



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
13.05.2026 Bulletin 2026/20

(51) International Patent Classification (IPC):
F24F 1/24 (2011.01) **F25B 1/00** (2006.01)

(21) Application number: **25766195.9**

(86) International application number:
PCT/JP2025/022651

(22) Date of filing: **24.06.2025**

(87) International publication number:
WO 2026/069882 (02.04.2026 Gazette 2026/14)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH LA MA MD TN

(72) Inventors:
• **NAKANISHI, Takaya**
Osaka-shi, Osaka 530-0001 (JP)
• **FUKUYAMA, Yuta**
Osaka-shi, Osaka 530-0001 (JP)
• **YAMADA, Yuji**
Osaka-shi, Osaka 530-0001 (JP)
• **YASUNO, Masafumi**
Osaka-shi, Osaka 530-0001 (JP)
• **YAMAMOTO, Kohei**
Osaka-shi, Osaka 530-0001 (JP)

(30) Priority: **24.09.2024 JP 2024165380**
24.09.2024 JP 2024165379

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(71) Applicant: **DAIKIN INDUSTRIES, LTD.**
Osaka-Shi, Osaka 530-0001 (JP)

(54) **HEAT SOURCE UNIT OF REFRIGERATION CYCLE DEVICE, AND REFRIGERATION CYCLE DEVICE**

(57) A heat source unit (2) includes an electric component unit (70), a heat source-side refrigerant main flow path (300), and a first refrigerant sub flow path (46) including a first cooling portion (47) that cools a first portion of the electric component unit (70) and a second portion of the electric component unit (70). The heat source-side refrigerant main flow path (300) includes an accumulator (29), a compressor (21), a heat source-side heat exchanger (23), and a heat source-side expansion valve (25). The heat source-side refrigerant

main flow path (300) is connected to a utilization-side refrigerant flow path (500) of a utilization unit (3a, 3b) to form a refrigerant circuit (10). The first refrigerant sub flow path (46) branches from a liquid flow path (340) extending from the heat source-side heat exchanger (23) to the utilization-side refrigerant flow path (500) in the heat source-side refrigerant main flow path (300), and causes a refrigerant to flow in a gas flow path (310) between the accumulator (29) and the compressor (21) in the heat source-side refrigerant main flow path (300).

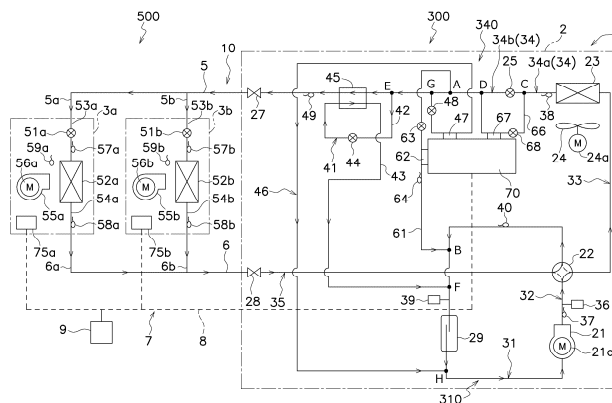


FIG. 1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a heat source unit of a refrigeration cycle apparatus and the refrigeration cycle apparatus.

BACKGROUND ART

[0002] Conventionally, there is a cooling circuit for cooling an electric component unit having one end connected to a liquid pipe and the other end connected to an upstream side of an accumulator (Patent Literature 1 (JP 2022-146443 A)).

SUMMARY OF THE INVENTION

<Technical Problem>

[0003] In the conventional cooling circuit, in order to suppress an increase in a discharge temperature of a compressor due to an R32 refrigerant, it is necessary to provide a liquid injection circuit, which may complicate the circuit, and there is a problem that the cooling capacity may be insufficient when the calorific value of the electric component unit increases.

<Solution to Problem>

[0004] A heat source unit of a refrigeration cycle apparatus according to a first aspect includes an electric component unit, a heat source-side refrigerant main flow path, and a first refrigerant sub flow path. The heat source-side refrigerant main flow path includes an accumulator, a compressor, a heat source-side heat exchanger, and a heat source-side main expansion mechanism. The heat source-side refrigerant main flow path is connected to a utilization-side refrigerant flow path of a utilization unit to form a refrigerant circuit. The first refrigerant sub flow path includes a first cooling portion that cools a first portion of an electric component unit and a second portion of the electric component unit. The first refrigerant sub flow path branches from a liquid flow path extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path in the heat source-side refrigerant main flow path, and causes a refrigerant to flow in a gas flow path between the accumulator and the compressor in the heat source-side refrigerant main flow path.

[0005] In the heat source unit of the refrigeration cycle apparatus, the first refrigerant sub flow path can be used for cooling the electric component unit, and can also cool a gas refrigerant sucked into the compressor.

[0006] A heat source unit of a refrigeration cycle apparatus according to a second aspect is the heat source unit according to the first aspect, and includes a first flow rate adjustment mechanism and a control unit. The first flow

rate adjustment mechanism adjusts a flow rate of the refrigerant flowing through the first refrigerant sub flow path. The control unit controls an opening degree of the first flow rate adjustment mechanism on the basis of a discharge pipe temperature of the compressor.

[0007] In the heat source unit of the refrigeration cycle apparatus, the opening degree of the first flow rate adjustment mechanism is increased to cool the gas refrigerant sucked into the compressor when the discharge pipe temperature of the compressor rises, so that the discharge pipe temperature of the compressor can be lowered to protect the compressor.

[0008] A heat source unit of a refrigeration cycle apparatus according to a third aspect is the heat source unit according to the second aspect, in which the control unit controls the opening degree of the first flow rate adjustment mechanism on the basis of the discharge pipe temperature of the compressor and a temperature of the electric component unit.

[0009] In the heat source unit of the refrigeration cycle apparatus, the opening degree of the first flow rate adjustment mechanism is increased when the discharge pipe temperature of the compressor rises and when the temperature of the electric component unit rises, so that the gas refrigerant sucked into the compressor can be cooled to lower the discharge pipe temperature of the compressor, and the electric component unit can be cooled.

[0010] A heat source unit of a refrigeration cycle apparatus according to a fourth aspect is the heat source unit according to any one of the first to third aspects, in which a housing space of the electric component unit is sealed by a housing. The first refrigerant sub flow path cools the housing space inside the housing.

[0011] In the heat source unit of the refrigeration cycle apparatus, the discharge pipe temperature of the compressor can be lowered, and the housing space for housing the electric component can be cooled with a smaller cooling amount than in a case of cooling the electric component.

[0012] A heat source unit of a refrigeration cycle apparatus according to a fifth aspect is the heat source unit according to any one of the second to fourth aspects, and further includes a second refrigerant sub flow path. The second refrigerant sub flow path includes a second cooling portion and a second flow rate adjustment mechanism. The second cooling portion cools the second portion of the electric component unit. The second flow rate adjustment mechanism adjusts an amount of the refrigerant flowing through the second cooling portion. The second refrigerant sub flow path connects the liquid pipe closer to the heat source-side heat exchanger with respect to the heat source-side main expansion mechanism and the liquid pipe opposite to the heat source-side heat exchanger with respect to the heat source-side main expansion mechanism. The first refrigerant sub flow path branches from a position closer to a utilization-side refrigerant circuit than a position opposite to the heat

source-side heat exchanger with respect to the heat source-side main expansion mechanism to which the second refrigerant sub flow path is connected in the liquid flow path extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path in the heat source-side refrigerant main flow path.

[0013] In the heat source unit of the refrigeration cycle apparatus, the first refrigerant sub flow path branches from a position closer to the utilization-side refrigerant circuit than the second refrigerant sub flow path in the liquid flow path, so that the amount of refrigerant for cooling in the second refrigerant sub flow path can be secured.

[0014] The heat source unit of the refrigeration cycle apparatus according to a sixth aspect is the heat source unit according to the fifth aspect, and further includes a fourth refrigerant sub flow path. The fourth refrigerant sub flow path includes a fourth cooling portion and a fourth flow rate adjustment mechanism. The fourth cooling portion cools the first portion of the electric component unit. The fourth flow rate adjustment mechanism expands the refrigerant flowing through the fourth cooling portion. The fourth refrigerant sub flow path branches from a liquid flow path extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path in the heat source-side refrigerant main flow path, and causes a refrigerant to flow in a gas flow path on a suction side of the compressor in the heat source-side refrigerant main flow path.

[0015] In the heat source unit of the refrigeration cycle apparatus, during an operation in which the heat source-side heat exchanger that cools the refrigerant with outside air is used as a condenser, the fourth flow rate adjustment mechanism of the fourth refrigerant sub flow path expands a high-temperature and high-pressure liquid refrigerant condensed by the heat source-side heat exchanger to lower the temperature, the gas-liquid two-phase refrigerant takes heat from the electric component unit to evaporate, and returns the refrigerant to the gas flow path on the suction side of the compressor. Therefore, the electric component unit can be cooled more strongly than a conventional case where the electric component unit is cooled by a high-temperature and high-pressure liquid refrigerant.

[0016] The heat source unit of the refrigeration cycle apparatus according to a seventh aspect is the heat source unit according to the sixth aspect, in which the heat source-side refrigerant main flow path further includes a subcooling heat exchanger. The subcooling heat exchanger is disposed in the liquid flow path extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path. The heat source unit further includes a third refrigerant sub flow path. The third refrigerant sub flow path branches from the liquid flow path. The third refrigerant sub flow path has a third flow rate adjustment mechanism that expands the refrigerant flowing inside. The third refrigerant sub flow path causes the subcooling heat exchanger to exchange heat be-

tween the refrigerant having passed through the third flow rate adjustment mechanism and the refrigerant flowing through the liquid flow path of the heat source-side refrigerant main flow path. The third refrigerant sub flow path causes the refrigerant after the heat exchange to flow into the gas flow path on the suction side of the compressor in the heat source-side refrigerant main flow path.

[0017] In the heat source unit of the refrigeration cycle apparatus, during an operation in which the heat source-side heat exchanger that cools the refrigerant with outside air is used as a condenser, the high-temperature and high-pressure liquid refrigerant condensed by the heat source-side heat exchanger is expanded by the third flow path adjustment mechanism of the third refrigerant sub flow path to reduce the temperature of the liquid refrigerant, and the refrigerant exchanges heat with the high-temperature and high-pressure liquid refrigerant, so that the high-temperature and high-pressure liquid refrigerant condensed by the heat source-side heat exchanger can be cooled.

[0018] A heat source unit of a refrigeration cycle apparatus according to an eighth aspect is the heat source unit according to the sixth or seventh aspect, in which the control unit controls an opening degree of the second flow rate adjustment mechanism or the fourth flow rate adjustment mechanism on the basis of the temperature of the electric component unit.

[0019] In the heat source unit of the refrigeration cycle apparatus, by controlling the opening degree of the second flow rate adjustment mechanism or the fourth flow rate adjustment mechanism on the basis of the temperature of the electric component unit, the temperature or the amount of refrigerant can be adjusted in accordance with the temperature of the electric component unit to cool the electric component unit.

