adjusting a revolving angle of each of the upper and lower revolving dampers 15a and 15b. In case of deflecting flames into the furnace 18 on the upper side of the burner 19, the upper revolving damper 15a is opened, and the lower revolving damper 15b is closed.

[0039] Since the secondary air nozzle 8 having the guide sleeve 13 at the distal end thereof is provided in the pulverized coal burner 19, the combustion air can be gradually injected. Two upper and lower opening portions 8a are provided at the outer peripheral portion of the secondary air nozzle 8, and it is desirable to provide an air capacity adjusting mechanism such as slide type dampers 9a and 9b that adjust an amount of air supplied into the secondary air nozzle 8 from the opening portions 8a as shown in FIG. 2.

[0040] For example, when the upper revolving damper 15a is closed and the lower revolving damper 15b is opened to increase an injection amount of the combustion air from the lower side of the burner 19, the air can be prevented from flowing into the upper secondary air nozzle 8 and the tertiary air nozzle 11 by fully closing the upper opening portion 8a of the secondary air nozzle 8 with use of the slide type damper 9a, and the momentum of the air injected into the furnace 18 from the secondary air nozzle 8 can be substantially homogeneously maintained in the circumferential direction, thereby keeping flame stabilizing properties.

[0041] It is to be noted that the momentum of the air injected from the secondary air nozzle 8 into the furnace 18 can be substantially evenly maintained along the circumferential direction of the secondary air nozzle 8 only if the combustion air flows into the secondary nozzle 8 from any position irrespective of whether the upper opening portion 8a of the secondary air nozzle 8 is fully closed by using the slide type damper 9a, but the upper opening portion 8a of the secondary air nozzle 8 must be fully closed by using the slide type damper 9a if softening the deflection of the flames in the furnace 18 toward the lower side is undesirable.

[0042] A direction of the flames in the furnace 18 can be deflected by just deviating the momentum of the combustion air in each of the upper half portion and the lower half portion in the burner 19 while maintaining flame stabilizing properties by adjusting an inflow amount of the combustion air. When each of the combustion air inlet openings 12a and 12b obtained by dividing the inside of the wind box shown in FIG. 5 into two parts by the partition plate 14 is further divided into two parts and dampers 15aa and 15ab and dampers 15ba and 15bb are provided to the respective combustion air inlet openings 12a and 12b, the momentum of the combustion air is deviated in each of the upper half and the lower half of the burner 19, whereby a direction of flames in the furnace 18 can be deflected.

[0043] In the explanatory example not according to the invention shown in FIG. 6, the burners 19 each having the wind box 12 are installed on the furnace wall 10 of the boiler furnace 18, and the combustion air is supplied into the burners 19 from the duct 16 provided on the outer side of the furnace wall 10. However, arrangement of the duct 16 is dependent on a boiler configuration and an installation angle of the burner 19 relative to the furnace wall 10. Further, even if the burners 19 each having the wind box 12 are arranged in the duct 16 as shown in FIG. 7, and the momentum of the combustion air in each of the upper half and the lower half of each burner 19 can be deviated, and a direction of flames in the furnace 18 can be deflected.

EMBODIMENT 2

[0044] In this embodiment, as shown in FIG. 8 and FIG. 9, a wind box 12 into which combustion air flows only from the upper side that is vertical to a central axis direction of a burner 19 is provided, and a plurality of partition plate 14 and revolving dampers 15 are provided in the wind box 12 so that the momentum of the combustion air injected into a furnace can be deviated depending on each of upper and lower sides by adjusting the dampers 15.

[0045] As shown in FIG. 8, in this embodiment, the partition plates 14 are provided so as to divide into three parts the wind box 12 into which the combustion air flows from one direction, i.e., either upper combustion air inlet opening 12a or 12b vertical to the central axis direction of the burner 19. Furthermore, the dampers 15a, 15b, and 15b as air capacity adjusters are provided on the upstream side of trifurcated air inflow paths in the wind box 12, respectively. Therefore, air flows into the upper side of the burner 19 from a central portion of the wind box 12, and air flows into the lower side of the burner 19 from left and right portions of the wind box 12.

[0046] In an embodiment shown in FIG. 9, two partition plates 14 are provided so as to divide into four parts a wind box 12 into which the combustion air flows from one direction, i.e., either upper combustion air inlet opening 12a or 12b vertical to the central axis direction of the burner 19. Furthermore, the combustion air inlet opening 12a at a central portion of the wind box 12 is divided into two parts, and dampers 15aa, 15ab, and 15b as air capacity adjusters are provided on the upstream side of respective air inflow paths. Therefore, also when shown in Fig. 9, air flows into the upper side of the burner 19 from an upper central portion of the wind box 12, and air flows into the lower side of the burner 19 from left and right portions of the wind box 12.

[0047] In the wind box 12 shown in each of FIG. 8 and FIG. 9, for example, when the damper 15a or the dampers 15aa and 15ab near the combustion air inlet opening 12a at the central portion are closed and the other two dampers 15b and 15b near the left and right combustion air inlet openings 12b and 12b are opened, an injection amount of the combustion air in the lower portion of the burner 19 increases, the momentum of the combustion air current flowing toward the lower side of the burner increases, and a direction of flames in a furnace 18 can be changed to a downward direction. A result obtained by conducting a test of deviating the momentum of tertiary air on each of upper and lower sides of the burner 19 based on a wind tunnel test is as shown in FIG. 3.

[0048] As described above, it can be confirmed that the momentum on the lower side of the burner 19 in the furnace 18 can be increased by adjusting an amount of the combustion air flowing into the wind box 12 by using three or four dampers 15. Performing an operation opposite to the above-described operation can cope with deflection of flames toward the upper side of the burner 19 in the furnace.

[0049] A secondary air nozzle 8 having a guide sleeve 13 at an end thereof is provided in the wind box 12 so that the combustion air can be gradually injected. An opening portion 8a is provided in an outer wall of the secondary air nozzle 8, and it is desirable to use an air capacity adjusting mechanism such as slide type dampers 9a and 9b shown in FIG. 2 that can adjust an amount of air supplied into the secondary air nozzle 8 in order to adjust an opening degree of the opening portion 8a. For example, when the damper 15a near the combustion air inlet opening 12a in the central portion shown in FIG. 8 is closed whilst the two dampers 15b and 15b near the left and right combustion air inlet openings 12b and 12b are opened and an injection amount of the combustion air on the lower side in the furnace 18 thereby increases, fully closing the opening portion 8a of the secondary air nozzle 8 provided on the upper side of the wind box 12 with use of the slide type dampers 9a and 9b enables preventing air from flowing into a tertiary air nozzle 11 in the upper portion of the burner 19, and the momentum of the air injected into the furnace 18 from the secondary air nozzle 8 can be substantially homogeneously maintained along the circumferential direction, whereby flame stabilizing properties can be maintained.

[0050] The flames can be deflected by just deviating the momentum of the tertiary air depending on each of the upper and lower sides of the burner 19 while maintaining the flame stabilizing properties by the above-described operation. According to these structures and the operating method, even when the combustion air inlet opening 12a in the central portion of the wind box 12 is divided into two portions as shown in FIG. 9 and the dampers 15aa and 15ab are provided near these divided portions, the same effect can be obtained by a damper adjustment method.

[0051] This embodiment provides a configuration that burners 19 each having the wind box 12 are installed on the outer side of the furnace wall 10 of the boiler furnace 18 and the combustion air is put into a duct 16 connected to each wind box 12 from an illustrated inflow direction. However, arrangement of the duct 16 is dependent on a boiler configuration and an installation angle of the burner 19 relative to the furnace wall 10. Further, the burners 19 each having the wind box 12 are arranged in the duct 16 as shown in FIG. 11, and the operation method can be executed.

EMBODIMENT 3

[0052] This embodiment shown in FIG. 12 and FIG. 13 has a configuration that a wind box 12 into which combustion air flows only from lower combustion air inlet openings 12a and 12b vertical to a central axis of the burner 19 is provided, the inside of the wind box 12 is partitioned by a plurality of partition plates 14, dampers 15b, 15a, and 15b or 15b, 15aa, 15ab, and 15b are provided in respective combustion air nozzles in the wind box 12 partitioned by the partition plates 14, and the momentum of the combustion air injected into a furnace 18 from the burner 19 is deviated depending on each of upper and lower sides of the burner 19 by adjusting opening/closing degrees of the dampers 15b, 15a, and 15b or 15b, 15aa, 15ab, and 15b.

[0053] In this embodiment shown in FIG. 12, the partition plates 14 and 14 are provided so as to divide the wind box 12, into which the combustion air flows from only one lower direction which is a direction vertical to the central axis direction of the burner 19, into three portions. Moreover, dampers 15b, 15a, and 15b as air capacity adjusters are provided on upstream portions of trifurcated air inflow paths 12b, 12a, and 12b of the wind box 12. Therefore, air from a combustion air inlet opening 12a at a central portion of the wind box 12 flows into the lower side of the burner 19, and air flows into the upper side of the burner 19 from the left and right combustion air inlet openings 12b and 12b of the wind box 12.

[0054] As described above, for example, when the damper 15a near the combustion air inlet opening 12a in the central portion of the wind box 12 is opened and the dampers 15b and 15b near the left and right combustion air inlet openings 12b and 12b are closed, an injection amount of the combustion air on the lower side of the burner 19 increases, and the momentum of the combustion air flowing toward the lower side of the burner 19 increases, thereby changing a direction of flames in the furnace 18 to a downward direction. A result obtained by conducting a test of deviating the momentum of tertiary air on each of upper and lower sides based on the wind tunnel test is as shown in FIG. 3.

