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(54) **Burner**

(57) The object is to provide a burner 1 capable of taking in sufficient primary air without using a fan, and being preferably used as an all-primary air burner.

The burner 1 includes a burner main body 2 having a mixing pipe 4 to which a fuel gas and combustion air are supplied, and a mixing chamber 6 is provided at a top end on the downstream side of the mixing pipe 4, and a burner head 3, which is provided at an upper part of the burner main body 2. The burner head communicates

with the mixing chamber 6 and ejects the mixed gas of the fuel gas and air for combustion mixed in the mixing chamber. The burner head 3 is in a cylindrical shape and provided right above the mixing chamber 16 of the burner main body 2. The burner head 3 has many first and second burner ports 15 and 16 bored around an almost whole periphery of a side face thereof. Further, the mixing pipe 4 is provided to direct in a direction where the mixing pipe 4 is crossed with an axis line of the burner head 3 at substantially right angles to each other.

Fig. 1A

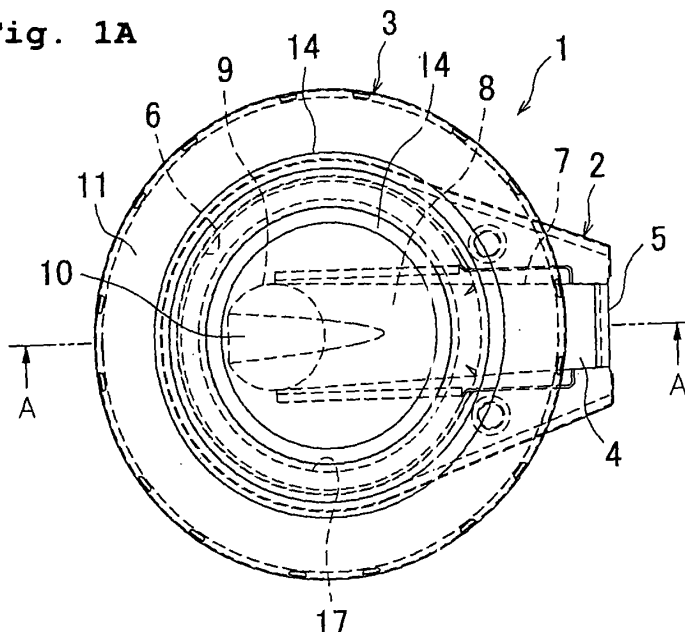


Fig. 1D

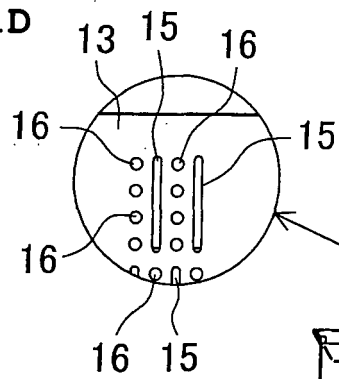


Fig. 1B

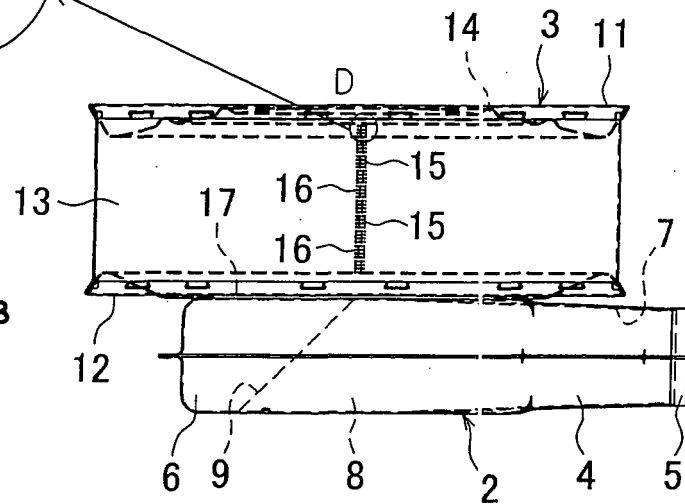
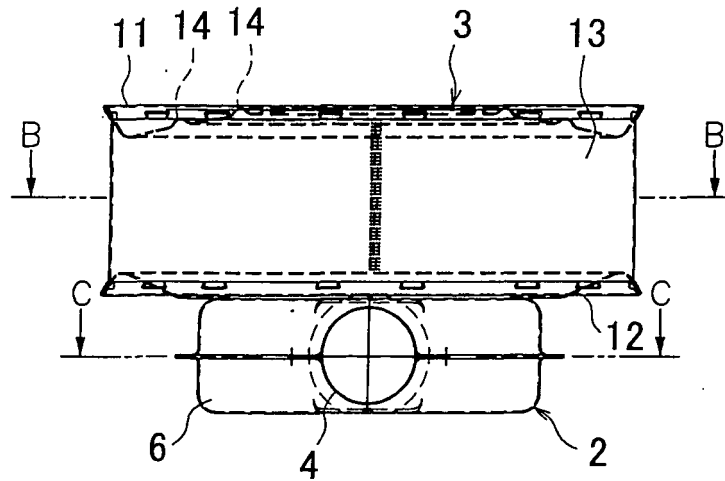


Fig. 1C



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a burner used for a gas combustion appliance such as a hot water storage type water heater.

