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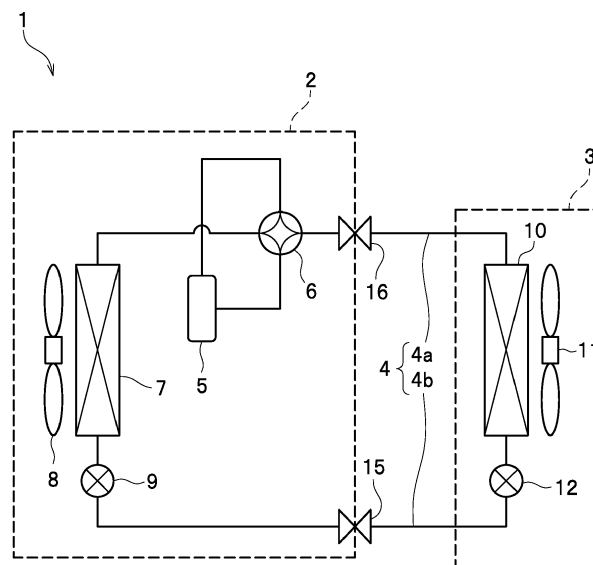
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(54) **AN OUTDOOR UNIT AND AN AIR CONDITIONER HAVING THE SAME**

(57) An outdoor unit 2 of an air conditioner 1 includes: a cabinet 20 in which at least one air inlet and at least one air outlet are formed; a heat exchanger 7 arranged inside the cabinet 20; an air inlet hood 41 that covers the air inlet; and an air outlet hood 42 that covers the air outlet. The air inlet hood 41 includes: a facing panel 51 arranged facing the air inlet; an upper surface panel 53 arranged on an upper surface of a part between the air

inlet and the facing panel 51; and two side panels 52 arranged respectively on two side surfaces of the part between the air inlet and the facing panel 51. A lower surface air intake hole 54 is provided to a lower surface of the part between the air inlet and the facing panel 51. A side surface air intake hole 55 is provided to at least one of the two side panels 52.

FIG.2



Description**Prior Art Document(s)****BACKGROUND OF THE INVENTION****Patent Literature(s)****1. Field of the Invention**

5 **[0006]** Patent Literature 1: JP2013-533457A1 (FIGS. 10 and 15A)

[0001] The present invention relates to an outdoor unit and an air conditioner having the same.

SUMMARY OF THE INVENTION**2. Description of the Related Art**

10 **[0007]** It has however been demanded that the conventional air conditioner disclosed in Patent Literature 1 could be less affected by wind and snow as discussed below.

[0002] One type of air conditioners for conditioning air is a separate-type one which includes: an outdoor unit installed outdoors; an indoor unit installed indoors; and a refrigerant pipe that connects the outdoor unit to the indoor unit. Many separate-type air conditioners are, for example, installed in buildings for business purposes, and perform cooling operation all the year round.

15 **[0008]** As is often the case with cold areas, mountainous areas and the like (hereinafter referred to as "cold areas and the like"), strong wind blows and relatively heavy snow falls in cold seasons such as winter. In a case where the conventional air conditioner disclosed in Patent Literature 1 is used in cold areas and the like, there is high likelihood that strong wind blows against the outdoor unit in windy days and snow piles up in the air inlets and air outlet of the outdoor unit in snowy days.

[0003] Since the outdoor unit of such a separate-type air conditioner is installed outdoors, winter-time cooling operation of the outdoor unit is more likely to become unstable when outside air temperature is low. For example, when outside air temperature decreases, the condensation temperature of the refrigerant in an outdoor heat exchanger included in the outdoor unit becomes lower, and the condensation pressure of the refrigerant therein accordingly becomes lower, under the influence of wind which blows against the outdoor unit. This resultantly leads to a decrease in the heat exchange efficiency of the outdoor heat exchanger, and instability of the cooling operation of the outdoor unit. This unstable operation is highly likely to occur particularly when outside air temperature is less than a threshold temperature (for example, -5 °C).

20 **[0009]** The outdoor unit is designed to adjust the amount of outside air to be sucked into the outdoor unit (outside air suction amount) by controlling the rotational speed of the built-in outdoor fan, thus to stabilize the heat exchange efficiency of the outdoor heat exchanger, and thereby to control the temperature of the air conditioner as a whole.

[0004] With this taken into consideration, a windbreak for restricting airflow is usually provided to air inlets and outlets of the outdoor unit in order to inhibit the decrease in the heat exchange efficiency of the outdoor heat exchanger even when the outside air temperature is less than the threshold temperature (for example, -5 °C). The configuration in which the windbreak is provided to the outdoor unit, however, means that the windbreak always restricts the airflow. When, therefore, the outside air temperature is not less than the threshold temperature (for example, -5 °C), this configuration decreases the heat exchange efficiency of the outdoor heat exchanger during cooling and heating operations.

25 **[0010]** In a case where, however, strong wind blows against the outdoor unit, a more-than-expected amount of external air (outside air), which exceeds an adjusted amount expected from control of the rotational speed of the outdoor fan, to enter the inside of the outdoor unit. Furthermore, since snow piling up in the air inlets and air outlet of the outdoor unit hinders suction of outside air, there is likelihood that only an amount of outside air, which is less than the adjusted amount expected from the control of the rotational speed of the outdoor fan, is sucked into the outdoor unit.

[0005] Against this background, there has been a proposal to provide a wind deflector and an air outlet hood, which have a function of deflecting airflow, to air inlets and an air outlet of the outdoor unit for the purpose of inhibiting a decrease in the heat exchange efficiency of the outdoor heat exchanger no matter what the outside air temperature is (for example, see JP2013-533457A1).

30 **[0011]** In these cases, therefore, the outdoor unit may have a problem that: the adjustment of the outside air suction amount by the outdoor fan is hindered; and in the outdoor heat exchanger, the condensation temperature and condensation pressure of the refrigerant thus decreases, and the heat exchange efficiency accordingly decreases. This is highly likely to make the cooling operation of the outdoor unit unstable, and to hinder the otherwise appropriate overall temperature control of the air conditioner. Against this background, it has been demanded that the conventional air conditioner disclosed in Patent Literature 1 could be less affected by wind and snow as discussed below.

35 **[0012]** The present invention has been made to solve the above problems and makes it an object thereof to provide an air conditioner which is less affected by wind and snow.

[0013] For the purpose of achieving the above object,

the present invention is an outdoor unit which includes: a cabinet in which at least one air inlet and at least one air outlet are formed; a heat exchanger arranged inside the cabinet; an air inlet hood that covers the air inlet; and an air outlet hood that covers the air outlet. The air inlet hood includes: a facing panel arranged facing the air inlet; an upper surface panel arranged on an upper surface of a part between the air inlet and the facing panel; and/or two side panels arranged respectively on two side surfaces of the part between the air inlet and the facing panel. A lower surface air intake hole is provided to a lower surface of the part between the air inlet and the facing panel. A side surface air intake hole is provided to at least one of the two side panels. The present invention is also an air conditioner having the outdoor unit.

[0014] The other components will be described later.

[0015] According to the present invention, it is possible to provide an air conditioner which is less affected by wind and snow.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a diagram of an overall configuration of an air conditioner according to an embodiment;

FIG. 2 is a diagram of a refrigeration cycle configuration of the air conditioner according to the embodiment;

FIG. 3A is a front view of an outdoor unit according to the embodiment;

FIG. 3B is a left side view of the outdoor unit according to the embodiment;

FIG. 3C is a rear view of the outdoor unit according to the embodiment;

FIG. 4A is a front view of a cabinet of the outdoor unit according to the embodiment;

FIG. 4B is a left side view of the cabinet of the outdoor unit according to the embodiment;

FIG. 4C is a rear view of the cabinet of the outdoor unit according to the embodiment;

FIG. 5 is a perspective view of an air inlet hood of the outdoor unit according to the embodiment;

FIG. 6 is a perspective view of an air outlet hood of the outdoor unit according to the embodiment;

FIGS. 7A and 7B are diagrams (1) for explaining how dampers of the outdoor unit according to the embodiment work;

FIGS. 8A and 8B are diagrams (2) for explaining how the dampers of the outdoor unit according to the embodiment work; and

FIG. 9 is a rear view of the outdoor unit to which air inlet hoods of a modification are attached.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0017] An embodiment of the present invention (hereinafter referred to as an "embodiment") will be hereinafter

described in detail with reference to the accompanying drawings. It should be noted that each drawing is schematic sufficiently to make the present invention fully understood. The present invention is not limited to shown examples alone. Components which are common or similar throughout the drawings will be denoted by the same reference signs, and descriptions for such components will be omitted.

10 [Embodiment]

[0018] The embodiment intends to: provide an outdoor unit with the following points taken into consideration; and an air conditioner having the same.

(1) The embodiment intends to provide: the outdoor unit which is capable of excellently controlling an amount of outside air to be sucked in by outdoor fans; and the air conditioner having the same.

For example, the conventional air conditioner disclosed in Patent Literature 1 (Japanese Patent Translation Publication No. 2013-533457) includes the wind deflector attached to the air inlets of the outdoor unit, and an opening is provided to an upper surface of the wind deflector, as shown in FIG. 10 of Patent Literature 1. The conventional air conditioner, therefore, has a problem that when snow falls, snow is likely to pile up on the opening of the wind deflector, or snow is likely to go through the opening of the wind deflector to adhere to the outdoor heat exchanger arranged inside the wind deflector. When these occur, snow hinders the outdoor fan from sucking external air (outside air), and the amount of outside air to be sucked in by the outdoor fan is accordingly less than the adjusted amount which is expected from the control of the rotational speed of the outdoor fan. Furthermore, the conventional air conditioner disclosed in Patent Literature 1, for example, includes no means for removing snow which piles up in the air outlet of the air outlet hood. The conventional air conditioner, therefore, has a problem that snow is likely to remain in the air outlet of the air outlet hood. When this occurs, snow partially occludes the flow path of the outside air, and the amount of outside air to be sucked in by the outdoor fan is less than the adjusted amount which is expected from the control of the rotational speed of the outdoor fan. With these taken into consideration, the present embodiment intends to provide: the outdoor unit which is capable of excellently controlling the amount of outside air to be sucked in by the outdoor fan; and the air conditioner having the same.

(2) The embodiment intends to provide: an outdoor unit with smaller-sized hoods; and the air conditioner having the same.