[0055] It can be confirmed that the momentum on the lower side of the burner 19 can be increased by adjusting opening/closing degrees of the three dampers 15b, 15a, and 15b, and performing an operation opposite to the above-described operation can cope with deflection of flames toward the upper side of the burner 19 in the furnace 18.

[0056] A secondary air nozzle 8 having a guide sleeve 13 is provided in the wind box 12 so that the combustion air can be injected along a spreading direction from an outlet of the burner 19. Further, an opening portion 8a (FIG. 2) is provided in the secondary air nozzle 8, and it is desirable to adjust an air inflow amount from the opening portion 8a by providing a slide type damper 9 shown in FIG. 2. For example, when the damper 15a near the combustion air inlet opening 12a in the central portion of the wind box 12 is closed whilst the dampers 15b and 15b near the left and right combustion air inlet openings 12b and 12b are opened and an injection amount of the combustion air in the upper portion of the burner 19 thereby increases, fully closing the opening portion 8a of the secondary air nozzle 8 provided on the lower side of the wind box 12 with use of the slide type damper 9 enables preventing air from flowing into a tertiary air nozzle 11 on the lower side of the burner 19, and the momentum of the air injected into the furnace 18 from the secondary air nozzle 8 can be substantially homogeneously maintained along the circumferential direction, whereby flame stabilizing properties can be maintained. The flames can be deflected by just adjusting a tertiary air injection amount to deviate the momentum of the air depending on each of the upper and lower sides of the burner 19 while maintaining the flame stabilizing properties by the above-described operation. According to these structures and the operating method, even when the combustion air inlet openings 12b and 12b are provided on both sides of the lower side of the wind box 12, the combustion air inlet opening 12a in the central portion is divided into two portions, and the dampers 15b, 15aa, 15ab, and 15b are provided on the upstream side of the respective air inflow paths as shown in FIG. 13, the same effect can be obtained by adjustment methods of the dampers 15b, 15aa, 15ab, and 15b.

[0057] This embodiment is characterized in that the burners 19 each having the wind box 12 are installed on the boiler furnace wall 10 and the combustion air is supplied into the burners 19 from a duct 16 provided on the outer side of the furnace wall 10. However, arrangement of the duct 16 is dependent on a boiler configuration and an installation angle of the burner 19. Further, the burners 19 each having the wind box 12 are arranged in the duct 16 as shown in FIG. 15, and the operation method can be carried out.

[0058] According to this embodiment 3, when flames in the furnace 18 are deflected to the downward direction, the maximum thermal load region in the furnace 18 shifts to the lower side, thermal absorption of the furnace thereby increases, an exhaust gas temperature at an outlet of the furnace 18 can be reduced, a detention time of an NOx reduction region in the furnace 18 between the burner 19 and an after-air port 24 can be increased beyond than that in a case where a combustion region is evenly formed on each of upper and lower sides of the burner 19 by shifting the combustion region of the burner 19 to the lower side, thus providing the pulverized coal burner 19 that can reduce the NOx concentration.

EMBODIMENT 4

[0059] This embodiment provides a configuration where a second damper 17 as a supply air capacity adjuster for each burner 19, which is configured to adjust a flow rate of combustion air flowing into each burner 19, is provided on the upstream side of a damper 15 in addition to the configurations of Embodiments 1 to 3.

[0060] Since a distribution can appear in a fuel supplied to a plurality of burners 19 arranged on a boiler furnace wall 10, it is desirable to enable adjusting a combustion air flow rate in accordance with each burner 19 so that a combustion air flow rate consistent with a fuel supply amount can be obtained.

[0061] Here, although the combustion air flow rate can be adjusted by a first damper 15 alone if its opening degree is adjusted in accordance with each burner 19, when the first damper 15 provided for the purpose of deviating a momentum of the combustion air on each of upper and lower sides of each burner 19 has a function of adjusting the combustion air flow rate consistent with the fuel supply amount, controlling this damper becomes difficult.

[0062] Thus, in this embodiment, the first damper 15 and the second damper 17 that share the two different functions are independently provided.

[0063] Each of FIG. 16 and FIG. 17 shows a configuration where, in addition to first dampers 15a and 15b configured to deviate an air momentum on each of upper and lower sides of the burner 19 described in Embodiment 1 (FIGS. 4 and 5), second dampers 17a and 17b for adjusting a flow rate of the combustion air flowing into each burner 19 are provided on the upstream side of the first dampers 15a and 15b.

[0064] As described above, for example, when the upper first damper 15a in the first dampers 15a and 15b that deviate the momentum of the combustion air depending on each of the upper and lower sides of each burner 19 is closed and the lower first damper 15b is opened, an injection amount of the combustion air on the lower side of the burner 19 increases, and an increase in the momentum of the combustion air flowing toward the lower side of the burner 19 enables deflecting flames in a furnace 18 to a downward direction (see FIG. 3(b)).

[0065] When the second dampers 17a and 17b are provided on the upstream side of the first dampers 15a and 15b, the flow rate of the combustion air flowing into each burner 19 can be individually adjusted without suppressing a deviation of the momentum of the combustion air on each of the upper and lower sides of the burner 19.

[0066] Providing the first dampers 15a and 15b, which are adjusters that deviate the momentum of the combustion air on each of the upper and lower sides of each burner 19 in each wind box 12, on the downstream side of the second dampers 17a and 17b can suffice, and the second dampers 17a and 17b can be arranged at any positions.

[0067] Furthermore, as each of the first dampers 15a and 15b and the second dampers 17a and 17b, a member that adjusts an opening area by sliding a plurality of laminated porous plates may be used in place of the illustrated butterfly type damper, and it can have any structure as long as it has a gas flow rate adjusting function.

[0068] In this embodiment, such a secondary air nozzle 8 having the guide sleeve 13 as shown in FIG. 2 is provided in the wind box 12, and the combustion air is injected into the furnace 18 from the outlet of the burner 19 in a spreading manner. The opening portion 8a is provided in the secondary air nozzle 8, and it is desirable to provide the slide type damper 9 that can adjust an air capacity flowing into the secondary air nozzle 8.

[0069] For example, when the upper first damper 15a in the wind box 12 shown in FIG. 16 is closed and the lower first damper 15b in the same is opened to increase an injection amount of the combustion air on the lower side of the burner 19, the combustion air can be prevented from flowing into the tertiary air nozzle 11 on the upper side in the wind box 12 by fully closing the opening portion 8a of the secondary air nozzle 8 provided on the upper side in the wind box 12 with use of the slide type damper 9a, and the momentum of the combustion air injected into the furnace 18 from the secondary air nozzle 8 can be substantially homogeneously maintained along the circumferential direction of the burner 19, thereby holding the flame stabilizing properties.

[0070] When the first dampers 15a and 15b and the slide type damper 9a are operated and the momentum of the tertiary air on each of the upper and lower sides of the burner 19 is deviated while maintaining the flame stabilizing properties of the burner 19, flames in the furnace 18 can be deflected.

[0071] According to these structures and the operating method, the damper adjustment method for dividing each of the combustion air inlet openings 12a and 12b in the wind box 12 into two parts and providing the first dampers 15aa, 15ab, 15ba, and 15bb and the second dampers 17aa, 17ab, 17ba, and 17bb to the respective combustion air inlet openings 12a and 12b as shown in FIG. 17 enables individually adjusting the flow rate of the combustion air flowing into each burner 19 without suppressing a deviation of the momentum of the combustion air on each of the upper and lower sides of the burner 19.

[0072] In this embodiment, as shown in FIG. 18, the burners 19 each having the wind box 12 are arranged in the duct 16. An air capacity of each of the plurality of burners 19 arranged on the furnace wall 10 along the horizontal direction in line can be adjusted by providing the second dampers 17 (17a, 17b and 17aa, 17ab; and 17ba, 17bb) shown in FIG. 16 and FIG. 17 in each wind box 12.

[0073] Moreover, as shown in the explanatory example of FIG. 19, the burners 19 each having the wind box 12 shown in FIG. 16 and FIG. 17 may be installed on the outer side of the furnace wall 10 of the boiler so that the combustion air from the outside of the furnace 18 can be supplied into the burners 19 each having the wind box 12 through the duct 16.

INDUSTRIAL APPLICABILITY

[0074] According to the present invention, when the flame deflection and heat absorption control function and the combustion gas flow rate adjustment function for each burner 19 are additionally provided, the industrial applicability can be further enhanced.

DESCRIPTION OF THE REFERENCE NUMERALS

[0075]

1 gas-particle flow
2 combustion air
3 fuel nozzle
4 flame stabilizer
5 pulverized coal concentrator
6 venturi tube
7 heavy oil nozzle
8 secondary air nozzle
9 slide type damper
10 boiler furnace wall
11 tertiary air nozzle
12 wind box
13 guide sleeve
14 partition wall
15 (15a, 15aa, 15ab, 15b, 15ba, 15bb) damper (first flow rate adjusting means)
16 duct
17 (17a, 17aa, 17ab, 17b, 17ba, 17bb) damper (second flow rate adjusting means)
18 boiler furnace
19 burner
20 bunker
21 mill
23 blower
24 after-air port
25 blower

Claims

1. A combustion device comprising a plurality of burners (19) arranged on a furnace wall (10) of a furnace (18), each burner (19) comprising: a cylindrical fuel nozzle (3) that injects a mixture of a fuel and a carrier gas therefor into the furnace (18); one or more cylindrical combustion gas nozzles (8, 11) that are provided on the outer circumference of the fuel nozzle (3) and inject a combustion gas into the furnace (18); and a wind box (12) that supplies the combustion gas to the combustion gas nozzles (8, 11), wherein the wind box (12) has a combustion gas inflow opening portion (12a, 12b) into which the combustion gas flows from one direction vertical to the axial direction of the burner (19) and is partitioned to form a plurality of parallel flow paths through which the combustion gas flows in from the combustion gas inflow opening

portion (12a, 12b), wherein
one duct (16) through which the combustion gas is collectively supplied to the plurality of wind boxes (12) from the outside of the furnace (18) is installed on the outer side of the furnace wall (10) on which the wind boxes (12) are installed, wherein
the plurality of wind boxes (12) are aligned and installed entirely inside the one duct (16) such that the combustion gas flows into the combustion gas inflow opening portion (12a, 12b) from one direction common to all burners (19), and wherein some of the plurality of flow paths in the wind box (12) are connected to an upper side of the combustion gas nozzles (8, 11), the other flow paths are connected to a lower side of the combustion gas nozzles (8, 11), and first flow rate adjusting means (15) for adjusting a flow rate of the combustion gas is independently provided to each of the plurality of flow paths in the wind box (12).