Description of the Background Art

[0002] A conventional burner includes a burner main body having a mixing pipe to which fuel gas and combustion air are supplied, and a mixing chamber at a top end on a downstream side of the mixing pipe. Further, the burner includes a burner head at an upper part of the burner main body while communicating with the mixing chamber and including a burner port for ejecting a mixed gas of the fuel gas and combustion air from the mixing chamber. For example, patent document 1 describes that such a burner is used to heat hot and cold water and the like in a gas combustion appliance such as a hot water storage type water heater. The burner used in this patent document 1 is a Bunsen burner in a combustion chamber arranged below a hot water storage chamber, and includes a burner main body facing a top end of a gas nozzle and having a throat part taking combustion air in, and a burner head placed on the burner main body and having intermittently burner ports therearound.

[0003] Patent document 1: Japanese Unexamined Patent Publication No. 2001-304691

SUMMARY OF THE INVENTION

[0004] From a viewpoint to suppress generating NOx (nitrogen oxide) in a combustion gas, it is desirable that a burner is an all-primary air burner taking in air which has more than the theoretical equivalence required for combustion as primary air. In the all-primary air burner, the highest temperature of a flame can be decreased by all primary low-load combustion, and thus NOx generation can be suppressed.

[0005] However, when an inner pressure of the burner is high, a volume of primary air taken in becomes insufficient. Particularly, when a burner port area is small like the burner disclosed in the above-described patent document 1, an ejection speed of the mixing air of primary air and air for combustion from the burner port becomes high to increase fluid resistance. Since sufficient primary air cannot be taken in due to increased inner pressure it becomes necessary to compulsively supply combustion air using a fan. Thus, downsizing of a burner cannot be made, which increases the cost.

[0006] An object of the present invention is to provide a burner capable of taking in sufficient primary air and mixing it with fuel gas without using a fan, and being used as an all primary air burner.

[0007] In order to achieve the above-described object, a first aspect of the invention includes a burner head, wherein the burner head is in a cylindrical shape having a plurality of burner ports bored around an almost whole periphery of a side face of the burner head, and is provided right above a mixing chamber of a burner main body while a mixing pipe is directed in a direction where an axis line of the mixing pipe crosses with an axis line of the burner head at substantially right angles.

[0008] A second aspect of the invention includes, in addition to the first aspect, the burner ports including a vertical slit-shaped first burner port, and the line of plural round second burner ports arranged vertically, each of which is alternately arranged in the peripheral direction and the vertical directions, in order to obtain suitable burner ports capable of having a necessary burner port area and securing rigidity.

[0009] According to the first aspect of the invention, a sufficient burner port area can be provided with the cylindrical burner head, and the ejection speed of mixing gas from the burner ports decreases to suppress fluid resistance. In addition, the mixing air can be smoothly and uniformly supplied from the mixing chamber to the burner head, and thus the whole height can be suppressed to be small. Thus, the burner can be suitably used as an all-primary air burner and a natural combustion type burner not using a fan, and thus downsizing of the burner and reduction of cost can be expected. Further, since a combustion surface becomes a side surface, dropping materials from above are not accumulated on the burner ports.

[0010] According to the second aspect of the invention, in addition to the effect of the first aspect, while a necessary burner port area is provided by the first burner ports, rigidity can be secured by the second burner ports.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Figs. 1 are descriptive views of a burner, and Fig. 1A illustrates a plane view, Fig. 1B illustrates a front view, and Fig. 1C illustrates a right side face; Fig. 2 is an enlarged cross sectional view taken along an A-A line; Fig. 3A is a cross sectional view taken along a B-B line, and Fig. 3B is a cross sectional view taken along a C-C line; Fig. 4A is a descriptive view of a caulking part between an upper plate and a side plate, and Fig. 4B is a descriptive view of a caulking part between a lower plate and a side plate; Fig. 5 is a descriptive view to illustrate a lower portion of a hot water storage type water heater; and Fig. 6A is a descriptive view of a modified example of a caulking part between the upper plate and the side plate, and Fig. 6B is a descriptive view of a modified example of a caulking part between the lower

plate and the side plate.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] Embodiments of the present invention will be described below with reference to the drawings.