[0019] For example, the conventional air conditioner disclosed in Patent Literature 1 is provided, for example,

with a wind deflector-integrated air outlet hood which covers the air inlets and the air outlet of the outdoor unit, as shown in FIG. 15A. This makes it possible for the conventional air conditioner to obtain anti-snow effect. Because of the configuration shown in FIG. 15A in Patent Literature 1, the conventional air conditioner requires an opening in a lower surface of the wind deflector to be larger in size in order to prevent a decrease in the heat exchange efficiency of the outdoor heat exchanger both in summer-time cooling operations and in winter-time heating operations. This accordingly makes the wind deflector-integrated air outlet hood larger in size. The outdoor unit of the air conditioner having the configuration shown in FIG. 15A in Patent Literature 1, therefore, is larger in size, and needs to secure a wider place where to install the outdoor unit. With these taken into consideration, the embodiment intends to provide the outdoor unit with the smaller-sized hoods; and the air conditioner having the same.

<Configuration of Air Conditioner>

[0020] Referring to FIGS. 1 and 2, descriptions will be hereinbelow provided for a configuration of the air conditioner according to the embodiment. FIG. 1 is a diagram of an overall configuration of the air conditioner. FIG. 2 is a diagram of a refrigeration cycle configuration of the air conditioner.

[0021] As shown in FIG. 1, the air conditioner 1 includes: an outdoor unit 2; an indoor unit 3; a refrigerant pipe 4 connecting the outdoor unit 2 and the indoor unit 3. Multiple outdoor units 2 and multiple indoor units 3 may be provided to the air conditioner 1. The air conditioner 1 is capable of performing cooling operation and heating operation because the outdoor unit 2 and the indoor unit 3 form the refrigeration cycle.

[0022] As shown in FIG. 2, the outdoor unit 2 includes: a compressor 5 for compressing refrigerant; a four-way valve 6 for reversing the flow of the refrigerant between the cooling operation and the heating operation; an outdoor heat exchanger 7 for making heat pass between the refrigerant and outside air; an outdoor fan 8 for sending the outside air to the outdoor heat exchanger 7; and an outdoor expansion valve 9 for expanding the refrigerant by decompression.

[0023] The indoor unit 3 includes: an indoor heat exchanger 10 for making heat pass between the refrigerant and indoor air; an indoor fan 11 for sending the indoor air to the indoor heat exchanger 10; and an indoor expansion valve 12 for expanding the refrigerant by decompression.

[0024] The outdoor unit 2 and the indoor unit 3 are connected by: a gas refrigerant pipe 4a in which gaseous refrigerant (hereinafter referred to simply as "gas refrigerant") flows; and a liquid refrigerant pipe 4b in which liquefied refrigerant (hereinafter referred to simply as "liquid refrigerant") flows. The outdoor unit 2 includes: a liquid check valve 15 provided to a part of the outdoor unit

2 to which the liquid refrigerant pipe 4b is connected; and a gas check valve 16 provided to a part of the outdoor unit 2 to which the gas refrigerant pipe 4a is connected.

[0025] For the cooling operation, the air conditioner 1 works as follows.

[0026] To begin with, in the outdoor unit 2, the compressor 5 compresses the gas refrigerant. Thus, the gas refrigerant becomes high in temperature and in pressure. The compressor 5 discharges the high-temperature high-pressure gas refrigerant to the four-way valve 6. The four-way valve 6 makes the high-temperature high-pressure gas refrigerant flow to the outdoor heat exchanger 7.

[0027] After flowing into the outdoor heat exchanger 7, the high-temperature high-pressure gas refrigerant exchanges heat with the outside air which is sent by the outdoor fan 8. Thus, the high-temperature high-pressure gas refrigerant is condensed into the liquid refrigerant. The outdoor unit 2 makes the liquid refrigerant flow to the indoor unit 3 via the liquid refrigerant pipe 4b.

[0028] In the indoor unit 3, the liquid refrigerant flows into an indoor expansion valve 12. The indoor expansion valve 12 expands the liquid refrigerant by decompressing the liquid refrigerant to a predetermined pressure. Thus, the liquid refrigerant turns into a low-temperature low-pressure gas-liquid two-phase refrigerant which is a mixture of the gas refrigerant and the liquid refrigerant. The low-temperature low-pressure gas-liquid two-phase refrigerant flows from the indoor expansion valve 12 to the indoor heat exchanger 10.

[0029] After flowing into the indoor heat exchanger 10, the low-temperature low-pressure gas-liquid two-phase refrigerant exchanges heat with the indoor air which is sent by the indoor fan 11. Thus, the indoor air is cooled. Meanwhile, the gas-liquid two-phase refrigerant evaporates into the gas refrigerant by heat absorption. The indoor unit 3 discharges the cooled indoor air to the inside of the room, and thereby cools the inside of the room. In addition, the indoor unit 3 makes the gas refrigerant flow to the outdoor unit 2 via the gas refrigerant pipe 4a. In the outdoor unit 2, the four-way valve 6 makes the gas refrigerant flow to the compressor 5.

[0030] Thereafter, the outdoor unit 2 and the indoor unit 3 repeat the same respective actions as discussed above.

[0031] On the other hand, for the heating operation, the air conditioner 1 works as follows.

[0032] To begin with, in the outdoor unit 2, the compressor 5 compresses the gas refrigerant. Thus, the gas refrigerant becomes high in temperature and in pressure. The compressor 5 discharges the high-temperature high-pressure gas refrigerant to the four-way valve 6. The four-way valve 6 makes the high-temperature high-pressure gas refrigerant flow to the indoor unit 3 via the gas refrigerant pipe 4a. In other words, for the heating operation, the four-way valve 6 makes the gas refrigerant flow in a direction reverse to the direction in which the four-way valve 6 makes the gas refrigerant flow for the cooling operation.

[0033] In the indoor unit 3, the high-temperature high-pressure gas refrigerant flows into the indoor heat exchanger 10. After flowing into the indoor heat exchanger 10, the high-temperature high-pressure gas refrigerant exchanges heat with the indoor air which is sent by the indoor fan 11. Thus, the indoor air is heated. Meanwhile, the high-temperature high-pressure gas refrigerant is condensed into the liquid refrigerant by condensation. The indoor unit 3 discharges the heated indoor air to the inside of the room, and thereby heats the inside of the room. In addition, the indoor unit 3 makes the liquid refrigerant flow to the outdoor unit 2 via the liquid refrigerant pipe 4b.

[0034] In the outdoor unit 2, the liquid refrigerant flows into the outdoor expansion valve 9. The outdoor expansion valve 9 expands the liquid refrigerant by decompressing the liquid refrigerant to a predetermined pressure. Thus, the liquid refrigerant turns into the low-temperature low-pressure gas-liquid two-phase refrigerant. The low-temperature low-pressure gas-liquid two-phase refrigerant flows from the outdoor expansion valve 9 to the outdoor heat exchanger 7.

[0035] After flowing into the outdoor heat exchanger 7, the low-temperature low-pressure gas-liquid two-phase refrigerant exchanges heat with the outside air which is sent by the outdoor fan 8. Thus, the gas-liquid two-phase refrigerant evaporates into the gas refrigerant by heat absorption. The outdoor unit 2 makes the gas refrigerant flow from the outdoor heat exchanger 7 to the four-way valve 6. The four-way valve 6 makes the gas refrigerant flow to the compressor 5.

[0036] Thereafter, the outdoor unit 2 and the indoor unit 3 repeat the same respective actions as discussed above.

<Configuration of Outdoor Unit>

(Configuration of Outdoor Unit)

[0037] Referring to FIGS. 3A, 3B and 3C, descriptions will be hereinbelow provided for an overall configuration of the outdoor unit 2. FIGS. 3A, 3B and 3C are a front view, a left side view and a rear view of the outdoor unit 2.

[0038] As shown in FIGS. 3A, 3B and 3C, the outdoor unit 2 includes a box-shaped cabinet 20, an air inlet hood 41, and an air outlet hood 42.

[0039] The air inlet hood 41 is a member which covers an air inlet 31 (see FIGS. 4B and 4C) which are provided to the cabinet 20.

[0040] The air outlet hood 42 is a member which covers air outlets 32 (see FIGS. 4A and 4C) which are provided to the cabinet 20.

[0041] In the embodiment, three air inlet hoods 41a, 41b, 41c and a single air outlet hood 42 are attached to the cabinet 20. Detailed configurations of the air inlet hoods 41a, 41b, 41c and the air outlet hood 42 will be discussed later.

(Configuration of Cabinet)

[0042] Referring to FIGS. 4A, 4B and 4C, descriptions will be hereinbelow provided for a configuration of the cabinet 20. FIGS. 4A, 4B and 4C are a front view, a left side view and a rear view of the cabinet 20, respectively.

[0043] As shown in FIGS. 4A and 4C, in the embodiment, the cabinet 20 has a structure in which: a main body portion of the cabinet 20 is substantially shaped like a quadrangular prism which is wide in the left-right direction; and two air outlets 32 project toward an upper surface of the main body portion.

[0044] The compressor 5, the four-way valve 6, the outdoor heat exchanger 7 and the outdoor expansion valve 9 are arranged inside the main body portion of the cabinet 20 (for each component, see FIG. 2).

[0045] Furthermore, the outdoor fan 8 is arranged inside each of the air outlets 32. Incidentally, in the embodiment, the number of air outlets 32 is two. The number of air outlets 32, nevertheless, may be changed depending on operation.

[0046] A front panel 21, a left side panel 22a, a right side panel 22b, and a rear (back) panel 23 are arranged on the front surface, the left side surface, the right side surface and the rear surface of the cabinet 20.

[0047] As shown in FIG. 4A, the front panel 21 has a flat surface, and the overall shape of the front panel 21 is rectangular.

[0048] As shown in FIG. 4B, the left side panel 22a has a structure in which a rectangular air inlet 31a is formed in a rectangular flat surface. Like the left side panel 22a of the cabinet 20, the right side panel 22b has a structure in which, although not shown a rectangular air inlet 31b is formed in a rectangular flat surface. The structures of the left and right side panels 22a, 22b are symmetrical with the front and rear (back) panels 21, 23 interposed between the left and right side panels 22a, 22b. The left and right side panels 22a, 22b have the same size.