2. The combustion device according to claim 1, wherein second flow rate adjusting means (17) for adjusting a flow rate of the combustion gas that flows into each burner (19) on the upstream side of the first flow rate adjusting means (15) is provided in each wind box (12).

Patentansprüche

1. Verbrennungsvorrichtung, mit einer Vielzahl von Brennern (19), die an einer Ofenwand (10) eines Ofens (18) angeordnet sind, wobei ein jeder Brenner (19) Folgendes aufweist: eine zylindrische Brennstoffdüse (3), die ein Gemisch aus einem Brennstoff und einem Trägergas dafür in den Ofen (18) eindüst; eine oder mehrere zylindrische Verbrennungsgasdüsen (8, 11), die an dem Außenumfang der Brennstoffdüse (3) vorgesehen sind und ein Verbrennungsgas in den Ofen (18) eindüsen; und einen Windkasten (12), der den Verbrennungsgasdüsen (8, 11) das Verbrennungsgas zuführt, wobei
der Windkasten (12) einen Verbrennungsgas-Einströmöffnungsabschnitt (12a, 12b) hat, in welchen das Verbrennungsgas aus einer Richtung strömt, die zu der Axialrichtung des Brenners (19) senkrecht ist, und aufgeteilt ist, um eine Vielzahl von parallelen Strömungspfaden auszubilden, durch welche das Verbrennungsgas aus dem Verbrennungsgas-Einströmöffnungsabschnitt (12a, 12b) einströmt, wobei ein Kanal (16), durch welchen das Verbrennungsgas von der Außenseite des Ofens (18) der Vielzahl von Windkästen (12) gemeinsam zugeführt wird, an der Außenseite der Ofenwand (10) installiert ist, an welcher die Windkästen (12) installiert sind, wobei
die Vielzahl von Windkästen (12) ausgerichtet und vollständig innerhalb des einen Kanals (16) installiert sind, sodass das Verbrennungsgas aus einer allen Brennern (19) gemeinsamen Richtung in den Verbrennungsgas-Einströmöffnungsabschnitt (12a, 12b) strömt, und wobei manche der Vielzahl von Strömungspfaden in dem Windkasten (12) mit einer oberen Seite der Verbrennungsgasdüsen (8, 11) verbunden sind, die anderen Strömungspfade mit einer unteren Seite der Verbrennungsgasdüsen (8, 11) verbunden sind und ein erstes Strömungsratenanpassungsmittel (15) zum Anpassen einer Strömungsrate des Verbrennungsgases bei einem jeden der Vielzahl von Strömungspfaden in dem Windkasten (12) unabhängig vorgesehen ist.

2. Verbrennungsvorrichtung nach Anspruch 1, wobei ein zweites Strömungsratenanpassungsmittel (17) zum Anpassen einer Strömungsrate des Verbrennungsgases, das auf der stromaufwärtigen Seite des ersten Strömungsratenanpassungsmittels (15) in einen jeden Brenner (19) strömt, in einem jeden Windkasten (12) vorgesehen ist.

Revendications

1. Dispositif de combustion comprenant une pluralité de brûleurs (19) agencés sur une paroi de fourneau (10) d'un fourneau (18), chaque brûleur (19) comprenant : un buse à carburant cylindrique (3) qui injecte un mélange d'un carburant et d'un gaz vecteur pour celui-ci dans le fourneau (18) ; une ou plusieurs buses à gaz de combustion cylindriques (8, 11) qui sont ménagées sur la circonférence externe de la buse à carburant (3) et injectent un gaz de combustion dans le fourneau (18) ; et une boîte à vent (12) qui alimente, avec le gaz de combustion, les buses à gaz de combustion (8, 11), dans lequel la boîte à vent (12) possède une partie d'ouverture d'entrée de gaz de combustion (12a, 12b) dans laquelle le gaz de combustion circule à partir d'une direction verticale à la direction axiale du brûleur (19) et est cloisonnée pour former une pluralité de chemins de circulation parallèles à travers lesquels le gaz de combustion circule à partir de la partie d'ouverture d'entrée de gaz de combustion (12a, 12b), dans lequel
un conduit (16), au travers duquel le gaz de combustion alimente collectivement la pluralité de boîtes à vent (12) à partir de l'extérieur du fourneau (18), est installé sur le côté externe de la paroi de fourneau (10) sur lequel les boîtes à vent (12) sont installées, dans lequel
la pluralité de boîtes à vent (12) sont alignées et installées entièrement à l'intérieur dudit un conduit (16) de sorte que le gaz de combustion circule dans la partie d'ouverture d'entrée de gaz de combustion (12a, 12b) à partir d'une direction commune à tous les brûleurs (19), et dans lequel certains de la pluralité de chemins de circulation dans la boîte à vent

(12) sont reliés à un côté supérieur des buses à gaz de combustion (8, 11), les autres chemins de circulation sont reliés à un côté inférieur des buses à gaz de combustion (8, 11), et un premier moyen de réglage de débit (15) pour régler un débit du gaz de combustion est indépendamment ménagé sur chacun de la pluralité de chemins de circulation dans la boîte à vent (12).

2. Dispositif de combustion selon la revendication 1, dans lequel un second moyen de réglage de débit (17) pour régler un débit du gaz de combustion qui circule dans chaque brûleur (19) sur le côté amont du premier moyen de réglage de débit (15) est ménagé dans chaque boîte à vent (12).

