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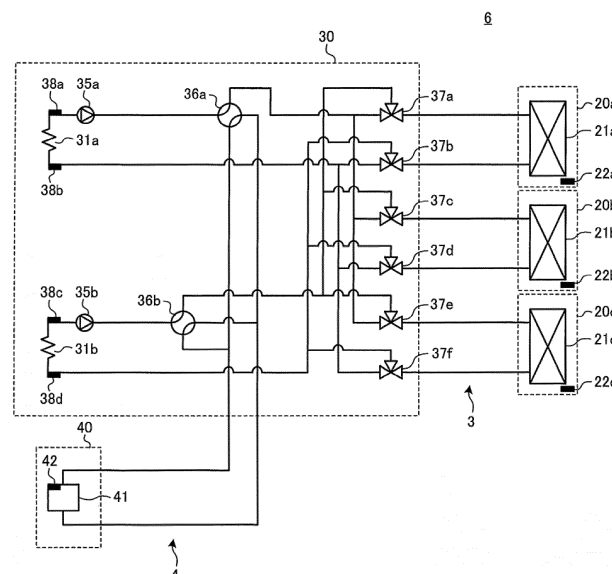
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(54) **AIR CONDITIONER**

(57) In an air-conditioning apparatus, which includes a refrigerant cycle circuit and a heat medium cycle circuit, a first intermediate heat exchanger exchanges heat between refrigerant and a heat medium. The air-conditioning apparatus includes a heat storage reservoir including a heat storage tank that stores the heat medium. The

heat medium cycle circuit includes a heat medium flow switching device that switches a passage to connect the heat storage reservoir to the heat medium cycle circuit and allow the heat medium to flow into and from the heat storage tank.

FIG. 3



Description

Technical Field

[0001] The present invention relates to an air-conditioning apparatus, and particularly to an air-conditioning apparatus applicable to an apparatus such as a multi-air-conditioning apparatus for a building.

Background Art

[0002] An existing air-conditioning apparatus, such as a multi-air-conditioning apparatus for a building, circulates refrigerant between an outdoor unit, which is a heat source unit disposed outdoors such as on the rooftop of a building, for example, and an indoor unit disposed in a space such as a room in a building, to thereby convey cooling energy or heating energy into the room to perform a cooling operation or a heating operation.

[0003] For example, hydrofluorocarbon (HFC) refrigerant is widely used as the refrigerant for use in such an air-conditioning apparatus. Further, an air-conditioning apparatus using natural refrigerant such as carbon dioxide (CO₂) has also been proposed.

[0004] The existing air-conditioning apparatus circulating the HFC refrigerant, however, conveys the refrigerant into the indoor unit to use the refrigerant, and thus has an issue in that the refrigerant may leak in the space such as the room and degrade the environment in the room.

[0005] Further, an air-conditioning apparatus called a chiller generates cooling energy or heating energy in a heat source unit disposed outside a building. The air-conditioning apparatus further heats or cools a heat medium, such as water or antifreeze, in a heat exchanger disposed in an outdoor unit, and conveys the heat medium to a device such as a fan coil unit or a panel heater, which serves as an indoor unit, to perform cooling or heating.

[0006] In the air-conditioning apparatus such as the chiller, the refrigerant is circulated only through the heat source unit disposed outdoors, and does not pass through the indoor unit. This air-conditioning apparatus therefore does not have the issue of refrigerant leakage into a room, which occurs in the existing air-conditioning apparatus that circulates the HFC refrigerant.

[0007] This air-conditioning apparatus, however, needs to heat or cool the heat medium, such as water or antifreeze, in the heat source unit outside the building and convey the heat medium into the indoor unit. If a circulation passage is extended therefor, the power for conveying the heat medium is substantially increased, causing an issue of difficulty in achieving energy saving.

[0008] As a method of addressing these issues, an air-conditioning apparatus has been proposed and practically used which includes an intermediate heat exchanger that exchanges heat between refrigerant and a heat medium different from the refrigerant and safe even in the event of leakage thereof in a room, and in which a

heat source unit and the intermediate heat exchanger form a refrigerant cycle circuit, and the intermediate heat exchanger and an indoor unit form a heat medium cycle circuit (see Patent Literature 1 and Patent Literature 2, for example).

[0009] Such an air-conditioning apparatus conveys the heat medium into the indoor unit disposed in a space such as a room, and thus is capable of preventing the refrigerant leakage into the space such as a room. The air-conditioning apparatus further enables the circulation passage of the heat medium to be shorter than that of the chiller, and thus is capable of achieving energy saving.

Citation List

Patent Literature

[0010]

Patent Literature 1: International Publication No. 2010/049998

Patent Literature 2: International Publication No. 2011/030429

Summary of Invention

Technical Problem

[0011] The air-conditioning apparatus described in Patent Literature 1 exchanges heat between the refrigerant in a refrigeration cycle and the air in the room via the heat medium and the intermediate heat exchanger, and thereby is capable of ensuring sufficient performance as compared with the performance of the chiller.

[0012] As compared with a normal direct-expansion air-conditioning apparatus, however, the air-conditioning apparatus described in Patent Literature 1 has an issue of degraded air-conditioning performance due to an increase in the number of heat exchanges and the difference in energy consumption of the conveyance of the heat medium from the conveyance of the refrigerant.

[0013] Further, the air-conditioning apparatus described in Patent Literature 2 includes a plurality of intermediate heat exchangers. In a cooling only operation mode in which the operation mode is cooling in all of a plurality of indoor units, or in a heating only operation mode in which the operation mode is heating in all of the plurality of indoor units, the air-conditioning apparatus switches the refrigerant cycle circuit to cause all of the intermediate heat exchangers to perform heat exchange according to cooling or heating, and thereby is capable of increasing the heat exchange efficiency.

[0014] In a cooling and heating mixed operation mode in which the indoor units have different operation modes, however, it is necessary to divide the plurality of intermediate heat exchangers into intermediate heat exchangers for cooling and intermediate heat exchangers for heating,

thereby causing an issue of difficulty in sufficiently increasing the heat exchange efficiency.

[0015] The present invention has therefore been made in view of the above-described issues of the existing techniques, and aims to provide an air-conditioning apparatus including an intermediate heat exchanger, a refrigerant cycle circuit, and a heat medium cycle circuit, and capable of achieving improvement in air-conditioning performance and energy saving.

Solution to Problem

[0016] An air-conditioning apparatus according to an embodiment of the present invention includes a refrigerant cycle circuit, which has a compressor, a heat source-side heat exchanger, an expansion device, and a refrigerant-side passage of a first intermediate heat exchanger connected by a refrigerant pipe to circulate refrigerant through the refrigerant cycle circuit, a heat medium cycle circuit, which has a heat medium-side passage of the first intermediate heat exchanger and a use-side heat exchanger connected by a heat medium pipe to circulate a heat medium through the heat medium cycle circuit, and a heat storage reservoir, which includes a heat storage tank to store the heat medium. The first intermediate heat exchanger exchanges heat between the refrigerant and the heat medium. The heat medium cycle circuit includes a heat medium flow switching device configured to switch a passage to connect the heat storage reservoir to the heat medium cycle circuit and allow the heat medium to flow into and from the heat storage tank.

Advantageous Effects of Invention

[0017] As described above, according to the present invention, the air-conditioning apparatus including the refrigerant cycle circuit and the heat medium cycle circuit switches the passage to connect the heat storage reservoir to the heat medium cycle circuit and use the heat medium in the heat storage tank provided in the heat storage reservoir, thereby enabling improvement in air-conditioning performance and energy saving.

Brief Description of Drawings

[0018]

[Fig. 1] Fig. 1 is a schematic diagram illustrating an example of the configuration of an air-conditioning apparatus according to Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a schematic diagram illustrating an example of the circuit configuration of a refrigerant cycle circuit in the air-conditioning apparatus according to Embodiment 1 of the present invention.

[Fig. 3] Fig. 3 is a schematic diagram illustrating an example of the circuit configuration of a heat medium cycle circuit in the air-conditioning apparatus accord-

ing to Embodiment 1 of the present invention.

[Fig. 4] Fig. 4 is a schematic diagram for illustrating a flow passage of refrigerant in the refrigerant cycle circuit of Fig. 2 in a cooling only operation mode.

[Fig. 5] Fig. 5 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 2 in a heating only operation mode.

[Fig. 6] Fig. 6 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 2 in a cooling main operation mode.

[Fig. 7] Fig. 7 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 2 in a heating main operation mode.

[Fig. 8] Fig. 8 is a schematic diagram for illustrating flow passages of a heat medium in the heat medium cycle circuit of Fig. 3 when a heat storage reservoir is not used.

[Fig. 9] Fig. 9 is a schematic diagram for illustrating flow passages of the heat medium in the heat medium cycle circuit of Fig. 3 when the heat storage reservoir is used.

[Fig. 10] Fig. 10 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir in the heat medium cycle circuit of Fig. 3 in a cooling operation.

[Fig. 11] Fig. 11 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir in the heat medium cycle circuit of Fig. 3 in a heating operation.

[Fig. 12] Fig. 12 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir in the heat medium cycle circuit of Fig. 3 at the end of the cooling operation.

[Fig. 13] Fig. 13 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir in the heat medium cycle circuit of Fig. 3 at the end of the heating operation.

[Fig. 14] Fig. 14 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir in the heat medium cycle circuit of Fig. 3 in a defrosting operation.

[Fig. 15] Fig. 15 is a schematic diagram illustrating an example of the configuration of an air-conditioning apparatus according to Embodiment 2 of the present invention.

[Fig. 16] Fig. 16 is a schematic diagram illustrating an example of the circuit configuration of a refrigerant cycle circuit in the air-conditioning apparatus according to Embodiment 2 of the present invention.

[Fig. 17] Fig. 17 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 16 in cooling energy storage in

the cooling only operation mode.

[Fig. 18] Fig. 18 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 16 in heating energy storage in the cooling only operation mode.

[Fig. 19] Fig. 19 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 16 in the cooling energy storage in the heating only operation mode.

[Fig. 20] Fig. 20 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 16 in the heating energy storage in the heating only operation mode.

[Fig. 21] Fig. 21 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 16 in the cooling energy storage in the cooling main operation mode.

[Fig. 22] Fig. 22 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 16 in the heating energy storage in the cooling main operation mode.

[Fig. 23] Fig. 23 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 16 in the cooling energy storage in the heating main operation mode.

[Fig. 24] Fig. 24 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit of Fig. 16 in the heating energy storage in the heating main operation mode.

Description of Embodiments

Embodiment 1

[0019] An air-conditioning apparatus according to Embodiment 1 of the present invention will be described below.

[0020] Fig. 1 is a schematic diagram illustrating an example of the configuration of an air-conditioning apparatus 1 according to Embodiment 1 of the present invention.

[0021] As illustrated in Fig. 1, the air-conditioning apparatus 1 is formed of an outdoor unit 10 serving as a heat source unit, a plurality of indoor units 20, an intermediate heat exchanger 30, a heat storage reservoir 40, and a controller 50. The example of Fig. 1 illustrates a case in which the air-conditioning apparatus 1 includes two indoor units 20. However, the configuration is not limited thereto, and the air-conditioning apparatus 1 may include three or more indoor units 20, for example.

[0022] The outdoor unit 10 is connected to a refrigerant-side passage of the intermediate heat exchanger 30 by two refrigerant pipes 2 through which refrigerant flows. Further, the outdoor unit 10, the intermediate heat exchanger 30, and the refrigerant pipes 2 form a refrigerant cycle circuit 5.

[0023] Further, each of the plurality of indoor units 20 is connected to a heat medium-side passage of the intermediate heat exchanger 30 by two heat medium pipes

3 through which a heat medium flows. Further, the heat storage reservoir 40 is connected to the heat medium-side passage of the intermediate heat exchanger 30 by two heat medium pipes 4 through which the heat medium flows. Further, the plurality of indoor units 20, the intermediate heat exchanger 30, the heat storage reservoir 40, and the heat medium pipes 3 and 4 form a heat medium cycle circuit 6.

[Circuit Configuration of Refrigerant Cycle Circuit]

[0024] Fig. 2 is a schematic diagram illustrating an example of the circuit configuration of the refrigerant cycle circuit 5 in the air-conditioning apparatus 1 according to Embodiment 1 of the present invention.

[0025] As described above, the refrigerant cycle circuit 5 is formed of the outdoor unit 10, the intermediate heat exchanger 30, and the refrigerant pipes 2.

[0026] The intermediate heat exchanger 30 includes parts related to the refrigerant cycle circuit 5 and parts related to the heat medium cycle circuit 6. In the intermediate heat exchanger 30 illustrated in Fig. 2, only the parts related to the refrigerant cycle circuit 5 will be illustrated and described.

[Outdoor Unit]

[0027] The outdoor unit 10 is formed of a compressor 11, a first refrigerant flow switching device 12, a heat source-side heat exchanger 13, and four check valves 14a to 14d.

[0028] The compressor 11 suctions low-temperature, low-pressure refrigerant, compresses the refrigerant, and discharges the refrigerant as high-temperature, high-pressure gas refrigerant. For example, the compressor 11 may be a compressor such as an inverter compressor, the driving frequency of which is changed as desired to enable control of the capacity of the inverter compressor, which corresponds to the amount of refrigerant sent out per unit time by the inverter compressor.

[0029] The first refrigerant flow switching device 12 switches the flow direction of the refrigerant to switch between a cooling operation and a heating operation. Fig. 2 illustrates the first refrigerant flow switching device 12 in the heating operation. The first refrigerant flow switching device 12 may use a four-way valve, for example, or may use a four-way valve in combination with another valve.

[0030] The heat source-side heat exchanger 13 exchanges heat between the refrigerant and air supplied by a not-illustrated, heat source-side air-sending device such as a fan (hereinafter referred to as the "outdoor air" as appropriate).

[0031] Specifically, in the cooling operation and a defrosting operation, the heat source-side heat exchanger 13 functions as a condenser that transfers the heat of the refrigerant to the outdoor air to condense the refrigerant. Further, in the heating operation, the heat source-

side heat exchanger 13 functions as an evaporator that evaporates the refrigerant to cool the outdoor air with evaporation heat generated in the evaporation.

[0032] The check valves 14a to 14d allow the refrigerant flowing through the refrigerant pipes 2 to flow only in a predetermined direction.

[0033] The check valve 14a is provided to the refrigerant pipe 2 between the intermediate heat exchanger 30 and the first refrigerant flow switching device 12 to allow the refrigerant to flow from the intermediate heat exchanger 30 toward the outdoor unit 10 in the cooling operation including a cooling only operation and a cooling main operation, which will be described later.

[0034] The check valve 14b is provided to a first connecting pipe 2a connecting the two refrigerant pipes 2 to allow the refrigerant returning from the intermediate heat exchanger 30 in the heating operation including a heating only operation and a heating main operation to flow into a suction side of the compressor 11.

[0035] The check valve 14c is provided to a second connecting pipe 2b connecting the two refrigerant pipes 2 to allow the refrigerant discharged from the compressor 11 in the heating operation to flow into the intermediate heat exchanger 30.

[0036] The check valve 14d is provided to the refrigerant pipe 2 between the heat source-side heat exchanger 13 and the intermediate heat exchanger 30 to allow the refrigerant to flow from the outdoor unit 10 toward the intermediate heat exchanger 30 in the cooling operation.

[Intermediate Heat Exchanger (Refrigerant Cycle Circuit Side)]

[0037] The intermediate heat exchanger 30 is formed of two first intermediate heat exchangers 31a and 31b, two expansion devices 32a and 32b, two opening and closing devices 33a and 33b, and two second refrigerant flow switching devices 34a and 34b.

[0038] Each of the first intermediate heat exchangers 31a and 31b functions as a condenser or an evaporator to exchange heat between the refrigerant flowing through the refrigerant cycle circuit 5 and the heat medium flowing through the heat medium cycle circuit 6.

[0039] The first intermediate heat exchanger 31a is provided between the expansion device 32a and the second refrigerant flow switching device 34a. Further, the first intermediate heat exchanger 31b is provided between the expansion device 32b and the second refrigerant flow switching device 34b.

[0040] Each of the expansion devices 32a and 32b functions as an expansion valve that reduces the pressure of the refrigerant flowing through the refrigerant cycle circuit 5 to expand the refrigerant. Each of the expansion devices 32a and 32b is formed of a valve having a controllable opening degree, such as an electronic expansion valve, for example.

[0041] The expansion device 32a is provided on the upstream side of the first intermediate heat exchanger

31a in the flow of the refrigerant in the cooling only operation mode. Further, the expansion device 32b is provided on the upstream side of the first intermediate heat exchanger 31b in the flow of the refrigerant in the cooling only operation mode.

[0042] Each of the opening and closing devices 33a and 33b, which is a two-way valve, for example, opens or closes the corresponding refrigerant pipe 2.

[0043] The opening and closing device 33a is provided to the refrigerant pipe 2 on a refrigerant inlet side of the intermediate heat exchanger 30. Further, the opening and closing device 33b is provided to a pipe connecting the refrigerant pipe 2 on the refrigerant inlet side of the intermediate heat exchanger 30 and the refrigerant pipe 2 on a refrigerant outlet side of the intermediate heat exchanger 30.

[0044] The second refrigerant flow switching devices 34a and 34b switch the flow direction of the refrigerant in accordance with the operation mode. Fig. 2 illustrates the second refrigerant flow switching devices 34a and 34b in the heating operation. Each of the second refrigerant flow switching devices 34a and 34b may use a four-way valve, for example, or may use a four-way valve in combination with another valve.

[0045] The second refrigerant flow switching device 34a is provided on the downstream side of the first intermediate heat exchanger 31a in the flow of the refrigerant in the cooling only operation mode. Further, the second refrigerant flow switching device 34b is provided on the downstream side of the first intermediate heat exchanger 31b in the flow of the refrigerant in the cooling only operation mode.

[Circuit Configuration of Heat Medium Cycle Circuit]

[0046] Fig. 3 is a schematic diagram illustrating an example of the circuit configuration of the heat medium cycle circuit 6 in the air-conditioning apparatus 1 according to Embodiment 1 of the present invention.

[0047] As described above, the heat medium cycle circuit 6 is formed of the plurality of indoor units 20a to 20c, the intermediate heat exchanger 30, the heat storage reservoir 40, and the heat medium pipes 3 and 4.

[0048] In the intermediate heat exchanger 30 illustrated in Fig. 3, only the parts thereof related to the heat medium cycle circuit 6 will be illustrated and described. Further, in this example, a description will be given of a case in which the heat medium cycle circuit 6 includes the three indoor units 20a to 20c. However, the number of the indoor units 20 is not limited thereto, and may be two, or may be four or more, for example.

[Intermediate Heat Exchanger (Heat Medium Cycle Circuit Side)]

[0049] The intermediate heat exchanger 30 is configured to include the two first intermediate heat exchangers 31a and 31b, two pumps 35a and 35b, two first heat me-

dium flow switching devices 36a and 36b, six second heat medium flow switching devices 37a to 37f, and four heat medium temperature sensors 38a to 38d.

[0050] The pumps 35a and 35b are provided to circulate the heat medium flowing through at least one of the heat medium pipes 3 and the heat medium pipes 4. It is preferable to form each of the pumps 35a and 35b with a pump having a controllable capacity, for example, to make the flow rate thereof adjustable in accordance with the magnitude of the load of the indoor units 20.

[0051] The pump 35a is provided between the first intermediate heat exchanger 31a and the first heat medium flow switching device 36a. Further, the pump 35b is provided to the heat medium pipe 3 between the first intermediate heat exchanger 31b and the first heat medium flow switching device 36b.

[0052] The first heat medium flow switching devices 36a and 36b switch the flow direction of the heat medium in accordance with the usage state of the later-described heat storage reservoir 40. Fig. 3 illustrates the first heat medium flow switching devices 36a and 36b in a state in which the heat storage reservoir 40 is not used. Each of the first heat medium flow switching devices 36a and 36b may use a four-way valve, for example, or may use a four-way valve in combination with another valve.

