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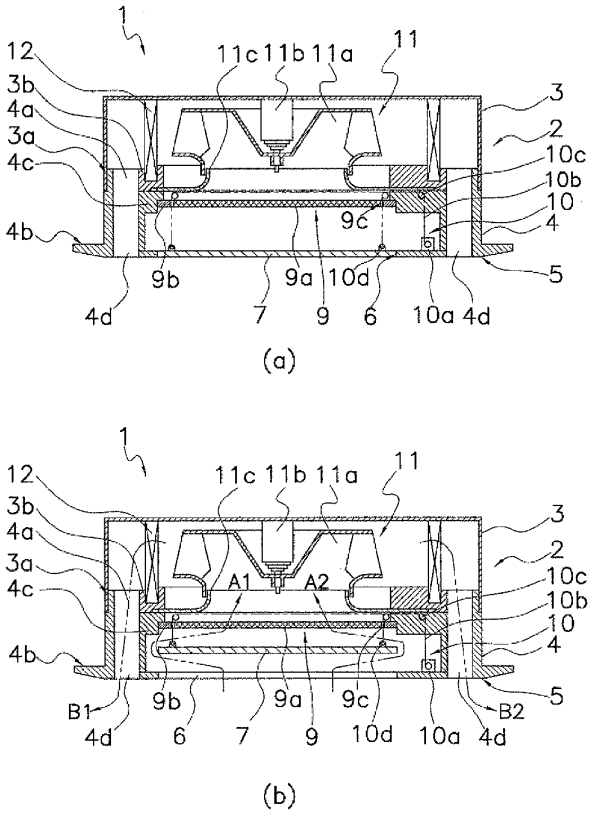

(57) Abstract: An indoor unit for a ceiling-embedded or ceiling-suspended air conditioner, having improved degree of design freedom of a lower surface panel. The indoor unit (1) has the lower surface panel (5), a suction opening (6) provided in the lower surface panel (5), a movable panel (7) for closing the suction opening (6) when operation of the unit is stopped, and drive means (10). The drive means (10) moves or rotates the movable panel (7). In operation, the movable panel (7) is moved or rotated and retracted upward from the lower surface of the lower surface panel (5).

(57) 要約: 下面パネルの意匠の自由度を向上させた、天井埋込型又は天井吊下型の空気調和装置の室内機を提供する。室内機（１）は、下面パネル（５）と、下面パネル（５）に設けられる吸込口（６）と、運転停止時に吸込口（６）を塞ぐ可動パネル（７）と、駆動手段（１０）とを備えている。駆動手段（１０）は、可動パネル（７）を移動あるいは回転させる。運転時に、可動パネル（７）が、移動あるいは回転し下面パネル（５）の下面よりも上方へ引っ込む。

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INDOOR UNIT OF AIR CONDITIONER

TECHNICAL FIELD

The present invention relates to an indoor unit of a ceiling-embedded type or ceiling-suspended type air conditioner in which an inlet of air is disposed at a bottom surface of the indoor unit.

BACKGROUND ART

Typically, a ceiling-mounted indoor unit of an air conditioner is equipped with a bottom panel that constitutes a bottom surface of the indoor unit. The bottom panel is disposed with an inlet for sucking air, and this inlet has a filter attached thereto for removing dust (for example, see Patent Document 1).

<Patent Document 1> Japanese Patent Application Publication No. 2005-241243.

Incidentally, the bottom panel is easily noticeable by people. For the user, the design of the bottom panel is an important factor in selecting a product. However, for the manufacturers, the necessity lies in designing the bottom panel such that the basic functions of an inlet and a filter are not impaired, and the design of the bottom panel is always subjected to the limitation.

Embodiments of the present invention therefore desirably provides an indoor unit of a ceiling-embedded type or ceiling-suspended type air conditioner in which the flexibility of the design of a bottom panel is improved compared to the conventional bottom panel.

Any discussion of documents, acts, materials, devices, articles or the like which has been included in the present specification is solely for the purpose of providing a context for the present invention. It is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the present invention as it existed before the priority date of each claim of this application.

SUMMARY

An indoor unit of an air conditioner according to a first aspect of the present invention is an indoor unit of a ceiling-embedded type or ceiling-suspended type air conditioner. The indoor unit includes a bottom panel, an inlet, a movable panel, and a driving means. The inlet is disposed at the bottom panel. During non-operation, the inlet is closed by the movable panel. The driving means moves or rotates the movable

invention, further including a fan and a filter. The fan sucks air from the inlet, and the filter removes dust in air sucked from the inlet. The filter is connected to the movable panel, and moves to a predetermined mounting position of the filter along with the movement of the movable panel.

With this indoor unit, the filter and the movable panel are assembled as one unit. Accordingly, the filter can be easily removed, and the maintainability of the filter improves.

An indoor unit of an air conditioner according to a third aspect of the present invention is the indoor unit of an air conditioner according to the first aspect of the present invention, wherein the movable panel is formed by a plurality of small-sized movable panels, and during operation, the plurality of small-sized movable panels move and recede above the bottom surface of the bottom panel and are arranged in a pyramid shape.

With this indoor unit, the movable panel closes the inlet during non-operation. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel improves. In addition, since the arrangement pattern of the movable panel changes depending on an open state and a closed state of the inlet, the differentiation of the product can be induced by the visual effect in which the design changes. Accordingly, the appeal of the product in the market is promoted.

An indoor unit of an air conditioner according to a fourth aspect of the present invention is the indoor unit of an air conditioner according to the first aspect of the present invention, wherein the movable panel is formed by at least a first movable panel and a second movable panel, and during operation, the first movable panel and the second movable panel rotate and recede above the bottom surface of the bottom panel.

With this indoor unit, the movable panel closes the inlet during non-operation. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel improves. In addition, since the arrangement pattern of the movable panel changes depending on an open state and a closed state of the inlet, the differentiation of the product can be induced by the visual effect in which the design changes. Accordingly, the appeal of the product in the market is promoted.

An indoor unit of an air conditioner according to a fifth aspect of the present invention is the indoor unit of an air conditioner according to the first aspect of the present invention, further including an outlet and a second movable panel. During non-operation, the inlet is closed by the first movable panel, and also during non-operation, the outlet is closed by the second movable panel. The driving means moves or rotates the first movable panel and the second movable panel. During operation, the first movable panel moves or rotates and

recedes above the bottom surface of the bottom panel. Likewise, during operation, the second movable panel moves or rotates away from the outlet.

With this indoor unit, during non-operation, both the inlet and the outlet are closed and thus the panel forms a flat surface without an opening. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel improves. In addition, since the arrangement pattern of the movable panel changes depending on an open state and a closed state of the inlet and outlet, the differentiation of the product can be induced by the visual effect in which the design changes. Accordingly, the appeal of the product in the market is promoted.

An indoor unit of an air conditioner according to a sixth aspect of the present invention is the indoor unit of an air conditioner according to the fifth aspect of the present invention, wherein, during operation, the second movable panel moves in a parallel manner toward the center of the bottom panel.

With this indoor unit, the second movable panel moves along the inlet and is housed in the inlet, and thus there is no need to newly provide a space for housing the second movable panel.

An indoor unit of an air conditioner according to a seventh aspect of the present invention is the indoor unit of an air conditioner according to any one of the first, third, fourth, and fifth aspects of the present invention, wherein the driving means uses a motor as a driving source.

With this indoor unit, the driving means achieves a small size and thus can be easily housed in a casing. Accordingly, the flexibility of the layout and the flexibility of the design improve.

An indoor unit of an air conditioner according to an eighth aspect of the present invention is the indoor unit of an air conditioner according to any one of the first, third, fourth, and fifth aspects of the present invention, wherein the bottom panel and the driving means are provided as a set of assembly.

With this indoor unit, the bottom panel and the driving means can be replaced at the same time, and even after the installation is completed, the user can select a movable type or a fixed type as desired. Thus, an improved service can be provided.

<EFFECTS OF THE INVENTION>

With the indoor unit of an air conditioner according to the first aspect of the present invention, the movable panel closes the inlet during non-operation. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design

of the bottom panel improves.

With the indoor unit of an air conditioner according to the second aspect of the present invention, the filter can be easily removed, and the maintainability of the filter improves.

With the indoor unit of an air conditioner according to the third, fourth, and fifth aspects of the present invention, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel improves. In addition, the differentiation of the product can be induced by the visual effect in which the design changes. Accordingly, the appeal of the product in the market is promoted.

With the indoor unit of an air conditioner according to the sixth aspect of the present invention, the second movable panel moves along the inlet and is housed in the inlet. Thus, there is no need to newly provide a space for housing the second movable panel.

With the indoor unit of an air conditioner according to the seventh aspect of the present invention, the motor is used as a driving source. Thus, the driving means achieves a small size and can be easily housed in the casing.

With the indoor unit of an air conditioner according to the eighth aspect of the present invention, at least the bottom panel and the driving means are provided as a set of assembly, and the user can select a movable type or a fixed type as desired even after the installation is completed. Thus, an improved service can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an external perspective view of an indoor unit according to a first embodiment of the present invention.

Figure 2 is an operational block diagram of a movable panel of the same indoor unit as above.

Figure 3(a) is a cross sectional view of the indoor unit according to the first embodiment during non-operation, and Figure 3(b) is a cross sectional view of the same indoor unit during operation.

Figure 4(a) is a cross sectional view of an indoor unit according to a second embodiment during non-operation, and Figure 4(b) is a cross sectional view of the same indoor unit during operation.