FIG. 1

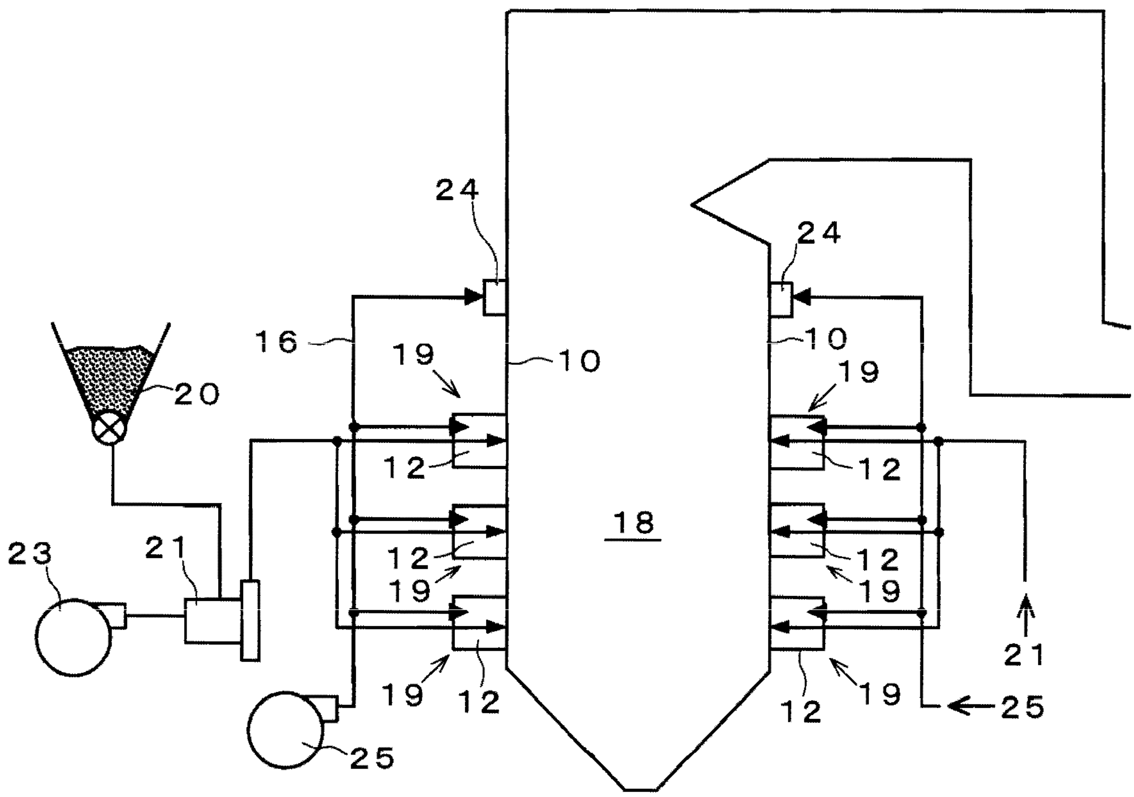


FIG. 2

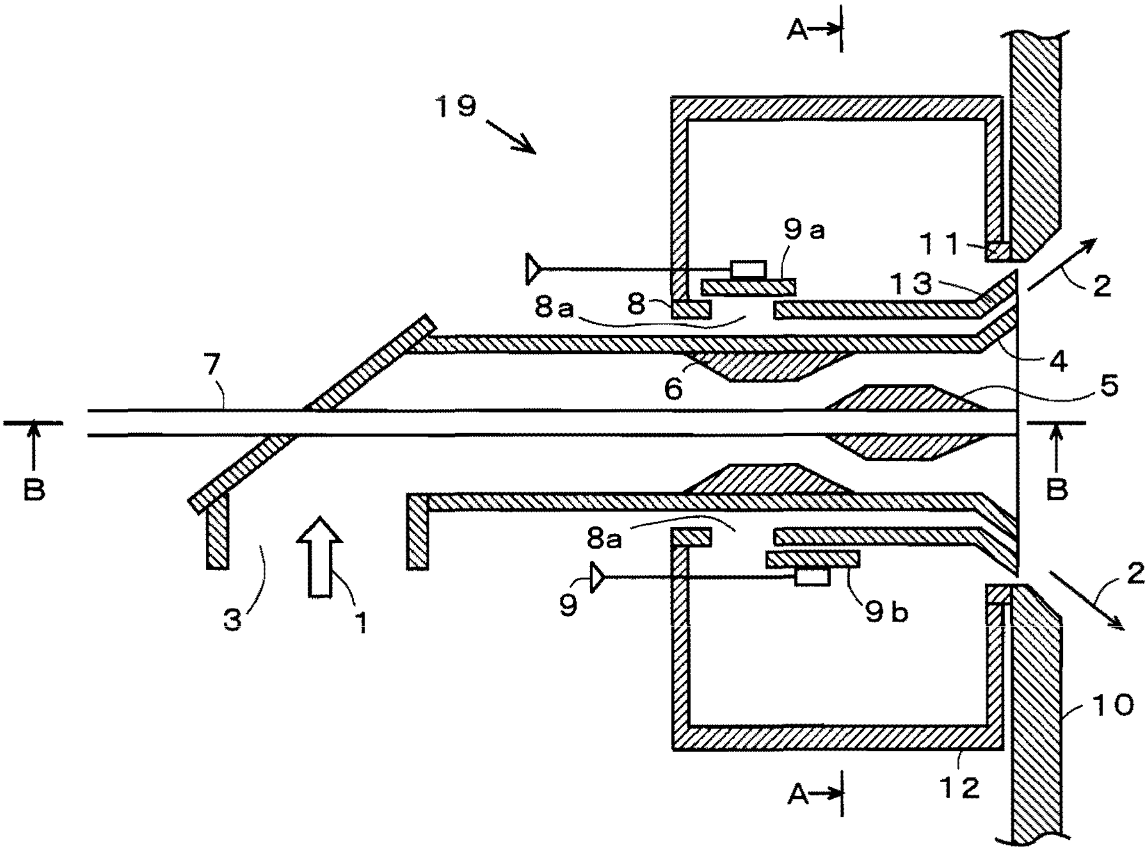
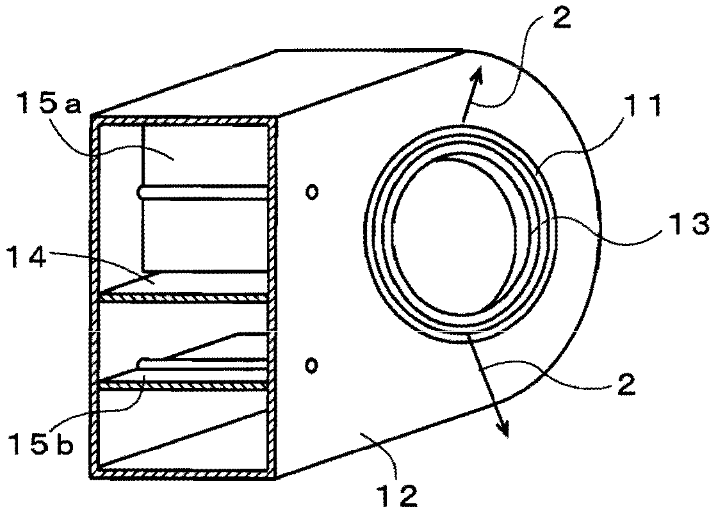
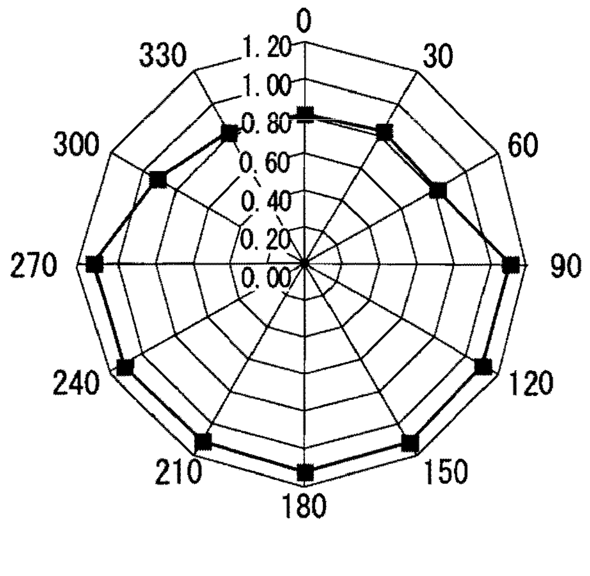


FIG. 3

(a)



(b)