[0049] As shown in FIG. 4C, the rear (back) panel 23 has a structure in which a rectangular air inlet 31c is formed in a rectangular flat surface.

[0050] Thereinafter, when the left and right side panels 22a, 22b are generically mentioned, each of them will be referred to as a "side panel 22." Furthermore, when the air inlets 31a, 31b, 31c are generically mentioned, each of them will be referred to as an "air inlet 31."

[0051] The outdoor heat exchanger 7 is arranged inside the cabinet 20. The outdoor heat exchanger 7 is exposed to the outside via the air inlets 31a, 31b, 31c.

[0052] It should be noted that in the embodiment, the shapes of the air inlets 31a, 31b, 31c are rectangular. The shapes of the air inlets 31a, 31b, 31c, nevertheless, are not limited to rectangular, and may be changed depending on operation.

[0053] Moreover, in the embodiment, the number of air inlets 31 is three: the air inlets 31a, 31b, 31c. The number of air inlets 31, however, may be changed depending on operation. To put it specifically, one of the air inlets 31

may not be provided to the cabinet 20. One of the air inlets 31 may be divided into multiple inlets. An additional air inlet 31 may be provided to the cabinet 20. For example, the number of air inlets 31 may be changed to two by providing only the air inlets 31a, 31b, but no air inlet 31c, to the cabinet 20. Otherwise, the number of air inlets 31 may be changed to one by providing only the air inlet 31c, but neither of the air inlets 31a, 31b, to the cabinet 20.

[0054] An upper portion of the cabinet 20 has a structure in which the two air outlets 32 project toward the flat upper surface of the cabinet 20.

[0055] A lower portion of the cabinet 20 has a structure in which part of the cabinet 20 touches the ground (see FIG. 3B). This reduces the contact area of the cabinet 20 with the ground, and makes the cabinet 20 less likely to corrode.

(Configuration of Air Inlet Hoods)

[0056] Referring to FIG. 5, descriptions will be hereinbelow provided for the configuration of the air inlet hoods 41. FIG. 5 is a perspective view of one air inlet hood 41 from diagonally below. Here, the air inlet hood 41a to be attached to the left side panel 22a (see FIGS. 3A, 3B and 3C) will be cited as an example of the air inlet hood 41, and the configuration of the air inlet hoods 41 will be discussed using the air inlet hood 41a.

[0057] It should be noted that in the embodiment, the air inlet hood 41b (see FIGS. 3A and 3C) to be attached to the right side panel 22b (see FIGS. 3A and 3C) has the same structure and size as the air inlet hood 41a. Meanwhile, the air inlet hood 41c (see FIGS. 3B and 3C) to be attached to the rear (back) panel 23 has the same structure as the air inlet hoods 41a, 41b, but is different from the air inlet hoods 41a, 41b in that the transverse width of the air inlet hood 41c is changed from the transverse width of the air inlet hoods 41a, 41b in order to be fit for the air inlet 31c (see FIG. 3C) formed in the rear (back) panel 23.

[0058] As shown in FIG. 5, each air inlet hood 41 includes: a facing panel 51 arranged facing the air inlet 31 (see FIG. 4B and 4C); an upper surface panel 53 arranged on an upper surface of a part between the air inlet 31 (see FIG. 4B and 4C) and the facing panel 51; and two side panels 52a, 52b arranged respectively on two side surfaces of the part between the air inlet 31 (see FIG. 4B and 4C) and the facing panel 51.

[0059] The side panel 52a is a panel arranged on the right side of the facing panel 51. Meanwhile, the side panel 52b is a panel arranged on the left side of the facing panel 51. Thereinafter, when the side panels 52a, 52b are generically mentioned, each of them will be referred to as a "side panel 52."

[0060] In each air inlet hood 41, a lower surface air intake hole 54 is provided to a lower surface of the part between the air inlet 31 (see FIG. 4B and 4C) and the facing panel 51, and a side surface air intake hole 55 is provided to at least one of the two side panels 52a, 52b.

In the shown example, as the side surface air intake hole 55, a side surface air intake hole 55a is provided to the side panel 52a, while as the side surface air intake hole 55, a side surface air intake hole 55b is provided to the side panel 52b.

[0061] It should be noted that the embodiment will be discussed on the assumption that: the lower surface air intake hole 54 is made of a single relatively large opening; and the side surface air intake holes 55 (55a, 55b) are each made of multiple relatively small openings. The side surface air intake holes 55 (55a, 55b), however, may be each made of a single relatively large opening.

[0062] The upper surface panel 53 has a flat surface. The overall shape of the upper surface panel 53 is rectangular. The upper surface panel 53 is arranged in a way that makes an outer end portion (an end portion farther from the cabinet 20) of the upper surface panel 53 lower than an inner end portion (an end portion closer to the cabinet 20) of the upper surface panel 53. Thus, the outer end portion of the upper surface panel 53 is the lower end portion of the upper surface panel 53, while the inner end portion of the upper surface panel 53 is the upper end portion of the upper surface panel 53.

[0063] Meanwhile, the facing panel 51 has a flat surface. The overall shape of the facing panel 51 is rectangular. The facing panel 51 is arranged in a way that makes an outer end portion (an end portion farther from the cabinet 20) of the facing panel 51 lower than an inner end portion (an end portion closer to the cabinet 20) of the facing panel 51. Thus, the outer end portion of the facing panel 51 is the lower end portion of the facing panel 51, while the inner end portion of the facing panel 51 is the upper end portion of the facing panel 51. The inner end portion (the upper end portion) of the facing panel 51 is connected to the outer end portion (the lower end portion) of the upper surface panel 53. Since the surfaces of the upper surface panel 53 and the facing panel 51 are flat, the air inlet hood 41 makes it easy for snow to slide down the upper surface panel 53 and the facing panel 51 when snow falls.

[0064] The right end portions of the upper surface panel 53 and the facing panel 51 are connected to the right side panel 52a. Meanwhile, the left end portions of the upper surface panel 53 and the facing panel 51 are connected to the left side panel 52b. In addition, the two side panels 52a, 52b each have a shape which is fit for the positions where the upper surface panel 53 and the facing panel 51 are arranged.

[0065] The side surface air intake hole 55a which allows the outside air to pass through to the inside of the air inlet hood 41 is formed in the side panel 52a. Similarly, the side surface air intake hole 55b which allows the outside air to pass through to the inside of the air inlet hood 41 is formed in the side panel 52b. In the shown example, each of the side surface air intake holes 55a, 55b is made of multiple relatively small openings which are elongated to extend in the transverse direction. It is desirable that the side surface air intake holes 55a, 55b be provided at

mutually-symmetrical positions on the two side surface panels 52a, 52b in order for the side surface air intake holes 55a, 55b to allow wind blowing against either side panel 52 to go out from the other side panel 52 after passing the inside of the air inlet hood 41.

[0066] A cover 56 which is downwardly opened is provided over each of the side surface air intake holes 55a, 55b (to put it strictly, each of the relatively small openings of which the side surface air intake holes 55a, 55b are made). This makes it possible for the air inlet hood 41 to prevent snow from entering the inside of the air inlet hood 41 through the side surface air intake holes 55a, 55b.

[0067] As shown in FIG. 3C, each air inlet hood 41 has a shape in which the lower end portions of the side panels 52 extend in the substantially horizontal direction (in other words, the lower end portions of the side panels 52 extend substantially vertically to the cabinet 20 of the outdoor unit 2). In addition, the lower surface air intake hole 54 (see FIG. 5) is formed in the lower surface of the each air inlet hood 41.

[0068] The air inlet hoods 41 are arranged to cover the air inlets 31 (31a, 31b, 31c) formed in the side panels 22a, 22b and the rear (back) panel 23. The lower end portions of the air inlet hoods 41, respectively, cover the air inlets 31 (31a, 31b, 31c) at a predetermined cover amount t1. It is desirable that the cover amount t1 is set at 10 mm or more (more preferably, 50 mm) in order to efficiently inhibit wind from entering the inside of the cabinet 20.

[0069] Furthermore, each air inlet hood 41 is arranged in a way that forms a clearance t2 between the lower end portion of the air inlet hood 41 and the ground. It is desirable that the clearance t2 be set at a value (for example, approximately 40 mm) which makes it efficiently possible to prevent wind from entering the inside of the cabinet 20, and to take the outside air in an amount manageable by control of the rotational speed of the outdoor fans 8 into the cabinet 20.

[0070] The outdoor unit 2 takes outside air into the cabinet 20 through the clearances t2 (see white arrows Aa1, Ab1, Ac1 in FIG. 3C) by rotating the outdoor fans 8. In this occasion, the outside air enters the insides of the air inlet hoods 41 via the lower surface air intake holes 54 (see FIG. 5) and the side surface air intake holes 55, and thereafter enters the inside of the cabinet 20 via the air inlets 31 of the cabinet 20. After entering the inside of the cabinet 20, the outside air moves toward the outdoor fans 8, and is discharged to the inside of the air outlet hood 42 via the air outlets 32 (see chain-lined arrows Aa2, Ab2, Ac2). After discharged to the inside of the air outlet hood 42, the outside air is discharged to the outside of the air outlet hood 42 via an air discharge hole 63 (see FIG. 3B) of the air outlet hood 42.

(Configuration of Air Outlet Hood)

[0071] Referring to FIGS. 3B and 6, descriptions will be hereinbelow provided for a configuration of the air

outlet hood 42. FIG. 6 is a perspective view of the air outlet hood 42 from diagonally below.

[0072] As shown in FIG. 3B, the air outlet hood 42 has a shape in which the front end portion of the air outlet hood 42 projects further forward than the front panel 21 of the cabinet 20. The front end portion of the air outlet hood 42 is provided with the air discharge hole 63 for expelling the outside air which is taken into the air outlet hood 42.

[0073] Furthermore, dampers 61 and a damper operator 62 are provided inside the air outlet hood 42. The dampers 61 are arranged near the air discharge hole 63, as well as are openable and closable. The damper operator 62 is connected to the dampers 61, and operates electrically. Furthermore, the air outlet hood 42 is provided with an opening 64 arranged at a position which is within an operating range of the dampers 61 and diagonally forward and downward from the dampers 61. The opening 64 is formed in order to discharge snow, if accumulating near the air discharge hole 63 inside the air outlet hood 42, to the outside of the air outlet hood 42.