[0020] A heat source unit of a refrigeration cycle apparatus according to a ninth aspect is the heat source unit according to any one of the sixth to eighth aspects, in which the electric component unit includes a first electric component and a second electric component. The fourth refrigerant sub flow path cools the first electric component.

[0021] In the heat source unit of the refrigeration cycle apparatus, the fourth refrigerant sub flow path can cool a specific electric component.

[0022] A heat source unit of a refrigeration cycle apparatus according to a tenth aspect is the heat source unit according to the ninth aspect, in which a calorific value of the first electric component is larger than a calorific value of the second electric component.

[0023] In the heat source unit of the refrigeration cycle apparatus, the first electric component having a large calorific value can be cooled by the fourth refrigerant sub flow path that lowers the temperature of the high-temperature and high-pressure liquid refrigerant.

[0024] A heat source unit of the refrigeration cycle apparatus according to an eleventh aspect is the heat

source unit according to any one of the sixth to tenth aspects, in which the fourth refrigerant sub flow path branches from a position closer to the utilization-side refrigerant flow path than a position opposite to the heat source-side heat exchanger with respect to the heat source-side main expansion mechanism to which the second refrigerant sub flow path is connected in the liquid flow path extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path in the heat source-side refrigerant main flow path.

[0025] In the heat source unit of the refrigeration cycle apparatus, the fourth refrigerant sub flow path branches from a position closer to the utilization-side refrigerant flow path than the second refrigerant sub flow path in the liquid flow path, so that the amount of refrigerant for cooling in the second refrigerant sub flow path can be secured.

[0026] A refrigeration cycle apparatus according to a twelfth aspect includes the heat source unit according to any one of the first to eleventh aspects, and one or more of the utilization units. The one or more utilization units are connected to the heat source unit.

[0027] In the refrigeration cycle apparatus, the first refrigerant sub flow path can be used for cooling the electric component unit, and can also cool the gas refrigerant sucked into the compressor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

FIG. 1 is a schematic configuration diagram of a refrigeration cycle apparatus according to the present embodiment.

FIG. 2 is a schematic external perspective view showing an arrangement and the like of a heat source-side control unit in a heat source unit.

FIG. 3 is a schematic configuration diagram of the interior of the heat source-side control unit in plan view.

FIG. 4 is a schematic configuration diagram of a front side portion of the interior of the heat source-side control unit as viewed from the front.

FIG. 5 is a schematic configuration diagram of a back side portion of the interior of the heat source-side control unit as viewed from the back.

DESCRIPTION OF EMBODIMENTS

(1) Configuration of refrigeration cycle apparatus

[0029] FIG. 1 is a schematic configuration diagram of a refrigeration cycle apparatus 1.

[0030] The refrigeration cycle apparatus 1 is used for cooling and heating a room in a building or the like by vapor compression refrigeration cycle operation. The refrigeration cycle apparatus 1 mainly includes a heat source unit 2, utilization units 3a and 3b, and a liquid-side

refrigerant connection pipe 5 and a gas-side refrigerant connection pipe 6 that connect the heat source unit 2 and the utilization units 3a and 3b. A refrigerant circuit 10 of the refrigeration cycle apparatus 1 is configured by connecting the heat source unit 2, the utilization units 3a and 3b, the liquid-side refrigerant connection pipe 5, and the gas-side refrigerant connection pipe 6.

[0031] Note that the refrigerant circuit 10 according to the present embodiment is filled with an optional refrigerant such as R32.

(1-1) Utilization unit

[0032] The utilization units 3a and 3b are installed by being embedded in or suspended from the ceiling of a room in a building or the like, or by being hung on a wall surface of the room. The utilization units 3a and 3b are connected to the heat source unit 2 via the liquid-side refrigerant connection pipe 5 and the gas-side refrigerant connection pipe 6, and constitute a part of the refrigerant circuit 10. The utilization units 3a and 3b each have a utilization-side refrigerant flow path 500 connected to a heat source-side refrigerant main flow path 100 to form the refrigerant circuit 10.

[0033] In the refrigeration cycle apparatus 1 according to the present embodiment, there is a plurality (here, two) of the utilization units 3a and 3b connected in parallel to each other in the refrigerant circuit 10.

[0034] Next, configurations of the utilization units 3a and 3b are described. Since the utilization units 3a and 3b have similar configurations, only the configuration of the utilization unit 3a will be described here. The description of the configuration of the utilization unit 3b is omitted, and instead of the subscript "a" indicating each part of the utilization unit 3a, the subscript "b" is added.

[0035] The utilization unit 3a mainly includes a utilization-side expansion valve 51a, a utilization-side heat exchanger 52a, a utilization-side fan 55a, and a utilization-side control unit 75a. The utilization unit 3a includes a utilization liquid-refrigerant pipe 53a connecting a liquid-side end of the utilization heat exchanger 52a and the liquid-refrigerant connection pipe 5, and a utilization gas-refrigerant pipe 54a connecting a gas-side end of the utilization heat exchanger 52a and the gas-refrigerant connection pipe 6.

[0036] The utilization-side heat exchanger 52a is, for example, a cross-fin type fin-and-tube heat exchanger including a heat transfer tube and a large number of fins. The utilization-side heat exchanger 52a functions as an evaporator for the refrigerant and cools indoor air during a cooling operation, and functions as a radiator or condenser for the refrigerant and heats indoor air during a heating operation. The gas-side refrigerant connection pipe 6 is connected to a gas side of the utilization-side heat exchanger 52a.

[0037] The utilization-side expansion valve 51a is an electronic expansion valve, a valve opening degree of which is adjustable. The utilization-side expansion valve

51a is provided in the refrigerant flow path between the utilization-side heat exchanger 52a and the liquid-side refrigerant connection pipe 5.

[0038] The utilization unit 3a includes the utilization-side fan 55a for sucking indoor air into the unit, causing the indoor air to exchange heat with the refrigerant in the utilization-side heat exchanger 52a, and then supplying the indoor air as supply air. The utilization-side fan 55a is a centrifugal fan, a multiblade fan, or the like. The utilization-side fan 55a has a utilization-side fan motor 56a.

[0039] The utilization unit 3a is provided with various sensors. Specifically, the utilization unit 3a is provided with a utilization-side heat exchange liquid-side sensor 57a configured to detect a refrigerant temperature Trl at the liquid-side end of the utilization-side heat exchanger 52a, a utilization-side heat exchange gas-side sensor 58a configured to detect a refrigerant temperature Trg at the gas side end of the utilization-side heat exchanger 52a, and an indoor air sensor 59a configured to detect a temperature Tra of indoor air sucked into the utilization unit 3a.

[0040] The utilization-side control unit 75a controls an operation of each part of the utilization unit 3a. The utilization-side control unit 75a includes a microcomputer, a memory, and the like provided for control of the utilization unit 3a. The utilization-side control unit 75a can exchange control signals and the like with a heat source-side control unit 70 of the heat source unit 2 or a remote controller 9 through a transmission line 8.

(1-2) Heat source unit

[0041] The heat source unit 2 is installed outside a building or the like, is connected to the utilization units 3a and 3b via the liquid-side refrigerant connection pipe 5 and the gas-side refrigerant connection pipe 6, and constitutes a part of the refrigerant circuit 10.

[0042] FIG. 2 is a schematic external perspective view showing an arrangement and the like of the heat source-side control unit 70 in the heat source unit 2. In the following description, unless otherwise specified, "up", "down", "left", "right", "front", and "rear" refer to the directions when the outdoor unit 2 shown in FIG. 2 is viewed from the front (left oblique front side in the drawing). Here, in the present embodiment, the direction in which the surface without the heat source-side heat exchanger 23 or the surface with the smallest portion where the heat source-side heat exchanger 23 exists is located is referred to as "front", as viewed from the center of the heat source unit 2 in plan view. In FIG. 2, the heat source-side control unit 70, a first cooling portion 47 and second cooling portion 67 around the heat source-side control unit 70, the heat source-side heat exchanger 23, a heat source-side fan 24, and the like are mainly shown, and other equipment, pipes, and the like are omitted.

[0043] The heat source unit 2 mainly includes a heat source unit casing 11, a compressor 21, a four-way switching valve 22, the heat source-side heat exchanger

23, a heat source-side expansion valve (heat source-side main expansion mechanism) 25, an accumulator 29, a liquid-side shutoff valve 27, a gas-side shutoff valve 28, a first refrigerant sub flow path 46, a second refrigerant sub flow path 66, the heat source-side fan 24, and the like. The four-way switching valve 22 and a suction side of the compressor 21 are connected via a suction refrigerant pipe 31. The suction refrigerant pipe 31 is provided with the accumulator 29 that temporarily accumulates the refrigerant sucked into the compressor 21. A discharge side of the compressor 21 and the four-way switching valve 22 are connected via a discharge refrigerant pipe 32. The four-way switching valve 22 and a gas-side end of the heat source heat exchanger 23 are connected via a first heat source gas-refrigerant pipe 33. A liquid-side end of the heat source heat exchanger 23 and the liquid-refrigerant connection pipe 5 are connected via the heat source liquid-refrigerant pipe 34. The heat source liquid-refrigerant pipe 34 and the liquid-refrigerant connection pipe 5 are connected at a portion provided with the liquid-side shutoff valve 27. The four-way switching valve 22 and the gas-refrigerant connection pipe 6 are connected via a second heat source gas-refrigerant pipe 35. The second heat source gas-refrigerant pipe 35 and the gas-refrigerant connection pipe 6 are connected at a portion provided with the gas-side shutoff valve 28. The liquid-side shutoff valve 27 and the gas-side shutoff valve 28 are configured to be manually opened and closed.

[0044] The heat source unit includes the accumulator 29, the compressor 21, the heat source-side heat exchanger 23, and the heat source-side expansion valve 25, and is connected to the utilization-side refrigerant flow paths 500 of the utilization units 3a and 3b to form the refrigerant circuit 10. A liquid flow path 340 is a flow path extending from the heat source-side heat exchanger 23 of a heat source-side refrigerant main flow path 300 to the utilization-side flow path 500. The liquid flow path 340 includes the heat source liquid-refrigerant pipe 34. The heat source liquid-refrigerant pipe 34 includes a first heat source liquid-refrigerant pipe 34a and a second heat source liquid-refrigerant pipe 34b. The first heat source liquid-refrigerant pipe 34a is a liquid pipe closer to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25. The second heat source liquid-refrigerant pipe 34b is a liquid pipe opposite to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25. A gas flow path 310 is a flow path of the heat source-side refrigerant main flow path 300 on the suction side of the compressor 21. The gas flow path 310 includes the suction refrigerant pipe 31.

[0045] The heat source unit 2 also includes the first refrigerant sub flow path 46, the second refrigerant sub flow path 66, a third refrigerant sub flow path 41, and a fourth refrigerant sub flow path 61.

[0046] In the present embodiment, the heat source unit 2 is a top-blowing heat exchange unit that sucks air from left and right side surfaces and a back surface of the heat

source unit casing 11 and blows the air upward from an upper end surface of the heat source unit casing 11.

[0047] The heat source unit casing 11 mainly has a main portion 13 and a fan module 12 provided on top of the main portion 13.

