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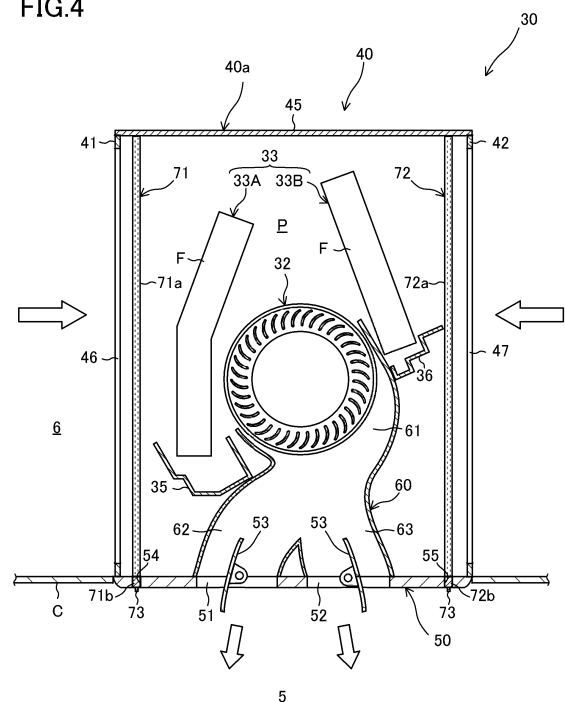
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(54) **CEILING-EMBEDDED INDOOR UNIT AND AIR-CONDITIONING DEVICE**

(57) A blow-out port (51, 52) that supplies air to an air conditioning target space (5) is formed in a panel (50). An intake port (46, 47) in which air is taken is formed in a casing body (40a). At least a part of each of the blow-out port (51, 52), a fan (32), and a heat exchanger (33) overlap each other in an up-and-down direction.

FIG.4



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a ceiling-embedded indoor unit and an air-conditioning device.

BACKGROUND ART

[0002] An air-conditioning device including a ceiling-embedded indoor unit is known.

[0003] The indoor unit of Patent Literature 1 houses a heat exchanger and a fan inside a casing installed in a ceiling space. On a lower surface of the casing, a blow-out port that supplies air that has passed through the heat exchanger to an indoor space is formed.

CITATION LIST

PATENT LITERATURE

[0004] Patent Literature 1: Japanese Patent Application Laid-Open No. 2010-164294

SUMMARY OF THE INVENTION

<Technical Problem>

[0005] In the ceiling-embedded indoor unit, a panel located on a lower surface of the casing is exposed to the indoor space. An object of the present disclosure is to reduce the area of the panel of the indoor unit.

<Solution to Problem>

[0006] A first aspect is a ceiling-embedded indoor unit for an air-conditioning device including: a casing (40); and a fan (32) and a heat exchanger (33) disposed inside the casing (40). The casing (40) includes: a casing body (40a) disposed in a backside space (6) of a ceiling (C) and having an open lower side; and a panel (50) provided in a lower open portion of the casing body (40a) and exposed to an air conditioning target space (5). A blow-out port (51, 52) configured to supply air to the air conditioning target space (5) is formed in the panel (50). An intake port (46, 47) into which air is taken is formed in the casing body (40a). At least a part of each of the blow-out port (51, 52), the fan (32), and the heat exchanger (33) overlap each other in an up-and-down direction.

[0007] In the first aspect, all of at least a part of each of the blow-out port (51, 52), the fan (32), and the heat exchanger (33) overlap each other in the up-and-down direction. Therefore, the size of the casing (40) can be reduced horizontally, and the size of the panel (50) can be reduced horizontally.

[0008] In the second aspect, the casing (40) has a long side extending along the ceiling (C) and a short side shorter than the long side in the first aspect.

[0009] The second aspect can form the panel (50) extending along the ceiling (C).

[0010] In the third aspect, when a total area including the blow-out port (51, 52) on a lower surface of the panel (50) is S1 and a total opening area of the blow-out port (51, 52) is S2 in the second aspect, the total opening area S2 is 20% or more of the total area S1.

[0011] In the third aspect, the opening area of the blow-out port (51, 52) with respect to the panel (50) is relatively large.

[0012] In the fourth aspect, the fan (32) is a cross-flow fan extending in a longitudinal direction of the casing (40) in the second or third aspect.

[0013] In the fourth aspect, since the casing (40) and the fan (32) extend in the same direction, the dead space in the casing (40) can be reduced.

[0014] In the fifth aspect, the intake port (46, 47) is formed in at least one side plate (41, 42) of the casing body (40a) in any one of the first to fourth aspects.

[0015] "Side plate" mentioned here means a plate forming the right, left, front, and rear surfaces, and does not include a plate forming the upper and lower surfaces.

[0016] The fifth aspect can secure the intake port (46, 47) in the side plate (41, 42) without forming the intake port (46, 47) in the top plate of the casing body (40a).

[0017] In the sixth aspect, the intake port (46, 47) is formed in each of the two side plates (41, 42) facing each other of the casing body (40a) in the fifth aspect.

[0018] The sixth aspect can secure the intake port (46, 47) in each side plate (41, 42) on both sides of the casing body (40a).

[0019] In the seventh aspect, the heat exchanger (33) includes: a first heat exchange unit (33A) disposed near a first side plate (41) of the casing body (40a); and a second heat exchange unit (33B) disposed near a second side plate (42) facing the first side plate (41) of the casing body (40a), and the first heat exchange unit (33A) and the second heat exchange unit (33B) are each disposed with an inclination at an interval widening downward from each other in any one of the first to sixth aspects.

[0020] The seventh aspect can dispose the heat exchange unit (33A, 33B) to correspond to each intake port (46, 47) of each side plate (41, 42). By inclining the heat exchange unit (33A, 33B), the heat transfer area can be increased.

[0021] The eighth aspect includes a filter (71, 72) configured to collect dust in the air taken into the intake port (46, 47), and a slit (54, 55) through which the filter (71, 72) is pulled out of the casing (40) is formed in the panel (50) in any one of the first to seventh aspects.

[0022] The eighth aspect allows the insertion and removal work of the filter (71, 72) to be executed without removing the panel (50) from the casing body (40a).

[0023] The ninth aspect is an air-conditioning device including: an outdoor unit (20); and any one of the first to eighth ceiling-embedded indoor unit (30).

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

FIG. 1 is a piping system diagram showing an overall configuration of an air-conditioning device according to an embodiment.

FIG. 2 is an enlarged perspective view of a part of internal structure of a system ceiling.

FIG. 3 is a perspective view of a part of the system ceiling viewed from the indoor space side.

FIG. 4 is a longitudinal sectional view of an indoor unit.

FIG. 5 is a bottom view of a ceiling panel of the indoor unit.

FIG. 6 is a schematic configuration diagram of the indoor unit showing air flow of an indoor space and a ceiling space.

FIG. 7 is a diagram corresponding to FIG. 4, showing a state in which a part of a filter is pulled out.

FIG. 8 is a diagram corresponding to FIG. 6 of an indoor unit according to a first modification.

FIG. 9 is a schematic configuration diagram showing internal structure of an indoor unit according to a second modification.

DESCRIPTION OF EMBODIMENTS

[0025] An embodiment of the present disclosure will be described below with reference to the drawings. Note that the following embodiment is an essentially preferred example, and is not intended to limit the scope of the present invention, matters to which the present invention is applicable, or the usage of the present invention.

«Embodiment»

<Overview of Air-Conditioning Device>

[0026] An air-conditioning device (10) of the embodiment adjusts the temperature of air in an air conditioning target space (5). The air-conditioning device (10) is applied to buildings and the like. The air conditioning target space (5) is an indoor space. The air-conditioning device (10) includes an outdoor unit (20) and at least one indoor unit (30). The air-conditioning device (10) in this example is configured as a so-called multi-type device including a plurality of indoor units (30). The indoor unit (30) is a ceiling-embedded unit. The outdoor unit (20) is installed outdoors. The indoor unit (30) and the outdoor unit (20) are connected to each other via a gas connection pipe (12) and a liquid connection pipe (13).

<Configuration of Refrigerant Circuit>

[0027] As shown in FIG. 1, the air-conditioning device (10) includes a refrigerant circuit (11). The refrigerant circuit (11) is filled with a refrigerant. The refrigerant circuit

(11) executes a refrigeration cycle by circulation of the refrigerant. The outdoor unit (20) includes an outdoor circuit (21) and an outdoor fan (22). Each indoor unit (30) includes an indoor circuit (31) and an indoor fan (32).

5 The refrigerant circuit (11) includes the outdoor circuit (21), the indoor circuit (31), and the connection pipe (12, 13) connecting the outdoor circuit (21) and the indoor circuit (31) to each other.

10 [0028] The outdoor circuit (21) includes a compressor (23), an outdoor heat exchanger (24), an outdoor expansion valve (25), and a four-way switching valve (26). The compressor (23) compresses the refrigerant and discharges the compressed refrigerant. The outdoor heat exchanger (24) exchanges heat between the outdoor air carried by the outdoor fan (22) and the refrigerant. The outdoor heat exchanger (24) is of a fin and tube type. The outdoor expansion valve (25) is a decompression mechanism for decompressing the refrigerant. The outdoor expansion valve (25) is, for example, an electronic expansion valve.