[0053] The first heat medium flow switching device 36a is provided on the downstream side of the pump 35a. Further, the first heat medium flow switching device 36b is provided on the downstream side of the pump 35b.

[0054] Each of the second heat medium flow switching devices 37a to 37f, which is a three-way valve, for example, switches the flow direction of the heat medium. The number of the second heat medium flow switching devices 37a to 37f to be provided is set in accordance with the number of the indoor units 20 provided to the air-conditioning apparatus 1.

[0055] The second heat medium flow switching device 37a is provided to an inlet side of a heat medium passage of a use-side heat exchanger 21a provided to the later-described indoor unit 20a. One of three ports of the second heat medium flow switching device 37a is connected to the first heat medium flow switching device 36a. Another one of the three ports of the second heat medium flow switching device 37a is connected to the first heat medium flow switching device 36b. The remaining one of the three ports of the second heat medium flow switching device 37a is connected to the use-side heat exchanger 21a of the indoor unit 20a.

[0056] The second heat medium flow switching device 37b is provided to an outlet side of the heat medium passage of the use-side heat exchanger 21a in the indoor unit 20a. One of three ports of the second heat medium flow switching device 37b is connected to the first intermediate heat exchanger 31a. Another one of the three ports of the second heat medium flow switching device 37b is connected to the first intermediate heat exchanger 31b. The remaining one of the three ports of the second heat medium flow switching device 37b is connected to

the use-side heat exchanger 21a of the indoor unit 20a.

[0057] The second heat medium flow switching device 37c is provided to an inlet side of a heat medium passage of a use-side heat exchanger 21b provided to the later-described indoor unit 20b. One of three ports of the second heat medium flow switching device 37c is connected to the first heat medium flow switching device 36a. Another one of the three ports of the second heat medium flow switching device 37c is connected to the first heat medium flow switching device 36b. The remaining one of the three ports of the second heat medium flow switching device 37c is connected to the use-side heat exchanger 21b of the indoor unit 20b.

[0058] The second heat medium flow switching device 37d is provided to an outlet side of the heat medium passage of the use-side heat exchanger 21b in the indoor unit 20b. One of three ports of the second heat medium flow switching device 37d is connected to the first intermediate heat exchanger 31a. Another one of the three ports of the second heat medium flow switching device 37d is connected to the first intermediate heat exchanger 31b. The remaining one of the three ports of the second heat medium flow switching device 37d is connected to the use-side heat exchanger 21b of the indoor unit 20b.

[0059] The second heat medium flow switching device 37e is provided to an inlet side of a heat medium passage of a use-side heat exchanger 21c provided to the later-described indoor unit 20c. One of three ports of the second heat medium flow switching device 37e is connected to the first heat medium flow switching device 36a. Another one of the three ports of the second heat medium flow switching device 37e is connected to the first heat medium flow switching device 36b. The remaining one of the three ports of the second heat medium flow switching device 37e is connected to the use-side heat exchanger 21c of the indoor unit 20c.

[0060] The second heat medium flow switching device 37f is provided to an outlet side of the heat medium passage of the use-side heat exchanger 21c in the indoor unit 20c. One of three ports of the second heat medium flow switching device 37f is connected to the first intermediate heat exchanger 31a. Another one of the three ports of the second heat medium flow switching device 37f is connected to the first intermediate heat exchanger 31b. The remaining one of the three ports of the second heat medium flow switching device 37f is connected to the use-side heat exchanger 21c of the indoor unit 20c.

[0061] The heat medium temperature sensors 38a to 38d are provided to the heat medium pipes 3 on an inlet side and an outlet side of the first intermediate heat exchanger 31a and on an inlet side and an outlet side of the first intermediate heat exchanger 31b to detect the temperature of the heat medium. Each of the heat medium temperature sensors 38a to 38d may use a thermometer, for example.

[0062] The heat medium temperature sensor 38a is provided to the heat medium pipe 3 on the outlet side of the first intermediate heat exchanger 31a to detect the

temperature of the heat medium flowing from the first intermediate heat exchanger 31a.

[0063] The heat medium temperature sensor 38b is provided to the heat medium pipe 3 on the inlet side of the first intermediate heat exchanger 31a to detect the temperature of the heat medium flowing into the first intermediate heat exchanger 31a.

[0064] The heat medium temperature sensor 38c is provided to the heat medium pipe 3 on the outlet side of the first intermediate heat exchanger 31b to detect the temperature of the heat medium flowing from the first intermediate heat exchanger 31 b.

[0065] The heat medium temperature sensor 38d is provided to the heat medium pipe 3 on the inlet side of the first intermediate heat exchanger 31b to detect the temperature of the heat medium flowing into the first intermediate heat exchanger 31 b.

[0066] Temperature information obtained by these heat medium temperature sensors 38a to 38d is supplied to the later-described controller 50.

[Indoor Units]

[0067] The indoor units 20a to 20c cool or heat the air in an indoor space (hereinafter referred to as the "indoor air" as appropriate"), for example.

[0068] The indoor unit 20a is formed of the use-side heat exchanger 21a and an indoor temperature sensor 22a. The indoor unit 20b is formed of the use-side heat exchanger 21b and an indoor temperature sensor 22b. The indoor unit 20c is formed of the use-side heat exchanger 21c and an indoor temperature sensor 22c.

[0069] In the following description, the indoor units 20a to 20c will be simply referred to as the "indoor units 20" where distinction therebetween is not particularly necessary. Further, the use-side heat exchangers 21a to 21b will similarly be simply referred to as the "use-side heat exchangers 21." Further, the indoor temperature sensors 22a to 22c will similarly be simply referred to as the "indoor temperature sensors 22."

[0070] Each of the use-side heat exchangers 21 exchanges heat between the heat medium and the indoor air supplies by a not-illustrated, use-side air-sending device such as a fan. Thereby, heating air or cooling air to be supplied to the indoor space is produced.

[0071] When the heat medium is conveying cooling energy in the cooling operation, the use-side heat exchanger 21 functions as an evaporator to perform cooling by cooling the indoor air. Further, when the heat medium is conveying heating energy in the heating operation, the use-side heat exchanger 21 functions as a condenser to perform heating by heating the indoor air.

[0072] The indoor temperature sensors 22 are provided at respective predetermined positions with respect to the indoor units 20.

[0073] The indoor temperature sensor 22a is provided at a predetermined position of the indoor unit 20a to detect the temperature of an indoor space provided with

the indoor unit 20a. The indoor temperature sensor 22b is provided at a predetermined position of the indoor unit 20b to detect the temperature of an indoor space provided with the indoor unit 20b. The indoor temperature sensor 22c is provided at a predetermined position of the indoor unit 20c to detect the temperature of an indoor space provided with the indoor unit 20c.

[0074] Temperature information obtained as results of detection by the indoor temperature sensors 22a to 22c and indicating the temperatures of the indoor spaces is supplied to the controller 50.

[Heat Storage Reservoir]

[0075] The heat storage reservoir 40 is formed of a heat storage tank 41 and a tank temperature sensor 42.

[0076] The heat storage tank 41 stores the heat medium flowing through the heat medium pipes 4. With a material or mechanism of the heat storage tank 41, the heat storage tank 41 has a function of maintaining the temperature of the heat medium in the tank.

[0077] The tank temperature sensor 42 is provided in the heat storage tank 41 to detect the temperature of the heat medium in the heat storage tank 41. Temperature information obtained as a detection result and indicating the water temperature of the heat medium in the heat storage tank 41 is supplied to the controller 50.

[0078] The controller 50, which is formed of a micro-computer, for example, controls the entire air-conditioning apparatus 1.

[0079] For example, based on information such as detection results obtained by a variety of detecting units such as the temperature sensors, the controller 50 executes later-described operation modes by controlling, for example, the driving frequency of the compressor 11, the rotation speeds of the air-sending devices (including turn-on and turn-off thereof), the switching of the first refrigerant flow switching device 12, the opening degrees of the expansion devices 32a and 32b, the opening and closing of the opening and closing devices 33a and 33b, the switching of the second refrigerant flow switching devices 34a and 34b, the driving of the pumps 35a and 35b, the switching of the first heat medium flow switching devices 36a and 36b, and the switching of the second heat medium flow switching devices 37a to 37f.

[0080] The controller 50 may be provided to a predetermined device, such as the outdoor unit 10, or may be provided to each of the devices.

[Operation of Refrigerant Cycle Circuit]

[0081] A description will now be given of movements of the refrigerant in the refrigerant cycle circuit 5 of the air-conditioning apparatus 1 having the above-described configuration in the cooling only operation mode, the heating only operation mode, the cooling main operation mode, and the heating main operation mode.

[0082] The air-conditioning apparatus 1 is capable of

performing the cooling operation or the heating operation with the control of the controller 50 based on instructions from the indoor units 20. That is, the air-conditioning apparatus 1 is capable of operating all of the indoor units 20 in the same mode, and is also capable of operating the indoor units 20 in different modes from one another.

[0083] Herein, the operation mode in which all of the indoor units 20 perform the cooling operation will be referred to as the "cooling only operation mode," and the operation mode in which all of the indoor units 20 perform the heating operation will be referred to as the "heating only operation mode." Further, the operation mode in which the majority of the operations performed by all of the indoor units 20 is the cooling operation will be referred to as the "cooling main operation mode," and the operation mode in which the majority of the operations performed by all of the indoor units 20 is the heating operation will be referred to as the "heating main operation mode."

[Cooling Only Operation Mode]

[0084] Fig. 4 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 2 in the cooling only operation mode.

[0085] In Fig. 4, a passage indicated by a bold line is a refrigerant passage in the cooling only operation mode, and the flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0086] In the cooling only operation mode, the first refrigerant flow switching device 12 and the second refrigerant flow switching devices 34a and 34b are first switched as illustrated in Fig. 4. Further, the opening and closing device 33a is opened, and the opening and closing device 33b is closed.

[0087] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0088] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows into the heat source-side heat exchanger 13 via the first refrigerant flow switching device 12. The high-temperature, high-pressure gas refrigerant flowing into the heat source-side heat exchanger 13 condenses while exchanging heat with and transferring heat to the outdoor air, and flows from the heat source-side heat exchanger 13 as subcooled high-pressure liquid refrigerant.

[0089] The high-pressure liquid refrigerant flowing from the heat source-side heat exchanger 13 flows from the outdoor unit 10 via the check valve 14d, and flows into the intermediate heat exchanger 30.

[0090] The high-pressure liquid refrigerant flowing into the intermediate heat exchanger 30 flows into the expansion devices 32a and 32b via the opening and closing device 33a.

[0091] The high-pressure liquid refrigerant flowing into the expansion device 32a is reduced in pressure and expanded to turn into low-temperature, low-pressure,

two-phase gas-liquid refrigerant, and flows into the first intermediate heat exchanger 31a.

[0092] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31a as low-temperature, low-pressure gas refrigerant. The low-temperature, low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31a flows from the intermediate heat exchanger 30 via the second refrigerant flow switching device 34a, and flows into the outdoor unit 10.

[0093] Meanwhile, the high-pressure liquid refrigerant flowing into the expansion device 32b is reduced in pressure and expanded to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows into the first intermediate heat exchanger 31b.

[0094] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31b exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31b as low-temperature, low-pressure gas refrigerant.

[0095] The low-temperature, low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31b flows from the intermediate heat exchanger 30 via the second refrigerant flow switching device 34b, and flows into the outdoor unit 10.

[0096] The low-temperature, low-pressure gas refrigerant flowing into the outdoor unit 10 is suctioned into the compressor 11 via the check valve 14a and the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Heating Only Operation Mode]

[0097] Fig. 5 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 2 in the heating only operation mode.

[0098] In Fig. 5, a passage indicated by a bold line is a refrigerant passage in the heating only operation mode, and the flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0099] In the heating only operation mode, the first refrigerant flow switching device 12 and the second refrigerant flow switching devices 34a and 34b are first switched as illustrated in Fig. 5. Further, the opening and closing device 33a is closed, and the opening and closing device 33b is opened.

[0100] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0101] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows from the outdoor unit 10 via the first refrigerant flow switching device 12 and the check valve 14c provided to the second

connecting pipe 2b, and flows into the intermediate heat exchanger 30.

[0102] The high-temperature, high-pressure gas refrigerant flowing into the intermediate heat exchanger 30 flows into the first intermediate heat exchangers 31a and 31b via the second refrigerant flow switching devices 34a and 34b, respectively.

[0103] The high-temperature, high-pressure gas refrigerant flowing into the first intermediate heat exchanger 31a condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31a as subcooled high-pressure liquid refrigerant.

[0104] The high-pressure liquid refrigerant flowing from the first intermediate heat exchanger 31a is reduced in pressure and expanded by the expansion device 32a to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32a.

[0105] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32a flows from the intermediate heat exchanger 30 via the opening and closing device 33b, and flows into the outdoor unit 10.

[0106] Meanwhile, the high-temperature, high-pressure gas refrigerant flowing into the first intermediate heat exchanger 31b condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31b as subcooled high-pressure liquid refrigerant.

[0107] The high-pressure liquid refrigerant flowing from the first intermediate heat exchanger 31b is reduced in pressure and expanded by the expansion device 32b to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32b.

[0108] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32b flows from the intermediate heat exchanger 30 via the opening and closing device 33b, and flows into the outdoor unit 10.

[0109] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the outdoor unit 10 flows into the heat source-side heat exchanger 13 via the check valve 14b provided to the first connecting pipe 2a.

[0110] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the heat source-side heat exchanger 13 exchanges heat with and receives heat from the outdoor air to evaporate, and flows from the heat source-side heat exchanger 13 as low-temperature, low-pressure gas refrigerant.

[0111] The low-temperature, low-pressure gas refrigerant flowing from the heat source-side heat exchanger 13 is suctioned into the compressor 11 via the first refrigerant flow switching device 12. Thereafter, the above-

described cycle is repeated.

[Cooling Main Operation Mode]

[0112] Fig. 6 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 2 in the cooling main operation mode.

[0113] In Fig. 6, a passage indicated by a bold line is a refrigerant passage in the cooling main operation mode, and the flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0114] In the cooling main operation mode, the first refrigerant flow switching device 12 and the second refrigerant flow switching devices 34a and 34b are first switched as illustrated in Fig. 6. Further, the opening and closing devices 33a and 33b are closed.

[0115] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0116] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows into the heat source-side heat exchanger 13 via the first refrigerant flow switching device 12. The high-temperature, high-pressure gas refrigerant flowing into the heat source-side heat exchanger 13 condenses while exchanging heat with and transferring heat to the outdoor air, and flows from the heat source-side heat exchanger 13 as two-phase gas-liquid refrigerant.

[0117] The two-phase gas-liquid refrigerant flowing from the heat source-side heat exchanger 13 flows from the outdoor unit 10 via the check valve 14d, and flows into the intermediate heat exchanger 30.

[0118] The two-phase gas-liquid refrigerant flowing into the intermediate heat exchanger 30 flows into the first intermediate heat exchanger 31a via the second refrigerant flow switching device 34a.

[0119] The two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31a as liquid refrigerant.

[0120] The liquid refrigerant flowing from the first intermediate heat exchanger 31a is reduced in pressure and expanded by the expansion device 32a to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32a.

[0121] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32a flows into the first intermediate heat exchanger 31b via the expansion device 32b.

[0122] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31b exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31b as low-pressure gas refrigerant.

[0123] The low-pressure gas refrigerant flowing from

the first intermediate heat exchanger 31b flows into the outdoor unit 10 via the second refrigerant flow switching device 34b.

[0124] The low-pressure gas refrigerant flowing into the outdoor unit 10 is suctioned into the compressor 11 via the check valve 14a and the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[0125] In this example, the one first intermediate heat exchanger 31a heats the heat medium, and the other first intermediate heat exchanger 31b cools the heat medium. However, the operation is not limited to this example. For example, the second refrigerant flow switching devices 34a and 34b may be switched to cool the heat medium with the one first intermediate heat exchanger 31a and heat the heat medium with the other first intermediate heat exchanger 31b.

[Heating Main Operation Mode]

[0126] Fig. 7 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 2 in the heating main operation mode.

[0127] In Fig. 7, a passage indicated by a bold line is a refrigerant passage in the heating main operation mode, and the flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0128] In the heating main operation mode, the first refrigerant flow switching device 12 and the second refrigerant flow switching devices 34a and 34b are first switched as illustrated in Fig. 7. Further, the opening and closing devices 33a and 33b are closed.

[0129] Then, low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0130] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows from the outdoor unit 10 via the first refrigerant flow switching device 12 and the check valve 14c, and flows into the intermediate heat exchanger 30.

[0131] The high-temperature, high-pressure gas refrigerant flowing into the intermediate heat exchanger 30 flows into the first intermediate heat exchanger 31b via the second refrigerant flow switching device 34b.

[0132] The high-temperature, high-pressure gas refrigerant flowing into the first intermediate heat exchanger 31b condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31b as liquid refrigerant.

[0133] The liquid refrigerant flowing from the first intermediate heat exchanger 31b is reduced in pressure and expanded by the expansion device 32b to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32b.

[0134] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32b flows into the first intermediate heat exchanger 31a

via the expansion device 32a.

[0135] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31a.

[0136] The refrigerant flowing from the first intermediate heat exchanger 31a flows into the outdoor unit 10 via the second refrigerant flow switching device 34a.

[0137] The refrigerant flowing into the outdoor unit 10 flows into the heat source-side heat exchanger 13 via the check valve 14b.

[0138] The refrigerant flowing into the heat source-side heat exchanger 13 exchanges heat with and receives heat from the outdoor air to evaporate, and flows from the heat source-side heat exchanger 13 as low-temperature, low-pressure gas refrigerant.

[0139] The low-temperature, low-pressure gas refrigerant flowing from the heat source-side heat exchanger 13 is suctioned into the compressor 11 via the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[0140] In this example, the one first intermediate heat exchanger 31a cools the heat medium, and the other first intermediate heat exchanger 31b heats the heat medium. However, the operation is not limited to this example. For example, the second refrigerant flow switching devices 34a and 34b may be switched to heat the heat medium with the one first intermediate heat exchanger 31a and cool the heat medium with the other first intermediate heat exchanger 31b.

[Operation of Heat Medium Cycle Circuit]

[0141] A description will now be given of movements of the heat medium in the heat medium cycle circuit 6 of the air-conditioning apparatus 1.

[0142] The air-conditioning apparatus 1 is capable of performing an operation according to the usage state of the heat storage reservoir 40 with the control of the controller 50.

[When Heat Storage Reservoir Is Not Used]

[0143] Fig. 8 is a schematic diagram for illustrating flow passages of the heat medium in the heat medium cycle circuit 6 of Fig. 3 when the heat storage reservoir 40 is not used.

[0144] In Fig. 8, passages indicated by bold lines are heat medium passages when the heat storage reservoir 40 is not used, and the flow directions of the heat medium in the heat medium passages are indicated by arrows.

[0145] In this example, to avoid complication of description, illustration and description will be given only of the passage of the heat medium flowing between the first intermediate heat exchanger 31a and the use-side heat exchanger 21a and the passage of the heat medium flow-

ing between the first intermediate heat exchanger 31b and the use-side heat exchanger 21c.

[0146] The passages of the heat medium flowing through the first intermediate heat exchanger 31a include passages passing through the use-side heat exchangers 21b and 21c other than the passage of this example. Further, the passages of the heat medium flowing through the first intermediate heat exchanger 31b include passages passing through the use-side heat exchangers 21a and 21b other than the passage of this example.

[0147] When the heat storage reservoir 40 is not used, the first heat medium flow switching devices 36a and 36b are first switched as illustrated in Fig. 8. Then, the heat medium cooled or heated by the first intermediate heat exchanger 31a flows from the intermediate heat exchanger 30 via the pump 35a, the first heat medium flow switching device 36a, and the second heat medium flow switching device 37a.