[0048] The main portion 13 has a pair of installation legs 18, a bottom frame 15, four supports 14, a front panel 13a, and mesh portions 13b, 13c, and 13d. The installation legs 18 are provided, one on the front side and one on the rear side, and extend in the left-right direction. The bottom frame 15 is bridged over the installation legs 18. The supports 14 extend vertically from the corners of the bottom frame 15. The front panel 13a extends between the two supports 14 on the front side. The mesh portion 13b is provided so as to extend forward and rearward between the supports 14 on the left side. The mesh portion 13c is provided so as to extend to the left and right between the supports 14 on the rear side. The mesh portion 13d is provided so as to extend forward and rearward between the supports 14 on the right side.

[0049] The bottom frame 15 forms the bottom of the heat source unit casing 11, and the heat source-side heat exchanger 23 is provided on the bottom frame 15. Here, the heat source-side heat exchanger 23 has a substantially U-shape in plan view facing the back surface and both left and right side surfaces of the heat source unit casing 11.

[0050] Note that each of the mesh portions 13b, 13c, and 13d is provided so as to extend along an outer surface of the heat source-side heat exchanger 23. The mesh portions 13b, 13c, and 13d substantially form three suction ports on the right side surface, left side surface, and back surface in the heat source unit casing 11.

[0051] The front panel 13a has an upper front panel 16 constituting the upper portion of the front surface of the heat source unit casing 11 and a lower front panel 17 constituting the lower portion of the front surface of the heat source unit casing 11.

[0052] The fan module 12 is attached to the upper ends of the supports 14. The fan module 12 is a substantially rectangular parallelepiped box having a front side plate 12a, a left-side panel 12b, a back side plate 12c, and a right-side panel 12d, and penetrates in the up-down direction. The fan module 12 houses the heat source-side fan 24 therein to form a flow path for an upward air flow.

[0053] The compressor 21 is, for example, a positive-displacement compressor driven by a compressor motor 21a. The compressor motor 21a is driven with power supplied through an inverter device. The operating capacity of the compressor 21 is variable by changing the drive frequency of the compressor motor 21a and varying the number of rotations. The discharge side of the compressor 21 is connected to one of a plurality of connection ports of the four-way switching valve 22. In the present embodiment, the compressor 21 is placed on the bottom frame 15.

[0054] The accumulator 29 is a refrigerant reservoir provided between the suction side of the compressor 21 and one of the plurality of connection ports of the four-way switching valve 22. In the present embodiment, the accumulator 29 is placed on the bottom frame 15.

[0055] The heat source-side heat exchanger 23 is, for example, a cross-fin type fin-and-tube heat exchanger including a heat transfer tube and a large number of fins. The heat source-side heat exchanger 23 functions as a radiator or condenser for the refrigerant during the cooling operation, and functions as an evaporator for the refrigerant during the heating operation. One of the plurality of connection ports of the four-way switching valve 22 is connected to the gas side of the heat source-side heat exchanger 23 through a refrigerant pipe. The heat source-side expansion valve 25 is connected to a liquid side of the heat source-side heat exchanger 23 via a refrigerant pipe.

[0056] The heat source-side fan 24 is housed in the fan module 12. The heat source-side fan 24 sucks outdoor air from a lower periphery of the heat source unit casing 11 into the interior, thereby forming an air flow that, after causing the heat source-side heat exchanger 23 to exchange heat between the sucked outdoor air and the refrigerant, discharges the heat-exchanged air upward through a blow-out port that is provided on the upper end surface of the fan module 12. The heat source-side fan 24 is a propeller fan or the like driven by a heat source-side fan motor 24a, which is a DC fan motor, and has a variable air volume. In the present embodiment, the heat source-side fan motor 24a is driven with power supplied through an inverter device.

[0057] The heat source-side expansion valve 25 is an electric expansion valve, the valve opening degree of which is adjustable in order to adjust the flow rate of the refrigerant flowing in the refrigerant circuit 10. The heat source-side expansion valve 25 is provided between the liquid-side outlet of the heat source-side heat exchanger 23 and the liquid-side shutoff valve 29.

[0058] The four-way switching valve 22 has the plurality of connection ports. The four-way switching valve 22 switches the refrigerant circuit 10 between a cooling operation connection state and a heating operation connection state by switching a connection state of the plurality of connection ports. In the cooling operation connection state, the discharge side of the compressor 21 is connected to the heat source-side heat exchanger 23, and the suction side of the compressor 21 is connected to the gas-side shutoff valve 28. In the heating operation connection state, the discharge side of the compressor 21 is connected to the gas-side shutoff valve 28, and the suction side of the compressor 21 is connected to the heat source-side heat exchanger 23.

[0059] The liquid-side shutoff valve 27 is provided at a connecting port with the liquid-side refrigerant connection pipe 5. The liquid-side shutoff valve 27 is connected to the opposite side of the heat source-side expansion valve 25 to the heat source-side heat exchanger 23

through the refrigerant pipe. The gas-side shutoff valve 28 is provided at a connecting port with the gas-side refrigerant connection pipe 6. The gas-side shutoff valve 28 is connected to one of the plurality of connection ports of the four-way switching valve 22 via a refrigerant pipe.

[0060] The first refrigerant sub flow path 46, the second refrigerant sub flow path 66, and the fourth refrigerant sub flow path 61 are flow paths for cooling electric components such as a heat generating component to be described later included in the heat source-side control unit (hereinafter also referred to as an electric component unit) 70.

[0061] The first refrigerant sub flow path 46 includes a first cooling portion 47 that cools an intelligent power module (IPM, first electric component) 81a of the electric component unit 70 and an intelligent power module (IPM, second electric component) 82a of the electric component unit 70. The first refrigerant sub flow path 46 branches from the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500 in the heat source-side refrigerant main flow path 300, and causes the refrigerant to flow in the gas flow path 310 between the accumulator 29 and the compressor 21 in the heat source-side refrigerant main flow path 300. The first refrigerant sub flow path 46 branches off from a position closer to the utilization-side refrigerant circuit 500 than a position opposite to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25 to which the second refrigerant sub flow path 66 is connected, in the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500 of the heat source-side refrigerant main flow path 300 (see points G and H in FIG. 1). In other words, the first refrigerant sub flow path 46 is connected to a portion of the heat source-side liquid-refrigerant pipe 34 between the heat source-side expansion valve 25 and the subcooling heat exchanger 45 (see the point G in FIG. 1). The first refrigerant sub flow path 46 is connected to the suction refrigerant pipe 31 through which the refrigerant sucked into the compressor 21 flows. The first refrigerant sub flow path 46 is connected to a portion of the suction refrigerant pipe 31 on an outlet side of the accumulator 29 (see the point H in FIG. 1).

[0062] The first refrigerant sub flow path 46 includes a first expansion valve (first flow rate adjustment mechanism) 48. The first expansion valve 48 is implemented by an electrically powered expansion valve. The first expansion valve 48 adjusts the amount of the refrigerant flowing through the first refrigerant sub flow path 46.

[0063] The second refrigerant sub flow path 66 includes the second cooling portion 67 and a second expansion valve (second flow rate adjustment mechanism) 68. The second cooling portion 67 further cools the intelligent power module (IPM, second electric component) 82a of the electric component unit 70 (see FIG. 3). The second expansion valve 68 adjusts an amount of the refrigerant flowing through the second cooling portion 67.

The second expansion valve 68 is implemented by an electrically powered expansion valve. The second refrigerant sub flow path 66 connects the first heat source-side liquid-refrigerant pipe (liquid pipe) 34a closer to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25 and the second heat source-side liquid-refrigerant pipe (liquid pipe) 34b opposite to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25 (see points C and D in FIG. 1). The second cooling portion 67 is provided to cool the electric components such as heat generating components of the heat source-side control unit 70 while being in thermal contact therewith from the front side with a second heat transfer member 67a described later interposed therebetween.

[0064] The fourth refrigerant sub flow path 61 includes a fourth cooling portion 62 and a fourth expansion valve (fourth flow rate adjustment mechanism) 63. The fourth cooling portion 62 further cools the intelligent power module (IPM, first electric component) 81a of the electric component unit 70 (see FIG. 3). The fourth expansion valve 63 expands the refrigerant flowing through the fourth cooling portion 62. The fourth expansion valve 63 is implemented by an electrically powered expansion valve. The fourth refrigerant sub flow path 61 branches from the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500 in the heat source-side refrigerant main flow path 300, and causes the refrigerant to flow in the gas flow path 310 on the suction side of the compressor 21 in the heat source-side refrigerant main flow path 300 (see points A and B in FIG. 1). The fourth refrigerant sub flow path 61 branches off from a position closer to the utilization-side refrigerant flow path 500 than a position opposite to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25 to which the second refrigerant sub flow path 66 is connected, in the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500 of the heat source-side refrigerant main flow path 300 (see the point A in FIG. 1). The fourth cooling portion 62 is provided to cool the electric components such as heat generating components of the heat source-side control unit 70 while being in thermal contact therewith from the front side with a fourth heat transfer member 62a described later interposed therebetween.

[0065] The third refrigerant sub flow path 41 branches from the liquid flow path 340 (see a point E in FIG. 1). The third refrigerant sub flow path 41 has a third expansion valve (third flow rate adjustment mechanism) 44 that expands the refrigerant flowing inside. The third expansion valve 44 is implemented by an electrically powered expansion valve. The subcooling heat exchanger 45 is disposed in the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500. The third refrigerant sub flow path 41 causes the subcooling heat exchanger 45 to

exchange heat between the refrigerant having passed through the third expansion valve 44 and the refrigerant flowing through the liquid flow path 340 of the heat source-side refrigerant main flow path 300. The third refrigerant sub flow path 41 causes the refrigerant after the heat exchange to flow into the gas flow path 310 on the suction side of the compressor 21 in the heat source-side refrigerant main flow path 300 (see a point F in FIG. 1). In other words, the third refrigerant sub flow path 41 is a refrigerant pipe causing the refrigerant branching from the heat source-side liquid-refrigerant pipe 34 to be sent to the suction side of the compressor 21. The third refrigerant sub flow path 41 mainly includes a refrigerant return inlet pipe 42 and a refrigerant return outlet pipe 43. The refrigerant return inlet pipe 42 is a refrigerant pipe that causes part of the refrigerant flowing in the heat source-side liquid-refrigerant pipe 34 to branch from a portion between the liquid-side end of the heat source-side heat exchanger 23 and the liquid-side shutoff valve 27 (here, a portion between the heat source-side expansion valve 25 and the subcooling heat exchanger 45) and be sent to an inlet of the subcooling heat exchanger 45 closer to the third refrigerant sub flow path 41. The refrigerant return outlet pipe 43 is a refrigerant pipe that causes refrigerant from an outlet of the subcooling heat exchanger 45 closer to the third refrigerant sub flow path 41 to be sent to the suction refrigerant pipe 31. Then, the refrigerant return outlet pipe 43 of the third refrigerant sub flow path 41 is connected to a portion of the suction refrigerant pipe 31 on an inlet side of the accumulator 29.

