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(54) **HEAT PUMP DEVICE**

(57) A heat pump device according to the present invention includes: a casing, a partition wall that partitions the space in the casing into a machine chamber in which a compressor is accommodated, and an air blower chamber in which a first heat exchanger that causes heat exchange between a refrigerant and air, an air blower, and a second heat exchanger that causes heat exchange between the refrigerant and a heat medium are accommodated, and an accommodation container in which the second heat exchanger is accommodated. The accommodation container includes a first opening portion for communicating the pipe extending from the second heat exchanger with the outside from a side surface, and a protruding portion that is provided around the first opening portion and that protrudes from the side surface to the outside. The partition wall includes a second opening portion for allowing the pipe to pass therethrough. Further, the accommodation container is arranged such that the pipe passes through the second opening portion from the air blower chamber side to the machine chamber side, and the protruding portion fits into the second opening portion.

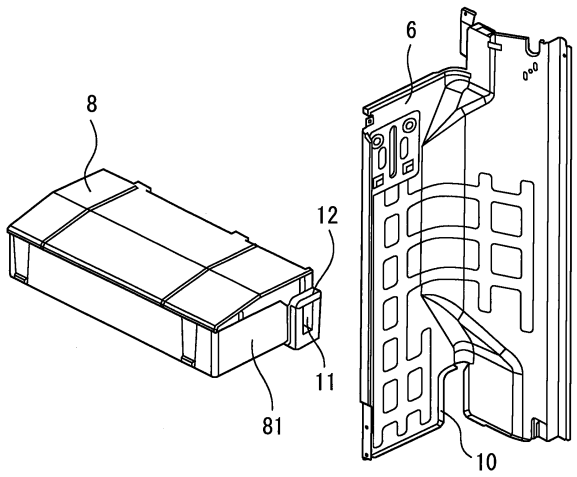

FIG. 3

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Description

[Technical Field]

[0001] The present invention relates to a heat pump device.

[Background Art]

[0002] A heat pump system that heats a liquid heat medium such as water by using heat absorbed from outside air has been widely used. As an outdoor unit for such a heat pump system, PTL 1 discloses an outdoor unit provided with a heat pump cycle, in which a compressor, an air-refrigerant heat exchanger, a pressure reducing means, and a water-refrigerant heat exchanger are sequentially connected by a refrigerant circulation pipe, in a casing. In this outdoor unit, the compressor is installed on one side of the casing partitioned by a partition wall, and an air blower and a water-refrigerant heat exchanger are provided on the other side of the casing. A cutout portion is formed in the lower front portion of the partition wall for passing a pipe extending from the water-refrigerant heat exchanger to the compressor side.

[Citation List]

[Patent Literature]

[0003] [PTL 1] Japanese Patent Application Publication No. 2011-196560

[Summary of Invention]

[Technical Problem]

[0004] The outdoor unit of PTL 1 has the following problem. The water-refrigerant heat exchanger is covered with a protective cover. The protective cover is engaged with the cutout portion of the partition wall. However, this protective cover does not completely block the cutout portion. For this reason, foreign matter represented by insects, small animals, and the like on the air blower side may enter the compressor side through a gap of the cutout portion. The foreign matter causes a failure of electronic components arranged on the compressor side.

[0005] The present invention has been created to solve the above problem, and it is an object thereof to provide a heat pump device partitioned by a partition wall into an air blower chamber side in which an air blower is arranged and a machine chamber side in which a compressor is arranged, wherein foreign matter can be prevented from entering the machine chamber side from the air blower chamber side through an opening in the partition wall through which pipe passes.

[Solution to Problem]

[0006] A heat pump device according to the present invention includes: a casing for accommodating therein a compressor that compresses a refrigerant, a first heat exchanger that causes heat exchange between the refrigerant and air, an air blower, and a second heat exchanger that causes heat exchange between the refrigerant and a heat medium, a partition wall that partitions a space inside the casing into a machine chamber in which the compressor is accommodated and an air blower chamber in which the first heat exchanger, the air blower, and the second heat exchanger are accommodated, and an accommodation container in which the second heat exchanger is accommodated. The accommodation container includes a first opening portion for communicating the pipe extending from the second heat exchanger with the outside from a side surface, and a protruding portion that is provided around the first opening portion and that protrudes from the side surface to the outside. The partition wall includes a second opening portion for allowing the pipe to pass therethrough. Further, the accommodation container is arranged such that the pipe passes through the second opening portion from the air blower chamber side to the machine chamber side, and the protruding portion fits into the second opening portion.

[Advantageous Effects of Invention]

[0007] According to the heat pump device of the present invention, the second opening portion opened in the partition wall is fitted to the protruding portion of the accommodation container. This makes it possible to prevent foreign matter from entering from the air blower chamber side to the machine chamber side through the second opening portion.