15 [0029] The four-way switching valve (26) is a flow path switching mechanism for switching between a first refrigeration cycle (cooling cycle) and a second refrigeration cycle (heating cycle). The four-way switching valve (26) switches between a first state (state shown by the solid line in FIG. 1) and a second state (state shown by the broken line in FIG. 1).

20 [0030] Each indoor circuit (31) includes an indoor heat exchanger (33) and an indoor expansion valve (34). The indoor heat exchanger (33) exchanges heat between the indoor air carried by the indoor fan and the refrigerant. The indoor heat exchanger (33) is of a fin and tube type. The indoor expansion valve (34) is a decompression mechanism for decompressing the refrigerant. The indoor expansion valve (34) is, for example, an electronic expansion valve.

25 [0031] In the cooling operation, the four-way switching valve (26) is in the first state, and the first refrigeration cycle is executed. In the first refrigeration cycle, the refrigerant compressed by the compressor (23) dissipates heat in the outdoor heat exchanger (24), is decompressed by the indoor expansion valve (34), and evaporates in the indoor heat exchanger (33).

30 [0032] In the second refrigeration cycle, the four-way switching valve (26) is in the second state, and the second refrigeration cycle is executed. The refrigerant compressed by the compressor (23) dissipates heat in the indoor heat exchanger (33), is decompressed by the outdoor expansion valve (25), and evaporates in the outdoor heat exchanger (24).

<System Ceiling>

35 [0033] As shown in FIGS. 2 and 3, the indoor unit (30) applies to a system ceiling (C). The system ceiling (C) is of a so-called line type. As shown in FIG. 2, the system ceiling (C) includes a plurality of bars (B1, B2) arranged in a grid pattern, and ceiling walls (W) fitted between the

bars (B1, B2).

[0034] The plurality of bars (B1, B2) includes a plurality of first bars (B1) and a plurality of second bars (B2). The first bar (B1) extends in the front-rear direction. The plurality of first bars (B1) is arranged parallel to each other in the right-left direction. The second bar (B2) extends in the right-left direction. The plurality of second bars (B2) is arranged parallel to each other in the front-rear direction. The first bar (B1) and the second bar (B2) are orthogonal to each other. The plurality of first bars (B1) and the plurality of second bars (B2) form grid structure. The first bar (B1) is formed to have an inverted T-shaped longitudinal cross section. In other words, at the lower end of the first bar (B1), protrusions (7) protruding on both sides of the width direction are formed.

[0035] The system ceiling (C) includes hanging bolts and fixing brackets (not shown). The hanging bolts are fixed to a slab above the system ceiling. The first bar (B1) and the second bar (B2) are supported by the lower end of the hanging bolts via the fixing brackets.

[0036] A first opening (O1) and a second opening (O2) are formed between the plurality of first bars (B1) and the plurality of second bars (B2). The right-left width of the first opening (O1) is smaller than the right-left width of the second opening. The plurality of first bars (B1) includes a plurality of pairs of first bars (B1) (line bars (LB)) at relatively narrow intervals from each other. The first opening (O1) is formed between the pair of first bars (B1).

[0037] As a general rule, the ceiling wall (W) is fitted into each second opening (O2). Similarly, as a general rule, the ceiling wall (W) is fitted into each first opening (O1). The ceiling wall (W) is installed on the upper surface of the protrusion (7) of each of the first bar (B1) and the second bar (B2). A ceiling space (6) is formed on the back side (upper side) of the ceiling wall (W) of the system ceiling (C). The indoor space (5) is formed on the front side (lower side) of the ceiling wall (W) of the system ceiling.

[0038] Illumination devices (8) are fitted in some first openings (O1) of the plurality of first openings (O1) (see FIG. 3). The illumination device (8) is installed on the upper surface of the protrusion (7) of each of the first bar (B1) and the second bar (B2). The illumination device (8) is formed in a substantially rectangular shape extending along one pair of line bars (LB).

[0039] A casing (40) of the indoor unit (30) (strictly speaking, casing body (40a)) is fitted in some first openings (O1) of the plurality of first openings (O1). The casing body (40a) is installed on the upper surface of the protrusion (7) of each of the first bar (B1) and the second bar (B2). The casing body (40a) extends along one pair of line bars (LB).

[0040] In the line-type system ceiling (C), the illumination device (8) and the indoor unit (30) are linearly arranged in the longitudinal direction. This gives a streamlined impression to the appearance of the ceiling surface.

<Overview of Indoor Unit>

[0041] The indoor unit (30) will be described with reference to FIGS. 2 to 5. The indoor unit (30) is installed in the first opening (O1) of the system ceiling (C). The indoor unit (30) includes the casing (40), the indoor fan (32), the indoor heat exchanger (33), drain pans (35, 36), flow path forming member (60), and filters (71, 72).

<Casing>

[0042] As shown in FIG. 4, the casing (40) includes the casing body (40a) with an open lower side and a ceiling panel (50) provided in the lower open portion of the casing body (40a). An air passage (P) through which air flows is formed inside the casing (40). The casing (40) is formed long sideways extending along the system ceiling (C).

<Casing Body>

[0043] The casing body (40a) is disposed in the ceiling space (6). The ceiling panel (50) is exposed to the indoor space (5) so as to form the ceiling surface.

[0044] The casing body (40a) is formed in a hollow box shape having a long side extending along the ceiling and a short side shorter than the long side. Specifically, the casing body (40a) is formed in an elongated rectangular shape extending in the longitudinal direction of the first bar (B1).

[0045] The casing body (40a) includes four side plates (41, 42, 43, 44) and one top plate (45). The top plate (45) is located on the upper side of the casing (40).

[0046] The four side plates include the first side plate (41), the second side plate (42), the third side plate (43), and the fourth side plate (44). The first side plate (41) is located on the left side of the casing (40). The second side plate (42) is located on the right side of the casing (40). The third side plate (43) is located on the front side of the casing (40). The fourth side plate (44) is located on the rear side of the casing (40). The first side plate (41) and the second side plate (42) are side plates along the long side of the casing (40). The first side plate (41) and the second side plate (42) face each other. The first side plate (41) and the second side plate (42) extend in the longitudinal direction of the first bar (B1) to go along the first bar (B1). The third side plate (43) and the fourth side plate (44) are side plates along the short side of the casing (40). The third side plate (43) and the fourth side plate (44) extend in the longitudinal direction of the second bar (B2) to go along the second bar (B2).

[0047] As shown in FIGS. 4 and 5, a first intake port (46) and a second intake port (47) are formed in the casing body (40a). The indoor air of the indoor space (5) is taken in the first intake port (46) and the second intake port (47) through a vent hole (9) described in detail later and the ceiling space (6).

[0048] The first intake port (46) is formed in the first side plate (41). The first intake port (46) is formed in a

rectangular shape along the outer edge of the first side plate (41). The first intake port (46) extends from near the upper end to near the lower end of the first side plate (41). The first intake port (46) extends from near the front end to near the rear end of the first side plate (41) in the longitudinal direction of the casing (40).

[0049] The second intake port (47) is formed in the second side plate (42). The second intake port (47) is formed in a rectangular shape along the outer edge of the second side plate (42). The second intake port (47) extends from near the upper end to near the lower end of the second side plate (42). The second intake port (47) extends from near the front end to near the rear end of the second side plate (42) in the longitudinal direction of the casing (40).

<Ceiling Panel>

[0050] As shown in FIGS. 4 and 5, the ceiling panel (50) constitutes the lower surface of the casing (40). The ceiling panel (50) is exposed to the indoor space (5). The ceiling panel (50) is formed in an elongated rectangular shape. The ceiling panel (50) extends in a direction along the line bar (LB).

[0051] In the ceiling panel (50), a first blow-out port (51) and a second blow-out port (52) are formed. The first blow-out port (51) and the second blow-out port (52) supply air in the casing (40) into the room. The first blow-out port (51) and the second blow-out port (52) extend in the longitudinal direction of the ceiling panel (50). The first blow-out port (51) and the second blow-out port (52) are disposed parallel and adjacent to each other.

[0052] The first blow-out port (51) and the second blow-out port (52) are each provided with a wind direction adjustment plate (53). The wind direction adjustment plate (53) extends along each blow-out port (51, 52) in the longitudinal direction of the blow-out port (51, 52). The angle of each wind direction adjustment plate (53) is adjusted by a motor (not shown). The angle of the wind direction adjustment plate (53) is adjusted between positions of closing and opening the blow-out port (51, 52). The wind direction adjustment plate (53) adjusts the direction of airflow blown out from the blow-out port (51, 52).

[0053] In the ceiling panel (50), a first slit (54) and a second slit (55) are formed. The first slit (54) is formed between the left edge of the ceiling panel (50) and the first slit (54). The second slit (55) is formed between the right edge of the ceiling panel (50) and the second slit (55). The first slit (54) and the second slit (55) extend in the longitudinal direction of the ceiling panel (50). A pull-out part (71b, 72b) of the corresponding filter (71, 72) is fitted into the first slit (54) and the second slit (55).