[0066] The heat source unit 2 is provided with various sensors. Specifically, the heat source unit 2 is provided with a discharge pressure sensor 36 that detects a pressure (discharge pressure P_d) of the refrigerant discharged from the compressor 21, a discharge temperature sensor 37 that detects a temperature (discharge temperature T_d , hereinafter also referred to as discharge pipe temperature T_d) of the refrigerant discharged from the compressor 21, a suction pressure sensor 39 that detects a pressure (suction pressure P_s) of the refrigerant sucked into the compressor 21, and a suction temperature sensor 40 that detects a temperature (suction temperature T_s) of the refrigerant sucked into the compressor 21. The heat source unit 2 is also provided with a heat source-side heat exchange liquid-side sensor 38 that detects a temperature T_{ol} (outdoor heat exchanger outlet temperature T_{ol}) of the refrigerant at the liquid-side end of the heat source-side heat exchanger 24, and a liquid pipe temperature sensor 49 that detects a temperature (liquid pipe temperature T_{lp}) of the refrigerant in a portion of the heat source-side liquid-refrigerant pipe 34 between the heat source-side expansion valve 25 and the liquid-side shutoff valve 27. The heat source unit 2 is provided with an internal air temperature sensor 64 that detects a temperature (internal air temperature T_a) of air near the electric component of the electric component unit 70.

[0067] The heat source-side control unit (electric com-

ponent unit) 70 is provided below the fan module 12, close to the front side, and facing the back side of the upper front panel 16, in the heat source unit casing 11. Specifically, the heat source-side control unit 70 is located forward of the compressor 21 and the accumulator 29. The heat source-side control unit 70 can be accessed from outside through an opening 16a that is exposed when the upper front panel 16 of the heat source unit casing 11 is removed. The opening 16a is bordered by the support 14 located at the left front, the support 14 located at the right front, a lower edge of the front side plate 12a of the fan module 12, and an upper edge of the lower front panel 17, and is open in the front-rear direction. The heat source-side control unit 70 controls an operation of each part constituting the heat source unit 2. The heat source-side control unit 70 has a microcomputer and a memory provided to control the heat source unit 2, and controls the states of the compressor motor 21a, the heat source-side fan motor 24a, the heat source-side expansion valve 25, the four-way switching valve 22, the first expansion valve 48, the second expansion valve 68, and the like. The heat source-side control unit 70 can exchange control signals and the like with the utilization-side control units 75a and 75b of the utilization units 3a and 3b and the remote controller 9 via a transmission line 70. The above-described utilization-side control units 75a and 75b, heat source-side control unit 50, and remote controller 9 are connected to each other by the transmission line 8 to constitute a control unit 7 that controls the operation of the entire refrigeration cycle apparatus 1.

[0068] The control unit 7 is connected so as to be able to receive detection signals of the various sensors 36, 37, 38, 39, 40, 49, 57a, 57b, 58a, 58b, 59a, 59b, and 64, and controls various devices on the basis of these detection signals and the like. The control unit 7 has a CPU that executes the above-described various controls, a memory that stores information used for executing the various controls, and the like.

(1-3) Refrigerant connection pipes

[0069] The liquid-side refrigerant connection pipe 5 and the gas-side refrigerant connection pipe 6 are refrigerant pipes that are constructed on site when installing the refrigeration cycle apparatus 1 in an installation place such as a building.

[0070] Note that, in the refrigeration cycle apparatus 1 according to the present embodiment having the plurality of utilization units 3a and 3b, the liquid-side refrigerant connection pipe 5 has a branch portion corresponding to each of the utilization units 3a and 3b, and the gas-side refrigerant connection pipe 6 has a branch portion corresponding to each of the utilization units 3a and 3b.

(2) Refrigeration cycle in refrigerant circuit

[0071] The refrigerant circuit 10 of the refrigeration cycle apparatus 1 mainly performs the cooling operation

and the heating operation by switching a connection state of the four-way switching valve 22.

(2-1) Cooling operation

[0072] The cooling operation is performed in a state where the connection state of the four-way switching valve 22 is switched such that the discharge side of the compressor 21 is closer to the heat source-side heat exchanger 23 and the suction side of the compressor 21 is closer to the utilization-side heat exchangers 52a and 52b.

[0073] The compressor 21 is frequency controlled, for example, to process a cooling load in each of the utilization units 3a and 3b. As a result, the low-pressure refrigerant sucked into the compressor 21 is discharged from the compressor 21 to become high-pressure refrigerant, which flows through the four-way switching valve 22 into the heat source-side heat exchanger 23.

[0074] The refrigerant flowing into the heat source-side heat exchanger 23 radiates heat and condenses. The refrigerant flowing out of the heat source-side heat exchanger 23 passes through the heat source-side expansion valve 25, which is controlled to be fully open by the control unit 7 during the cooling operation.

[0075] The refrigerant that has passed through the heat source-side expansion valve 25 passes through the liquid-side shutoff valve 27 and is sent to the liquid-side refrigerant connection pipe 5.

[0076] The refrigerant flowing through the liquid-side refrigerant connection pipe 5 is branched and then sent to each of the utilization units 3a and 3b.

[0077] The refrigerant flowing into the utilization units 3a and 3b is decompressed by the utilization-side expansion valves 51a and 51b until reaching a low pressure of the refrigeration cycle. Note that the control unit 7 controls the valve opening degree of the utilization-side expansion valves 51a and 51b such that, for example, the degree of superheating of the refrigerant on the outlet side of the utilization-side heat exchangers 52a and 52b becomes a predetermined target degree of superheating.

[0078] The refrigerant decompressed by the utilization-side expansion valves 51a and 51b of the utilization units 3a and 3b evaporates in the utilization-side heat exchangers 52a and 52b. The flows of the refrigerant evaporated in the utilization-side heat exchangers 51a and 51b join together, and then flow through the gas-side refrigerant connection pipe 6.

[0079] The refrigerant flowing through the gas-side refrigerant connection pipe 6 is sucked again into the compressor 21 through the gas-side shutoff valve 28, the four-way switching valve 22, and the accumulator 29 of the heat source unit 2.

[0080] During the cooling operation, the refrigerant is sent to the compressor 21 by the first refrigerant sub flow path 46 that branches part of the refrigerant flowing through the heat source-side liquid-refrigerant pipe 34

at a portion of the heat source-side liquid-refrigerant pipe 34 closer to the heat source-side heat exchanger 23 than the subcooling heat exchanger 45 is. The first refrigerant sub flow path 46 cools the housing space inside an electric component casing 70a. In other words, the first refrigerant sub flow path 46 cools the internal air of the electric component unit 70. The control unit 7 controls the opening degree of the first expansion valve 48 on the basis of the discharge temperature (discharge pipe temperature) T_d of the compressor 21. In a case where the discharge temperature T_d rises to a discharge temperature threshold T_{dx} , the control unit 7 performs control to increase the opening degree of the first expansion valve 48 until the discharge temperature T_d falls to or below the discharge temperature threshold T_{dx} .

[0081] Furthermore, during the cooling operation, the high-temperature and high-pressure liquid refrigerant condensed by the heat source-side heat exchanger 23 flows through the second refrigerant sub flow path 66 to cool the electric component unit 70. The control unit 7 controls the opening degree of the second expansion valve 68 on the basis of the temperature of the electric component unit 70. In other words, the control unit 7 adjusts the opening degree of the second expansion valve 68 on the basis of the internal air temperature T_a detected by the internal air temperature sensor 64.

[0082] Furthermore, in the cooling operation, the refrigerant in a gas-liquid two-layer state takes heat from the electric component unit 70 and evaporates by the fourth expansion valve 63 provided in the fourth refrigerant sub flow path 61, and returns to the gas flow path 310 on the suction side of the compressor 21. The control unit 7 controls the opening degree of the fourth expansion valve 63 on the basis of the temperature of the electric component unit 70. In other words, the control unit 7 controls the opening degree of the fourth expansion valve 63 on the basis of the internal air temperature T_a detected by the internal air temperature sensor 64.

[0083] Furthermore, in the cooling operation, the operation of cooling the refrigerant in the portion of the heat source-side liquid-refrigerant pipe 34 between the subcooling heat exchanger 45 and the heat source-side heat exchanger 23 is performed by the third refrigerant sub flow path 41 that branches part of the refrigerant flowing through the heat source-side liquid-refrigerant pipe 34 and sends the branched part of the refrigerant to the compressor 21, and the subcooling heat exchanger 45 that cools the refrigerant flowing through the portion of the heat source-side liquid-refrigerant pipe 34 closer to the heat source-side heat exchanger 23 than the liquid-side shutoff valve 27 by the refrigerant flowing through the third refrigerant sub flow path 41. The control unit 7 performs control to increase the opening degree of the third expansion valve 44 in a case where the liquid pipe temperature T_{lp} is higher than a target liquid pipe temperature T_{lpt} , and performs control to decrease the opening degree of the third expansion valve 44 in a case where the liquid pipe temperature T_{lp} is lower than the target

liquid pipe temperature T_{lpt} .

(2-2) Heating operation

[0084] The heating operation is performed in a state where the connection state of the four-way switching valve 22 is switched such that the discharge side of the compressor 21 is closer to the utilization-side heat exchangers 52a and 52b and the suction side of the compressor 21 is closer to the heat source-side heat exchanger 23.

[0085] The compressor 21 is frequency controlled, for example, to process the heating load in each of the utilization units. As a result, the high-pressure refrigerant discharged from the compressor 21 flows toward the utilization units 3a and 3b through the four-way switching valve 22 and the gas-side refrigerant connection pipe 6.

[0086] Here, the refrigerant that has passed through the gas-side refrigerant connection pipe 6 branches off and flows into each of the utilization units 3a and 3b.

[0087] The refrigerant flowing into the utilization units 3a and 3b radiates heat and condenses in the utilization-side heat exchangers 52a and 52b. During the heating operation, the valve opening degree of each of the utilization-side expansion valves 51a and 51b is controlled such that the degree of subcooling of the refrigerant flowing through the outlet of the utilization-side heat exchangers 52a and 52b becomes a predetermined value, for example.

[0088] In this way, the flows of the refrigerant condensed in the utilization-side heat exchangers 52a and 52b and passing through the utilization-side expansion valves 51a and 51b join together, and then flow through the liquid-side refrigerant connection pipe 5.

[0089] The refrigerant flowing through the liquid-side refrigerant connection pipe 5 is supplied to the heat source unit 2 through the liquid-side shutoff valve 27. The refrigerant that has passed through the liquid-side shutoff valve 27 is decompressed by the heat source-side expansion valve 25 until reaching a low pressure of the refrigeration cycle. Specifically, for example, the valve opening degree of the heat source-side expansion valve 25 is controlled such that the degree of superheating of the refrigerant flowing through the suction side of the compressor 21 becomes a target degree of superheating.

[0090] The refrigerant sent to the heat source-side heat exchanger 23 evaporates and is sucked again into the compressor 21 through the four-way switching valve 22 and the accumulator 29.

[0091] In the heating operation, the control unit 7 fully closes the opening degree of the first expansion valve 48 to prevent the refrigerant from flowing into the first refrigerant sub flow path 46. The control unit 7 fully closes the opening degree of the second expansion valve 68 to prevent the refrigerant from flowing into the second refrigerant sub flow path 66. The control unit 7 fully closes the opening degree of the fourth expansion valve 63 to

prevent the refrigerant from flowing into the fourth refrigerant sub flow path 61. The control unit 7 fully closes the opening degree of the third expansion valve 44 to prevent the refrigerant from flowing into the third refrigerant sub flow path 41 and the first refrigerant sub flow path 46.