TERTIARY AIR FLOW PATH OUTLET VELOCITY DISTRIBUTION
AT THE TIME OF DEFLECTING FLAMES TO DOWNWARD DIRECTION

FIG. 4

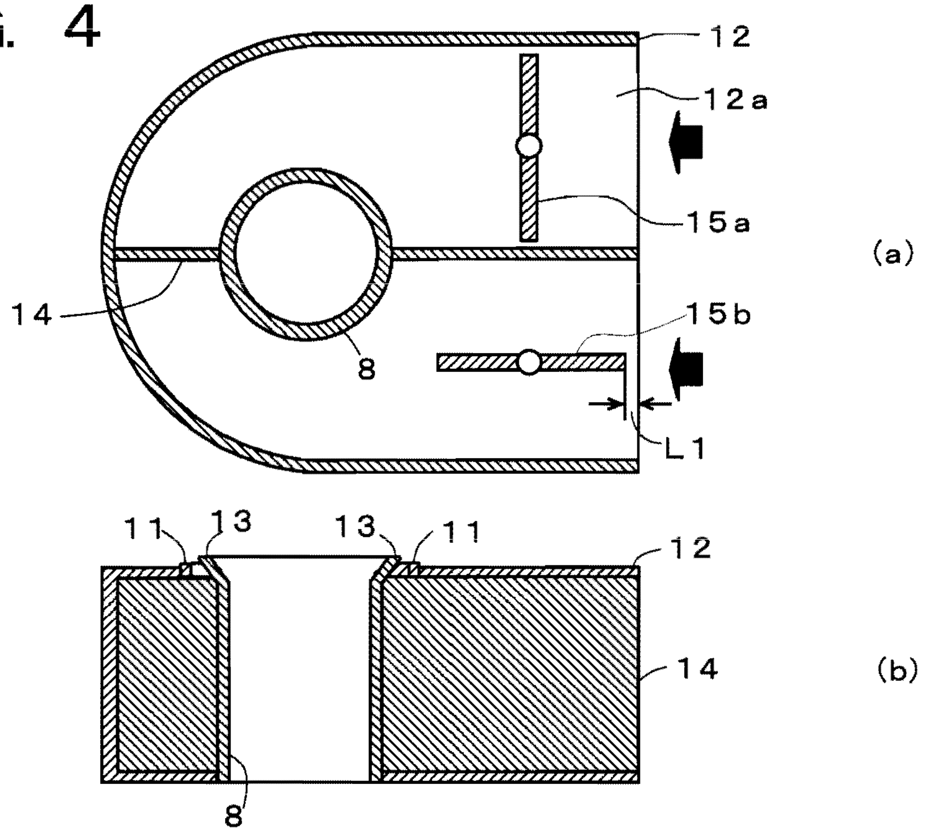

12
12a
15a
(a)
14
15b
8
L1
11
13
13
11
12
14
(b)
8

FIG. 5

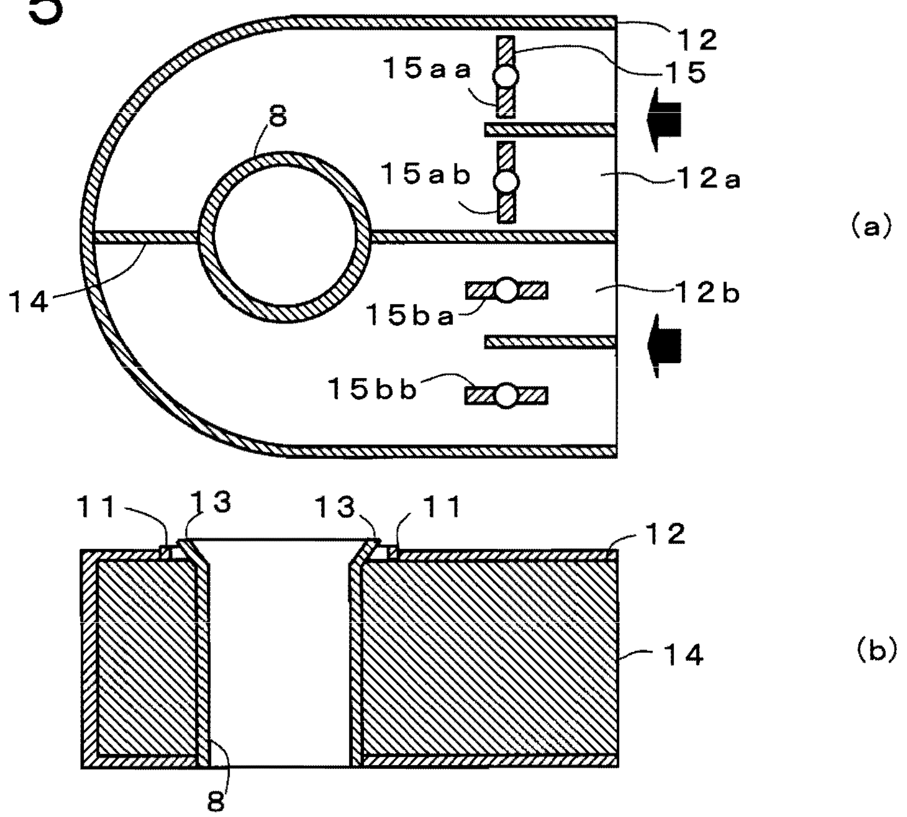

12
15aa
15
8
15ab
12a
(a)
14
12b
15ba
15bb
11
13
13
11
12
14
(b)
8

FIG. 6