<Indoor Fan>

[0054] The indoor fan (32) is a fan that carries air. The indoor fan (32) of this example includes a cross-flow fan

(also called a transverse fan). The indoor fan (32) is disposed in the middle of the width direction (right-left direction) of the casing (40). The indoor fan (32) is disposed in the middle of the height direction of the casing (40).

5 [0055] The indoor fan (32) extends in the longitudinal direction of the casing (40). In other words, the axis of rotation of the indoor fan (32) extends in the longitudinal direction of the casing (40) or the line bar (LB). Since the cross-flow fan (32) has an elongated shape, the dead volume is reduced even if the casing (40) is elongated.

<Outdoor Heat Exchanger>

10 [0056] The outdoor heat exchanger (24) is disposed inside the casing (40). The outdoor heat exchanger (24) includes a first heat exchange unit (33A) and a second heat exchange unit (33B). The first heat exchange unit (33A) is disposed near the first side plate (41). The first heat exchange unit (33A) is disposed at a position corresponding to the first intake port (46). The second heat exchange unit (33B) is disposed near the second side plate (42). The second heat exchange unit (33B) is disposed at a position corresponding to the second intake port (47).

25 [0057] The first heat exchange unit (33A) and the second heat exchange unit (33B) include a large number of fins (F) and heat transfer tubes (not shown) penetrating each fin (F). The large number of fins (F) are arranged in the longitudinal direction of the casing (40) or the indoor fan (32).

30 [0058] The first heat exchange unit (33A) and the second heat exchange unit (33B) are slightly inclined from the vertical direction. Specifically, the first heat exchange unit (33A) is inclined such that the upper part thereof is near the middle of the width direction of the casing (40). The second heat exchange unit (33B) is inclined such that the upper part thereof is near the middle of the width direction of the casing (40). In other words, the first heat exchange unit (33A) and the second heat exchange unit (33B) are disposed with an inclination at an interval widening downward from each other. This forms a space at a relatively wide interval in the width direction between the lower part of the first heat exchange unit (33A) and the lower part of the second heat exchange unit (33B).

40 The indoor fan (32) is disposed in this space.

<Drain Pan>

50 [0059] The first drain pan (35) and the second drain pan (36) are disposed inside the casing (40). The first drain pan (35) is disposed below the first heat exchange unit (33A). The first drain pan (35) is a tray that receives condensed water generated around the first heat exchange unit (33A). The second drain pan (36) is a tray that receives condensed water generated around the second heat exchange unit (33B). The first drain pan (35) extends in the longitudinal direction of the casing (40) to go along the first side plate (41). The second drain pan

(36) extends in the longitudinal direction of the casing (40) to go along the second side plate (42).

<Flow Path Forming Member>

[0060] The flow path forming member (60) is disposed below the indoor fan (32). The flow path forming member (60) forms a main flow path (61) that covers the lower part of the indoor fan (32) and two branch flow paths (62,63) that branch right and left from the lower part of the main passage (61). The flow path forming member (60) extends in the longitudinal direction of the casing (40). The two branch flow paths (62,63) include the first branch flow path (62) connected to the first blow-out port (51) and the second branch flow path (63) connected to the second blow-out port (52).

<Filter>

[0061] The first filter (71) and the second filter (72) are disposed inside the casing (40). Each filter (71, 72) is formed in a plate shape or a sheet shape. The first filter (71) and the second filter (72) are disposed upstream of the indoor heat exchanger (33) in the air passage (P). The first filter (71) and the second filter (72) collect dust in the air.

[0062] The first filter (71) is disposed behind the first intake port (46) so as to cover the first intake port (46). The first filter (71) extends up and down from the top plate (45) to the ceiling panel (50). The first filter (71) is attached to the casing (40) in a state of standing up and down. The first filter (71) includes a first filter body (71a) that covers the first intake port (46) and the first pull-out part (71b) connected to the lower end of the first filter body (71a). With the first filter (71) attached, the first pull-out part (71b) protrudes downward from the first slit (54). The first pull-out part (71b) is provided with a handle (73) for a worker or user to pull out the first filter (71).

[0063] Similarly, the second filter (72) is disposed behind the second intake port (47) so as to cover the second intake port (47). The second filter (72) extends up and down from the top plate (45) to the ceiling panel (50). The second filter (72) is attached to the casing (40) in a state of standing up and down. The second filter (72) includes a second filter body (72a) that covers the second intake port (47) and the second pull-out part (72b) connected to the lower end of the second filter body (72a). With the second filter (72) attached, the second pull-out part (72b) protrudes downward from the second slit (55). The second pull-out part (72b) is provided with a handle (73) for a worker or user to pull out the second filter (72).

<Vent Hole>

[0064] As schematically shown in FIG. 6, the system ceiling (C) is provided with the vent hole (9) that causes the indoor space (5) to communicate with the ceiling space (6). The intake port (46, 47) of the indoor unit (30)

communicates with the indoor space (5) via the vent hole (9) and the ceiling space (6). The intake port (46, 47) is configured to substantially take in the indoor air of the indoor space (5).

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-Operation-

[0065] The operation of the air-conditioning device (10) will be described. The air-conditioning device (10) switches between a cooling operation and a heating operation. The following describes the cooling operation as a typical example.

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[0066] In the cooling operation, the outdoor fan (22), the indoor fan (32), and the compressor (23) are operated. Accordingly, the first refrigeration cycle described above is executed. When the indoor fan (32) is in operation, the indoor air of the indoor space (5) is taken in from the vent hole (9) to the ceiling space (6). The air in the ceiling space (6) is taken in from the first intake port (46) and the second intake port (47) to the air passage (P) in the casing (40).

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[0067] The air taken in from the first intake port (46) passes through the first filter (71). The first filter (71) collects dust in the air. The air that has passed through the first filter (71) is cooled by the first heat exchange unit (33A). The air taken in from the second intake port (47) passes through the second filter (72). The second filter (72) collects dust in the air. The air that has passed through the second filter (72) is cooled by the second heat exchange unit (33B).

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[0068] The air cooled by the indoor heat exchanger (33) flows through the main passage (61) and is divided into the first branch flow path (62) and the second branch flow path (63). The air in the first branch flow path (62) is supplied from the first blow-out port (51) to the indoor space (5). The air in the second branch flow path (63) is supplied from the second blow-out port (52) to the indoor space (5).

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[0069] In the heating operation, the second refrigeration cycle described above is executed. The heating operation is basically the same as the cooling operation except that the air is heated by the indoor heat exchanger (33).

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<Component Layout of Indoor Unit>

[0070] As shown in FIG. 4, in the indoor unit (30), at least a part of each of the blow-out port (51, 52), the indoor fan (32), and the indoor heat exchanger (33) overlaps each other in the up-and-down direction. Specifically, in this example, the upper part of the first heat exchange unit (33A), the left part of the indoor fan (32), and the first blow-out port (51) overlap each other in the up-and-down direction. The upper part of the second heat exchange unit (33B), the right part of the indoor fan (32), and the second intake port (47) overlap each other in the up-and-down direction. In this way, when the indoor fan (32), the indoor heat exchanger (33), and the blow-out

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port (51,52) are disposed so as to be stacked in the up-and-down direction, the size of the casing (40) can be reduced horizontally. This can reduce the area of the ceiling panel (50) exposed to the indoor space (5).

[0071] In addition, the intake port (46, 47) is not formed in the ceiling panel (50) in this example. Therefore, the area of the ceiling panel (50) can be made smaller than the ceiling panel (50) in which the intake port is formed.

[0072] In this example, the casing (40) has a long front-rear length and a narrow right-left width. Therefore, as shown in FIG. 3, the indoor unit (30) can be arranged together with the illumination device (8) between one pair of line bars (LB). This allows the indoor unit (30) and the illumination device (8) to be linearly arranged in the longitudinal direction thereof. This allows formation of a ceiling surface with a streamlined impression.

[0073] If the right-left length of the ceiling panel (50) is $L1$ and the front-rear length is $L2$, the aspect ratio A of the ceiling panel (50) is $L2/L1$. The aspect ratio A is preferably 1.25 or more, more preferably 3.0 or more, and even more preferably 4.0 or more.

[0074] It is assumed that the total area including the blow-out port (51,52) on the lower surface of the ceiling panel (50) is $S1$, and the total opening area of the blow-out port (51,52) is $S2$. Strictly speaking, the total opening area $S2$ in this example is the sum of the opening area of the first blow-out port (51) and the opening area of the second blow-out port (52). The total opening area $S2$ is preferably 20% or more of the total area $S1$. Setting the total opening area to 20% or more makes it possible to secure a sufficient flow rate of blow-out air.

<Insertion and Removal Work of Filter>

[0075] A person in the room such as a worker or a user performs the work of removing and installing the filter (71, 72) from and into the indoor space (5).