Figure 5(a) is a cross sectional view of an indoor unit according to a third embodiment during non-operation, and Figure 5(b) is a cross sectional view of the same indoor unit during operation.

Figure 6(a) is a cross sectional view of an indoor unit according to a fourth

embodiment during non-operation, and Figure 6(b) is a cross sectional view of the same indoor unit during operation.

Figure 7(a) is a cross sectional view of an indoor unit according to a fifth embodiment during non-operation, and Figure 7(b) is a cross sectional view of the same indoor unit during operation.

Figure 8(a) is a cross sectional view of an indoor unit according to a sixth embodiment during non-operation, and Figure 8(b) is a cross sectional view of the same indoor unit during operation.

Figure 9(a) is a cross sectional view of an indoor unit according to a seventh embodiment during non-operation, and Figure 9(b) is a cross sectional view of the same indoor unit during operation.

DESCRIPTION OF THE REFERENCE SYMBOLS

1, 21, 31, 41, 51, 61, 71	Indoor unit
5, 25, 35, 45, 55, 65, 75	Bottom panel
6, 26, 36, 46, 56, 66, 76	Inlet
7, 27, 37, 47, 57, 67	Movable panel
9	Filter
10	Driving means
11	Fan
37a, 37b, 37c, 37d, 37e	Small-sized movable panel
47a, 47b, 47c, 47d, 47e	Small-sized movable panel
58, 68, 77	First movable panel
59, 69, 79	Second movable panel
78	Outlet

BEST MODE FOR CARRYING OUT THE INVENTION

<FIRST EMBODIMENT>

<CONFIGURATION OF INDOOR UNIT 1>

Figure 1 shows an external perspective view of an indoor unit according to a first embodiment of the present invention. A casing 2 of an indoor unit 1 is constituted by a casing upper portion 3 and a casing lower portion 4, and is embedded in a ceiling at the time of installation. Note that part of the casing lower portion 4 is exposed from the ceiling, and this portion is referred to as a bottom panel 5. The bottom panel 5 is disposed with an inlet 6 into which air is sucked, and an outlet 4d out of which air is blown.

When the indoor unit 1 is not operated, a movable panel 7 completely closes the

inlet 6 and thus the inlet 6 is not exposed. Figure 2 is an operational block diagram of the movable panel 7. The movable panel 7 can move into the casing 2 by a driving means 10 installed in the casing 2. A control unit 13 controls the driving means 10 to move or rotate the movable panel 7. Positional information of the movable panel 7 is detected by a position detecting means 14 and transmitted to the control unit 13.

Figure 3(a) is a cross sectional view of the indoor unit according to the first embodiment during non-operation, and Figure 3(b) is a cross sectional view of the same indoor unit during operation. As shown in Figure 3, the casing upper portion 3 and the casing lower portion 4 are interconnected at a junction area 3a. The casing lower portion 4 is disposed with an air passage 4a, a flange 4b, and an inner frame 4c. The air passage 4a serves as a passage when air is blown out, and is connected to the outlet 4d. When the casing 2 is embedded in the ceiling, the flange 4b comes to contact with the ceiling surface, thereby positioning the casing 2. Further, the flange 4b closes a gap between a working hole disposed on the ceiling and the casing 2, preventing the working hole from being exposed from the ceiling surface. The inner frame 4c forms a space in which the movable panel 7, a filter 9 (described later), and the like are housed.

The filter 9 is housed inside of the casing 2 and removes dust in the air sucked in from the inlet 6. The filter 9 is formed by a filter element 9a and a filter frame 9b. The filter element 9a removes dust in the air, and the filter frame 9b is supported at a predetermined mounting position on the inner frame 4c of the casing lower portion 4 in a state in which the filter frame 9b holds the filter element 9a. In addition, according to need, the filter 9 is disposed with a hole 9c through which passes a wire 10b (described later).

The driving means 10 is constituted by a motor 10a, the wire 10b, a plurality of pulleys 10c, and a plurality of hooks 10d, and moves the movable panel 7. The motor 10a is housed in the space of the casing lower portion 4. The wire 10b is a rope with the diameter of approximately 1 mm having an appropriate strength. One end thereof is connected to a rotor of the motor 10a, and the other end thereof is connected to the movable panel 7 by the hooks 10d. The wire 10b is supported by the pulleys 10c at a plurality of positions such that the driving force of the motor 10a is transmitted without attenuation. Positions to install the hooks 10d can be arbitrarily set according to the shape of the movable panel 7.

A fan 11 is arranged in the casing upper portion 3. The fan 11 is a centrifugal fan, and constituted by an impeller 11a, a motor 11b that rotates the impeller 11a, and a bellmouth 11c that collects air sucked in. The fan 11 sucks air into the casing 2 from the inlet 6 and blows out the air in the peripheral direction. The air blown out passes through the air passage

4a and exits from the outlet 4d.

A heat exchanger 12 is arranged so as to surround the periphery of the fan 11 in a state in which the heat exchanger 12 is held at a base portion 3b in the casing upper portion 3. An entrance of the aforementioned air passage 4a is arranged adjacently to the heat exchanger 12.

<OPERATION OF MOVABLE PANEL 7>

When the operation of the indoor unit 1 of an air conditioner is stopped, the movable panel 7 completely closes the opening of the inlet 6. Only the boundary of the movable panel 7 is visible on the bottom panel 5. When the indoor unit 1 is about to start operating, prior to the start of operation, the motor 10a rotates, the wire 10b is wound up, and the movable panel 7 is pulled up into the casing lower portion 4. Note that the control unit 13 (see Figure 2) detects by the position detecting means 14 (see Figure 2) that the movable panel 7 has risen to a predetermined height, and stops the motor 10a.

After the movable panel 7 is stopped, the operation of the fan 11 starts and air is sucked in from the inlet 6 that is open. After the dust is removed from the air by the filter 9, the air is taken into the fan 11 and blown out in the peripheral direction. The air blown out undergoes heat exchange by passing through the heat exchanger 12. The air that passed through the heat exchanger 12 passes through the air passage 4a and is blown out from the outlet 4d.

When the operation of the indoor unit 1 is stopped, the motor 10a rotates backward, the wire 10b is loosened, the movable panel 7 descends, thereby closing the inlet 6. Note that the control unit 13 (see Figure 2) detects by the position detecting means 14 (see Figure 2) that the movable panel 7 has reached the inlet 6, and stops the motor 10a.

<CHARACTERISTICS OF THE FIRST EMBODIMENT>

The indoor unit 1 is the indoor unit of a ceiling-embedded type air conditioner, and is equipped with the bottom panel 5, the inlet 6, the movable panel 7, and the driving means 10. The bottom panel 5 is exposed from the ceiling surface and disposed with the inlet 6. During non-operation, the inlet 6 is closed by the movable panel 7. The driving means 10 moves or rotates the movable panel 7. During operation, the movable panel 7 moves and recedes above the bottom surface of the bottom panel 5.

With this indoor unit 1, the inlet 6 is closed during non-operation and forms a planar portion. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel 5 improves. In addition, the shape of the bottom panel 5 is hardly limited by the filter 9 and the flexibility of the design of the bottom

panel 5 improves. Further, since the filter 9 is located at a position that is not noticeable by people, contamination on the filter 9 does not impair the external appearance of the bottom panel 5. In addition, since the movable panel 7 moves without protruding from the bottom panel 5, the external appearance of the bottom panel 5 does not become impaired.

<SECOND EMBODIMENT>

<CONFIGURATION OF INDOOR UNIT 21>

Next, a second embodiment of the present invention is described. Note that the elements same as those in the first embodiment are denoted by the same reference symbols, and the descriptions thereof are omitted. Figure 4(a) is a cross sectional view of an indoor unit according to the second embodiment during non-operation, and Figure 4(b) is a cross sectional view of the same indoor unit during operation.

A bottom panel 25 is disposed with an inlet 26 into which air is sucked, and the outlet 4d out of which air is blown. When an indoor unit 21 is not operated, a movable panel 27 completely closes the inlet 26 and thus the inlet 26 is not exposed.

The movable panel 27 and the filter 9 are interconnected by a connecting rod 27a with a predetermined gap therebetween. The wire 10b extends vertically upwardly from the hooks 10d attached to the filter 9 and is led to the motor 10a via the plurality of pulleys 10c.

<OPERATION OF THE MOVABLE PANEL 27>

Prior to the start of operation, the motor 10a rotates, the wire 10b is wound up, and the movable panel 27 is pulled up into the casing lower portion 4. When the movable panel 27 and the filter 9 rise to a predetermined height, the filter frame 9b of the filter 9 comes into contact with a mounting surface 4e at a filter mounting position. At this time, the control unit 13 detects by the position detecting means 14 that the movable panel 27 has risen to a predetermined height, and stops the motor 10a.

When the operation of the indoor unit 21 is stopped, the motor 10a rotates backward, the wire 10b is loosened, the movable panel 27 and the filter 9 descend, and the inlet 26 is closed by the movable panel 27. Note that the control unit 13 detects by the position detecting means 14 that the movable panel 27 has reached the inlet 26, and stops the motor 10a.

<CHARACTERISTICS OF THE SECOND EMBODIMENT>

With this indoor unit 21, the filter 9 is connected to the movable panel 27, and the filter 9 moves to the predetermined mounting position of the filter 9 along with the movement of the movable panel 27. With this indoor unit 21, since the filter 9 and the movable panel 27 are assembled as one unit, the filter 9 can be easily removed and the maintainability of the filter 9 improves.

