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(54) **DECORATIVE PANEL FOR AIR CONDITIONER, AND IN-ROOM UNIT**

(57) A decorative panel (40) is attached to a lower portion of an indoor unit body (30) inserted and installed in an opening (O) of a ceiling (U). A panel body (41) of the decorative panel (40) includes a panel central portion (400) having an inlet (401a) and an outlet (402a) and covering a lower surface of the indoor unit body (30), and a panel extension portion (404) extending from the entire periphery of the panel central portion (400) along a ceiling surface (U1). A movement restrictor (60) for restricting movement of water from an outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1) is provided on an outer peripheral surface (404a) of the panel extension portion (404), and is formed along an outer periphery of the panel extension portion (404).

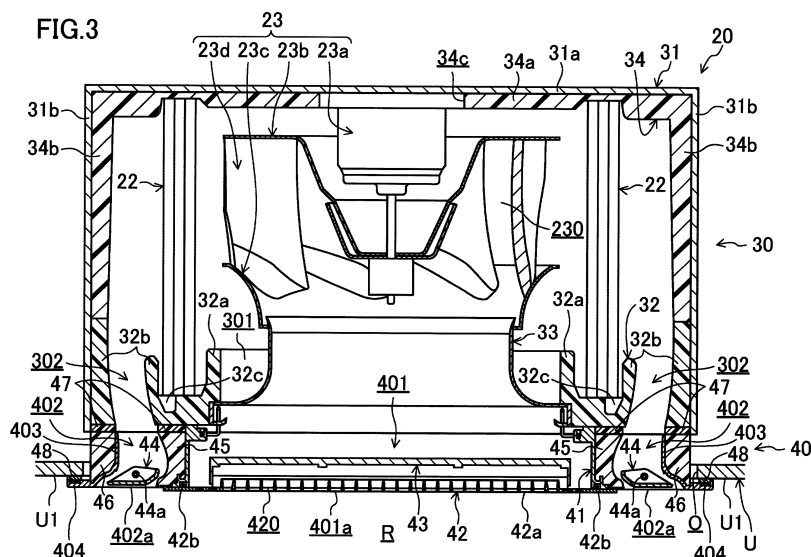
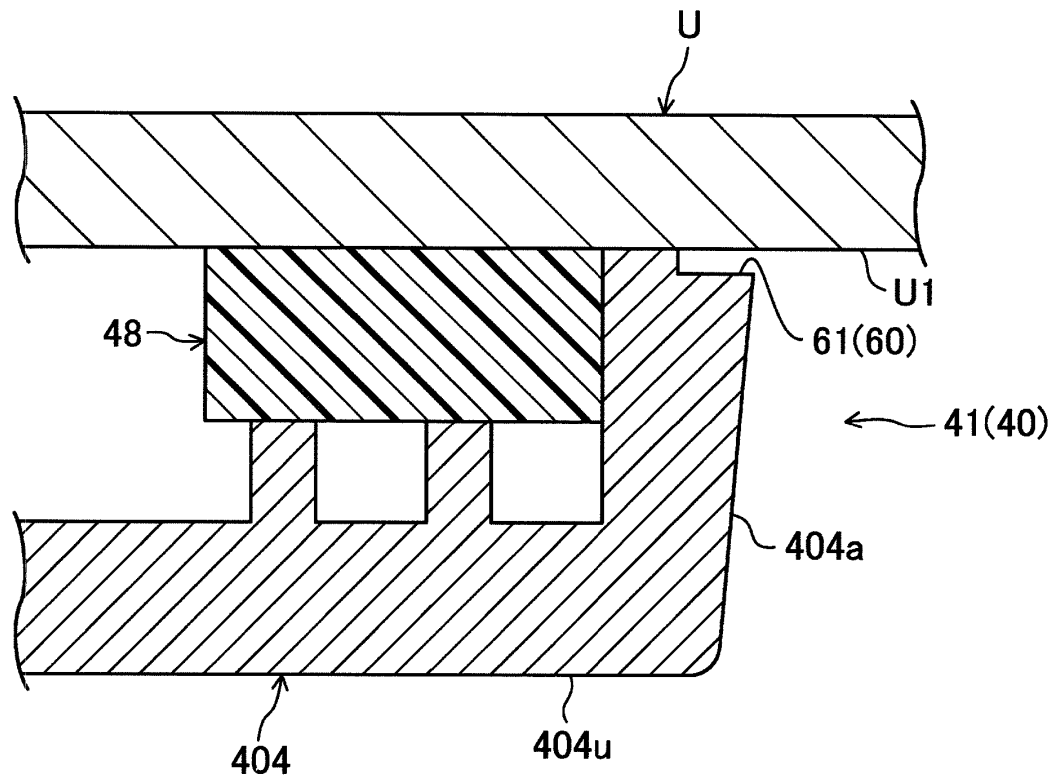


FIG.6



Description

TECHNICAL FIELD

[0001] This invention relates to a decorative panel for an air conditioner, and an indoor unit for an air conditioner including the decorative panel, and more particularly relates to a decorative panel attached to a lower portion of an indoor unit body inserted into an opening in a ceiling.

BACKGROUND ART

[0002] It has been conventionally known to arrange, in a ceiling, an indoor unit for an air conditioner. For example, Patent Documents 1 and 2 describe an indoor unit that includes an indoor unit body housing therein an indoor fan, an indoor heat exchanger, and other components and embedded in a ceiling, and a decorative panel attached to a lower portion of the indoor unit body.

CITATION LIST

PATENT DOCUMENT

[0003]

PATENT DOCUMENT 1: Japanese Unexamined Patent Publication No. H07-127878

PATENT DOCUMENT 2: Japanese Unexamined Utility Model (Registration) Publication No. S64-35327

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0004] Unfortunately, if condensation occurs on a peripheral protrusion portion of the decorative panel of the indoor unit of each of Patent Documents 1 and 2 (a portion thereof protruding along the ceiling surface), condensed water that has adhered to the peripheral protrusion portion of the decorative panel may penetrate the ceiling surface. In this situation, the penetration of the condensed water may degrade the ceiling surface.

[0005] It is therefore an object of this invention to provide a decorative panel that can reduce the penetration of condensed water from its peripheral protrusion portion into the ceiling surface, and an indoor unit including the decorative panel.

SOLUTION TO THE PROBLEM

[0006] A first aspect of the invention provides a decorative panel (40) for an air conditioner (1), attached to a lower portion of an indoor unit body (30) inserted and installed in an opening (O) of a ceiling (U). The decorative panel (40) includes: a panel body (41) including a panel central portion (400) having an inlet (401a) and an outlet

(402a) and covering a lower surface of the indoor unit body (30), and a panel extension portion (404) extending from an entire periphery of the panel central portion (400) along a ceiling surface (U1). A movement restrictor (60) for restricting movement of water from an outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1) is provided on an outer peripheral surface (404a) of the panel extension portion (404), and is formed along an outer periphery of the panel extension portion (404).

[0007] According to the first aspect of the invention, the movement restrictor (60) formed on the outer peripheral surface (404a) of the panel extension portion (404) allows for restricting the movement of condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1).

[0008] According to a second aspect of the invention which is an embodiment of the decorative panel of the first aspect of the invention, the movement restrictor (60) may be configured as a notch (61) formed along an upper end of the outer peripheral surface (404a) of the panel extension portion (404).

[0009] According to the second aspect of the invention, the notch (61) formed along the upper end of the outer peripheral surface (404a) of the panel extension portion (404) allows for forming a clearance between the ceiling surface (U1) and the outer peripheral surface (404a) of the panel extension portion (404). Thus, the movement of condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1) is restricted.

[0010] According to a third aspect of the invention which is an embodiment of the decorative panel of the first aspect of the invention, the movement restrictor (60) may be configured as a groove (62) extending along an upper end portion of the outer peripheral surface (404a) of the panel extension portion (404).

[0011] According to the third aspect of the invention, the groove (62) formed to extend along the upper end portion of the outer peripheral surface (404a) of the panel extension portion (404) allows for restricting the movement of condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1).

[0012] According to a fourth aspect of the invention which is an embodiment of the decorative panel of any one of the first through third aspects of the invention, a lower surface (404u) of the panel extension portion (404) may be flat, and the outer peripheral surface (404a) of the panel extension portion (404) may be formed to substantially vertically extend from the lower surface (404u) of the panel extension portion (404) toward the ceiling surface (U1).

[0013] According to the fourth aspect of the invention, the outer peripheral surface (404a) of the panel extension portion (404) is formed to substantially vertically extend from the lower surface (404u) of the panel extension portion (404) toward the ceiling surface (U1), thereby reduc-

ing the area of the decorative panel (40) as viewed in plan.

[0014] A fifth aspect of the invention provides an indoor unit (20) for an air conditioner (1). The indoor unit (20) includes: an indoor unit body (30) inserted and installed in an opening (O) of a ceiling (U); and a decorative panel (40) attached to a lower portion of the indoor unit body (30). The decorative panel (40) is configured as the decorative panel (40) of any one of the first through fourth aspects of the invention.

[0015] According to the fifth aspect of the invention, even if condensation occurs on the outer peripheral surface (404a) of the panel extension portion (404) of the decorative panel (40), the penetration of condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) into the ceiling surface (U1) can be reduced.

ADVANTAGES OF THE INVENTION

[0016] According to the first through third aspects of the invention, the movement of condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1) can be restricted. Thus, even if condensation occurs on the outer peripheral surface (404a) of the panel extension portion (404), the penetration of condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) into the ceiling surface (U1) can be reduced.

[0017] According to the fourth aspect of the invention, the area of the decorative panel (40) as viewed in plan can be reduced, and the decorative panel (40) can be downsized.