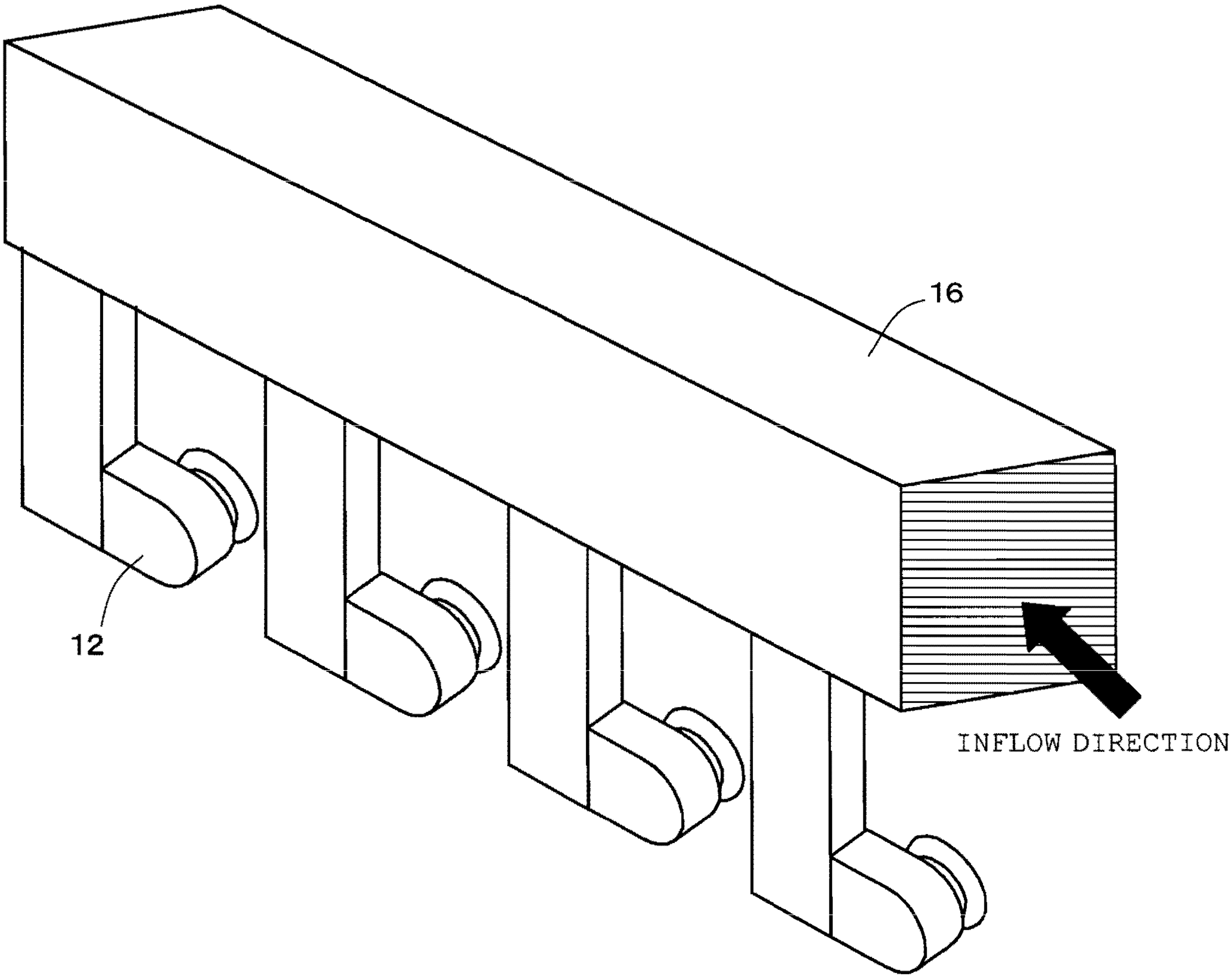


FIG. 7

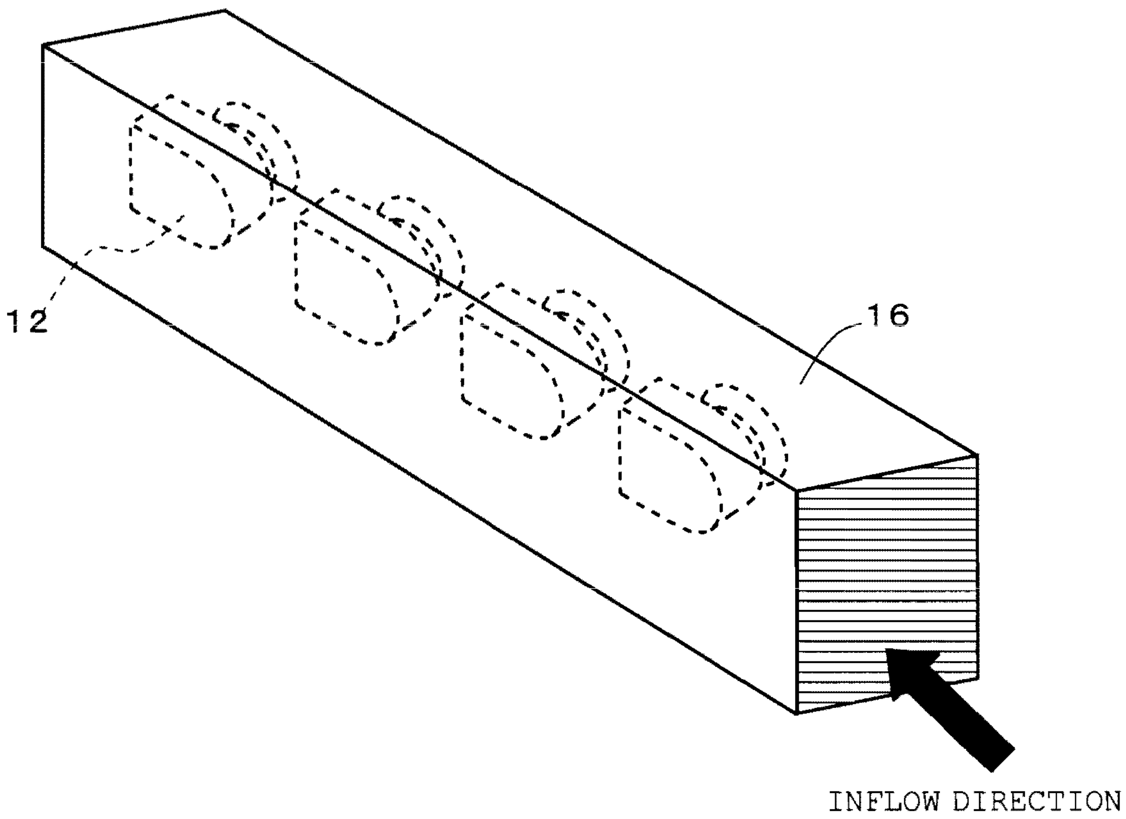


FIG. 8

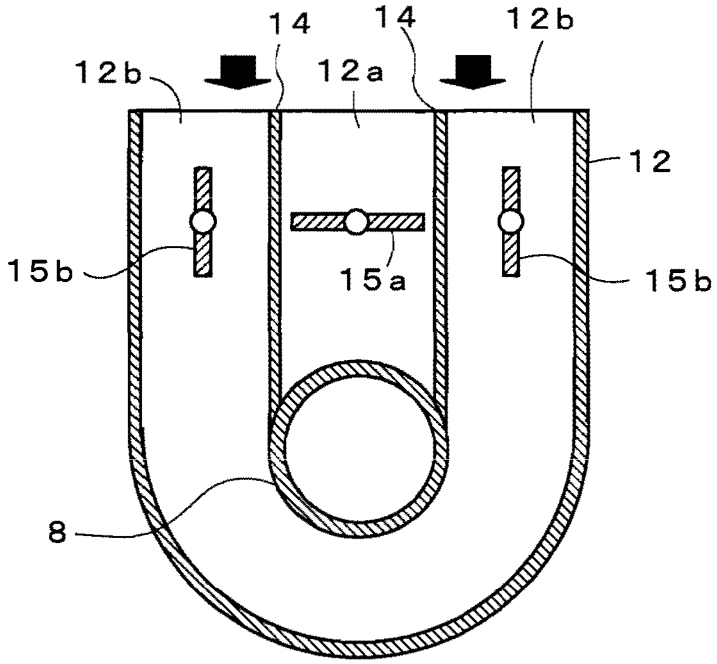

14
14
12b
12b
12a
12
15b
15a
15b
8

FIG. 9

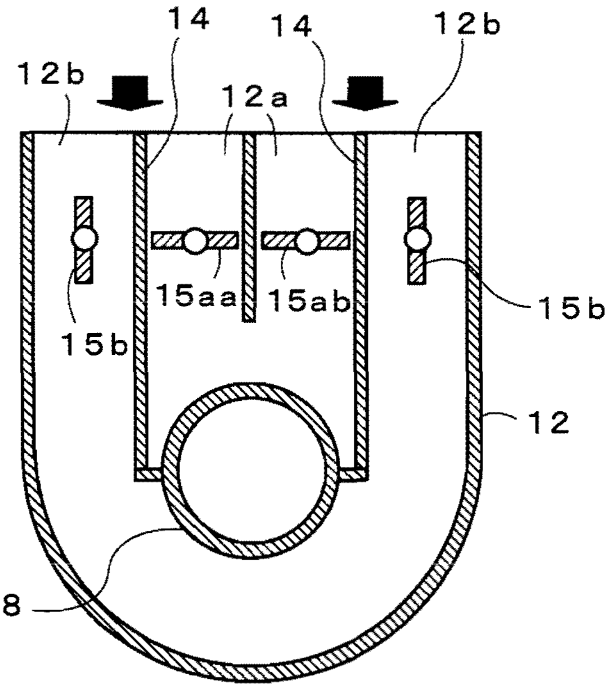

14
14
12b
12b
12a
15aa
15ab
15b
15b
12
8

FIG. 10

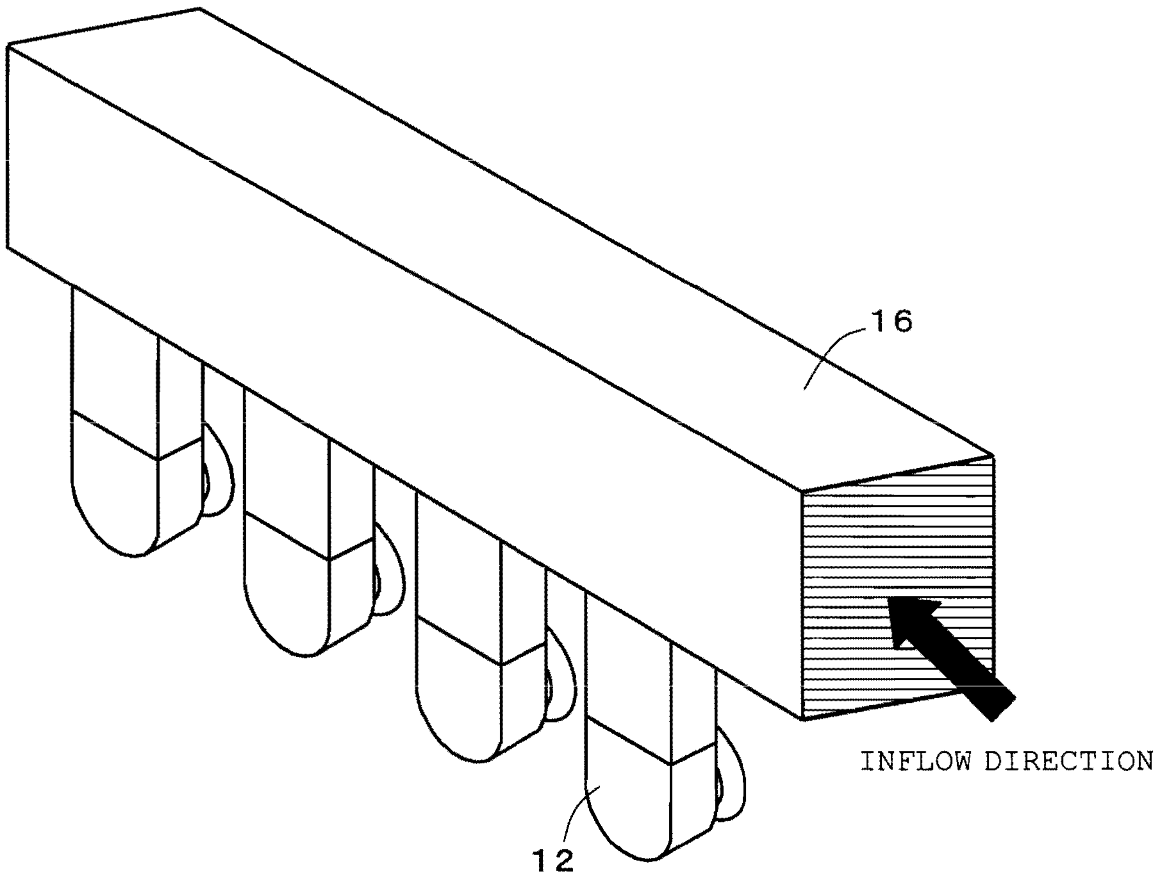


FIG. 11

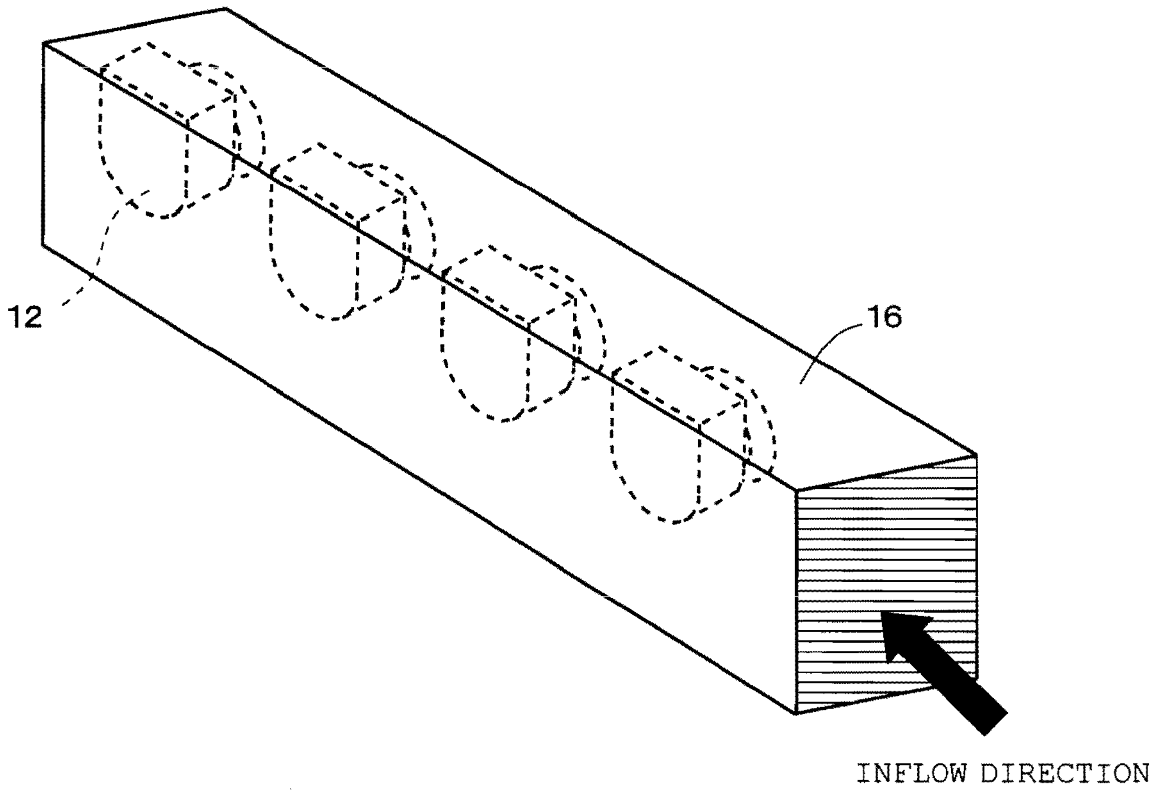


