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(54) **AIR-CONDITIONING INDOOR UNIT**

(57) An air-conditioning indoor unit having high heat exchange performance is provided.

In an air-conditioning indoor unit (4), when a heat exchanger unit (42) is used as a condenser, at least a part of a subcooling area (Sc1, Sc2) of the heat exchanger unit (42) is disposed at a position that is lower than an upper end (40u) of a wall portion (40w) of a drain pan (40).

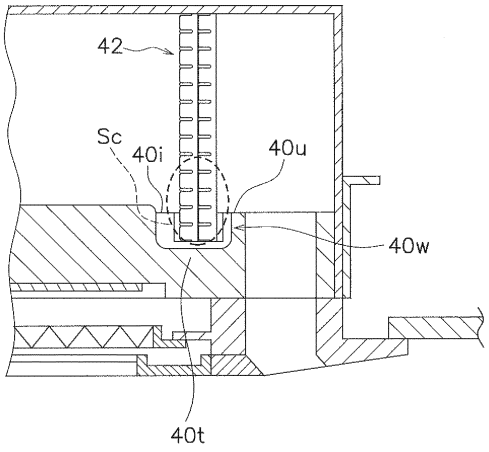

FIG. 5

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Description

TECHNICAL FIELD

[0001] The present invention relates to an air-conditioning indoor unit.

BACKGROUND ART

[0002] Hitherto, air-conditioning indoor units that blow out conditioned air have been used. For example, Patent Literature 1 (Japanese Unexamined Patent Application Publication No. 2011-099609) discloses an air-conditioning indoor unit in which a fin-and-tube-type heat exchanger is installed.

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] In recent years, installing a micro-channel-type heat exchanger using flat multi-perforated pipes in an air-conditioning unit has been considered. In the heat exchanger using flat multi-perforated pipes, different heat-exchange areas corresponding to the numbers of divisions of refrigerant flow paths may be formed. In addition, in the air-conditioning indoor unit, due to the influence of, for example, an internal structure, the wind speed distribution of air flow produced by a centrifugal fan may vary greatly in accordance with position. Therefore, in the air-conditioning indoor unit in which the heat exchanger using flat multi-perforated pipes is installed, the heat-exchange performance may be reduced greatly in accordance with an internal wind speed distribution and the position where the heat exchanger is disposed.

[0004] An object of the present invention is to provide an air-conditioning indoor unit having high heat-exchange performance.

<Solution to Problem>

[0005] An air-conditioning indoor unit according to a first aspect of the present invention includes a casing that is installed indoors, a fan that is provided inside the casing, a heat exchanger that is disposed inside the casing and that includes a plurality of flat multi-perforated pipes arranged side by side one above another, and a drain pan that is provided below the heat exchanger. Here, the heat exchanger is divided into an upper heat-exchange area and a lower heat-exchange area. When the heat exchanger is used as a condenser, a subcooling area that is formed by one or more of the flat multi-perforated pipes is formed at the lower heat-exchange area, the subcooling area being where a refrigerant flowing in an interior is subcooled. The drain pan includes a bottom portion that is provided below the heat exchanger and a wall portion that stands from the bottom portion and that is provided on a downwind side of the heat exchanger. In the air-conditioning indoor unit, at least a part of the subcooling area is disposed at a position that is lower than an upper end of the wall portion of the drain pan.

[0006] In the air-conditioning indoor unit according to the first aspect, since at least a part of the subcooling area of the heat exchanger is disposed at a position that is lower than the upper end of the wall portion of the drain pan, it is possible to improve heat-exchange efficiency.

[0007] In the present invention, the term "indoor" is used to distinguish from other chambers, and is used to mean not only an indoor space that is divided by a wall surface, but also, for example, a space on a back side of an indoor ceiling.

[0008] In the present invention, the configuration in which the plurality of flat multi-perforated pipes "are arranged side by side one above another" means any configuration in which the position of the center of gravity of each flat multi-perforated pipe is arranged side by side one above another. Therefore, the configuration means not only a configuration in which an upper surface and/or a lower surface of each flat multi-perforated pipe is arranged along a horizontal direction side by side one above another, but also a configuration in which the upper surface and/or the lower surface of each flat multi-perforated pipe is arranged obliquely from the horizontal direction side by side one above another. In addition, the configuration means not only a configuration in which the plurality of flat multi-perforated pipes are arranged along a vertical direction side by side one above another, but also a configuration in which the plurality of flat multi-perforated pipes are arranged obliquely from the vertical direction side by side one above another.

[0009] An air-conditioning indoor unit according to a second aspect of the present invention is the air-conditioning indoor unit of the first aspect, in which an area of the upper heat-exchange area is larger than an area of the lower heat-exchange area.

[0010] In the air-conditioning indoor unit according to the second aspect, since the area of the upper heat-exchange area is larger than the area of the lower heat-exchange area, it is possible to provide an air-conditioning indoor unit having high heat-exchange efficiency.

[0011] An air-conditioning indoor unit according to a third aspect of the present invention is the air-conditioning indoor unit of the first aspect or the second aspect, in which at least a part of the subcooling area is disposed near the upper end of the wall portion of the drain pan. Such a configuration allows a heat exchanger having a large area where heat is exchanged between a gas refrigerant and air to be disposed above the drain pan.

[0012] An air-conditioning indoor unit according to a fourth aspect of the present invention is the air-conditioning indoor unit of any one of the first aspect to the third aspect, in which at least a part of the subcooling area is disposed on both sides of the upper end of the wall portion of the drain pan. Such a configuration allows a heat exchanger having a high rate of exchanging heat with a gas refrigerant to be disposed above the drain pan.

[0013] An air-conditioning indoor unit according to a fifth aspect of the present invention is the air-conditioning indoor unit of any one of the first aspect to the fourth aspect, in which the casing has a blow-out port in a lower portion thereof, the fan is a centrifugal fan, and the heat exchanger is disposed so as to surround the centrifugal fan inside the casing.

[0014] The air-conditioning indoor unit according to the fifth aspect, for example, a ceiling-embedded-type air-conditioning indoor unit can have improved heat-exchange efficiency.

[0015] An air-conditioning indoor unit according to a sixth aspect of the present invention is the air-conditioning indoor unit of any one of the first aspect to the fourth aspect, in which the casing has a blow-out port in a side thereof and a partition plate is provided inside the casing. Here, the partition plate is a member for forming a heat exchanger chamber and a blowing chamber, the heat exchanger chamber communicating with the blow-out port and being where the heat exchanger is disposed, the blowing chamber communicating with the heat exchanger chamber and being where the fan is disposed.

[0016] The air-conditioning indoor unit according to the sixth aspect, for example, a duct-type air-conditioning indoor unit can have improved heat-exchange efficiency.

[0017] An air-conditioning indoor unit according to a seventh aspect of the present invention is the air-conditioning indoor unit of any one of the first aspect to the sixth aspect, in which, as the heat exchanger, a heat exchanger unit that includes a plurality of the heat exchangers is used.

[0018] The air-conditioning indoor unit according to the seventh aspect, or the air-conditioning indoor unit in which the heat exchanger unit including a plurality of the heat exchangers is installed can have improved heat-exchange efficiency.

[0019] An air-conditioning indoor unit according to an eighth aspect of the present invention is the air-conditioning indoor unit of the seventh aspect, in which, of the heat exchanger unit, a heat exchanger that is disposed on a downwind most side with respect to the fan is such that at least a part of the subcooling area is disposed at a position that is lower than the upper end of the wall portion of the drain pan.

[0020] The air-conditioning indoor unit according to the eighth aspect, or the air-conditioning indoor unit in which the heat exchanger unit including a plurality of the heat exchangers is installed can have further improved heat-exchange efficiency.

<Advantageous Effects of Invention>

[0021] The air-conditioning indoor unit according to the first aspect can have improved heat-exchange efficiency.

[0022] The air-conditioning indoor unit according to the second aspect can be an air-conditioning indoor unit having high heat-exchange efficiency.

[0023] The air-conditioning indoor unit according to the third aspect allows a heat exchanger having a large area where heat is exchanged between a gas refrigerant and air to be disposed above the drain pan.

[0024] The air-conditioning indoor unit according to the fourth aspect allows a heat exchanger having a high rate of exchanging heat with a gas refrigerant to be disposed above the drain pan.

[0025] The air-conditioning indoor unit according to the fifth aspect, for example, a ceiling-embedded-type air-conditioning indoor unit can have improved heat-exchange efficiency.

[0026] The air-conditioning indoor unit according to the sixth aspect, for example, a duct-type air-conditioning indoor unit can have improved heat-exchange efficiency.

[0027] The air-conditioning indoor unit according to the seventh aspect, or the air-conditioning indoor unit in which the heat exchanger unit including a plurality of the heat exchangers is installed can have improved heat-exchange efficiency.

[0028] The air-conditioning indoor unit according to the eighth aspect, or the air-conditioning indoor unit in which the heat exchanger unit including a plurality of the heat exchangers is installed can have further improved heat-exchange efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

Fig. 1 is a schematic view of a configuration of an air conditioner 1 according to a first embodiment of the present invention.

Fig. 2 is an external perspective view of an indoor unit 4 of a ceiling-installed-type air conditioner according the same embodiment.

Fig. 3 is a schematic side sectional view of the indoor unit 4 of the ceiling-installed-type air conditioner according to the same embodiment.

Fig. 4 is a schematic plan view illustrating a state in which a top plate 33 of the indoor unit 4 of a ceiling-embedded-type according to the same embodiment is removed.

Fig. 5 is a partial enlarged view for describing a structure of a drain water-receiving groove 40i according to the same embodiment.

Fig. 6 is a schematic perspective view of a heat exchanger 42a used in a heat exchanger unit 42 according to the same embodiment.

Fig. 7 is a schematic vertical sectional view of the heat exchanger used in the heat exchanger unit 42 according to the same embodiment.

Fig. 8 is a schematic perspective view illustrating another example of a heat exchanger 42a used in the heat exchanger unit 42 according to the same embodiment.

Fig. 9 is a schematic view illustrating a configuration of the heat exchanger unit 42 according to the same embodiment.

Fig. 10 is a schematic view illustrating a configuration of the heat exchanger unit 42 according to the same embodiment.
Fig. 11 is a schematic view illustrating a configuration of a first heat exchanger 52 according to the same embodiment.
Fig. 12 is a schematic view illustrating a configuration of a second heat exchanger 62 according to the same embodiment.
Fig. 13 is a diagram for describing an internal state when the heat exchanger unit 42 according to the same embodiment is used as a condenser.
Fig. 14 is a diagram illustrating a wind speed distribution between a drain pan 40 and an inner wall of a casing 31 according to the same embodiment.
Fig. 15 is a diagram illustrating an air-flow flow-line distribution between the drain pan 40 and the inner wall of the casing 31 according to the same embodiment.
Fig. 16 is a schematic view illustrating a planar shape of the heat exchanger unit 42 according to the same embodiment.
Fig. 17 is a schematic view illustrating a configuration of an indoor heat exchanger according to Modification 1A.
Fig. 18 is a schematic view illustrating a configuration of the indoor heat exchanger according to Modification 1A.
Fig. 19 is a schematic view illustrating an example of a heat exchanger unit according to Modification 1B.
Fig. 20 is a schematic view illustrating an example of a heat exchanger unit according to Modification 1D.
Fig. 21 is a schematic sectional view of a duct-type indoor unit 4S according to a second embodiment of the present invention.
Fig. 22 is a schematic view illustrating a modification of the indoor unit 4S according to the same embodiment.

DESCRIPTION OF EMBODIMENTS

[0030] Embodiments and modifications thereof of an air conditioner according to the present invention are described below with reference to the drawings. Specific configurations of the air conditioner according to the present invention are not limited to those of the embodiments and the modifications thereof below, and are changeable within a scope that does not depart from the spirit of the invention.

<First Embodiment

(1) Overview of Air Conditioner

(1-1) Basic Configuration of Air Conditioner

[0031] Fig. 1 is a schematic view of a configuration of an air conditioner 1 according to a first embodiment of the present invention.

[0032] The air conditioner 1 is a device that is capable of cooling and warming the interior of rooms of, for example, a building by performing a vapor-compression-type refrigeration cycle. The air conditioner 1 is constructed primarily by connecting an outdoor unit 2 and an indoor unit 4 to each other. Here, the outdoor unit 2 and the indoor unit 4 are connected to each other via a liquid-refrigerant connection pipe 5 and a gas-refrigerant connection pipe 6. Various operations of the air conditioner 1 are controlled by a control unit 8 including an indoor control unit 8a and an outdoor control unit 8. The control unit 8 controls, for example, various devices and valves based on detection signals from various sensors.

[0033] Here, although the air conditioner 1 of a pair-type in which one outdoor unit 2 is connected to one indoor unit 4 is illustrated, the air conditioner 1 according to the embodiment may be a multi-type air conditioner in which a plurality of indoor units are connected to one outdoor unit.

(1-2) Basic Operations of Air Conditioner

[0034] Next, basic operations of the air conditioner 1 are described. As basic operations, the air conditioner 1 is capable of performing a cooling operation and a heating operation. The air conditioner 1 is also capable of performing, for example, a defrost operation and an oil return operation. These operations are controlled by the control unit 8.

(1-2-1) Cooling Operation

[0035] In a cooling operation, a refrigerant circuit 10 is a state that a four-way switching valve 22 becomes as indicated by a solid line in Fig. 1. In the refrigerant circuit 10, a low-pressure gas refrigerant is compressed by a compressor 21 and becomes a high-pressure gas refrigerant. The high-pressure gas refrigerant is sent to an outdoor heat exchanger 23 via the four-way switching valve 22. The high-pressure gas refrigerant sent to the outdoor heat exchanger exchanges heat with outdoor air and is condensed at the outdoor heat exchanger 23. This causes the high-pressure gas refrigerant to become a high-pressure liquid refrigerant. The high-pressure liquid refrigerant has its pressure reduced and becomes a low-pressure refrigerant in a gas-liquid two-phase state at an expansion valve 24. The low-pressure refrigerant in a gas-liquid two-phase state is sent to an indoor heat exchanger 42 via the liquid-refrigerant connection pipe 5

and a liquid-side connection pipe 5a. Then, the refrigerant exchanges heat with air that is blown out from an indoor fan 41 and evaporates at the indoor heat exchanger 42. This causes the refrigerant sent to the indoor heat exchanger 42 to become a low-pressure gas refrigerant. The low-pressure gas refrigerant is sent again to the compressor 21 via a gas-side connection pipe 6a, the gas-refrigerant connection pipe 6, and the four-way switching valve 22.

(1-2-2) Heating Operation

[0036] In a heating operation, the refrigerant circuit 10 is in a state that the four-way switching valve 22 becomes as indicated by a broken line in Fig. 1. In the refrigerant circuit 10, a low-pressure gas refrigerant is compressed by the compressor 21 and becomes a high-pressure gas refrigerant. The high-pressure gas refrigerant is sent to the indoor heat exchanger 42 via the four-way switching valve 22, the gas-refrigerant connection pipe 6, and the gas-side connection pipe 6a. The high-pressure gas refrigerant sent to the indoor heat exchanger 42 exchanges heat with air that is blown out from the indoor fan 41 and is condensed. This causes the high-pressure gas refrigerant to become a high-pressure liquid refrigerant. The high-pressure liquid refrigerant is sent to the expansion valve 24 via the liquid-side connection pipe 5a and the liquid-refrigerant connection pipe 5. The high-pressure liquid refrigerant has its pressure reduced and becomes a low-pressure refrigerant in a gas-liquid two-phase state at the expansion valve 24. The low-pressure refrigerant in a gas-liquid two-phase state is sent to the outdoor heat exchanger 23. Then, the refrigerant exchanges heat with outdoor air and evaporates at the outdoor heat exchanger 23. This causes the refrigerant sent to the outdoor heat exchanger 23 to become a low-pressure gas refrigerant. The low-pressure gas refrigerant is sent again to the compressor 21 via the four-way switching valve 22.

(2) Configuration of Indoor Unit

[0037] In addition to the air conditioner according to the embodiment having the above-described basic configuration, the indoor unit has the following configuration.