[0013] Figs. 1 are descriptive views of a burner, and Fig. 1A illustrates a plane view, Fig. 1B illustrates a front view, and Fig. 1C illustrates a right side face, respectively. A burner 1 includes a burner main body 2 on a lower side thereof, and a burner head 3 placed on the burner main body 2. The burner main body 2 includes a cylindrical mixing pipe 4 at an end part thereof, having a throat part 5 to which fuel gas and combustion air are supplied, and a round shaped mixing chamber 6 continuously provided at a downstream end of the mixing pipe 4. The burner main body 2 is formed with a pair of upper and lower metal plates which are bonded by caulking at a center thereof along the whole periphery. The mixing chamber 6 has a space having a radius larger than that of the mixing pipe 4, and is continuously provided to the mixing pipe 4 in such a way that an axis line of the mixing pipe 4 in the horizontal direction is orthogonally crossed with an axis line of the mixing chamber 6 in a vertical direction.

[0014] Further, an internal pipe 7 is provided in the mixing pipe 4. As illustrated in Figs. 2 and 3, the internal pipe 7 is a pipe in which one end thereof is inserted in and held by the mixing pipe 4, and is formed with a pair of upper and lower metal plates which are bonded by caulking at the center of left and right side edges similar to the burner main body 2. The other end of the internal pipe 7 is protruded in the mixing chamber 6 in its diameter direction so as to be an extension pipe 8 to extend the mixing pipe 4. A protruded end of the extension pipe 8 is cut to be inclined so as to have an upward opening 9. A chamfered part 10 is provided at the bottom surface of the extension pipe 8 below the opening 9 for stabilizing the extension pipe 8 and comes into contact with the bottom surface of the mixing chamber 6.

[0015] On the other hand, the burner head 3 has cylindrical shape comprises an upper plate 11, a lower plate 12, and a side plate 13. The upper plate 11 and lower plate 12 have round shapes when viewed from a plane side, and the side plate 13 surrounds along peripheral edges of both the plates 11 and 12. As illustrated in Figs. 4A and 4B, the burner head 3 is formed by folding back of the ends of upper and lower plates 11 and 12 clipping the upper and lower ends of the side plate 12 between them at peripheral edges of the upper plate 11 and the lower plate 12 and by being caulking bonded.. The upper and lower ends of the side plate 13 are bent to be outwardly enlarged. Further, ring-shaped ribs 14 and 14 having different diameters are concentrically formed on the upper plate 11 for absorbing deformation due to thermal stress.

[0016] Furthermore, as illustrated in Fig. 1D where the D part is enlarged in Fig. 1A a long slit-shaped first burner

port 15 and a line of four circular second burner ports 16, 16, ...are provided on the side plate 13. The first burner port 15 is long in a vertical direction and the second burner ports 16, 16, ...are lined up in the vertical upper and lower direction. The first burner port 15 and the line of the second burner ports 16, 16, and... are alternately arranged each other in a peripheral direction and the upper and lower direction along an almost whole periphery (only a part thereof is illustrated in Fig. 1D). The reasons of together using the slit shape and round shape burner ports are to have a burner port area by the slit-shaped first burner ports 15 and secure rigidity by the round second burner ports 16. Further, at the lower plate 12, a round communication hole 17 is provided. The communication hole 17 has an opening area almost equal to a total opening area of the first burner ports 15 and the second burner ports 16. A peripheral edge of the communication hole 17 is caulking bonded with an upper part of the mixing chamber 6 in the burner main body 2 to thereby co-axially position the burner head 3 right above the mixing chamber 6.

[0017] For example, the burner 1 having the above-described constitution is used for a hot water storage type water heater 20 as illustrated in Fig. 5. This hot water storage type water heater 20 includes a hot water storage chamber 23 upper and lower sides of which are closed with an upper mirror plate (which are not illustrated) and a lower mirror plate 22, on the upper side of a cylindrical main body 21. The hot water storage type water heater 20 includes a combustion chamber 24 below the hot water storage chamber 23. The burner 1 is provided in the combustion chamber 24. In addition, a water supplying pipe to supply water into the hot water storage chamber 23 and a hot water supplying pipe to externally take out hot water from the hot water storage chamber 23 (both pipes are not illustrated) are provided on the upper side of the hot water storage chamber 23.

[0018] An exhaust pipe 25 is provided on the center of axle of hot water storage chamber 23, and this exhaust pipe 25 penetrates the hot water storage chamber 23 to be protruded toward the upper side of the main body 21. Through the exhaust pipe 25, combustion gas generated in the combustion chamber 24 is exhausted outside the main body 21. A baffle plate (not illustrated) having a spiral passage is provided inside the exhaust pipe 25.

[0019] The burner 1 is supported on a disc-shaped placing base 26 provided at a lower side of the combustion chamber 24 by a supporting plate 27. The throat part 5 of the burner main body 2 faces a gas nozzle 28 whose top end protrudes into the combustion chamber 24. The burner head 3 is positioned at a center of the combustion chamber 24. The reference numeral "29" indicates a pilot burner.