FIG. 12

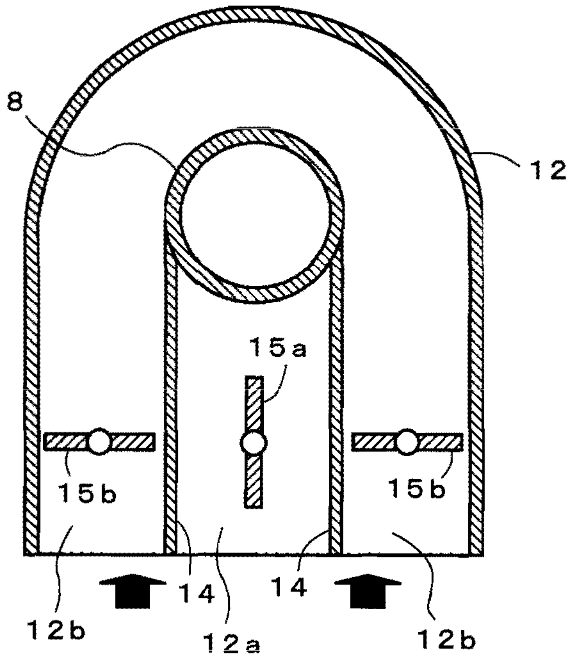

8
12
15a
15b
15b
14
14
12b
12a
12b

FIG. 13

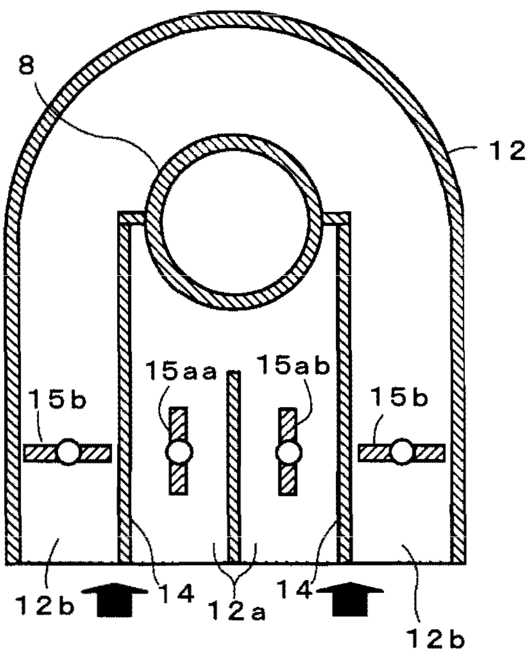

8
12
15aa
15ab
15b
15b
12b
14
12a
14
12b

FIG. 14

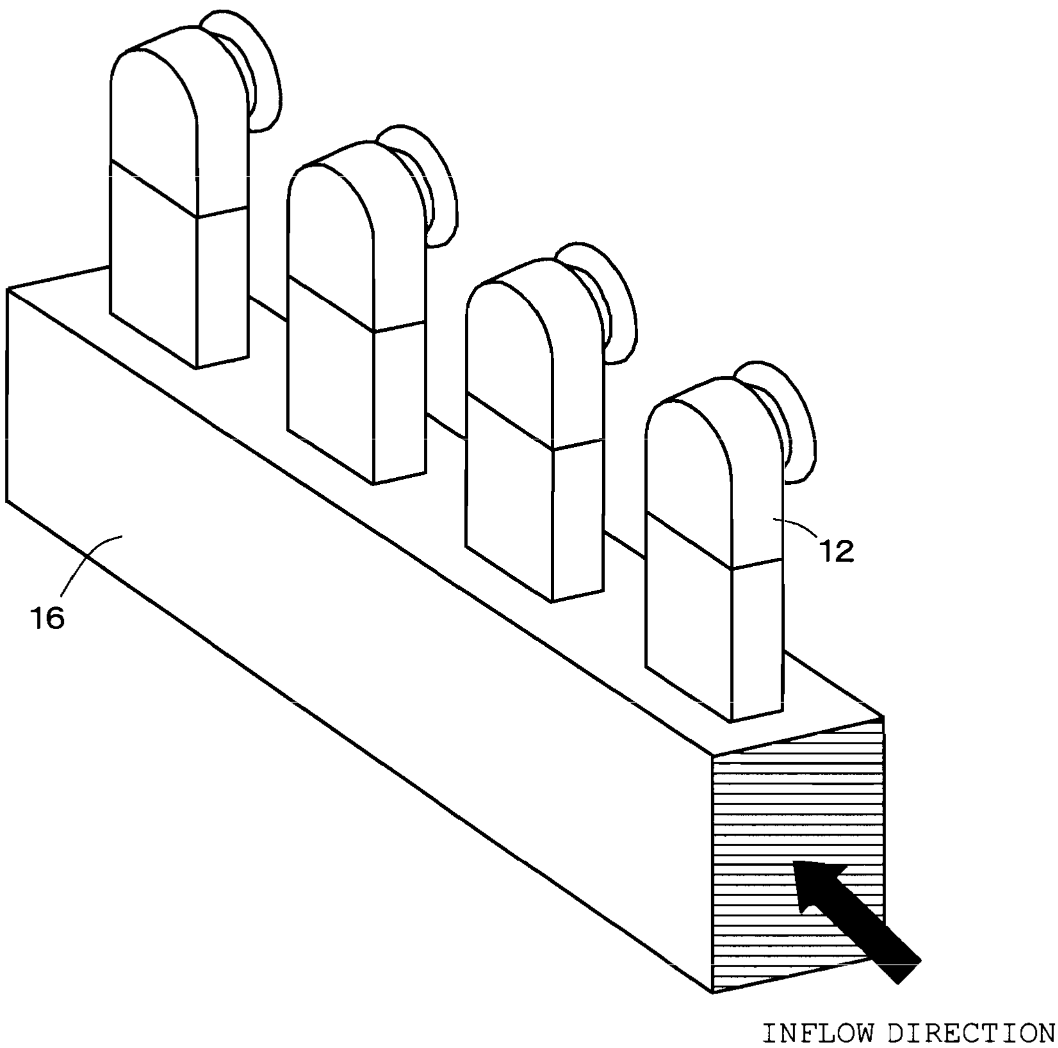


FIG. 15

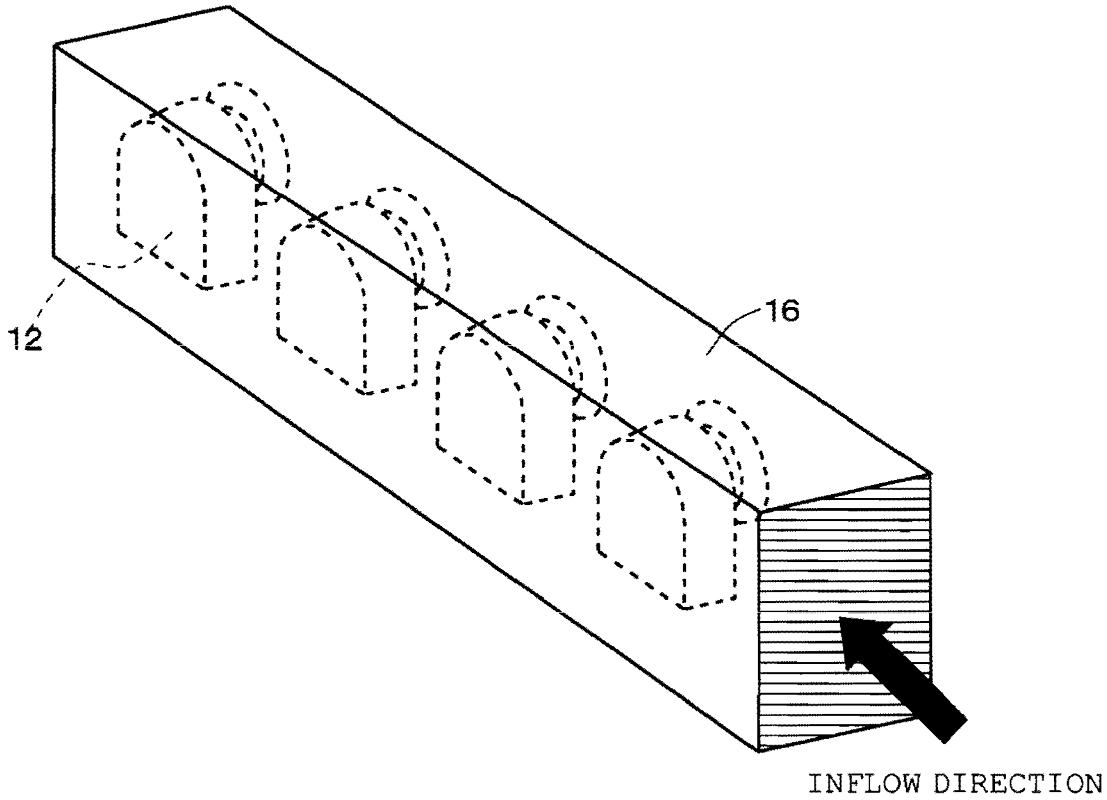


FIG. 16

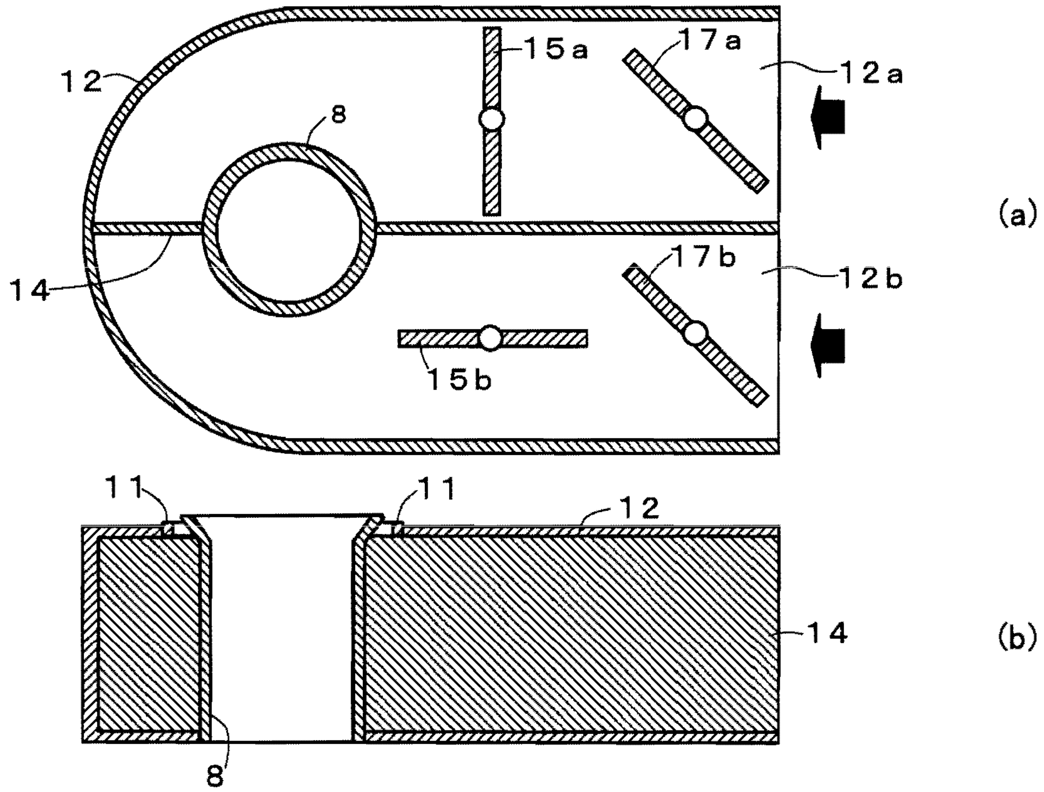