<THIRD EMBODIMENT>

<CONFIGURATION OF INDOOR UNIT 31>

Next, a third embodiment of the present invention is described. Note that the elements same as those in the first embodiment are denoted by the same reference symbols, and the descriptions thereof are omitted. Figure 5(a) is a cross sectional view of an indoor unit according to the third embodiment during non-operation, and Figure 5(b) is a cross sectional view of the same indoor unit during operation.

A bottom panel 35 is disposed with an inlet 36 into which air is sucked, and the outlet 4d out of which air is blown. When an indoor unit 31 is not operated, a movable panel 37 completely closes the inlet 36 and thus the inlet 36 is not exposed.

The movable panel 37 is formed by a plurality of plate-shaped small-sized movable panels 37a - 37e. In addition, guides 39 allow the small-sized movable panels 37a - 37e to move in the vertical direction but not in the horizontal direction.

In Figure 5(a), a right end of the small-sized movable panel 37a and a left end of the small-sized movable panel 37b are held by the guide 39, and the small-sized movable panel 37a can move in the vertical direction with respect to the small-sized movable panel 37b by a distance equal to the height of the guide 39.

A right end of the small-sized movable panel 37b and a left end of the small-sized movable panel 37c are held by the guide 39. The small-sized movable panel 37b can move in the vertical direction with respect to the small-sized movable panel 37c by a distance equal to the height of the guide 39.

A right end of the small-sized movable panel 37c and a left end of the small-sized movable panel 37d are held by the guide 39. The small-sized movable panel 37d can move in the vertical direction with respect to the small-sized movable panel 37c by a distance equal to the height of the guide 39.

A right end of the small-sized movable panel 37d and a left end of the small-sized movable panel 37e are held by the guide 39. The small-sized movable panel 37e can move in the vertical direction with respect to the small-sized movable panel 37d by a distance equal to the height of the guide 39.

The wire 10b extends vertically upwardly from the hooks 10d attached to the small-sized movable panels 37a, 37e, and is led to the motor 10a via the plurality of pulleys 10c.

<OPERATION OF MOVABLE PANEL 37>

Prior to the start of operation, the motor 10a rotates, the wire 10b is wound up, and

the small-sized movable panels 37a, 37e are pulled up into the casing lower portion 4. When the small-sized movable panels 37a, 37e rise by a distance equal to the height of the guide 39, the small-sized movable panels 37b, 37d start rising and rise by a distance equal to the height of the guide 39. At this time, the control unit 13 detects by the position detecting means 14 that the height to which the small-sized movable panels 37a, 37e have risen becomes equal to the height of the two guides 39, and stops the motor 10a. Consequently, the small-sized movable panels 37a, 37b, 37d, and 37e are arranged in a downward convex pyramid shape with the small-sized movable panel 37c as the center of the shape, and the inlet 36 is opened.

When the operation of the indoor unit 31 is stopped, the motor 10a rotates backwards and the wire 10b is loosened. Then, first, the small-sized movable panels 37b, 37d descend by a distance equal to the height of the guide 39 and reach the inlet 36. Subsequently, the small-sized movable panels 37a, 37e further descend by a distance equal to the height of the guide 39 and reach the inlet 36. At this time, the control unit 13 detects by the position detecting means 14 that the small-sized movable panels 37a, 37e have reached the inlet 36, and stops the motor 10a. In this way, the inlet 36 is closed.

<CHARACTERISTICS OF THE THIRD EMBODIMENT>

With this indoor unit 31, the movable panel 37 is formed by the plurality of the small-sized movable panels 37a - 37e. The plurality of the small-sized movable panels 37a - 37e are horizontally arranged on the inlet 36, and thereby the inlet 36 is closed. During operation, the driving means 10 first raises the small-sized movable panels 37a, 37e at both ends, and subsequently raises the small-sized movable panels 37d, 37e. Thereby, the small-sized movable panels 37a - 37e are arranged in a downward convex pyramid shape, and the inlet 36 opens.

With this indoor unit 31, the inlet 36 is closed during non-operation and forms a planar portion. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel 35 improves. In addition, since the arrangement pattern of the movable panel 37 changes depending on an open state and a closed state of the inlet 36, the differentiation of the product can be induced by the visual effect in which the design changes. Accordingly, the appeal of the product in the market is promoted. In addition, since the movable panel 37 moves without protruding from the bottom panel 35, the external appearance of the bottom panel 35 does not become impaired.

<FOURTH EMBODIMENT>

<CONFIGURATION OF INDOOR UNIT 41>

Next, a fourth embodiment of the present invention is described. Note that the

elements same as those in the first embodiment are denoted by the same reference symbols, and the descriptions thereof are omitted. Figure 6(a) is a cross sectional view of an indoor unit according to the fourth embodiment during non-operation, and Figure 6(b) is a cross sectional view of the same indoor unit during operation.

A bottom panel 45 is disposed with an inlet 46 into which air is sucked, and the outlet 4d out of which air is blown. When an indoor unit 41 is not operated, the movable panel 47 completely closes the inlet 46 and thus the inlet 46 is not exposed.

The movable panel 47 is formed by a plurality of plate-shaped small-sized movable panels 47a - 47e. Guides 49 allow the small-sized movable panels 47a - 47e to move in the vertical direction but not in the horizontal direction.

The wire 10b extends vertically upwardly from the hooks 10d attached to the small-sized movable panel 47c, and is led to the motor 10a via the plurality of pulleys 10c.

<OPERATION OF MOVABLE PANEL 47>

Prior to the start of operation, the motor 10a rotates, the wire 10b is wound up, and the small-sized movable panel 47c is pulled up into the casing lower portion 4. First, the small-sized movable panel 47c rises by a distance equal to the height of the guide 49, and subsequently the small-sized movable panels 47b, 47d rise by a distance equal to the height of the guide 49. At this time, the height to which the small-sized movable panel 47c has risen is equal to the height of the two guides 49. At this point, since the small-sized movable panels 47a, 47e have not risen yet, the motor 10a further rotates and raises the small-sized movable panels 47a, 47e.

The control unit 13 detects by the position detecting means 14 that the small-sized movable panel 47c has risen to a predetermined height, and stops the motor 10a. Consequently, the small-sized movable panels 47a, 47b, 47d, and 47e are arranged in an upward convex pyramid shape with the small-sized movable panel 47c as the center, and the inlet 46 is opened.

When the operation of the indoor unit 41 is stopped, the motor 10a rotates backwards and the wire 10b is loosened. Then, first, the small-sized movable panels 47a, 47e descend and reach the inlet 46. Subsequently, the small-sized movable panels 47b, 47d further descend by a distance equal to the height of the guide 49 and reach the inlet 46. The small-sized movable panel 47c further descends by a distance equal to the height of the guide 49 and reaches the inlet 46. At this time, the control unit 13 detects by the position detecting means 14 that the small-sized movable panel 47c has reached the inlet 46, and stops the motor 10a. In this way, the inlet 46 is closed.

<CHARACTERISTICS OF THE FOURTH EMBODIMENT>

With this indoor unit 41, the movable panel 47 is formed by the plurality of small-sized movable panels 47a - 47e. The plurality of small-sized movable panels 47a - 47e are horizontally arranged on the inlet 46, and thereby the inlet 46 is closed. During operation, the driving means 10 first raises the small-sized movable panel 47c at the center of the movable panel 47, subsequently raises the small-sized movable panels 47b, 47d, and lastly raises the small-sized movable panels 47a, 47e. Thereby, the small-sized movable panels 47a - 47e are arranged in an upward convex pyramid shape, and the inlet 46 opens.

With this indoor unit 41, the inlet 46 is closed during non-operation and forms a planar portion. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel 45 improves. In addition, since the arrangement pattern of the movable panel 47 changes depending on an open state and a closed state of the inlet 46, the differentiation of the product can be induced by the visual effect in which the design changes. Accordingly, the appeal of the product in the market is promoted. In addition, since the movable panel 47 moves without protruding from the bottom panel 45, the external appearance of the bottom panel 45 does not become impaired.

<FIFTH EMBODIMENT>

<CONFIGURATION OF INDOOR UNIT 51>

Next, a fifth embodiment of the present invention is described. Note that the elements same as those in the first embodiment are denoted by the same reference symbols, and the descriptions thereof are omitted. Figure 7(a) is a cross sectional view of an indoor unit according to the fifth embodiment during non-operation, and Figure 7(b) is a cross sectional view of the same indoor unit during operation.

A bottom panel 55 is disposed with an inlet 56 into which air is sucked, and the outlet 4d out of which air is blown. When an indoor unit 51 is not operated, a movable panel 57 completely closes the inlet 56 and thus the inlet 56 is not exposed.

The movable panel 57 is formed by a first movable panel 58 and a second movable panel 59, and the first movable panel 58 and the second movable panel 59 can rotate in a direction into the casing 2.

In Figure 7(a), a left end of the first movable panel 58 is rotatably supported at a left end of the inlet 56 by a hinge mechanism. Likewise, a right end of the second movable panel 59 is rotatably supported at a right end of the inlet 56 by a hinge mechanism. A right end of the first movable panel 58 and a left end of the second movable panel 59 are disposed side by side on the inlet 56 and close the inlet 56.

The wire 10b extends vertically upwardly from the hooks 10d attached to the free end side of the first movable panel 58 and the second movable panel 59, and is led to the motor 10a via the plurality of pulleys 10c.

<OPERATION OF MOVABLE PANEL 57>

Prior to the start of operation, the motor 10a rotates, the wire 10b is wound up, and the free ends of the first movable panel 58 and the second movable panel 59 are pulled up into the casing lower portion 4. Consequently, the first movable panel 58 rotates counterclockwise about a left end 58a as an axis. Likewise, the second movable panel 59 rotates clockwise about a right end 59a as an axis.