[0020] The burner 1 is supported by the supporting plate 27 so that the burner head 3 is protruded into a space covered by a lower mirror plate 22 and the side surface of the burner 1 faces the whole periphery of the hot water storage chamber 23.

[0021] Plural air feed ports 30, 30, and ... for air for combustion are arranged at predetermined intervals in the peripheral direction at the lower peripheral edge of the placing base 26. By means of the air feed ports, an inside of the placing base 26 is communicated with an external of the main body 21. Inside the placing base 26, a partition plate 31 which separates inside of the placing base 26 into upper and lower parts is provided. The partition has an opening at a center thereof. On the other hand, an air passage 32 is provided vertically on a gas nozzle 28 side of the combustion chamber 24, where the air passage 32 partitions the inside space of the chamber combustion 24. However, an upper space in the placing base 26 partitioned by the partition plate 31 is kept communicated with the throat part 5 of the burner main body 2. Thus, as indicated by an arrow, external air passes through the opening of the partition plate 31 and reaches to the air passage 32 after flowing into the placing base 26 from the air feed port 30. Then, the air goes up through the air passage 32 and is introduced into the burner main body 2.

[0022] In the hot water storage type water heater 20, when an ignition knob of a controller (not illustrated) provided at an external of the main body 21 is operated, a gas flow passage to the pilot burner 29 is opened and the pilot burner 29 is ignited. When the ignition is detected by a thermocouple (not illustrated), an electromagnetic valve of the gas flow path is opened and is kept open. In such a condition, when the ignition knob is operated to open a main gas flow passage, the fuel gas ejects from the gas nozzle 28 to be supplied from the throat part 5 to the burner main body 2. By the ejecting energy of the fuel gas, air outside of the main body 21 is taken into the mixing pipe 4 of the burner main body 2 from the air feed port 30 through the inside of the placing base 26 and the air passage 32.

[0023] At this time, since the length from the throat part 5 to the opening 9 is sufficiently kept by the extension pipe 8 protruding inside the mixing chamber 6, the fuel gas and the air for combustion are suitably mixed. In addition to this, the mixed gas ejecting from the opening 9 collides with an inner surface of the mixing chamber 6, and is divided into two directions. Then the mixed gas reversely directs along the inner surface of the mixing chamber 6. Thus, the flow of the gas promotes mixing of the fuel gas and the combustion air more. Further, an eddy flow does not occur at the both sides of the extension pipe 8.

[0024] When the mixing chamber 6 is filled with the mixed gas, the mixed gas is led into the burner head 3 through the communication hole 17, and ejects from respective first and second burner ports 15 and 16 for combustion. At this time, since ejecting speeds of the mixed gases from the burner ports 15 and 16 are small, the flame comes close to the burner ports 15 and 16. Thus, surface combustion is carried out at an almost whole surface of the side plate 13, and temperatures of the burner ports become 800°C or more. Further, since the whole

surface of the cylindrical side face becomes a combusted surface, the influence of thermal stress can be suppressed.

[0025] The high temperature combustion gas generated by burner combustion goes up along a lower surface of the lower mirror plate 22, and passes through the central exhaust pipe 25 to be exhausted to outside of the main body 21. By the movement of the combustion gas, hot water in the hot water storage chamber 23 is heated by the lower mirror plate 22 and the exhaust pipe 25.

[0026] On the other hand, radiation heat generated by combustion at the side surface of the burner head 3 is radially radiated from the burner head 3 as illustrated with wavy arrows. However, since the whole side surface of the burner head 3 faces the hot water storage chamber 23, the radiation heat is effectively transmitted to hot water in the hot water storage chamber 23 to heat the hot water.

[0027] Since the radiation heat is effectively transmitted to the hot water storage chamber 23 as illustrated above, a temperature of the air below the burner 1 in the combustion chamber 24 does not become high.. Thus, the combustion air from the air feed port 30 to the throat part 5 can be suppressed to become high temperature. Therefore, a volume of the combustion air is not expanded, and a sufficient amount of primary air can be taken into the burner 1, which leads to the reduction of NOx generation.

[0028] According to the burner 1 of the above-described embodiment, the burner head 3 is in a cylindrical shape having a plurality of first and second burner ports 15 and 16 bored at an almost whole periphery of the side face thereof, and is provided right above the mixing chamber 6 of the burner main body 2. On the other hand, since the mixing pipe 4 is provided to direct to a direction where the mixing pipe 4 is crossed with the axis line of the burner head 3 at substantially right angles to each other, the sufficient burner port area can be secured, and the ejection speed of the mixing gas from the first and second burner ports 15 and 16 is decreased to suppress fluid resistance. In addition, the mixing air can be smoothly and uniformly supplied from the mixing chamber 6 to the burner head. 3, and thus the size of the whole burner height can be suppressed to be small. Thus, the burner can be suitably used as an all primary air burner and a natural combustion type burner not using a fan, and downsizing and reduction of cost can be expected. Further, since a combustion surface becomes the side surface, dropping materials from an upper side are not accumulated on the first and second burner ports 15 and 16.