[0076] In the removal work of the filter (71,72), the person in the room grabs the handle (73) of the pull-out part (71b, 72b) of the filter (71,72) and pulls the pull-out part (71b, 72b) downward. Then, the filter (71, 72) moves downward through the slit (54, 55) (see FIG. 7). This allows the filter (71, 72) to be taken out of the casing (40) without removing the ceiling panel (50) from the casing body (40a).

[0077] In the installation work of the filter (71, 72), the person in the room grabs the handle (73) of the pull-out part (71b, 72) and inserts the upper end of the filter (71, 72) into the slit (54, 55). In this state, the filter (71, 72) is pushed upward. This allows the filter (71, 72) to be attached to the inside of the casing (40) without removing the ceiling panel (50) from the casing body (40a).

-Effects of Embodiment-

[0078] The embodiment is the ceiling-embedded indoor unit (30) for the air-conditioning device (10) including the casing (40), and the indoor fan (32) and the indoor

heat exchanger (33) disposed inside the casing (40). The casing (40) includes the casing body (40a) disposed in the ceiling space (6) of the system ceiling (C) with the open lower side, and the panel (50) provided in the lower open portion of the casing body (40a) and exposed to the air conditioning target space (5). In the ceiling panel (50), the blow-out port (51, 52) that supplies air to the indoor space (5) is formed. In the casing body (40a), the intake port (46, 47) in which the air of the indoor space (5) is taken is formed. At least a part of each of the blow-out port (51, 52), the indoor fan (32), and the indoor heat exchanger (33) overlaps each other in the up-and-down direction.

[0079] In this embodiment, at least a part of each of the blow-out port (51,52), the indoor fan, and the indoor heat exchanger (33) overlaps each other in the up-and-down direction, making it possible to reduce the size of the casing (40) horizontally. This can also reduce the area of the ceiling panel (50) facing the indoor space (5).

[0080] In this embodiment, the intake port (46, 47) is not formed in the ceiling panel (50), and the intake port (46, 47) is formed in the casing body (40a). This can reduce the area of the ceiling panel (50) more than the configuration of forming the intake port (46, 47) in the ceiling panel (50). In addition, the so-called short circuit, in which the air blown out from the blow-out port (51, 52) is immediately taken in the intake port (46, 47), can be avoided.

[0081] In the embodiment, the casing (40) has a long side extending in the direction along the system ceiling (C) and a short side shorter than the long side.

[0082] In this embodiment, since the casing (40) is formed in a rectangular shape extending along the system ceiling (C), the casing (40) can be adopted for the line-type system ceiling (C). Specifically, the illumination device (8) and the indoor unit (30) are installed between one pair of elongated line bars (LB), and are arranged in a straight line (see FIG. 3). This gives a streamlined impression to the ceiling surface and can improve the comfort of the person in the room.

[0083] In the embodiment, if the total area including the blow-out port (51,52) on the lower surface of the ceiling panel (50) is $S1$ and the total opening area of the blow-out port (51,52) is $S2$, the total opening area $S2$ is 20% or more of the total area $S1$.

[0084] This embodiment can secure the total opening area $S2$ of the blow-out port (51, 52) relatively large while reducing the area of the ceiling panel (50). This embodiment can secure a sufficient flow rate of the blow-out air, and reduce the pressure loss of the blow-out air. Since there is no intake port in the ceiling panel (50), even if the opening area of the blow-out port (51, 52) is increased in this way, the so-called short circuit is not generated.

[0085] In the embodiment, the intake port (46, 47) is formed in at least one side plate (41, 42) of the casing body (40a).

[0086] This embodiment can secure a sufficient area of the intake port (46, 47) by forming the intake port (46,

47) in the side plate (41, 42) having a relatively large area. If the intake port (46, 47) is formed on the upper surface of the casing body (40a), there is a possibility that the air cannot be taken in sufficiently under the constraint of height of the ceiling space (6) (such as slab). The present embodiment is not subjected to such a constraint.

[0087] In the embodiment, the intake port (46, 47) is formed in each of the two side plates (41, 42) of the casing body (40a) facing each other.

[0088] This embodiment can further increase the area of the intake port (46, 47).

[0089] In the embodiment, the indoor heat exchanger (33) includes the first heat exchange unit (33A) disposed near the first side plate (41) of the casing body (40a), and the second heat exchange unit (33B) disposed near the second side plate (42) facing the first side plate (41) of the casing body (40a). The first heat exchange unit (33A) and the second heat exchange unit (33B) are each disposed with an inclination at an interval widening downward from each other.

[0090] This embodiment can cause the air taken in from the intake port (46, 47) of the first side plate (41) to pass through the first heat exchange unit (33A), and can cause the air taken in from the intake port (46, 47) of the second side plate (42) to pass through the second heat exchange unit (33B). Since the first heat exchange unit (33A) and the second heat exchange unit (33B) are inclined with respect to the vertical direction, the heat transfer area of each heat exchange unit (33A, 33B) can be increased. In addition, the casing (40) can be made smaller in the horizontal direction than when each heat exchange unit (33A, 33B) is placed horizontally.

[0091] In the embodiment, the indoor fan (32) is a cross-flow fan extending in the longitudinal direction of the casing (40).

[0092] By disposing the cross-flow fan along the elongated casing (40), the dead space can be reduced and the right-left width of the casing (40) can be reduced. The casing (40), which is elongated horizontally, can be adapted to the line-type system ceiling (C).

[0093] In the embodiment, the casing (40) has a long side extending along the system ceiling (C) and a short side shorter than the many years. The casing body (40a) includes the first side plate (41) along the long side of the casing body (40a) and the second side plate (42) facing the first side plate (41). The intake port (46, 47) is formed in each of the first side plate (41) and the second side plate (42). The indoor heat exchanger (33) includes the first heat exchange unit (33A) disposed near the first side plate (41) of the casing body (40a), and the second heat exchange unit (33B) disposed near the second side plate (42) facing the first side plate (41) of the casing body (40a). The first heat exchange unit (33A) and the second heat exchange unit (33B) are each disposed with an inclination at an interval widening downward from each other. The indoor fan (32) is a cross-flow fan extending in the longitudinal direction of the casing (40).

The cross-flow fan (32) is disposed between the lower part of the first heat exchange unit (33A) and the lower part of the second heat exchange unit (33B).

[0094] In this embodiment, the horizontally long indoor fan (32) can be disposed in the space between the lower parts of the first heat exchange unit (33A) and the second heat exchange unit (33B). This can reduce the dead space inside the casing (40). By disposing the indoor fan (32) in this space, the height of the casing (40) can also be reduced.

[0095] The embodiment includes the filter (71, 72) that collects dust in the air taken in the intake port (46, 47). In the ceiling panel (50), the slit (54, 55) is formed to pull the filter (71, 72) out of the casing (40).

[0096] This embodiment allows the work of inserting and removing the filter (71, 72) into and from the indoor space (5) to be easily executed without removing the ceiling panel (50) from the casing body (40a).

20 -Modifications of Embodiment-

[0097] The above-described embodiment may be configured as the following modifications.

25 <First modification>

[0098] An air-conditioning device (10) of the first modification shown in FIG. 8 includes a first duct (D1) and a second duct (D2). In this example, a system ceiling (C) is provided with a first vent hole (9a) and a second vent hole (9b). The inflow end of the first duct (D1) is connected to the first vent hole (9a). The outflow end of the first duct (D1) is connected to the first intake port (46). The inflow end of the second duct (D2) is connected to the second vent hole (9b), and the outflow end of the second duct (D2) is connected to the second intake port (47). The basic configuration of an indoor unit (30) is similar to the configuration of the embodiment described above.

[0099] In the first modification, when an indoor fan (32) is operated, the indoor air of indoor space (5) is taken into the first duct (D1) via the first intake port (46). The air in the first duct (D1) flows from the first intake port (46) into an air passage (P) of the indoor unit (30). The air in the second duct (D2) flows from the second intake port (47) into the air passage (P) of the indoor unit (30). The air in the air passage (P) is cooled or heated by an indoor heat exchanger (33) and then supplied from a blow-out port (51, 52) to the indoor space (5).

50 <Second modification>

[0100] In a casing (40) of the second modification shown in FIG. 9, an indoor fan (32), an indoor heat exchanger (33), and a blow-out port (51, 52) are disposed to overlap each other in the up-and-down direction. The indoor fan (32) of the second modification is a sirocco fan. The indoor heat exchanger (33) is of a horizontal type with the longitudinal direction of the fin in the hori-

zontal direction. In the second modification as well, by disposing the indoor fan (32), the indoor heat exchanger (33), and the blow-out port (51,52) to overlap each other in the up-and-down direction, the casing (40) can be made small horizontally. As a result, the area of the ceiling panel (50) can be reduced. The indoor heat exchanger (33) may be disposed obliquely.

«Other embodiments»

[0101] The above-described embodiment and each modification may have the following configuration.

[0102] The air-conditioning device (10) may be of a so-called pair type including one outdoor unit (20) and one indoor unit (30).

[0103] The ceiling panel (50) does not necessarily have to be a rectangle, and may be, for example, a square.

[0104] The intake port (46, 47) may be formed in the top plate (45) of the casing body (40a).