[0074] It should be noted that the outdoor unit 2 includes an outside air temperature sensor SN and a control board 60 therein. The control board 60 controls operations of the components, including damper operator 62, of the outdoor unit 2.

[0075] As shown in FIG. 6, the front end portion of the air outlet hood 42 is provided with the above-discussed air discharge hole 63. In addition, the lower portion of the air outlet hood 42 is provided with: the above-discussed opening 64; and an opening 65. The opening 65 is formed in order to take the outside air, which is discharged from the cabinet 20, into the air outlet hood 42.

(Working of Dampers)

[0076] Referring to FIGS. 7A, 7B, 8A and 8B, descriptions will be hereinbelow provided for how the dampers 61 provided inside the air outlet hood 42 work. FIGS. 7A, 7B, 8A and 8B are diagrams for explaining how the dampers 61 work. FIG. 7A illustrates the dampers 61 which are about to start turning in the fully-closed direction, while FIG. 7B illustrates the dampers 61 which completes the turn. On the other hand, FIG. 8A illustrates the dampers 61 which are about to start turning in the fully-opened direction, while FIG. 8B illustrates the dampers 61 which completes the turn.

[0077] The control board 60 outputs an instruction signal for turning the dampers 61 in the fully-closed direction from a damper control terminal (not shown) to the damper operator 62, for example, when all the following conditions are satisfied: (a) the lowest rotational speed of the outdoor fans 8, (b) the outside air temperature lower than a threshold temperature (for example, -5 °C), and (c) the cooling operation mode. In response to the instruction signal, the damper operator 62 turns the dampers 61 in the fully-closed direction (see an arrow A1 in FIG. 7B).

[0078] As shown in FIGS. 7A and 7B, while turning in

the fully-closed direction, the dampers 61 scrape snow SW which piles up between the air discharge hole 63 and the opening 64 after entering the inside of the air outlet hood 42, and expels the scraped snow SW out of the air outlet hood 42 through the opening 64.

[0079] On the other hand, the control board 60 outputs an instruction signal for turning the dampers 61 in the fully-opened direction from the damper control terminal (not shown) to the damper operator 62, when one of the following conditions are not satisfied: (a) the lowest rotational speed of the outdoor fans 8, (b) the outside air temperature lower than the threshold temperature (for example, -5 °C), and (c) the cooling operation mode. In response to the instruction signal, the damper operator 62 turns the dampers 61 in the fully-opened direction (see an arrow A2 in FIG. 8B).

[0080] As shown in FIGS. 8A and 8B, while turning in the fully-opened direction, the dampers 61 scrape snow SW which piles up between the dampers 61 and the opening 64 after entering the inside of the air outlet hood 42, and expels the scraped snow SW out of the air outlet hood 42 through the opening 64.

<Working of Outdoor Unit as Whole>

[0081] For the cooling and heating operations, the outdoor unit 2 works as follows.

[0082] The outdoor unit 2 takes outside air into the inside of the cabinet 20 from the outside of the cabinet 20 through the air inlets 31 (31a, 31b, 31c) by rotating the outdoor fans 8, and makes the taken-in outside air pass through the outdoor heat exchanger 7. While the taken-in outside air is passing through the outdoor heat exchanger 7, the outdoor unit 2 exchanges heat between the outside air and the high-temperature high-pressure gas refrigerant which is supplied from the compressor 5. The outdoor unit 2 discharges the outside air from the inside to outside of the cabinet 20 through the air outlets 32.

[0083] The rotational speed of the outdoor fans 8 is controlled by the control board 60. Based on a rotational speed of the compressor 5 and a temperature value measured by the outside air temperature sensor SN, the control board 60 controls the rotational speed of the outdoor fans 8 in order to keep the pressure of the refrigerant high enough to continue the cooling operation. As the outside air temperature becomes lower, the rotational speed of the outdoor fans 8 becomes lower. When the outside air temperature becomes less than the threshold temperature (for example, -5 °C), the rotational speed of the outdoor fans 8 becomes lowest.

<Main Characteristics of Outdoor Unit>

[0084]

(1) The outdoor unit 2 includes the air inlet hoods 41 (41a, 41b, 41c). From this configuration, the outdoor

unit 2 can obtain the following characteristics.

(a) If the outdoor unit 2 included no air inlet hoods 41 (41a, 41b, 41c), the outdoor heat exchanger 7 would be exposed to the outside of the cabinet 20 through the air inlets 31 (31a, 31b, 31c). This configuration thus would allow a more-than-expected amount of outside air, which exceeds the adjusted amount expected from the control of the rotational speed of the outdoor fans 8, to enter the inside of the cabinet 20 and blows against the outdoor heat exchanger 7, when strong wind blows against the outdoor unit 2. This configuration accordingly would decrease the condensation temperature and pressure of the refrigerant in the outdoor heat exchanger 7, and resultantly would decrease the heat exchange efficiency of the outdoor heat exchanger 7.

In contrast to this, in the embodiment, the outdoor unit 2 includes the air inlet hoods 41 (41a, 41b, 41c). Because of this configuration, the embodiment does not allow a more-than-expected amount of outside air, which exceeds the adjusted amount expected from the control of the rotational speed of the outdoor fans 8, to enter the inside of the cabinet 20 and blows against the outdoor heat exchanger 7, even when strong wind blows against the outdoor unit 2. The embodiment is accordingly capable of inhibiting decreases in the condensation temperature and pressure of the refrigerant in the outdoor heat exchanger 7, and is resultantly capable of inhibiting a decrease in the heat exchange efficiency of the outdoor heat exchanger 7.

The use of the thus-configured outdoor unit 2 makes it possible for the air conditioner 1 to inhibit a more-than-expected amount of outside air, which exceeds the adjusted amount expected from the control of the rotational speed of the outdoor fans 8, from entering the inside of the cabinet 20 of the outdoor unit 2, even when strong wind blows against the outdoor unit 2 in cold seasons such as winter. This makes it possible for the air conditioner 1 to secure adjustment of the amount of outside air to be sucked in by the outdoor fans 8. The air conditioner 1 is thus capable of inhibiting decreases in the condensation temperature and pressure of the refrigerant in the outdoor heat exchanger 7, and is resultantly capable of inhibiting a fluctuation in an amount of heat exchange by the outdoor heat exchanger 7. The air conditioner 1 is accordingly capable of inhibiting a decrease in the heat exchange efficiency of the outdoor heat exchanger 7, and is capable of realizing the preferable temperature control of the air conditioner 1 as a whole. In addition, the use of the air outlet

hood 42 makes it possible for the air conditioner 1 to secure the flow path of the air around the air outlets 32, and to thereby eliminate influence of snowfall. The air conditioner 1 is thus capable of improving the heat exchange efficiency of the outdoor heat exchanger 7 even in the case where the outside air temperature is low (for example, less than the threshold temperature of -5 °C). The air conditioner 1 is accordingly capable of excellently performing the cooling operation all the year around in cold areas and the like. (b) Furthermore, in each of the air inlet hoods 41 (41a, 41b, 41c), the lower surface air intake hole 54 is provided to the lower surface of the part between the air inlet 31 and the facing panel 51, and the side surface air intake hole 55 is provided to at least one of the two side panels 52a, 52b. Thereby, the air inlet hoods 41 (41a, 41b, 41c) are each capable of allowing the outside air to pass through the inside of the hood in an amount corresponding to the sum of an opening area of the lower surface air intake hole 54 and an opening area(s) of the side surface air intake hole(s) 55. In a case where there is a need to increase the amount of outside air to be sucked in by the outdoor fans 8 in summer or the like, the use of the air inlet hoods 41 (41a, 41b, 41c) makes it possible for the air conditioner 1 to excellently meet the need. The air conditioner 1 is accordingly capable of preventing the heat exchange efficiency from being affected during winter-time heating operations and summer-time cooling operations. (C) Moreover, in each of the air inlet hoods 41 (41a, 41b, 41c), the opening area of the lower surface air intake hole 54 can be reduced by the opening area(s) of the side surface air intake hole(s) 55. This makes it possible to construct each of the air inlet hoods 41 (41a, 41b, 41c) in a relatively small size. The use of the air inlet hoods 41 (41a, 41b, 41c) accordingly makes it possible to achieve a reduction in the size of the outdoor unit 2 while allowing the outdoor unit 2 to secure the air intake area which is needed to keep the heat exchange efficiency.

It should be noted that each of the air inlet hoods 41 (41a, 41b, 41c) has the structure in which: no air intake hole is provided to the facing panel 51 or the upper surface panel 53; and the air intake hole (the side surface air intake hole 55) is provided to the side panel(s) 52. Since there is high likelihood that strong wind may blow against the facing panel 51 in cold seasons such as winter, the purpose of the above structure is to inhibit influence of the strong wind which blows against the facing panel 51. In other words, even when strong wind blows against the outdoor unit 2 in cold seasons such as winter, the

structure is employed to inhibit a more-than-expected amount of outside air, which exceeds the adjusted amount expected from the control of the rotational speed of the outdoor fans 8, from entering the inside of the cabinet 20 of the outdoor unit 2. Detailed descriptions will be hereinbelow provided for why this structure works.

If the air inlet hoods 41 (41a, 41b, 41c) each had, for example, a structure in which air intake holes are respectively provided to the facing panel 51 and the upper surface panel 53, there would be likelihood that strong wind enters the inside of the cabinet 20 through the air intake holes and blows against the outdoor heat exchanger 7 when the strong wind blows against the outdoor unit 2. This would likely decrease the heat exchange efficiency of the outdoor heat exchanger 7. This embodiment, therefore, aims to inhibit the decrease in the heat exchange efficiency of the outdoor heat exchanger 7. To this end, each of the air inlet hoods 41 (41a, 41b, 41c) has the structure in which: no air intake hole is provided to the facing panel 51 or the upper surface panel 53; and the air intake hole (the side surface air intake hole 55) is provided to the side panel(s) 52. The outdoor unit 2 is thus capable of taking outside air in an amount manageable by the control of the rotational speed of the outdoor fans 8, into the cabinet 20. The outdoor unit 2 is thereby capable of managing the amount of heat exchange by the outdoor heat exchanger 7, and is accordingly capable of achieving an excellent temperature control of the air conditioner 1 as a whole.