[0029] Particularly, since the burner port is configured that a slit-shaped first burner port 15 in the vertical direction, and the line of plural round second burner ports 16 arranged in the vertical directions are alternately arranged each other in the peripheral direction and the vertical directions, a preferable burner port can be arranged, in which while a necessary burner port area is provided by the first burner port 15, rigidity can be kept by the

second burner ports 16.

[0030] Further, as the extension pipe 8 protruding inside the mixing chamber 6 is provided on the mixing pipe 4 of the burner main body 2, a sufficient mixing distance inside the mixing chamber can be secured. Further, since an eddy flow does not occur when the mixing air flows into the mixing chamber 6 from the mixing pipe 4, the required primary air can be taken in using ejecting energy of the fuel gas. Further, the fuel gas and the air for combustion can be favorably mixed in the mixing chamber 6. Furthermore, since the protruded end of the extension pipe 8 is cut to be inclined so as to have the upward opening 9, a preferable configuration in which the more amount of primary air is taken can be obtained.

[0031] It should be noted that in the burner head, a burner port in a burner head is not limited to the burner port in the above-described embodiment. A size, a shape, an arrangement pattern, and the like can be suitably changed. The structure of an upper plate and a lower plate, and connecting configuration are not limited to the above-described embodiment. For example, when caulking parts between an upper or lower plate and a side plate are bent in a V shape toward an opposite side of the upper or lower plate as illustrated in Fig. 6, the strength is increased, and thus warping under thermal conditions can be effectively prevented.

[0032] Additionally, in the above-described embodiment, the protruded end of the extension pipe is cut to be inclined so as to have the upward opening. However, contrary to this, the protruded end may be cut to be inclined so as to have a downward opening, or be cut in the vertical direction so as to have a sideways opening. In these cases, the amount of primary air taken in is more increased compared to a burner main body not having an extension pipe.

[0033] Further, an extension pipe is not limited to the pipe using an end part of an internal pipe. An extension pipe can be formed by connecting only a portion corresponding to an opening edge of a mixing pipe in a mixing chamber.

[0034] Furthermore, a burner of the present invention is not limited to the above-described hot water storage type water heater, and can be used as heating means in the other gas combustion appliance such as a hot water supply appliance in which water passing through the inside of the appliance is heated by a heat exchanger.

Claims

1. A burner (1) comprising:

a burner main body (2) having a mixing pipe (4) to be supplied with a fuel gas and combustion air, and formed with a mixing chamber (6) at a top end on a downstream side of the mixing pipe (4); and
a burner head (3) provided at an upper part of

the burner main body (2) while communicating with the mixing chamber (6), and having burner ports for ejecting the mixed gas of the fuel gas and combustion air mixed in the mixing chamber, **characterized in that**

the burner head (3) is in a cylindrical shape having a plurality of burner ports (15, 16) bored around an almost whole periphery of a side face thereof, and provided right above a mixing chamber of a burner main body; and
wherein the mixing pipe (4) is provided to be directed in a direction where the mixing pipe (4) is crossed with an axis line of the burner head (3) at substantially right angles to each other.

2. The burner (1) according to claim 1, wherein the burner ports comprise a slit-shaped first burner port (15) in the vertical direction and a line of plural round second burner ports (16) arranged in vertical direction, the slit-shaped first burner port (15) and the line of plural round second burner ports (16) each being alternately arranged in the peripheral direction and the vertical directions.