The control unit 13 detects by the position detecting means 14 that the first movable panel 58 and the second movable panel 59 have rotated approximately 90 degrees, and stops the motor 10a. Consequently, the first movable panel 58 and the second movable panel 59 move in a double door opening manner and the inlet 56 is opened.

When the operation of the indoor unit 51 is stopped, the motor 10a rotates backwards and the wire 10b is loosened. Then, the free ends of the first movable panel 58 and the second movable panel 59 descend in the direction of the inlet 56. Consequently, the first movable panel 58 rotates clockwise about the left end 58a as an axis. Likewise, the second movable panel 59 rotates counterclockwise about the right end 59a as an axis.

The control unit 13 detects by the position detecting means 14 that the first movable panel 58 and the second movable panel 59 have reached the inlet 56, and stops the motor 10a. In this way, the inlet 56 is closed.

<CHARACTERISTICS OF THE FIFTH EMBODIMENT>

With this indoor unit 51, the movable panel 57 is formed by the first movable panel 58 and the second movable panel 59. The first movable panel 58 and the second movable panel 59 are both arranged on the inlet 56 in a freely rotatable manner. The first movable panel 58 and the second movable panel 59 are both horizontally arranged on the inlet 56, and thereby the inlet 56 is closed. The first movable panel 58 and the second movable panel 59 both rotate toward the inside of the casing lower portion 4, and thereby the inlet 56 is opened.

With this indoor unit 51, the inlet 56 is closed during non-operation and forms a planar portion. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel 55 improves. In addition, since the arrangement pattern of the movable panel 57 changes depending on an open state and a closed state of the inlet 56, the differentiation of the product can be induced by the visual effect in which the design changes. Accordingly, the appeal of the product in the market is

promoted. In addition, since the first movable panel 58 and the second movable panel 59 move without protruding from the bottom panel 55, the external appearance of the bottom panel 55 does not become impaired.

<SIXTH EMBODIMENT>

<CONFIGURATION OF INDOOR UNIT 61>

Next, a sixth embodiment of the present invention is described. Note that the elements same as those in the first embodiment are denoted by the same reference symbols, and the descriptions thereof are omitted. Figure 8(a) is a cross sectional view of an indoor unit according to the sixth embodiment during non-operation, and Figure 8(b) is a cross sectional view of the same indoor unit during operation.

A bottom panel 65 is disposed with an inlet 66 into which air is sucked, and the outlet 4d out of which air is blown.

When an indoor unit 61 is not operated, a movable panel 67 completely closes the inlet 66 and thus the inlet 66 is not exposed.

The movable panel 67 is formed by a first movable panel 68 and a second movable panel 69, and the first movable panel 68 and the second movable panel 69 can rotate in a direction into the casing 2.

In Figure 8(a), a right end 68a of the first movable panel 68 and a left end 69a of the second movable panel 69 are rotatably supported on the inlet 66 by a hinge mechanism.

The wire 10b extends upwardly from a left end 68b of the first movable panel 68 and a right end 69b of the second movable panel 69, and is led to the motor 10a via the plurality of pulleys 10c.

<OPERATION OF MOVABLE PANEL 67>

Prior to the start of operation, the motor 10a rotates, the wire 10b is wound up, and the left end 68b of the first movable panel 68 and the right end 69b of the second movable panel 69 are pulled up into the casing lower portion 4. Consequently, the first movable panel 68 rotates clockwise about the right end 68a as an axis. Likewise, the second movable panel 69 rotates counterclockwise about the left end 69a as an axis.

The control unit 13 detects by the position detecting means 14 that the first movable panel 68 and the second movable panel 69 have rotated 90 degrees, and stops the motor 10a. Consequently, the first movable panel 68 and the second movable panel 69 move in a folding movement and the inlet 66 is opened.

When the operation of the indoor unit 61 is stopped, the motor 10a rotates backwards and the wire 10b is loosened. The left end 68b of the first movable panel 68 and

the right end 69b of the second movable panel 69 descend in the direction of the inlet 66. Consequently, the first movable panel 68 rotates counterclockwise about the right end 68a as an axis. Likewise, the second movable panel 69 rotates clockwise about the left end 69a as an axis.

The control unit 13 detects by the position detecting means 14 that the left end 68b of the first movable panel 68 and the right end 69b of the second movable panel 69 have reached the inlet 66, and stops the motor 10a. In this way, the inlet 66 is closed.

<CHARACTERISTICS OF THE SIXTH EMBODIMENT>

With this indoor unit 61, the movable panel 67 is formed by the first movable panel 68 and the second movable panel 69. The first movable panel 68 and the second movable panel 69 are both arranged on the inlet 66 in a freely rotatable manner. The first movable panel 68 and the second movable panel 69 are both horizontally arranged on the inlet 66, and thereby the inlet 66 is closed. The first movable panel 68 and the second movable panel 69 both rotate toward the inside of the casing lower portion 4, and thereby the inlet 66 is opened.

With this indoor unit 61, the inlet 66 is closed during non-operation and forms a planar portion. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel 65 improves. In addition, since the arrangement pattern of the movable panel 67 changes depending on an open state and a closed state of the inlet 66, the differentiation of the product can be induced by the visual effect in which the design changes. Accordingly, the appeal of the product in the market is promoted. In addition, since the first movable panel 68 and the second movable panel 69 move without protruding from the bottom panel 65, the external appearance of the bottom panel 65 does not become impaired.

<SEVENTH EMBODIMENT>

<CONFIGURATION OF INDOOR UNIT 71>

Next, a seventh embodiment of the present invention is described. Note that the elements same as those in the first embodiment are denoted by the same reference symbols, and the descriptions thereof are omitted. Figure 9(a) is a cross sectional view of an indoor unit according to the seventh embodiment during non-operation, and Figure 9(b) is a cross sectional view of the same indoor unit during operation.

A bottom panel 75 is disposed with an inlet 76 into which air is sucked, and an outlet 78 out of which air is blown. When an indoor unit 71 is not operated, a first movable panel 77 closes the inlet 76, and a second movable panel 79 closes the outlet 78. Thus, the inlet 76 and the outlet 78 are not exposed from the bottom panel 75.

The first movable panel 77 moves in the vertical direction, thereby opening and closing the inlet 76. The second movable panel 79 moves in the horizontal direction, thereby opening and closing the outlet 78.

The driving means 10 includes the motor 10a, the wire 10b, the plurality of pulleys 10c, and the plurality of hooks 10d, and moves the first movable panel 77.

Further, the driving means 10 includes another motor 10a, a ball screw 10e, and slide screws 10f, 10g, and moves the second movable panel 79.

<OPERATION OF MOVABLE PANELS 77, 79>

When the operation of the indoor unit 71 is stopped, the first movable panel 77 closes the inlet 76, and the second movable panel 79 closes the outlet 78. Therefore, only the peripheral boundaries of the first movable panel 77 and the second movable panel 79 are visible on the bottom panel 75.

When the indoor unit 71 is about to start operating, prior to the start of operation, the motor 10a rotates, the wire 10b is wound up, and the first movable panel 77 is pulled up into the casing lower portion 4. In addition, when the indoor unit 71 is about to start operating, prior to the start of operation, the other motor 10a rotates the ball screw 10e and moves the slide screw 10f and the slide screw 10g in a sliding manner toward the center of the bottom panel 75.

In the front view of Figure 9(a), the slide screw 10f is connected to the second movable panel 79 on the left, and the second movable panel 79 on the left moves to the right as the ball screw 10e rotates. In addition, in the front view of Figure 9(a), the slide screw 10g is connected to the second movable panel 79 on the right, and the second movable panel 79 on the right moves to the left as the ball screw 10e rotates. Note that the control unit 13 detects by the position detecting means 14 that the first movable panel 77 has risen to a predetermined height, and stops the motor 10a.

Further, the control unit 13 detects by the position detecting means 14 that the second movable panel 79 has moved to a predetermined position, and stops the other motor 10a.

When the operation of the indoor unit 71 is stopped, the motor 10a rotates backwards, the wire 10b is loosened, the first movable panel 77 descends, thereby closing the inlet 76. Further, the other motor 10a rotates backward. In the front view of Figure 9(a), as the ball screw 10e rotates backward, the second movable panel 79 on the left moves to the left, and the second movable panel 79 on the right moves to the right, thereby closing the outlet 78.

Note that the control unit 13 detects by the position detecting means 14 that the first movable panel 77 has reached the inlet 76, and stops the motor 10a. Further, the control unit 13 detects by the position detecting means 14 that the second movable panel 79 has reached the original position, and stops the other motor 10a.

<CHARACTERISTICS OF THE SEVENTH EMBODIMENT>

(1)

The indoor unit 71 is equipped with the casing 2 embedded in a ceiling and the bottom panel 75 exposed from a ceiling surface. The bottom panel 75 is disposed with the inlet 76 into which air is sucked, and the outlet 78 out of which air is blown. The driving means 10 moves the first movable panel 77 in the vertical direction without causing the first movable panel 77 to protrude from the bottom panel 75, thereby opening and closing the inlet 76. Further, the driving means 10 moves the second movable panel 79 in the horizontal direction without causing the second movable panel 79 to protrude from the bottom panel 75, thereby opening and closing the outlet 78. The filter 9 is housed in the casing 2, and is arranged away from the bottom panel 75.