[Brief Description of Drawings]

[0008]

FIG. 1 is a front view showing the internal structure of the heat pump device according to Embodiment 1.
FIG. 2 is a perspective view of the internal structure of the heat pump device according to Embodiment 1 as seen obliquely from the front.
FIG. 3 is a perspective view showing configurations of a heat insulating member and a partition wall.
FIG. 4 is a perspective view showing a state where a heat insulating member is fitted to a partition wall.
FIG. 5 is a rear view showing a state where the heat insulating member is fitted to the partition wall.
FIG. 6 is a diagram showing an arrangement of a protruding portion of the heat insulating member.
FIG. 7 is a view of the protruding portion and a cutout portion as seen from a machine chamber side.
FIG. 8 is a diagram showing another modification

example of the shapes of the protruding portion of the heat insulating member and the cutout portion of the partition wall.

[Description of Embodiments]

[0009] Embodiments will be described below with reference to the drawings. Elements common to each drawing are denoted by the same reference numerals, and redundant description will be simplified or omitted. Further, the present disclosure may include any combination of configurations that can be combined among the configurations described in each of the following embodiments.

Embodiment 1.

[0010] FIG. 1 is a front view showing the internal structure of the heat pump device according to Embodiment 1. FIG. 2 is a perspective view of the internal structure of the heat pump device according to Embodiment 1 as seen obliquely from the front. A heat pump device 100 according to the present embodiment is installed outdoors. The heat pump device 100 heats a liquid heat medium. The heat medium in the present embodiment is water. The heat pump device 100 heats water to generate hot water. The heat medium in the present invention may be, for example, a calcium chloride aqueous solution, an ethylene glycol aqueous solution, an alcohol, or the like.

[0011] As shown in FIG. 1, the heat pump device 100 includes a bottom plate 7 that forms the bottom of a casing. On the bottom plate 7, as viewed from the front, a machine chamber 20 is formed on the right side, and an air blower chamber 22 is formed on the left side. The machine chamber 20 and the air blower chamber 22 are separated by a partition wall 6 extending in the vertical direction. The casing forming the outer shell of the heat pump device 100 further includes a front panel, a back panel, and a top panel (not shown), in addition to the bottom plate 7 mentioned hereinabove. The front panel includes a front surface portion that covers the front surface of the casing and a left side surface portion that covers the left side surface of the casing. Further, the back panel is composed of a rear surface portion that covers the rear surface of the casing and a right side surface portion that covers the right side surface of the casing. The top panel is configured to cover the top surface of the casing. These components of the casing are molded from, for example, a sheet metal material. The outer surface of the heat pump device 100 is covered by this casing except the air-refrigerant heat exchanger 4 arranged on the rear surface side. An opening for discharging the air that has passed through the air blower chamber 22 is formed in the front surface portion, and a grid is attached to this opening. FIGS. 1 and 2 show a state in which each part of the casing other than the bottom plate 7 is removed. Further, in FIG. 1, illustration of some of the components is omitted.

[0012] As shown in FIG. 1, a compressor 1 that compresses a refrigerant, an expansion valve 3 that decompresses the refrigerant, a refrigerant pipe such as a suction pipe and a discharge pipe connecting the compressor 1 and the expansion valve 3, and the like are incorporated as refrigerant circuit components in the machine chamber 20.

[0013] The compressor 1 includes a compression unit (not shown) inside a cylindrical shell and a motor (not shown). The compression unit performs a compression operation of the refrigerant. The motor drives the compression unit. The motor of the compressor 1 is driven by electric power supplied from the outside. The refrigerant is sucked into the compressor 1 through the suction pipe. A discharge pipe that discharges the refrigerant compressed inside the compressor 1 is connected to the upper portion of the compressor 1. The expansion valve 3 has a coil assembly member attached to the outer surface of the main body thereof. By energizing the coil from the outside, the internal flow path resistance adjusting unit is operated to adjust the flow path resistance of the refrigerant. By the expansion valve 3, the pressure of the high-pressure refrigerant on the upstream side and the pressure of the low-pressure refrigerant on the downstream side can be adjusted. The expansion valve 3 is an example of a pressure reducing device that reduces the pressure of the refrigerant.

[0014] The air blower chamber 22 has a larger space than the machine chamber 20 in order to ensure an air passage. The air blower 5 is incorporated in the air blower chamber 22. The air blower 5 includes a plurality of propeller blades and a motor that rotationally drives the propeller blades. The motor and the propeller blades are rotated by electric power supplied from the outside. An air-refrigerant heat exchanger 4 is installed as a first heat exchanger on the rear surface side of the air blower chamber 22 so as to face the air blower 5. The air-refrigerant heat exchanger 4 is provided with a large number of thin aluminum plate fins and a long refrigerant pipe that is in close contact with a large number of thin aluminum plate fins and reciprocates several times. Each fin has a vertically long rectangular shape, and the fins are fixed to the refrigerant pipe in a stacked state with a minute spacing in the horizontal direction. The air-refrigerant heat exchanger 4 has a flat outer shape that is bent in an L shape. The air-refrigerant heat exchanger 4 is installed from the rear surface to the left side surface of the heat pump device 100. The end portion on the rear surface side of the air-refrigerant heat exchanger 4 extends to the rear side of the machine chamber 20. Therefore, the partition wall 6 has a flat outer shape that is bent in an L shape, and is installed so as to partition a space from the front surface of the heat pump device 100 to the end portion on the rear surface side of the air-refrigerant heat exchanger 4. In the air-refrigerant heat exchanger 4, heat is exchanged between the refrigerant in the refrigerant pipe and the air around the fins. The air blower

5 increases and adjusts the volume of the air flowing and passing through between the fins, and the amount of heat exchange is increased and adjusted. The air-refrigerant heat exchanger 4 is an example of an evaporator that evaporates a refrigerant.