[0105] The indoor unit (30) may take in outdoor air into the intake port (46, 47) and adjust the temperature of the taken air to supply the air to the air conditioning target space (indoor space (5)). In this case, the indoor unit (30) may take in the outdoor air directly into the intake port (46, 47) through a duct, or take in the outdoor air indirectly into the intake port (46, 47) via the ceiling space (6).

[0106] The indoor unit (30) does not necessarily have to be applied to the line-type ceiling panel (50).

[0107] While the embodiment and modifications have been described above, it will be appreciated that various changes in the form and detail may be made without departing from the spirit and scope of the claims. The above-described embodiment, modifications, and other embodiments may be combined or replaced appropriately unless impairing functions of the present disclosure. The above-described terms "first", "second", "third", ... are just used to distinguish words to which these terms are attached, and do not limit the number or order of the words.

INDUSTRIAL APPLICABILITY

[0108] As described above, the present disclosure is useful for the indoor unit and the air-conditioning device.

REFERENCE SIGNS LIST

[0109]

5: indoor space (air conditioning target space)
6: ceiling space (backside space)
10: air-conditioning device
20: outdoor unit
30: indoor unit
32: indoor fan (fan, cross-flow fan, sirocco fan)
33: heat exchanger
33A: first heat exchange unit
33B: second heat exchange unit

40: casing
40a: casing body P6
41: first side plate
42: second side plate
5 46: first intake port
47: second intake phrase
50: panel
51: first blow-out port
52: second blow-out port
10 54: first slit
55: second slit
71: first filter
72: second filter

Claims

1. A ceiling-embedded indoor unit for an air-conditioning device, the ceiling-embedded indoor unit comprising:

a casing (40); and
a fan (32) and a heat exchanger (33) disposed inside the casing (40),
wherein
the casing (40) includes:

a casing body (40a) disposed in a backside space (6) of a ceiling (C) and having an open lower side; and
a panel (50) provided in a lower open portion of the casing body (40a) and exposed to an air conditioning target space (5),
a blow-out port (51, 52) configured to supply air to the air conditioning target space (5) is formed in the panel (50),
an intake port (46, 47) in which air is taken is formed in the casing body (40a), and
at least a part of each of the blow-out port (51, 52), the fan (32), and the heat exchanger (33) overlap each other in an up-and-down direction.

2. The ceiling-embedded indoor unit according to claim 1, wherein
the casing (40) has a long side extending along the ceiling (C) and a short side shorter than the long side.

3. The ceiling-embedded indoor unit according to claim 2, wherein
when a total area including the blow-out port (51,52) on a lower surface of the panel (50) is S1 and a total opening area of the blow-out port (51,52) is S2, the total opening area S2 is 20% or more of the total area S1.

4. The ceiling-embedded indoor unit according to claim 2 or 3, wherein

the fan (32) is a cross-flow fan extending in a longitudinal direction of the casing (40).

5. The ceiling-embedded indoor unit according to any one of claims 1 to 4, wherein 5
the intake port (46, 47) is formed in at least one side plate (41, 42) of the casing body (40a).

6. The ceiling-embedded indoor unit according to claim 5, wherein 10
the intake port (46, 47) is formed in each of two side plates (41, 42) facing each other of the casing body (40a).

7. The ceiling-embedded indoor unit according to any one of claims 1 to 6, wherein 15
the heat exchanger (33) includes:

a first heat exchange unit (33A) disposed near a first side plate (41) of the casing body (40a); 20
and
a second heat exchange unit (33B) disposed near a second side plate (42) facing the first side plate (41) of the casing body (40a), and 25
the first heat exchange unit (33A) and the second heat exchange unit (33B) are each disposed with an inclination at an interval widening downward from each other.

8. The ceiling-embedded indoor unit according to any one of claims 1 to 7, further comprising 30

a filter (71, 72) configured to collect dust in the air taken in the intake port (46, 47), wherein 35
a slit (54, 55) through which the filter (71, 72) is pulled out of the casing (40) is formed in the panel (50).

9. An air-conditioning device comprising: 40

an outdoor unit (20); and
the ceiling-embedded indoor unit (30) according to any one of claims 1 to 8.