With this indoor unit 71, the inlet 76 and the outlet 78 are closed during non-operation and forms a planar portion. Accordingly, the percentage of the planar portion without an opening increases and the flexibility of the design of the bottom panel 75 improves. In addition, since the first movable panel 77 and the second movable panel 79 move without protruding from the bottom panel 75, the external appearance of the bottom panel 75 does not become impaired. In addition, the shape of the bottom panel 75 is hardly limited by the filter 9 and the flexibility of the design of the bottom panel 75 improves. Further, since the filter 9 is located at a position that is not noticeable by people, contamination on the filter 9 does not impair the external appearance of the bottom panel 75.

<OTHER EMBODIMENT>

While the present invention has been described, the specific configuration is not limited to the above-described embodiments, and various changes and modifications can be made herein without departing from the scope of the invention.

For example, in the above embodiments, the driving means 10 is constituted by the motor 10a, the wire 10b, and the pulleys 10c, however, the driving means 10 may be constituted by a motor and a gear.

INDUSTRIAL APPLICABILITY

As described above, the indoor unit of the present invention is useful as an indoor unit of a ceiling-embedded type or ceiling-suspended type air conditioner in which the

flexibility of the design of a bottom panel thereof is desired to be improved.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An indoor unit of a ceiling-embedded type or ceiling-suspended type air conditioner including:

a bottom panel constituting a bottom surface;

an inlet disposed to the bottom panel;

a movable panel configured to close the inlet during non-operation; and

a driving means configured to move or rotate the movable panel,

wherein

during operation, the movable panel moves or rotates and recedes above a bottom surface of the bottom panel.

2. The indoor unit of an air conditioner according to claim 1, further including

a fan configured to suck air from the inlet; and

a filter configured to remove dust in air sucked from the inlet,

wherein

the filter is connected to the movable panel, and moves to a predetermined mounting position of the filter along with the movement of the movable panel.

3. The indoor unit of an air conditioner according to claim 1 or claim 2, wherein the movable panel is formed by a plurality of small-sized movable panels, and

during operation, the plurality of small-sized movable panels move and are arranged in a pyramid shape above a bottom surface of the bottom panel.

4. The indoor unit of an air conditioner according to any one of the preceding claims, wherein

the movable panel is formed by at least a first movable panel and a second movable panel, and

during operation, the first movable panel and the second movable panel rotate and open upwardly above a bottom surface of the bottom panel.

5. The indoor unit of an air conditioner according to any one of the preceding claims further including:

an outlet disposed to the bottom panel; and

a second movable panel configured to close the outlet during non-operation,

wherein

during operation, the first movable panel moves or rotates and recedes above a bottom surface of the bottom panel, and

during operation, the second movable panel moves or rotates away from the outlet.

6. The indoor unit of an air conditioner according to claim 5, wherein

2007241895 01 May 2008

during operation, the second movable panel moves in a parallel manner toward the center of the bottom panel.

7. The indoor unit of an air conditioner according to any one of the preceding claims, wherein

the driving means uses a motor as a driving source.

8. The indoor unit of an air conditioner according to any one of the preceding claims, wherein

the bottom panel and the driving means are provided as a set of assembly.

9. An indoor unit of a ceiling-embedded type or ceiling-suspended type air conditioner substantially as hereinbefore described with any one of the embodiments and/or any one of the accompanying figures.

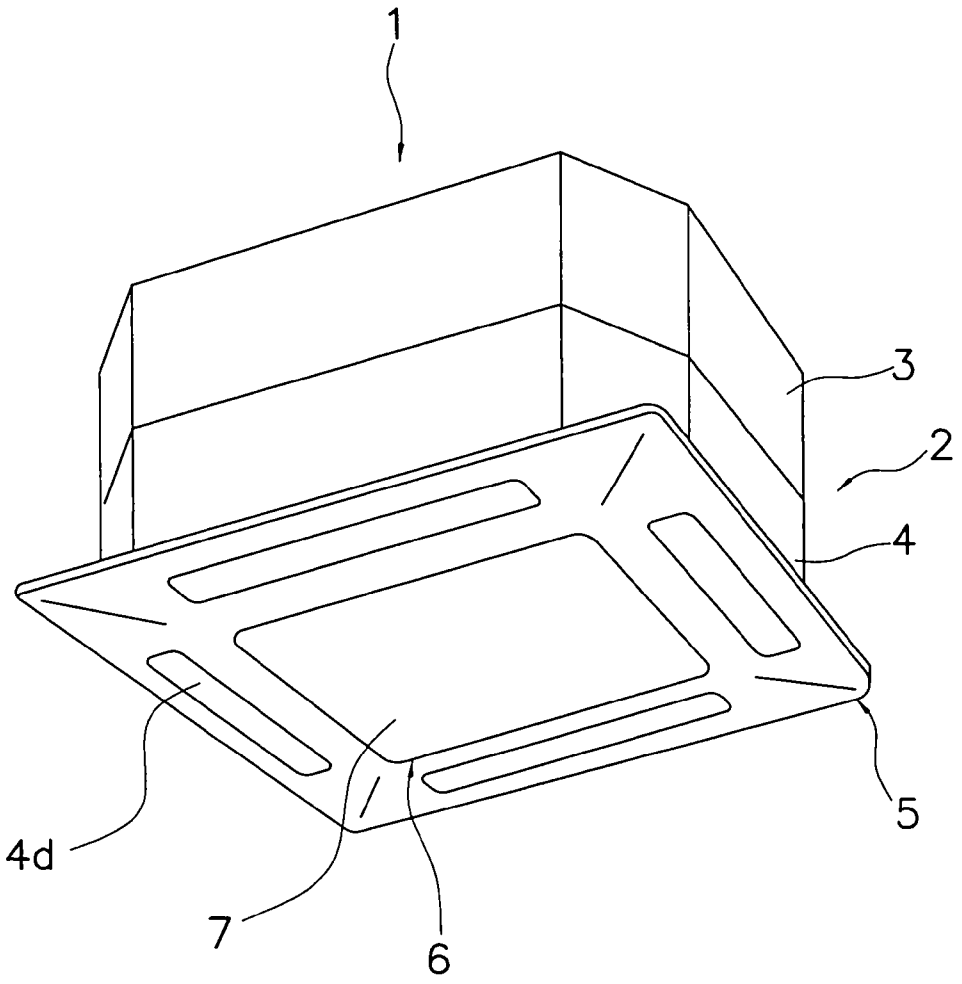
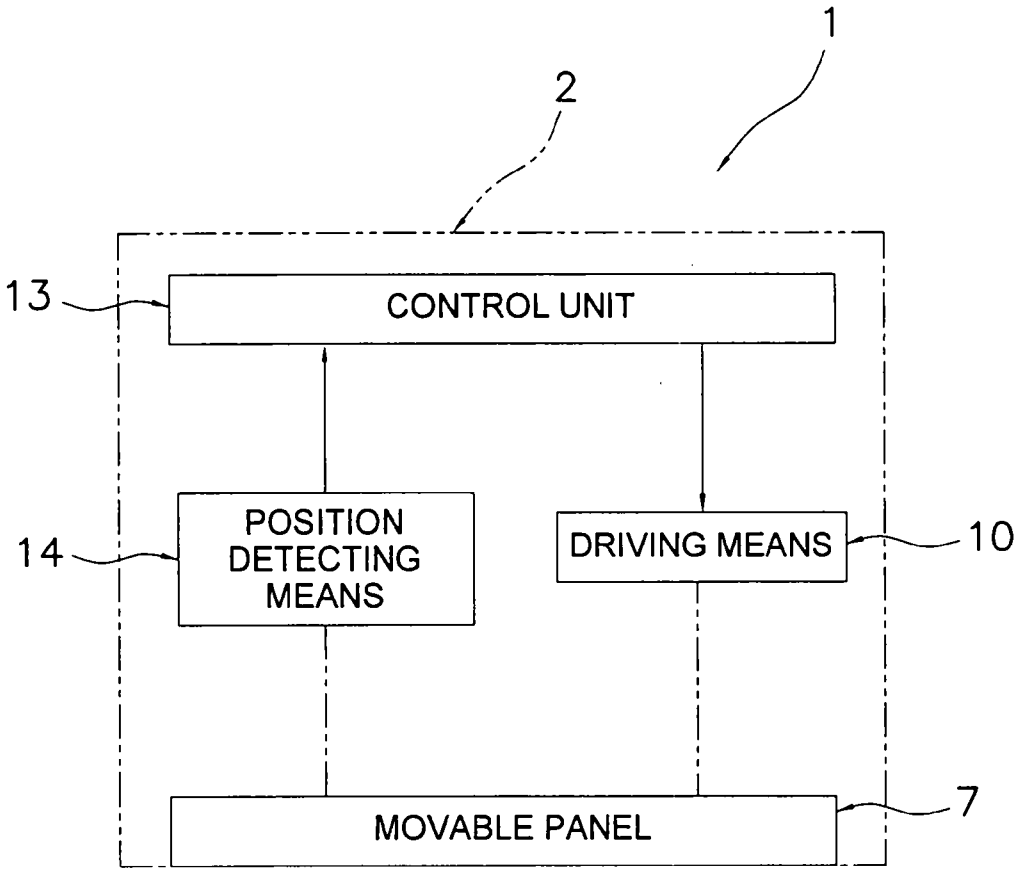