(3) Configuration of heat source-side control unit

[0092] FIG. 3 is a schematic configuration diagram of the interior of the heat source-side control unit 70 in plan view. FIG. 4 is a schematic configuration diagram of a front side portion of the interior of the heat source-side control unit 70 as viewed from the front. FIG. 5 is a schematic configuration diagram of a back surface portion of the interior of the heat source-side control unit 70 as viewed from the back.

[0093] The heat source-side control unit (electric component unit) 70 includes the electric component casing (housing) 70a, a first board 81, and a second board 82. The heat source-side control unit 70 may further include another board. The housing space of the electric component unit 70 is sealed by the electric component casing 70a.

[0094] The electric component casing 70a includes a back surface 77, a top surface 75, a lower surface 76, a right side surface 74, a left side surface 73, a front lid 72, and a partition plate 71. The partition plate 71 extends upward, downward, and to the left and right so as to partition the interior of the electric component casing 70a into a front side and a rear side. The partition plate 71 is provided near the center of the interior of the electric component casing 70a in the front-rear direction. Accordingly, the interior of the electric component casing 70a is partitioned into a first space S1 on the back surface side with respect to the partition plate 71 and a second space S2 on the front surface side with respect to the partition plate 71. For example, the second space S2 may be partitioned into an upper space and a lower space by another partition plate.

[0095] The first board 81 and the second board 82 are all plate-shaped members extending vertically and horizontally, have a rectangular shape in a front view, and are fixed to the partition plate 71.

[0096] The first board 81 is provided with an intelligent power module (IPM, first electric component) 81a, which is an electric component for the inverter of the compressor 21 and is a heat generating component. The second board 82 is provided with an intelligent power module (IPM, second electric component) 82a, which is an electric component used for the heat source-side fan 24 and is a heat generating component. A calorific value of the IPM (first electric component) 81a is larger than a calorific value of the IPM (second electric component) 82a. The IPM 81a and the IPM 82a are both housed in the first space S1.

(4) Cooling by first refrigerant sub flow path

[0097] The first refrigerant sub flow path 46 cools the internal air of the electric component casing 70a, so that the IPM 81a and the IPM 82a are cooled by the air cooled by the first refrigerant sub flow path 46.

[0098] As shown in FIG. 5, the first space S1 of the heat source-side control unit 70 is cooled by the first cooling portion 47 of the first refrigerant sub flow path 46. The first cooling portion 47 of the first refrigerant sub flow path 46 is provided so as to be in thermal contact with the back surface side of the electric component casing 70a via a first heat transfer member 47a. The first heat transfer member 47a has a flat surface that extends parallel to the back surface 77 of the electric component casing 70a, and is used with the flat surface of the first heat transfer member 47a in surface contact with the back surface 77. The first cooling portion 47 extends from a lower end to an upper end on the back surface side of the electric component casing 70a, is then folded back with a U shape, and extends to the lower end.

[0099] In this manner, in the first space S1 of the heat source-side control unit 70, the first cooling portion 47 of the first refrigerant sub flow path 46 cools the internal air of the electric component casing 70a, so that the IPM 81a and the IPM 82a, which are heat generating components, are cooled.

(5) Cooling by second refrigerant sub flow path

[0100] The second cooling portion 67 of the second refrigerant sub flow path 66 is provided in thermal contact with a side of the partition plate 71 of the heat source-side control unit 70 facing the second space S2 with the second heat transfer member 67a interposed therebetween. The second heat transfer members 67a have a flat surface that extends in parallel to the partition plate 71, and are used in such a manner that the flat surface is in surface contact with the partition plate 71. The second cooling portion 67 extends from a lower end to an upper end on the front surface side of the electric component casing 70a, is then folded back with a U shape, and extends to the lower end.

[0101] The partition plate 71 of the heat source-side control unit 70 is cooled by the second cooling portion 67 of the second refrigerant sub flow path 66, so that the IPM 82a, which is a heat generating component provided on the back surface side of the partition plate 71, can be further cooled.

[0102] In a case where the IPM 82a is provided on the front surface side of the partition plate 71, the second cooling portion 67 of the second refrigerant sub flow path 66 may be provided to be in thermal contact from the back surface side of the partition plate 71 with the second heat transfer member 67a interposed therebetween.

(6) Cooling by fourth refrigerant sub flow path

[0103] The fourth cooling portion 62 of the fourth refrigerant sub flow path 61 is provided in thermal contact with a side of the partition plate 71 of the heat source-side control unit 70 facing the second space S2 with the fourth heat transfer member 62a interposed therebetween. The fourth heat transfer members 62a have a flat surface that extends in parallel to the partition plate 71, and are used in such a manner that the flat surface is in surface contact with the partition plate 71. The fourth cooling portion 62 extends from a lower end to an upper end on the front surface side of the electric component casing 70a, is then folded back with a U shape, and extends to the lower end.

[0104] The partition plate 71 of the heat source-side control unit 70 is cooled by the fourth cooling portion 62 of the fourth refrigerant sub flow path 61, so that the IPM (first electric component) 81a, which is a heat generating component provided on the back surface side of the partition plate 71, can be further cooled.

[0105] In a case where the IPM 81a is provided on the front surface side of the partition plate 71, the fourth cooling portion 62 of the fourth refrigerant sub flow path 61 may be provided to be in thermal contact from the back surface side of the partition plate 71 with the first heat transfer member 62a interposed therebetween.

(7) Characteristics

[0106] (7-1) The heat source unit 2 of the refrigeration cycle apparatus 1 according to the present embodiment includes the electric component unit 70, the heat source-side refrigerant main flow path 300, and the first refrigerant sub flow path 46. The heat source-side refrigerant main flow path 300 includes the accumulator 29, the compressor 21, the heat source-side heat exchanger 23, and the heat source-side expansion valve 25. The heat source-side refrigerant main flow path 300 is connected to the utilization-side refrigerant flow path 500 of the utilization units 3a and 3b to form the refrigerant circuit 10. The first refrigerant sub flow path 46 includes the first cooling portion 47 that cools the IPM 81a and the IPM 82a of the electric component unit 70. The first refrigerant sub flow path 46 branches from the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500 in the heat source-side refrigerant main flow path 300, and causes the refrigerant to flow in the gas flow path 310 between the accumulator 29 and the compressor 21 in the heat source-side refrigerant main flow path 300.

[0107] A cooling circuit for cooling a conventional electric component unit has one end connected to a liquid pipe and the other end connected to an upstream side of an accumulator. The use of R32 as the refrigerant has required a liquid injection circuit to be provided in order to suppress a rise of the discharge pipe temperature, which complicates the circuit and increases the cost.

[0108] In the refrigeration cycle apparatus 1, the first

refrigerant sub flow path 46 for cooling the electric component unit 70 has a liquid injection function, and the outlet of the first refrigerant sub flow path 46 is merged between the compressor 21 and the accumulator 29. This configuration can reduce the cost. When the R32 refrigerant is introduced into the accumulator 29, the injection effect is reduced. In the refrigeration cycle apparatus 1, liquid injection into the compressor 21 is directly performed, and thus, a decrease in the injection effect can be suppressed.

[0109] In the heat source unit 2 of the refrigeration cycle apparatus 1, the first refrigerant sub flow path 46 can be used for cooling the electric component unit 70, and can also cool a gas refrigerant sucked into the compressor 21.

[0110] (7-2) The heat source unit 2 of the refrigeration cycle apparatus 1 according to the present embodiment includes the first expansion valve 48 and the control unit 7. The first expansion valve 48 adjusts the flow rate of the refrigerant flowing through the first refrigerant sub flow path 46. The control unit 7 controls the opening degree of the first expansion valve 48 on the basis of the discharge temperature Td of the compressor 21.

[0111] The control unit 7 adopts the discharge temperature Td of the compressor 21 as a temperature substituting for a directly undetectable temperature of an internal port of the compressor 21. This configuration can secure necessary cooling capacity and protect the compressor 21.

[0112] In the heat source unit 2 of the refrigeration cycle apparatus 1, the opening degree of the first expansion valve 48 is increased to cool the gas refrigerant sucked into the compressor 21 when the discharge temperature Td of the compressor 21 rises, so that the discharge temperature Td of the compressor 21 can be lowered to protect the compressor 21.

[0113] (7-3) In the heat source unit 2 of the refrigeration cycle apparatus 1 according to the present embodiment, the housing space of the electric component unit 70 is sealed by the electric component casing 70a. The first refrigerant sub flow path 46 cools the housing space inside an electric component casing 70a.

[0114] In the heat source unit 2 of the refrigeration cycle apparatus 1, the discharge pipe temperature Td of the compressor 21 can be lowered, and the housing space for housing the electric component can be cooled with a smaller cooling amount than in a case of cooling the electric component.

[0115] (7-4) The heat source unit 2 of the refrigeration cycle apparatus 1 according to the present embodiment further includes the second refrigerant sub flow path 66. The second refrigerant sub flow path 66 includes the second cooling portion 67 and the second expansion valve 68. The second cooling portion 67 cools the second portion of the electric component unit 70. The second expansion valve 68 adjusts an amount of the refrigerant flowing through the second cooling portion 67. The second refrigerant sub flow path 66 connects the first heat

source-side liquid-refrigerant pipe 34a closer to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25 and the second heat source-side liquid-refrigerant pipe 34b opposite to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25. The first refrigerant sub flow path 46 branches from a position closer to the utilization-side refrigerant circuit 500 than a position opposite to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25 to which the second refrigerant sub flow path 66 is connected in the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500 in the heat source-side refrigerant main flow path 300.

[0116] In the heat source unit 2 of the refrigeration cycle apparatus 1, the first refrigerant sub flow path 46 branches from a position closer to the utilization-side refrigerant circuit 500 than the second refrigerant sub flow path 66 in the liquid flow path 340, so that the amount of refrigerant for cooling in the second refrigerant sub flow path 66 can be secured.

[0117] (7-5) The heat source unit 2 of the refrigeration cycle apparatus 1 according to the present embodiment further includes the fourth refrigerant sub flow path 61. The fourth refrigerant sub flow path 61 includes the fourth cooling portion 62 and the fourth expansion valve 64. The fourth cooling portion 62 cools the IPM 81a of the electric component unit 70. The fourth expansion valve 63 expands the refrigerant flowing through the fourth cooling portion 62. The fourth refrigerant sub flow path 61 branches from the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500 in the heat source-side refrigerant main flow path 300, and causes a refrigerant to flow in the gas flow path 310 on a suction side of the compressor 21 in the heat source-side refrigerant main flow path 300.

[0118] In a conventional cooling circuit, an electric component used for a fan and an electric component for an inverter of a compressor are cooled by a high-temperature and high-pressure liquid refrigerant. However, in the conventional cooling circuit, cooling capacity is insufficient particularly when a calorific value of an electric component unit such as the electric component for the inverter of the compressor increases.