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FIG.1

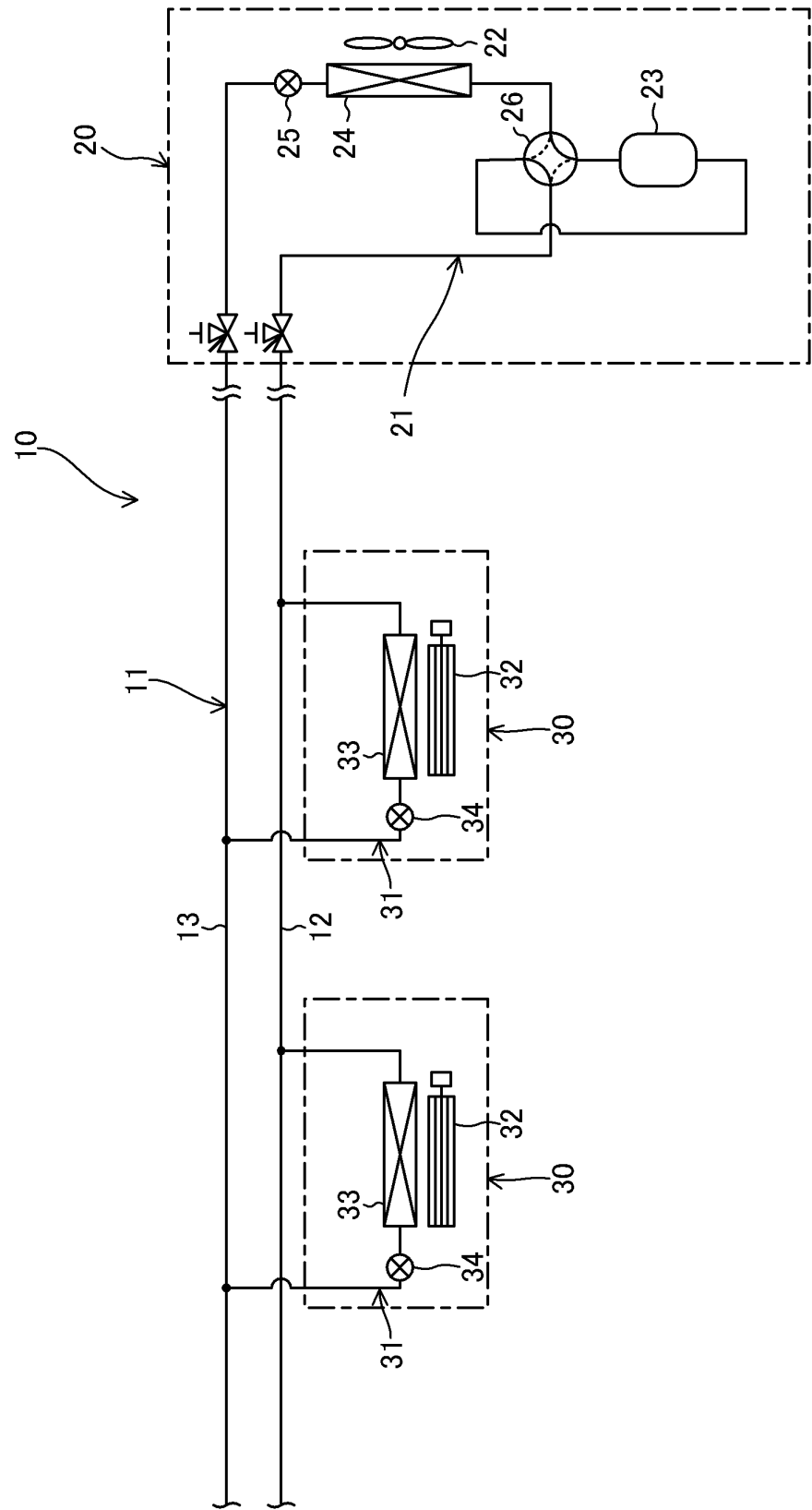


FIG.2

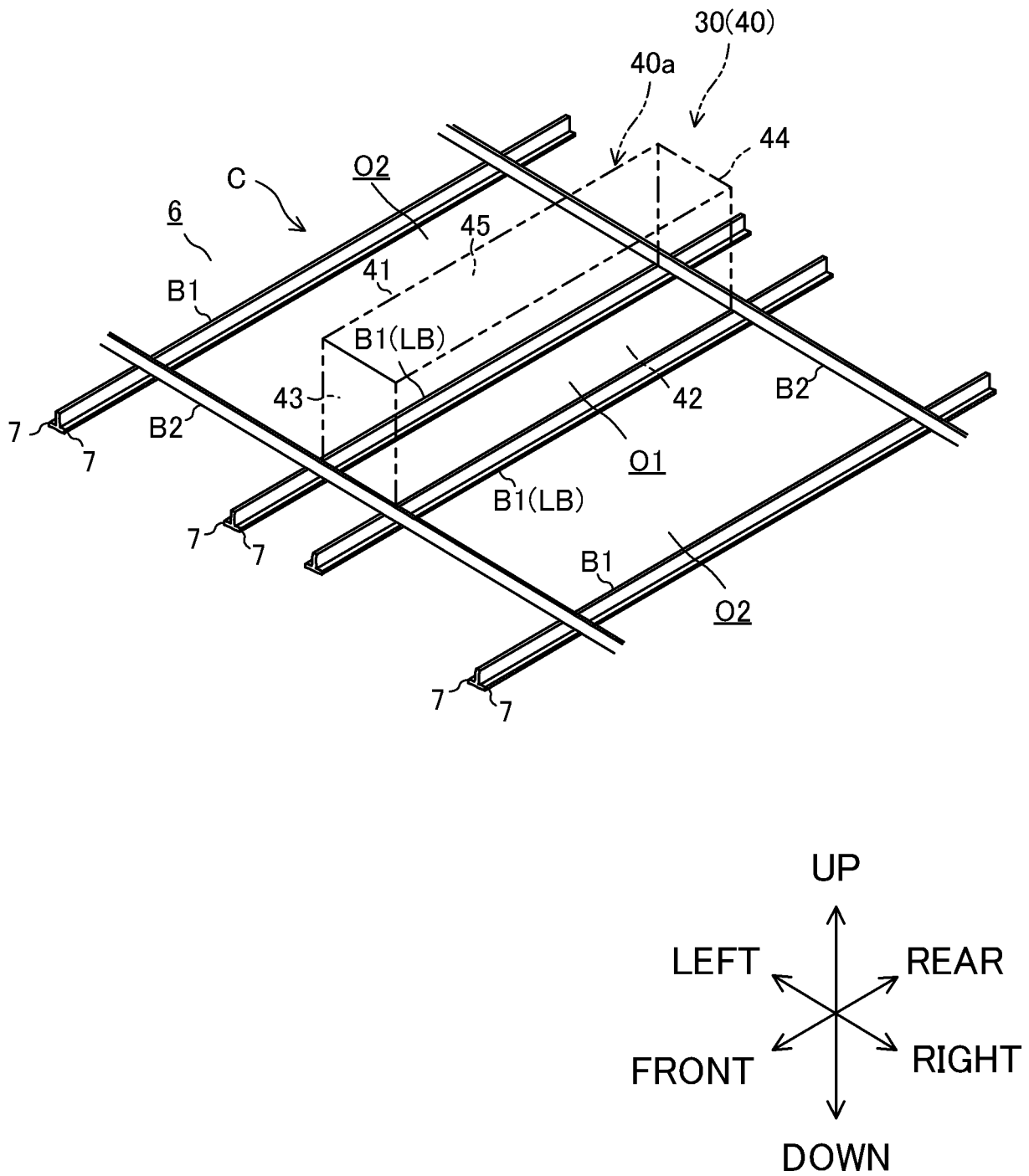


FIG.3

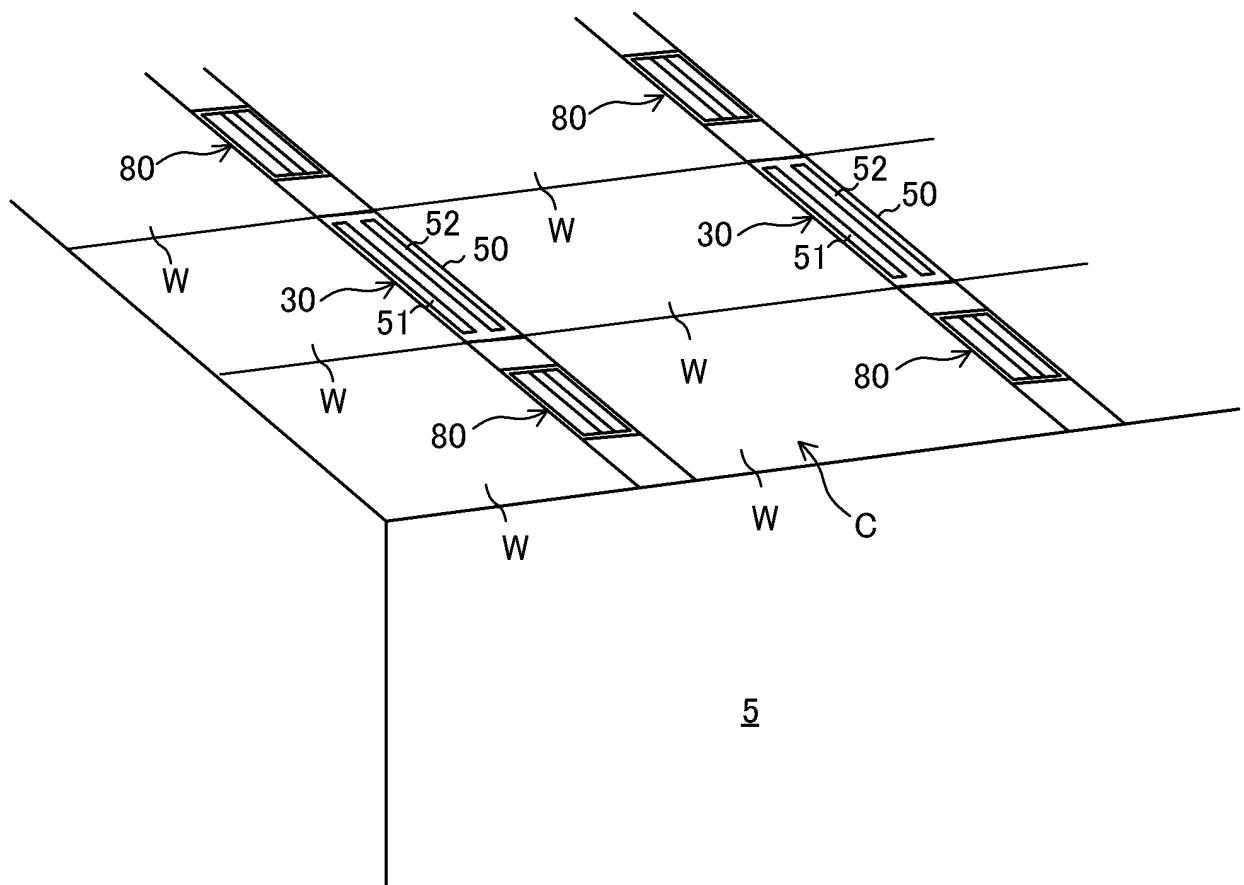


FIG.4

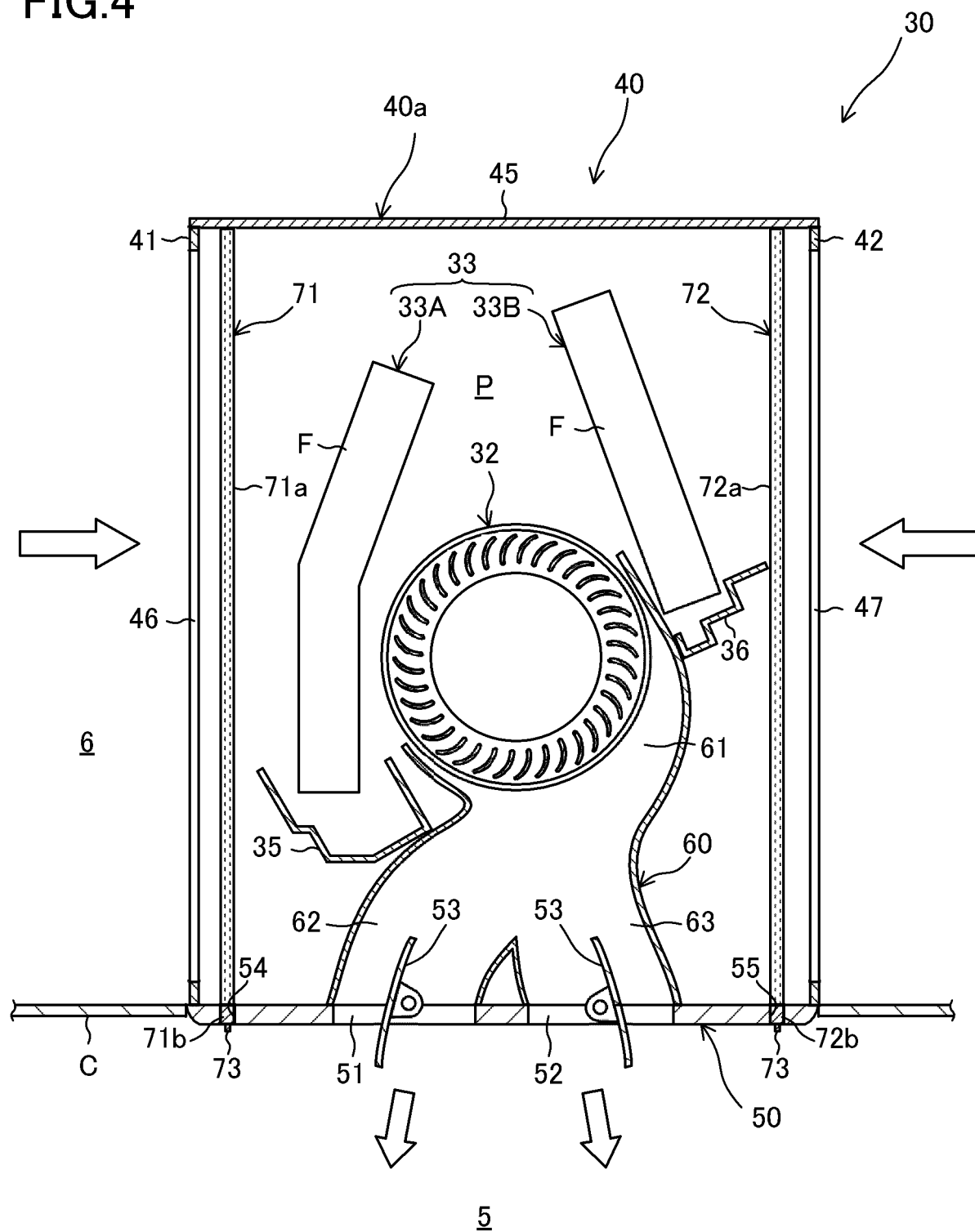


FIG.5

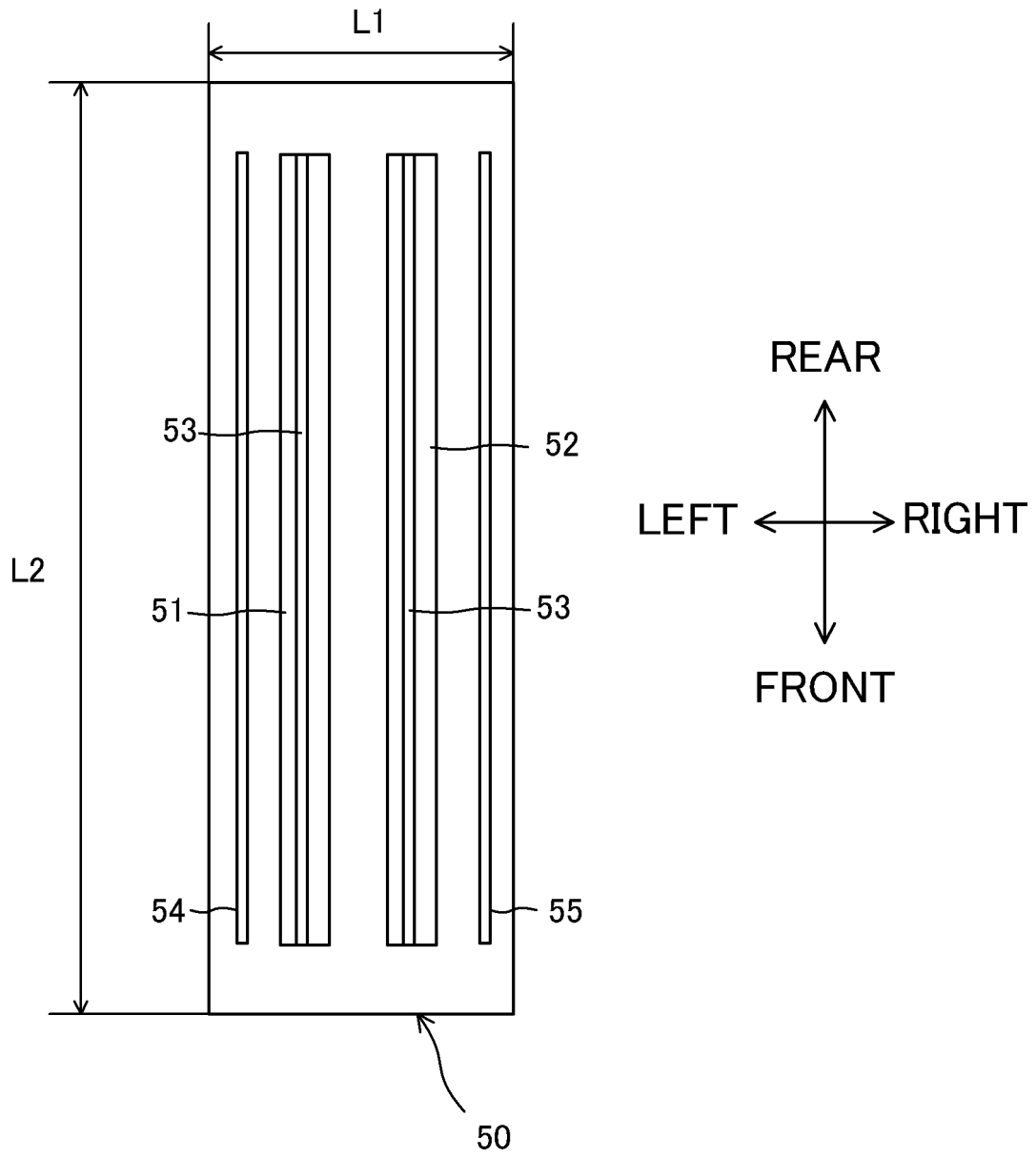


FIG.6

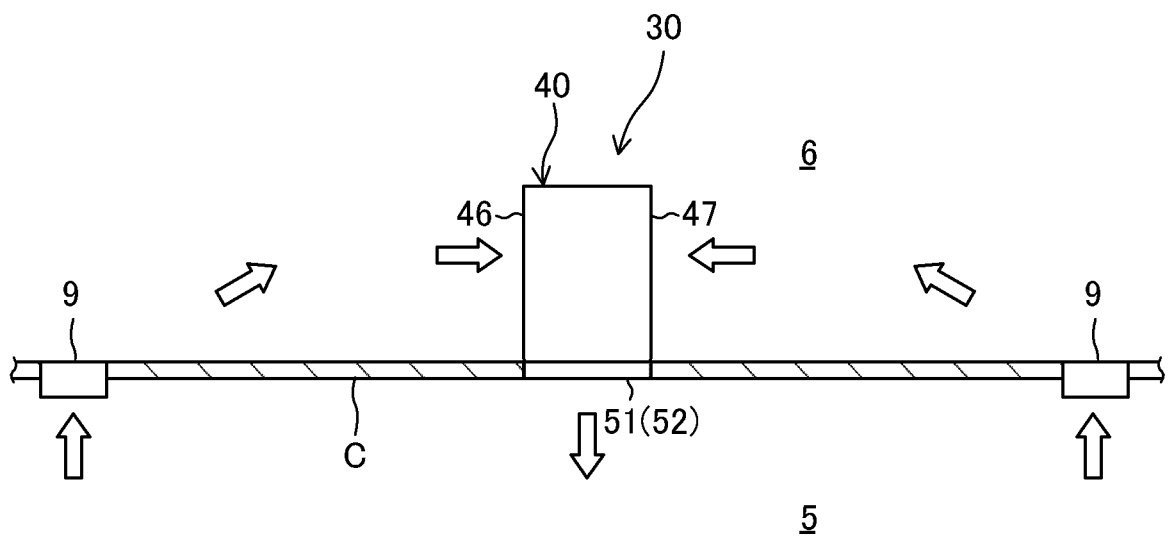


FIG.7

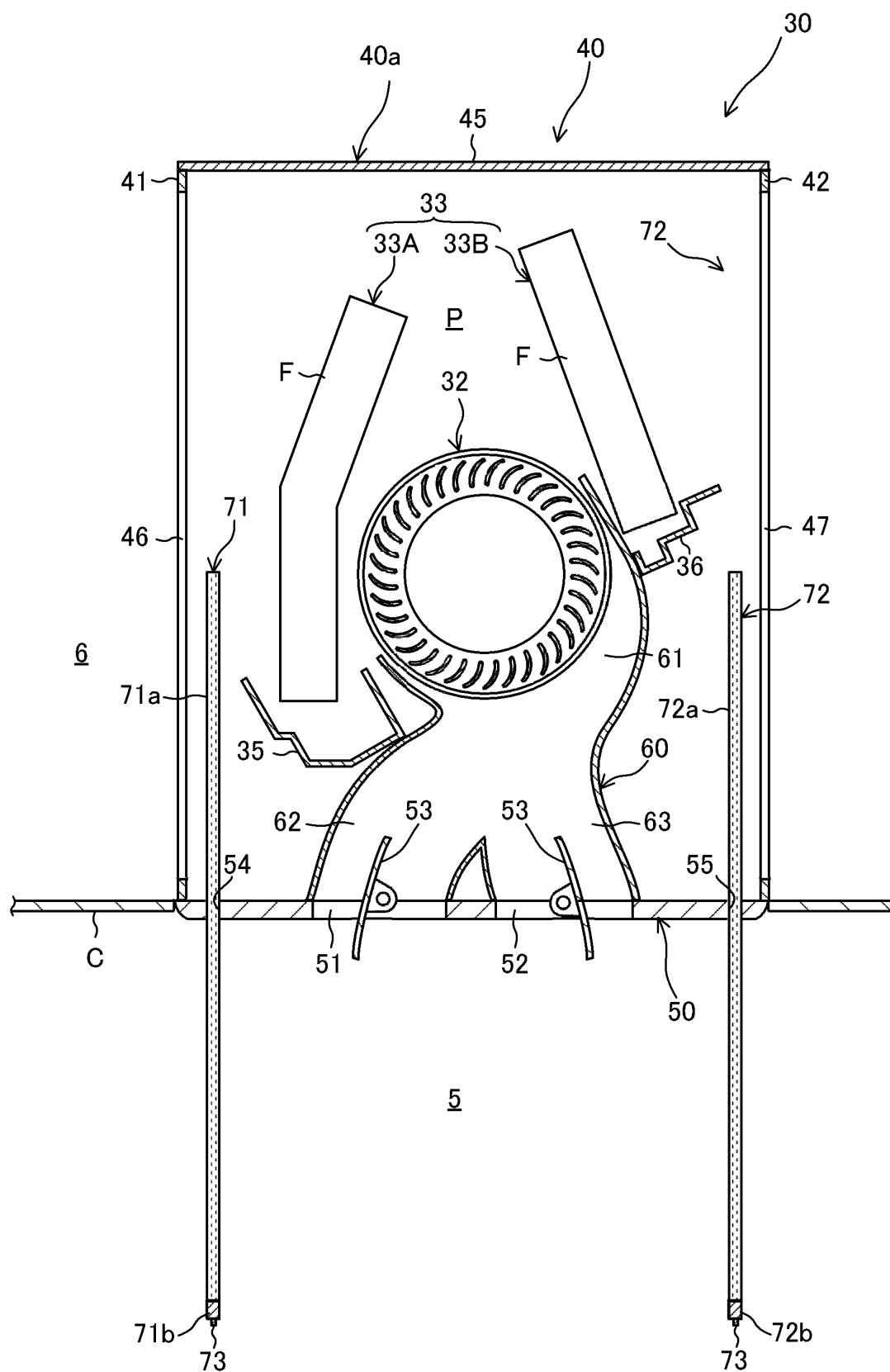


FIG.8

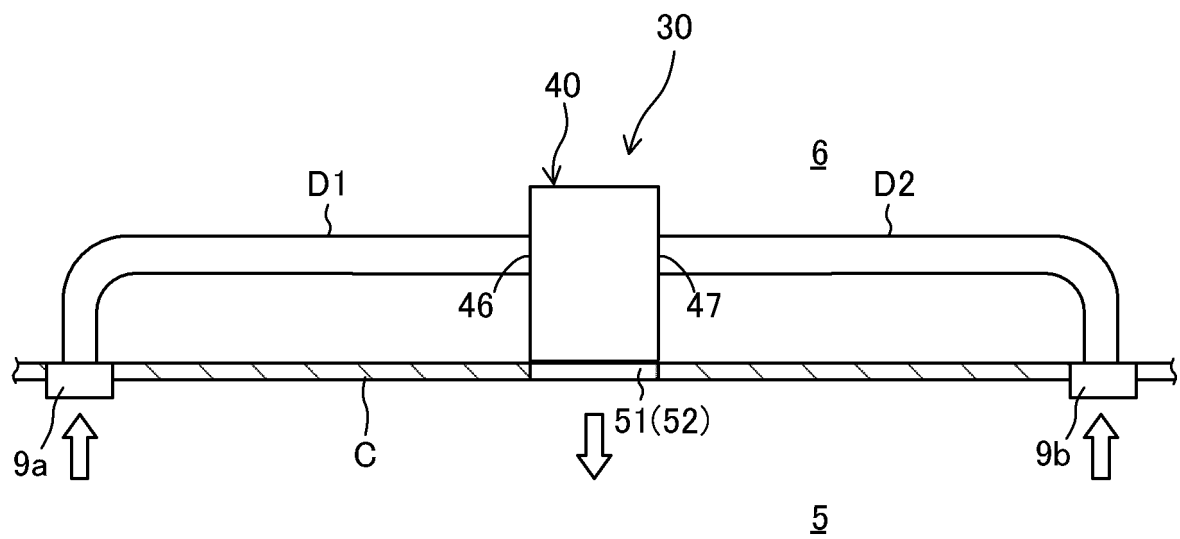
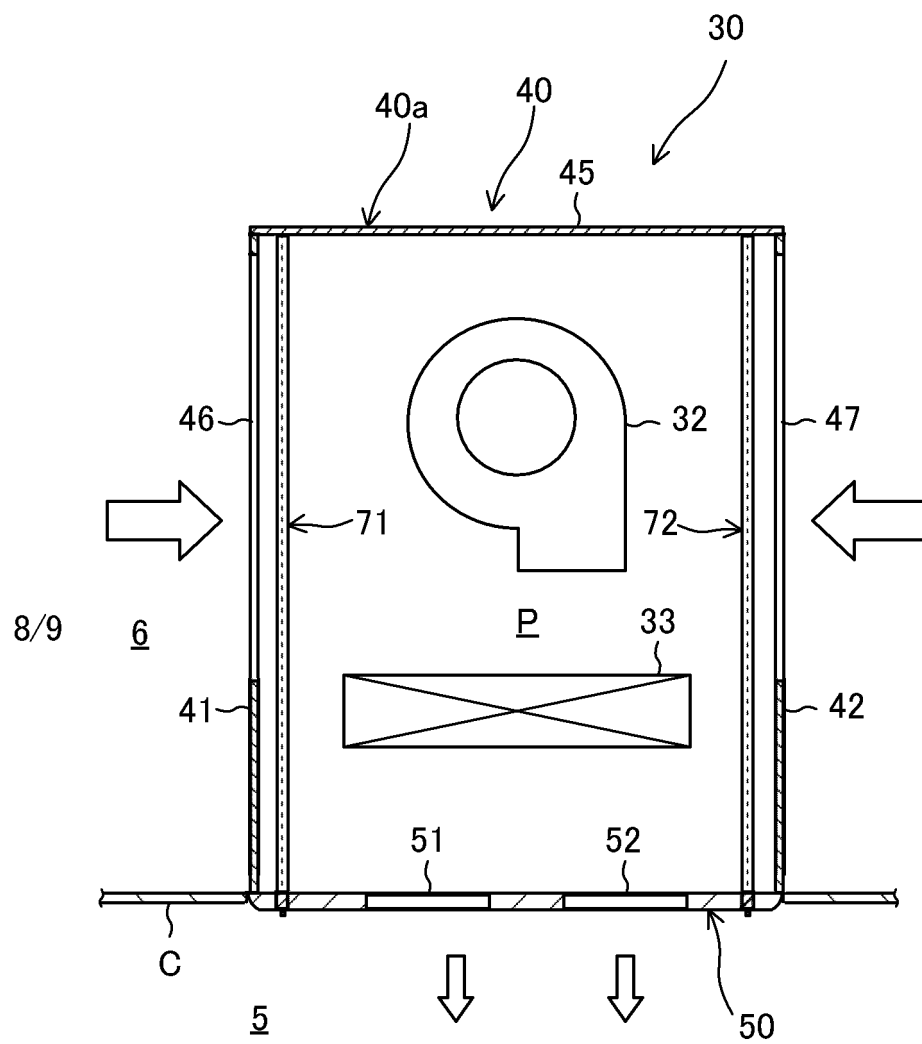


FIG.9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2020/016327

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. F24F1/0047(2019.01)i, F24F1/0007(2019.01)i, F24F1/0063(2019.01)i, F24F13/20(2006.01)i

FI: F24F1/0047, F24F1/0007401B, F24F1/0063, F24F1/0007321