[0038] In the embodiment, the term "indoor" is used to distinguish from other chambers, and is used to mean not only an indoor space that is divided by a wall surface, but also, for example, a space on a back side of an indoor ceiling.

(2-1) Basic Configuration of Indoor Unit

[0039] The indoor unit 4 is installed indoors, and constitutes a part of the refrigerant circuit 10. The indoor unit 4 primarily includes the indoor fan 41, the indoor heat exchanger 42, and the indoor control unit 8a.

[0040] The indoor fan 41 sucks in indoor air into the indoor unit 4. This allows the indoor air and a refrigerant to exchange heat at the indoor heat exchanger 42. The indoor fan 41 supplies the indoor air that has exchanged heat at the indoor heat exchanger 42 into the interior as supply air. As the indoor fan 41, for example, a centrifugal fan or a multi-blade fan is used. The indoor fan 41 is driven by an indoor-fan motor whose number of rotations is controllable.

[0041] When a cooling operation is performed, the indoor heat exchanger 42 functions as an "evaporator" of a refrigerant to cool indoor air, and, when a heating operation is performed, the indoor heat exchanger 42 functions as a "condenser" (radiator) of a refrigerant to heat indoor air. The indoor heat exchanger 42 is connected to the liquid-refrigerant connection pipe 5 and the gas-refrigerant connection pipe 6. The indoor heat exchanger 42 is described in more detail below.

[0042] The indoor control unit 8a is a unit that controls the operation of various portions that constitute the indoor unit 4. Specifically, the indoor control unit 8a includes, for example, a microcomputer and a memory, and controls the operations of the indoor unit 4 based on, for example, detection values of various sensors or the like provided inside the indoor unit 4. The indoor control unit 8a communicates by using a control signal with a remote controller (not illustrated) for individually operating the indoor unit 4, and communicates by using a control signal with the outdoor control unit 8b via a transmission line.

[0043] The indoor unit 4 is provided with the various sensors. Therefore, for example, the temperature of a refrigerant at the indoor heat exchanger 42 and the temperature of indoor air that is sucked into the indoor unit 4 are detected.

(2-2) Ceiling-Embedded-Type Indoor Unit

[0044] For the indoor unit 4 according to the embodiment, a configuration of a type that is called a ceiling-embedded type can be used. Fig. 2 is an external perspective view of the indoor unit 4 of the ceiling-embedded-type according the embodiment. Fig. 3 is a schematic sectional view of the ceiling-embedded-type indoor unit 4 according to the embodiment. Here, Fig. 3 is a sectional view along A-O-A in Fig. 4 described below. Fig. 4 is a schematic plan view illustrating a state in which a top plate 33 of the ceiling-embedded-type indoor unit 4 according to the embodiment is removed.

[0045] The ceiling-embedded-type indoor unit accommodates the indoor fan 41 and the indoor heat exchanger 42 inside a casing 31. A drain pan 40 is mounted in a lower portion of the casing 31.

(2-2-1) Casing

[0046] The casing 31 is a casing that accommodates various structural devices therein. The casing 31 primarily includes a casing main body 31a and a decorative panel 32 disposed on a lower side of the casing main body 31a. As illustrated in Fig. 3, the casing main body

31a is disposed on a ceiling U of the room that is provided with conditioned air. The ceiling U has an opening, and the casing main body 31a is inserted into the opening of the ceiling U. The decorative panel 32 is fitted and disposed in the opening of the ceiling U.

[0047] As illustrated in Figs. 3 and 4, the casing main body 31a is a box-shaped body in which a lower surface having a substantially octagonal shape in plan view has is opened, the substantially octagonal shape having long sides and short sides that are alternately formed. Specifically, the casing main body 31a includes the substantially octagonal top plate 33 having long sides and short sides alternately formed continuously and a side plate 34 extending downward from peripheral edge portions of the top plate 33. The side plate 34 includes side plates 34a, 34b, 34c, and 34d that correspond to the long sides of the top plate 33, and side plates 34e, 34f, 34g, and 34h that correspond to the short sides of the top plate 33. The side plate 34h includes a portion through which the liquid-side connection pipe 5a and the gas-side connection pipe 6a pass, and allows the refrigerant connection pipes 5 and 6 to be connected to the indoor heat exchanger 42.

[0048] As illustrated in Figs. 2 to 4, the decorative panel 32 is a substantially square plate-shaped body in plan view, and primarily includes a panel main body 32a fixed to a lower end portion of the casing main body 31a. The panel main body 32a has a suck-in port 35 that is disposed at a substantial center thereof and that sucks in air inside the air-conditioned room and a blow-out port 36 that is formed so as to surround the suck-in port 35 in plan view and that blows out air into the air-conditioned room. The suck-in port 35 is a substantially square opening. The suck-in port 35 is provided with a suck-in grill 37 and a filter 38 for removing dust in the air sucked in from the suck-in port 35. The blow-out port 36 is a substantially square, ring-shaped opening. Horizontal flaps 39a, 39b, 39c, and 39d that adjust the wind direction of the air that is blown out into the air-conditioned room are provided at the blow-out port 36 so as to be in correspondence with the sides of the square shape of the panel main body 32a.

(2-2-2) Drain Pan

[0049] The drain pan 40 is a member for receiving drain water that is produced due to moisture in the air being condensed at the indoor heat exchanger 42. The drain pan 40 is mounted at a lower portion of the casing main body 31a. The drain pan 40 has blow-out ports 40a, 40b, 40c, 40d, 40e, 40f, and 40g, a suck-in port 40h, and a drain water-receiving groove 40i. The blow-out ports 40a to 40g are formed so as communicate with the blow-out port 36 of the decorative panel 32. The suck-in port 40h is formed so as to communicate with the suck-in port 35 of the decorative panel 32. The drain water-receiving groove 40i is formed on a lower side of the indoor heat exchanger 42. A bell mouth 41c for guiding air that is sucked in from the suck-in port 35 to an impeller 41b of the indoor fan is disposed at the suck-in port 40h of the drain pan 40.

[0050] As illustrated in Fig. 5, the drain water-receiving groove 40i includes a bottom portion 40t that is provided below the indoor heat exchanger 42 and a wall portion 40w that stands from the bottom portion 40t and that is provided on a downwind side of the indoor heat exchanger 42. When the indoor heat exchanger 42 is used as a condenser, the indoor heat exchanger 42 has a subcooling area Sc that is constituted by one or more flat multi-perforated pipes, the subcooling area Sc being where a refrigerant flowing in the interior is subcooled. The indoor unit 4 according to the embodiment is formed so that at least a part of the subcooling area Sc of the indoor heat exchanger 42 is disposed at a position that is lower than an upper end 40u of the wall portion 40w of the drain pan 40. Examples of such a configuration include a configuration in which the entire subcooling area Sc is disposed at a position that is lower than the upper end 40u of the wall portion 40w of the drain pan 40, a configuration in which a part of the subcooling area Sc is disposed near the upper end 40u, and a configuration in which a part of the subcooling area Sc is disposed on both sides of the upper end 40u.

(2-2-3) Indoor Fan

[0051] The indoor fan 41 is constituted by a centrifugal blower. Here, the indoor fan 41 is a fan that sucks indoor air into the casing main body 31a via the suck-in port 35 of the decorative panel 32 and that blows out the air from the casing main body 31a via the blow-out port 36 of the decorative panel 32. Specifically, the indoor fan 41 includes a fan motor 41a that is provided at the center of the top plate 33 of the casing main body 31a and the impeller 41b that is coupled to the fan motor 41a and rotationally driven. The impeller 41b includes turbo blades. By the impeller 41b, air is sucked into the impeller 41b from there below and the sucked-in air is blown out towards an outer peripheral side of the impeller 41b in plan view.

(2-2-4) Indoor Heat Exchanger

[0052] The indoor heat exchanger 42 is bent so as to surround the indoor fan 41 in plan view and is disposed inside the casing 31. A liquid side of the indoor heat exchanger 42 is connected to the liquid-refrigerant connection pipe 5 via the liquid-side connection pipe 5a. A gas side of the indoor heat exchanger 42 is connected to the gas-refrigerant connection pipe 6 via the gas-side connection pipe 6a. The indoor heat exchanger 42 functions as an evaporator of a refrigerant at the time of a cooling operation, and functions as a condenser of a refrigerant at the time of a heating operation. Therefore, the indoor heat exchanger 42 exchanges heat with air blown out from the indoor fan 41, and cools the air at the time of

the cooling operation and heats the air at the time of the heating operation.

(2-2-4-1) Basic Configuration of Heat Exchanger

[0053] Fig. 6 is a schematic perspective view of a basic configuration of a heat exchanger 42a used in the indoor heat exchanger 42. Fig. 6 does not illustrate, for example, the refrigerant pipes and the connection pipes. Fig. 7 is a schematic vertical sectional view of the heat exchanger used in the heat exchanger 42a.

[0054] The heat exchanger 42a is an insertion-fin-type and lamination-type heat exchanger primarily including heat transfer pipes 421 that are constituted by flat multi-perforated pipes, a plurality of fins 422, and two headers 423 and 424.

[0055] The heat transfer pipes 421 are realized by the flat multi-perforated pipes. Here, two ends of each heat transfer pipe 421 are connected to a corresponding one of the headers 423 and 424. With planar portions of the heat transfer pipes 421 facing an up-down direction, the heat transfer pipes 421 are arranged in a plurality of layers and apart from each other. Specifically, each heat transfer pipe 421 includes upper and lower planar portions that become heat transfer surfaces and a plurality of small refrigerant flow paths 421a in which a refrigerant flows. As the refrigerant flow paths 421a, those having small flow path ports having a circular shape whose inside diameter is 1 mm or less or a polygonal shape having a cross-sectional area equivalent thereto are used. The heat transfer pipes 421 are made of aluminum or an aluminum alloy.

[0056] The fins 422 are inserted with respect to the plurality of layers of heat transfer pipes 421 arranged between the headers 423 and 424. Specifically, the fins 422 have a plurality of cutouts 422a extending horizontally in an elongated form. The shapes of the cutouts 422a substantially correspond to the cross-sectional external shapes of the heat transfer pipes 421. Therefore, by engaging the cutouts 422a and outer surfaces of the heat transfer pipes 421 with each other, it is possible to insert the fins 422 with respect to the heat transfer pipes 421 so as to contact the heat transfer pipes 421. The fins 422 are made of aluminum or an aluminum alloy. The fins 422 can have various shapes, and may have, for example, a wavy shape as that illustrated in Fig. 8.

[0057] The two headers 423 and 424 each have the function of supporting the heat transfer pipes 421, the function of guiding a refrigerant to the refrigerant flow paths 421a of the heat transfer pipes 421, and the function of gathering a refrigerant that has come out from the refrigerant flow paths 421a.

(2-2-4-2) Configuration of Heat Exchanger Unit

[0058] The indoor heat exchanger 42 according to the embodiment is constituted by a heat exchanger unit in which a plurality of the above-described heat exchangers 42a are combined. In the description below, for convenience sake, in describing the heat exchanger unit, reference numeral "42" denoting the indoor heat exchanger is added to describe the heat exchanger unit. The heat exchanger unit 42 is assumed as including at least a first heat exchanger 52 and a second heat exchanger 62. Here, although the first heat exchanger 52 and the second heat exchanger 62 are assumed as having a configuration that is similar to that of the above-described heat exchanger 42a, for convenience sake, the reference numeral 42a is replaced by the reference numerals 52 and 62. Specifically, in the description below, when the overall configuration of the heat exchanger unit is to be described, the first number of the reference numeral is "4"; when the first heat exchanger 52 is to be described, the first number of the reference numeral is replaced by "5"; and when the second heat exchanger 62 is to be described, the first number of the reference numeral is replaced by "6". For example, although the heat transfer pipes of the first heat exchanger 52 or the second heat exchanger 62 have the same structure as the above-described heat transfer pipes 421, instead of the reference numeral 421, the heat transfer pipes of the first heat exchanger 52 are each given reference numeral "521" and are described, and the heat transfer pipes of the second heat exchanger 62 are each given reference numeral "621" and are described.

[0059] Fig. 9 is a schematic view illustrating a configuration of the heat exchanger unit 42 according to the embodiment. The heat exchanger unit 42 includes the first heat exchanger 52 that is disposed on an upwind side of air flow produced by the indoor fan (fan) 41 and the second heat exchanger 62 that is disposed beside the first heat exchanger 52 on a downwind side of the air flow produced by the indoor fan 41. Here, a first direction D1 in which a refrigerant flows from a first header 523 of the first heat exchanger 52 towards a second header 524 and a second direction D2 in which a refrigerant flows from an upper third header 523U of the second heat exchanger 62 towards an upper fourth header 624U oppose each other. In Fig. 9, although, for convenience of explanation, the first heat exchanger 52 and the second heat exchanger 62 are illustrated apart from each other, they are disposed sufficiently close to each other so as to function together (refer to Fig. 10).

[0060] The first heat exchanger 52 includes the first header 523 and the second header 524, and a first flat pipe group 500 including a plurality of flat multi-perforated pipes (heat transfer pipes) that are each connected to the first header 523 and the second header 523. In the first flat pipe group 500, the plurality of flat multi-perforated pipes are arranged side by side one above another. In the first flat pipe group 500, as illustrated in Fig. 11, one or more of the flat multi-perforated pipes on an upper side form an upper first heat-exchange area 500U, and one or more of the flat multi-perforated pipes on a lower side form a lower first heat-exchange area 500L.

[0061] As illustrated in Fig. 11, the first header 523 in-

cludes an upper first header 523U that is connected to the upper first heat-exchange area 500U and a lower first header 523L that is connected to the lower first heat-exchange area 500L. The gas-side connection pipe 6a (gas refrigerant pipe) in which a gas refrigerant flows is connected to the upper first header 523U. Coupling pipes 525 and 526 are connected to the lower first header 523L. Therefore, an upper second header 524U and the lower first header 523L are coupled to each other. In the first header 523, an internal space is partitioned by a partition plate 523a into upper and lower portions (here, two portions). Consequently, the upper first header 523U and the lower first header 523L are formed so that they do not internally communicate with each other.

[0062] As illustrated in Fig. 11, the second header 524 includes the upper second header 524U that is connected to the upper first heat-exchange area 500U and a lower second header 524L that is connected to the lower first heat-exchange area 500L. Coupling pipes 525 and 526 are connected to the upper second header 524U. Therefore, the upper second header 524U and the lower first header 523L are coupled to each other. The liquid-side connection pipe 5a in which a liquid refrigerant flows is connected to the lower second header 524L. In the second header 524, an internal space is partitioned by a partition plate 524a into upper and lower portions (here, two portions). Consequently, the upper second header 524U and the lower second header 524L are formed so that they do not internally communicate with each other.

[0063] The coupling pipes 525 and 526 are pipes that couple the upper second header 524U and the lower first header 523L to each other. A temperature measuring instrument for measuring the temperature of a refrigerant is mounted on each of the coupling pipes 525 and 526.

[0064] The second heat exchanger 62 includes a third header 623 and a fourth header 624, and a second flat pipe group 600 including a plurality of flat multi-perforated pipes that are each connected to the third header 623 and the fourth header 624. In the second flat pipe group 600, the plurality of flat multi-perforated pipes are arranged side by side one above another. In the second flat pipe group 600, as illustrated in Fig. 12, one or more of the flat multi-perforated pipes on an upper side form an upper second heat-exchange area 600U, and one or more of the flat multi-perforated pipes on a lower side form a lower second heat-exchange area 600L.

[0065] As illustrated in Fig. 12, the third header 623 includes an upper third header 623U that is connected to the upper second heat-exchange area 600U and a lower third header 623L that is connected to the lower second heat-exchange area 600L. Specifically, in the third header 623, an internal space is partitioned by a partition plate 623a into upper and lower portions (here, two portions). Therefore, a space 623g on an upper side of the partition plate 623a is connected to the upper second heat-exchange area 600U, and a space 623h on a lower side of the partition plate is connected to the lower second heat-exchange area 600L. The gas-side connection pipe 6a is connected to the upper third header 623U. The liquid-side connection pipe 5a is connected to the lower third header 623L.