(2) The air outlet hood 42 includes the openable/closable dampers 61, and the damper operator 62 connected to the dampers 61, inside the air outlet hood 42. The air outlet hood 42 further includes the opening 64 provided in the position which is within the operating range of the dampers 61 and diagonally forward and downward from the dampers 61 (outward and downward from the dampers 61). The use of the air outlet hood 42 makes it possible for the outdoor unit 2 to scrape snow SW, which piles up inside the air discharge hole 63 of the air outlet hood 42, using the dampers 61, and thereby to expel the snow SW out of the air outlet hood 42 through the opening 64. In other words, in the outdoor unit 2, the means for expelling snow which piles up inside the air discharge hole 63 of the air outlet hood 42 is formed from the dampers 61, the damper operator 62 and the opening 64. The air conditioner 1 is thus capable of securing the flow path of the air around the air outlets 32, and is thereby capable of eliminating influence of snow. This, too, makes it possible for the air conditioner 1 to excellently control the amount of outside air to be sucked in by the outdoor fans 8. The air conditioner 1 is accordingly capable of improving the heat exchange efficiency of the outdoor heat exchanger 7 even when relatively heavy

snow falls. The thus-configured air conditioner 1 can be excellently used in cold areas and the like.

[0085] As discussed above, the air conditioner 1 according to the embodiment can be less affected by wind and snow than ever.

[0086] The present invention is not limited to the above-discussed embodiment, but includes various modifications. For example, the embodiment has been discussed in detail for the purpose of making the embodiment easy to understand, and is not necessarily limited to what includes all the discussed components. Furthermore, some of the configurations included in the embodiment may be replaced with other configuration(s). Otherwise, other configuration(s) may be added to the configurations of the embodiment. Moreover, other configuration(s) may be added to part of any one of the configurations of the embodiment, or part of any one of the configurations of the embodiment may be eliminated or replaced with other configuration.

[0087] For example, in the above-discussed embodiment, the air inlet hoods 41 (41a, 41b, 41c) have the structure in which the covers 56 are provided over the side surface air intake holes 55. The air inlet hoods 41 (41a, 41b, 41c), however, each have a structure in which no covers 56 are provided over the side surface air intake holes 55 (in other words, a structure in which only the side surface air intake holes 55 are provided).

[0088] For example, the air inlet hoods 41 (41a, 41b, 41c) each may further have a configuration in which the side surface air intake holes 55 (55a, 55b) are provided with louvers (not shown) which operate to open and close. This configuration makes it possible for the outdoor unit 2 to control the amount of outside air to be taken into the outdoor unit 2 from the outside of the outdoor unit 2 (the airflow rate) by changing the directions of the louvers (not shown).

[0089] Besides, in the embodiment, for example, the air inlet hoods 41 (41a, 41b, 41c) are attached to the outdoor unit 2 (see FIG. 3C). Each air inlet hood 41 has the shape in which the lower end portions of the side panels 52 extend in the substantially horizontal direction (in other words, the lower end portions of the side panels 52 extend substantially vertically to the cabinet 20 of the outdoor unit 2). Instead of the air inlet hoods 41, air inlet hoods 141 shown in FIG. 9 may be attached to the outdoor unit 2. FIG. 9 is a rear view of the outdoor unit 2 to which air inlet hoods 141 (141a, 141b, 141c) of a modification are attached.

[0090] As shown in FIG. 9, the air inlet hoods 141 (141a, 141b, 141c) each have a shape in which the lower end portions of the side panels 52 incline in a way that makes the inner end parts (the end parts closer to the cabinet 20) of the lower end portions lower than the outer end parts (the end parts farther from the cabinet 20) of the lower end portions. The air inlet hoods 141 (141a, 141b, 141c) are respectively attached to the left side panel 22a, the right side panel 22b and the rear (back) panel

23 of the cabinet 20. The air inlet hoods 141a, 141b have the same structure and the same size. Meanwhile, the air inlet hood 141c has the same structure as the air inlet hoods 141a, 141b, but is different from the air inlet hoods 141a, 141b in that the transverse width of the air inlet hood 141c is changed from the transverse width of the air inlet hoods 141a, 141b in order to be fit for the air inlet 31c formed in the rear (back) panel 23 of the cabinet 20. Like the air inlet hoods 41 according to the above-discussed embodiment, the air inlet hoods 141 (141a, 141b, 141c) according to the modification can be made small in size, and is capable of obtaining the work and effect of making it possible for the air conditioner 1 to perform the cooling operation when the outside temperature is low.

[0091] Features, components and specific details of the structures of the above-described embodiments may be exchanged or combined to form further embodiments optimized for the respective application. As far as those modifications are readily apparent for an expert skilled in the art they shall be disclosed implicitly by the above description without specifying explicitly every possible combination, for the sake of conciseness of the present description.

Claims

1. An outdoor unit (2) comprising:

a cabinet (20) in which at least one air inlet and at least one air outlet are formed;
a heat exchanger (7) arranged inside the cabinet (20);
an air inlet hood (41) that covers the air inlet; and
an air outlet hood (42) that covers the air outlet, wherein
the air inlet hood (41) includes

a facing panel (51) arranged facing the air inlet,
an upper surface panel (53) arranged on an upper surface of a part between the air inlet and the facing panel (51), and
two side panels (52) arranged respectively on two side surfaces of the part between the air inlet and the facing panel (51),

a lower surface air intake hole (54) is provided to a lower surface of the part between the air inlet and the facing panel (51), and
a side surface air intake hole (55) is provided to at least one of the two side panels (52).

2. The outdoor unit (2) according to claim 1, wherein the side surface air intake hole (55) is provided at mutually-symmetrical positions on the two side panels (52).

3. The outdoor unit (2) according to claim 1, wherein a cover (56) is provided over the side surface air intake hole (55).
4. The outdoor unit (2) according to claim 1, wherein a damper and a damper operator (62) are provided inside the air outlet hood (42), the damper being openable and closable, and the damper operator (62) being connected to the damper, and the air outlet hood (42) is provided with an opening at a position which is within an operating range of the damper and diagonally forward and downward from the damper.
5. An air conditioner (1) comprising:
- the outdoor unit (2) according to claim 1;
an indoor unit (3); and
a refrigerant pipe (4) that connects the outdoor unit (2) to the indoor unit (3).