[0015] A water-refrigerant heat exchanger 2 is installed as a second heat exchanger on the bottom plate 7 in the lower part of the air blower chamber 22. The water-refrigerant heat exchanger 2 is installed on the bottom plate 7 in a state of being covered with a heat insulating member 8 and a protective cover 9. The water-refrigerant heat exchanger 2 is shaped by bending so that a long water pipe and a long refrigerant pipe can be accommodated in the heat insulating member 8 in close contact with each other. In the water-refrigerant heat exchanger 2, heat is exchanged between the refrigerant in the refrigerant pipe and water, that is, the heat medium, in the water pipe. In the water-refrigerant heat exchanger 2, water, that is, the heat medium, is heated. The air blower 5 is arranged above the water-refrigerant heat exchanger 2.

[0016] An outlet of the compressor 1 is connected to a refrigerant inlet of the water-refrigerant heat exchanger 2 via a discharge pipe. The refrigerant outlet of the water-refrigerant heat exchanger 2 is connected to the inlet of the expansion valve 3 in the machine chamber 20 via a refrigerant pipe. An outlet of the expansion valve 3 is connected to a refrigerant inlet of the air-refrigerant heat exchanger 4 via a refrigerant pipe. The refrigerant outlet of the air-refrigerant heat exchanger 4 is connected to the inlet of the compressor 1 via a suction pipe. Other refrigerant circuit components may be attached in the middle of each refrigerant pipe.

[0017] The refrigerant is enclosed in the closed space of the refrigerant circuit included in the heat pump device 100. The refrigerant may be, for example, a CO_2 refrigerant.

[0018] Next, characteristic features of the heat pump device 100 according to Embodiment 1 will be described. The heat pump device 100 according to Embodiment 1 is characterized in that the heat insulating member 8 is fitted to the partition wall 6. FIG. 3 is a perspective view showing the configurations of the heat insulating member and the partition wall. Further, FIG. 4 is a perspective view showing a state where the heat insulating member is fitted to the partition wall.

[0019] As shown in FIGS. 3 and 4, the heat insulating member 8 has a rectangular parallelepiped shape. A contact surface 81 of the side surface of the heat insulating member 8 that is in contact with the partition wall 6 is provided with a rectangular first opening portion 11 for communicating the water pipe and the refrigerant pipe, which extend from the water-refrigerant heat exchanger 2, to the outside. A protruding portion 12 that protrudes toward the partition wall 6 in a rectangular shape is provided around the first opening portion 11.

[0020] In the configuration in which the water-refrigerant heat exchanger 2 is arranged on the air blower chamber 22 side, it is necessary to pass the pipes extending from the water-refrigerant heat exchanger 2 to the machine chamber 20 side. Therefore, the partition wall 6 is provided with a cutout portion 10 as a second opening portion. The cutout portion 10 is a rectangular cutout that is cut out upward from the lower end side of the surface of the partition wall 6 facing the heat insulating member 8. The position and shape of the cutout portion 10 are determined so that the protruding portion 12 of the heat insulating member fits into the cutout portion 10 without a gap when the heat insulating member 8 is fixed to the bottom plate 7.

[0021] Since the air blower chamber 22 has a structure that takes in air from the outside space, insects or small animals may enter along with the outside air. Where such foreign matter enters the machine chamber 20 through the gap of the partition wall 6, there is a possibility that the electronic components installed in the machine chamber 20 may be damaged.

[0022] In the heat pump device 100 according to Embodiment 1, the cutout portion 10 of the partition wall 6 is fitted into the protruding portion 12 of the heat insulating member 8 without any gap. With such a configuration, the pipe can be passed from the air blower chamber 22 to the machine chamber 20 side without creating a gap in the partition wall 6. As a result, it is possible to suppress the entry of foreign matter into the machine chamber 20, so that the reliability of the heat pump device 100 can be improved.

[0023] Further, the heat insulating member 8 is also characterized by the shape thereof. FIG. 5 is a rear view showing a state where the heat insulating member is fitted to the partition wall. As shown in this figure, the heat insulating member 8 is configured to include a side surface portion 13 that mainly covers the lateral side and the bottom side of the water-refrigerant heat exchanger 2, and a lid portion 14 that is disposed on the upper side of the side surface portion 13 and mainly covers the upper surface side of the water-refrigerant heat exchanger 2. In the example shown in FIG. 5, among the contact portions between the side surface portion 13 and the lid portion 14, a contact portion 82 around the protruding portion 12 is formed at a position lower than the contact portion 83 of other portions, and a contact portion 84 therebetween is constituted by an inclined surface. With such a configuration, the lid portion 14 can be slid in the direction away from the partition wall 6, so that the lid portion 14 can be removed without removing the partition wall 6. As a result, the state of the water-refrigerant heat exchanger 2 accommodated in the heat insulating member 8 can be easily confirmed.