[0066] As illustrated in Fig. 12, the fourth header 624 includes the upper fourth header 624U that is connected to the upper second heat-exchange area 600U and a lower fourth header 624L that is connected to the lower second heat-exchange area 600L. Specifically, in the fourth header 624, an internal space is partitioned by a partition plate 624a into upper and lower portions (here, two portions). Therefore, a space 624i on an upper side of the partition plate 624a is connected to the upper second heat-exchange area 600U, and a space 624j on a lower side of the partition plate 624a is connected to the lower second heat-exchange area 600L. The fourth header 624 includes a "turn-around portion" that couples the upper fourth header 624U and the lower fourth header 624L and that causes a refrigerant flowing in from a side of the third header 623 to turn around towards the side of the third header 623. Specifically, as the turn-around portion, the fourth header 624 includes a coupling pipe 625 that couples the upper fourth header 624U and the lower fourth header 624L to each other. A temperature measuring instrument for measuring the temperature of a refrigerant is mounted on the coupling pipe 625.

(3) Features

(3-1)

[0067] In the heat exchanger unit 42 described above, the first heat exchanger 52 forms the upper first heat-exchange area 500U and the lower first heat-exchange area 500L, a connection port with the gas-side connection pipe 6a is disposed in the upper first heat-exchange area 500U, and a connection port with the liquid-side connection pipe 5a is disposed in the lower first heat-exchange area 500L. The second heat exchanger 62 forms the upper second heat-exchange area 600U and the lower second heat-exchange area 600L, a connection port with the gas-side connection pipe 6a is disposed in the upper second heat-exchange area 600U, and a connection port with the liquid-side connection pipe 5a is disposed in the lower second heat-exchange area 600L.

[0068] Therefore, when the heat exchanger unit 42 is used as a condenser, a state of an internal portion of the heat-exchange areas becomes a state such as that illustrated in Fig. 13, and subcooling areas Sc1 and Sc2 that are constituted by one or more flat multi-perforated pipes are formed at the lower first heat-exchange area 500L and the lower second heat-exchange area 600L. In Fig. 13, the hatching of the area Sc1 and the hatching of the area Sc2 each indicate a subcooling area where a refrigerant is subcooled, and the hatching of an area Sh1 and the hatching of an area Sh2 each indicate a superheating area where a refrigerant is superheated.

[0069] Here, in the indoor unit 4 (air-conditioning indoor

unit) according to the embodiment, at least a part of the subcooling areas Sc1 and Sc2 of the heat exchanger unit 42 is disposed at a position that is lower than the upper end 40u of the wall portion 40w of the drain pan 40. Therefore, in the indoor unit 4 according to the embodiment, compared to a configuration in which the entire subcooling area Sc is disposed at a position that is higher than the upper end 40u of the wall portion 40w of the drain pan 40, it is possible to improve heat exchange efficiency.

[0070] To supplement, according to studies conducted by the present inventors, in the indoor unit 4, the flow speed of air flow (wind speed) in a space above the drain pan 40 is increased. Specifically, the wind speed distribution between the drain pan 40 and an inner wall of the casing 31 is as indicated in the graph illustrated in Fig. 14. Here, in Fig. 14, the vertical axis indicates the position in an up-down direction inside the casing 31, and the horizontal axis indicates the wind speed. Fig. 14 shows that, in the indoor unit 4, the wind speed in the space above the drain pan 40 is increased. A flow-line distribution of air flow at a location between the drain pan 40 and the inner wall of the casing 31 is as indicated in Fig. 15.

[0071] In the configuration of the indoor unit 4 according to the embodiment, the heat-exchange areas (primarily, the lower heat-exchange areas 500L and 600L), where heat is exchanged between a liquid refrigerant and air, are disposed below the upper end 40u of the wall portion 40w of the drain pan 40, and the heat-exchange areas (primarily, the upper heat-exchange areas 500U and 600U), where heat is exchanged between a gas refrigerant and air, are disposed in the space above the drain pan 40. In short, when the heat exchanger unit 42 according to the embodiment is used as a condenser, a large part of each of the upper first heat-exchange area 500U and upper second heat-exchange area 600U, where the flow speed of a refrigerant is high, is disposed in the space above the drain pan 40, where the wind speed of air flow is high. Therefore, it is possible to provide the indoor unit 4 having high heat-exchange efficiency.

(3-2)

[0072] In the first heat exchanger 52 according to the embodiment, the area of the upper first heat-exchange area 500U is larger than the area of the lower second heat-exchange area 500L. Therefore, the number of divisions of refrigerant flow paths of the lower first heat-exchange area 500L is smaller than the number of divisions of refrigerant flow paths of the upper first heat-exchange area 500U. Consequently, in the first heat exchanger 52, it is possible to increase the refrigerant flow speed in the lower first heat-exchange area 500L than in the upper first heat-exchange area 500U.

[0073] When the first heat exchanger 52 is used as a condenser, the subcooling area Sc is formed in the lower first heat-exchange area 500L. Therefore, in the indoor unit 4 according to the embodiment, compared to a configuration in which the entire subcooling area Sc is disposed at a position that is higher than the upper end 40u of the wall portion 40w of the drain pan 40, it is possible to improve heat exchange efficiency.

[0074] The argument for the first heat exchanger 52 also holds for the second heat exchanger 62. Therefore, it is possible to increase the heat transfer coefficient in the lower second heat-exchange area 600L.

(3-3)

[0075] As described above, in the indoor unit 4 according to the embodiment, the casing 31 has the blow-out port 36 in the lower portion thereof, and the indoor heat exchanger 42 is disposed so as to surround the centrifugal fan 41 inside the casing 31. That is, as illustrated in Fig. 16, the indoor unit 4 is bent so as to surround the indoor fan 41 in plan view and is disposed inside the casing 31. Therefore, for example, the ceiling-embedded-type indoor unit 4 can have improved heat-exchange efficiency.

(3-4)

[0076] As described above, in the heat exchanger unit 42 according to the embodiment, since the heat exchangers 52 and 62 are installed, it is possible to improve heat-exchange efficiency. As illustrated in Fig. 13, when the first direction D1 in which a refrigerant flows inside the first heat exchanger 52 and the second direction D2 in which a refrigerant flows inside the second heat exchanger 62 (the upper second heat-exchange area 600U) oppose each other, temperature irregularities of blown-out air are suppressed. Therefore, the heat exchanger unit 42 according to the embodiment can provide blown-out air having little temperature irregularities.

[0077] When the heat exchanger unit 42 includes a plurality of heat exchangers 52 and 62, it is desirable that, of the heat exchangers 52 and 62, the heat exchanger that is disposed on a downwind most side with respect to the indoor fan 41 (in the example in Fig. 13, the first heat exchanger 52) be such that at least a part of the subcooling area Sc is disposed at a position that is lower than the upper end 40u of the wall portion 40w of the drain pan 40.

(4) Modifications

(4-1) Modification 1A

[0078] Although the description above is given by using the heat exchanger unit 42 as an indoor heat exchanger, the indoor heat exchanger according to the embodiment may be constituted by a single heat exchanger. For example, as illustrated in Figs. 17 and 18, the indoor heat exchanger 42 may be constituted by only the first heat exchanger 52 or the second heat exchanger 62. Even in such a configuration, as long as at least a part of the

subcooling area Sc1 of the first heat exchanger 52 or the subcooling area Sc2 of the second heat exchanger 62 is disposed at a position that is lower than the upper end 40u of the wall portion 40w of the drain pan 40, it is possible to improve heat exchange efficiency.

(4-2) Modification 1B

[0079] Although the description above is given by using the heat exchanger unit 42 as an indoor heat exchanger, the heat exchanger unit according to the embodiment may be constituted by a combination of the heat exchangers 52 and 62 that are arbitrarily constructed. For example, the heat exchanger unit 42 may have another configuration illustrated in Fig. 19. Even in such a configuration, as long as at least a part of the subcooling area Sc1 of the first heat exchanger 52 or the subcooling area Sc2 of the second heat exchanger 62 is disposed at a position that is lower than the upper end 40u of the wall portion 40w of the drain pan 40, it is possible to improve heat exchange efficiency.

(4-3) Modification 1C

[0080] In the indoor unit 4 according to the embodiment, when the indoor heat exchanger 42 is used as a condenser, at least a part of the subcooling area Sc only needs to be disposed near the upper end 40u of the wall portion 40w of the drain pan 40. In short, the indoor unit 4 according to the embodiment need not be one in which the entire subcooling area Sc of the heat exchanger unit 42 is formed at a position that is lower than the upper end 40u of the wall portion 40w of the drain pan 40.

[0081] The inventors conducted studies and found out that, near the upper end 40u of the wall portion 40w of the drain pan 40, as illustrated in Fig. 13, local wind speeds are increased. Therefore, even if the subcooling area Sc is not formed entirely over the position that is lower than the upper end 40u of the wall portion 40w of the drain pan 40, as long as the subcooling area Sc is formed at least near the upper end 40u, the degree of subcooling of a refrigerant can be increased.

[0082] Further, in the indoor unit 4 according to the embodiment, when the indoor heat exchanger 42 is used as a condenser, at least a part of the subcooling area Sc may be disposed on both sides of the upper end 40u of the wall portion 40w of the drain pan 40. Due to such an arrangement, at both sides of the upper end 40u of the wall portion 40w of the drain pan 40, the rate of heat exchange between a liquid refrigerant and air is increased, so that it is possible to increase the degree of subcooling of a refrigerant at the subcooling area Sc.

(4-4) Modification 1D

[0083] In the heat exchanger unit 42 according to the embodiment, although the upper side and the lower side are defined at the first heat exchanger 52 and the second heat exchanger 62, the upper side and the lower side may be defined based on the heat exchanger unit 42 according to the embodiment as a whole. Specifically, when the heat exchanger unit 42 is one in which the first heat exchanger 52 and the second heat exchanger 62 are connected and integrated to each other with coupling pipes, a connection port side with the gas-side connection pipe 6a is defined as the "upper side", and a connection port side with the liquid-side connection pipe 5a is defined as the "lower side". In this case, the area of the upper heat-exchange area of the heat exchanger unit 42 is larger than the area of the lower heat-exchange area. In short, the indoor heat exchanger according to the embodiment includes one in which, even if, in the single first heat exchanger 52 or second heat exchanger 62, the area of the upper heat-exchange area (500U or 600U) is not larger than the area of the lower heat-exchange area (500L or 600L), the area of the upper heat-exchange area is larger than the area of the lower heat-exchange area as a whole. For example, as the configuration illustrated in Fig. 20, the indoor heat exchanger according to the embodiment is one in which the first heat exchanger 52 and the second heat exchanger 62 are connected and integrated to each other with coupling pipes 427 and 428. In the example of Fig. 20, although only the first heat exchanger 52 includes the subcooling areas Sc1 and Sc2, the heat exchanger unit 42 is one in which, in terms of the definitions above, the area of the upper heat-exchange area is larger than the area of the lower heat-exchange area as a whole.

[0084] In Modification 1D, when the heat exchanger unit 42 is used as a condenser, it is desirable that the upwind-side first heat exchanger 52 include the subcooling area Sc instead of the downwind-side second heat exchanger 62.

<Second Embodiment

[0085] Portions corresponding to those that have already been described are given substantially the same reference numerals, and overlapping descriptions are not given below. In order to distinguish the portions from those of other embodiments, in the embodiment, the letter "S" is sometimes added.

[0086] An air conditioner 1S according to a second embodiment of the present invention differs from the air conditioner 1 according to the first embodiment in a specific form of an indoor unit 4S. Specifically, the indoor unit 4S in the embodiment uses a configuration of a type that is called a duct type.

[0087] Fig. 21 is a schematic sectional view of the duct-type indoor unit 4S according to the embodiment. In such a duct-type indoor unit 4S, a casing 31S has a blow-out port 36S in a side thereof. In the duct-type indoor unit 4S, a heat exchanger chamber 31H that communicates with the blow-out port 36S and a blowing chamber 31S that communicates with the heat exchanger chamber 31H via a partition plate B are formed inside the casing

31S. An indoor heat exchanger 42 is installed in the heat exchanger chamber 31H. An indoor fan 41 is installed in the blowing chamber 31S. Here, the configuration of the indoor heat exchanger 42 is the same as the configuration in the first embodiment.

[0088] Even in the indoor unit 4S having such a configuration, when at least a part of a subcooling area Sc of an indoor heat exchanger 42S is disposed at a position that is lower than an upper end 40Su of a wall portion 40Sw of a drain pan 40S, compared to a configuration in which the entire subcooling area Sc is disposed at a position that is higher than the upper end 40Su of the wall portion 40Sw of the drain pan 40S, it is possible to improve heat exchange efficiency.

[0089] In the embodiment, the configuration in which a plurality of flat multi-perforated pipes "are arranged side by side one above another" in the indoor heat exchanger 42S refers not to a configuration in which an upper surface and/or a lower surface of each flat multi-perforated pipe is arranged along a horizontal direction side by side one above another, but to, as illustrated in Fig. 21, a configuration in which the upper surface and/or the lower surface of each flat multi-perforated pipe is arranged obliquely from the horizontal direction side by side one above another. As long as, for example, heat exchangers having such a configuration are used, heat exchangers of other types can be installed as they are, and, for example, such heat exchangers can be easily manufactured.

[0090] However, the configuration of the heat exchanger 42S according to the embodiment is not limited thereto, and, as illustrated in Fig. 22, may be a configuration in which the plurality of flat multi-perforated pipes are arranged obliquely from a vertical direction side by side one above another. As long as, for example, heat exchangers having such a configuration are used, it is possible to allow air flow having a high flow speed to pass the heat-exchange areas and to improve heat-exchange efficiency between a refrigerant and air.

[0091] The above-described indoor heat exchanger 42S may be a heat exchanger unit including a plurality of heat exchangers, or may be constituted by a single heat exchanger. This is the same as for the first embodiment. That is, when the heat exchanger unit 42S including heat exchangers 52S and 62S is installed, it is possible to improve heat exchange efficiency compared to one that is constituted by a single heat exchanger. Further, when a first direction D1 in which a refrigerant flows inside the first heat exchanger 52S and a second direction D2 in which a refrigerant flows inside the second heat exchanger 62S oppose each other, temperature irregularities of blown-out air can be suppressed.

[0092] When the heat exchanger unit 42 includes a plurality of heat exchangers, it is desirable that the upwind-side first heat exchanger include the subcooling area rather than the downwind-side heat exchanger. In addition, it is desirable that the subcooling area of the upwind-side heat exchanger be disposed at a position that is lower than the upper end 40u of the wall portion 40w of the drain pan 40 rather than the subcooling area of the downwind-side heat exchanger.

<Other Embodiments>

[0093] Although embodiments and modifications thereof of the present invention are described based on the drawings, specific configurations are not limited to those of the embodiments and the modifications thereof, and are changeable within a scope that does not depart from the spirit of the invention. For example, although, in the above-described embodiments and modifications thereof, examples in which the present invention is applied to a ceiling-embedded-type air conditioner and to a duct-type air conditioner are described, air conditioners are not limited thereto. The present invention may also be applied to air conditioners of a type that is called a ceiling-suspension type in which the entire device is disposed below a ceiling.