15a
17a
12
12a
8
(a)
14
17b
12b
15b
11
11
12
14
(b)
8

FIG. 17

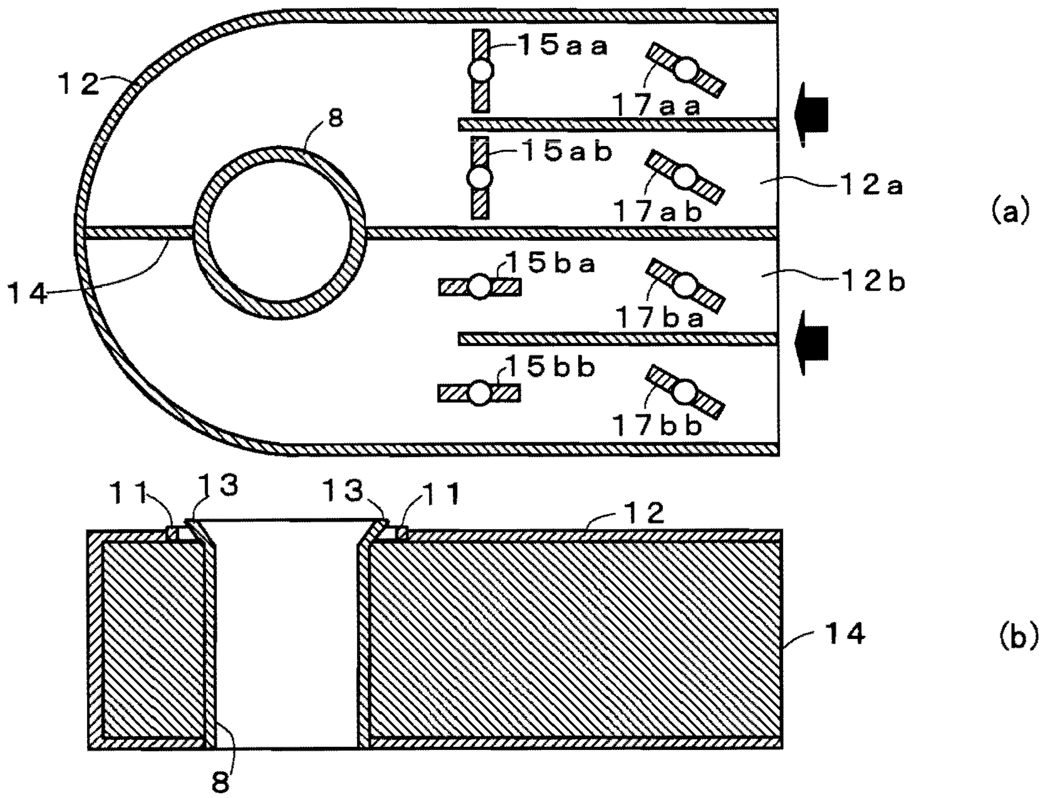

15aa
12
17aa
8
15ab
12a
17ab
(a)
15ba
14
12b
17ba
15bb
17bb
11
13
13
11
12
14
(b)
8

FIG. 18

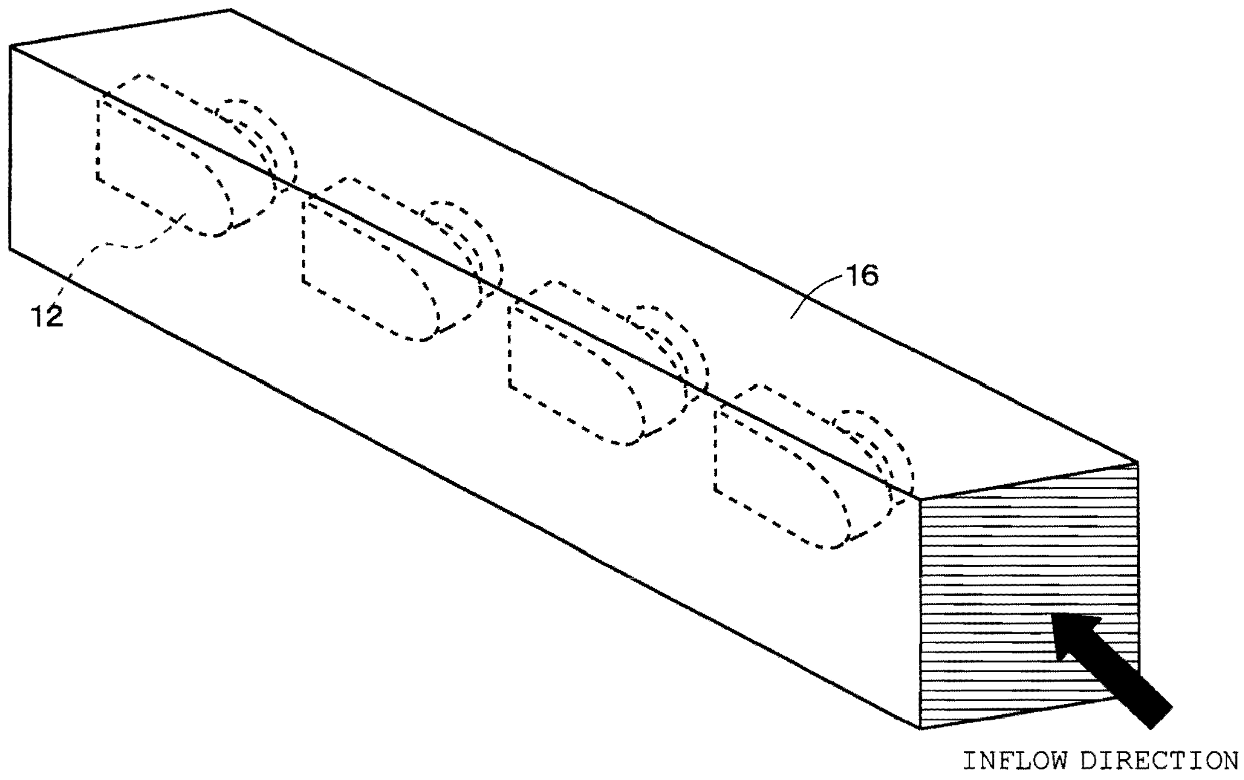
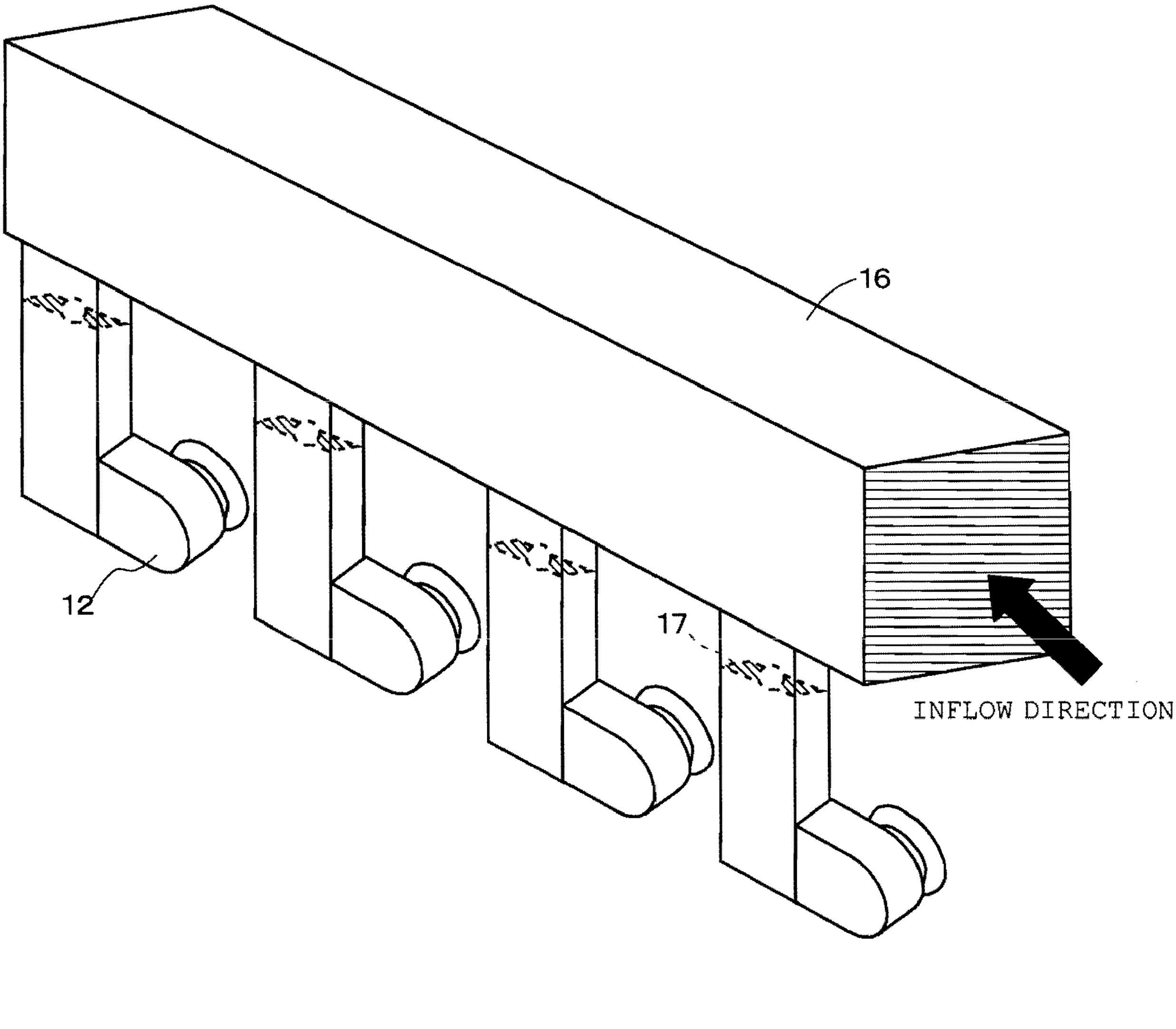


FIG. 19



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