[0148] The heat medium flowing from the intermediate heat exchanger 30 flows into the indoor unit 20a via the corresponding heat medium pipe 3, and flows into the use-side heat exchanger 21a. The heat medium flowing into the use-side heat exchanger 21a exchanges heat with the indoor air to receive heat from or transfer heat to the indoor air, cools or heats the indoor air, and flows from the use-side heat exchanger 21a. The heat medium flowing from the use-side heat exchanger 21a flows from the indoor unit 20a, and flows into the intermediate heat exchanger 30 via the corresponding heat medium pipe 3.

[0149] The heat medium flowing into the intermediate heat exchanger 30 flows into the first intermediate heat exchanger 31a via the second heat medium flow switching device 37b. Thereafter, the above-described cycle is repeated.

[0150] Meanwhile, the heat medium cooled or heated by the first intermediate heat exchanger 31b flows from the intermediate heat exchanger 30 via the pump 35b, the first heat medium flow switching device 36b, and the second heat medium flow switching device 37e.

[0151] The heat medium flowing from the intermediate heat exchanger 30 flows into the indoor unit 20c via the corresponding heat medium pipe 3, and flows into the use-side heat exchanger 21c. The heat medium flowing into the use-side heat exchanger 21c exchanges heat with the indoor air to receive heat from or transfer heat to the indoor air, cools or heats the indoor air, and flows from the use-side heat exchanger 21c. The heat medium flowing from the use-side heat exchanger 21c flows from the indoor unit 20c, and flows into the intermediate heat exchanger 30 via the corresponding heat medium pipe 3.

[0152] The heat medium flowing into the intermediate heat exchanger 30 flows into the first intermediate heat exchanger 31b via the second heat medium flow switching device 37f. Thereafter, the above-described cycle is repeated.

[When Heat Storage Reservoir Is Used]

[0153] Fig. 9 is a schematic diagram for illustrating flow passages of the heat medium in the heat medium cycle circuit 6 of Fig. 3 when the heat storage reservoir 40 is used.

[0154] In Fig. 9, passage indicated by bold lines are heat medium passages when the heat storage reservoir 40 is used, and the flow directions of the heat medium in the heat medium passages are indicated by arrows.

[0155] In this example, to avoid complication of description, illustration and description will be given of the heat medium passage of the heat medium flowing between the first intermediate heat exchanger 31a and the use-side heat exchanger 21a via the heat storage reservoir 40 and the heat medium passage of the heat medium flowing between the first intermediate heat exchanger 31b and the use-side heat exchanger 21c via the heat storage reservoir 40.

[0156] The passages of the heat medium flowing through the first intermediate heat exchanger 31a include passages passing through the use-side heat exchangers 21b and 21c via the heat storage reservoir 40 other than the passage of this example. Further, the passages of the heat medium flowing through the first intermediate heat exchanger 31b include passages passing through the use-side heat exchangers 21a and 21b via the heat storage reservoir 40 other than the passage of this example.

[0157] When the heat storage reservoir 40 is used, the first heat medium flow switching devices 36a and 36b are first switched as illustrated in Fig. 8. Then, the heat medium cooled or heated by the first intermediate heat exchanger 31a flows from the intermediate heat exchanger 30 via the pump 35a and the first heat medium flow switching device 36a.

[0158] The heat medium flowing from the intermediate heat exchanger 30 flows into the heat storage reservoir 40 via the corresponding heat medium pipe 4, and flows into the heat storage tank 41. When the heat medium flows into the heat storage tank 41, the heat medium stored in the heat storage tank 41 flows therefrom by the same amount as the amount of the heat medium flowing thereinto, and flows from the heat storage reservoir 40.

[0159] The heat medium flowing from the heat storage reservoir 40 flows into the intermediate heat exchanger 30 via the corresponding heat medium pipe 4. The heat medium flowing into the intermediate heat exchanger 30 flows from the intermediate heat exchanger 30 via the first heat medium flow switching device 36a and the second heat medium flow switching device 37a.

[0160] The heat medium flowing from the intermediate heat exchanger 30 flows into the indoor unit 20a via the corresponding heat medium pipe 3, and flows into the use-side heat exchanger 21a. The heat medium flowing into the use-side heat exchanger 21a exchanges heat with the indoor air to receive heat from or transfer heat to the indoor air, cools or heats the indoor air, and flows

from the use-side heat exchanger 21 a. The heat medium flowing from the use-side heat exchanger 21a flows from the indoor unit 20a, and flows into the intermediate heat exchanger 30 via the corresponding heat medium pipe 3.

[0161] The heat medium flowing into the intermediate heat exchanger 30 flows into the first intermediate heat exchanger 31a via the second heat medium flow switching device 37b. Thereafter, the above-described cycle is repeated.

[0162] Meanwhile, the heat medium cooled or heated by the first intermediate heat exchanger 31b flows from the intermediate heat exchanger 30 via the pump 35b and the first heat medium flow switching device 36b.

[0163] The heat medium flowing from the intermediate heat exchanger 30 flows into the heat storage reservoir 40 via the corresponding heat medium pipe 4, and flows into the heat storage tank 41. When the heat medium flows into the heat storage tank 41, the heat medium stored in the heat storage tank 41 flows therefrom by the same amount as the amount of the heat medium flowing thereinto, and flows from the heat storage reservoir 40.

[0164] The heat medium flowing from the heat storage reservoir 40 flows into the intermediate heat exchanger 30 via the corresponding heat medium pipe 4. The heat medium flowing into the intermediate heat exchanger 30 flows from the intermediate heat exchanger 30 via the first heat medium flow switching device 36b and the second heat medium flow switching device 37e.

[0165] The heat medium flowing from the intermediate heat exchanger 30 flows into the indoor unit 20c via the corresponding heat medium pipe 3, and flows into the use-side heat exchanger 21c. The heat medium flowing into the use-side heat exchanger 21c exchanges heat with the indoor air to receive heat from or transfer heat to the indoor air, cools or heats the indoor air, and flows from the use-side heat exchanger 21c. The heat medium flowing from the use-side heat exchanger 21c flows from the indoor unit 20c, and flows into the intermediate heat exchanger 30 via the corresponding heat medium pipe 3.

[0166] The heat medium flowing into the intermediate heat exchanger 30 flows into the first intermediate heat exchanger 31b via the second heat medium flow switching device 37f. Thereafter, the above-described cycle is repeated.

[0167] As described above, in the operation of the air-conditioning apparatus 1, the heat storage reservoir 40 is not always included in the heat medium cycle circuit 6, and whether or not to use the heat storage reservoir 40 is determined based on preset conditions. Further, the first heat medium flow switching devices 36a and 36b are switched based on the result of the determination to thereby connect the heat storage reservoir 40 to the heat medium cycle circuit 6.

[Process of Determining whether or not to Use Heat Storage Reservoir]

[0168] A process of determining whether or not to use

the heat storage reservoir 40 will now be described.

[0169] In the air-conditioning apparatus 1 according to Embodiment 1, whether or not to use the heat storage reservoir 40 is determined based on the state of operation, such as the cooling operation or the heating operation, and the temperature information indicated by the variety of indoor temperature sensors 22a to 22c, 38a to 38d, and 42 provided to the heat medium cycle circuit 6. Herein, a procedure of the process of determining whether or not to use the heat storage reservoir 40 will be described for each of operation states.

[In Cooling Operation]

[0170] Fig. 10 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir 40 in the heat medium cycle circuit 6 of Fig. 3 in the cooling operation.

[0171] In the following, a passage through which the heat medium is circulated by the pump 35a will be described as an example. Further, the "cooling operation" in the following description will refer to an operation such as the cooling only operation or the cooling main operation, for example, in which the heat medium is cooled by the first intermediate heat exchanger 31a.

[0172] At step S1, the controller 50 first performs switching of the first heat medium flow switching device 36a and the second heat medium flow switching devices 37a to 37f, and drives the pump 35a to start the cooling operation.

[0173] Then, at step S2, the controller 50 compares an outlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38a with a target water temperature.

[0174] Herein, the target water temperature refers to the temperature calculated based on the indoor temperature requested by the corresponding indoor unit 20. Specifically, the target water temperature refers to, for example, the temperature of the heat medium required to adjust the temperature of the indoor air to the indoor temperature requested by the indoor unit 20.

[0175] The controller 50 thus compares the outlet water temperature of the first intermediate heat exchanger 31a with the target water temperature to determine whether or not it is possible to cool the indoor air to the requested temperature with the heat medium flowing from the first intermediate heat exchanger 31a.

[0176] If it is determined as a result of the comparison that the outlet water temperature of the first intermediate heat exchanger 31a is higher than the target water temperature (YES at step S2), the process proceeds to step S3.

[0177] At step S3, the controller 50 compares the outlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38a with the water temperature of the heat medium in the heat storage

tank 41 based on the temperature information supplied from the tank temperature sensor 42.

[0178] The controller 50 thus compares the outlet water temperature of the first intermediate heat exchanger 31a with the water temperature of the heat medium in the heat storage tank 41 to determine whether or not to use the heat storage reservoir 40.

[0179] If it is determined as a result of the comparison that the outlet water temperature of the first intermediate heat exchanger 31a is higher than the water temperature of the heat medium in the heat storage tank 41 (YES at step S3), the process proceeds to step S4.

[0180] At step S4, the controller 50 controls the first heat medium flow switching device 36a to connect a left passage and a lower passage illustrated on the sheet of Fig. 3 and connect a right passage and an upper passage illustrated on the sheet of Fig. 3. Thereby, the heat medium in the heat storage tank 41 flows into the heat medium cycle circuit 6.

[0181] Then, at step S5, the controller 50 compares an inlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38b with a predicted water temperature.

[0182] The predicted water temperature is calculated based on the indoor temperature detected by the indoor temperature sensor 22 of the indoor unit 20 being operated and the temperature of the heat medium in the heat storage tank 41 detected by the tank temperature sensor 42. The predicted temperature refers to the temperature of the heat medium flowing into the first intermediate heat exchanger 31a after flowing from the heat storage tank 41 and circulating through the heat medium cycle circuit 6.

[0183] The controller 50 thus compares the inlet water temperature of the first intermediate heat exchanger 31a with the predicted water temperature to determine whether or not the heat medium flowing from the heat storage tank 41 has circulated through the heat medium cycle circuit 6.

[0184] If it is determined as a result of the comparison that the inlet water temperature of the first intermediate heat exchanger 31a is equal to or lower than the predicted water temperature (YES at step S5), the process proceeds to step S6.

[0185] Meanwhile, if it is determined that the inlet water temperature of the first intermediate heat exchanger 31a is higher than the predicted water temperature (NO at step S5), the process of step S5 is repeated until the inlet water temperature of the first intermediate heat exchanger 31a falls to or below the predicted water temperature.

[0186] Then, at step S6, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the upper passage illustrated on the sheet of Fig. 3 and connect the right passage and the lower passage illustrated on the sheet of Fig. 3. Thereby, the heat storage tank 41 is disconnected from the heat medium cycle circuit 6, and a sequence of processes is

completed.

[0187] Meanwhile, if it is determined at step S2 that the outlet water temperature of the first intermediate heat exchanger 31a is equal to or lower than the target water temperature (NO at step S2), the sequence of processes is completed.

[0188] Further, the sequence of processes is also completed if it is determined at step S3 that the outlet water temperature of the first intermediate heat exchanger 31a is equal to or lower than the water temperature of the heat medium in the heat storage tank 41 (NO at step S3).

[0189] In the cooling operation, the above-described processes of steps S1 to S6 thus performed enable the temperature of the indoor air to approach the requested temperature faster than in a case in which the heat medium in the heat storage tank 41 is not used.

[0190] Although the description in the foregoing example has been given of the process on the passage through which the heat medium is circulated by the pump 35a, a similar description applies to the process on the passage through which the heat medium is circulated by the pump 35b.

[In Heating Operation]

[0191] Fig. 11 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir 40 in the heat medium cycle circuit 6 of Fig. 3 in the heating operation.

[0192] In the following, a passage through which the heat medium is circulated by the pump 35a will be described as an example. Further, the "heating operation" in the following description will refer to an operation such as the heating only operation or the heating main operation, for example, in which the heat medium is heated by the first intermediate heat exchanger 31a.

[0193] At step S11, the controller 50 first performs switching of the first heat medium flow switching device 36a and the second heat medium flow switching devices 37a to 37f, and drives the pump 35a to start the heating operation.

[0194] Then, at step S12, the controller 50 compares the outlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38a with the target water temperature.

[0195] If the result of the comparison indicates that the outlet water temperature of the first intermediate heat exchanger 31a is lower than the target water temperature (YES at step S12), the controller 50 determines that it is possible to heat the indoor air with the heat medium flowing from the first intermediate heat exchanger 31a such that the indoor air has the required temperature, and the process proceeds to step S13.

[0196] At step S13, the controller 50 compares the outlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38a with

the water temperature of the heat medium in the heat storage tank 41 based on the temperature information supplied from the tank temperature sensor 42.

[0197] If the result of the comparison indicates that the outlet water temperature of the first intermediate heat exchanger 31a is lower than the water temperature of the heat medium in the heat storage tank 41 (YES at step S13), the controller 50 determines to use the heat storage reservoir 40, and the process proceeds to step S14.

[0198] At step S14, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the lower passage illustrated on the sheet of Fig. 3 and connect the right passage and the upper passage illustrated on the sheet of Fig. 3. Thereby, the heat medium in the heat storage tank 41 flows into the heat medium cycle circuit 6.

[0199] Then, at step S15, the controller 50 compares the inlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38b with the predicted water temperature.

[0200] If the result of the comparison indicates that the inlet water temperature of the first intermediate heat exchanger 31a is equal to or higher than the predicted water temperature (YES at step S15), the controller 50 determines that the heat medium flowing from the heat storage tank 41 has circulated through the heat medium cycle circuit 6 and flowed into the first intermediate heat exchanger 31a, and the process proceeds to step S16.

[0201] Meanwhile, if it is determined that the inlet water temperature of the first intermediate heat exchanger 31a is lower than the predicted water temperature (NO at step S15), the process of step S15 is repeated until the inlet water temperature of the first intermediate heat exchanger 31a reaches or exceeds the predicted water temperature.

[0202] Then, at step S16, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the upper passage illustrated on the sheet of Fig. 3 and connect the right passage and the lower passage illustrated on the sheet of Fig. 3. Thereby, the heat storage tank 41 is disconnected from the heat medium cycle circuit 6, and a sequence of processes is completed.

[0203] Meanwhile, if it is determined at step S12 that the outlet water temperature of the first intermediate heat exchanger 31a is equal to or higher than the target water temperature (NO at step S12), the sequence of processes is completed.

[0204] Further, the sequence of processes is also completed if it is determined at step S13 that the outlet water temperature of the first intermediate heat exchanger 31a is equal to or higher than the water temperature of the heat medium in the heat storage tank 41 (NO at step S13).

[0205] In the heating operation, the above-described processes of steps S11 to S16 thus performed enable the temperature of the indoor air to approach the requested temperature faster than in a case in which the heat

medium in the heat storage tank 41 is not used.

[0206] Although the description in the foregoing example has been given of the process on the passage through which the heat medium is circulated by the pump 35a, a similar description applies to the process on the passage through which the heat medium is circulated by the pump 35b.

[At End of Cooling Operation]

[0207] Fig. 12 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir 40 in the heat medium cycle circuit 6 of Fig. 3 at the end of the cooling operation.

[0208] In the following, a passage through which the heat medium is circulated by the pump 35a will be described as an example.

[0209] At step S21, the controller 50 first stops the cooling operation while maintaining the respective states of the first heat medium flow switching device 36a and the second heat medium flow switching devices 37a to 37f in the cooling operation.

[0210] Then, at step S22, the controller 50 compares the outlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38a with the water temperature of the heat medium in the heat storage tank 41 based on the temperature information supplied from the tank temperature sensor 42.

[0211] The controller 50 thus compares the outlet water temperature of the first intermediate heat exchanger 31a with the water temperature of the heat medium in the heat storage tank 41 to determine whether or not it is possible to collect the cooling energy remaining in the heat medium cycle circuit 6 into the heat storage tank 41.

[0212] If it is determined as a result of the comparison that the outlet water temperature of the first intermediate heat exchanger 31a is lower than the water temperature of the heat medium in the heat storage tank 41 (YES at step S22), the process proceeds to step S23.

[0213] At step S23, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the lower passage illustrated on the sheet of Fig. 3 and connect the right passage and the upper passage illustrated on the sheet of Fig. 3. Thereby, the heat medium in the heat medium cycle circuit 6, which is lower in temperature than the heat medium in the heat storage tank 41, flows into the heat storage tank 41.

[0214] Then, at step S24, the controller 50 compares the outlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38a with the water temperature of the heat medium in the heat storage tank 41 based on the temperature information supplied from the tank temperature sensor 42.

[0215] The controller 50 thus compares the outlet water temperature of the first intermediate heat exchanger 31a and the water temperature of the heat medium in the

heat storage tank 41 to determine whether or not the cooling energy remaining in the heat medium cycle circuit 6 has successfully been collected into the heat storage tank 41.

[0216] If it is determined as a result of the comparison that the outlet water temperature of the first intermediate heat exchanger 31a is equal to or higher than the water temperature of the heat medium in the heat storage tank 41 (YES at step S24), the process proceeds to step S25.

[0217] Meanwhile, if it is determined that the outlet water temperature of the first intermediate heat exchanger 31a is lower than the water temperature of the heat medium in the heat storage tank 41 (NO at step S24), the process of step S24 is repeated until the outlet water temperature of the first intermediate heat exchanger 31a reaches or exceeds the water temperature of the heat medium in the heat storage tank 41.

[0218] It is difficult in some cases to accurately detect the water temperature of the heat medium in the heat storage tank 41 depending on factors such as the structure of the heat storage tank 41 and the installation position of the tank temperature sensor 42. If it is difficult to meet the condition of step S24, therefore, the temperature used for the determination may be set with a margin, for example.

[0219] Then, at step S25, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the upper passage illustrated on the sheet of Fig. 3 and connect the right passage and the lower passage illustrated on the sheet of Fig. 3. Thereby, the heat storage tank 41 is disconnected from the heat medium cycle circuit 6.

[0220] Meanwhile, if it is determined at step S22 that the outlet water temperature of the first intermediate heat exchanger 31a is equal to or higher than the water temperature of the heat medium in the heat storage tank 41 (NO at step S22), the process proceeds to step S26.

[0221] Then, at step S26, the controller 50 stops driving the pump 35a. Thereby, a sequence of processes is completed.

[0222] With the above-described processes of steps S21 to S26 thus performed, it is possible to collect into the heat storage tank 41 the cooling energy remaining in the heat medium cycle circuit 6 when the cooling operation is stopped.

[0223] Although the description in the foregoing example has been given of the process on the passage through which the heat medium is circulated by the pump 35a, a similar description applies to the process on the passage through which the heat medium is circulated by the pump 35b.

[At End of Heating Operation]

[0224] Fig. 13 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir 40 in the heat medium cycle circuit 6 of Fig. 3 at the end of the heating operation.

[0225] In the following, a passage through which the heat medium is circulated by the pump 35a will be described as an example.

[0226] At step S31, the controller 50 first stops the heating operation while maintaining the respective states of the first heat medium flow switching device 36a and the second heat medium flow switching devices 37a to 37f in the heating operation.

[0227] Then, at step S32, the controller 50 compares the outlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38a and the water temperature of the heat medium in the heat storage tank 41 based on the temperature information supplied from the tank temperature sensor 42.

[0228] The controller 50 thus compares the outlet water temperature of the first intermediate heat exchanger 31a with the water temperature of the heat medium in the heat storage tank 41 to determine whether or not it is possible to collect the heating energy remaining in the heat medium cycle circuit 6 into the heat storage tank 41.

[0229] If it is determined as a result of the comparison that the outlet water temperature of the first intermediate heat exchanger 31a is higher than the water temperature of the heat medium in the heat storage tank 41 (YES at step S32), the process proceeds to step S33.