REFERENCE SIGNS LIST

[0094]

4	indoor unit (air-conditioning indoor unit)
4S	indoor unit (air-conditioning indoor unit)
31	casing
31S	casing
31H	heat exchanger chamber
31W	blowing chamber
36	blow-out port
36S	blow-out port
40	drain pan
40S	drain pan
40t	bottom portion of drain pan
40w	wall portion of drain pan
40u	upper end of wall portion of drain pan
41	indoor fan (fan)
41S	indoor fan (fan)
42	indoor heat exchanger, heat exchanger unit (heat exchanger)
42S	indoor heat exchanger, heat exchanger unit (heat exchanger)
52	first heat exchanger (heat exchanger)
62	second heat exchanger (heat exchanger)
500U	upper first heat-exchange area (upper heat-exchange area)
500L	lower first heat-exchange area (lower heat-exchange area)
600U	upper second heat-exchange area (upper heat-exchange area)
600L	lower second heat-exchange area (lower heat-exchange area)
B	partition plate
Sc	subcooling area
Sc1	subcooling area
Sc2	subcooling area

CITATION LIST

PATENT LITERATURE

[0095] Patent Literature 1
Japanese Unexamined Patent Application Publication No. 2011-099609

Claims

1. An air-conditioning indoor unit (4, 4S) comprising:

a casing (31, 31S) that is installed indoors;
a fan (41, 41S) that is provided inside the casing;
a heat exchanger (42, 42S, 52, 62) that is disposed inside the casing and that includes a plurality of flat multi-perforated pipes arranged side by side one above another; and
a drain pan (40, 40S) that is provided below the heat exchanger, wherein
the heat exchanger includes an upper heat-exchange area (500U, 600U) and a lower heat-exchange area (500L, 600L),
when the heat exchanger is used as a condenser, a subcooling area (Sc, Sc1, Sc2) that is formed by one or more of the flat multi-perforated pipes is formed at the lower heat-exchange area, the subcooling area being where a refrigerant flowing in an interior is subcooled,
the drain pan includes a bottom portion (40t) that is provided below the heat exchanger and a wall portion (40w) that stands from the bottom portion and that is provided on a downwind side of the heat exchanger, and
at least a part of the subcooling area is disposed at a position that is lower than an upper end (40u) of the wall portion of the drain pan.

2. The air-conditioning indoor unit according to claim 1, wherein
an area of the upper heat-exchange area is larger than an area of the lower heat-exchange area.

3. The air-conditioning indoor unit according to claim 1 or claim 2, wherein
at least a part of the subcooling area is disposed near the upper end of the wall portion of the drain pan.

4. The air-conditioning indoor unit according to any one of claims 1 to 3, wherein
at least a part of the subcooling area is disposed on both sides of the upper end of the wall portion of the drain pan.

5. The air-conditioning indoor unit according to any one of claims 1 to 4, wherein
the casing has a blow-out port (36) in a lower portion of the casing,
the fan is a centrifugal fan, and
the heat exchanger is disposed so as to surround the centrifugal fan inside the casing.

6. The air-conditioning indoor unit according to any one of claims 1 to 4, wherein
the casing has a blow-out port (36S) in a side thereof,
a heat exchanger chamber (31H) that communicates with the blow-out port and a blowing chamber (31W) that communicates with the heat exchanger chamber via a partition plate (B) are formed inside the casing,
the heat exchanger is installed in the heat exchanger chamber, and
the fan is installed in the blowing chamber.

7. The air-conditioning indoor unit according to any one of claims 1 to 6, wherein
the heat exchanger is a heat exchanger unit that includes a plurality of the heat exchangers.

8. The air-conditioning indoor unit according to claim 7, wherein
of the heat exchanger unit, a heat exchanger that is disposed on a downwind most side with respect to the fan is such that at least a part of the subcooling area is disposed at a position that is lower than the upper end of the wall portion of the drain pan.

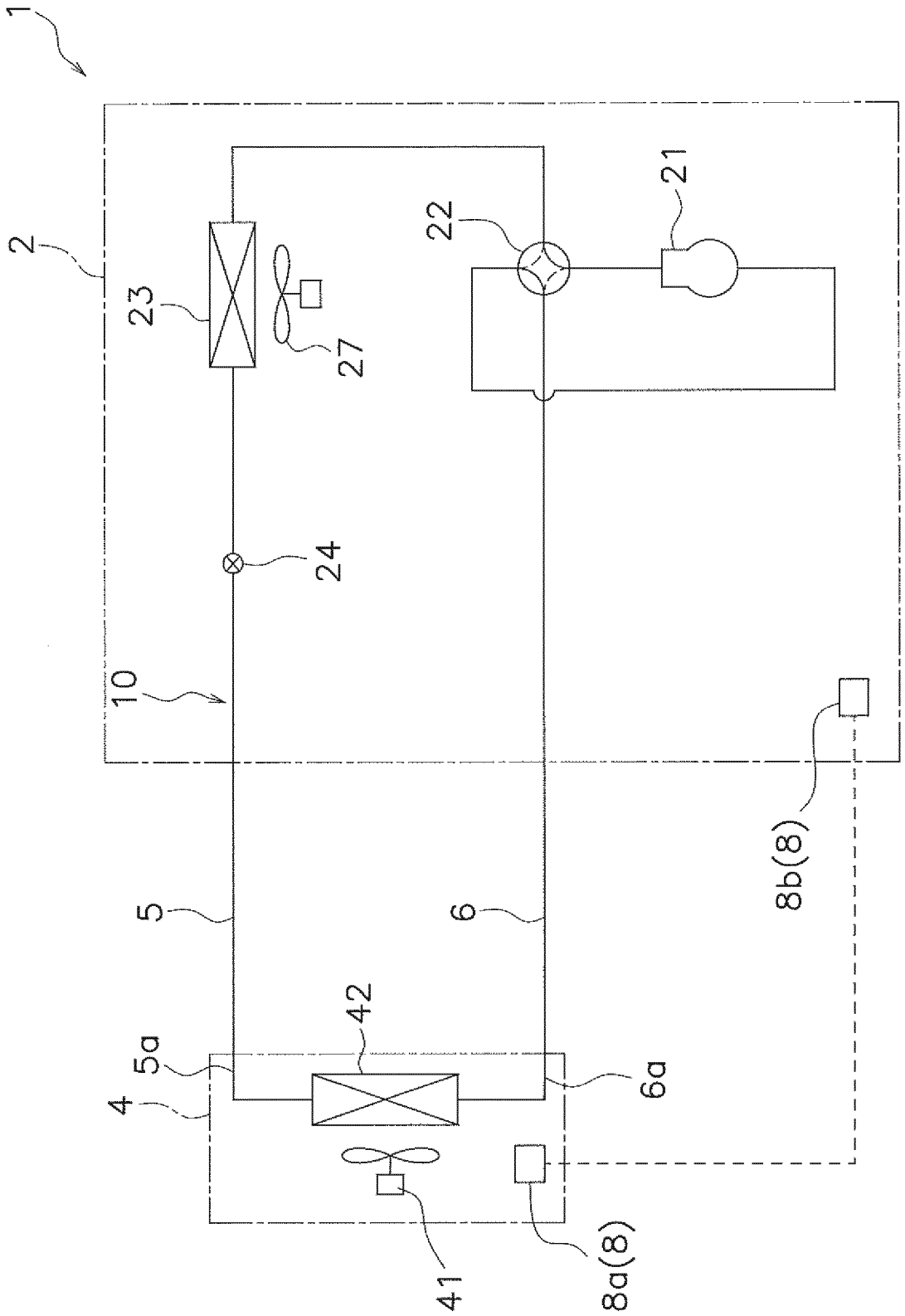

FIG. 1

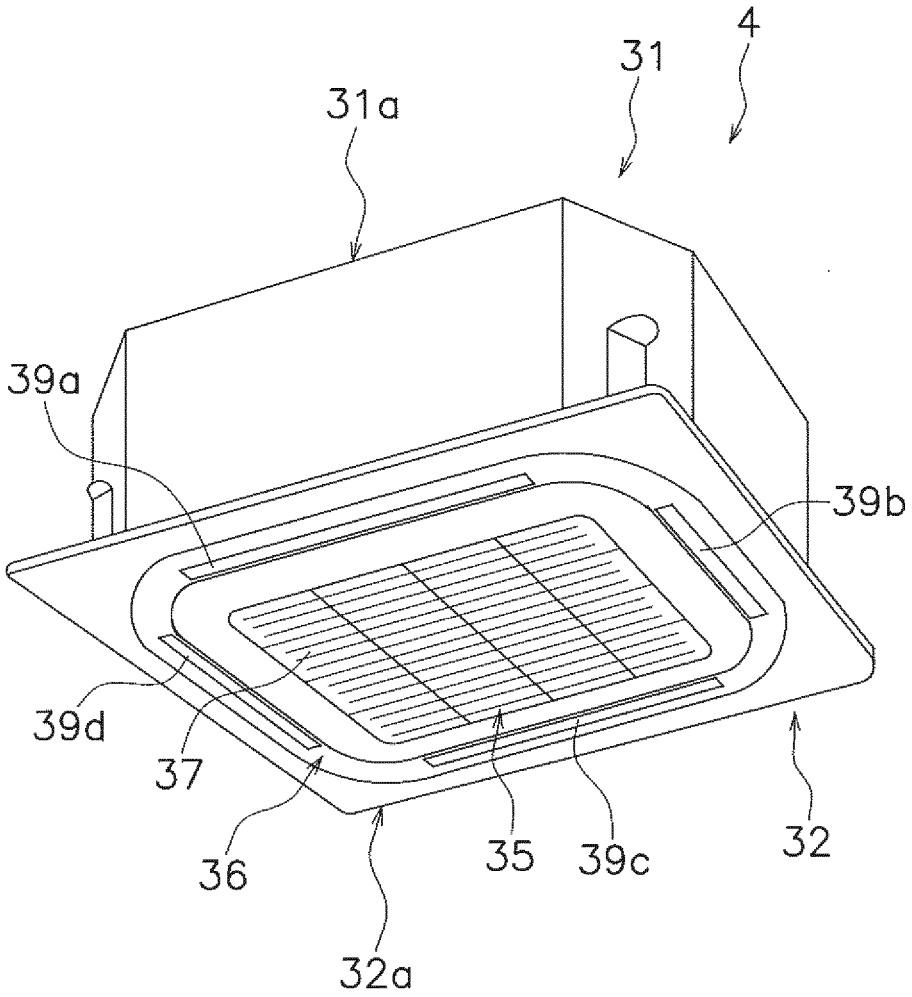

FIG. 2

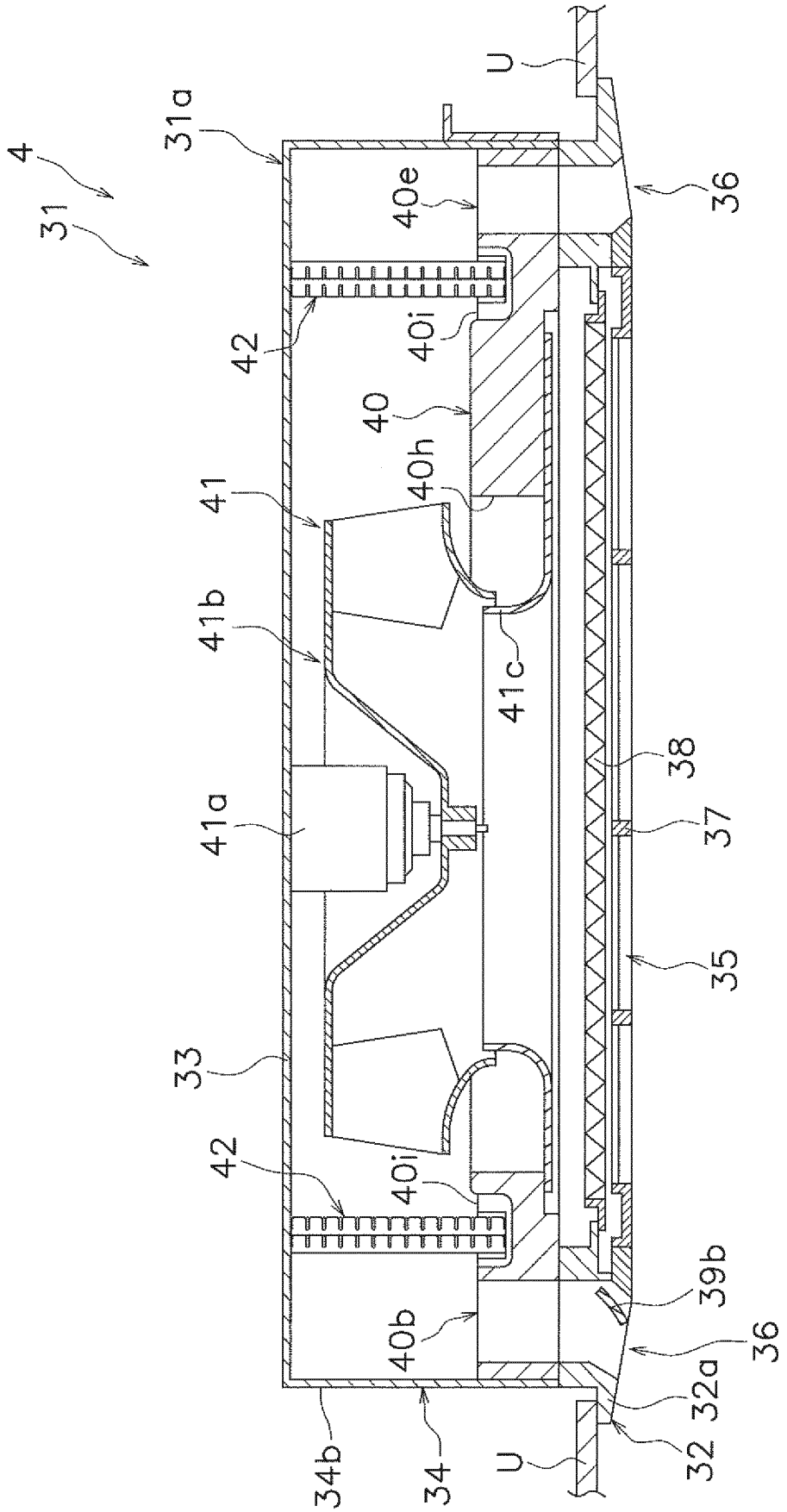
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FIG. 3

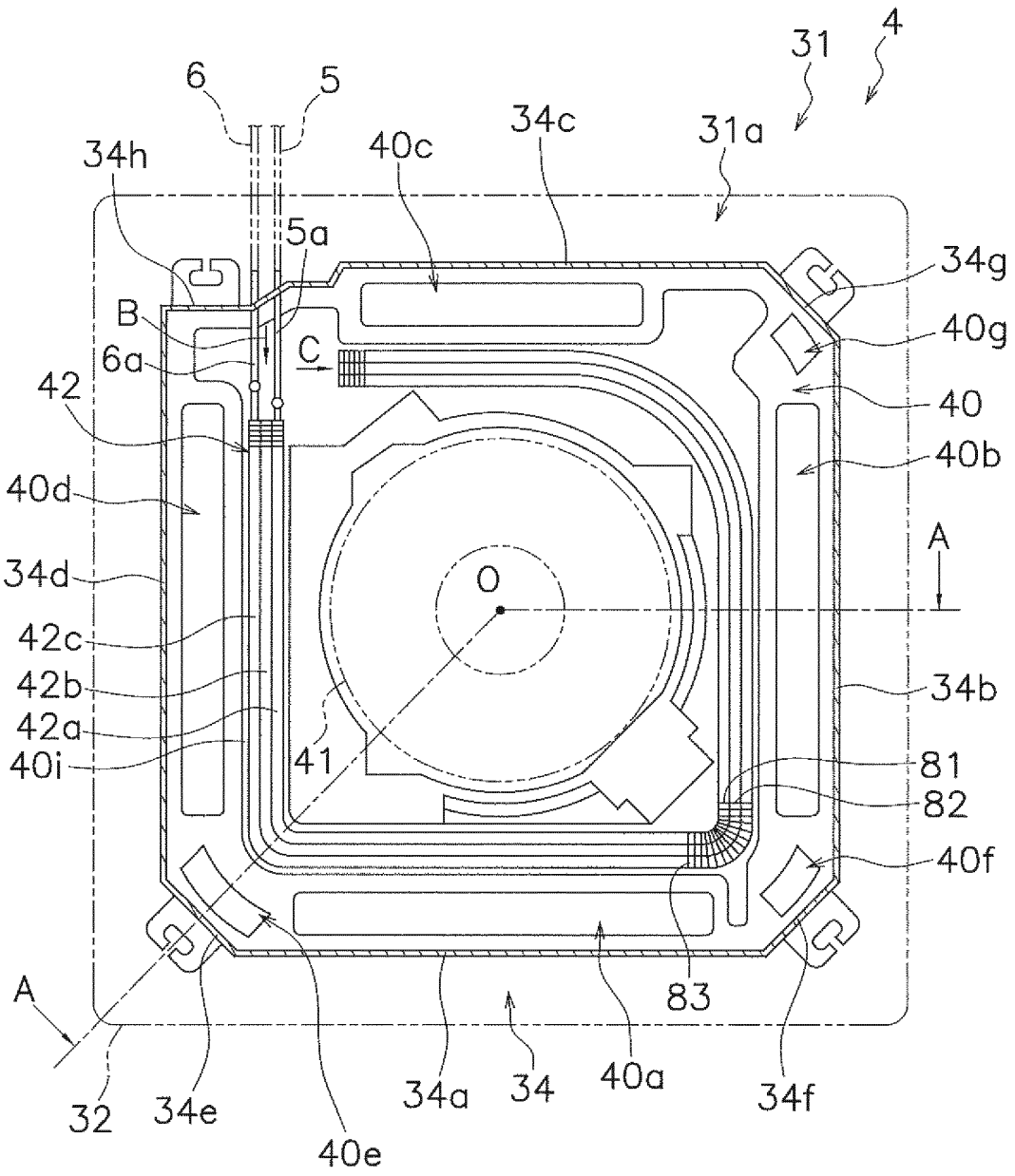
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FIG. 4