[0018] According to the fifth aspect of the invention, the penetration of condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) into the ceiling surface (U1) can be reduced. Thus, degradation of the ceiling surface (U1) due to the penetration of condensed water (W) therein can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

[FIG. 1] FIG. 1 is a piping system diagram for explaining a configuration for an air conditioner.

[FIG. 2] FIG. 2 is a general perspective view illustrating the appearance of an indoor unit.

[FIG. 3] FIG. 3 is a general longitudinal cross-sectional view for explaining the structure of the indoor unit.

[FIG. 4] FIG. 4 is a general plan view for explaining the structure of the indoor unit.

[FIG. 5] FIG. 5 is a general plan view for explaining the structure of a decorative panel.

[FIG. 6] FIG. 6 is a general longitudinal cross-sectional view for explaining the structure of a panel extension portion.

[FIG. 7] FIG. 7 is a general fragmentary longitudinal

cross-sectional view for explaining a mechanism by which condensation occurs.

[FIG. 8] FIG. 8 is a general fragmentary plan view for explaining the mechanism by which condensation occurs.

[FIG. 9] FIG. 9 is a general partial longitudinal cross-sectional view for explaining a variation of a movement restrictor.

DESCRIPTION OF EMBODIMENTS

[0020] An embodiment of this invention will now be described in detail with reference to the drawings. Note that like reference characters denote the same or equivalent components in the drawings, and the description thereof will not be repeated.

(Air Conditioner)

[0021] FIG. 1 shows an exemplary configuration for an air conditioner (1). This air conditioner (1) cools and heats the inside of a room, and includes an outdoor unit (10) installed outside the room, and an indoor unit (20) installed in the room. The outdoor and indoor units (10) and (20) are connected together via a liquid communication pipe (P1) and a gas communication pipe (P2), thereby constituting a refrigerant circuit (C). This refrigerant circuit (C) performs a vapor compression refrigeration cycle by circulating a refrigerant that fills the refrigerant circuit (C).

[Outdoor Unit]

[0022] The outdoor unit (10) includes a compressor (11), an outdoor heat exchanger (12), an outdoor expansion valve (13), a four-way switching valve (14), a liquid stop valve (V1) connected to one end of the liquid communication pipe (P1), and a gas stop valve (V2) connected to one end of the gas communication pipe (P2). Also, an outdoor fan (15) for transferring outdoor air to the outdoor heat exchanger (12) is provided in the vicinity of the outdoor heat exchanger (12). In this example, the outdoor fan (15) is configured as a propeller fan, and includes an outdoor fan motor (15a) as its power source. The outdoor fan motor (15a) is capable of varying its rotational speed using an inverter device (not shown).

[0023] The compressor (11) compresses a low-pressure refrigerant, and discharges the compressed refrigerant as a high-pressure refrigerant. In this example, the compressor (11) includes a scroll, rotary, or any other suitable type of compression mechanism, and a compressor motor (11a) for driving the compression mechanism. The compressor motor (11a) is capable of varying its rotational speed (operating frequency) using an inverter device (not shown).

[0024] The outdoor heat exchanger (12) is configured to make outdoor air transferred by the outdoor fan (15) exchange heat with a refrigerant flowing through the out-

door heat exchanger (12). The outdoor heat exchanger (12) is configured as a fin-and-tube heat exchanger, for example.

[0025] The outdoor expansion valve (13) is connected between a liquid-side end of the outdoor heat exchanger (12) and the liquid stop valve (V1), and decompresses a refrigerant passing through the outdoor expansion valve (13). The outdoor expansion valve (13) is configured as an electronic expansion valve with a variable degree of opening, for example.

[0026] The four-way switching valve (14) has first through fourth ports. In the four-way switching valve (14), the first port is connected to a discharge side end of the compressor (11), the second port is connected to a suction side end of the compressor, the third port is connected to a gas-side end of the outdoor heat exchanger (12), and the fourth port is connected to the gas stop valve (V2). In addition, the four-way switching valve (14) can switch between a first state (the state indicated by the solid lines in FIG. 1) and a second state (the state indicated by the broken lines in FIG. 1). In the first state, the first and third ports of the four-way switching valve (14) communicate with each other, and the second and fourth ports thereof communicate with each other. In the second state, the first and fourth ports of the four-way switching valve (14) communicate with each other, and the second and third ports thereof communicate with each other.

[Indoor Unit]

[0027] The indoor unit (20) includes an indoor expansion valve (21), and an indoor heat exchanger (22). An indoor fan (23) for transferring indoor air to the indoor heat exchanger (22) is provided in the vicinity of the indoor heat exchanger (22). In this example, the indoor fan (23) is configured as a centrifugal blower, and includes an indoor fan motor (23a) as its power source. The indoor fan motor (23a) is capable of varying its rotational speed using an inverter device (not shown).

[0028] The indoor expansion valve (21) is connected between the other end of the liquid communication pipe (P1) and a liquid-side end of the indoor heat exchanger (22), and decompresses a refrigerant passing through the indoor expansion valve (21). The indoor expansion valve (21) is configured as an electronic expansion valve with a variable degree of opening, for example.

[0029] The indoor heat exchanger (22) is configured to make indoor air transferred by the indoor fan (23) exchange heat with a refrigerant flowing through the indoor heat exchanger (22). In this example, the indoor heat exchanger (22) is configured as a fin-and-tube heat exchanger. Also, a gas-side end of the indoor heat exchanger (22) is connected to the other end of the gas communication pipe (P2).

[Operation of Air Conditioner]

[0030] Next, an operation of the air conditioner (1) will

be described. This air conditioner (1) can switch between a cooling operation and a heating operation.

<Cooling Operation>

[0031] In the cooling operation, the four-way switching valve (14) is in the first state (the state indicated by the solid lines in FIG. 1), and the compressor (11), the outdoor fan (15), and the indoor fan (23) are in operation. Accordingly, in the refrigerant circuit (C), the outdoor heat exchanger (12) functions as a condenser, and the indoor heat exchanger (22) functions as an evaporator. Specifically, the high-pressure refrigerant compressed by the compressor (11) flows into the outdoor heat exchanger (12), and dissipates heat to outdoor air in the outdoor heat exchanger (12) to condense. The refrigerant that has condensed in the outdoor heat exchanger (12) is decompressed by the outdoor expansion valve (13) and the indoor expansion valve (21), then flows into the indoor heat exchanger (22), and absorbs heat from indoor air in the indoor heat exchanger (22) to evaporate. Thus, the indoor air is cooled. The refrigerant that has evaporated in the indoor heat exchanger (22) is sucked into the compressor (11), and is again compressed.

<Heating Operation>

[0032] In the heating operation, the four-way switching valve (14) is in the second state (the state indicated by the broken lines in FIG. 1), and the compressor (11), the outdoor fan (15), and the indoor fan (23) are in operation. Accordingly, in the refrigerant circuit (C), the indoor heat exchanger (22) functions as a condenser, and the outdoor heat exchanger (12) functions as an evaporator. Specifically, the high-pressure refrigerant compressed by the compressor (11) flows into the indoor heat exchanger (22), and dissipates heat to indoor air in the indoor heat exchanger (22) to condense. Thus, the indoor air is heated. The refrigerant that has condensed in the indoor heat exchanger (22) is decompressed by the indoor expansion valve (21) and the outdoor expansion valve (13), then flows into the outdoor heat exchanger (12), and absorbs heat from the indoor air in the outdoor heat exchanger (12) to evaporate. The refrigerant that has evaporated in the outdoor heat exchanger (12) is sucked into the compressor (11), and is again compressed.

[Structure of Indoor Unit]

[0033] Next, the structure of the indoor unit (20) will be described with reference to FIGS. 2-4. The indoor unit (20) is configured so as to be embedded in a ceiling, and includes an indoor unit body (30) inserted into an opening (O) of a ceiling (U) facing an indoor space (R), and a decorative panel (40) attached to a lower portion of the indoor unit body (30). In this example, the indoor unit body (30) is suspended in a space above the ceiling (U)

(that is, a roof space) by a suspending mechanism (not shown). Furthermore, the decorative panel (40) attached to the lower portion of the indoor unit body (30) blocks the opening (O) of the ceiling (U) and a lower surface of the indoor unit body (30).

<Indoor Unit Body>

[0034] The indoor unit body (30) includes a casing (31). The casing (31) is formed in the shape of a substantially rectangular parallelepiped box having an open lower face, and includes a top (31 a) being in the shape of a substantially square plate, and four side plates (31b) being in the shape of a substantially rectangular plate and extending downward from the edges of the top (31 a). The casing (31) houses the indoor expansion valve (21), the indoor heat exchanger (22), the indoor fan (23), a drain pan (32), and a bell mouth (33). A body side heat insulator (34) is further provided inside the casing (31).

[0035] FIG. 2 is a general view illustrating the appearance of the indoor unit (20) as viewed obliquely from below. FIG. 3 is a general longitudinal cross-sectional view of the indoor unit (20). FIG. 4 is a general plan view, as viewed from above, of the indoor unit (20) with the top (31 a) of the casing (31) and the body side heat insulator (34) removed therefrom. FIG. 3 corresponds to the longitudinal cross-sectional structure taken along the plane III-III in FIG. 4.

«Body Side Heat Insulator»

[0036] The body side heat insulator (34) is formed in the shape of a substantially rectangular parallelepiped box having an open lower face, and includes a top heat insulating portion (34a) formed along the top (31a) of the casing (31), and four side plate heat insulating portions (34b) extending downward from the edges of the top heat insulating portion (34a) along the four side plates (31b) of the casing (31). A central portion of the top heat insulating portion (34a) has a circular opening (34c) through which an upper end portion of the indoor fan motor (23a) is insertable. Note that in order to allow the drain pan (32) to be housed in the casing (31), the vertical length of the side plate side heat insulating portions (34b) is shorter than that of the side plates (31b).