Fig. 1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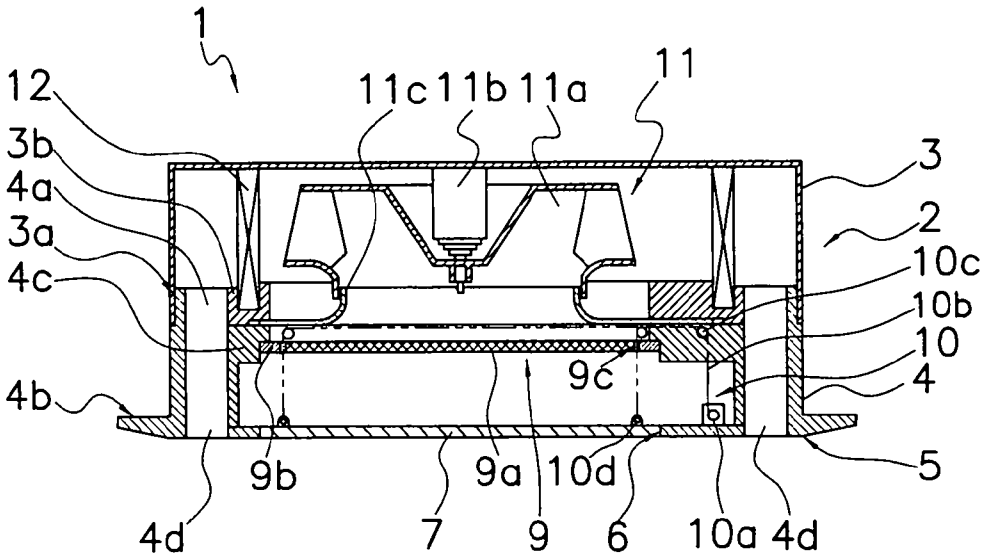
CONTROL UNIT
14
POSITION DETECTING MEANS
DRIVING MEANS
10
MOVABLE PANEL
7

Fig. 2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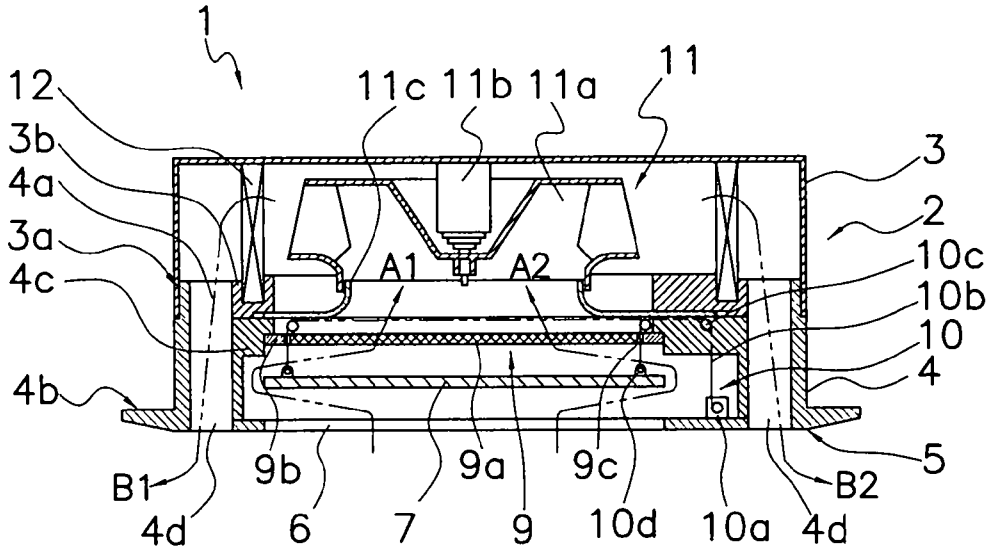
(a)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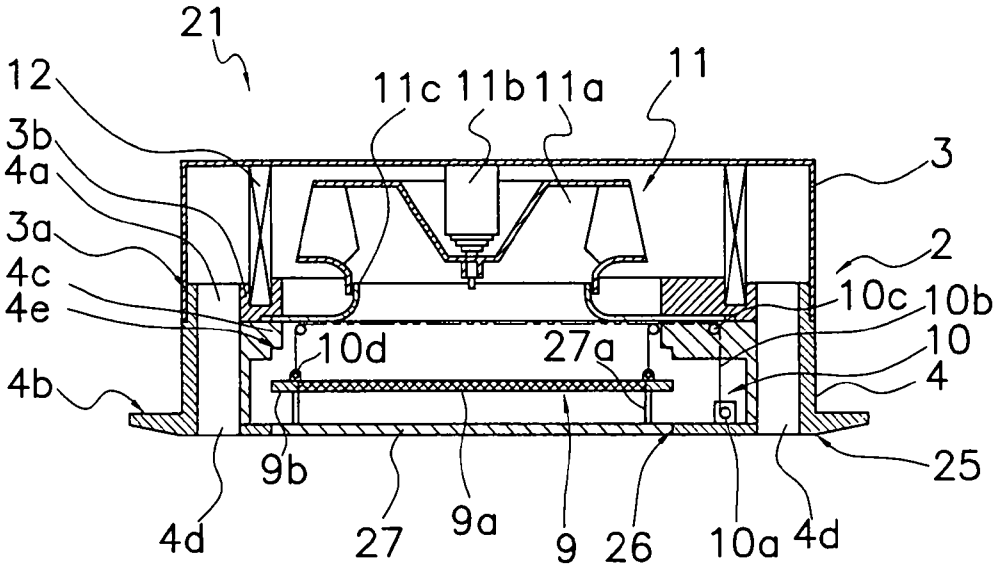
(b)

Fig. 3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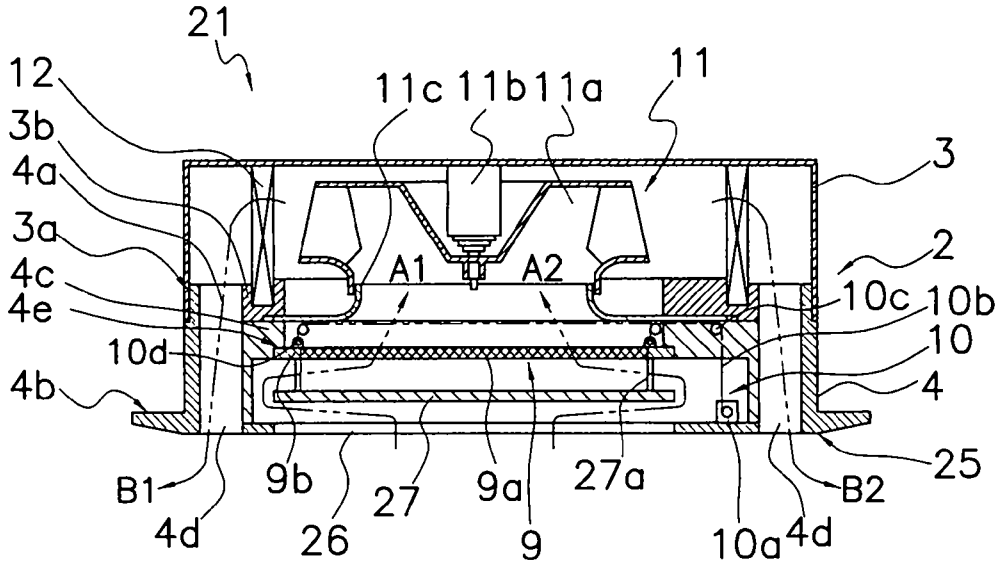
(a)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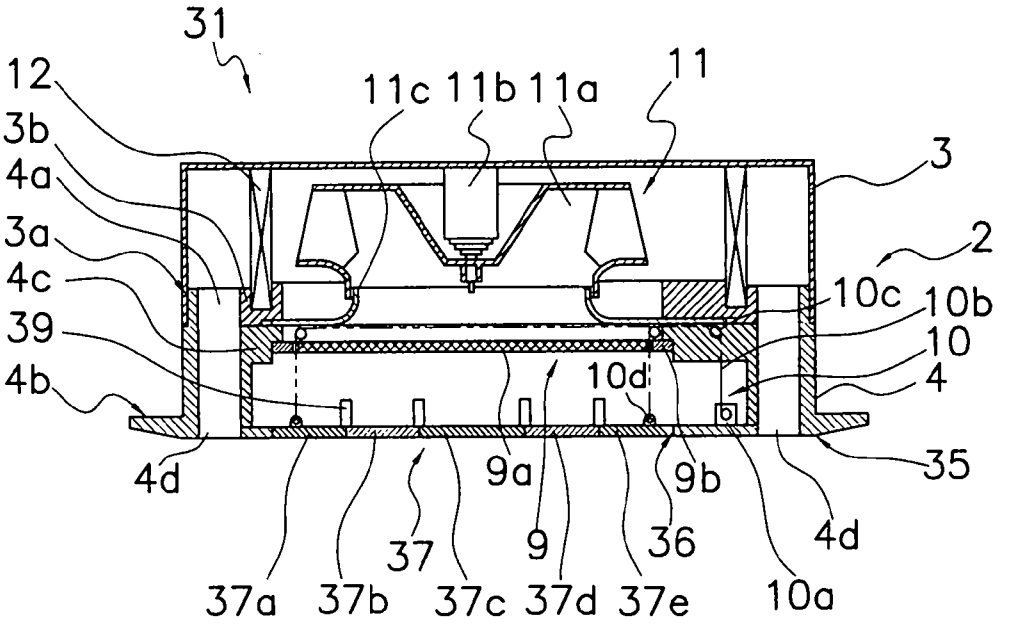
4d

(b)