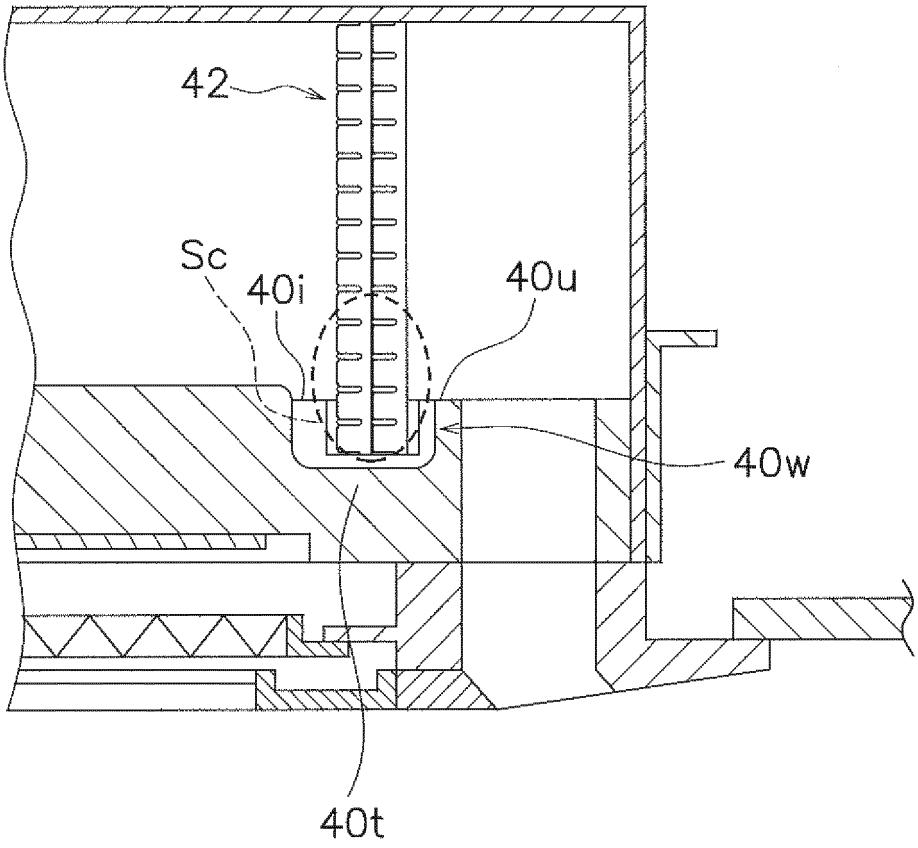


FIG. 5

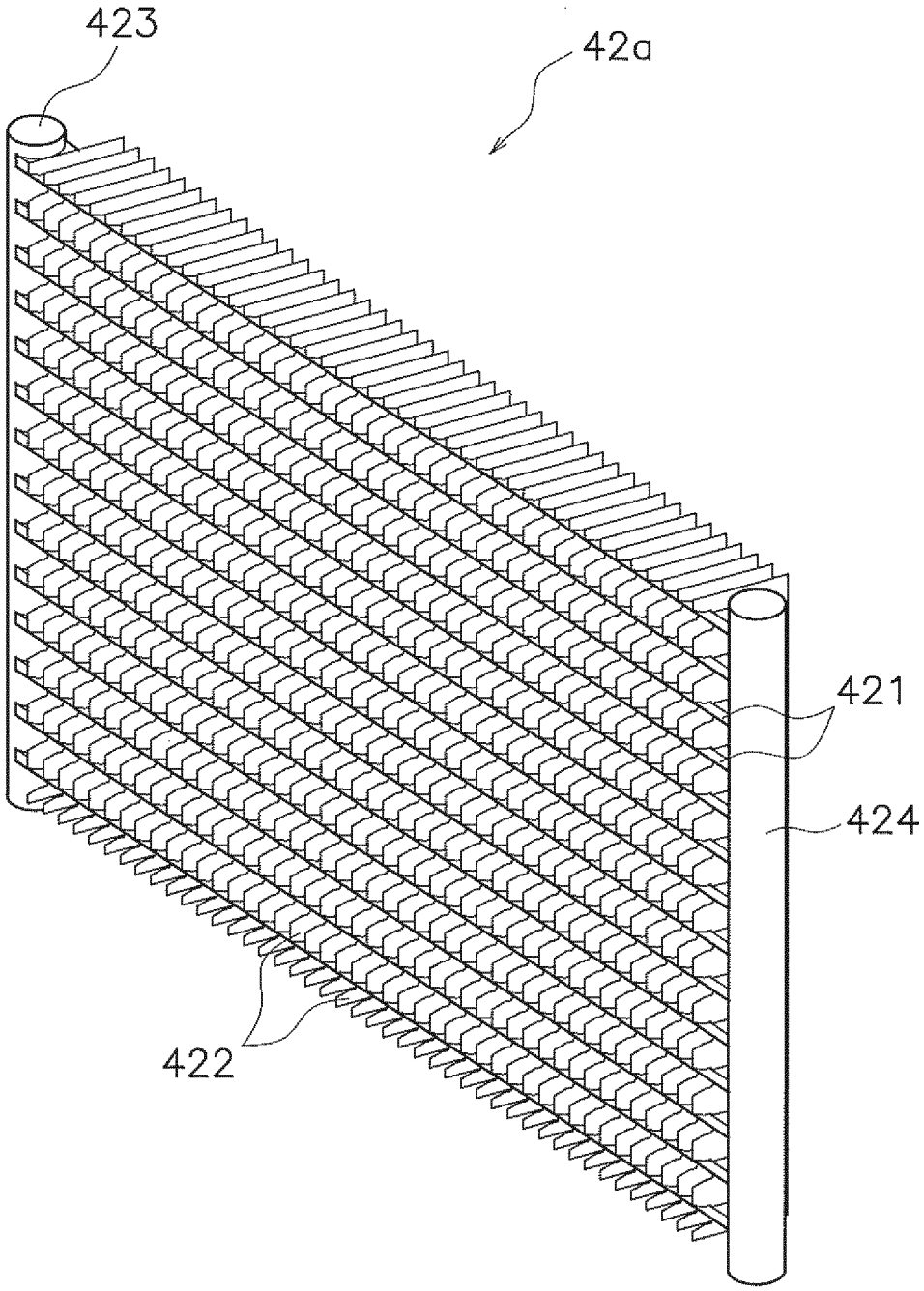


FIG. 6

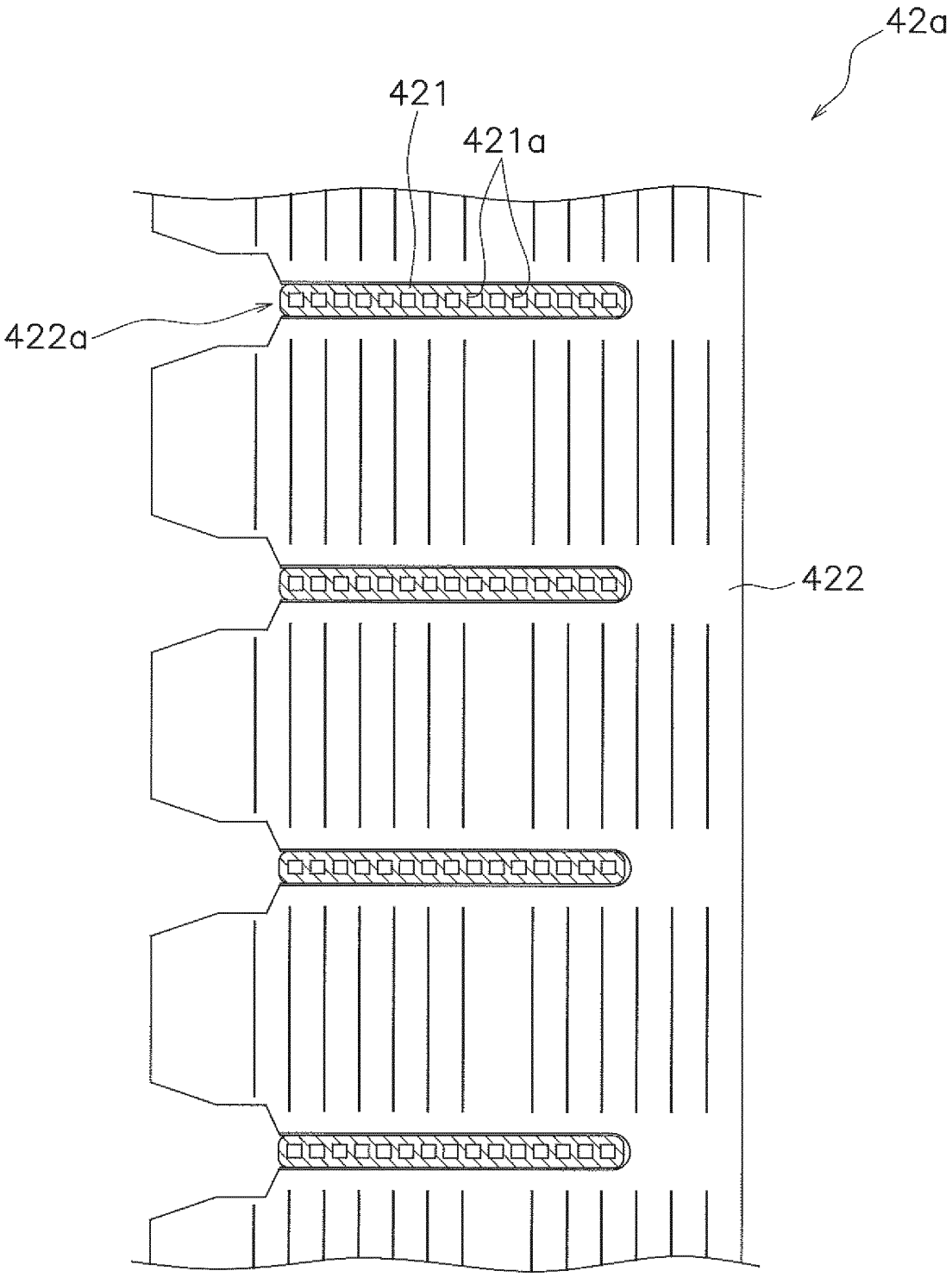


FIG. 7

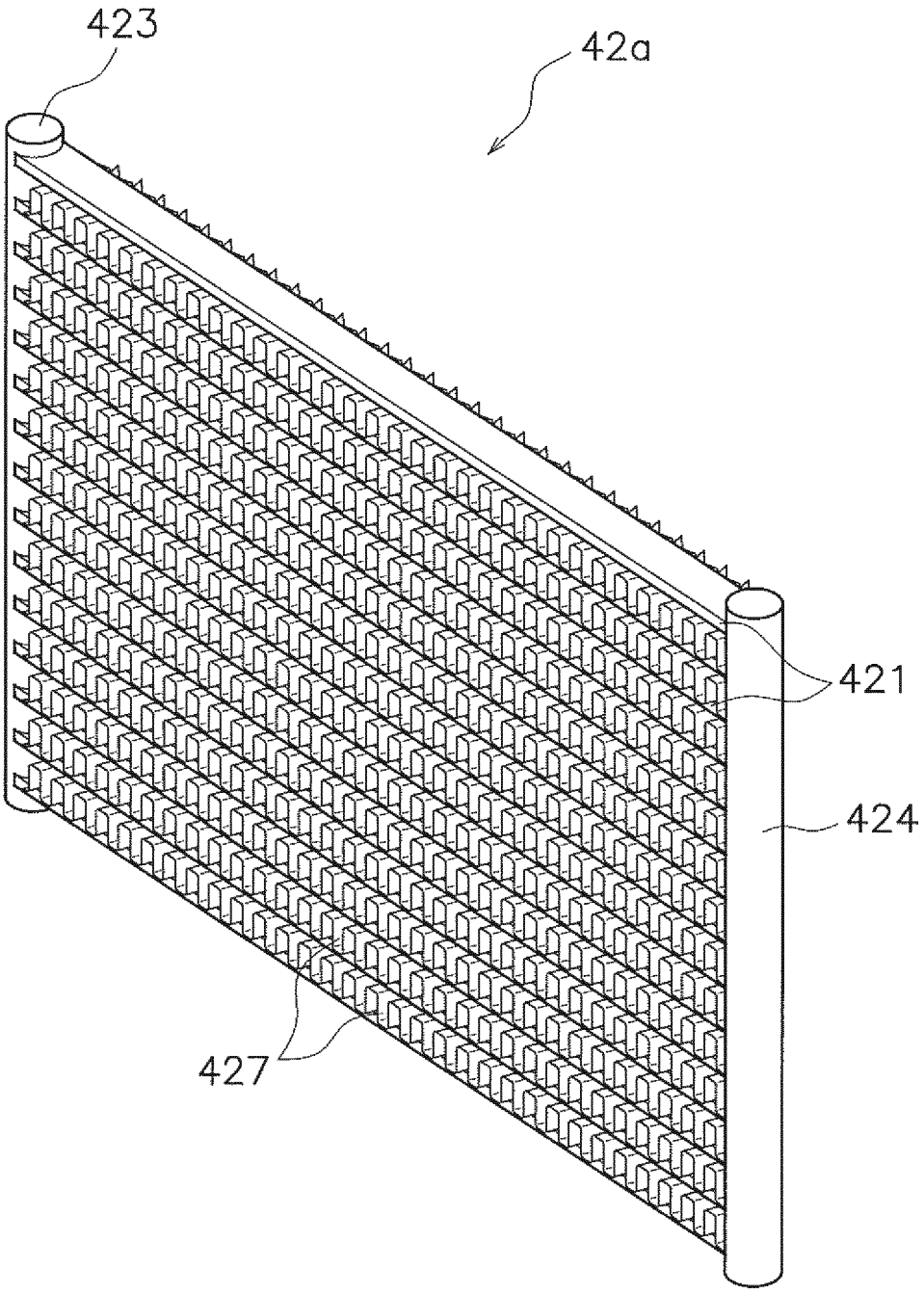
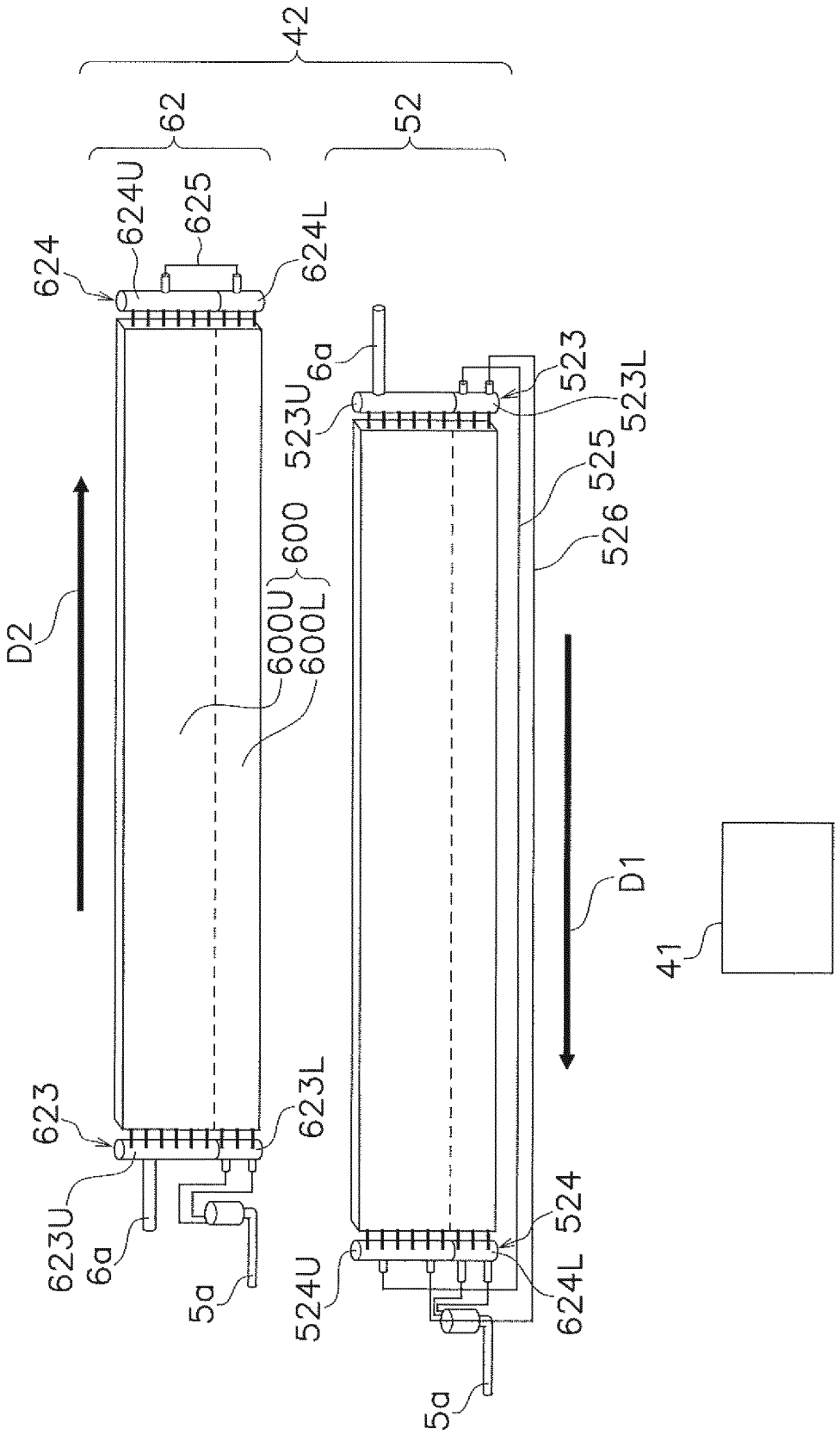