[0230] At step S33, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the lower passage illustrated on the sheet of Fig. 3 and connect the right passage and the upper passage illustrated on the sheet of Fig. 3. Thereby, the heat medium in the heat medium cycle circuit 6, which is higher in temperature than the heat medium in the heat storage tank 41, flows into the heat storage tank 41.

[0231] Then, at step S34, the controller 50 compares the outlet water temperature of the first intermediate heat exchanger 31a based on the temperature information supplied from the heat medium temperature sensor 38a with the water temperature of the heat medium in the heat storage tank 41 based on the temperature information supplied from the tank temperature sensor 42.

[0232] The controller 50 thus compares the outlet water temperature of the first intermediate heat exchanger 31a with the water temperature of the heat medium in the heat storage tank 41 to determine whether or not the heating energy remaining in the heat medium cycle circuit 6 has successfully been collected into the heat storage tank 41.

[0233] If it is determined as a result of the comparison that the outlet water temperature of the first intermediate heat exchanger 31a is equal to or lower than the water temperature of the heat medium in the heat storage tank 41 (YES at step S34), the process proceeds to step S35.

[0234] Meanwhile, if it is determined that the outlet water temperature of the first intermediate heat exchanger 31a is higher than the water temperature of the heat medium in the heat storage tank 41 (NO at step S34), the process of step S34 is repeated until the outlet water

temperature of the first intermediate heat exchanger 31a falls to or below the water temperature of the heat medium in the heat storage tank 41.

[0235] It is difficult in some cases to accurately detect the water temperature of the heat medium in the heat storage tank 41 depending on factors such as the structure of the heat storage tank 41 and the installation position of the tank temperature sensor 42. If it is difficult to meet the condition of step S34, therefore, the temperature used for the determination may be set with a margin, for example.

[0236] Then, at step S35, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the upper passage illustrated on the sheet of Fig. 3 and connect the right passage and the lower passage illustrated on the sheet of Fig. 3. Thereby, the heat storage tank 41 is disconnected from the heat medium cycle circuit 6.

[0237] Meanwhile, if it is determined at step S32 that the outlet water temperature of the first intermediate heat exchanger 31a is equal to or lower than the water temperature of the heat medium in the heat storage tank 41 (NO at step S32), the process proceeds to step S36.

[0238] Then, at step S36, the controller 50 stops driving the pump 35a. Thereby, a sequence of processes is completed.

[0239] With the above-described processes of steps S31 to S36 thus performed, it is possible to collect into the heat storage tank 41 the heating energy remaining in the heat medium cycle circuit 6 when the heating operation is stopped.

[0240] Although the description in the foregoing example has been given of the process on the passage through which the heat medium is circulated by the pump 35a, a similar description applies to the process on the passage through which the heat medium is circulated by the pump 35b.

[In Defrosting Operation]

[0241] Fig. 14 is a flowchart illustrating an example of the procedure of a process of determining whether or not to use the heat storage reservoir 40 in the heat medium cycle circuit 6 of Fig. 3 in the defrosting operation.

[0242] It is assumed in this example that the first intermediate heat exchangers 31a and 31b are supplied with cooling energy. It is also assumed that all of the indoor units 20a to 20c start the defrosting operation during the heating operation.

[0243] In the following, a passage through which the heat medium is circulated by the pump 35a will be described as an example.

[0244] After the defrosting operation starts at step S41, the controller 50 at step S42 compares the water temperature of the heat medium in the heat storage tank 41 based on the temperature information supplied from the tank temperature sensor 42 with a heating application temperature.

[0245] Herein, the heating application temperature refers to the water temperature of the heat medium calculated based on the temperature information supplied from the indoor temperature sensor 22 of the indoor unit 20 performing the heating operation, and is defined as a value lower than the value of the target water temperature described in the process of the heating operation illustrated in Fig. 11. The heating application temperature is a temperature at which a heat amount for increasing the indoor temperature to the target temperature requested by the indoor unit 20 is not provided, but which enables the present room temperature to increase.

[0246] The controller 50 thus compares the water temperature of the heat medium in the heat storage tank 41 with the heating application temperature to determine whether or not it is possible to perform the heating operation with the heat medium in the heat storage tank 41.

[0247] If it is determined as a result of the comparison that the water temperature of the heat medium in the heat storage tank 41 is higher than the heating application temperature (YES at step S42), the process proceeds to step S43.

[0248] At step S43, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the lower passage illustrated on the sheet of Fig. 3 and connect the right passage and the upper passage illustrated on the sheet of Fig. 3. Thereby, the heat medium in the heat storage tank 41 flows into the heat medium cycle circuit 6. It is therefore possible to supply the heat medium having the heating energy from the heat storage tank 41 to the passage through which the heat medium is circulated by the pump 35a, and which is not supplied with heating energy owing to the defrosting operation. Accordingly, it is possible to continue the heating operation even during the defrosting operation.

[0249] Then, at step S45, the controller 50 compares the water temperature of the heat medium in the heat storage tank 41 with the heating application temperature similarly as in the process of step S42.

[0250] If it is determined as a result of the comparison that the water temperature of the heat medium in the heat storage tank 41 is higher than the heating application temperature (YES at step S45), the process proceeds to step S46.

[0251] At step S46, the controller 50 determines whether or not the defrosting operation has been completed.

[0252] To determine whether or not the defrosting operation has been completed, a method is conceivable in which the controller 50 requests the outdoor unit 10 to send information indicating the present operating node, for example. Further, the method is not limited thereto. For example, a method may be employed in which the controller 50 receives the information indicating the present operating node from the outdoor unit 10 when the operation mode changes.

[0253] If it is determined that the defrosting operation has been completed (YES at step S46), the process pro-

ceeds to step S48. Meanwhile, if it is determined that the defrosting operation has not been completed (NO at step S46), the process returns to step S45.

[0254] Then, at step S48, the controller 50 controls the first heat medium flow switching device 36a to connect the left passage and the upper passage illustrated on the sheet of Fig. 3 and connect the right passage and the lower passage illustrated on the sheet of Fig. 3. Thereby, the heat storage tank 41 is disconnected from the heat medium cycle circuit 6, and a sequence of processes is completed.

[0255] Meanwhile, if it is determined at step S42 that the water temperature of the heat medium in the heat storage tank 41 is equal to or lower than the heating application temperature (NO at step S42), the process proceeds to step S44.

[0256] At step S44, the controller 50 performs control of stopping the fans of all of the indoor units 20 similarly as in a normal defrosting operation.

[0257] Further, if it is determined at step S45 that the water temperature of the heat medium in the heat storage tank 41 is equal to or lower than the heating application temperature (NO at step S45), the process proceeds to step S47.

[0258] At step S47, the controller 50 performs the control of stopping the fans of all of the indoor units 20 similarly as in the process of step S44.

[0259] After the processes of steps S41 to S48 are thus performed, the controller 50 starts a process according to the operation mode changed from the defrosting operation, such as the cooling operation or the heating operation.

[0260] The process on the passage through which the heat medium is circulated by the pump 35b is similar to that of the above-described example.

[0261] As described above, when the cooling operation or the heating operation starts in Embodiment 1, the temperature of the heat medium flowing into or from each of the first intermediate heat exchangers 31a and 31b is compared with the temperature of the heat medium in the heat storage tank 41 to determine whether or not to use the heat storage reservoir 40. Then, if the conditions are met, the heat storage reservoir 40 is connected to the heat medium cycle circuit 6 to use the heat medium in the heat storage tank 41, which has cooling energy or heating energy greater than that of the heat medium circulating through the heat medium cycle circuit 6.

[0262] It is thereby possible to make the temperature of the indoor air approach the requested temperature faster than in the case in which the heat medium in the heat storage tank 41 is not used,

[0263] That is, at the time of starting the cooling operation or the heating operation, or at the time of switching between operations, the use of the heat medium in the heat storage reservoir 40 reduces the time for switching between operations, thereby achieving improvement of air-conditioning performance and energy saving.

[0264] Further, at the end of the cooling operation or

the heating operation, the temperature of the heat medium flowing from each of the first intermediate heat exchangers 31a and 31b is compared with the temperature of the heat medium in the heat storage tank 41. Then, if the condition is met, the heat storage reservoir 40 is connected to the heat medium cycle circuit 6 to store the heat medium circulating through the heat medium cycle circuit 6 into the heat storage tank 41.

[0265] It is thereby possible to collect the cooling energy or the heating energy remaining in the heat medium cycle circuit 6 into the heat storage tank 41.

[0266] Further, in the defrosting operation, the temperature of the heat medium in the heat storage tank 41 is compared with the heating application temperature. Then, if the condition is met, the heat storage reservoir 40 is connected to the heat medium cycle circuit 6 to allow the heat medium in the heat storage tank 41 to circulate through the heat medium cycle circuit 6.

[0267] It is thereby possible to continue the heating operation even during the defrosting operation.

Embodiment 2

[0268] An air-conditioning apparatus according to Embodiment 2 of the present invention will now be described.

[0269] Embodiment 1 described above allows the heat medium circulating through the heat medium cycle circuit 6 to flow into the heat storage tank 41, to thereby store cooling energy or heating energy in the heat storage reservoir 40.

[0270] Meanwhile, in Embodiment 2, a heat storage reservoir is provided with an intermediate heat exchanger for cooling or heating the heat medium in the heat storage tank. Thereby, cooling energy or heating energy is stored in the heat storage tank 41.

[0271] Fig. 15 is a schematic diagram illustrating an example of the configuration of an air-conditioning apparatus 101 according to Embodiment 2 of the present invention.

[0272] As illustrated in Fig. 15, the air-conditioning apparatus 101 is formed of the outdoor unit 10 serving as the heat source unit, the plurality of indoor units 20, an intermediate heat exchanger 130, a heat storage reservoir 140, and the controller 50. The example of Fig. 15 illustrates a case in which the air-conditioning apparatus 101 includes two indoor units 20. However, the configuration is not limited thereto, and the air-conditioning apparatus 101 may include three or more indoor units 20, for example.

[0273] In the following description, parts similar to those of Embodiment 1 described above will be assigned with the same reference signs, and detailed description thereof will be omitted. Further, in the air-conditioning apparatus 101, the indoor units 20, parts of the intermediate heat exchanger 130 on the side of the heat medium cycle circuit 6, and parts of the heat storage reservoir 140 on the side of the heat medium cycle circuit 6 are similar to those of Embodiment 1, and thus detailed de-

scription thereof will be omitted.

[0274] The outdoor unit 10 is connected to a refrigerant-side passage of the intermediate heat exchanger 130 by the two refrigerant pipes 2 through which the refrigerant flows. Further, the refrigerant-side passage of the intermediate heat exchanger 130 is connected to a refrigerant-side passage of the heat storage reservoir 140 by three refrigerant pipes 7. Further, the outdoor unit 10, the intermediate heat exchanger 130, the heat storage reservoir 140, and the refrigerant pipes 2 and 7 form the refrigerant cycle circuit 5.

[0275] Further, each of the plurality of indoor units 20 is connected to a heat medium-side passage of the intermediate heat exchanger 30 by the two heat medium pipes 3 through which the heat medium flows. Further, a heat medium-side passage of the heat storage reservoir 40 is connected to the heat medium-side passage of the intermediate heat exchanger 30 by the two heat medium pipes 4 through which the heat medium flows. Further, the plurality of indoor units 20, the intermediate heat exchanger 130, the heat storage reservoir 140, and the heat medium pipes 3 and 4 form the heat medium cycle circuit 6.

[Circuit Configuration of Refrigerant Cycle Circuit]

[0276] Fig. 16 is a schematic diagram illustrating an example of the circuit configuration of the refrigerant cycle circuit 5 in the air-conditioning apparatus 101 according to Embodiment 2 of the present invention.

[0277] As described above, the refrigerant cycle circuit 5 is formed of the outdoor unit 10, the intermediate heat exchanger 130, the heat storage reservoir 140, and the refrigerant pipes 2 and 7.

[0278] Each of the intermediate heat exchanger 130 and the heat storage reservoir 140 includes parts related to the refrigerant cycle circuit 5 and parts related to the heat medium cycle circuit 6. In the intermediate heat exchanger 130 and the heat storage reservoir 140 illustrated in Fig. 16, only the parts related to the refrigerant cycle circuit 5 will be illustrated and described.

[0279] Further, the outdoor unit 10 is similar to that of Embodiment 1 described above, and thus description thereof will be omitted here.

[Intermediate Heat Exchanger (Refrigerant Cycle Circuit Side)]

[0280] The intermediate heat exchanger 130 is provided with the three refrigerant pipes 7 connecting to the heat storage reservoir 140, in addition to the configuration of the intermediate heat exchanger 30 according to Embodiment 1.

[Heat Storage Reservoir (Refrigerant Cycle Circuit Side)]

[0281] The heat storage reservoir 140 is formed of a second intermediate heat exchanger 141, an expansion

device 142, and a third refrigerant flow switching device 143.

[0282] The second intermediate heat exchanger 141 functions as a condenser or an evaporator to exchange heat between the refrigerant flowing through the refrigerant cycle circuit 5 and the heat medium in the not-illustrated heat storage tank 41 in the heat storage reservoir 140.

[0283] The second intermediate heat exchanger 141 is provided between the expansion device 142 and the third refrigerant flow switching device 143.

[0284] The expansion device 142 functions as an expansion valve that reduces the pressure of the refrigerant flowing through the refrigerant cycle circuit 5 to expand the refrigerant. The expansion device 142 is formed of a valve having a controllable opening degree, such as an electronic expansion valve, for example.

[0285] The expansion device 142 is provided on the upstream side of the second intermediate heat exchanger 141 in the flow of the refrigerant in the storage of cooling energy into the heat storage reservoir 140.

[0286] The third refrigerant flow switching device 143 switches the flow direction of the refrigerant in accordance with the operation mode. Fig. 16 illustrates the third refrigerant flow switching device 143 when heating energy is stored into the heat storage reservoir 140. The third refrigerant flow switching device 143 may use a four-way valve, for example, or may use a four-way valve in combination with another valve.

[0287] The third refrigerant flow switching device 143 is provided on the downstream side of the first intermediate heat exchanger 31a in the flow of the refrigerant in the storage of cooling energy into the heat storage reservoir 140.

[Operation of Refrigerant Cycle Circuit]

[0288] A description will now be given of movements of the refrigerant in the cooling only operation mode, the heating only operation mode, the cooling main operation mode, and the heating main operation mode in the refrigerant cycle circuit 5 of the air-conditioning apparatus 101 having the above-described configuration.

[0289] Further, the following description will be given of cases in which the heat medium in the heat storage tank 41 is cooled or heated in these operation modes.

[Cooling Energy Storage in Cooling Only Operation Mode]

[0290] Fig. 17 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 16 in cooling energy storage in the cooling only operation mode.

[0291] In Fig. 17, a passage indicated by a bold line is a refrigerant passage in the storage of cooling energy into the heat storage reservoir 140 in the cooling only operation mode. The flow direction of the refrigerant in

the refrigerant passage is indicated by arrows.

[0292] In this case, the first refrigerant flow switching device 12, the second refrigerant flow switching devices 34a and 34b, and the third refrigerant flow switching device 143 are first switched as illustrated in Fig. 17. Further, the opening and closing device 33a is opened, and the opening and closing device 33b is closed.

[0293] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0294] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows into the heat source-side heat exchanger 13 via the first refrigerant flow switching device 12. The high-temperature, high-pressure gas refrigerant flowing into the heat source-side heat exchanger 13 condenses while exchanging heat with and transferring heat to the outdoor air, and flows from the heat source-side heat exchanger 13 as subcooled high-pressure liquid refrigerant.

[0295] The high-pressure liquid refrigerant flowing from the heat source-side heat exchanger 13 flows from the outdoor unit 10 via the check valve 14d, and flows into the intermediate heat exchanger 130.

[0296] The high-pressure liquid refrigerant flowing into the intermediate heat exchanger 130 flows into the expansion devices 32a and 32b via the opening and closing device 33a. Further, the high-pressure liquid refrigerant directly flows from the intermediate heat exchanger 130, and also flows into the heat storage reservoir 140 via the corresponding refrigerant pipe 7.

[0297] The high-pressure liquid refrigerant flowing into the expansion device 32a is reduced in pressure and expanded to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows into the first intermediate heat exchanger 31a.

[0298] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31a as low-temperature, low-pressure gas refrigerant.

[0299] The low-temperature, low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31a flows from the intermediate heat exchanger 130 via the second refrigerant flow switching device 34a, and flows into the outdoor unit 10.

[0300] Meanwhile, the high-pressure liquid refrigerant flowing into the expansion device 32b is reduced in pressure and expanded to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows into the first intermediate heat exchanger 31b.

[0301] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31b exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31b as low-temperature, low-pressure

gas refrigerant.

[0302] The low-temperature, low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31b flows from the intermediate heat exchanger 130 via the second refrigerant flow switching device 34b, and flows into the outdoor unit 10.

[0303] Further, the high-pressure liquid refrigerant flowing into the heat storage reservoir 140 is reduced in pressure and expanded by the expansion device 142 to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows into the second intermediate heat exchanger 141.

[0304] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the second intermediate heat exchanger 141 exchanges heat with and receives heat from the heat medium in the heat storage tank 41 to evaporate and thereby cool the heat medium, and flows from the second intermediate heat exchanger 141 as low-temperature, low-pressure gas refrigerant.

[0305] The low-temperature, low-pressure gas refrigerant flowing from the second intermediate heat exchanger 141 flows from the heat storage reservoir 140 via the third refrigerant flow switching device 143, and flows into the intermediate heat exchanger 130 via the corresponding refrigerant pipe 7.

[0306] The low-temperature, low-pressure gas refrigerant flowing into the intermediate heat exchanger 130 directly flows from the intermediate heat exchanger 130, and flows into the outdoor unit 10.

[0307] The low-temperature, low-pressure gas refrigerant flowing into the outdoor unit 10 is suctioned into the compressor 11 via the check valve 14a and the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Heating Energy Storage in Cooling Only Operation Mode]

[0308] Fig. 18 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 16 in heating energy storage in the cooling only operation mode.

[0309] In Fig. 18, a passage indicated by a bold line is a refrigerant passage in the storage of heating energy into the heat storage reservoir 140 in the cooling only operation mode. The flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0310] In this case, the first refrigerant flow switching device 12, the second refrigerant flow switching devices 34a and 34b, and the third refrigerant flow switching device 143 are first switched as illustrated in Fig. 18. Further, the opening and closing devices 33a and 33b are closed.

[0311] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0312] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows into

the heat source-side heat exchanger 13 via the first refrigerant flow switching device 12. The high-temperature, high-pressure gas refrigerant flowing into the heat source-side heat exchanger 13 condenses while exchanging heat with and transferring heat to the outdoor air, and flows from the heat source-side heat exchanger 13 as two-phase gas-liquid refrigerant.

[0313] The two-phase gas-liquid refrigerant flowing from the heat source-side heat exchanger 13 flows from the outdoor unit 10 via the check valve 14d, and flows into the intermediate heat exchanger 130.

[0314] The two-phase gas-liquid refrigerant flowing into the intermediate heat exchanger 130 directly flows from the intermediate heat exchanger 130, and flows into the heat storage reservoir 140 via the corresponding refrigerant pipe 7.

[0315] The two-phase gas-liquid refrigerant flowing into the heat storage reservoir 140 flows into the second intermediate heat exchanger 141 via the third refrigerant flow switching device 143.

[0316] The two-phase gas-liquid refrigerant flowing into the second intermediate heat exchanger 141 condenses while exchanging heat with and transferring heat to the heat medium in the heat storage tank 41 to thereby heat the heat medium, and flows from the second intermediate heat exchanger 141 as liquid refrigerant.

[0317] The liquid refrigerant flowing from the second intermediate heat exchanger 141 is reduced in pressure and expanded by the expansion device 142 to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 142.

[0318] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 142 flows from the heat storage reservoir 140, and flows into the intermediate heat exchanger 130 via the corresponding refrigerant pipe 7.