[0024] Further, the heat insulating member 8 is also characterized by the arrangement of the protruding portion 12. FIG. 6 is a diagram showing the arrangement of the protruding portion of the heat insulating member. As shown in this figure, the protruding portion 12 is provided on the rear portion of the contact surface 81 of the heat insulating member 8. With such an arrangement, the pipe 16 extending from the water-refrigerant heat exchanger

2 into the machine chamber 20 is routed to the rear side of the compressor 1. Accordingly, the pipe of the water-refrigerant heat exchanger 2 does not get in the way when the service maintenance of the compressor 1 is performed, so that the pipe can be prevented from being accidentally damaged.

[0025] The heat pump device according to the Embodiment 1 described above may be modified, for example, in the following manner.

[0026] The shape of the heat insulating member 8 is not limited to a rectangular parallelepiped shape as long as the heat insulating member is configured as an accommodation container inside which the water-refrigerant heat exchanger 2 is accommodated and which is arranged in the air blower chamber 22. The first opening portion 11 may also have another shape as long as the pipe of the water-refrigerant heat exchanger 2 passes therethrough. The protruding portion 12 may have another shape as long as the protruding portion fits into the cutout portion 10 of the partition wall 6 without a gap. Further, the cutout portion 10 of the partition wall 6 is not limited to the cutout shape as long as the cutout portion is configured as an opening portion that fits to the protruding portion 12 without a gap, and may have, for example, a hole shape.

[0027] FIG. 7 is a diagram showing a modification example of the shapes of the protruding portion of the heat insulating member and the cutout portion of the partition wall. FIG. 7 is a view of the protruding portion 12 and the cutout portion 10 as seen from the machine chamber side. In the modification example shown in this figure, the cutout portion 10 is configured to include an inclined portion 101 that is inclined so that the cutout width increases from the closed side toward the open side. Further, a sidewall surface 121 of the protruding portion 12 corresponding to the inclined portion 101 is inclined at the same inclination angle so that the sidewall surface 121 is fitted to the inclined portion 101 without a gap. According to such a configuration, when the protruding portion 12 of the heat insulating member 8 is fitted into the cutout portion 10 of the partition wall 6, the cutout portion 10 can be prevented from being caught and damaged by the protruding portion 12 of the heat insulating member 8, and it is possible to prevent the operability of assembling from deteriorating.

[0028] FIG. 8 is a diagram showing another modification example of the shapes of the protruding portion of the heat insulating member and the cutout portion of the partition wall. FIG. 8 is a view of the protruding portion 12 and the cutout portion 10 from the machine chamber side as in FIG. 7. In the modification example shown in this figure, a corner R 102 is provided at the opening-side end of the cutout portion 10. According to such a configuration, when the protruding portion 12 of the heat insulating member 8 is fitted into the cutout portion 10 of the partition wall 6, the cutout portion 10 can be prevented from being caught and damaged by the protruding portion 12 of the heat insulating member 8, and it is possible to prevent the operability from deteriorating.

[Reference Signs List]

[0029]

1	Compressor
2	Water-refrigerant heat exchanger
3	Expansion valve
4	Air-refrigerant heat exchanger
5	Air blower
6	Partition wall
7	Bottom plate
8	Heat insulating member
9	Protective cover
10	Cutout portion
11	First opening portion
12	Protruding portion
13	Side surface portion
14	Lid portion
20	Machine chamber
22	Air blower chamber
81	Contact surface
82, 83, 84	Contact portion
100	Heat pump device
101	Inclined portion
121	Sidewall surface
102	Corner R

Claims

1. A heat pump device comprising:

a casing configured to accommodate therein a compressor configured to compress a refrigerant, a first heat exchanger configured to cause heat exchange between the refrigerant and air, an air blower, and a second heat exchanger configured to cause heat exchange between the refrigerant and a heat medium;
a partition wall that partitions a space inside the casing into a machine chamber in which the compressor is accommodated and an air blower chamber in which the first heat exchanger, the air blower, and the second heat exchanger are accommodated; and
an accommodation container in which the second heat exchanger is accommodated,
wherein the accommodation container includes:

a first opening portion for communicating the pipe extending from the second heat exchanger with the outside from a side surface, and
a protruding portion that is provided around the first opening portion and that protrudes from the side surface to the outside,

the partition wall includes a second opening portion for allowing the pipe to pass therethrough, and
the accommodation container is arranged such that the pipe passes through the second opening portion from the air blower chamber side to the machine chamber side, and the protruding portion fits into the second opening portion.

2. The heat pump device according to claim 1, wherein the accommodation container includes:

a side surface portion that covers a lateral side and a bottom side of the second heat exchanger, and
a lid portion arranged above the side surface portion and covering a top side of the second heat exchanger, and

the lid portion is removable by sliding in a direction away from the partition wall.

3. The heat pump device according to claim 1 or 2, wherein the second opening portion is configured as a cutout portion that is cut out in a rectangular shape from a lower end side of the partition wall upwards, the cutout portion includes an inclined portion that is inclined so that a cutout width expands from a closed side toward an open side, and
a sidewall surface corresponding to the inclined portion among sidewall surfaces forming the protruding portion is inclined at the same inclination angle as the inclined portion.

4. The heat pump device according to claim 3, wherein the second opening portion has a corner R formed at an opening-side end of the cutout portion.