FIG. 8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624U
625
624
624L
6a
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523U
523L
525
526
600
600U
600L
D2
D1
623
623L
623U
6a
5a
524
524U
624L
5a
41

FIG. 9

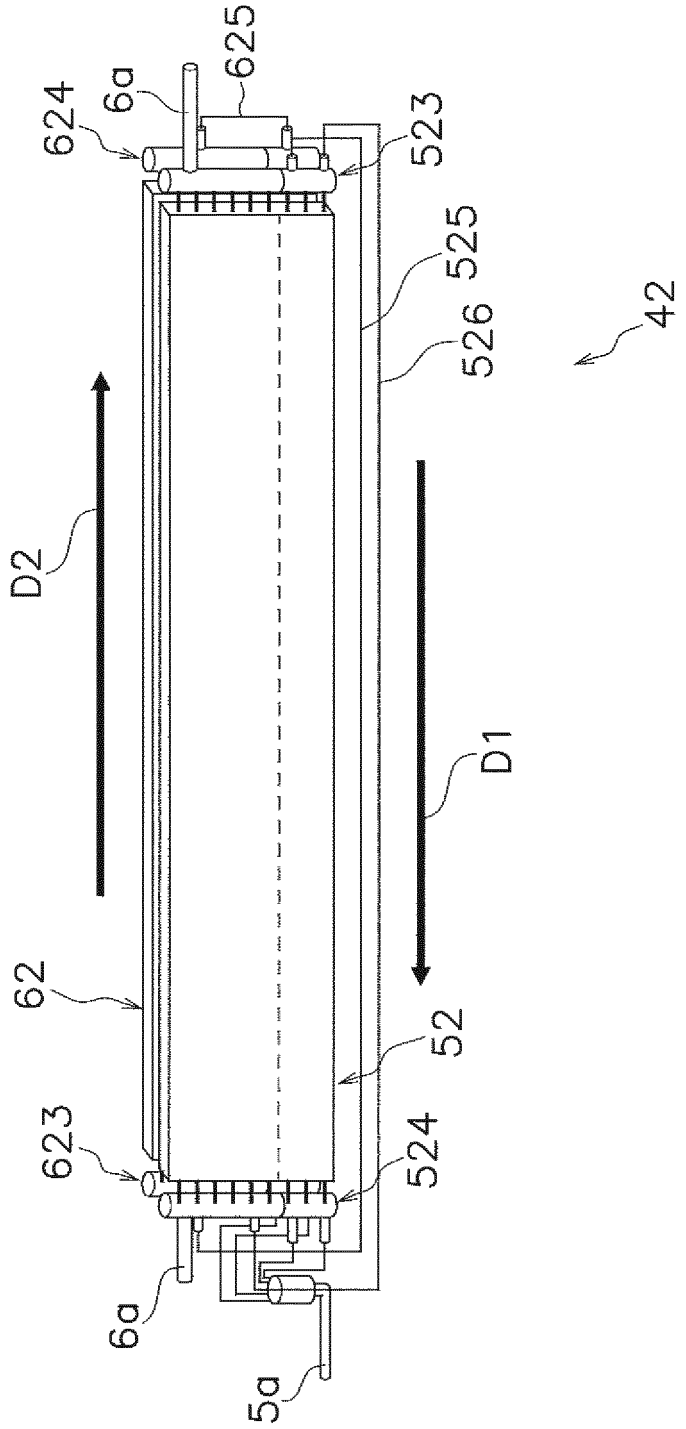
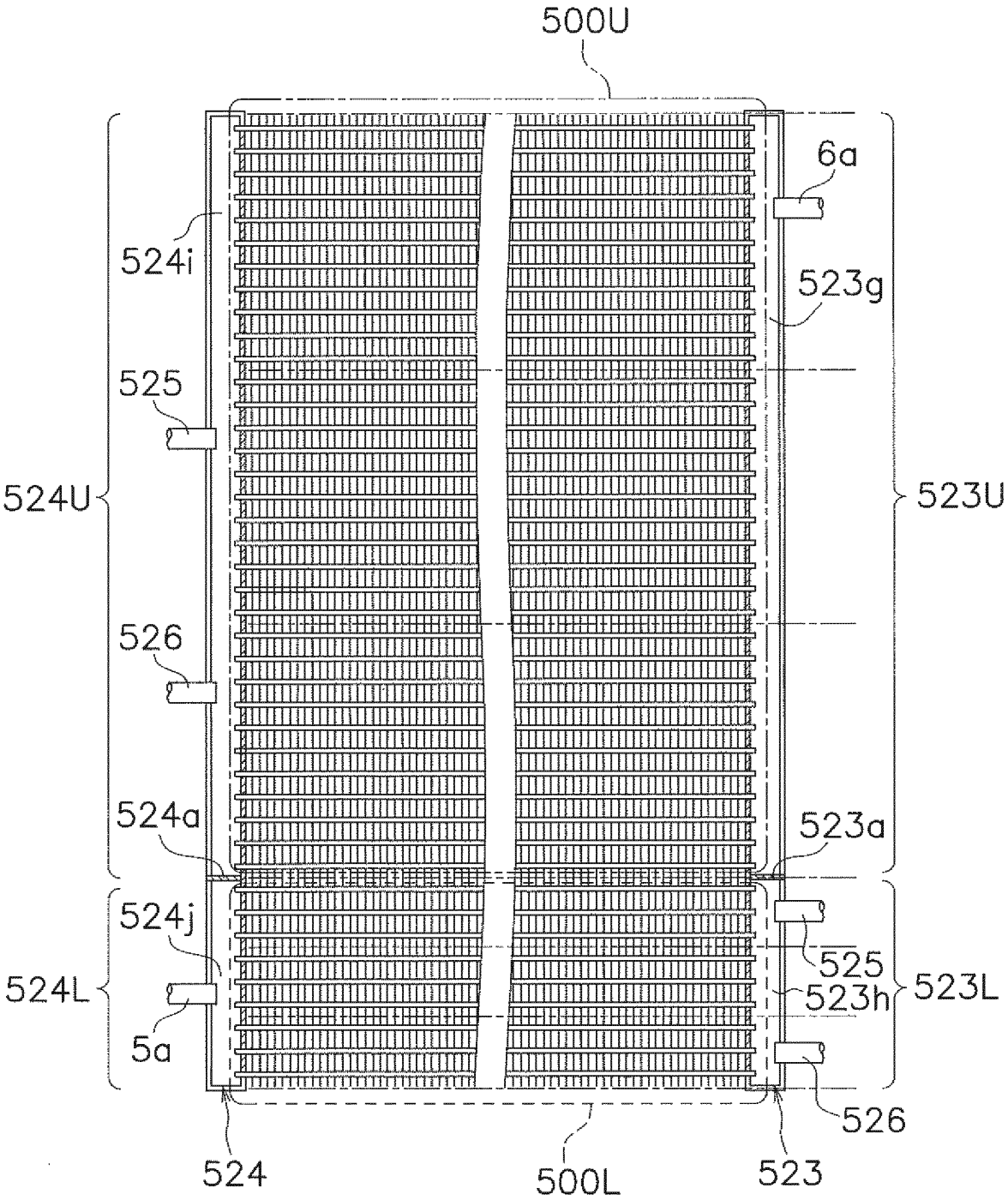


FIG. 10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523g
525
524U
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524a
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524L
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523L
5a
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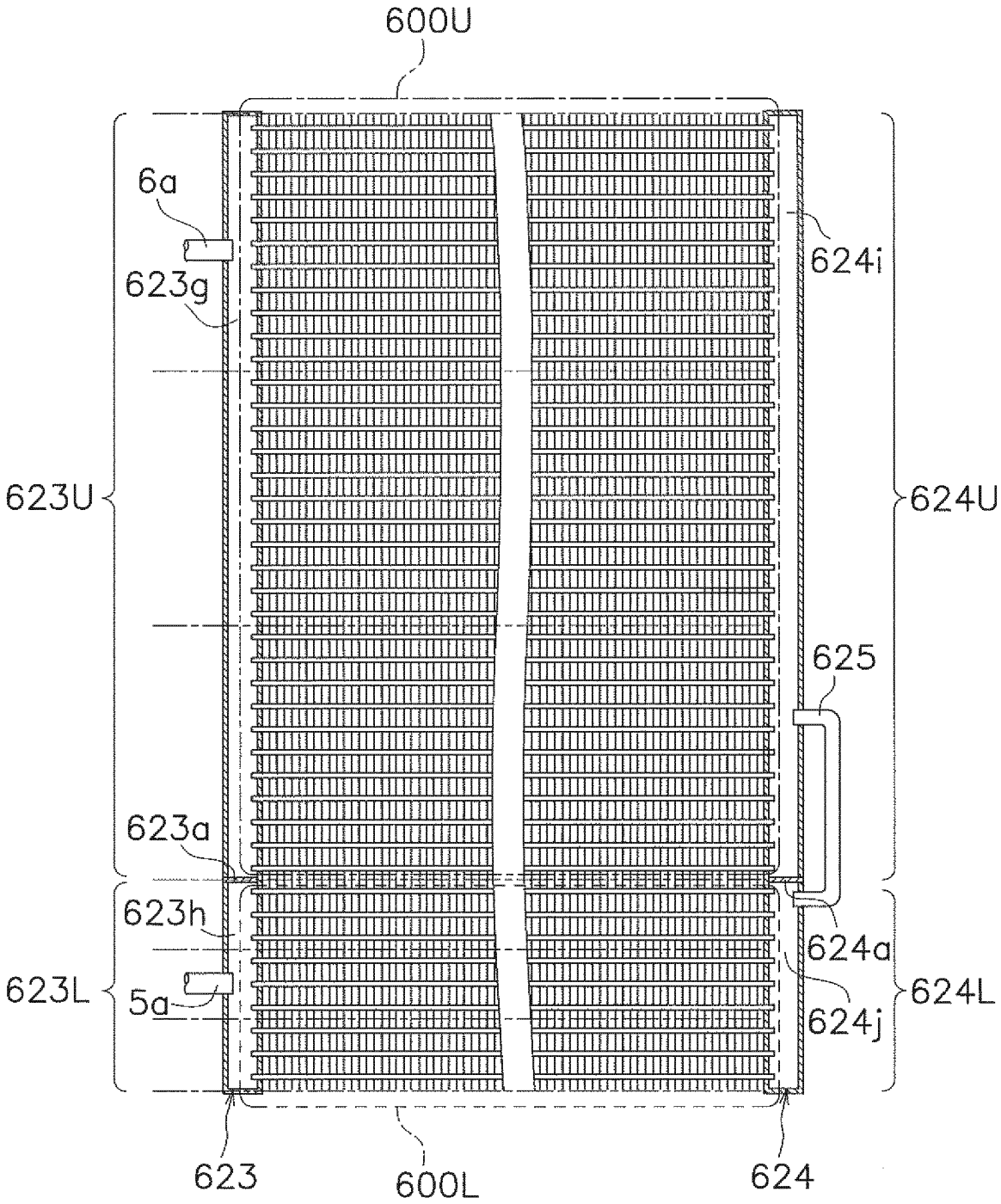
524
500L
523

FIG. 11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6a
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624U
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623h
624a
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5a
624j
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623
600L
624

FIG. 12

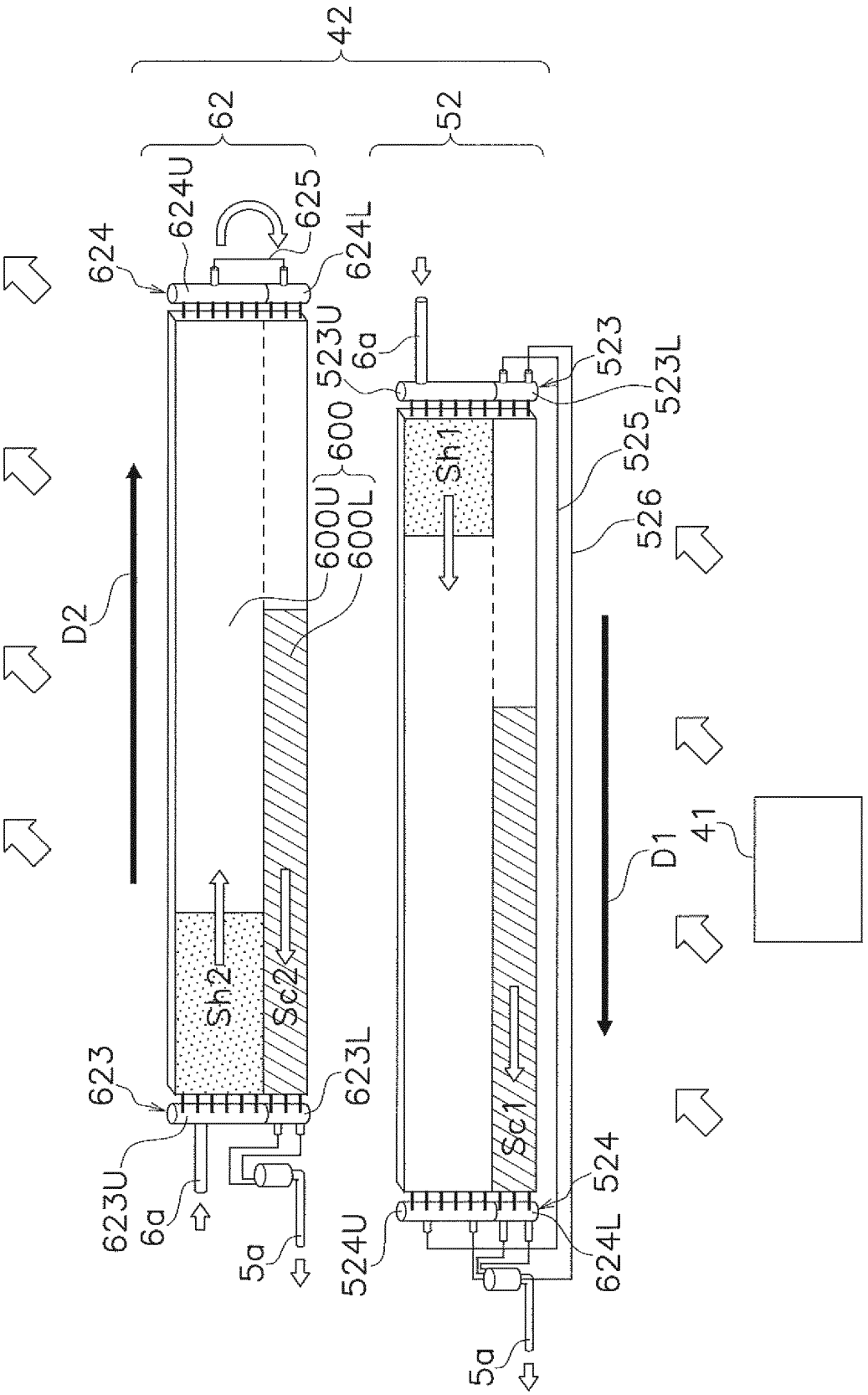
42
62
52
624U
625
624
624L
523U
6a
523
523L
600
525
Sh1
526
600U
600L
D2
D1
41
Sh2
Sc2
Sc1
623
623L
623U
6a
5a
524
524U
624L
5a