«Indoor Fan»

[0037] The indoor fan (23) is arranged centrally in the casing (31). The indoor fan (23) includes the indoor fan motor (23a), a hub (23b), a shroud (23c), and an impeller (23d). The indoor fan motor (23 a) is attached to the top (31 a) of the casing (31) such that the upper end portion of the indoor fan motor (23a) is inserted through the opening (34c) of the top heat insulating portion (34a). Thus, the indoor fan motor (23a) is supported by the top (31a) of the casing (31). The hub (23b) includes an annular base part formed radially outward from the indoor fan

motor (23a), and a central protrusion part protruding downward from the inner peripheral edge of the base part, and is fixed to a lower end of a rotating shaft of the indoor fan motor (23a). The shroud (23c) has a cylindrical shape that has a circular opening at each of the upper and lower ends and a cross-sectional area that decreases from the upper end toward the lower end, and is arranged below the base part of the hub (23b) to face the base part of the hub (23b) with a predetermined space therebetween. The impeller (23d) includes a plurality of turbo blades arranged along the direction of rotation of the indoor fan motor (23a), and is provided in an impeller accommodation space (230) between the hub (23b) and the shroud (23c).

«Indoor Heat Exchanger»

[0038] The indoor heat exchanger (22) includes a refrigerant pipe (heat transfer tube) bent to surround the indoor fan (23), and is arranged in a vertically upright position. Also, an upper end portion of the indoor heat exchanger (22) is in contact with the top heat insulating portion (34a) of the body side heat insulator (34).

«Drain Pan»

[0039] The drain pan (32) is formed in the shape of a vertically thin, substantial rectangular parallelepiped, and is arranged below the indoor heat exchanger (22). Also, an upper surface of the drain pan (32) is in contact with a lower end portion of the indoor heat exchanger (22). The drain pan (32) includes an inner wall portion (32a), an outer wall portion (32b), and a water receiving portion (32c). The inner wall portion (32a) annularly extends along the inner periphery of the indoor heat exchanger (22), and is formed in the shape of an upright vertical wall. The outer wall portion (32b) annularly extends along the four side plates (31b) of the casing (31), and is formed in the shape of an upright vertical wall. The water receiving portion (32c) is formed in the shape of a groove annularly extending along the gap between the inner and outer wall portions (32a) and (32b) so that water condensed in the indoor heat exchanger (22) can be collected.

[0040] Also, an accommodation opening (301) that vertically passes through the drain pan is formed inside the inner wall portion (32a) of the drain pan (32) to accommodate the bell mouth (33). The outer wall portion (32b) of the drain pan (32) has four body side discharge channels (302) each extending along an associated one of the four side plates (31b) of the casing (31) and vertically passing through the drain pan. Furthermore, an outer peripheral portion of the outer wall portion (32b) of the drain pan (32) (more specifically, a portion thereof outside the body side discharge channels (302)) is in contact with the lower ends of the four side plate heat insulating portions (34b) of the body side heat insulator (34).

«Bell mouth»

[0041] The bell mouth (33) has a cylindrical shape that has a circular opening at each of the upper and lower ends and a cross-sectional area that increases from the upper end toward the lower end. The bell mouth (33) is inserted into the accommodation opening (301) of the drain pan (32) such that its upper end is inserted into the lower opening of the shroud (23c) of the indoor fan (23). This allows the internal space of the bell mouth (33) to communicate with the impeller accommodation space (230) of the indoor fan (23).

<Decorative Panel>

[0042] The decorative panel (40) includes a panel body (41) formed in the shape of a vertically thin, substantial rectangular parallelepiped, and a suction grille (42) formed in the shape of a substantially square plate.

«Panel Body»

[0043] The panel body (41) is attached to a lower portion of the casing (31) to cover a lower surface (an open lower face) of the casing (31). The panel body (41) has a panel side suction channel (401), four panel side discharge channels (402), and four panel side surface recesses (403). Also, a panel extension portion (404) in the shape of a substantially rectangular frame is provided around a lower end portion of the panel body (41), and extends outward along a ceiling surface (U1).

-Panel Side Suction Channel-

[0044] The panel side suction channel (401) is formed in a central portion of the panel body (41), and vertically passes through the central portion of the panel body (41) to communicate with the internal space of the bell mouth (33) of the indoor unit body (30). Furthermore, an inlet (401a) facing the indoor space (R) is formed at the lower end of the panel side suction channel (401). In other words, the panel side suction channel (401) allows communication between the inlet (401a) of the panel body (41) and the internal space of the bell mouth (33) of the indoor unit body (30).

-Dust Collecting Filter-

[0045] A dust collecting filter (43) for trapping dust in air sucked through the inlet (401a) is provided in the panel side suction channel (401).

-Panel Side Discharge Channels-

[0046] The four panel side discharge channels (402) are formed in the panel body (41) and outside the panel side suction channel (401) to surround the panel side suction channel (401). More particularly, the four panel

side discharge channels (402) extend along four associated side portions of the panel body (41), and vertically pass through the four side portions of the panel body (41) to communicate with the four body side discharge channels (302) of the indoor unit body (30). Moreover, four outlets (402a) are formed at the lower ends of the four associated panel side discharge channels (402). In other words, the four panel side discharge channels (402) allow communication between the four outlets (402a) of the panel body (41) and the four body side discharge channels (302) of the indoor unit body (30).

-Wind Direction Adjusting Blades-

[0047] Each of the four panel side discharge channels (402) includes a wind direction adjusting blade (44) for adjusting the direction of air flowing through the panel side discharge channel (402). The wind direction adjusting blade (44) is formed in the shape of a substantially rectangular plate extending from one longitudinal end of the panel side discharge channel (402) toward the other longitudinal end, and is arranged in a lower end portion of the panel side discharge channel (402). Also, both longitudinal end portions of the wind direction adjusting blade (44) are each provided with a rotating shaft (44a) rotatably supported on the panel body (41). This allows the wind direction adjusting blade (44) to rotate around the rotating shafts (44a).

-Panel Side Surface Recesses-

[0048] The four panel side surface recesses (403) are formed on four associated outer side surfaces of the panel body (41), and extend from the four associated outer side surfaces of the panel body (41) toward the four associated panel side discharge channels (402). The longitudinal length of the panel side surface recesses (403) is substantial equal to that of the panel side discharge channels (402).

-Heat Insulating Members and Seal Members-

[0049] Four inner heat insulating members (45) are arranged inside the four associated panel side discharge channels (402) (that is, near the center of the panel body (41)). The four panel side surface recesses (403) include four associated outer heat insulating members (46). Further, four inner seal members (47) are interposed between upper surfaces of the four associated inner heat insulating members (45) and a lower surface of the drain pan (32) of the indoor unit body (30). Similarly, four inner seal members (47) are interposed between upper surfaces of the four associated outer heat insulating members (46) and the lower surface of the drain pan (32) of the indoor unit body (30). Also, an outer seal member (48) is interposed between an upper surface of the panel extension portion (404) and the ceiling surface (U1).

«Suction Grille»

[0050] The suction grille (42) is attached to a lower portion of the panel body (41) to cover a lower end (that is, the inlet (401 a)) of the panel side suction channel (401) of the panel body (41). The suction grille (42) includes a grille body (42a) and a grille extending portion (42b).

-Grille Body-

[0051] The grille body (42a) is formed in the shape of a substantially square plate, and covers the lower end (that is, the inlet (401 a)) of the panel side suction channel (401) of the panel body (41). A central portion of the grille body (42a) has many suction holes (420) arranged in a grid pattern. The many suction holes (420) vertically pass through the central portion of the grille body (42a). The cross section of an opening of each suction hole (420) is formed in the shape of a substantial square.

-Grille Extending Portion-

[0052] The grille extending portion (42b) is formed in the shape of a substantially square frame extending outward from the entire perimeter of the grille body (42a) toward the four outlets (402a) of the panel body (41). Furthermore, when viewed in plan, the grille extending portion (42b) overlaps with lower surfaces of the four inner heat insulating members (45) arranged inside the four panel side discharge channels (402) of the panel body (41). Note that when viewed in plan, the outer edges of the grille extending portion (42b) are located inside (closer to the grille body (42a) than) the inner edges of the four outlets (402a) of the panel body (41).

[Flow of Air in Indoor Unit]

[0053] Next, the flow of air in the indoor unit (20) will be described with reference to FIG. 3. First, if the indoor fan (23) comes into operation, indoor air is sucked from the indoor space (R) through the many suction holes (420) of the suction grille (42), the panel side suction channel (401) of the panel body (41), and the internal space of the bell mouth (33) into the impeller accommodation space (230) of the indoor fan (23). The air in the impeller accommodation space (230) is transferred by the impeller (23d) of the indoor fan (23), and is discharged radially outward from the space between the hub (23b) and the shroud (23c) of the indoor fan (23). While the air discharged from the indoor fan (23) passes through the indoor heat exchanger (22), the air exchanges heat with a refrigerant flowing through the indoor heat exchanger (22). Thus, if the indoor heat exchanger (22) functions as an evaporator (that is, in the cooling operation), the air passing through the indoor heat exchanger (22) is cooled, and if the indoor heat exchanger (22) functions as a condenser (that is, in the heating operation), the air

is heated. Then, the air that has passed through the indoor heat exchanger (22) is divided to flow into the four body side discharge channels (302) of the indoor unit body (30), then flows downward through the four panel side discharge channels (402) of the decorative panel (40), and is discharged through the four outlets (402a) to the indoor space (R).