Fig. 1A

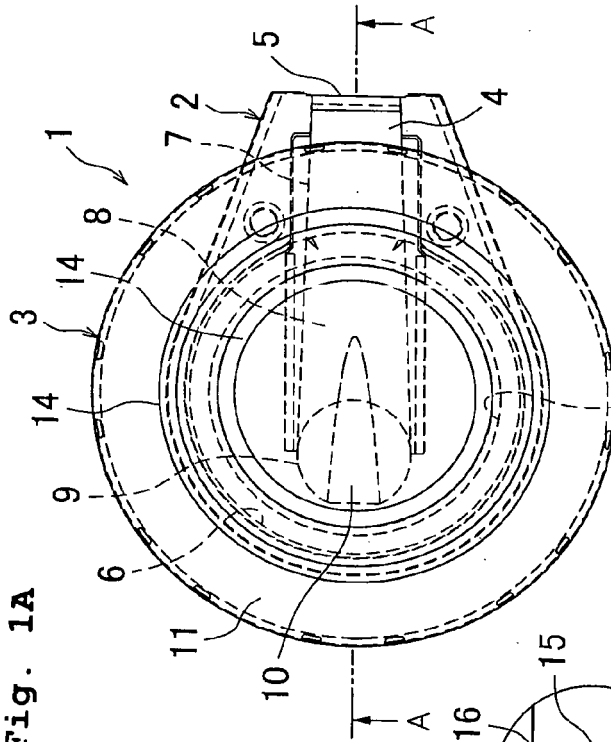


Fig. 1D

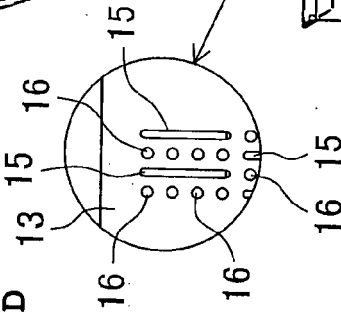


Fig. 1C

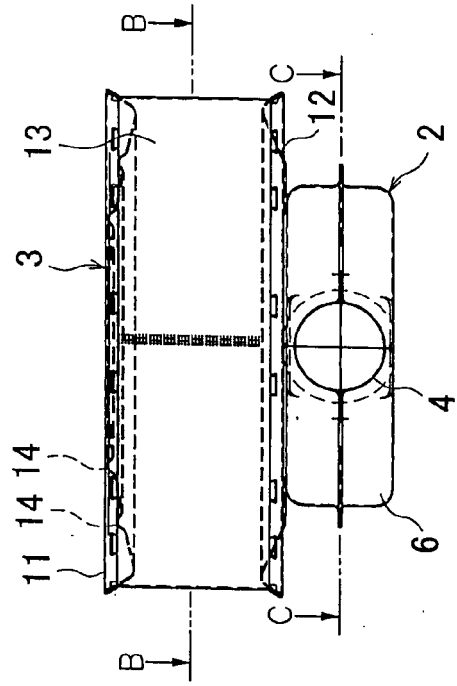


Fig. 1B

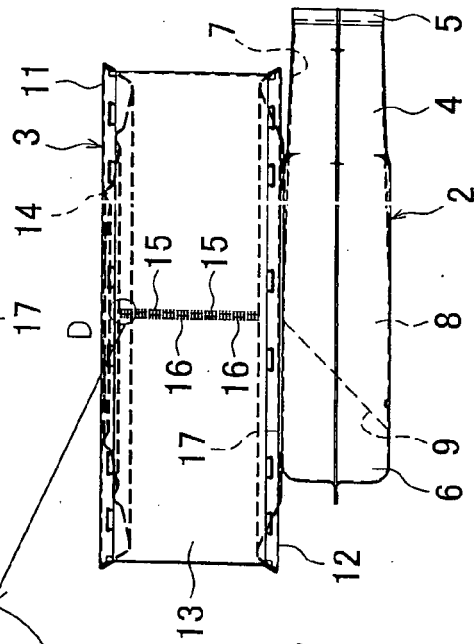


Fig. 2

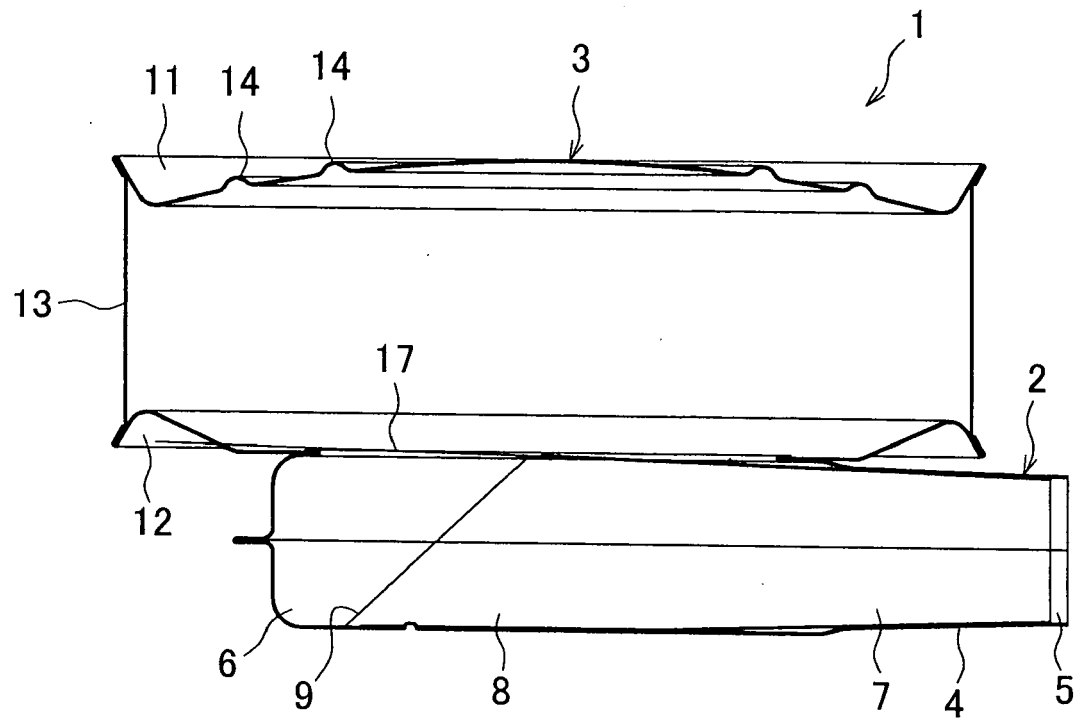