FIG. 13

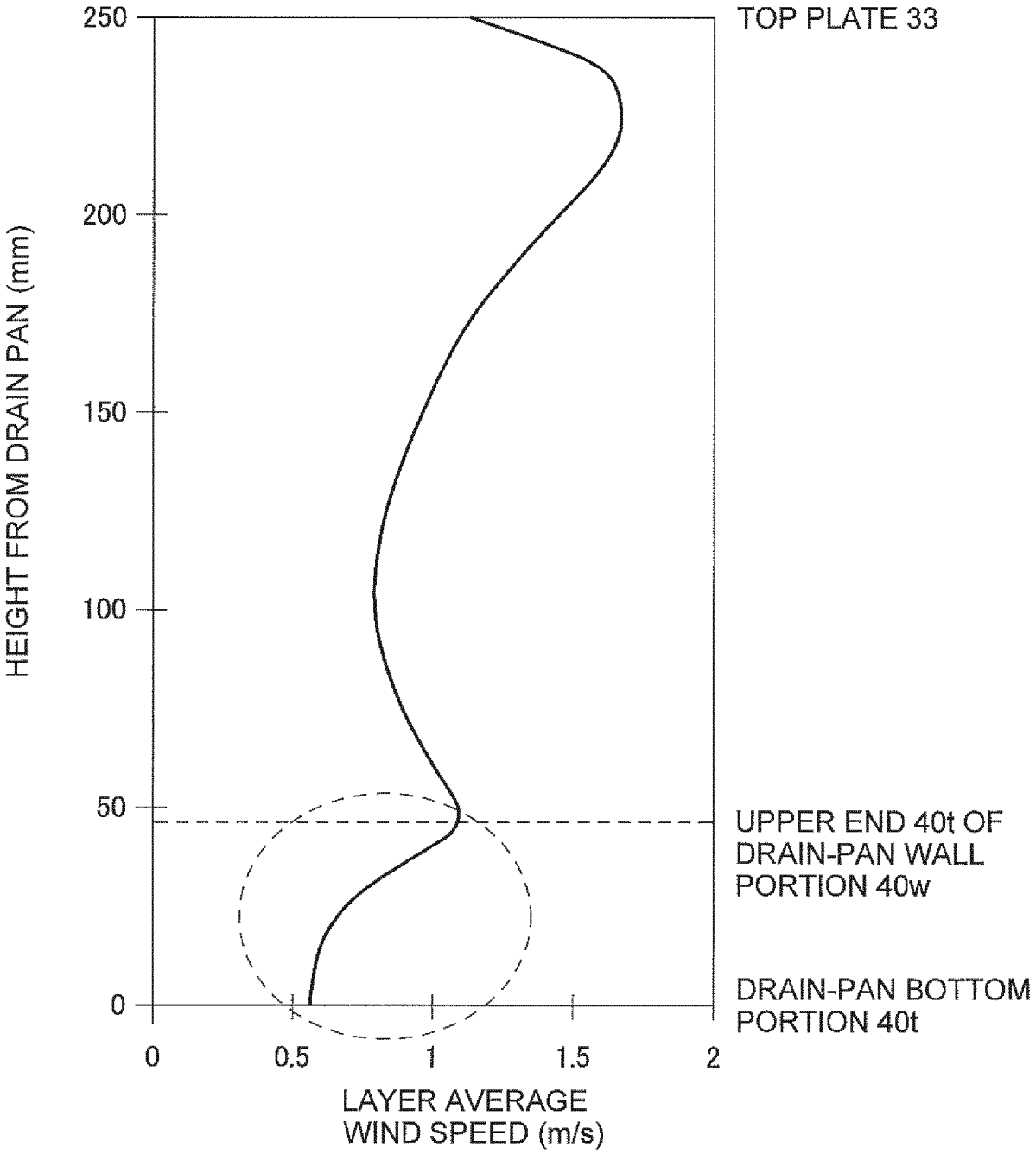
250
200
150
100
50
0
HEIGHT FROM DRAIN PAN (mm)
TOP PLATE 33
UPPER END 40t OF DRAIN-PAN WALL PORTION 40w
DRAIN-PAN BOTTOM PORTION 40t
0
0.5
1
1.5
2
LAYER AVERAGE WIND SPEED (m/s)