5. The heat pump device according to any one of claims 1 to 4,
wherein the protruding portion is provided on a rear portion of the side surface, and the pipe is configured so as to be routed to the rear side of the compressor in the machine chamber.

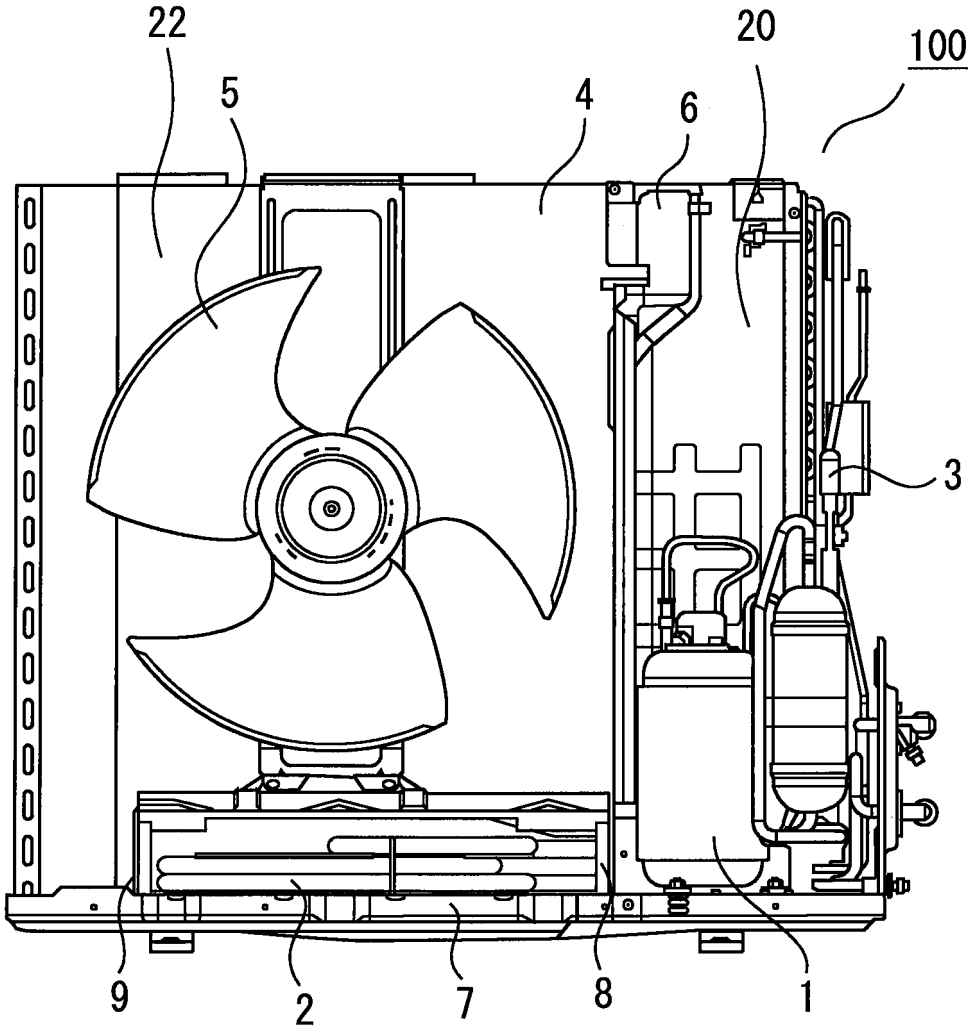

FIG. 1

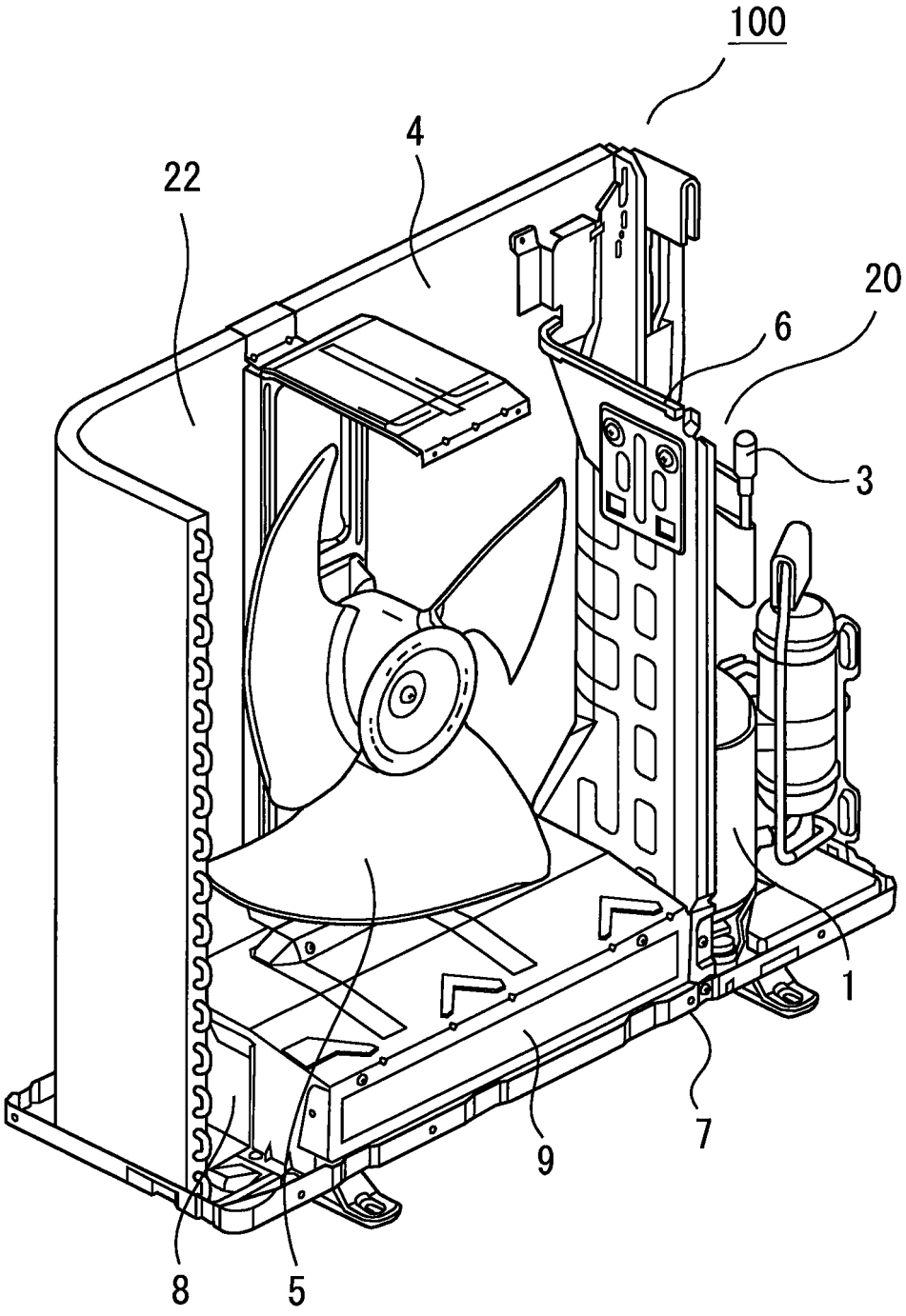

FIG. 2

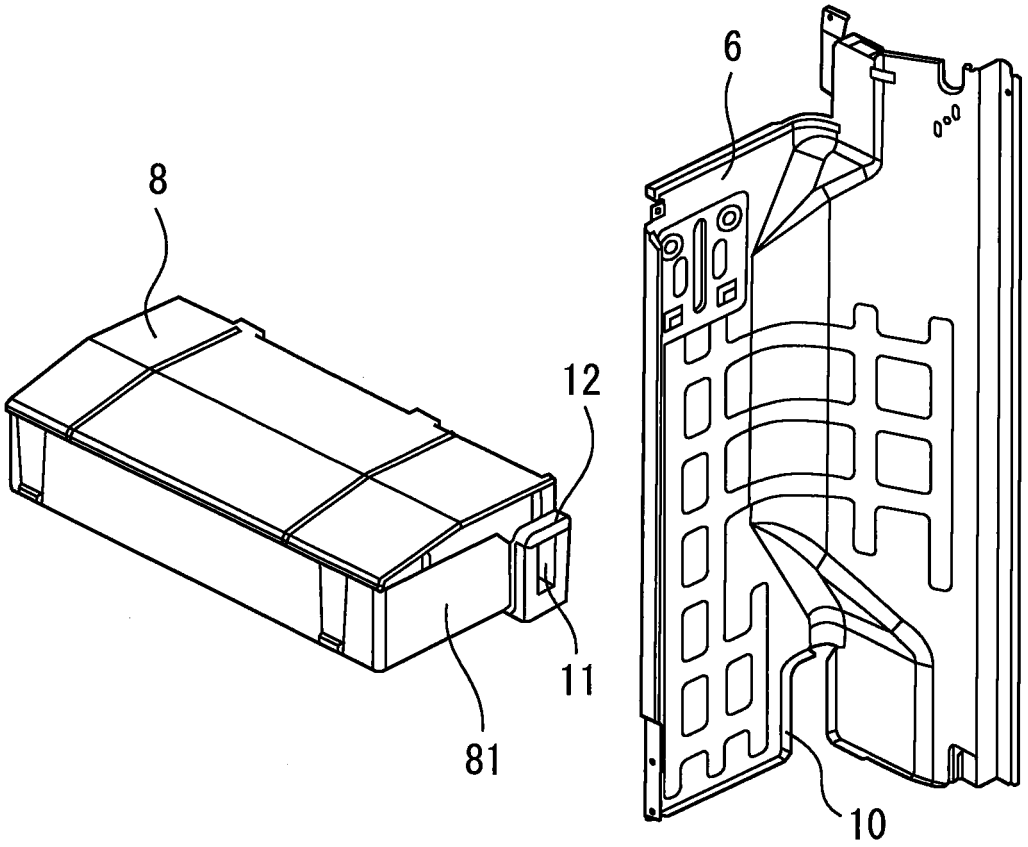

FIG. 3

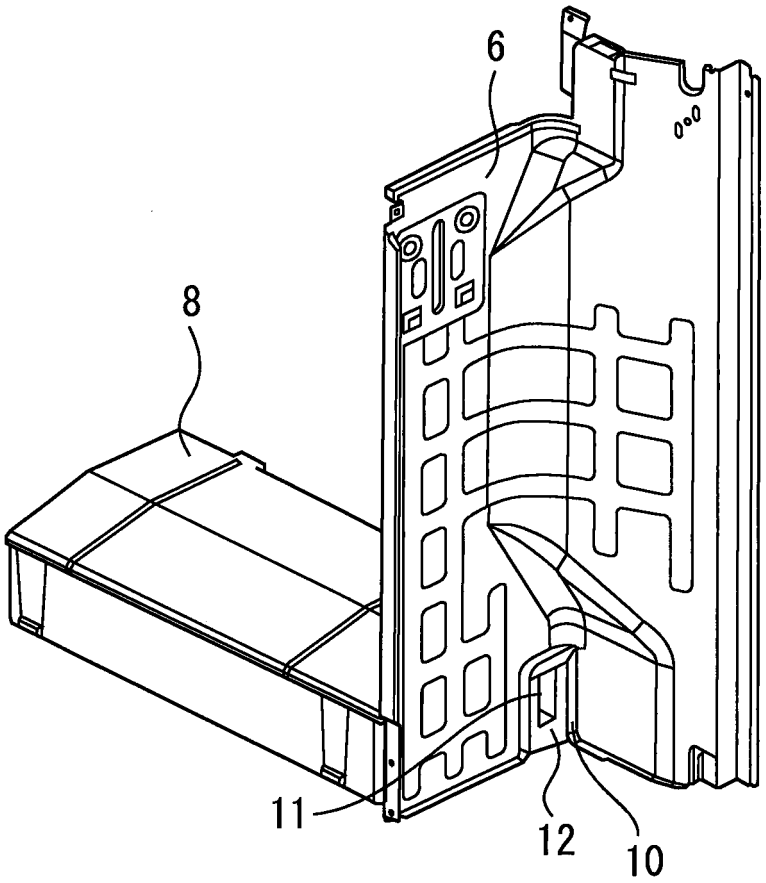

FIG. 4