Fig. 4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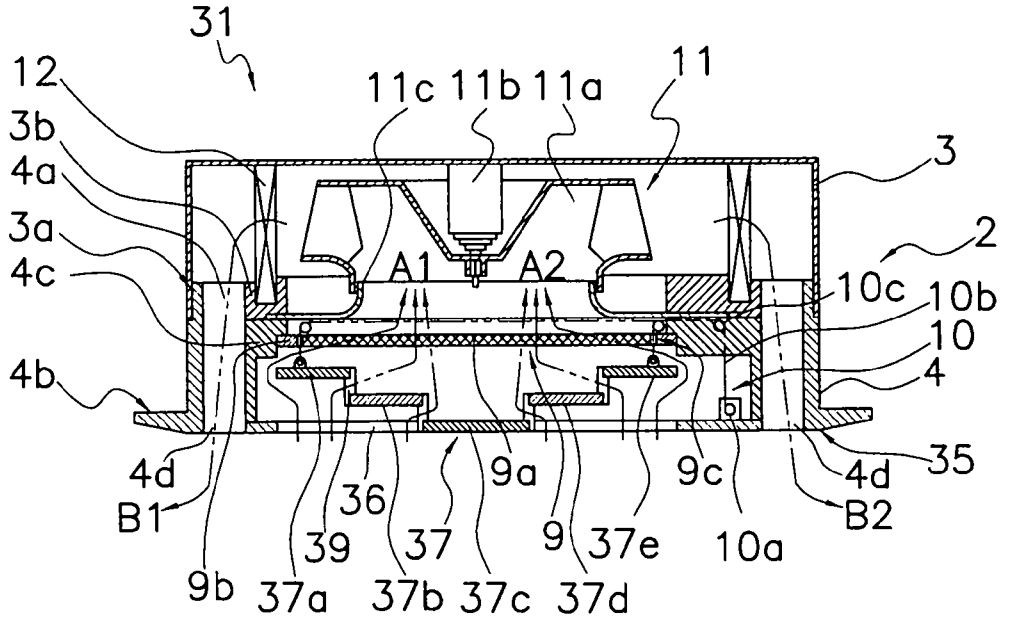
10a

(a)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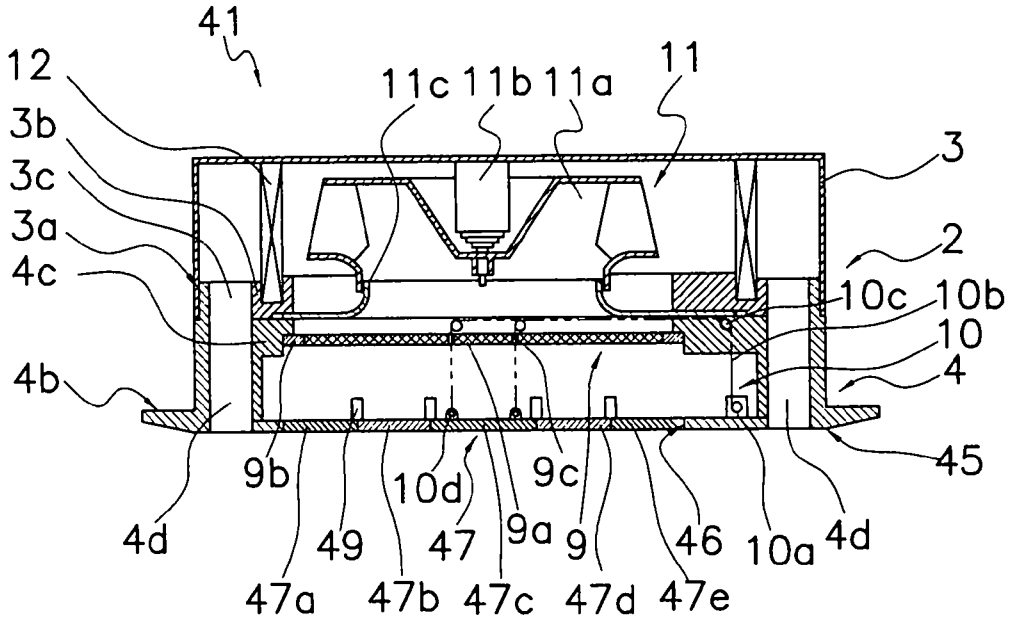
(b)

Fig. 5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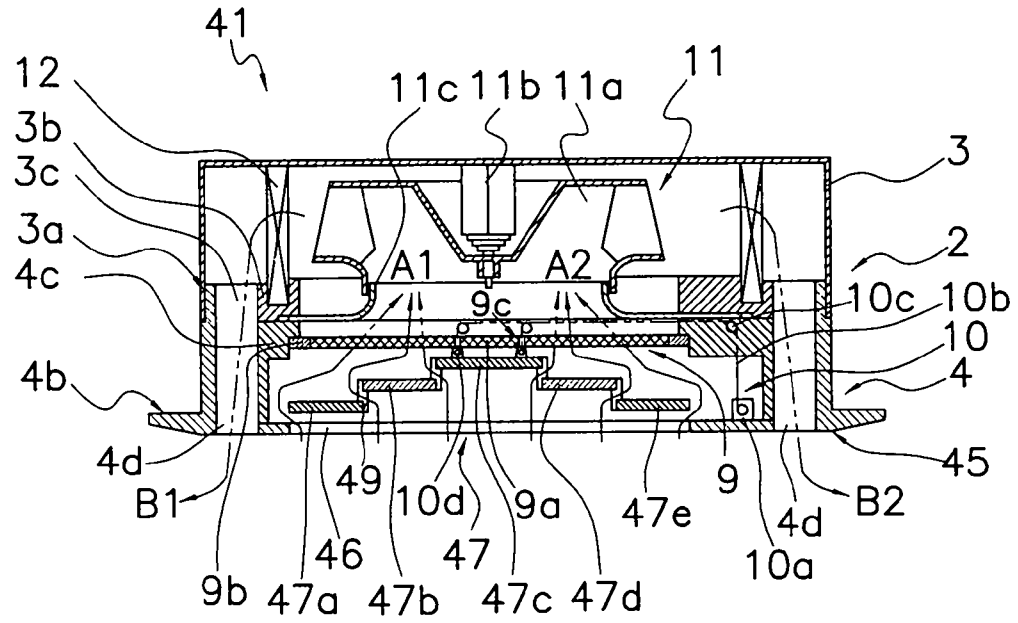
47d
47e

(a)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10b
10
4
45
4d
B1
49
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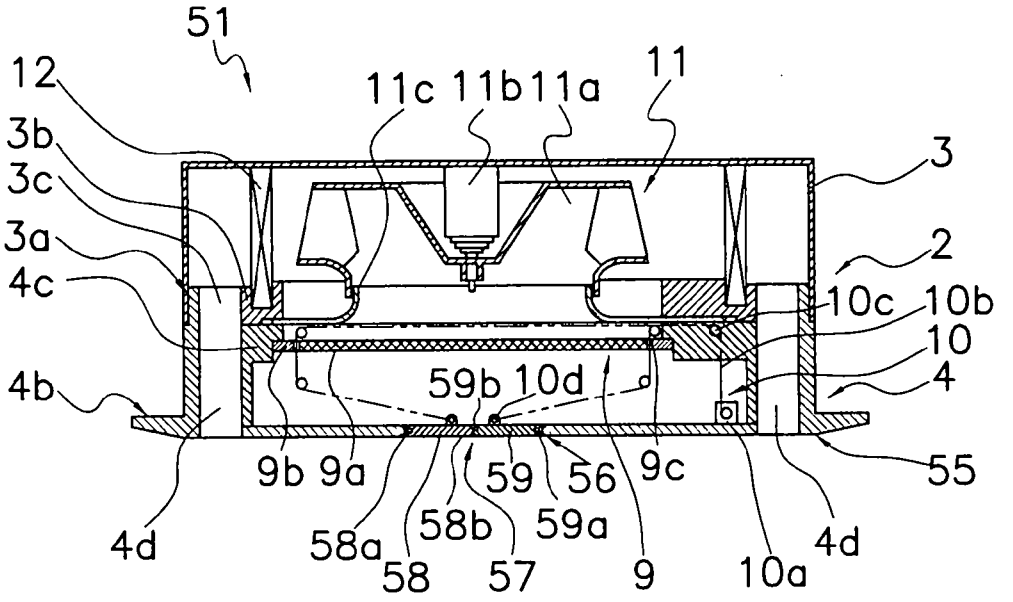
47b
47c
47d

(b)

Fig. 6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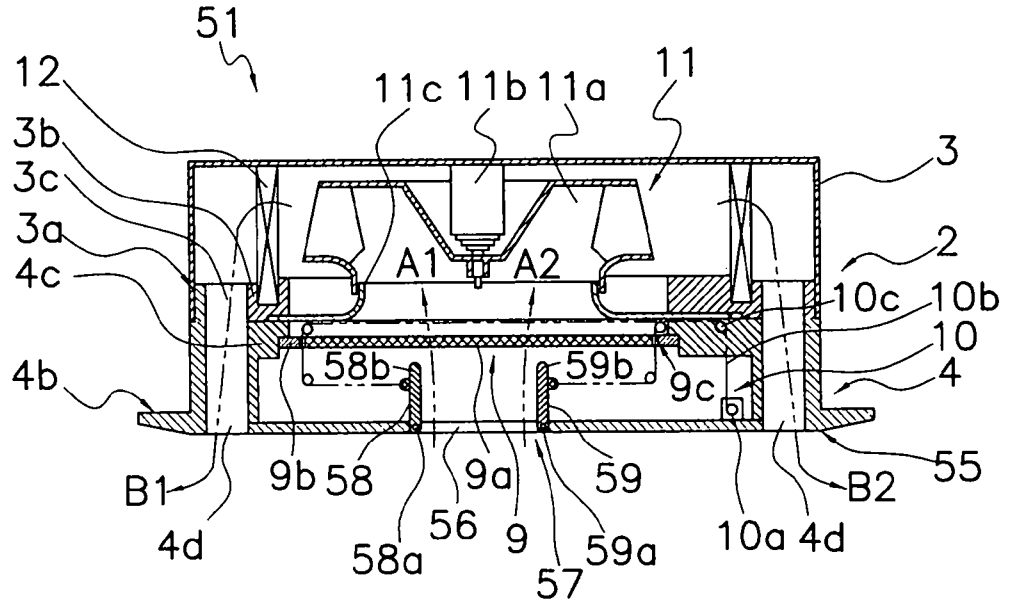
4d