[0119] In the heat source unit 2 of the refrigeration cycle apparatus 1, during an operation in which the heat source-side heat exchanger 23 that cools the refrigerant with outside air is used as a condenser, the fourth expansion valve 63 of the fourth refrigerant sub flow path 61 expands a high-temperature and high-pressure liquid refrigerant condensed by the heat source-side heat exchanger 23 to lower the temperature, the gas-liquid two-phase refrigerant takes heat from the electric component unit to evaporate, and returns the refrigerant to the gas flow path 310 on the suction side of the compressor 21. Therefore, the electric component unit 70 can be cooled

more strongly than a conventional case where the electric component unit 70 is cooled by a high-temperature and high-pressure liquid refrigerant.

[0120] (7-6) In the heat source unit of the refrigeration cycle apparatus 1 according to the present embodiment, the heat source-side refrigerant main flow path 300 further includes the subcooling heat exchanger 45. The subcooling heat exchanger 45 is disposed in the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500. The heat source unit 2 further includes the third refrigerant sub flow path 41. The third refrigerant sub flow path 41 branches from the liquid flow path 340. The third refrigerant sub flow path 41 has a third expansion valve 44 that expands the refrigerant flowing inside. The third refrigerant sub flow path 41 causes the subcooling heat exchanger 45 to exchange heat between the refrigerant having passed through the third expansion valve 44 and the refrigerant flowing through the liquid flow path 340 of the heat source-side refrigerant main flow path 300. The third refrigerant sub flow path 41 causes the refrigerant after the heat exchange to flow into the gas flow path on the suction side of the compressor 21 in the heat source-side refrigerant main flow path.

[0121] In the heat source unit of the refrigeration cycle apparatus 1, during an operation in which the heat source-side heat exchanger 23 that cools the refrigerant with outside air is used as a condenser, the high-temperature and high-pressure liquid refrigerant condensed by the heat source-side heat exchanger 23 is expanded by the third expansion valve 44 of the third refrigerant sub flow path 41 to reduce the temperature of the liquid refrigerant, and the refrigerant exchanges heat with the high-temperature and high-pressure liquid refrigerant, so that the high-temperature and high-pressure liquid refrigerant condensed by the heat source-side heat exchanger 23 can be cooled.

[0122] (7-7) In the heat source unit of refrigeration cycle apparatus 1 according to the present embodiment, the control unit 7 controls the opening degree of the second expansion valve 68 or the fourth expansion valve 63 on the basis of the temperature of the electric component unit 70.

[0123] In the heat source unit 2 of the refrigeration cycle apparatus 1, by controlling the opening degree of the second expansion valve 68 or the fourth expansion valve 63 on the basis of the temperature of the electric component unit 70, the temperature or the amount of refrigerant can be adjusted in accordance with the temperature of the electric component unit 70 to cool the electric component unit 70.

[0124] (7-8) In the heat source unit of the refrigeration cycle apparatus 1 according to the present embodiment, the electric component unit 70 includes the IPM 81a and the IPM 82a. The fourth refrigerant sub flow path 61 cools the IPM 81a.

[0125] In the heat source unit of the refrigeration cycle apparatus, the fourth refrigerant sub flow path 61 can cool

a specific electric component.

[0126] (7-9) In the heat source unit 2 of the refrigeration cycle apparatus 1 according to the present embodiment, the calorific value of the IPM 81a is larger than the calorific value of the IPM 82a.

[0127] In the heat source unit 2 of the refrigeration cycle apparatus 1, the IPM 81a having a large calorific value can be cooled by the fourth refrigerant sub flow path 61 that lowers the temperature of the high-temperature and high-pressure liquid refrigerant.

[0128] (7-10) In the heat source unit of the refrigeration cycle apparatus 1 according to the present embodiment, the fourth refrigerant sub flow path 61 branches off from a position closer to the utilization-side refrigerant flow path 500 than a position opposite to the heat source-side heat exchanger 23 with respect to the heat source-side expansion valve 25 to which the second refrigerant sub flow path 66 is connected, in the liquid flow path 340 extending from the heat source-side heat exchanger 23 to the utilization-side refrigerant flow path 500 of the heat source-side refrigerant main flow path 300.

[0129] In the heat source unit of the refrigeration cycle apparatus, the fourth refrigerant sub flow path 61 branches from a position closer to the utilization-side refrigerant flow path 500 than the second refrigerant sub flow path 66 in the liquid flow path 340, so that the amount of refrigerant for cooling in the second refrigerant sub flow path 66 can be secured.

[0130] (7-11) The refrigeration cycle apparatus 1 according to the present embodiment includes the heat source unit 2 and the utilization units 3a and 3b. The utilization units 3a and 3b are connected to the heat source unit 2.

[0131] In the refrigeration cycle apparatus 1, the first refrigerant sub flow path 46 can be used for cooling the electric component unit 70, and can also cool the gas refrigerant sucked into the compressor 21.

(8) Modifications

(8-1) Modification 1A

[0132] The refrigeration cycle apparatus 1 is not limited to an apparatus used for cooling and heating, and may be a cooling dedicated apparatus.

(8-2) Modification 1B

[0133] The control unit 7 may control the opening degree of the first expansion valve 48 on the basis of the discharge temperature T_d of the compressor and the temperature of the electric component unit 70. The internal air temperature sensor 64 may detect the internal air temperature T_a to detect the temperature of the electric component unit 70, or a sensor (not shown) that detects the air temperature in the space S1 of the electric component unit 70 may detect the temperature of the electric component unit 70.

[0134] In Modification 1B, the opening degree of the first expansion valve 48 is increased when the discharge pipe temperature Td of the compressor 21 rises and when the temperature of the electric component unit 70 rises, so that the gas refrigerant sucked into the compressor 21 can be cooled to lower the discharge temperature Td of the compressor 21, and the electric component unit 70 can be cooled.

(8-3) Modification 1C

[0135] In the present embodiment, a case has been described in which the first refrigerant sub flow path 46 cools the IPM 81a and the IPM 82a, the fourth cooling portion 62 of the fourth refrigerant sub flow path 61 cools the IPM 81a, and the second cooling portion 67 of the second refrigerant sub flow path 66 cools the IPM 82a. The fourth cooling portion 62 of the fourth refrigerant sub flow path 61 may cool the IPM 81a and the IPM 82a.

[0136] (8-4) While the embodiment of the present disclosure has been described above, it will be understood that various changes in forms and details can be made without departing from the gist and scope of the present disclosure recited in the claims.

REFERENCE SIGNS LIST

[0137]

1	Refrigeration cycle apparatus	50
2	Heat source unit	
3a, 3b	Utilization unit	
5	Liquid-refrigerant connection pipe	
6	Gas-refrigerant connection pipe	
7	Control unit	35
10	Refrigerant circuit	
11	Heat source unit casing	
21	Compressor	
23	Heat source-side heat exchanger	
24	Heat source-side fan	40
25	Heat source-side expansion valve (heat source-side main expansion mechanism)	
29	Accumulator	
34a, 34b	Liquid pipe	
41	Third refrigerant sub flow path	45
44	Third expansion valve (third flow rate adjustment mechanism)	
45	Subcooling heat exchanger (refrigerant cooler)	
46	First refrigerant sub flow path	50
47	First cooling portion	
48	First expansion valve (first flow rate adjustment mechanism)	
61	Fourth refrigerant sub flow path	
62	Fourth cooling portion	55
63	Fourth expansion valve (fourth flow rate adjustment mechanism)	
66	Second refrigerant sub flow path	

67	Second cooling portion
68	Second expansion valve (second flow rate adjustment mechanism)
70	Heat source-side control unit (electric component unit)
70a	Electric component casing (housing)
81	First board
81a	IPM (first electric component)
82	Second board
82a	IPM (second electric component)
300	Heat source-side refrigerant main flow path
310	Gas flow path
340	Liquid flow path
500	Utilization-side refrigerant flow path

CITATION LIST

PATENT LITERATURE

[0138] Patent Literature 1: JP 2022-146443 A

Claims

- 25 **1.** A heat source unit (2) of a refrigeration cycle apparatus, the heat source unit comprising:
 - an electric component unit (70);
 - a heat source-side refrigerant main flow path (300) that includes an accumulator (29), a compressor (21), a heat source-side heat exchanger (23), and a heat source-side main expansion mechanism (25), and is connected to a utilization-side refrigerant flow path (500) of a utilization unit (3a, 3b) to form a refrigerant circuit (10); and
 - a first refrigerant sub flow path (46) including a first cooling portion (47) that cools a first portion of the electric component unit and a second portion of the electric component unit, wherein the first refrigerant sub flow path branches from a liquid flow path (340) extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path in the heat source-side refrigerant main flow path, and causes a refrigerant to flow in a gas flow path (310) between the accumulator and the compressor in the heat source-side refrigerant main flow path.
- 50 **2.** The heat source unit of the refrigeration cycle apparatus according to claim 1, the heat source unit further comprising:
 - a first flow rate adjustment mechanism (48) that adjusts a flow rate of the refrigerant flowing through the first refrigerant sub flow path; and
 - a control unit (7), wherein the control unit controls an opening degree of

the first flow rate adjustment mechanism on a basis of a discharge pipe temperature (T_d) of the compressor.

3. The heat source unit of the refrigeration cycle apparatus according to claim 2, wherein the control unit controls the opening degree of the first flow rate adjustment mechanism on a basis of the discharge pipe temperature of the compressor and a temperature of the electric component unit. 5
4. The heat source unit of the refrigeration cycle apparatus according to any one of claims 1 to 3, wherein
 - a housing space of the electric component unit is sealed by a housing (70a), and 15
 - the first refrigerant sub flow path cools the housing space inside the housing.
5. The heat source unit of the refrigeration cycle apparatus according to any one of claims 2 to 4, the heat source unit further comprising: 20
 - a second refrigerant sub flow path (66) including a second cooling portion (67) that cools a second portion of the electric component unit, and a second flow rate adjustment mechanism (68) that adjusts an amount of the refrigerant flowing through the second cooling portion, wherein 25
 - the second refrigerant sub flow path connects a liquid pipe (34a) closer to the heat source-side heat exchanger with respect to the heat source-side main expansion mechanism and a liquid pipe (34b) opposite to the heat source-side heat exchanger with respect to the heat source-side main expansion mechanism, 30
 - the first refrigerant sub flow path branches from a position closer to the utilization-side refrigerant circuit than a position opposite to the heat source-side heat exchanger with respect to the heat source-side main expansion mechanism to which the second refrigerant sub flow path is connected in the liquid flow path extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path in the heat source-side refrigerant main flow path. 35
6. The heat source unit of the refrigeration cycle apparatus according to claim 5, the heat source unit further comprising 40
 - a fourth refrigerant sub flow path (61) including a fourth cooling portion (62) that cools the first portion of the electric component unit, and a fourth flow rate adjustment mechanism (63) that expands the refrigerant flowing through the fourth cooling portion, wherein 45

the fourth refrigerant sub flow path branches from the liquid flow path extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path in the heat source-side refrigerant main flow path, and causes the refrigerant to flow to a gas flow path on a suction side of the compressor in the heat source-side refrigerant main flow path.