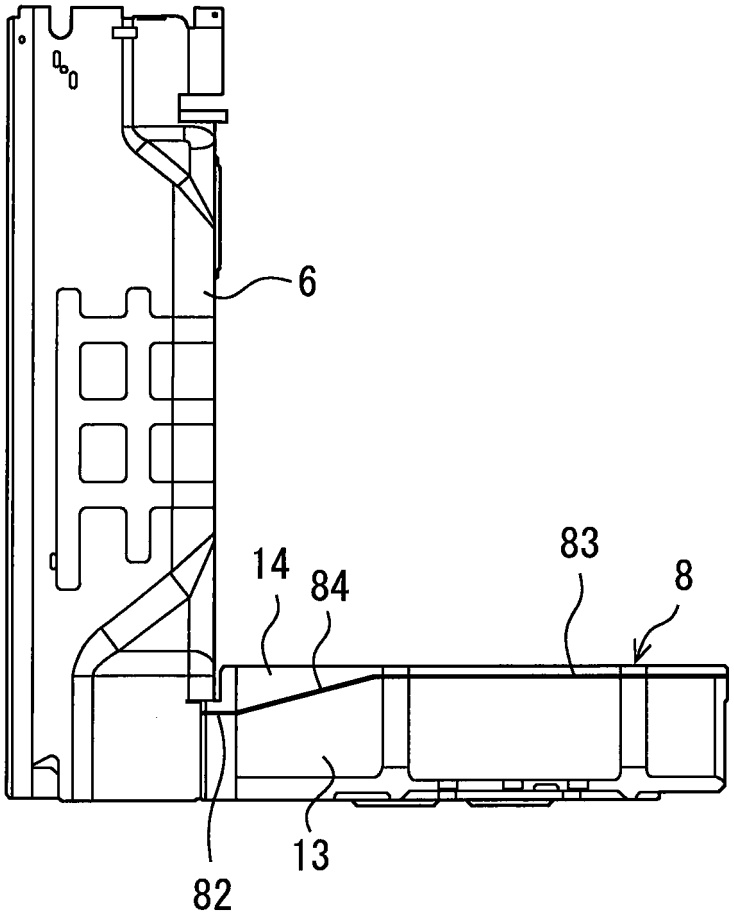

FIG. 5

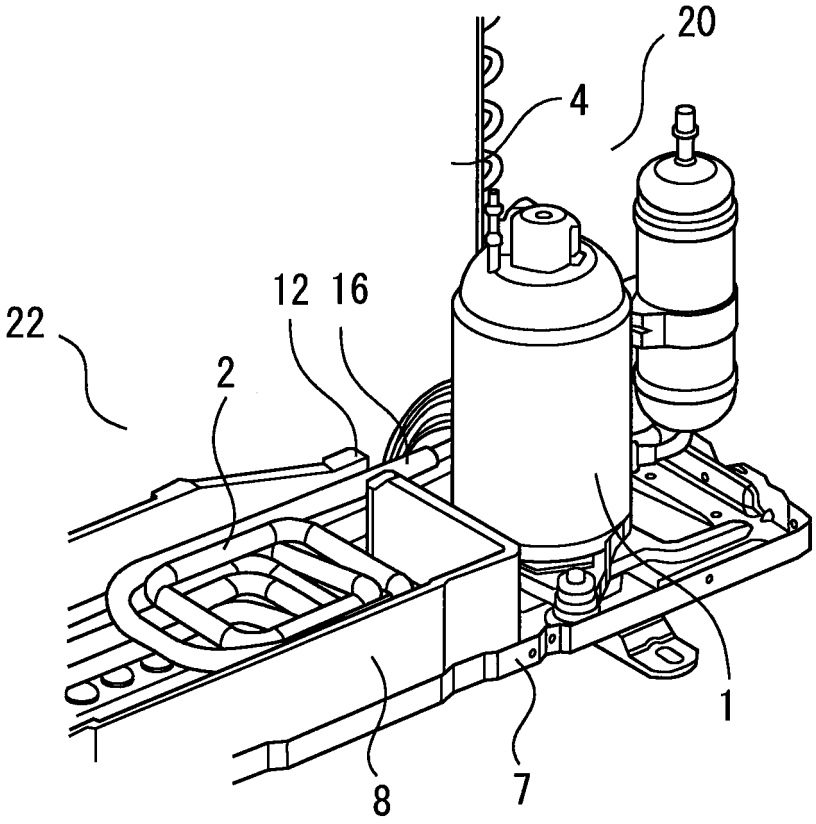

FIG. 6

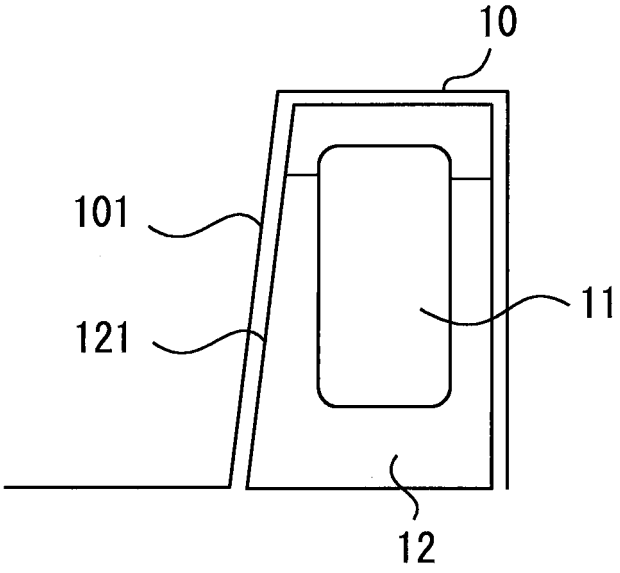

FIG. 7

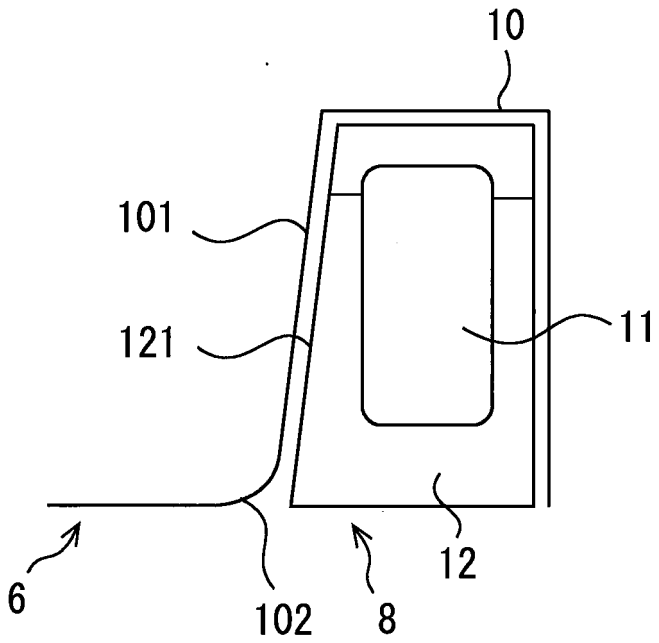

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/024895

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24H4/02(2006.01)i, F24F1/46(2011.01)i, F24H9/02(2006.01)i, F25B30/02(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. F24H1/00-4/06, F24H9/02-9/14, F24F1/06-5/00, F25B30/02

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.
A	JP 2016-191535 A (DAIKIN INDUSTRIES, LTD.) 10 November 2016, entire text, all drawings & JP 6011669 B1	1-5
A	JP 2013-47591 A (NORITZ CORPORATION) 07 March 2013, entire text, all drawings (Family: none)	1-5
A	JP 2012-247186 A (PANASONIC CORPORATION) 13 December 2012, entire text, all drawings (Family: none)	1-5

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search 06.09.2018	Date of mailing of the international search report 18.09.2018
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/024895

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2011-196560 A (PANASONIC CORPORATION) 06 October 2011, entire text, all drawings (Family: none)	1-5
A	JP 2012-145274 A (MITSUBISHI ELECTRIC CORPORATION) 02 August 2012, entire text, all drawings (Family: none)	1-5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2011196560 A **[0003]**