[Electrical Component Box and Connection Pipe]

[0054] An electrical component box (50) is provided on the outer side surface of one of the side plates (31b) of the casing (31) (hereinafter referred to as the "outer mounting surface (310)"). The electrical component box (50) is formed in the shape of a horizontally oriented rectangular parallelepiped box, and houses a controller (such as a microcomputer or memory) for controlling an operation of each of components of the indoor unit (20) (such as the indoor fan (23)).

[0055] Furthermore, a liquid-side connection pipe (P3) and a gas-side connection pipe (P4) pass through the outer mounting surface (310) of the casing (31). The liquid-side connection pipe (P3) is a connection pipe communicating with a liquid pipe arranged in the casing (31) (in this example, a liquid pipe connected to the liquid-side end of the indoor heat exchanger (22)), and is connected to the liquid communication pipe (P1). The gas-side connection pipe (P4) is a connection pipe communicating with a gas pipe arranged in the casing (31) (in this example, a gas pipe connected to the gas-side end of the indoor heat exchanger (22)), and is connected to the gas communication pipe (P2).

[Detailed Structure of Decorative Panel]

[0056] Next, the structure of the decorative panel (40) will be described in detail with reference to FIGS. 5 and 6. FIG. 5 is a general plan view of the decorative panel (40) as viewed from below. FIG. 6 is a general fragmentary longitudinal cross-sectional view illustrating, on an enlarged scale, the panel extension portion (404) of the decorative panel (40).

[0057] As described above, the panel body (41) of the decorative panel (40) has the inlet (401a) (the panel side suction channel (401)) and the four outlets (402a) (the panel side discharge channels (402)), and the panel extension portion (404) extending outward along the ceiling surface (U1) is provided around the lower end portion of the panel body (41). In this embodiment, if a portion of the panel body (41) covering the lower face of the indoor unit body (30) (more specifically, the open lower surface of the casing (31)) is referred to as the "panel central portion (400)," the panel body (41) includes the panel central portion (400) and the panel extension portion (404).

<Panel Central Portion>

[0058] The panel central portion (400) is formed in the shape of a vertically thin, substantial rectangular parallelepiped, and is attached to the lower portion of the indoor unit body (30) to cover the lower surface of the indoor unit body (30). The panel central portion (400) has the inlet (401a) (the panel side suction channel (401)) and the four outlets (402a) (the panel side discharge channels (402)). Furthermore, in this example, the four outer side surfaces of the panel central portion (400) each have the panel side surface recess (403) (see FIG. 3). In addition, a lower surface (400u) of the panel central portion (400) is flat, and extends in a horizontal direction to be substantially parallel to the ceiling surface (U1).

<Panel extension portion>

[0059] The panel extension portion (404) is formed in the shape of a substantially rectangular frame extending from the entire perimeter of the panel central portion (400) (more specifically, the perimeter of the lower end portion of the panel central portion (400)) along the ceiling surface (U1). The periphery of the outer panel extension portion (404) is located outside the edge of the opening (O) of the ceiling (U) as viewed in plan. Thus, the opening (O) of the ceiling (U) into which the indoor unit body (30) is inserted is blocked by the decorative panel (40). Furthermore, a lower surface (404u) of the panel extension portion (404) is flat, and extends in a horizontal direction to be substantially parallel to the ceiling surface (U1). In addition, an outer peripheral surface (404a) of the panel extension portion (404) substantially vertically extends from the lower surface (404u) of the panel extension portion (404) toward the ceiling surface (U1).

<Movement restrictor>

[0060] A movement restrictor (60) for restricting movement of water from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1) is provided on the outer peripheral surface (404a) of the panel extension portion (404), and is formed along the periphery of the panel extension portion (404). In this example, the movement restrictor (60) is configured as a notch (61) formed along the upper end of the outer peripheral surface (404a) of the panel extension portion (404). Also, in this example, the notch (61) (the movement restrictor (60)) is formed along the entire periphery of the panel extension portion (404).

[Mechanism by Which Condensation Occurs on Panel Extension Portion]

[0061] Next, a mechanism by which condensation occurs on the panel extension portion (404) will be described with reference to FIGS. 7 and 8. FIG. 7 is a general fragmentary longitudinal cross-sectional view corre-

sponding to FIG. 6, and FIG. 8 is a general fragmentary plan view illustrating, on an enlarged scale, a portion of the decorative panel (40) as viewed from below. Note that in FIG. 8, the wind direction adjusting blade (44) is not shown.

[0062] Assume that when the air conditioner (1) performs the cooling operation, air (cold air) discharged through the outlets (402a) of the panel central portion (400) flows along the lower surface (404u) of the panel extension portion (404), and as a result, flows outward of the decorative panel (40). This air flow causes negative pressure to be generated forward of the outer peripheral surface (404a) of the panel extension portion (404), and indoor air (warm air) is suctioned forward of the outer peripheral surface (404a) of the panel extension portion (404) from a lateral side of this air flow. At this time, the air (cold air) flowing along the lower surface (404u) of the panel extension portion (404) cools the lower surface (404u) and a lower end portion of the outer peripheral surface (404a) of the panel extension portion (404). Thus, if the indoor air (warm air) suctioned forward of the outer peripheral surface (404a) of the panel extension portion (404) collides with the outer peripheral surface (404a) of the panel extension portion (404), condensation will occur on the lower end portion of the outer peripheral surface (404a) of the panel extension portion (404), and condensed water (W) will adhere thereto. This condensed water (W) will increase and extend toward the upper end of the outer peripheral surface (404a) of the panel extension portion (404).

[0063] In the decorative panel (40) according to this embodiment, the notch (61) (the movement restrictor (60)) is formed along the upper end of the outer peripheral surface (404a) of the panel extension portion (404), thereby forming a clearance between the ceiling surface (U1) and the outer peripheral surface (404a) of the panel extension portion (404). Thus, the movement of the condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1) is restricted.

[Advantages]

[0064] As can be seen from the foregoing description, the movement restrictor (60) formed on the outer peripheral surface (404a) of the panel extension portion (404) allows for restricting the movement of the condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1). Thus, even if condensation occurs on the outer peripheral surface (404a) of the panel extension portion (404), the penetration of the condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) into the ceiling surface (U1) can be reduced. Thus, degradation of the ceiling surface (U1) due to the penetration of the condensed water (W) can be reduced.

[0065] Furthermore, the outer peripheral surface (404a) of the panel extension portion (404) is formed to

substantially vertically extend from the lower surface (404u) of the panel extension portion (404) toward the ceiling surface (U1), thereby reducing the area of the decorative panel (40) as viewed in plan and downsizing the decorative panel (40). As the angle of inclination of the outer peripheral surface (404a) of the panel extension portion (404) with respect to the lower surface (404u) of the panel extension portion (404) is steeper, negative pressure tends to be more easily generated forward of the outer peripheral surface (404a) of the panel extension portion (404), and condensation tends to more easily occur on the outer peripheral surface (404a) of the panel extension portion (404). Thus, it is particularly effective to form the movement restrictor (60) on the outer peripheral surface (404a) of the panel extension portion (404) in a situation where the outer peripheral surface (404a) of the panel extension portion (404) is formed to substantially vertically extend from the lower surface (404u) of the panel extension portion (404) toward the ceiling surface (U1).

[0066] The notch (61) is preferably formed to restrict the flow of air (warm air) into the notch (61). In other words, the notch (61) is preferably configured to make it impossible (or difficult) for air to flow into the notch (61). The notch (61) may be formed to have, for example, a notch depth (a horizontal length) of about 1.5 mm and a notch width (a vertical length) of about 0.5 mm. Optionally, the notch depth (or width) of the notch (61) may be uniform, or may vary, along the entire periphery of the panel extension portion (404).

[Variation of Movement restrictor]

[0067] As shown in FIG. 9, the movement restrictor (60) may be configured as a groove (62) extending along an upper end portion of the outer peripheral surface (404a) of the panel extension portion (404). In this example, the groove (62) (the movement restrictor (60)) extends along the entire periphery of the panel extension portion (404). This configuration can also restrict the movement of water (condensed water (W)) from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1), and can also reduce the penetration of condensed water (W) from the outer peripheral surface (404a) of the panel extension portion (404) into the ceiling surface (U1).

[0068] The groove (62) is preferably formed to restrict the flow of air (warm air) into the groove (62). In other words, the groove (62) is preferably configured to make it impossible (or difficult) for air to flow into the groove (62). The groove (62) may be formed to have, for example, a groove depth (a horizontal length) of about 1.5 mm and a groove width (a vertical length) of about 0.5 mm. Optionally, the groove depth (or width) of the groove (62) may be uniform, or may vary, along the entire periphery of the panel extension portion (404).

(Other Embodiments)

[0069] In the foregoing embodiment, an example in which the movement restrictor (60) is formed along the entire periphery of the panel extension portion (404) has been described. However, the movement restrictor (60) may be discontinuously formed along the periphery of the panel extension portion (404). In other words, the notch (61) (or the groove (62)) may be partially discontinuous. Such a configuration can also restrict the movement of water (condensed water (W)) from the outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1).

[0070] An example in which the lower surface (404u) of the panel extension portion (404) is flat, and extends in a horizontal direction to be substantially parallel to the ceiling surface (U1) has been described. However, the lower surface (404u) of the panel extension portion (404) may be formed to extend while being inclined with respect to the ceiling surface (U1). The lower surface (404u) of the panel extension portion (404) may be formed, for example, so as to be inclined upward and laterally outward from the panel central portion (400).

[0071] An example in which the panel body (41) has the four outlets (402a) surrounding the inlet (401a) has been described. However, the panel body (41) may have two outlets (402a) facing each other with the inlet (401a) interposed therebetween, or may have a single outlet (402a) adjacent to the inlet (401a).