[0319] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the intermediate heat exchanger 130 flows into the first intermediate heat exchangers 31a and 31b via the expansion devices 32a and 32b, respectively.

[0320] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31a as low-pressure gas refrigerant.

[0321] The low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31a flows from the intermediate heat exchanger 130 via the second refrigerant flow switching device 34a, and flows into the outdoor unit 10.

[0322] Meanwhile, the low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31b exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31b as low-pressure gas

refrigerant.

[0323] The low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31b flows from the intermediate heat exchanger 130 via the second refrigerant flow switching device 34b, and flows into the outdoor unit 10.

[0324] The low-pressure gas refrigerant flowing into the outdoor unit 10 is suctioned into the compressor 11 via the check valve 14a and the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Cooling Energy Storage in Heating Only Operation Mode]

[0325] Fig. 19 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 16 in cooling energy storage in the heating only operation mode.

[0326] In Fig. 19, a passage indicated by a bold line is a refrigerant passage in the storage of cooling energy into the heat storage reservoir 140 in the heating only operation mode. The flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0327] In this case, the first refrigerant flow switching device 12, the second refrigerant flow switching devices 34a and 34b, and the third refrigerant flow switching device 143 are first switched as illustrated in Fig. 19. Further, the opening and closing devices 33a and 33b are closed.

[0328] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0329] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows from the outdoor unit 10 via the first refrigerant flow switching device 12 and the check valve 14c provided to the second connecting pipe 2b, and flows into the intermediate heat exchanger 130.

[0330] The high-temperature, high-pressure gas refrigerant flowing into the intermediate heat exchanger 130 flows into the first intermediate heat exchangers 31a and 31b via the second refrigerant flow switching devices 34a and 34b, respectively.

[0331] The high-temperature, high-pressure gas refrigerant flowing into the first intermediate heat exchanger 31a condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31a as subcooled high-pressure liquid refrigerant.

[0332] The high-pressure liquid refrigerant flowing from the first intermediate heat exchanger 31a is reduced in pressure and expanded by the expansion device 32a to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32a.

[0333] Meanwhile, the high-temperature, high-pres-

sure gas refrigerant flowing into the first intermediate heat exchanger 31b condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31b as subcooled high-pressure liquid refrigerant.

[0334] The high-pressure liquid refrigerant flowing from the first intermediate heat exchanger 31b is reduced in pressure and expanded by the expansion device 32b to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32b.

[0335] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion devices 32a and 32b flows from the intermediate heat exchanger 130, and flows into the heat storage reservoir 140 via the corresponding refrigerant pipe 7.

[0336] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the heat storage reservoir 140 flows into the second intermediate heat exchanger 141 via the expansion device 142.

[0337] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the second intermediate heat exchanger 141 exchanges heat with and receives heat from the heat medium in the heat storage tank 41 to evaporate and thereby cool the heat medium, and flows from the second intermediate heat exchanger 141 as low-temperature, low-pressure gas refrigerant.

[0338] The low-temperature, low-pressure gas refrigerant flowing from the second intermediate heat exchanger 141 flows from the heat storage reservoir 140 via the third refrigerant flow switching device 143, and flows into the intermediate heat exchanger 130 via the corresponding refrigerant pipe 7.

[0339] The low-temperature, low-pressure gas refrigerant flowing into the intermediate heat exchanger 130 directly flows from the intermediate heat exchanger 130, and flows into the outdoor unit 10.

[0340] The low-temperature, low-pressure gas refrigerant flowing into the outdoor unit 10 flows into the heat source-side heat exchanger 13 via the check valve 14b provided to the first connecting pipe 2a.

[0341] The low-temperature, low-pressure gas refrigerant flowing into the heat source-side heat exchanger 13 exchanges heat with and receives heat from the outdoor air to evaporate, and flows from the heat source-side heat exchanger 13.

[0342] The low-temperature, low-pressure gas refrigerant flowing from the heat source-side heat exchanger 13 is suctioned into the compressor 11 via the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Heating Energy Storage in Heating Only Operation Mode]

[0343] Fig. 20 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle

circuit 5 of Fig. 16 in heating energy storage in the heating only operation mode.

[0344] In Fig. 20, a passage indicated by a bold line is a refrigerant passage in the storage of heating energy into the heat storage reservoir 140 in the heating only operation mode. The flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0345] In this case, the first refrigerant flow switching device 12, the second refrigerant flow switching devices 34a and 34b, and the third refrigerant flow switching device 143 are first switched as illustrated in Fig. 20. Further, the opening and closing device 33a is closed, and the opening and closing device 33b is opened.

[0346] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0347] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows from the outdoor unit 10 via the first refrigerant flow switching device 12 and the check valve 14c provided to the second connecting pipe 2b, and flows into the intermediate heat exchanger 130.

[0348] The high-temperature, high-pressure gas refrigerant flowing into the intermediate heat exchanger 130 flows into the first intermediate heat exchangers 31a and 31b via the second refrigerant flow switching devices 34a and 34b, respectively. Further, the high-temperature, high-pressure gas refrigerant directly flows from the intermediate heat exchanger 130, and also flows into the heat storage reservoir 140 via the corresponding refrigerant pipe 7.

[0349] The high-temperature, high-pressure gas refrigerant flowing into the first intermediate heat exchanger 31a condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31a as subcooled high-pressure liquid refrigerant.

[0350] The high-pressure liquid refrigerant flowing from the first intermediate heat exchanger 31a is reduced in pressure and expanded by the expansion device 32a to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32a.

[0351] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32a flows from the intermediate heat exchanger 130 via the opening and closing device 33b, and flows into the outdoor unit 10.

[0352] Meanwhile, the high-temperature, high-pressure gas refrigerant flowing into the first intermediate heat exchanger 31b condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31b as subcooled high-pressure liquid refrigerant.

[0353] The high-pressure liquid refrigerant flowing from the first intermediate heat exchanger 31b is reduced

in pressure and expanded by the expansion device 32b to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32b.

[0354] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32b flows from the intermediate heat exchanger 130 via the opening and closing device 33b, and flows into the outdoor unit 10.

[0355] Further, the high-temperature, high-pressure gas refrigerant flowing into the heat storage reservoir 140 flows into the second intermediate heat exchanger 141 via the third refrigerant flow switching device 143.

[0356] The high-temperature, high-pressure gas refrigerant flowing into the second intermediate heat exchanger 141 condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the second intermediate heat exchanger 141 as subcooled high-pressure liquid refrigerant.

[0357] The high-pressure liquid refrigerant flowing from the second intermediate heat exchanger 141 is reduced in pressure and expanded by the expansion device 142 to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 142.

[0358] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 142 flows from the heat storage reservoir 140, and flows into the intermediate heat exchanger 130 via the corresponding refrigerant pipe 7.

[0359] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the intermediate heat exchanger 130 flows from the intermediate heat exchanger 130 via the opening and closing device 33b, and flows into the outdoor unit 10.

[0360] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the outdoor unit 10 flows into the heat source-side heat exchanger 13 via the check valve 14b provided to the first connecting pipe 2a.

[0361] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the heat source-side heat exchanger 13 exchanges heat with and receives heat from the outdoor air to evaporate, and flows from the heat source-side heat exchanger 13 as low-temperature, low-pressure gas refrigerant.

[0362] The low-temperature, low-pressure gas refrigerant flowing from the heat source-side heat exchanger 13 is suctioned into the compressor 11 via the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Cooling Energy Storage in Cooling Main Operation Mode]

[0363] Fig. 21 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle

circuit 5 of Fig. 16 in cooling energy storage in the cooling main operation mode.

[0364] In Fig. 21, a passage indicated by a bold line is a refrigerant passage in the storage of cooling energy into the heat storage reservoir 140 in the cooling main operation mode. The flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0365] In this case, the first refrigerant flow switching device 12, the second refrigerant flow switching devices 34a and 34b, and the third refrigerant flow switching device 143 are first switched as illustrated in Fig. 21. Further, the opening and closing devices 33a and 33b are closed.

[0366] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0367] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows into the heat source-side heat exchanger 13 via the first refrigerant flow switching device 12. The high-temperature, high-pressure gas refrigerant flowing into the heat source-side heat exchanger 13 condenses while exchanging heat with and transferring heat to the outdoor air, and flows from the heat source-side heat exchanger 13 as two-phase gas-liquid refrigerant.

[0368] The two-phase gas-liquid refrigerant flowing from the heat source-side heat exchanger 13 flows from the outdoor unit 10 via the check valve 14d, and flows into the intermediate heat exchanger 130.

[0369] The two-phase gas-liquid refrigerant flowing into the intermediate heat exchanger 130 flows into the first intermediate heat exchanger 31a via the second refrigerant flow switching device 34a.

[0370] The two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31a as liquid refrigerant.

[0371] The liquid refrigerant flowing from the first intermediate heat exchanger 31a is reduced in pressure and expanded by the expansion device 32a to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32a.

[0372] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32a flows into the first intermediate heat exchanger 31b via the expansion device 32b. Further, the low-temperature, low-pressure, two-phase gas-liquid refrigerant flows from the intermediate heat exchanger 130, and also flows into the heat storage reservoir 140 via the corresponding refrigerant pipe 7.

[0373] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31b exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31b as low-pressure gas refrigerant.

[0374] The low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31b flows from the intermediate heat exchanger 130 via the second refrigerant flow switching device 34b, and flows into the outdoor unit 10.

[0375] Further, the low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the heat storage reservoir 140 flows into the second intermediate heat exchanger 141 via the expansion device 142.

[0376] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the second intermediate heat exchanger 141 exchanges heat with and receives heat from the heat medium in the heat storage tank 41 to evaporate and thereby cool the heat medium, and flows from the second intermediate heat exchanger 141 as low-pressure gas refrigerant.

[0377] The low-pressure gas refrigerant flowing from the second intermediate heat exchanger 141 flows from the heat storage reservoir 140 via the third refrigerant flow switching device 143, and flows into the intermediate heat exchanger 130 via the corresponding refrigerant pipe 7.

[0378] The low-pressure gas refrigerant flowing into the intermediate heat exchanger 130 directly flows from the intermediate heat exchanger 130, and flows into the outdoor unit 10.

[0379] The low-pressure gas refrigerant flowing into the outdoor unit 10 is suctioned into the compressor 11 via the check valve 14a and the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Heating Energy Storage in Cooling Main Operation Mode]

[0380] Fig. 22 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 16 in heating energy storage in the cooling main operation mode.

[0381] In Fig. 22, a passage indicated by a bold line is a refrigerant passage in the storage of heating energy into the heat storage reservoir 140 in the cooling main operation mode. The flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0382] In this case, the first refrigerant flow switching device 12, the second refrigerant flow switching devices 34a and 34b, and the third refrigerant flow switching device 143 are first switched as illustrated in Fig. 22. Further, the opening and closing devices 33a and 33b are closed.

[0383] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0384] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows into the heat source-side heat exchanger 13 via the first refrigerant flow switching device 12. The high-temperature, high-pressure gas refrigerant flowing into the heat

source-side heat exchanger 13 condenses while exchanging heat with and transferring heat to the outdoor air, and flows from the heat source-side heat exchanger 13 as two-phase gas-liquid refrigerant.

[0385] The two-phase gas-liquid refrigerant flowing from the heat source-side heat exchanger 13 flows from the outdoor unit 10 via the check valve 14d, and flows into the intermediate heat exchanger 130.

[0386] The two-phase gas-liquid refrigerant flowing into the intermediate heat exchanger 130 flows into the first intermediate heat exchanger 31a via the second refrigerant flow switching device 34a. Further, the two-phase gas-liquid refrigerant directly flows from the intermediate heat exchanger 130, and also flows into the heat storage reservoir 140 via the corresponding refrigerant pipe 7.

[0387] The two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31a as liquid refrigerant.

[0388] The liquid refrigerant flowing from the first intermediate heat exchanger 31a is reduced in pressure and expanded by the expansion device 32a to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32a.

[0389] Further, the two-phase gas-liquid refrigerant flowing into the heat storage reservoir 140 flows into the second intermediate heat exchanger 141 via the third refrigerant flow switching device 143.

[0390] The two-phase gas-liquid refrigerant flowing into the second intermediate heat exchanger 141 condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the second intermediate heat exchanger 141 as subcooled high-pressure liquid refrigerant.

[0391] The high-pressure liquid refrigerant flowing from the second intermediate heat exchanger 141 is reduced in pressure and expanded by the expansion device 142 to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 142.

[0392] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 142 flows from the heat storage reservoir 140, and flows into the intermediate heat exchanger 130 via the corresponding refrigerant pipe 7.

[0393] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32a and the low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 142 into the intermediate heat exchanger 130 flow into the first intermediate heat exchanger 31b via the expansion device 32b.

[0394] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31b exchanges heat with and receives

heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31b as low-pressure gas refrigerant.

[0395] The low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31b flows from the intermediate heat exchanger 130 via the second refrigerant flow switching device 34b, and flows into the outdoor unit 10.

[0396] The low-pressure gas refrigerant flowing into the outdoor unit 10 is suctioned into the compressor 11 via the check valve 14a and the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Cooling Energy Storage in Heating Main Operation Mode]

[0397] Fig. 23 is a schematic diagram for illustrating a flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 16 in cooling energy storage in the heating main operation mode.

[0398] In Fig. 23, a passage indicated by a bold line is a refrigerant passage in the storage of cooling energy into the heat storage reservoir 140 in the heating main operation mode. The flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0399] In this case, the first refrigerant flow switching device 12, the second refrigerant flow switching devices 34a and 34b, and the third refrigerant flow switching device 143 are first switched as illustrated in Fig. 23. Further, the opening and closing devices 33a and 33b are closed.

[0400] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0401] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows from the outdoor unit 10 via the first refrigerant flow switching device 12 and the check valve 14c provided to the second connecting pipe 2b, and flows into the intermediate heat exchanger 130.

[0402] The high-temperature, high-pressure gas refrigerant flowing into the intermediate heat exchanger 130 flows into the first intermediate heat exchanger 31b via the second refrigerant flow switching device 34b.

[0403] The high-temperature, high-pressure gas refrigerant flowing into the first intermediate heat exchanger 31b condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31b as subcooled high-pressure liquid refrigerant.

[0404] The high-pressure liquid refrigerant flowing from the first intermediate heat exchanger 31b is reduced in pressure and expanded by the expansion device 32b to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32b.

[0405] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32b flows into the first intermediate heat exchanger 31a via the expansion device 32a. Further, the low-temperature, low-pressure, two-phase gas-liquid refrigerant flows from the intermediate heat exchanger 130, and also flows into the heat storage reservoir 140 via the corresponding refrigerant pipe 7.

[0406] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31a as low-pressure gas refrigerant.

[0407] The low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31a flows from the intermediate heat exchanger 130 via the second refrigerant flow switching device 34a, and flows into the outdoor unit 10.

[0408] Further, the low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the heat storage reservoir 140 flows into the second intermediate heat exchanger 141 via the expansion device 142.

[0409] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the second intermediate heat exchanger 141 exchanges heat with and receives heat from the heat medium in the heat storage tank 41 to evaporate and thereby cool the heat medium, and flows from the second intermediate heat exchanger 141 as low-pressure gas refrigerant.

[0410] The low-pressure gas refrigerant flowing from the second intermediate heat exchanger 141 flows from the heat storage reservoir 140 via the third refrigerant flow switching device 143, and flows into the intermediate heat exchanger 130 via the corresponding refrigerant pipe 7.

[0411] The low-pressure gas refrigerant flowing into the intermediate heat exchanger 130 directly flows from the intermediate heat exchanger 130, and flows into the outdoor unit 10.

[0412] The low-pressure gas refrigerant flowing into the outdoor unit 10 flows into the heat source-side heat exchanger 13 via the check valve 14b provided to the first connecting pipe 2a.

[0413] The low-pressure gas refrigerant flowing into the heat source-side heat exchanger 13 exchanges heat with and receives heat from the outdoor air to evaporate, and flows from the heat source-side heat exchanger 13.

[0414] The low-pressure gas refrigerant flowing from the heat source-side heat exchanger 13 is suctioned into the compressor 11 via the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Heating Energy Storage in Heating Main Operation Mode]

[0415] Fig. 24 is a schematic diagram for illustrating a

flow passage of the refrigerant in the refrigerant cycle circuit 5 of Fig. 16 in heating energy storage in the heating main operation mode.

[0416] In Fig. 24, a passage indicated by a bold line is a refrigerant passage in the storage of heating energy into the heat storage reservoir 140 in the heating main operation mode. The flow direction of the refrigerant in the refrigerant passage is indicated by arrows.

[0417] In this case, the first refrigerant flow switching device 12, the second refrigerant flow switching devices 34a and 34b, and the third refrigerant flow switching device 143 are first switched as illustrated in Fig. 24. Further, the opening and closing devices 33a and 33b are closed.

[0418] Low-temperature, low-pressure refrigerant is compressed by the compressor 11 and discharged as high-temperature, high-pressure gas refrigerant.

[0419] The high-temperature, high-pressure gas refrigerant discharged from the compressor 11 flows from the outdoor unit 10 via the first refrigerant flow switching device 12 and the check valve 14c provided to the second connecting pipe 2b, and flows into the intermediate heat exchanger 130.

[0420] The high-temperature, high-pressure gas refrigerant flowing into the intermediate heat exchanger 130 flows into the first intermediate heat exchanger 31b via the second refrigerant flow switching device 34b. Further, the high-temperature, high-pressure gas refrigerant flows from the intermediate heat exchanger 130, and also flows into the heat storage reservoir 140 via the corresponding refrigerant pipe 7.

[0421] The high-temperature, high-pressure gas refrigerant flowing into the first intermediate heat exchanger 31b condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the first intermediate heat exchanger 31b as subcooled high-pressure liquid refrigerant.

[0422] The high-pressure liquid refrigerant flowing from the first intermediate heat exchanger 31b is reduced in pressure and expanded by the expansion device 32b to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 32b.

[0423] Further, the high-temperature, high-pressure gas refrigerant flowing into the heat storage reservoir 140 flows into the second intermediate heat exchanger 141 via the third refrigerant flow switching device 143.

[0424] The high-temperature, high-pressure gas refrigerant flowing into the second intermediate heat exchanger 141 condenses while exchanging heat with and transferring heat to the heat medium to thereby heat the heat medium, and flows from the second intermediate heat exchanger 141 as subcooled high-pressure liquid refrigerant.

[0425] The high-pressure liquid refrigerant flowing from the second intermediate heat exchanger 141 is reduced in pressure and expanded by the expansion de-

vice 142 to turn into low-temperature, low-pressure, two-phase gas-liquid refrigerant, and flows from the expansion device 142.

[0426] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 142 flows from the heat storage reservoir 140, and flows into the intermediate heat exchanger 130 via the corresponding refrigerant pipe 7.

[0427] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the intermediate heat exchanger 130 flows from the intermediate heat exchanger 130 via the opening and closing device 33b, and flows into the outdoor unit 10.

[0428] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the expansion device 32b and the low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing from the heat storage reservoir 140 into the intermediate heat exchanger 130 flow into the first intermediate heat exchanger 31a via the expansion device 32a.

[0429] The low-temperature, low-pressure, two-phase gas-liquid refrigerant flowing into the first intermediate heat exchanger 31a exchanges heat with and receives heat from the heat medium to evaporate and thereby cool the heat medium, and flows from the first intermediate heat exchanger 31a as low-pressure gas refrigerant.

[0430] The low-pressure gas refrigerant flowing from the first intermediate heat exchanger 31a flows from the intermediate heat exchanger 130 via the second refrigerant flow switching device 34a, and flows into the outdoor unit 10.

[0431] The low-pressure gas refrigerant flowing into the outdoor unit 10 flows into the heat source-side heat exchanger 13 via the check valve 14b provided to the first connecting pipe 2a.