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FIG.1

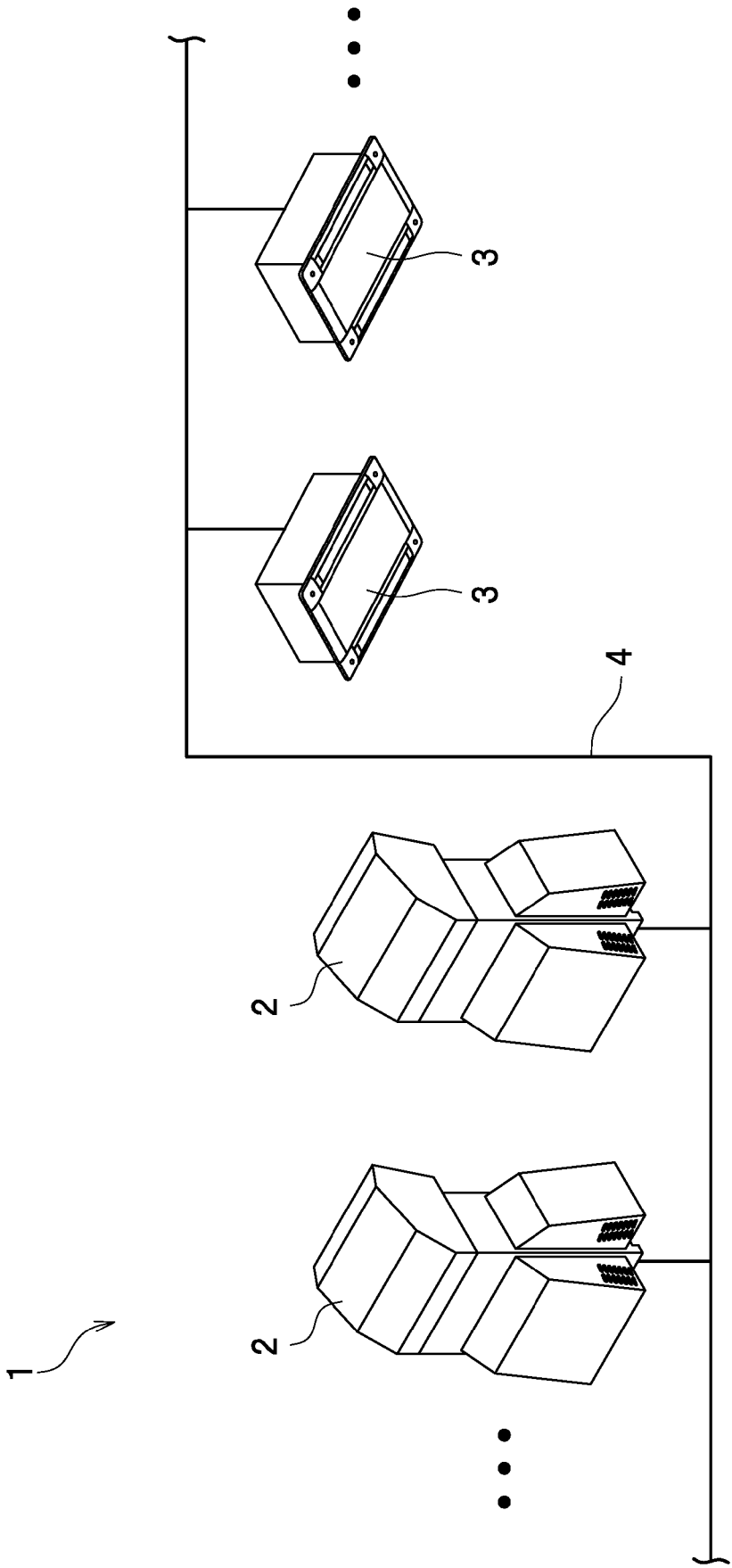


FIG.2

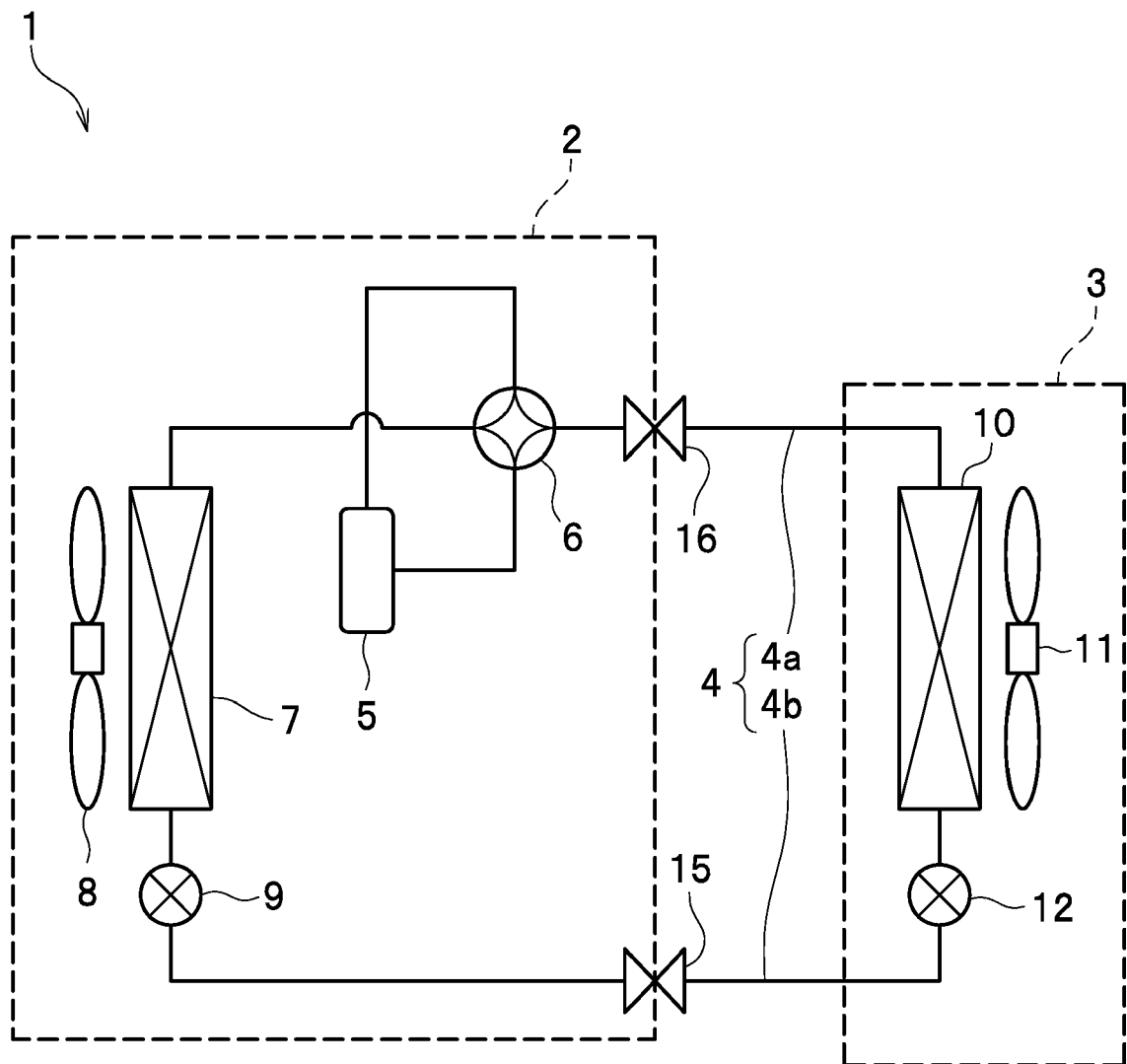


FIG.3A

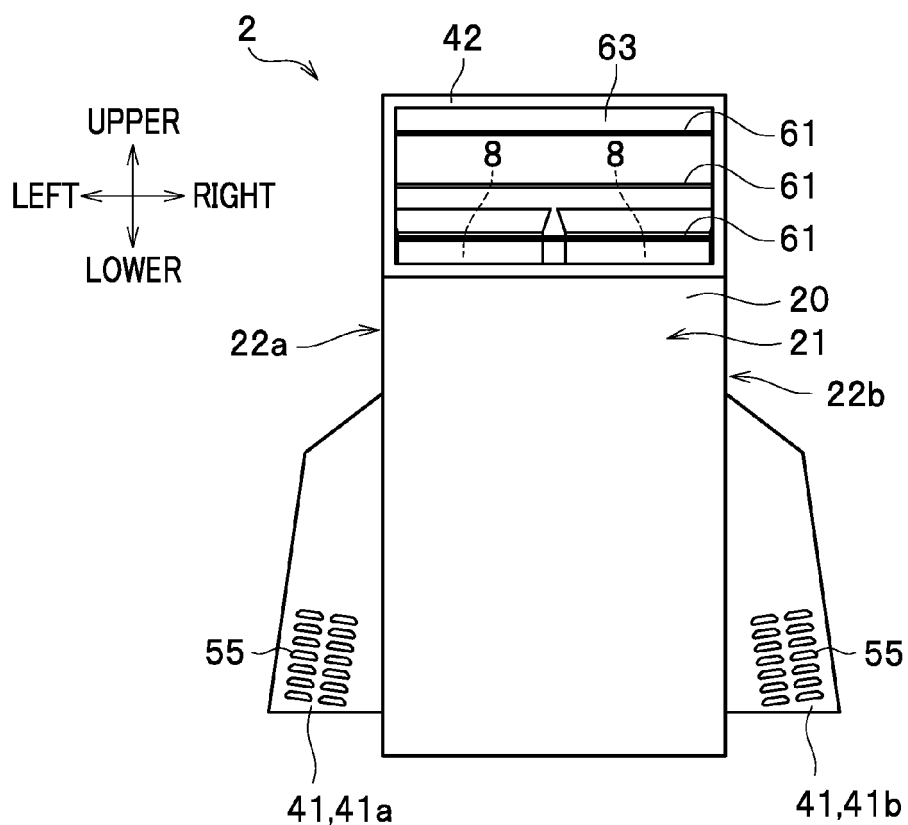


FIG.3B

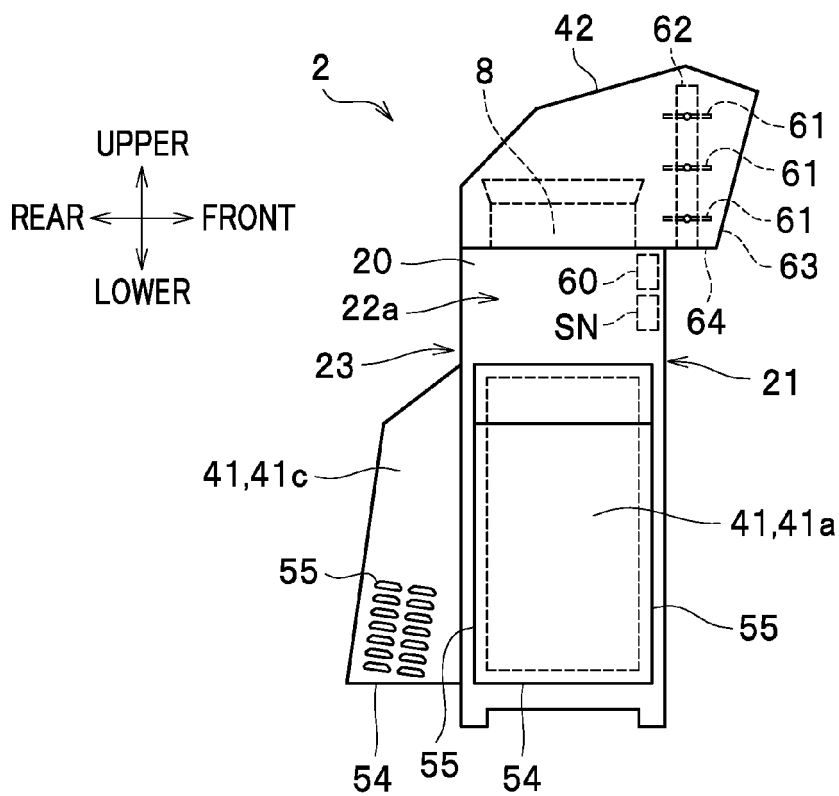


FIG.3C

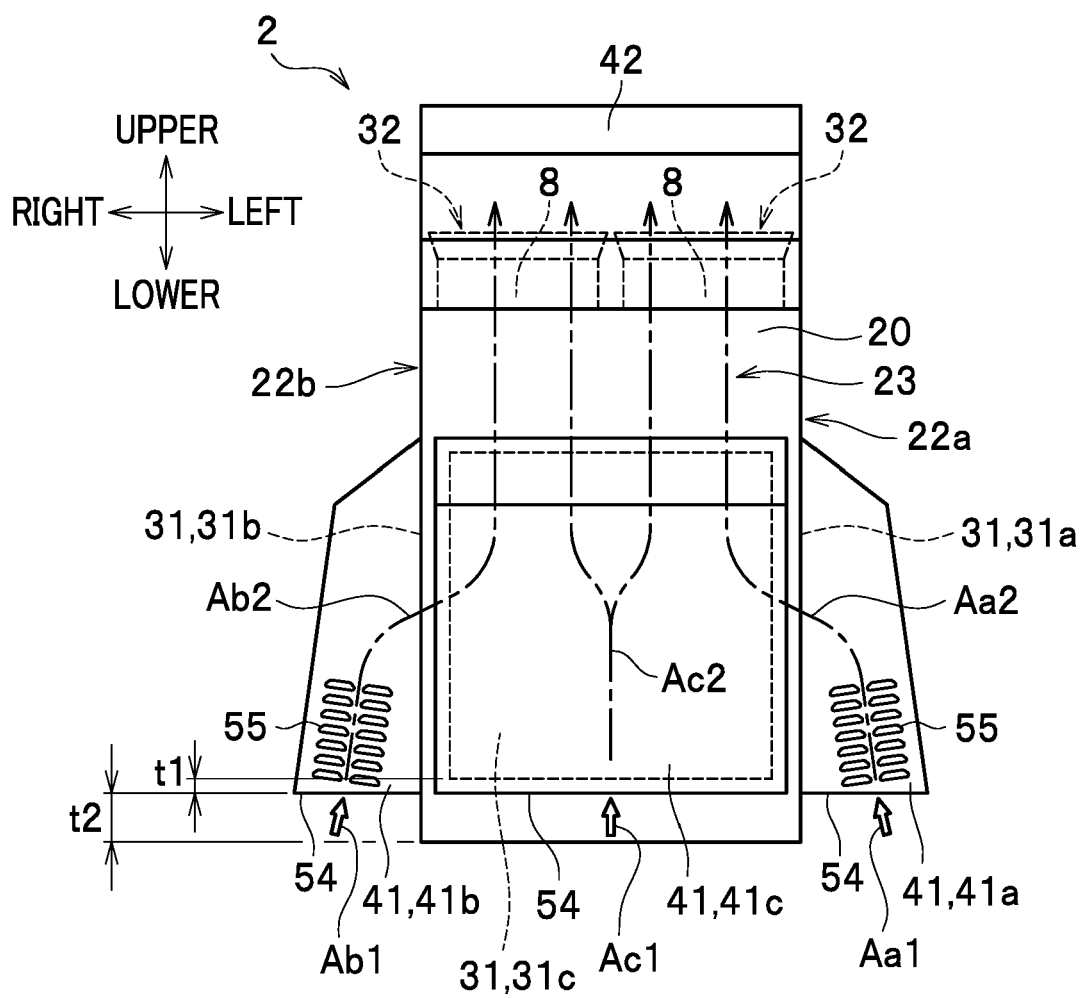


FIG.4A

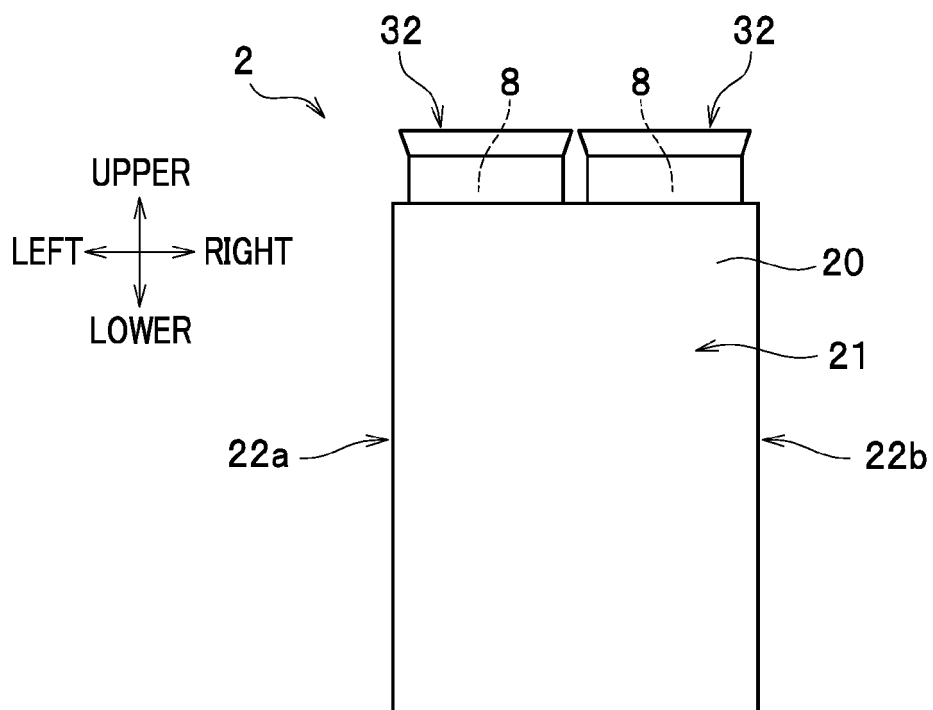


FIG.4B

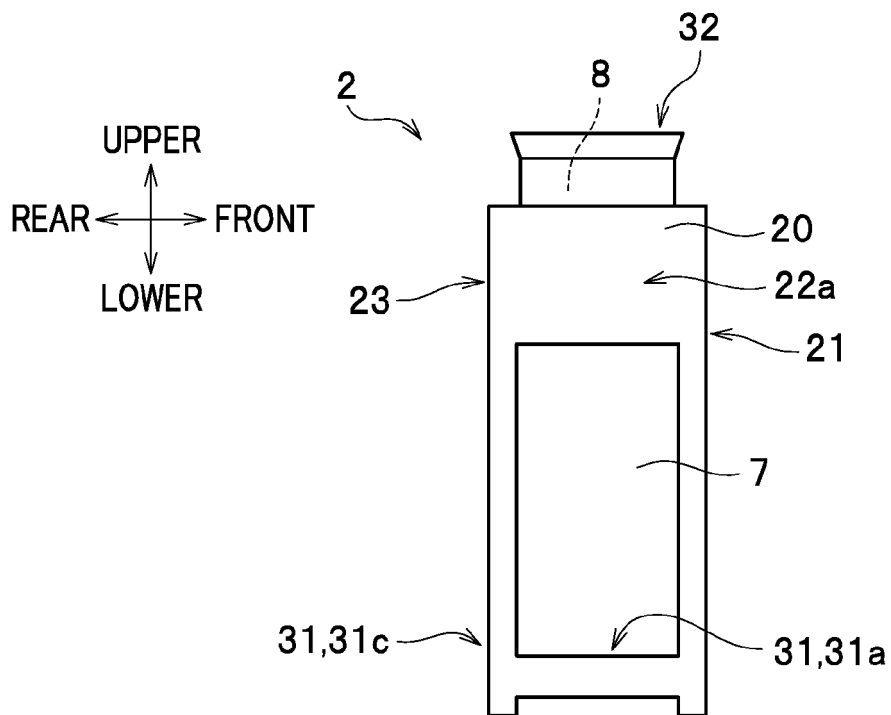