7. The heat source unit of the refrigeration cycle apparatus according to claim 6, wherein
 - the heat source-side refrigerant main flow path further includes a subcooling heat exchanger (45) disposed in the liquid flow path extending from the heat source-side heat exchanger to the utilization-side refrigerant flow path, 50
 - the heat source unit further includes a third refrigerant sub flow path (41) branching from the liquid flow path, and
 - the third refrigerant sub flow path includes a third flow rate adjustment mechanism (44) that expands the refrigerant flowing inside, causes the subcooling heat exchanger to exchange heat between the refrigerant having passed through the third flow rate adjustment mechanism and the refrigerant flowing through the liquid flow path of the heat source-side refrigerant main flow path, and causes the refrigerant after heat exchange to flow into the gas flow path on the suction side of the compressor in the heat source-side refrigerant main flow path.
8. The heat source unit of the refrigeration cycle apparatus according to claim 6 or 7, wherein the control unit controls an opening degree of the second flow rate adjustment mechanism or the fourth flow rate adjustment mechanism on a basis of the temperature of the electric component unit. 55
9. The heat source unit of the refrigeration cycle apparatus according to any one of claims 6 to 8, wherein
 - the electric component unit includes a first electric component (81a) and a second electric component (82a), 60
 - the fourth refrigerant sub flow path cools the first electric component.
10. The heat source unit of the refrigeration cycle apparatus according to claim 9, wherein a calorific value of the first electric component is larger than a calorific value of the second electric component. 65
11. The heat source unit of the refrigeration cycle apparatus according to any one of claims 6 to 10, wherein

the fourth refrigerant sub flow path
branches from a position closer to the utilization-
side refrigerant flow path than a position oppo-
site to the heat source-side heat exchanger with
respect to the heat source-side main expansion 5
mechanism to which the second refrigerant sub
flow path is connected in the liquid flow path
extending from the heat source-side heat ex-
changer to the utilization-side refrigerant flow
path in the heat source-side refrigerant main 10
flow path.

12. A refrigeration cycle apparatus (1) comprising:

the heat source unit (2) according to any one of 15
claims 1 to 11; and
one or more of the utilization units (3a, 3b) con-
nected to the heat source unit.