[0072] The foregoing embodiments may be appropriately combined. The foregoing embodiments are merely preferred examples in nature, and are not intended to limit the scope, applications, and use of the invention.

INDUSTRIAL APPLICABILITY

[0073] As can be seen from the foregoing description, the above-described decorative panel and indoor unit are useful as an air conditioner decorative panel attached to a lower portion of an indoor unit body inserted and installed in an opening of a ceiling, and an indoor unit including the decorative panel.

DESCRIPTION OF REFERENCE CHARACTERS

[0074]

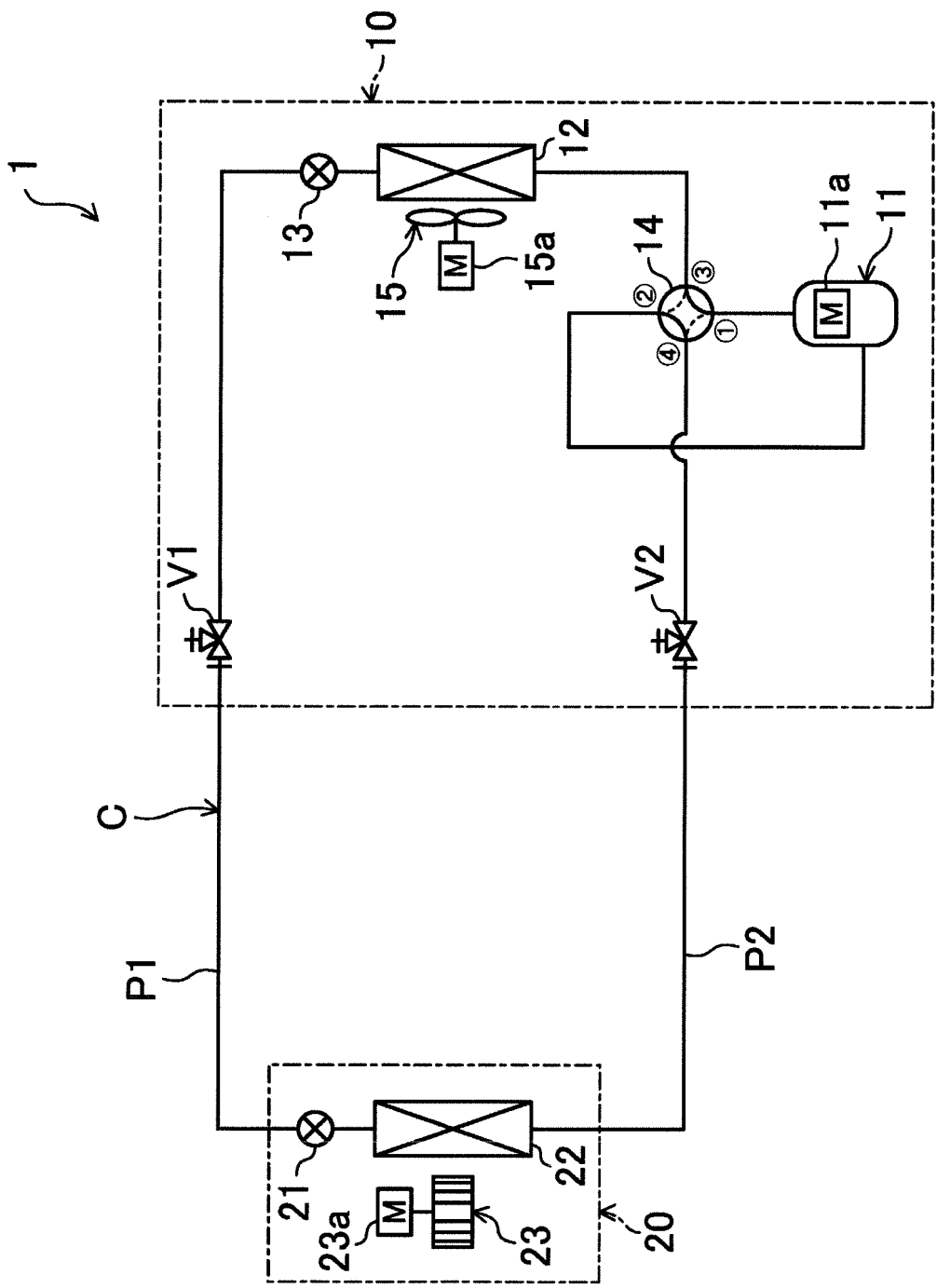
1	Air Conditioner
10	Outdoor Unit
11	Compressor
12	Outdoor Heat Exchanger
13	Outdoor Expansion Valve
14	Four-Way Switching Valve
15	Outdoor Fan
20	Indoor Unit
21	Indoor Expansion Valve
22	Indoor Heat Exchanger
23	Indoor Fan

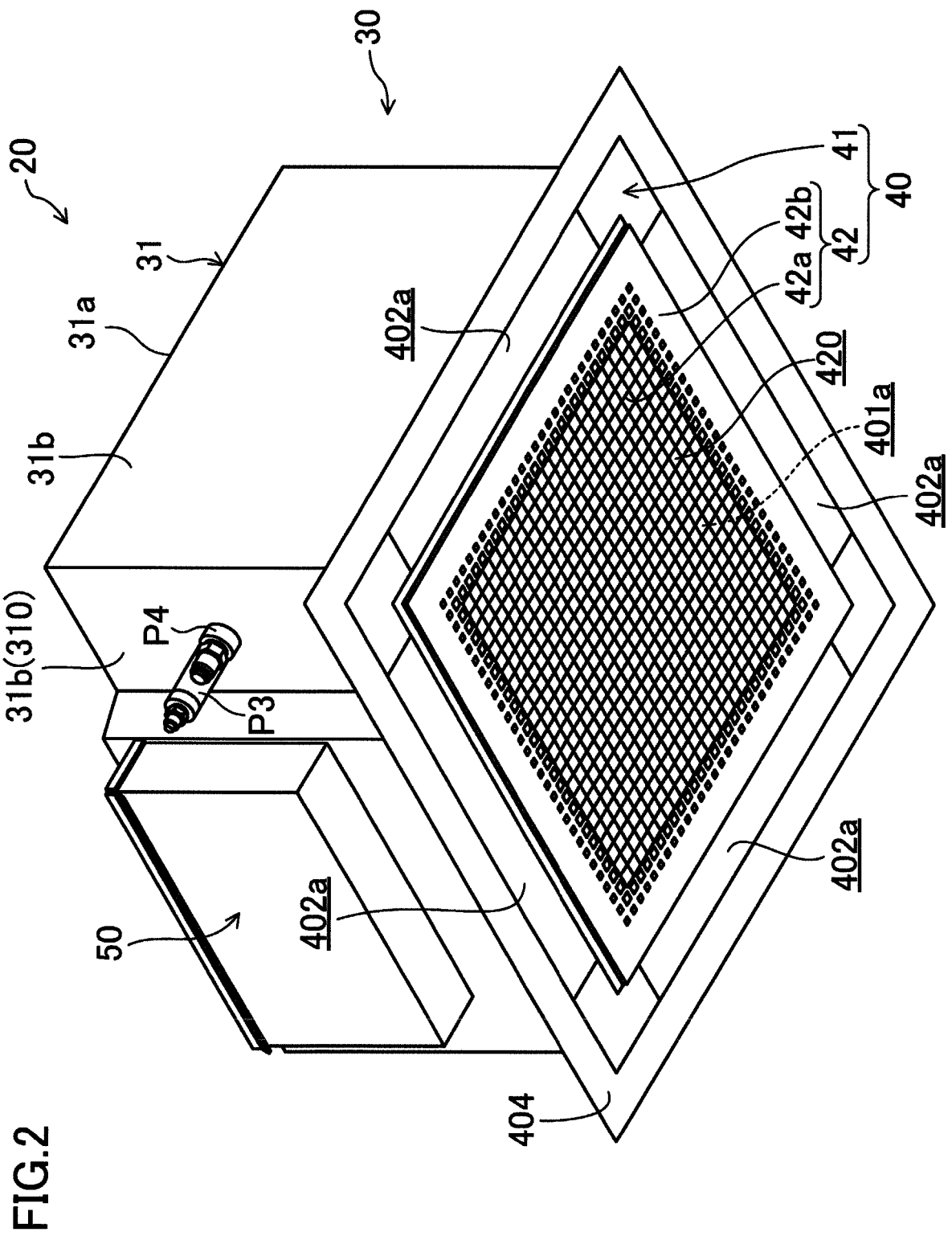
30	Indoor Unit Body			groove (62) extending along an upper end portion of the outer peripheral surface (404a) of the panel extension portion (404).
31	Casing			
32	Drain Pan			
33	Bell Mouth			
40	Decorative Panel	5	4.	The decorative panel of any one of claims 1-3, wherein
41	Panel Body			a lower surface (404u) of the panel extension portion (404) is flat, and
42	Suction Grille			the outer peripheral surface (404a) of the panel extension portion (404) is formed to substantially vertically extend from the lower surface (404u) of the panel extension portion (404) toward the ceiling surface (U1).
400	Panel Central Portion			
400u	Lower Surface of Panel Central Portion			
401	Panel Side Suction Channel	10		
401a	Inlet			
402	Panel Side Discharge Channel			
402a	Outlet			
403	Panel Side Surface Recess			
404	Panel Extension Portion	15	5.	An indoor unit (20) for an air conditioner (1), the indoor unit (20) comprising:
404a	Outer Peripheral Surface of Panel extension portion			an indoor unit body (30) inserted and installed in an opening (O) of a ceiling (U); and
404u	Lower Surface of Panel Extension Portion			a decorative panel (40) attached to a lower portion of the indoor unit body (30), wherein the decorative panel (40) is configured as the decorative panel (40) of any one of claims 1-4.
50	Electrical Component Box			
60	Movement restrictor	20		
61	Notch			
62	Groove			
U	Ceiling			
U1	Ceiling Surface			
O	Opening of Ceiling	25		
W	Condensed Water			