(a)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58b
59b
9c
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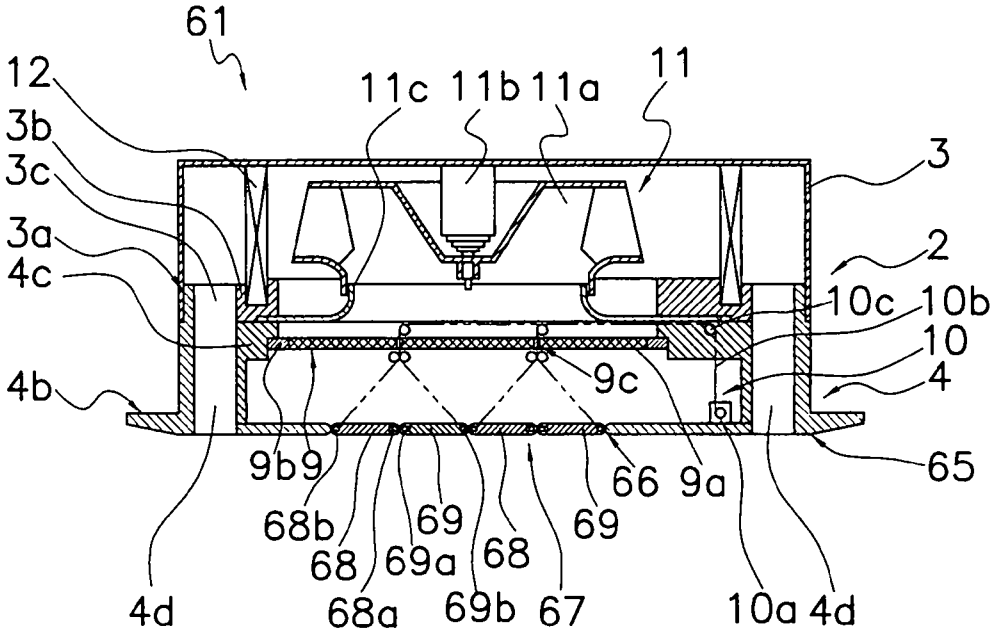
59a
10a 4d
57

(b)

Fig. 7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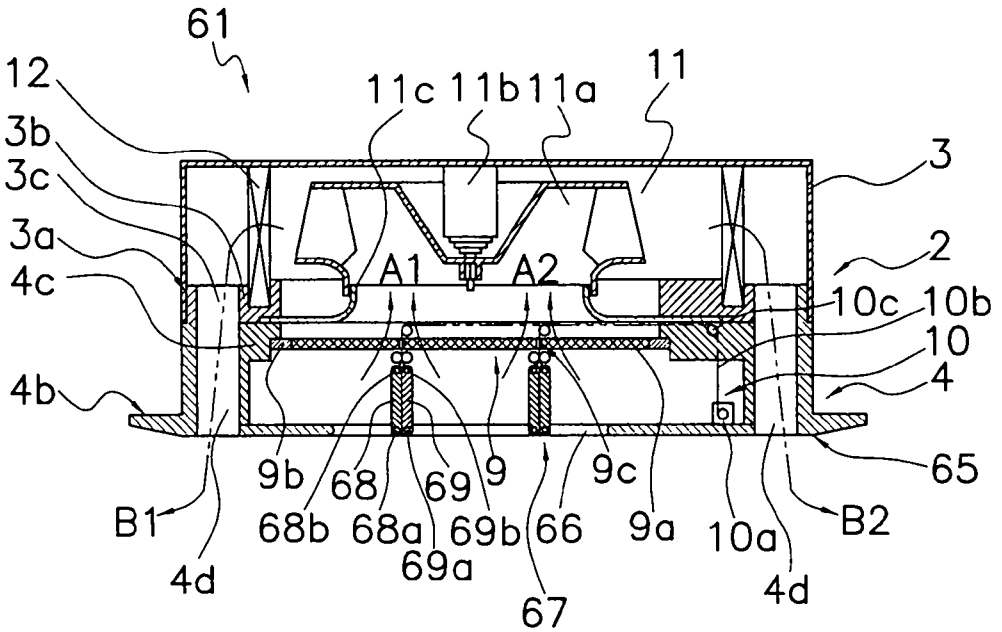
4d

(a)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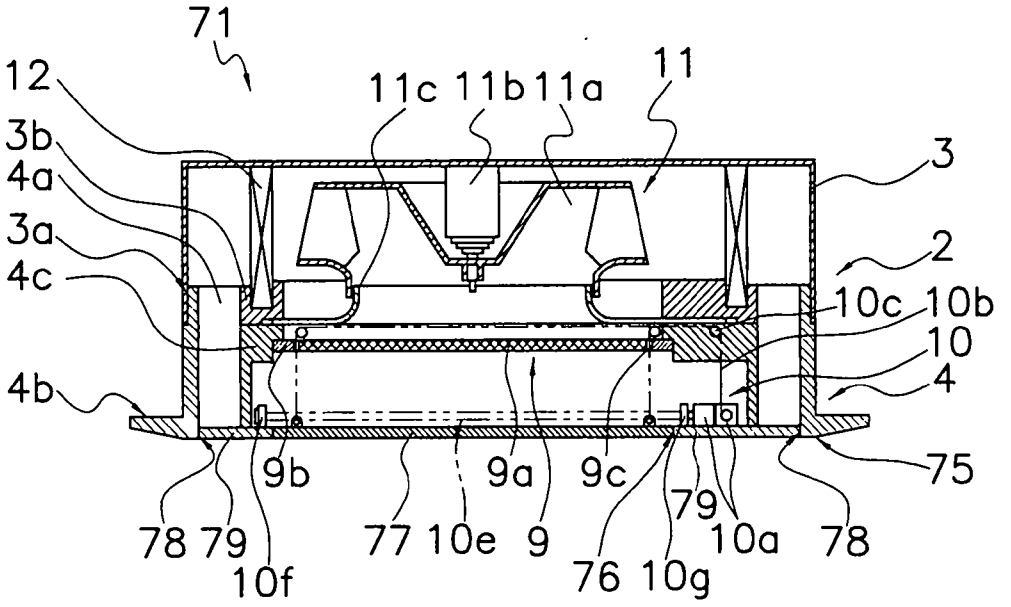
(b)

Fig. 8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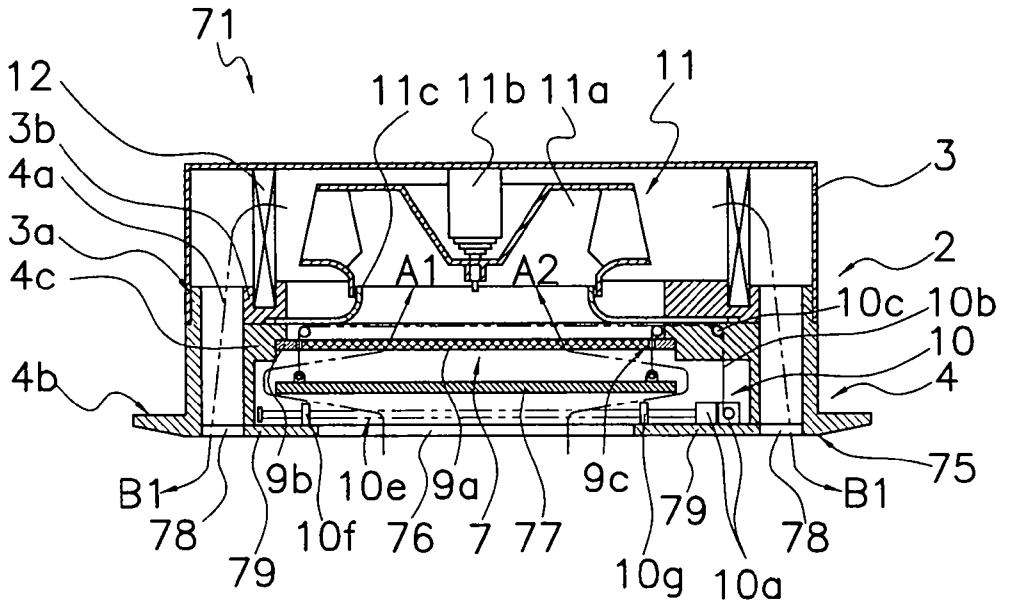
77 10e
9
10a
78
10f
76 10g

(a)


71
12
11c 11b 11a
11
3b
4a
3a
4c
3
2
A1
A2
10c 10b
10
4
4b
75
B1
9b
10e
9a
9c
79
B1
78
10f
76
7
77
78
79
10g
10a

(b)

Fig. 9