[0432] The low-pressure gas refrigerant flowing into the heat source-side heat exchanger 13 exchanges heat with and receives heat from the outdoor air to evaporate, and flows from the heat source-side heat exchanger 13.

[0433] The low-pressure gas refrigerant flowing from the heat source-side heat exchanger 13 is suctioned into the compressor 11 via the first refrigerant flow switching device 12. Thereafter, the above-described cycle is repeated.

[Process of Determining whether or not to Use Heat Storage Reservoir]

[0434] The process of determining whether or not to use the heat storage reservoir 140 in Embodiment 2 is similar to the above-described process of determining whether or not to use the heat storage reservoir 40 in Embodiment 1, and thus description thereof will be omitted here.

[0435] As described above, in Embodiment 2, the second intermediate heat exchanger 141 is provided to the heat storage reservoir 140 to enable the heat medium in the heat storage tank 41 to be cooled or heated by the

refrigerant circulating through the refrigerant cycle circuit 5. It is thereby possible to store cooling energy or heating energy in the heat storage tank 41 without operating the pumps 35a and 35b provided to the heat medium cycle circuit 6.

[0436] That is, the use of the heat in the refrigerant cycle circuit 5 enables energy saving.

[0437] Further, in Embodiment 2, it is possible to store cooling energy or heating energy in the heat medium in the heat storage tank 41 of the heat storage reservoir 140 in all of the operation modes. Accordingly, it is possible to store necessary heat in accordance with the need of a user.

[0438] It is preferable to perform such heat storage into the heat storage reservoir 140 during a period to which low electric rate is applied, such as a nighttime period, for example. The heat storage performed during the nighttime period enables further energy saving.

Reference Signs List

[0439] 1, 101 air-conditioning apparatus 2 refrigerant pipe 2a first connecting pipe 2b second connecting pipe 3, 4 heat medium pipe 5 refrigerant cycle circuit 6 heat medium cycle circuit 7 refrigerant pipe 10 outdoor unit 11 compressor 12 first refrigerant flow switching device 13 heat source-side heat exchanger 14a, 14b, 14c, 14d check valve 20, 20a, 20b, 20c indoor unit 21, 21a, 21b, 21c use-side heat exchanger 22, 22a, 22b, 22c indoor temperature sensor 30, 130 intermediate heat exchanger 31a, 31b first intermediate heat exchanger 32a, 32b expansion device 33a, 33b opening and closing device 34a, 34b second refrigerant flow switching device 35a, 35b pump 36a, 36b first heat medium flow switching device 37a, 37b, 37c, 37d, 37e, 37f second heat medium flow switching device 38a, 38b, 38c, 38d heat medium temperature sensor 40, 140 heat storage reservoir 41 heat storage tank 42 tank temperature sensor 50 controller 141 second intermediate heat exchanger 142 expansion device 143 third refrigerant flow switching device

Claims

1. An air-conditioning apparatus comprising:

a refrigerant cycle circuit having a compressor, a heat source-side heat exchanger, an expansion device, and a refrigerant-side passage of a first intermediate heat exchanger connected by a refrigerant pipe to circulate refrigerant through the refrigerant cycle circuit;
a heat medium cycle circuit having a heat medium-side passage of the first intermediate heat exchanger and a use-side heat exchanger connected by a heat medium pipe to circulate a heat medium through the heat medium cycle circuit; and

a heat storage reservoir including a heat storage tank to store the heat medium, wherein the first intermediate heat exchanger is configured to exchange heat between the refrigerant and the heat medium, and wherein the heat medium cycle circuit includes a heat medium flow switching device configured to switch a passage to connect the heat storage reservoir to the heat medium cycle circuit and allow the heat medium to flow into and from the heat storage tank.

2. The air-conditioning apparatus of claim 1, wherein the heat storage reservoir further includes a second intermediate heat exchanger configured to exchange heat between the refrigerant and the heat medium stored in the heat storage tank, and wherein a refrigerant-side passage of the second intermediate heat exchanger is connected to the refrigerant cycle circuit.

3. The air-conditioning apparatus of claim 1 or 2, further comprising:

a controller configured to control the compressor and the expansion device;
a heat medium temperature sensor configured to detect a temperature of the heat medium flowing from the first intermediate heat exchanger;
an indoor temperature sensor configured to detect a temperature of a space provided with the use-side heat exchanger; and
a tank temperature sensor configured to detect a temperature of the heat medium in the heat storage tank, wherein the controller is configured to cause the heat medium flow switching device to switch the passage based on the temperature detected by the heat medium temperature sensor, the temperature detected by the indoor temperature sensor, and the temperature detected by the tank temperature sensor.

4. The air-conditioning apparatus of claim 3, wherein when the temperature detected by the heat medium temperature sensor is higher than the temperature detected by the tank temperature sensor in a cooling operation, the controller is configured to cause the heat medium flow switching device to switch the passage to connect the heat storage reservoir to the heat medium cycle circuit, and wherein when the temperature detected by the heat medium temperature sensor is lower than the temperature detected by the tank temperature sensor in a heating operation, the controller is configured to cause the heat medium flow switching device to switch the passage to connect the heat storage reservoir to the heat medium cycle circuit.

5. The air-conditioning apparatus of claim 3 or 4, wherein when the temperature detected by the heat medium temperature sensor is lower than the temperature detected by the tank temperature sensor when a cooling operation is stopped, the controller is configured to cause the heat medium flow switching device to switch the passage to connect the heat storage reservoir to the heat medium cycle circuit, and wherein when the temperature detected by the heat medium temperature sensor is higher than the temperature detected by the tank temperature sensor when a heating operation is stopped, the controller is configured to cause the heat medium flow switching device to switch the passage to connect the heat storage reservoir to the heat medium cycle circuit.
6. The air-conditioning apparatus of one of claims 3 to 5, wherein when the temperature detected by the tank temperature sensor is higher than a heating application temperature calculated based on the temperature detected by the indoor temperature sensor in a defrosting operation, the controller is configured to cause the heat medium flow switching device to switch the passage to connect the heat storage reservoir to the heat medium cycle circuit.
7. The air-conditioning apparatus of claim 2, wherein in a cooling operation, the second intermediate heat exchanger heats the heat medium stored in the heat storage tank, and wherein in a heating operation, the second intermediate heat exchanger cools the heat medium stored in the heat storage tank.