Claims

1. A decorative panel (40) for an air conditioner (1), attached to a lower portion of an indoor unit body (30) inserted and installed in an opening (O) of a ceiling (U), the decorative panel (40) comprising:
 - a panel body (41) including a panel central portion (400) having an inlet (401a) and an outlet (402a) and covering a lower surface of the indoor unit body (30), and a panel extension portion (404) extending from an entire periphery of the panel central portion (400) along a ceiling surface (U1), wherein
 - a movement restrictor (60) for restricting movement of water from an outer peripheral surface (404a) of the panel extension portion (404) to the ceiling surface (U1) is provided on an outer peripheral surface (404a) of the panel extension portion (404), and is formed along an outer periphery of the panel extension portion (404).
2. The decorative panel of claim 1, wherein the movement restrictor (60) is configured as a notch (61) formed along an upper end of the outer peripheral surface (404a) of the panel extension portion (404).
3. The decorative panel of claim 1, wherein the movement restrictor (60) is configured as a

FIG.1





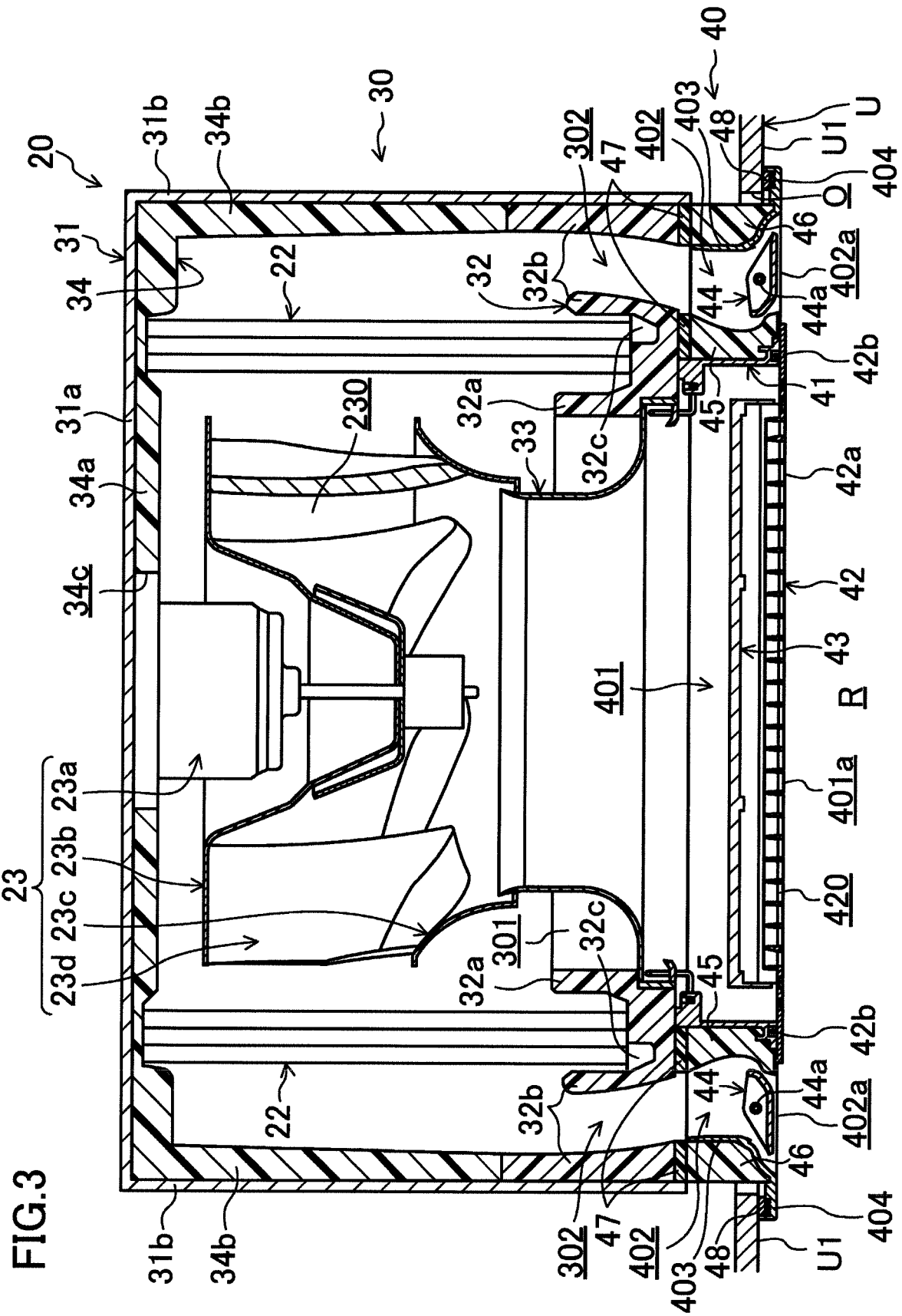


FIG.4

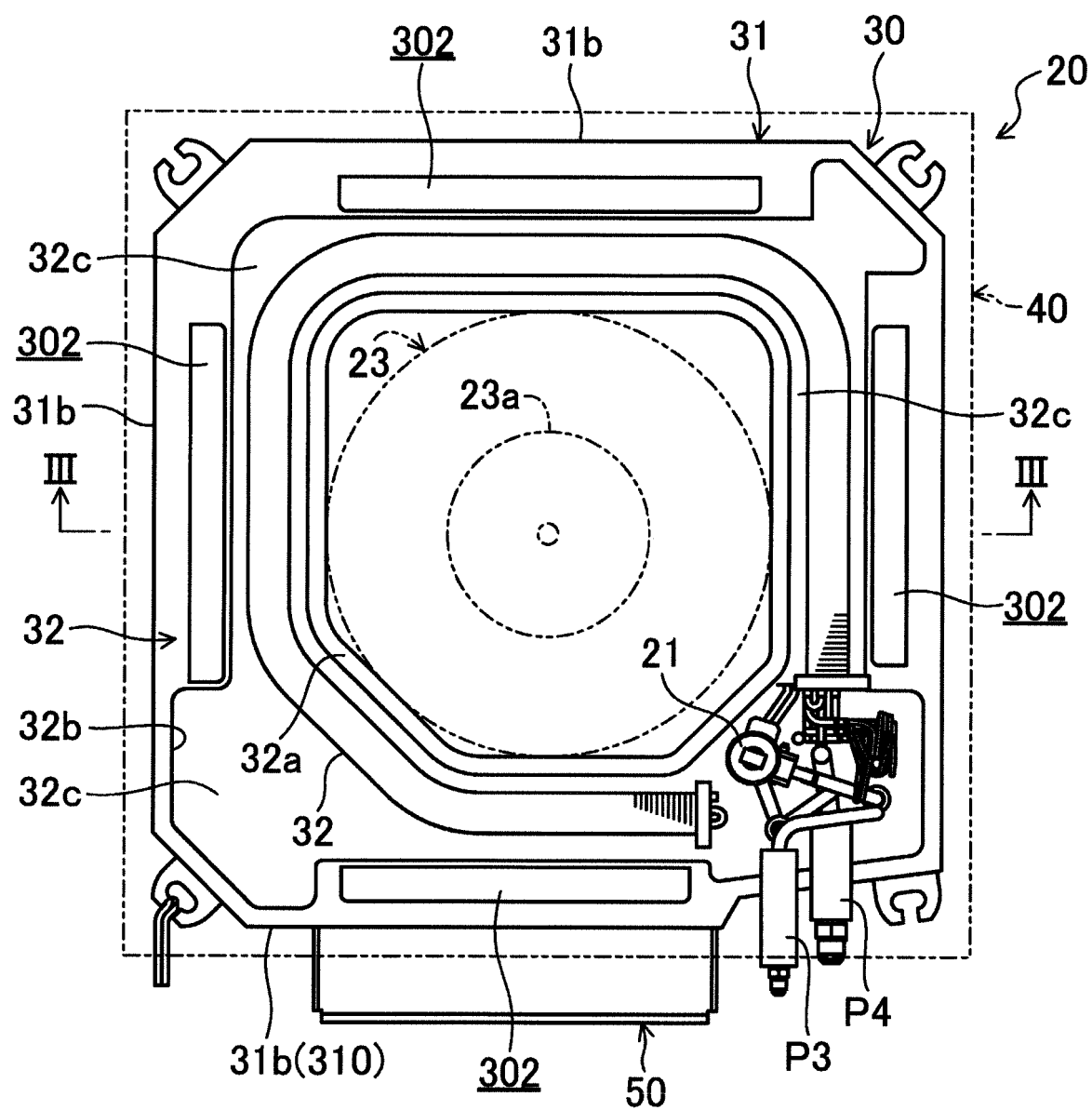


FIG.5

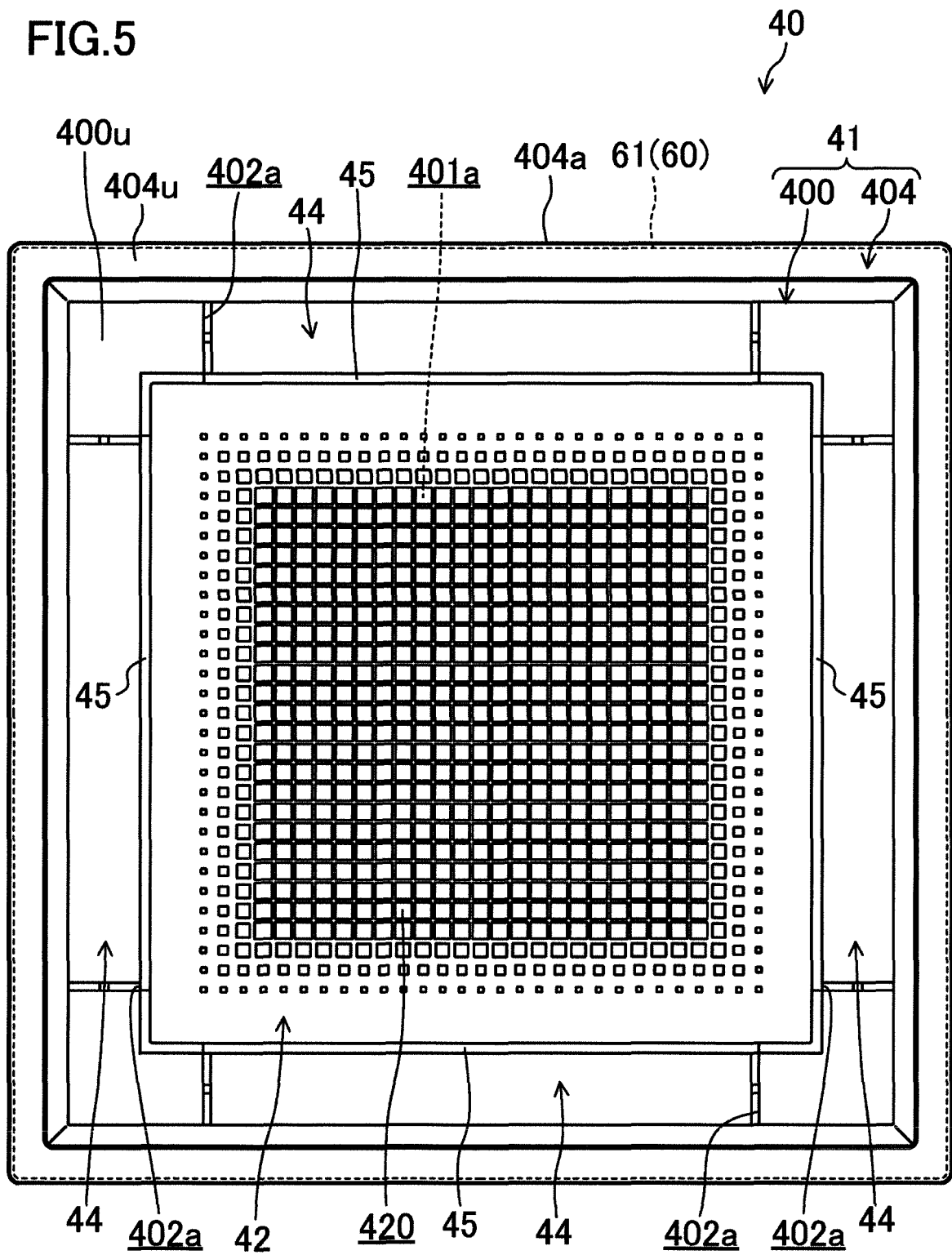


FIG.6

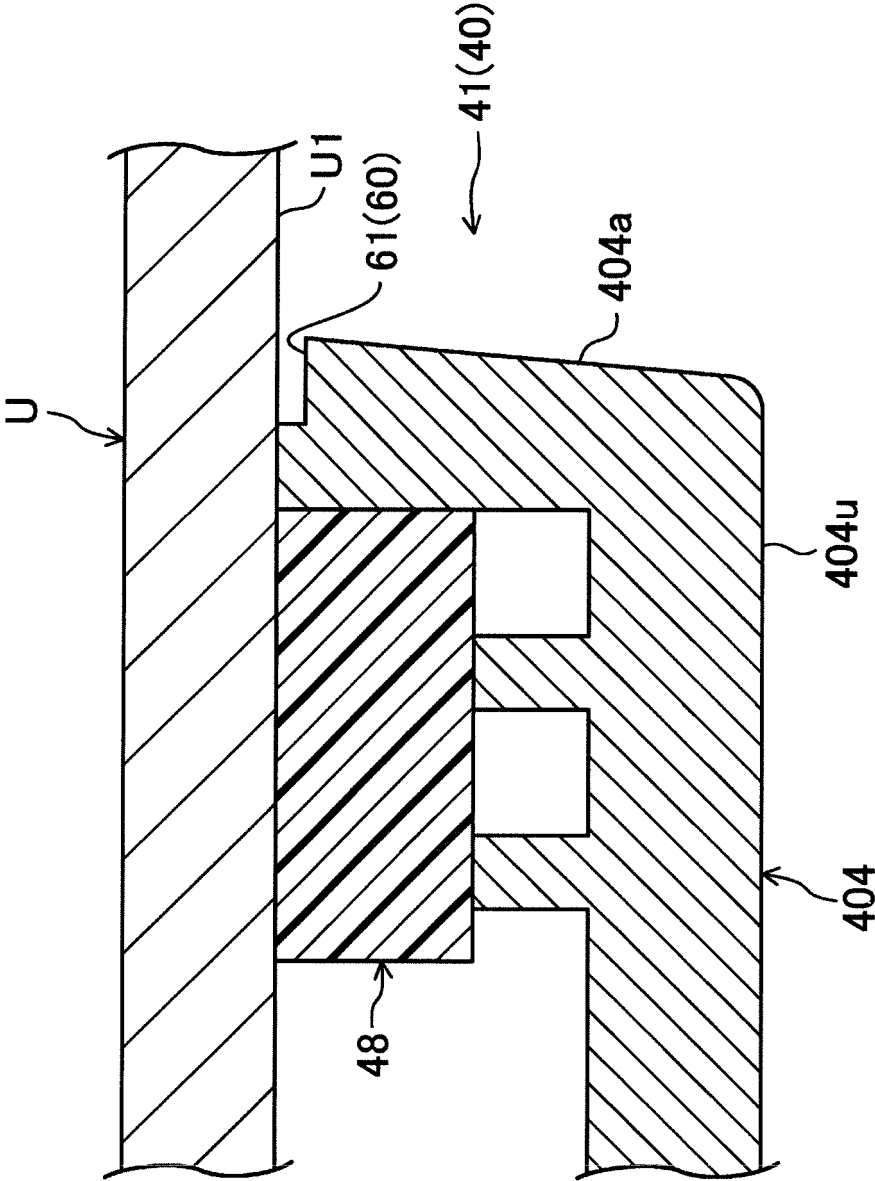


FIG.7

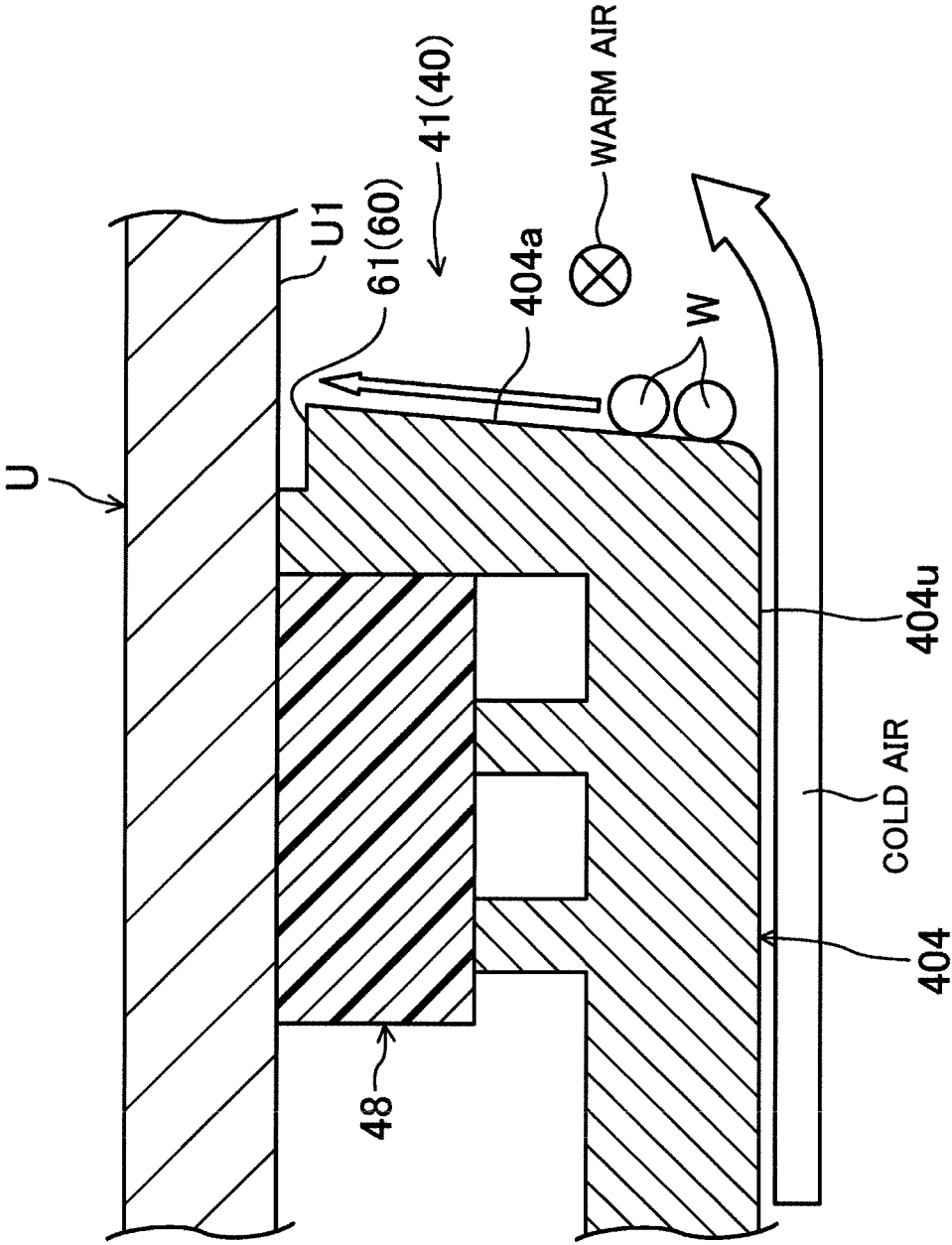


FIG.8

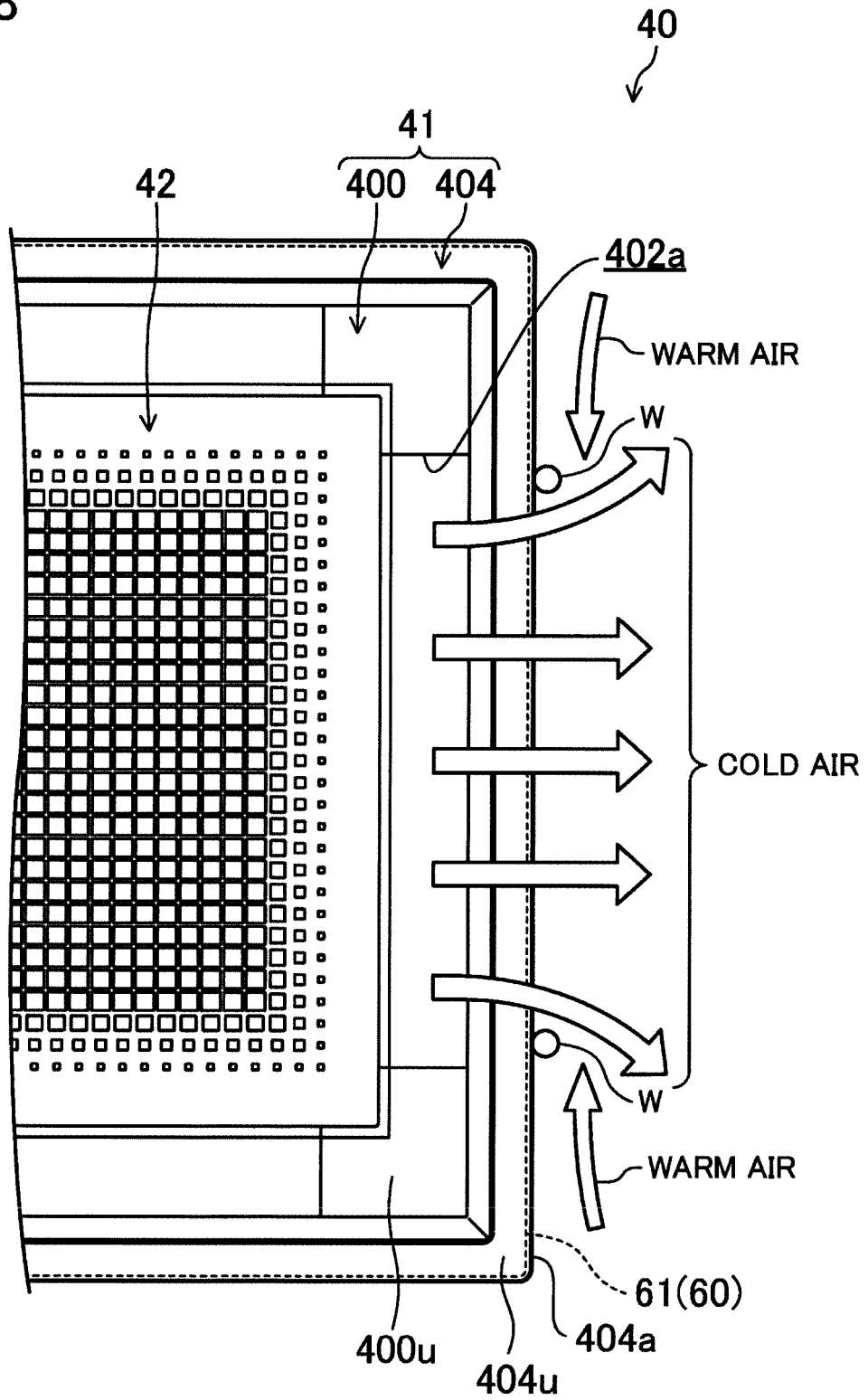
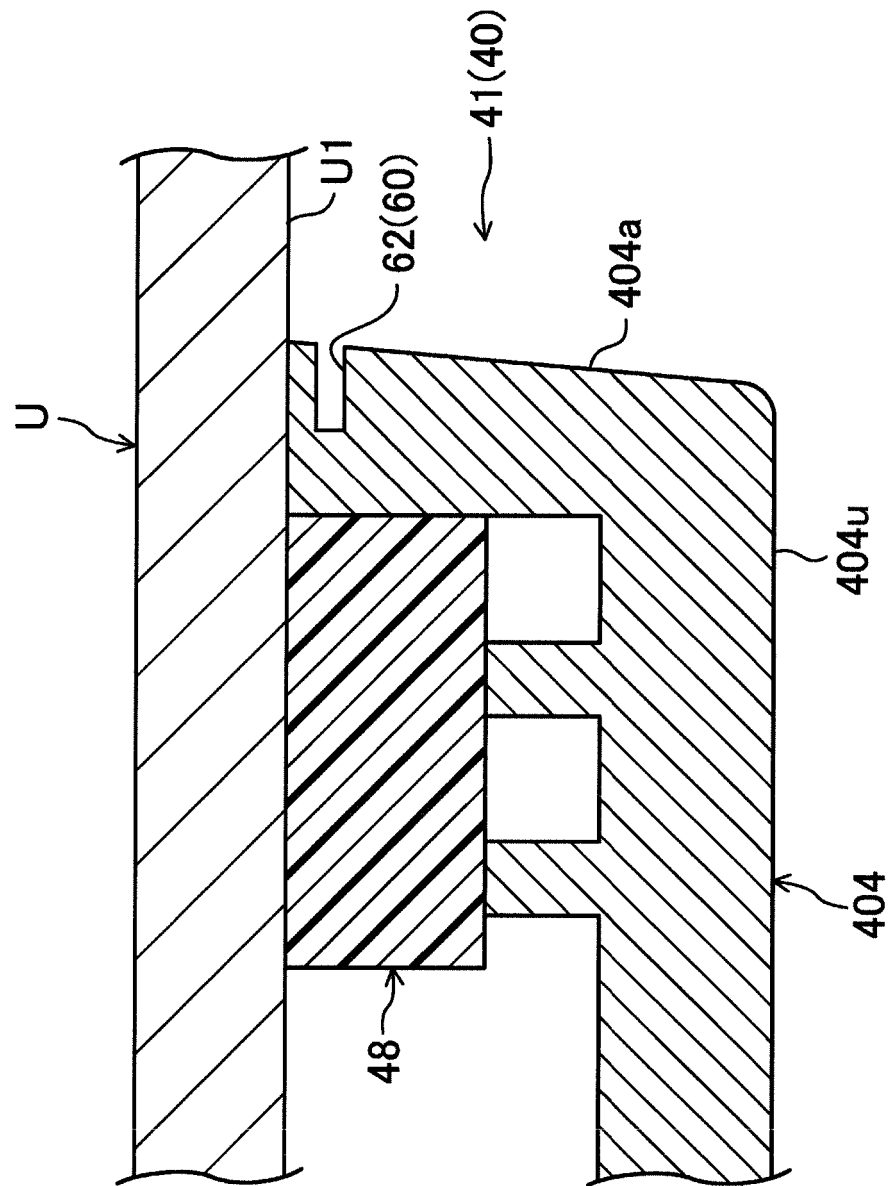


FIG.9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/002379

A. CLASSIFICATION OF SUBJECT MATTER

F24F13/20(2006.01)i, F24F13/068(2006.01)i, F24F13/22(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24F13/20, F24F13/068, F24F13/22

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2001-289460 A (Hitachi, Ltd.), 19 October 2001 (19.10.2001), entire text; all drawings (Family: none)	1-2, 4-5 3
Y A	US 2002/0086633 A1 (W. Larry Dill), 04 July 2002 (04.07.2002), paragraphs [0011] to [0013], [0028] to [0045]; fig. 1 to 5 & WO 2002/053980 A2	1-2, 4-5 3