20

25

30

35

40

45

50

55

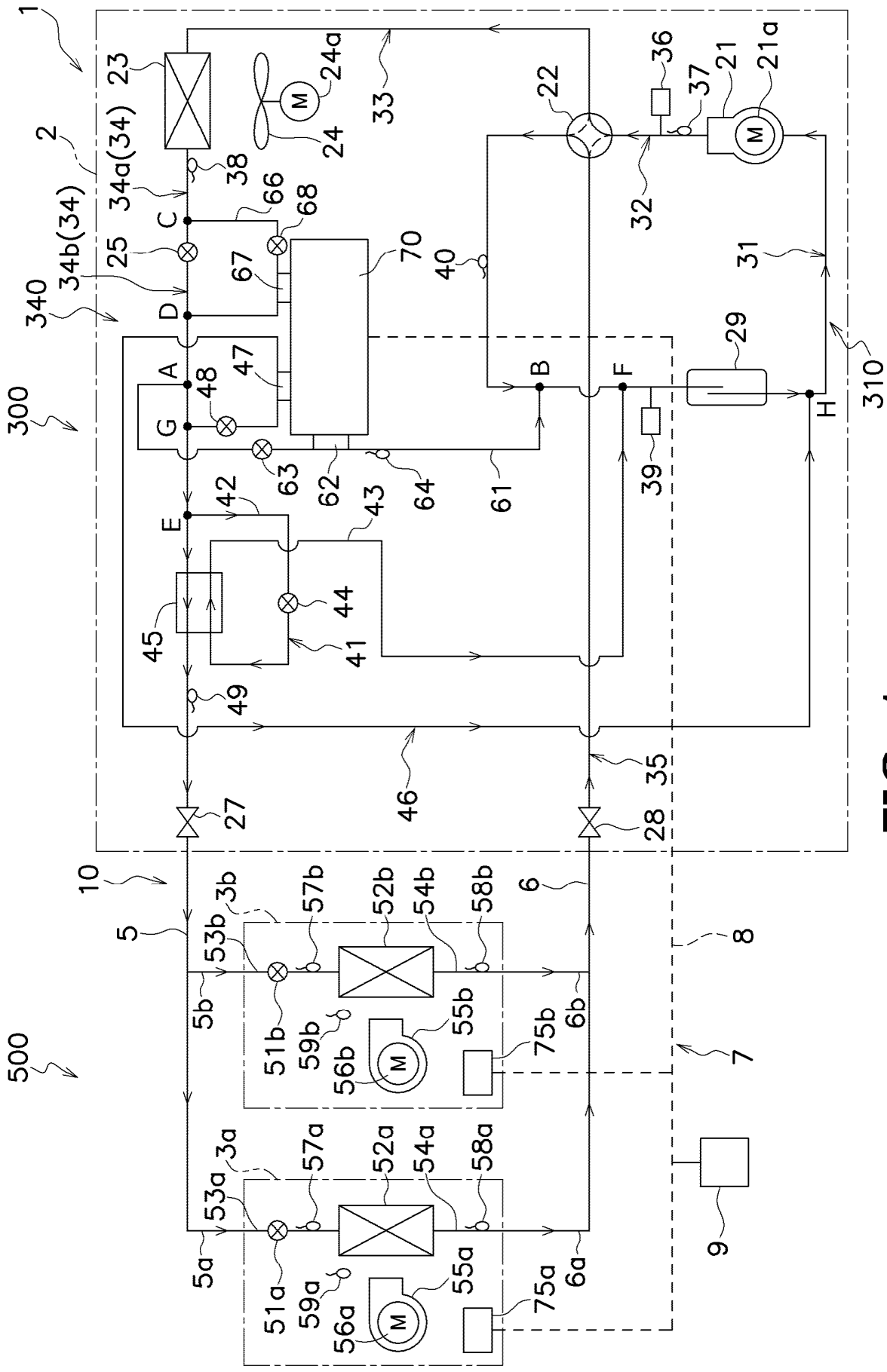


FIG. 1

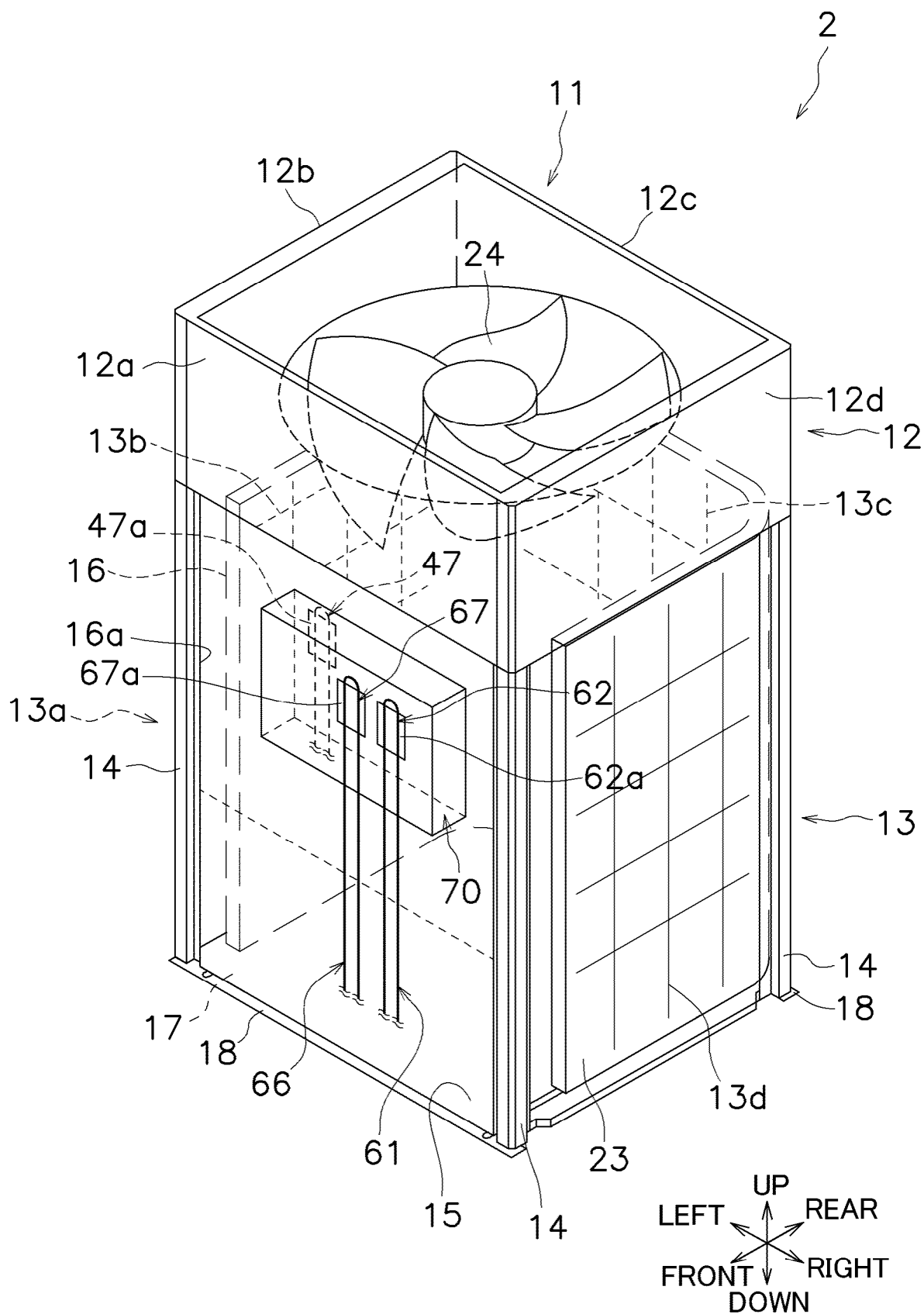


FIG. 2

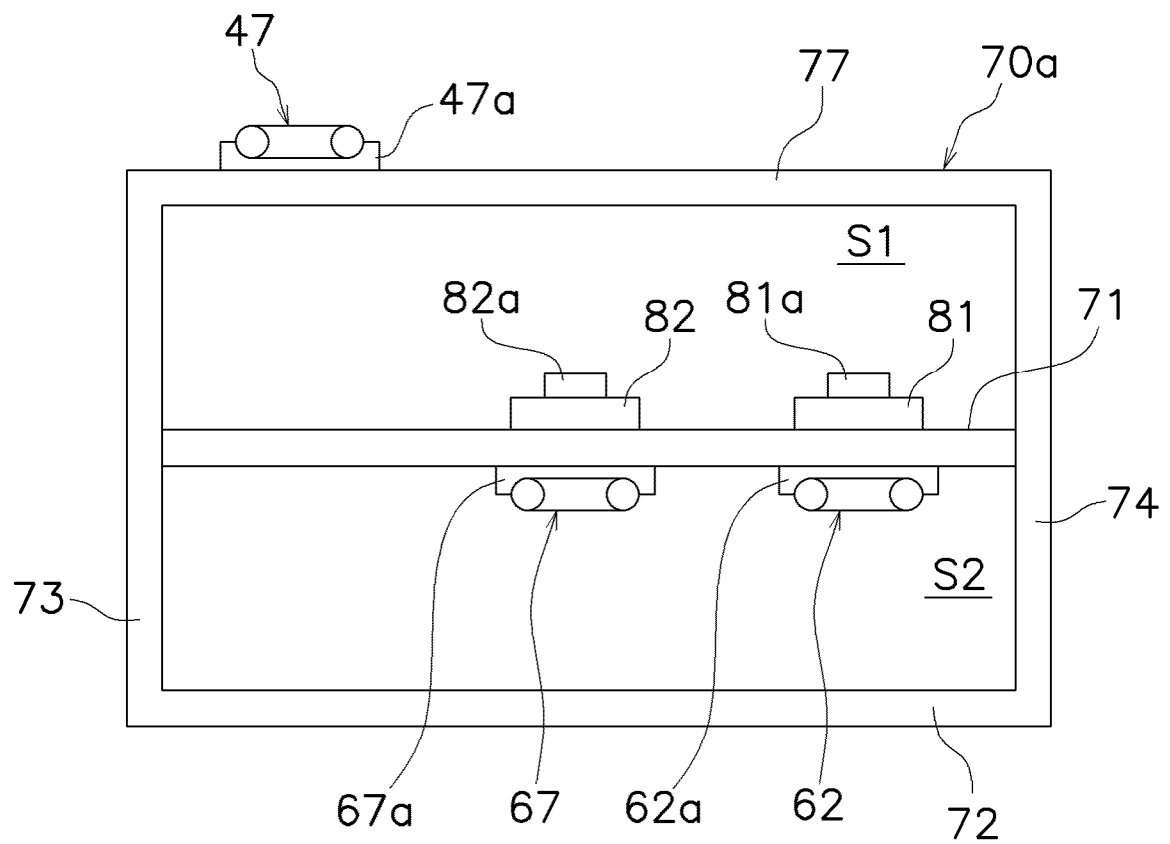


FIG. 3

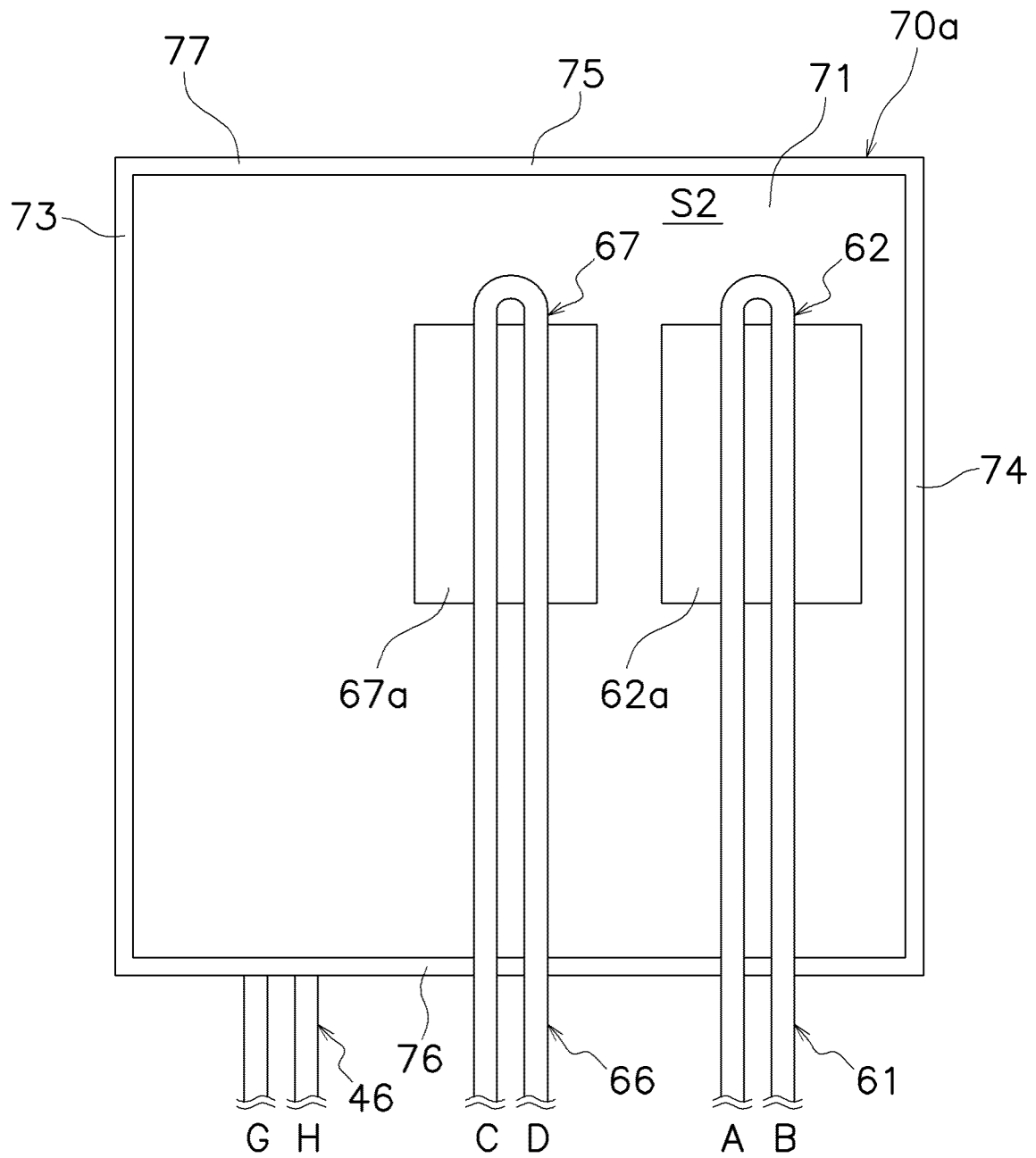


FIG. 4

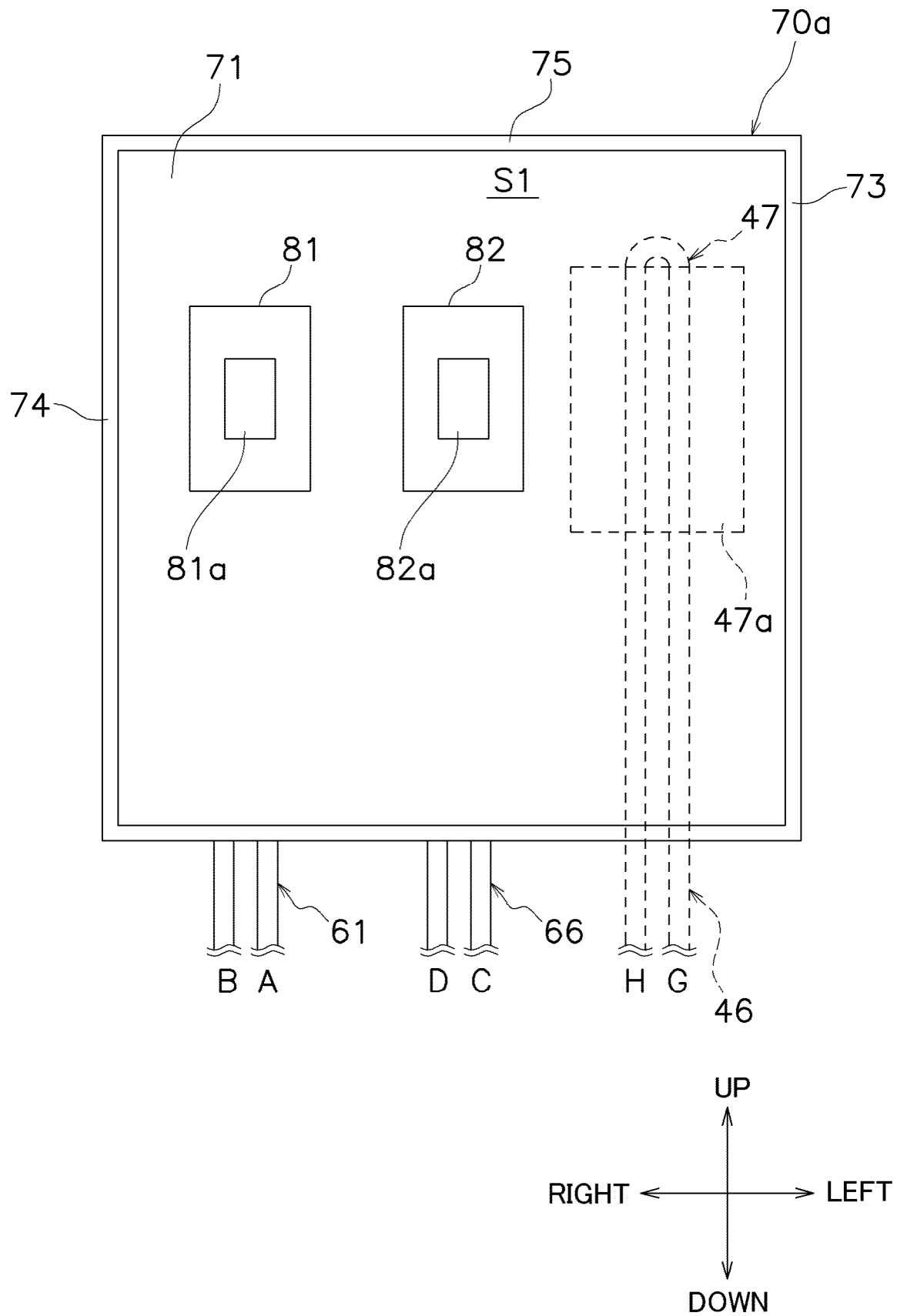


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2025/022651

A. CLASSIFICATION OF SUBJECT MATTER*F24F 1/24*(2011.01)i; *F25B 1/00*(2006.01)i

FI: F24F1/24; F25B1/00 304P; F25B1/00 321L; F25B1/00 331E

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)

F24F1/24; F25B1/00

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 1971-2025

Registered utility model specifications of Japan 1996-2025

Published registered utility model applications of Japan 1994-2025

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 7224503 B2 (MITSUBISHI ELECTRIC CORPORATION) 17 February 2023 (2023-02-17) paragraphs [0009]-[0074], fig. 1-10	1, 4, 12
A		2-3, 5-11
Y	JP 2014-89024 A (DAIKIN INDUSTRIES, LTD.) 15 May 2014 (2014-05-15) paragraphs [0030]-[0031], fig. 1-2	1, 4, 12
Y	JP 5-157372 A (MITSUBISHI ELECTRIC CORPORATION) 22 June 1993 (1993-06-22) paragraph [0029], fig. 1	1, 4, 12
Y	JP 2022-146443 A (DAIKIN INDUSTRIES, LTD.) 05 October 2022 (2022-10-05) paragraph [0049], fig. 3	4, 12

☐ 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

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“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

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“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

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

“&” document member of the same patent family

Date of the actual completion of the international search

26 August 2025

Date of mailing of the international search report

09 September 2025

Name and mailing address of the ISA/JP

Japan Patent Office (ISA/JP)

3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915

Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2025/022651

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 7224503 B2	17 February 2023	US 2022/0412622 A1 paragraphs [0018]-[0086], fig. 1-10 WO 2021/156901 A1 EP 4102153 A1	
JP 2014-89024 A	15 May 2014	(Family: none)	
JP 5-157372 A	22 June 1993	(Family: none)	
JP 2022-146443 A	05 October 2022	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2022146443 A [0002] [0138]