Fig. 3A

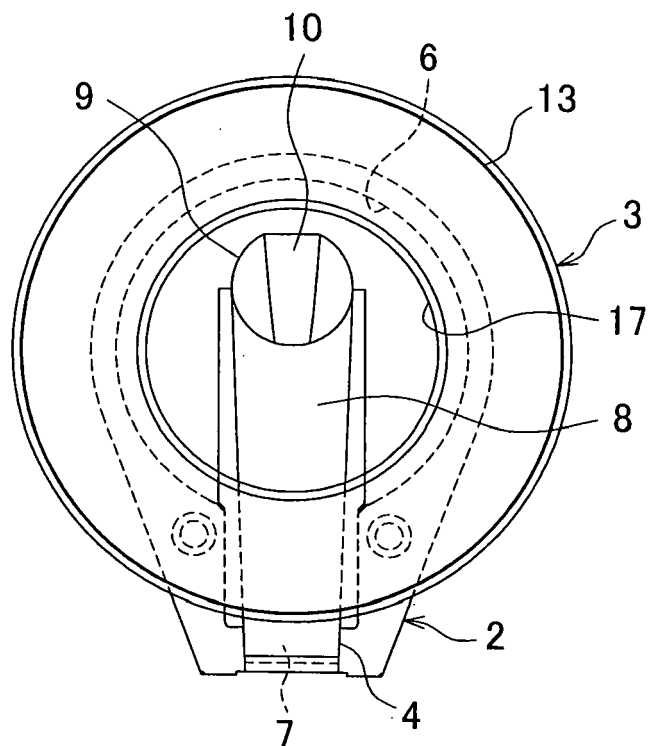


Fig. 3B

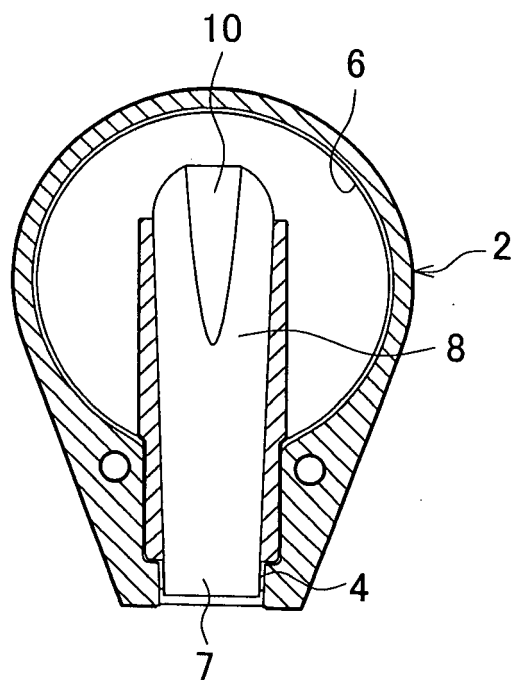


Fig. 4A

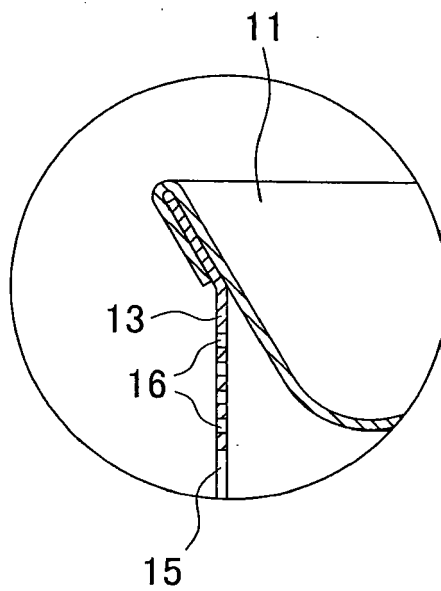


Fig. 4B

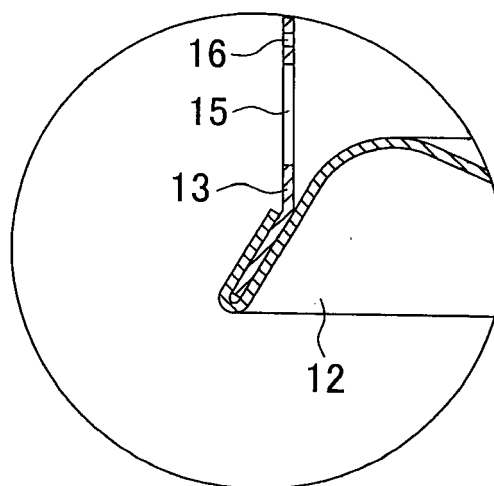


Fig. 5