FIG.4C

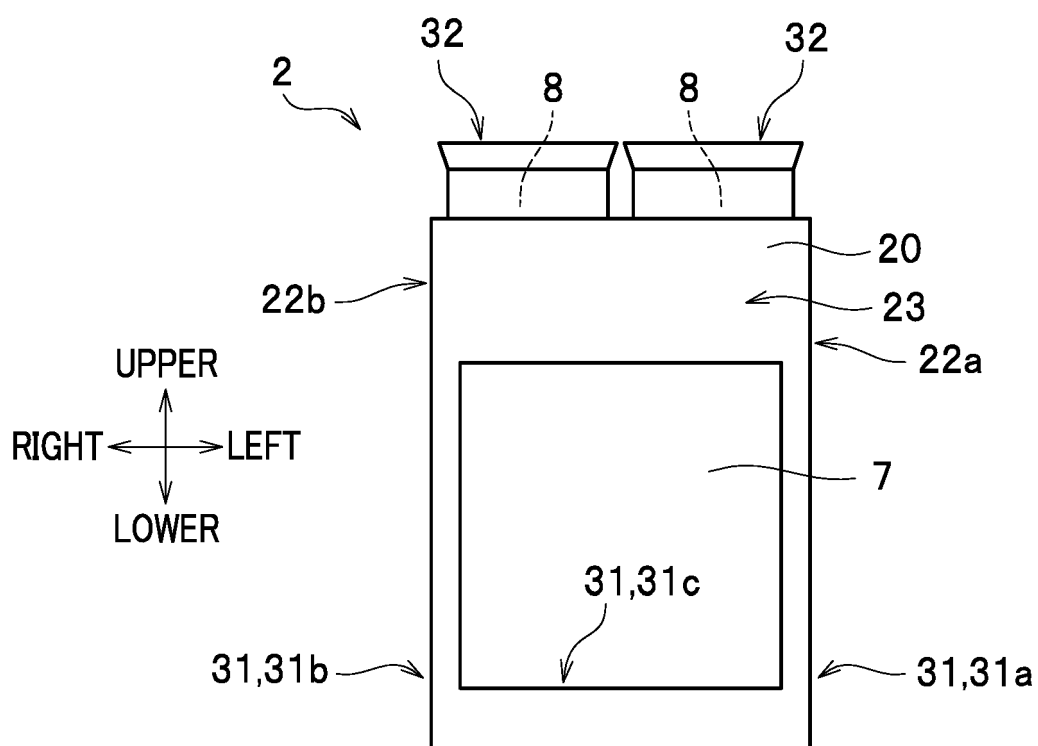


FIG.5

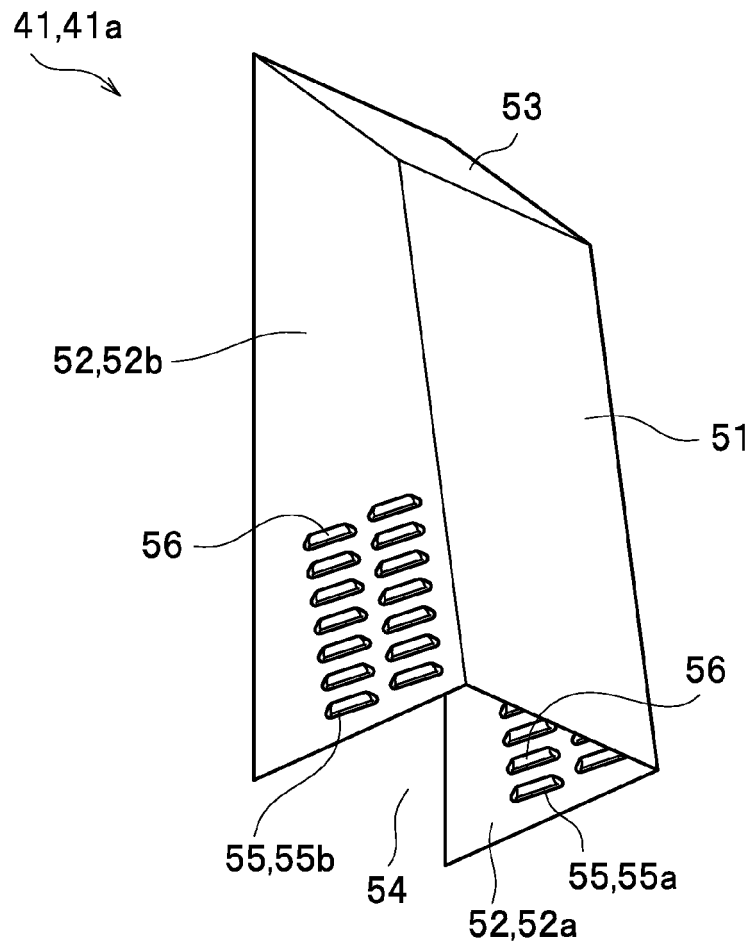


FIG.6

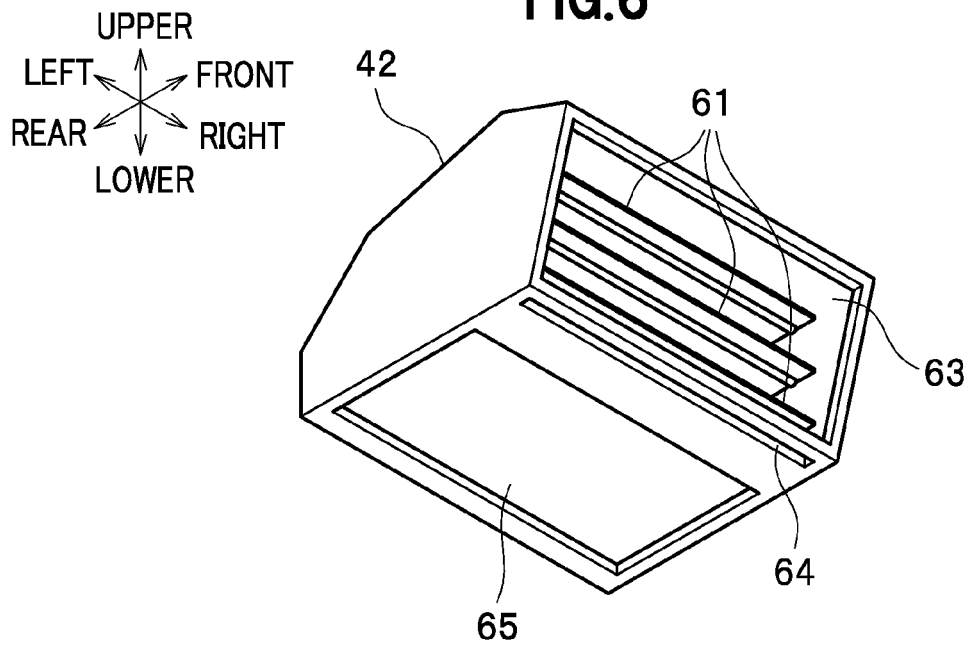


FIG.7A

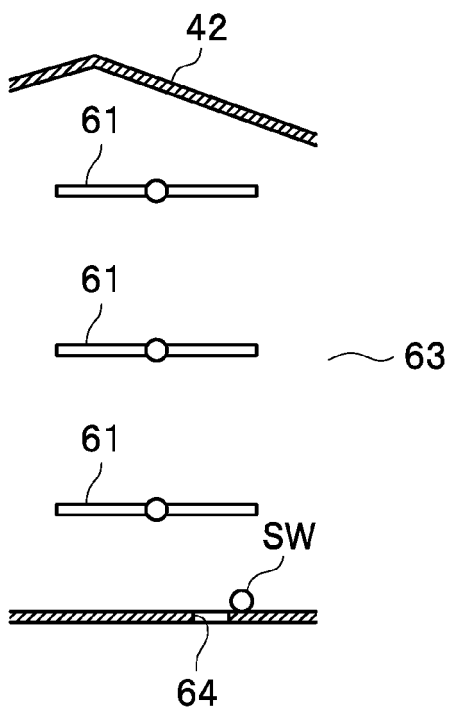


FIG.7B

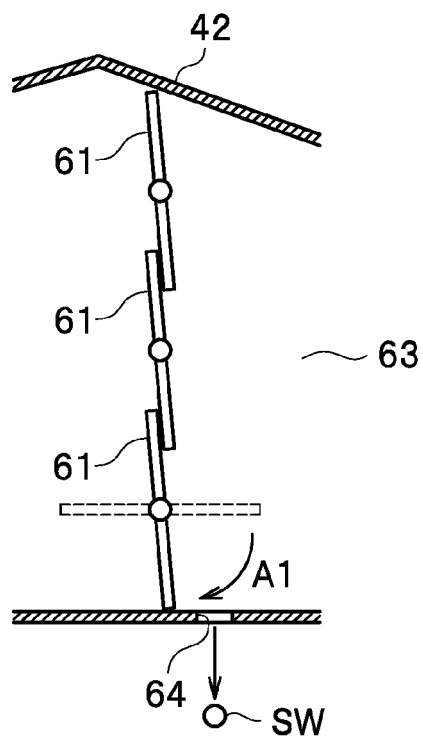


FIG.8A

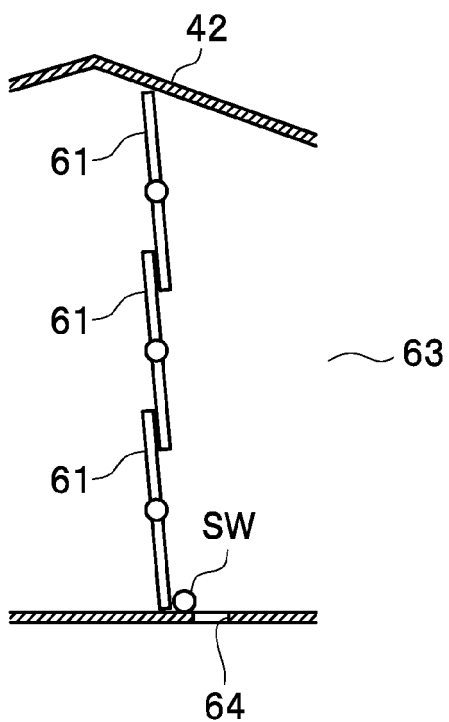


FIG.8B

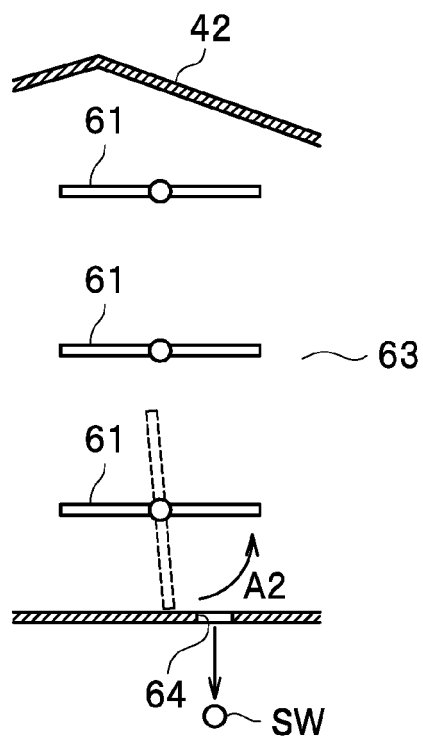
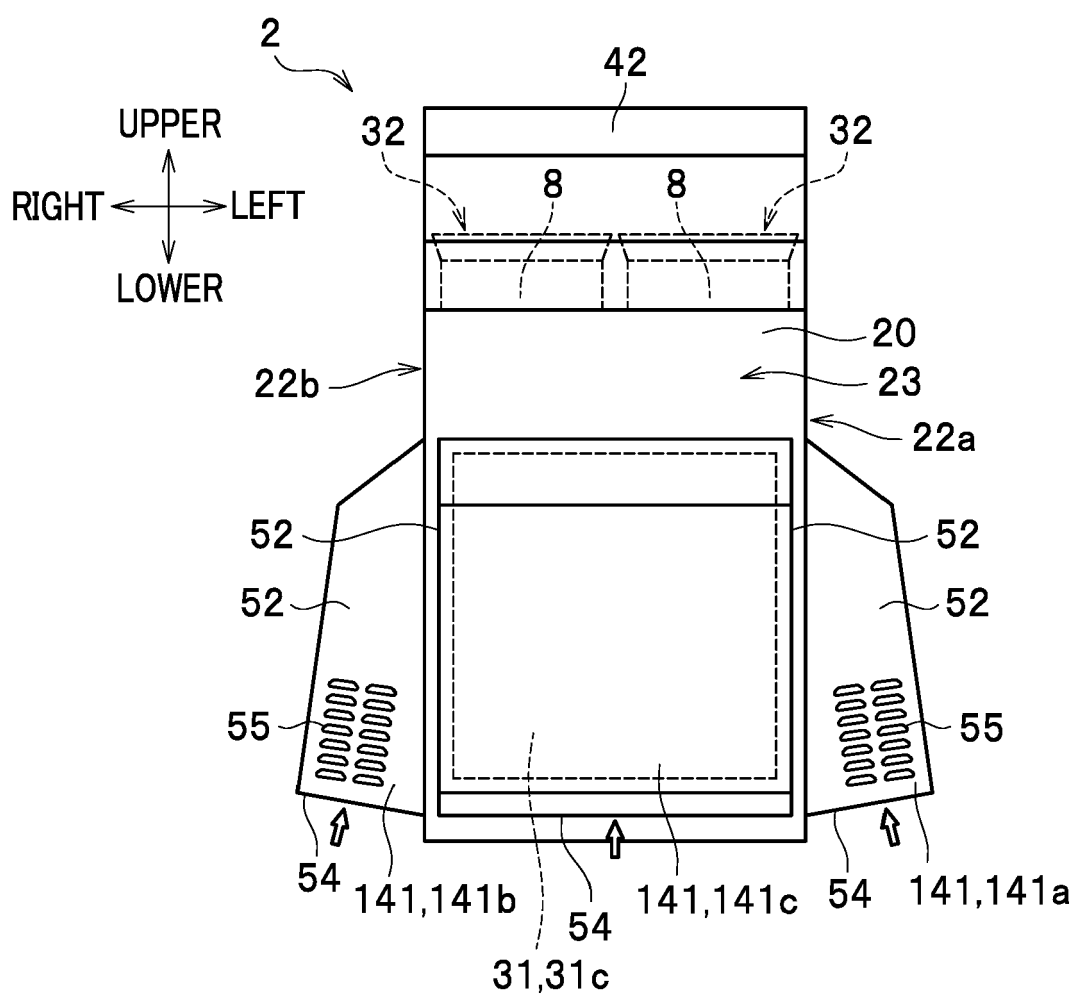


FIG.9





EUROPEAN SEARCH REPORT

Application Number
EP 18 16 4346

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Y	* column 2, line 35 - column 2, line 55; figures 1,2 *		
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Place of search Munich		Date of completion of the search 16 August 2018	Examiner Anconetani, Mirco
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