Y	EP 1589292 A1 (Unico Consumers Products Co., Ltd.), 26 October 2005 (26.10.2005), paragraphs [0021] to [0026]; fig. 4, 5 (Family: none)	2, 4-5

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search
26 June, 2014 (26.06.14)Date of mailing of the international search report
08 July, 2014 (08.07.14)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/002379

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 2498015 A1 (Hitachi Appliances, Inc.), 12 September 2012 (12.09.2012), paragraph [0020]; fig. 3 & JP 2010-84994 A & JP 2010-84996 A & JP 4391575 B & EP 2498015 A1 & EP 2169329 A2 & CN 101713572 A & CN 102607111 A	2, 4-5
A	JP 2008-57843 A (Fujitsu General Ltd.), 13 March 2008 (13.03.2008), paragraphs [0020] to [0022]; fig. 1 (Family: none)	1
A	JP 5-312380 A (Sanyo Electric Co., Ltd.), 22 November 1993 (22.11.1993), paragraph [0022]; fig. 3 & US 5379606 A & EP 570130 A2 & DE 69311762 T & SG 50686 A & BR 9301775 A & CA 2095382 A & KR 10-1996-0010637 B & CN 1079043 A & CA 2095382 A1	1

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H07127878 A [0003]
- JP S6435327 A [0003]