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FIG. 1

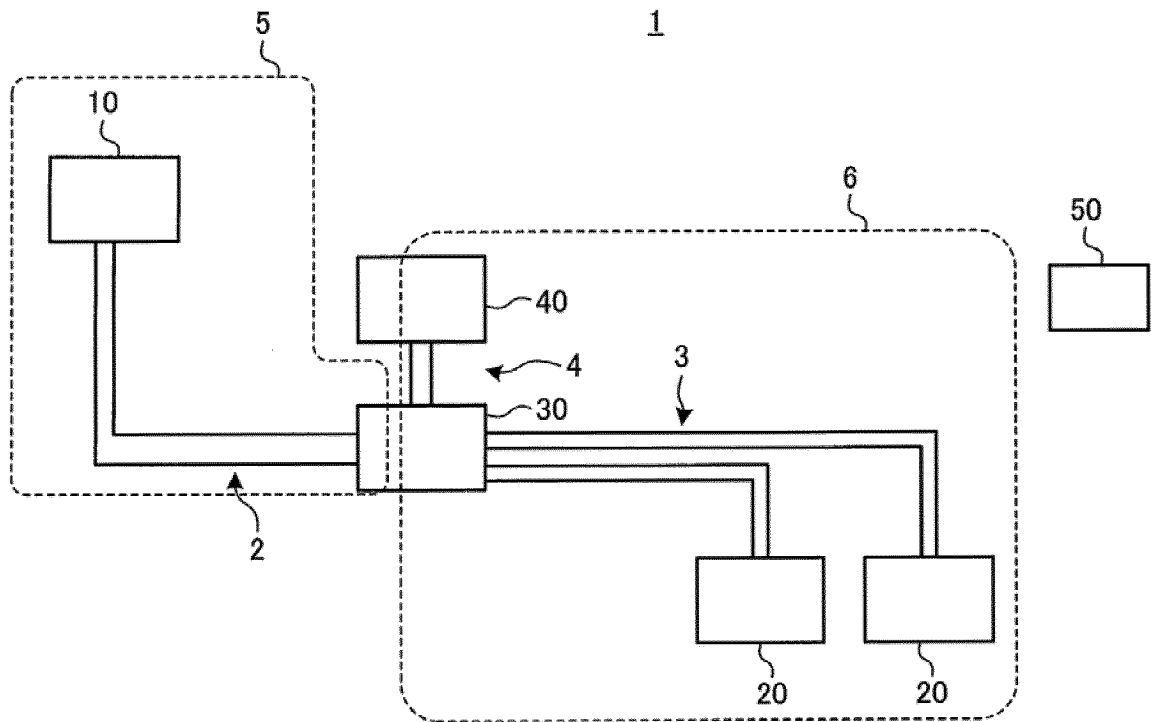


FIG. 2

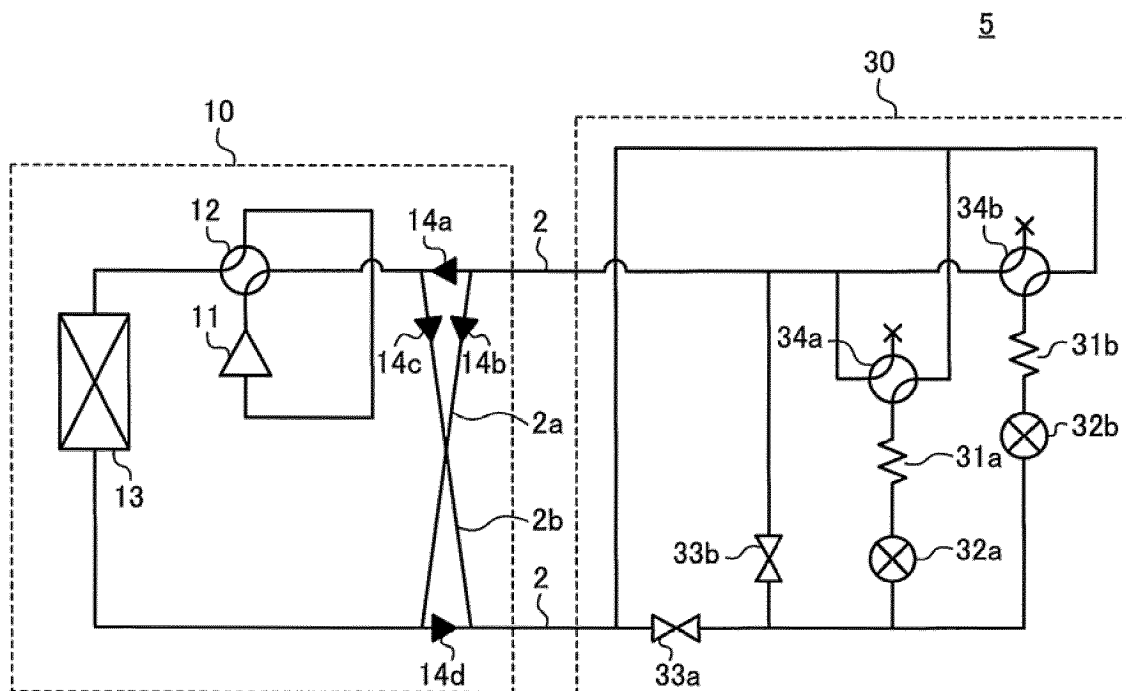


FIG. 3

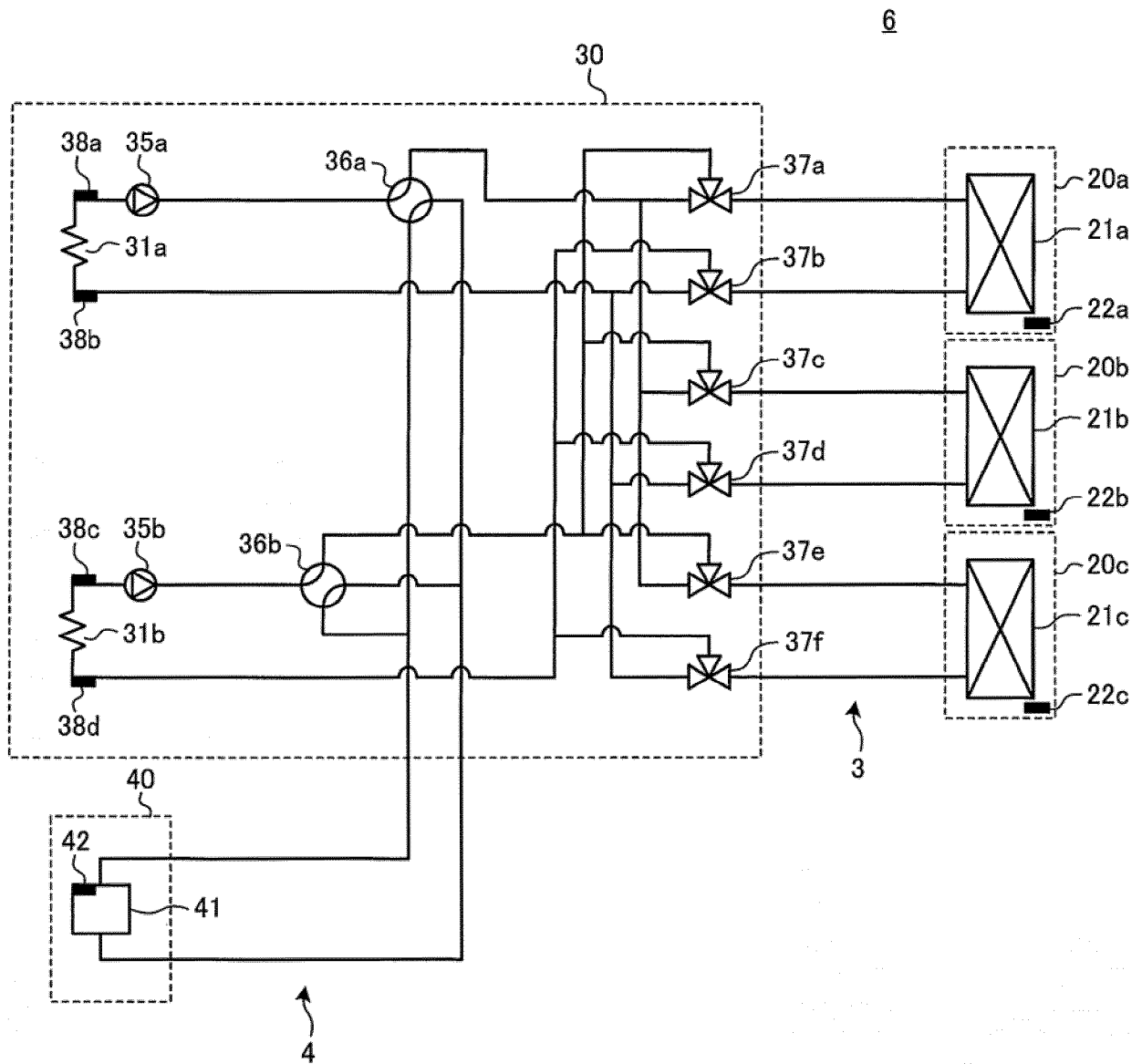


FIG. 4

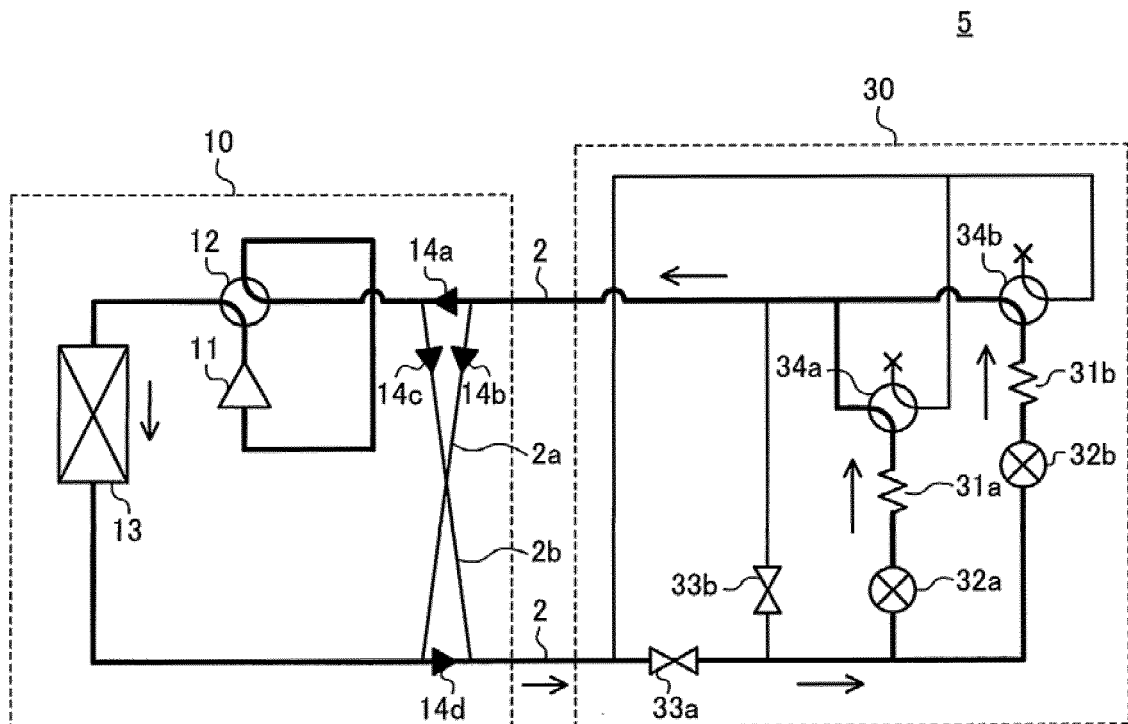


FIG. 5

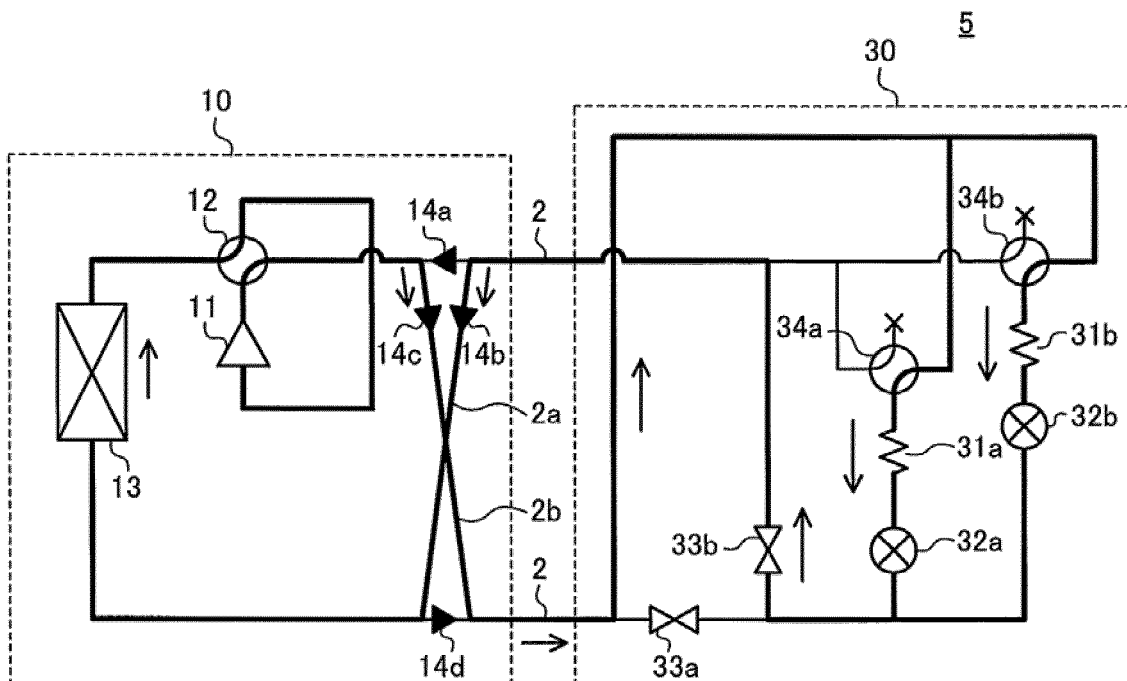


FIG. 6

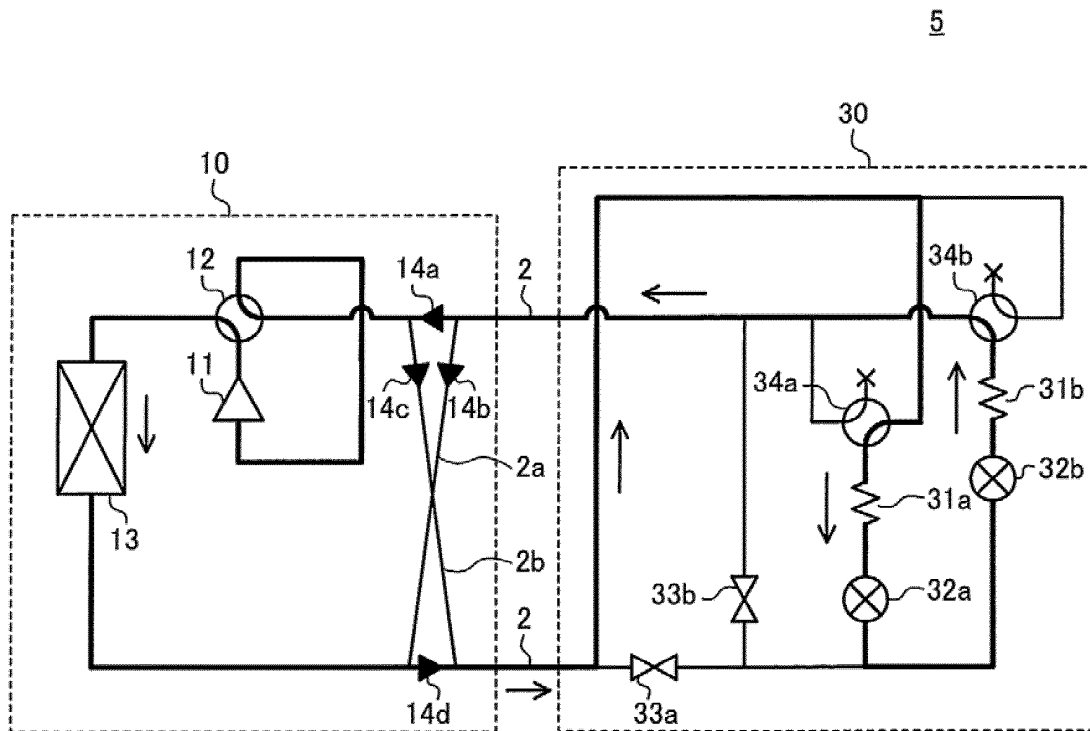


FIG. 7

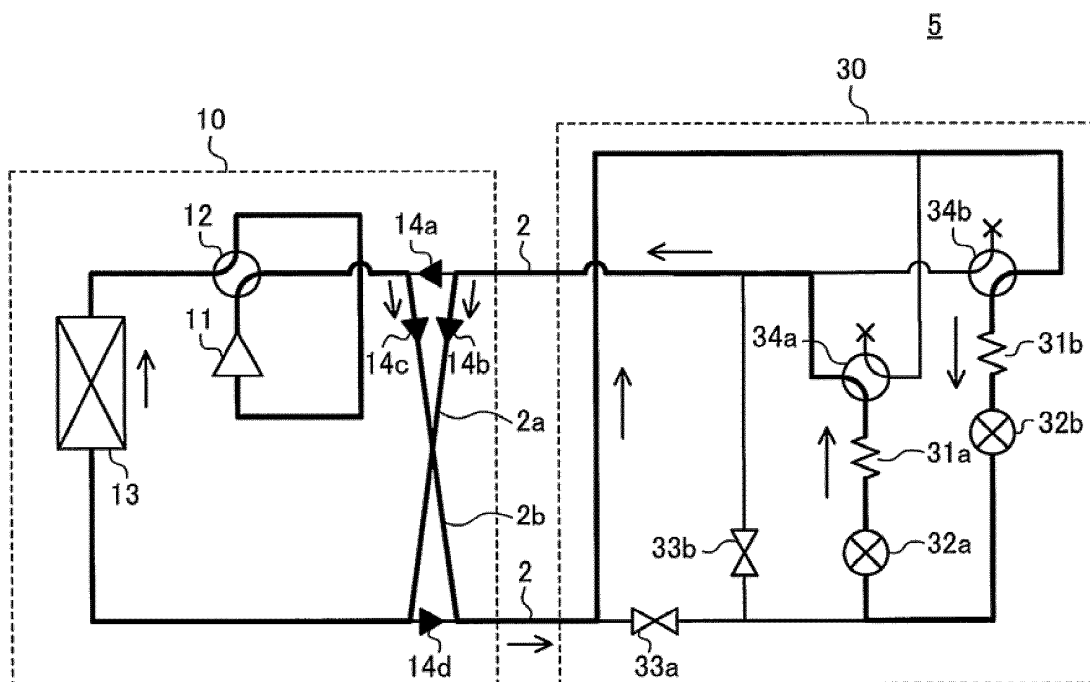


FIG. 8

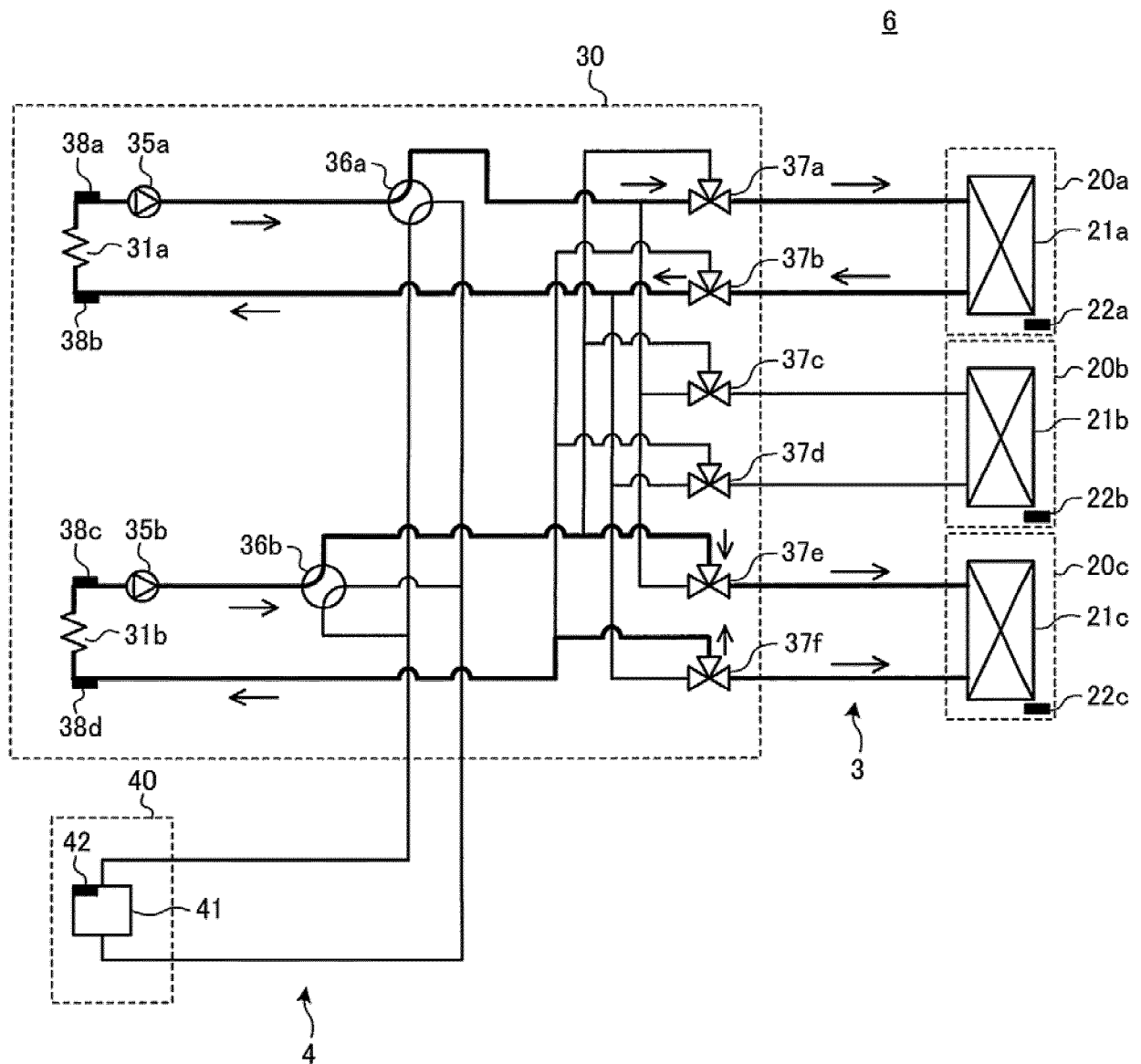


FIG. 9