FIG. 14

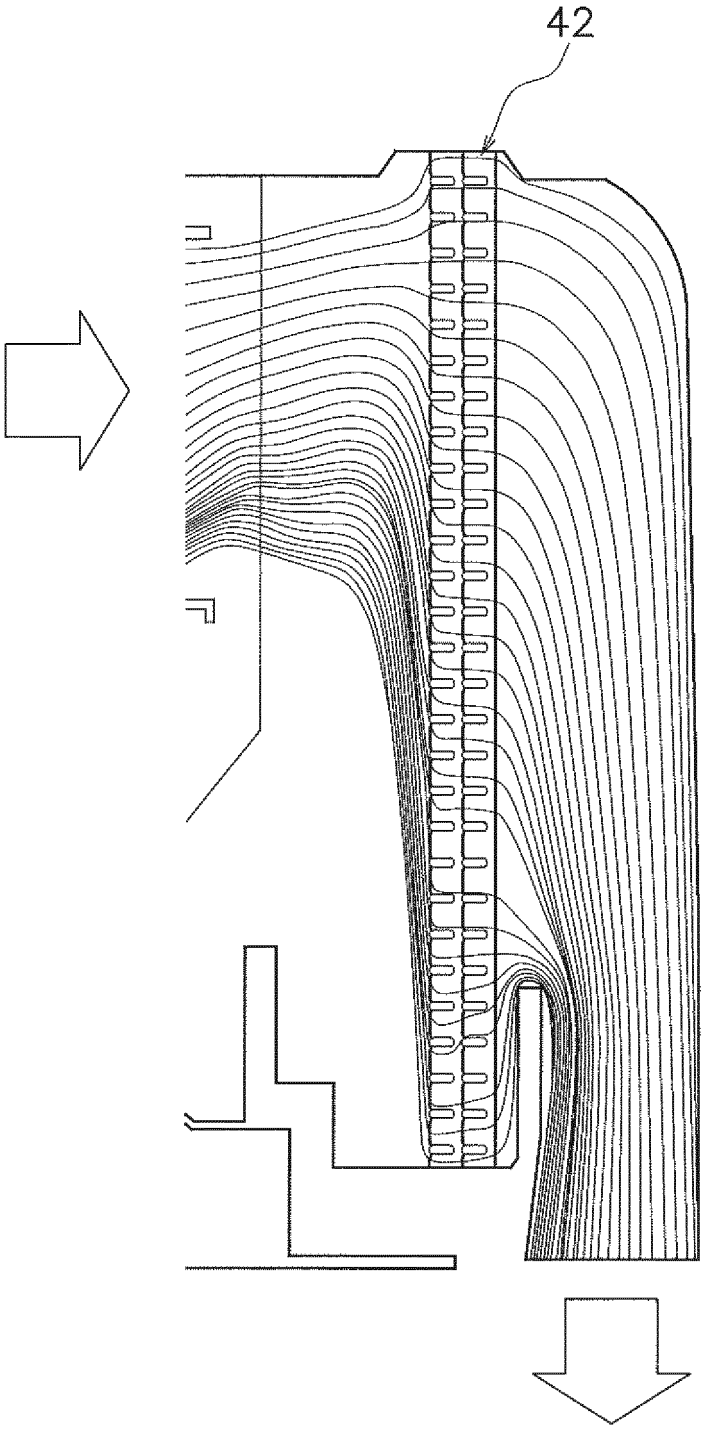

FIG. 15

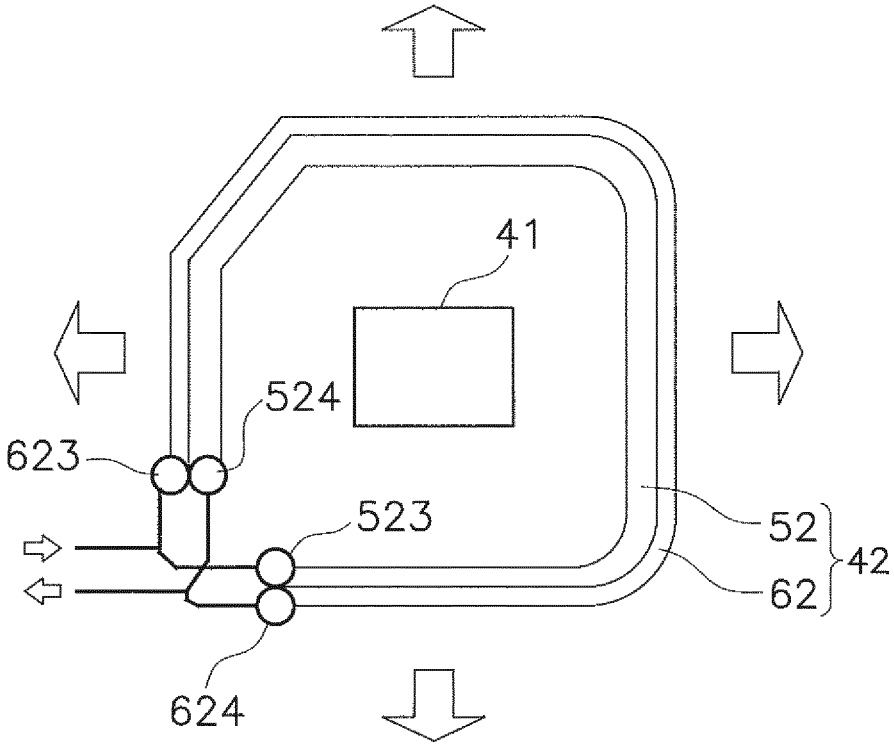

FIG. 16

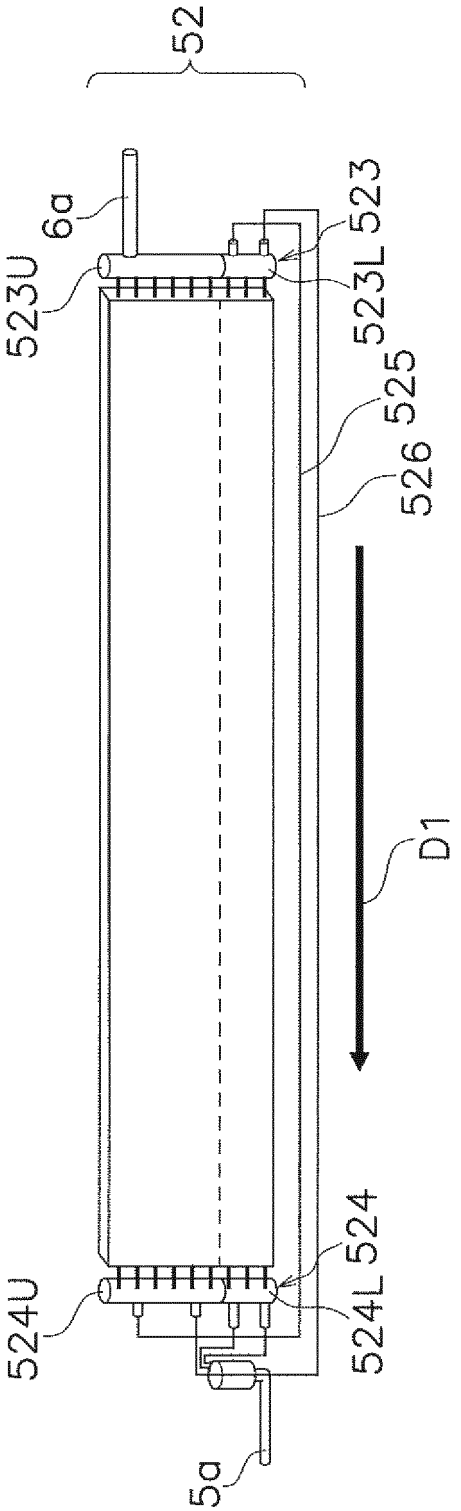

FIG. 17

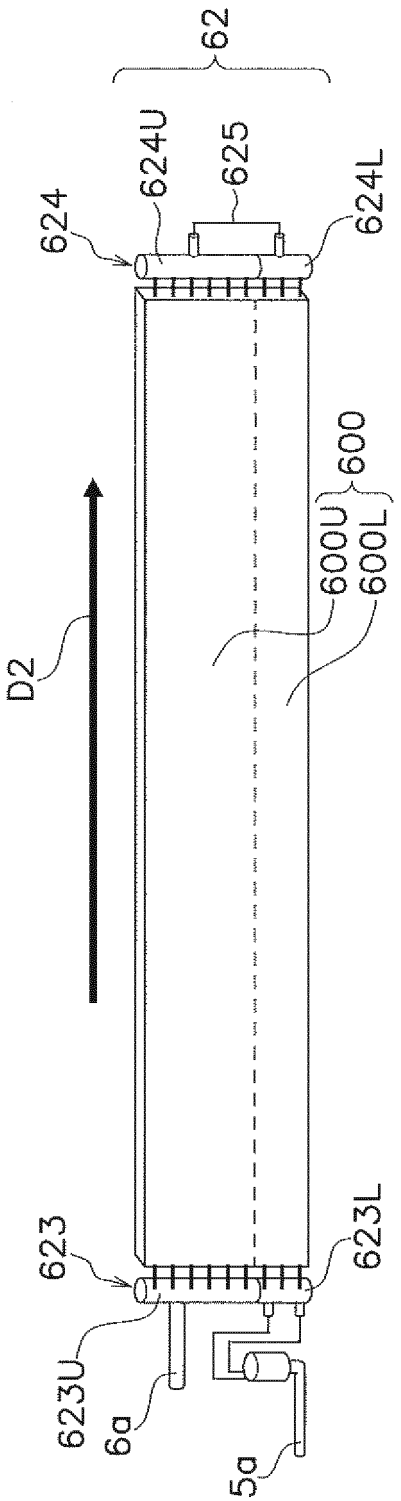

FIG. 18

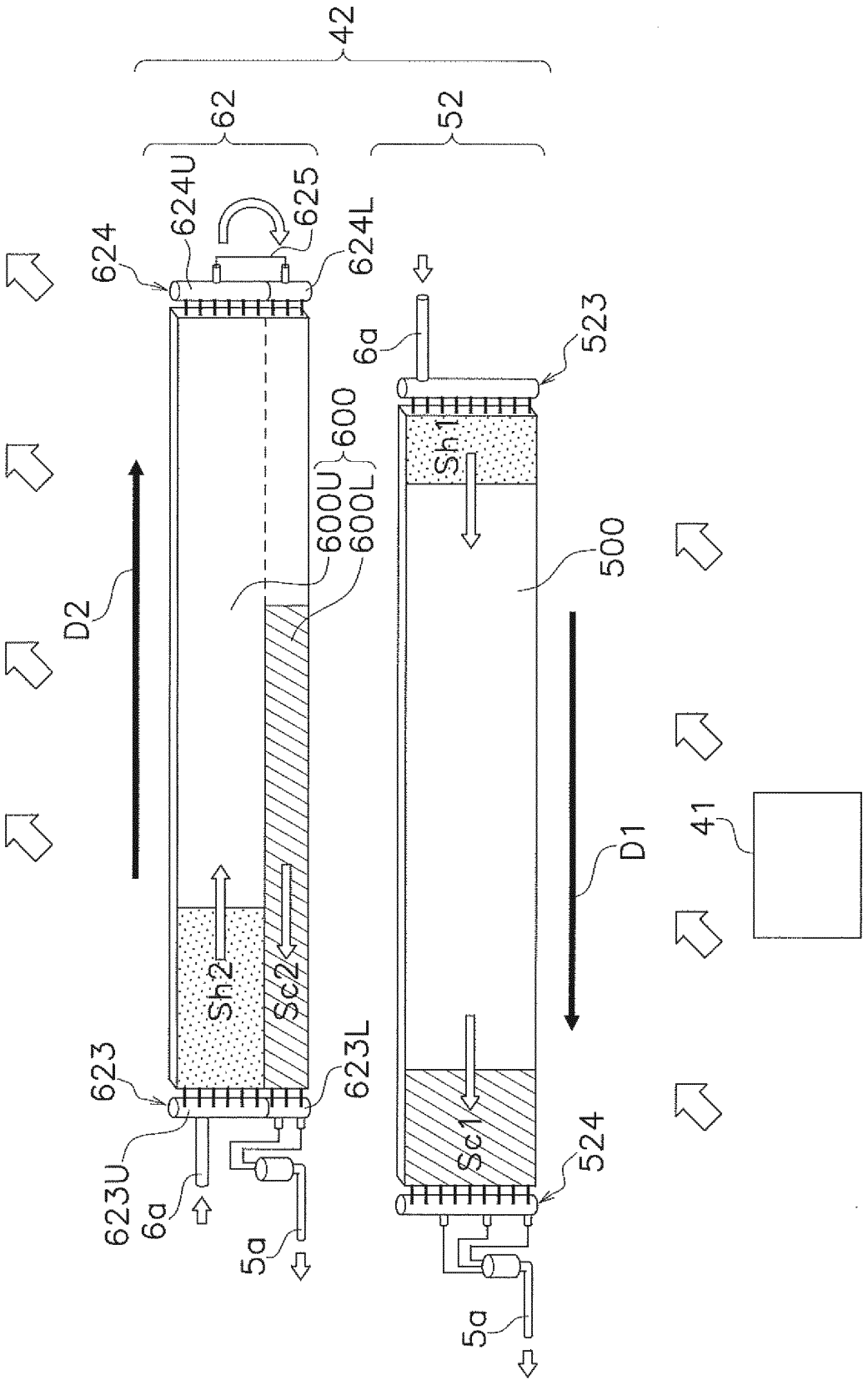
42
62
52
624
624U
625
624L
6a
523
600
600U
600L
Sh1
500
D2
D1
41
Sh2
Sc2
Sc1
623
623L
623U
6a
5a
524
5a

FIG. 19

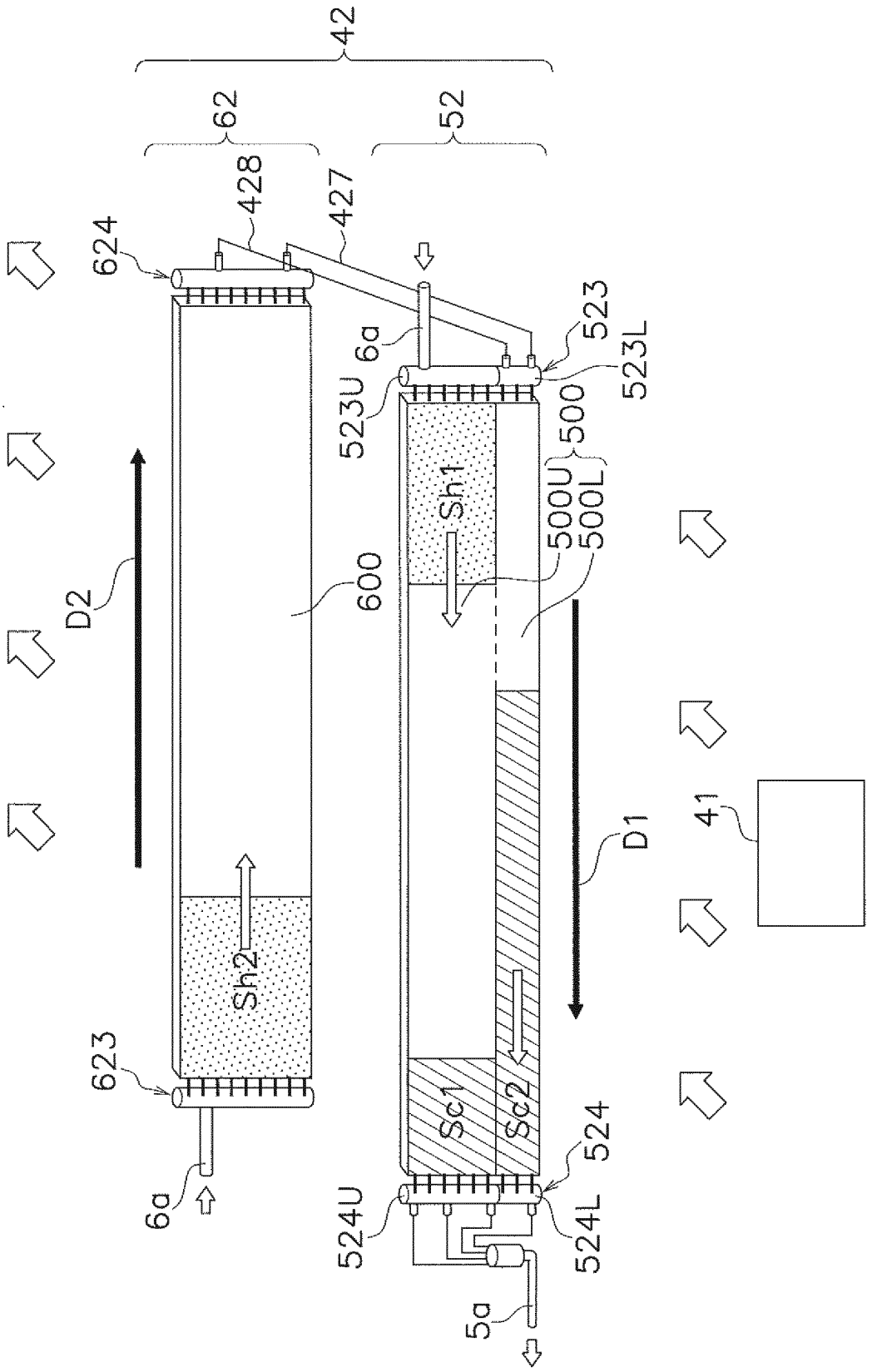
42
62
52
428
427
624
6a
523
523L
523U
500
500U
500L
Sh1
600
D2
D1
41
Sh2
623
Sc1
Sc2
524
524U
524L
5a

FIG. 20

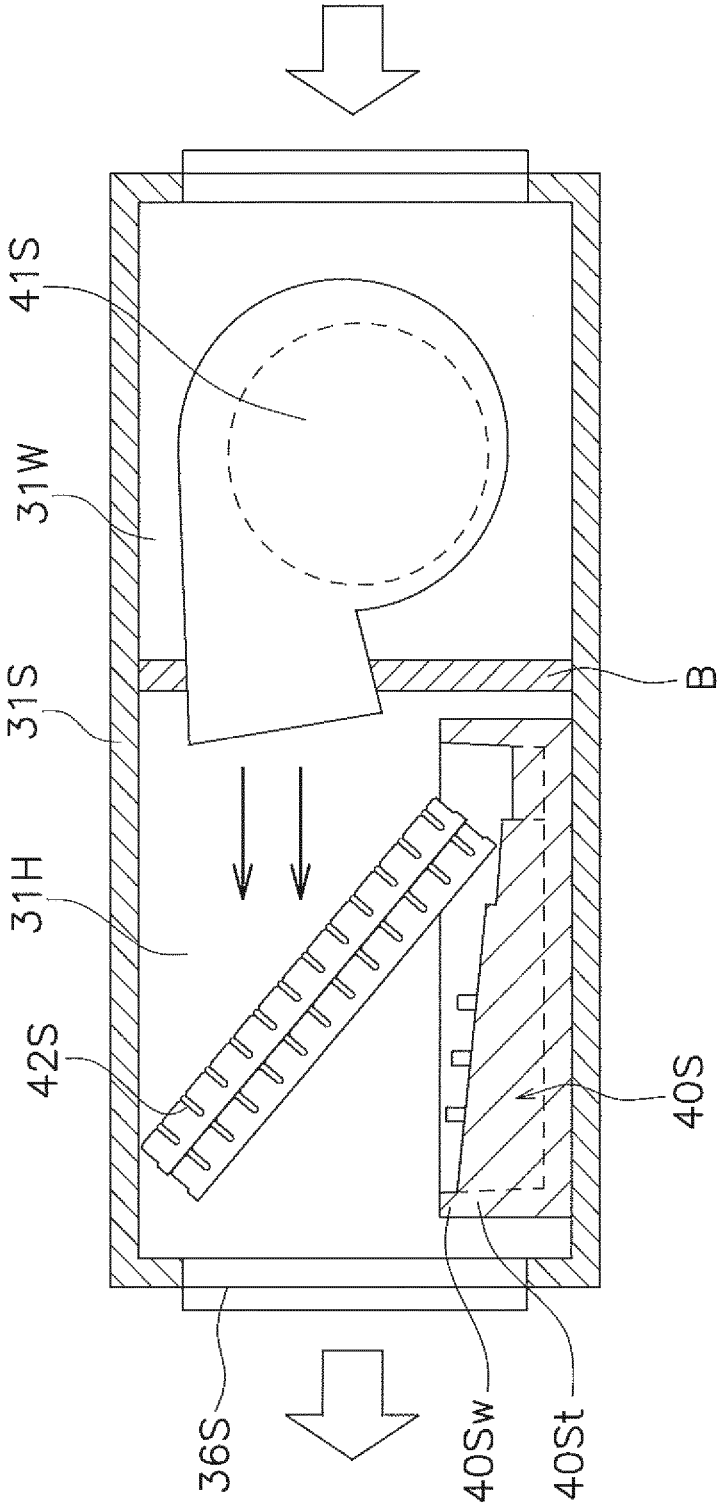

FIG. 21

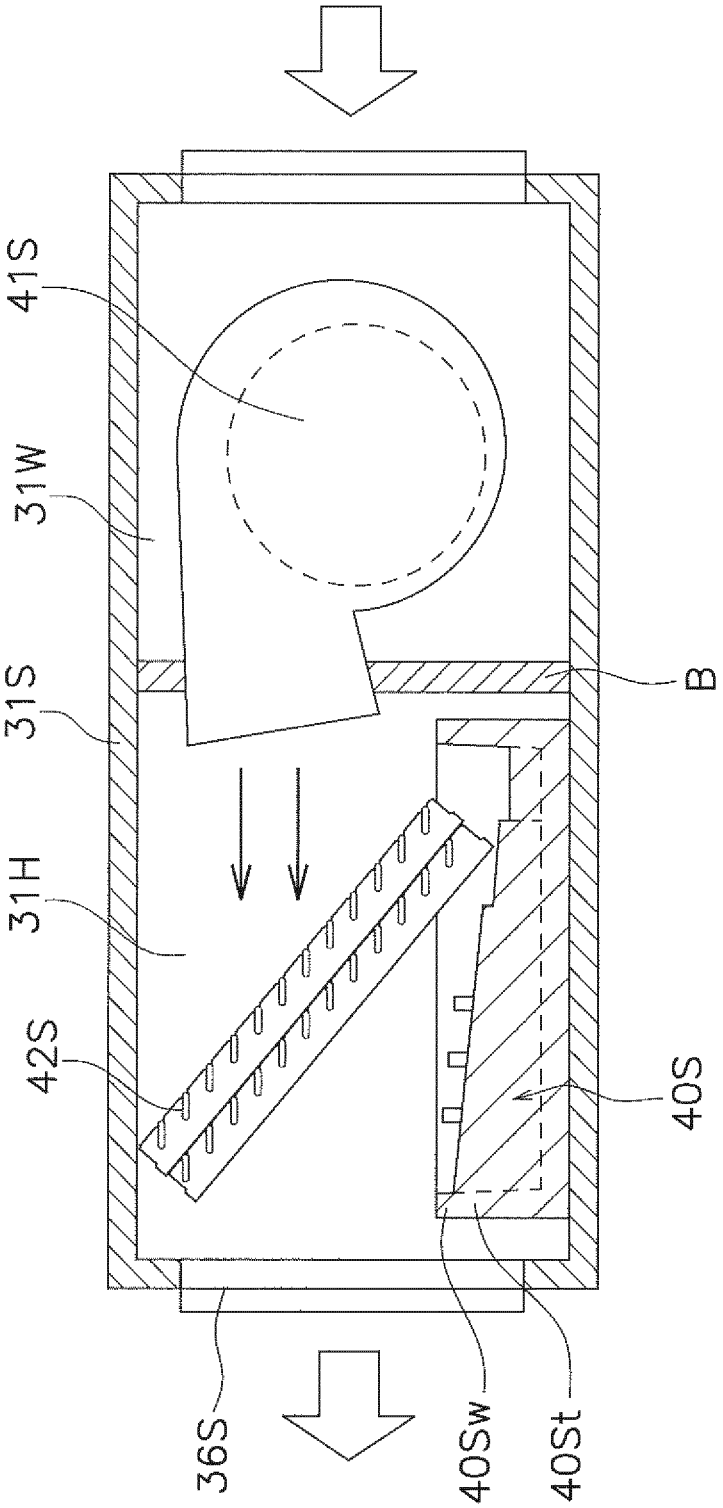

FIG. 22

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/008552

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F13/30(2006.01)i, F24F1/00(2011.01)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)
Int.Cl. F24F13/30, F24F1/00, F24F13/22, F25B39/00-39/04, F28F1/00-99/00

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	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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	WO 2016/174830 A1 (DAIKIN INDUSTRIES, LTD.) 03 November 2016, paragraphs [0030]-[0094], [0149], fig. 1-11 & EP 3276289 A1, paragraphs [0029]-[0093], [0148], fig. 1-11 & CN 107429975 A & JP 2016-205744 A	1-8
Y	JP 2016-38192 A (TOSHIBA CARRIER CORPORATION) 22 March 2016, paragraphs [0043]-[0052], fig. 4 (Family: none)	1-5, 7-8

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

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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search 24.05.2018	Date of mailing of the international search report 05.06.2018
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/008552

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2014-215017 A (DAIKIN INDUSTRIES, LTD.) 17 November 2014, paragraphs [0032]-[0048], fig. 3, 5 & US 2016/0138839 A1, paragraphs [0044]-[0062], fig. 3, 5 & WO 2014/178164 A1 & EP 2957842 A1 & AU 2014260968 B2 & CN 104937353 A	1-5, 7-8
Y	JP 2005-164211 A (TOSHIBA CARRIER CORPORATION) 23 June 2005, paragraphs [0007]-[0010], fig. 1 (Family: none)	1-4, 6-8
A	JP 2013-83420 A (DAIKIN INDUSTRIES, LTD.) 09 May 2013, entire text, all drawings & WO 2013/046729 A1	1-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2011099609 A **[0002] [0095]**