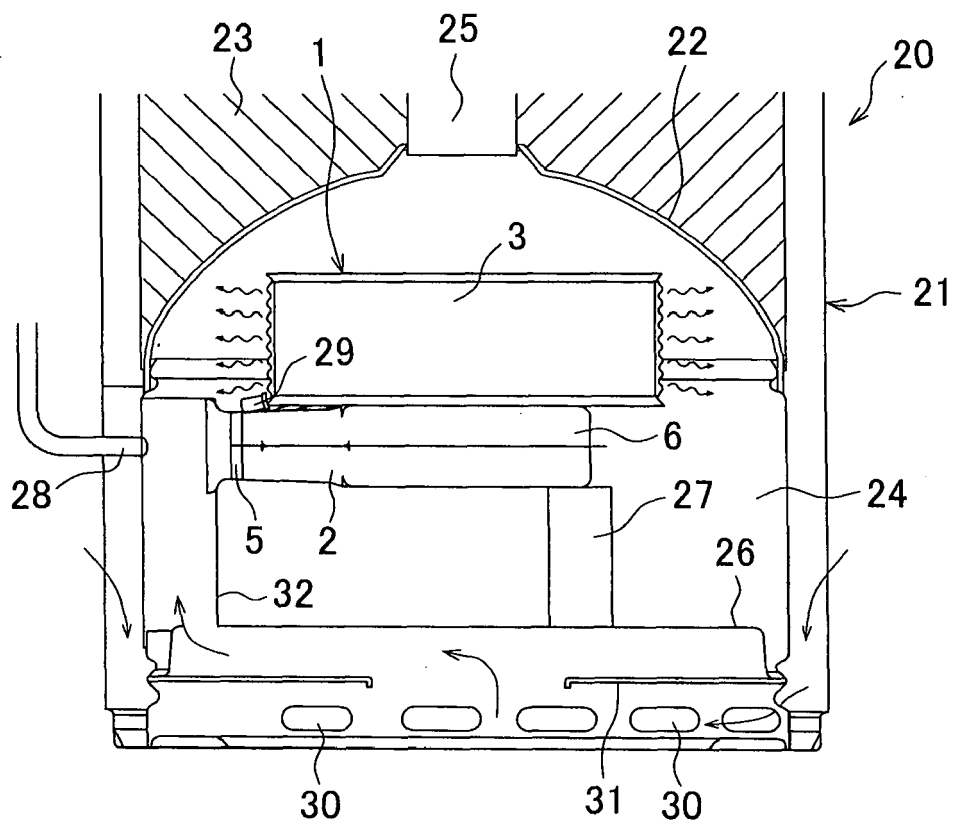


Fig. 6A

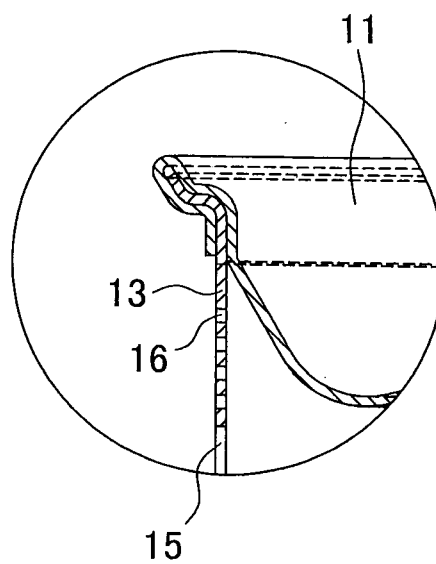
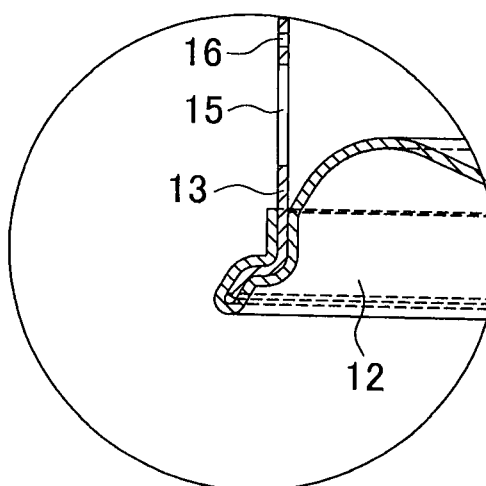


Fig. 6B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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