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)

Int.Cl. F24F1/0007, F24F13/20, F24F1/0047, F24F1/0063

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

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2020

Registered utility model specifications of Japan 1996-2020

Published registered utility model applications of Japan 1994-2020

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	JP 2010-164294 A (DAIKIN INDUSTRIES, LTD.) 29.07.2010 (2010-07-29), paragraphs [0071]-[0094], fig. 1-7	1-9
Y	JP 2008-57948 A (DAIKIN INDUSTRIES, LTD.) 13.03.2008 (2008-03-13), paragraphs [0095]-[0099], [0126], [0128], [0129], fig. 14	1-9
A	WO 2008/111372 A1 (MITSUBISHI ELECTRIC CORPORATION) 18.09.2008 (2008-09-18), entire text, all drawings	1-9



Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

03.07.2020

Date of mailing of the international search report

14.07.2020

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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2020/016327

JP 2010-164294 A 29.07.2010	US 2011/0240255 A1 paragraphs [0094]-[0118], fig. 1-7 WO 2010/070889 A1 EP 2378217 A1 CN 102245975 A CN 103542460 A CN 103557561 A
JP 2008-57948 A 13.03.2008	JP 2008-57966 A US 2009/0211284 A1 paragraphs [0131]-[0135], [0162], [0164], [0165], fig. 14 WO 2007/069507 A1 EP 1965141 A1 KR 10-2008-0073363 A CN 101346587 A
WO 2008/111372 A1 18.09.2008	JP 2012-78085 A US 2010/0050678 A1 US 2012/0325442 A1 GB 2459063 A GB 2486985 A CN 101631958 A CN 102563758 A

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2010164294 A [0004]