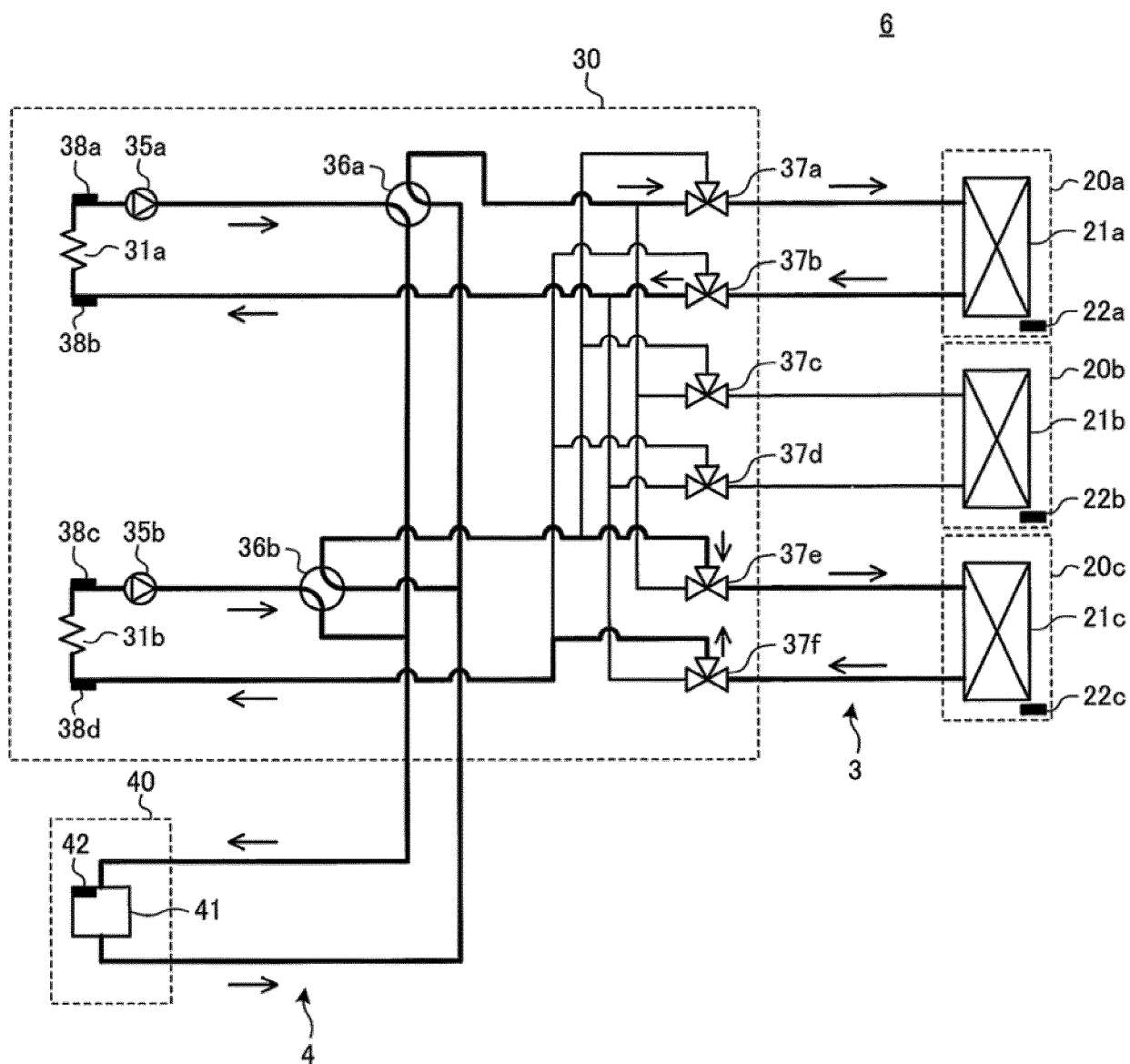


FIG. 10

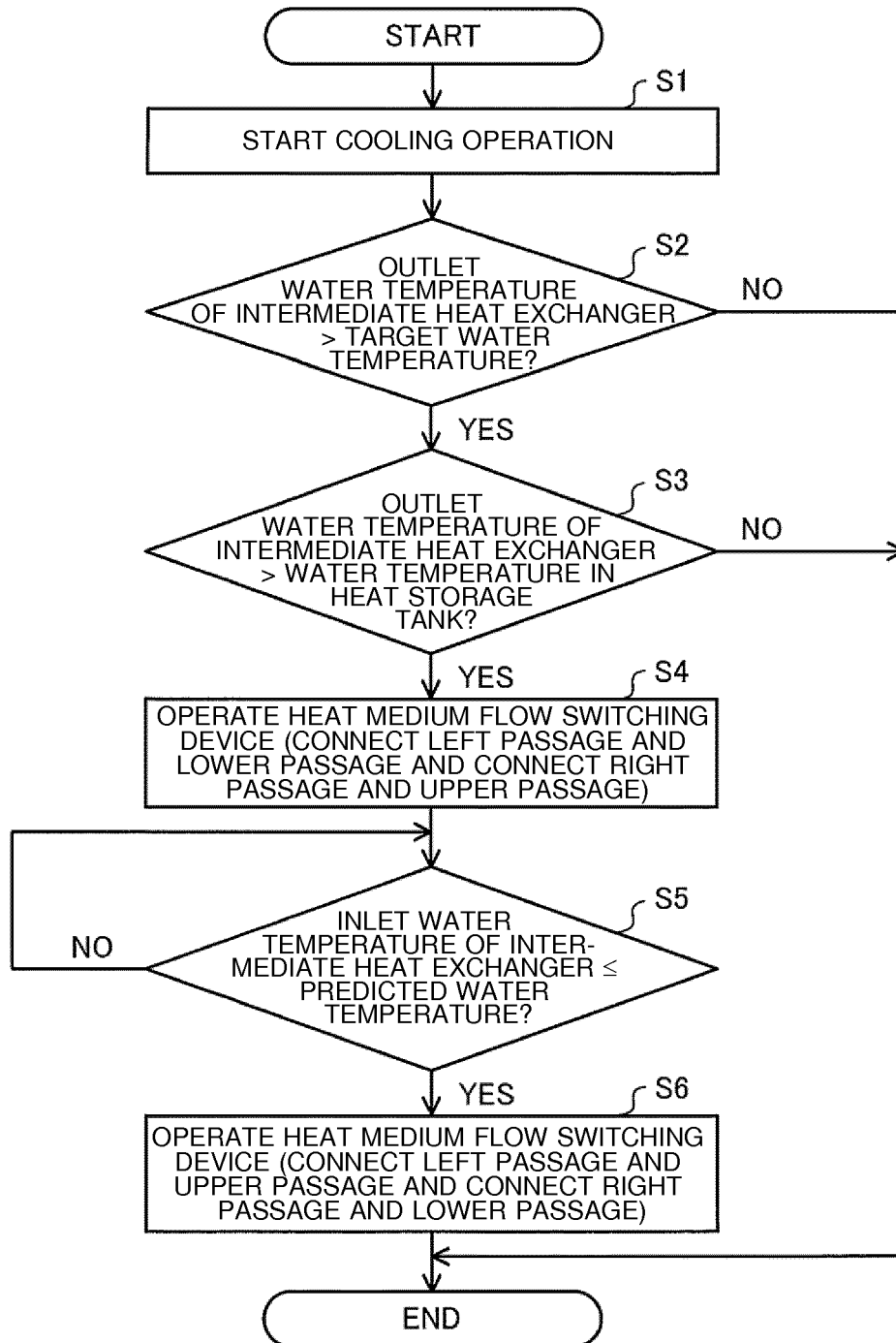


FIG. 11

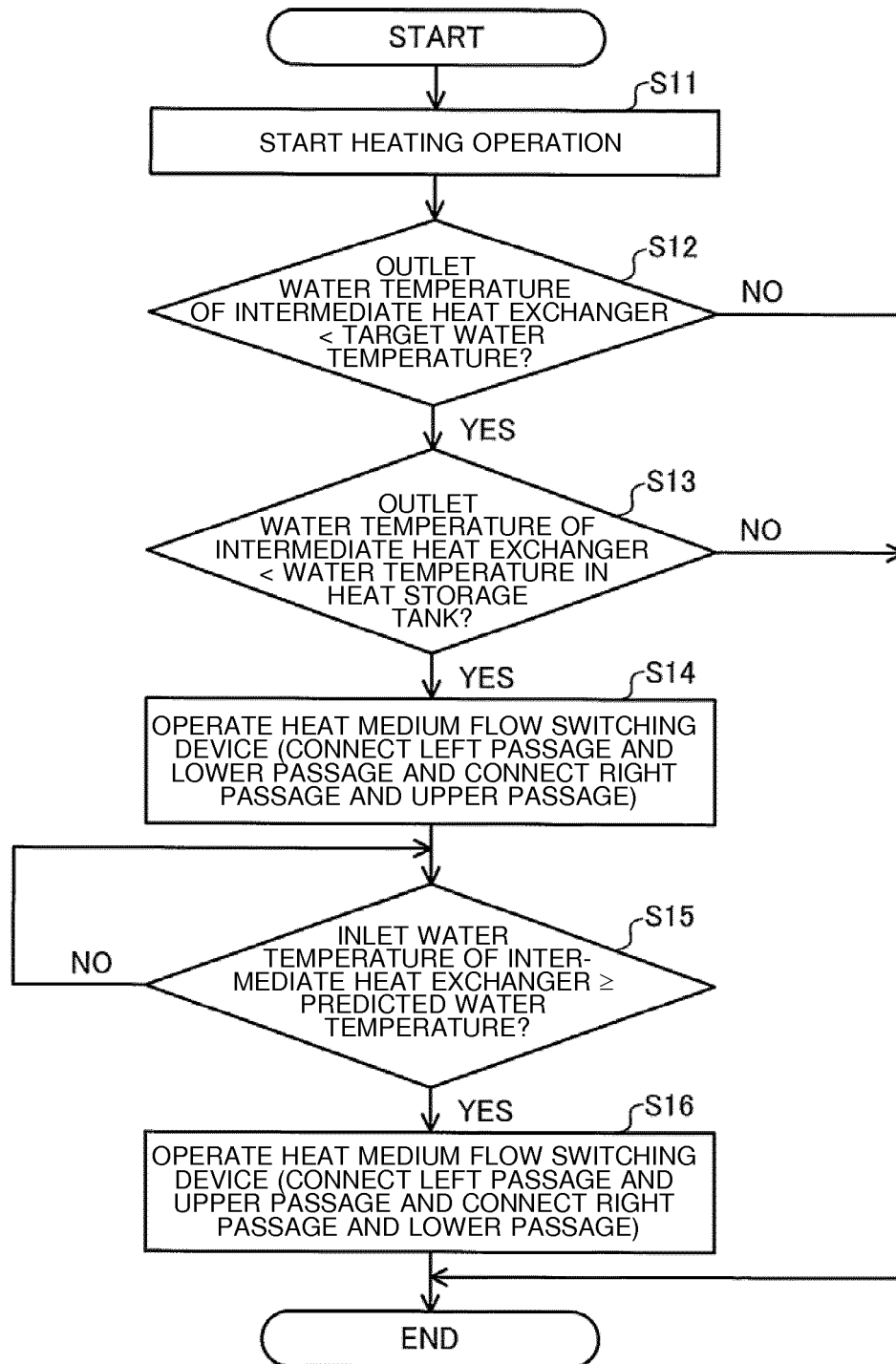


FIG. 12

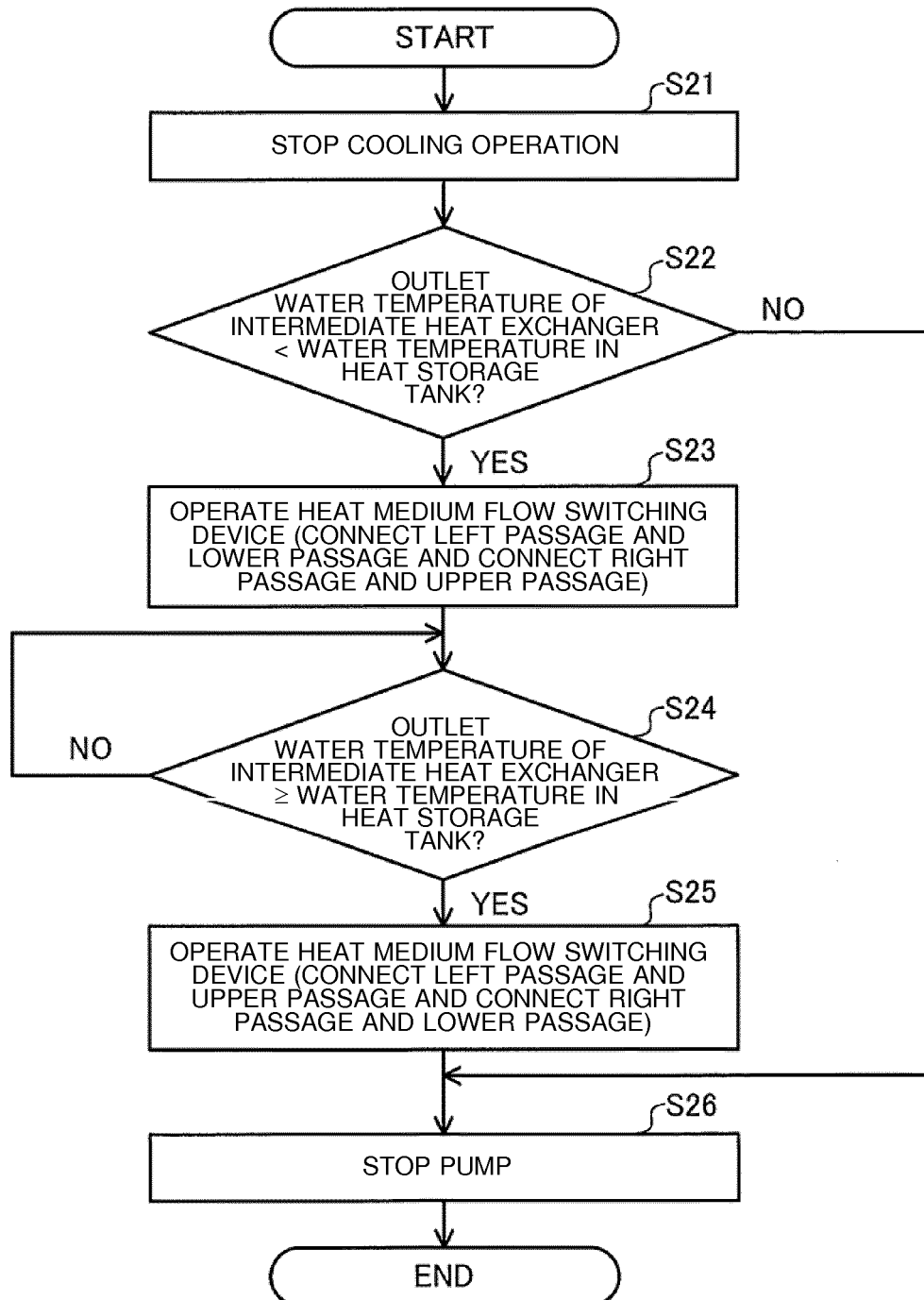


FIG. 13

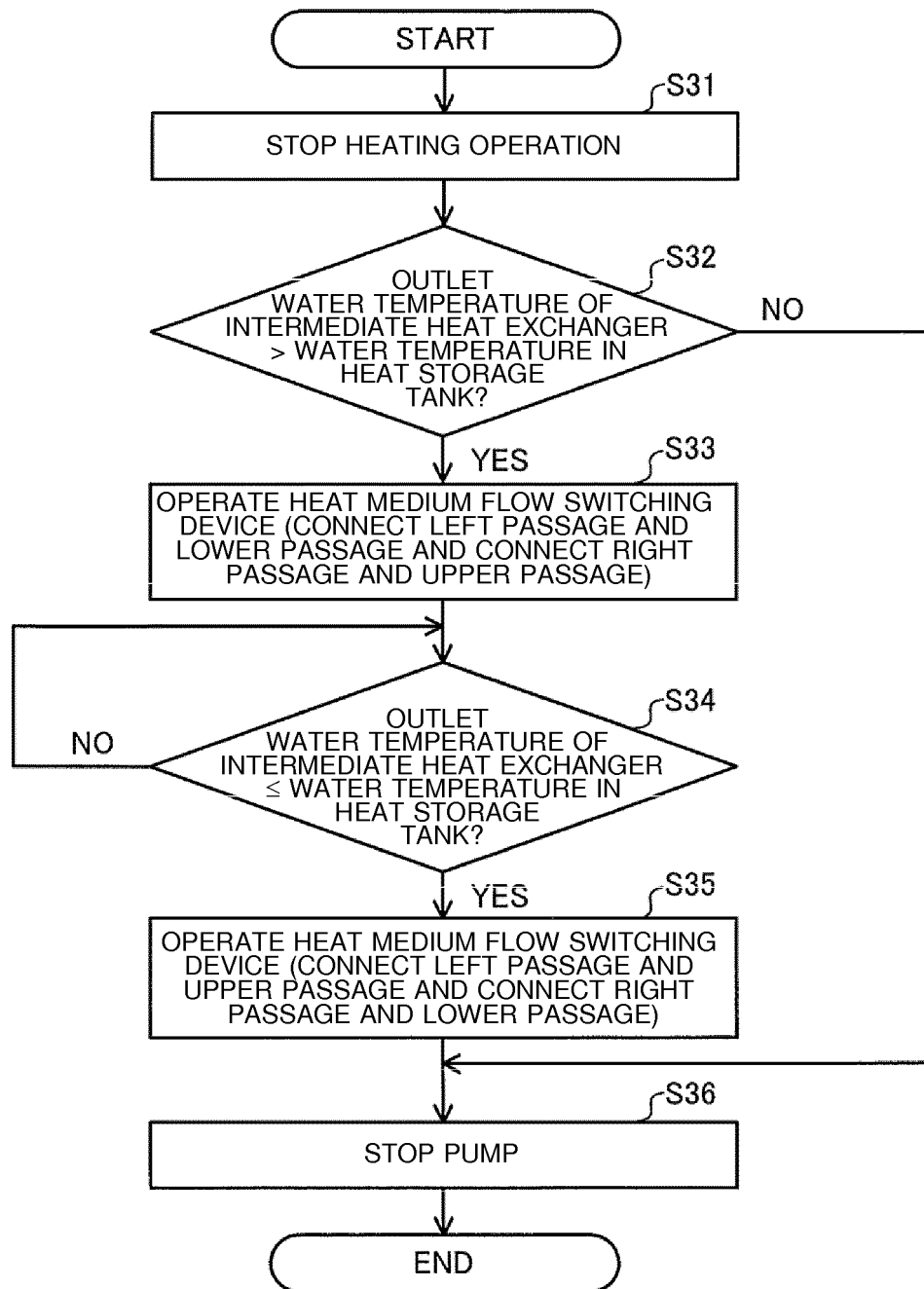


FIG. 14

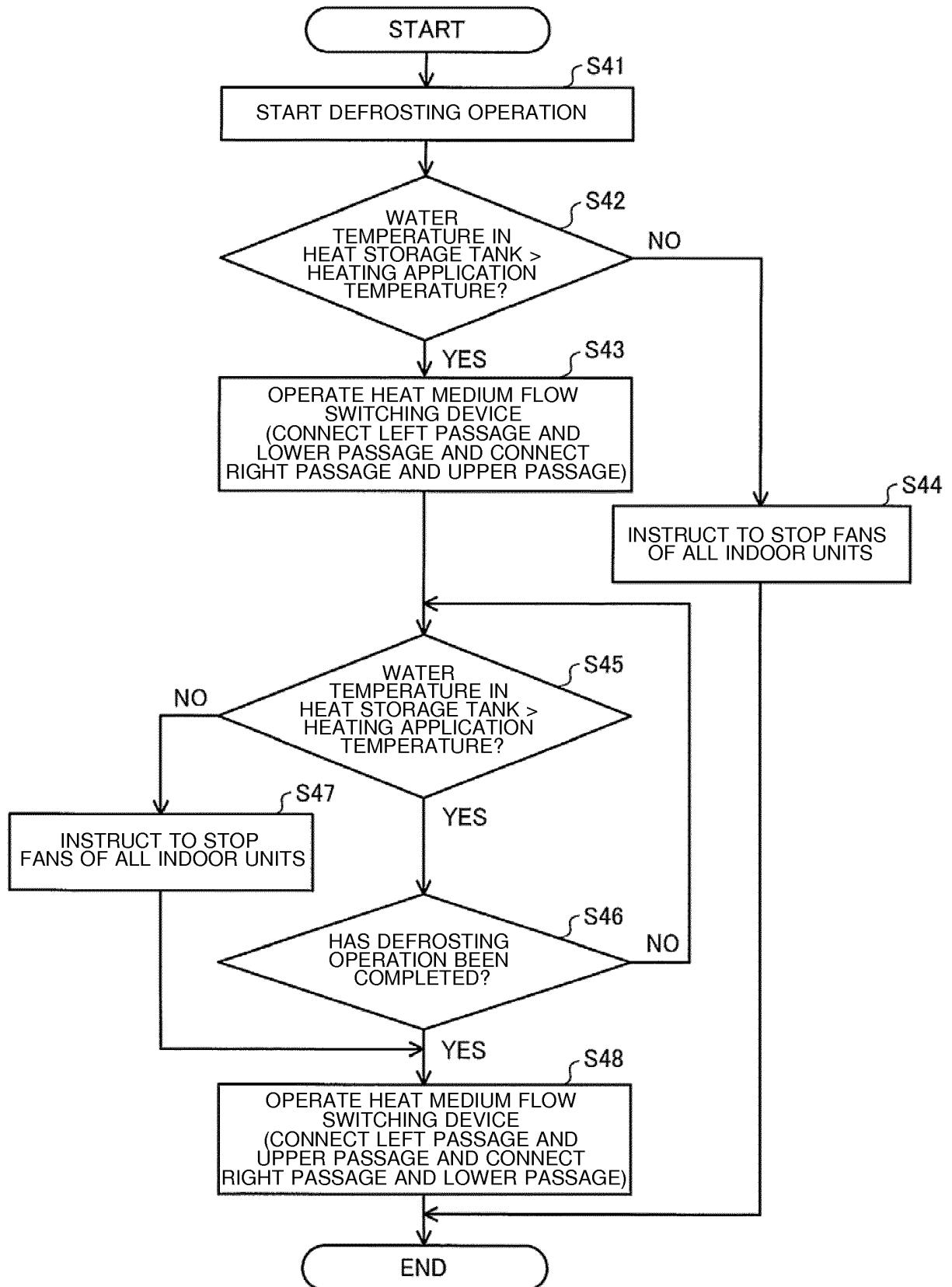


FIG. 15

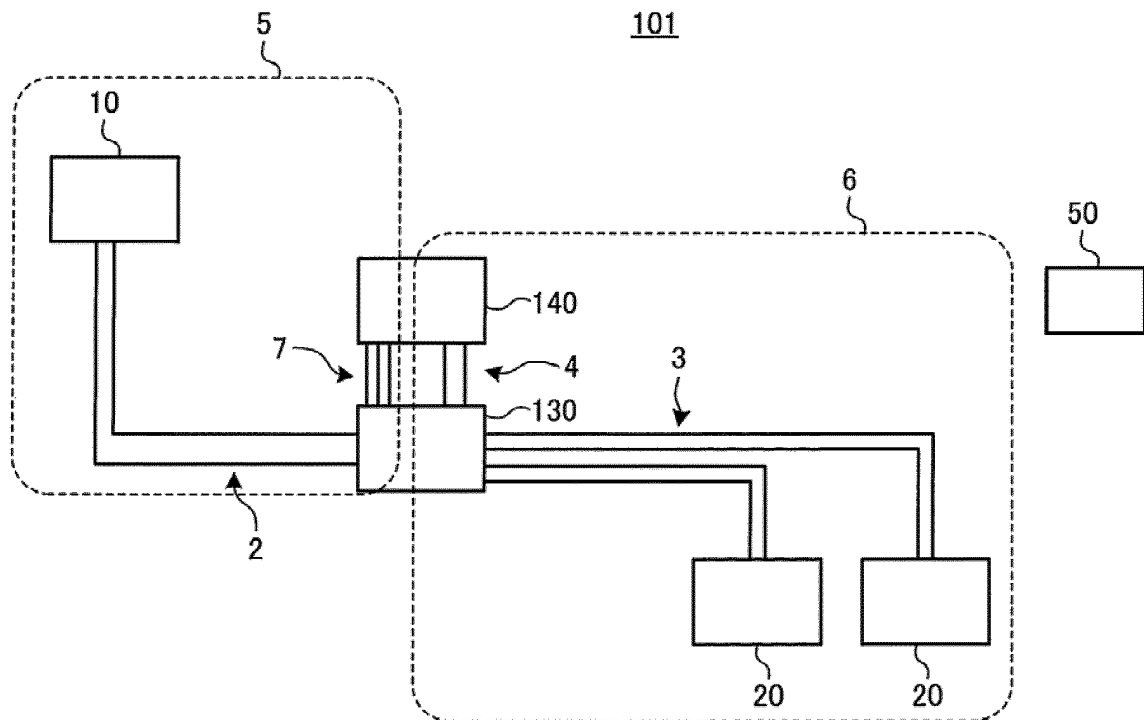


FIG. 16

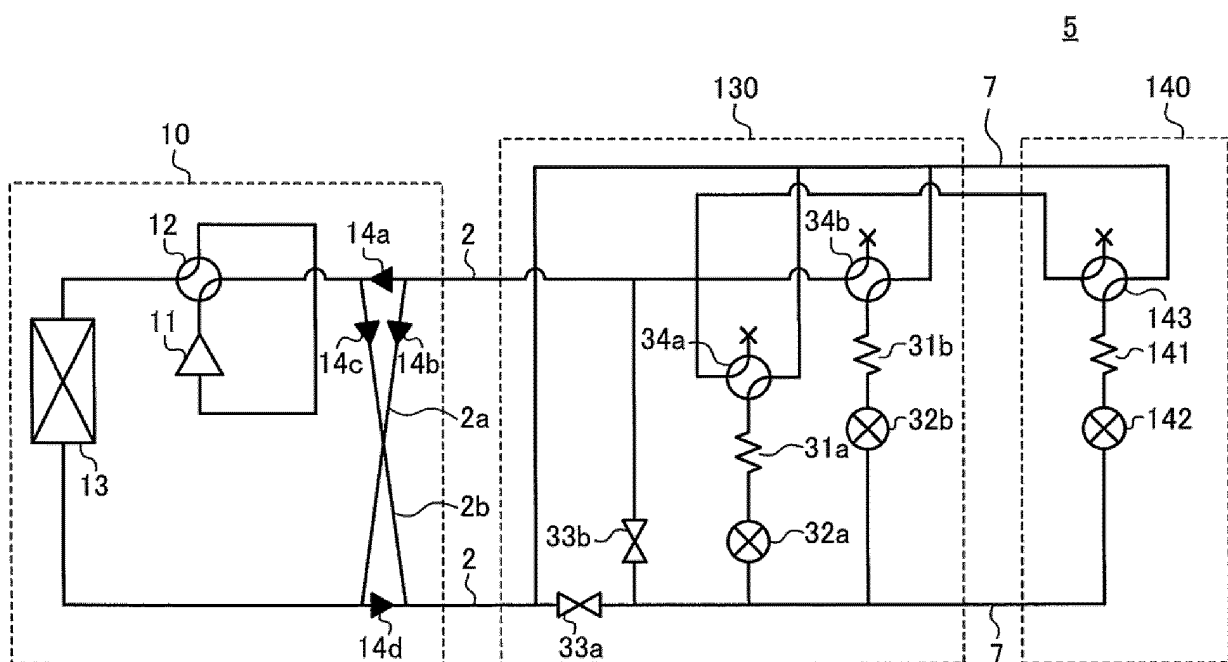


FIG. 17

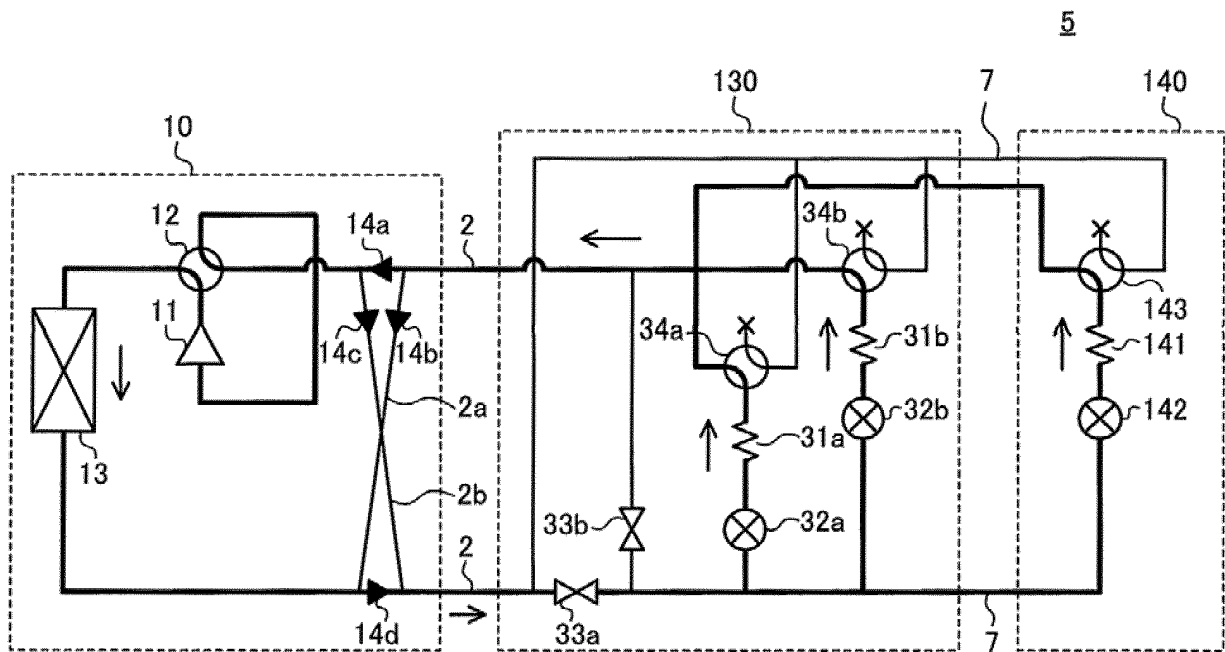


FIG. 18

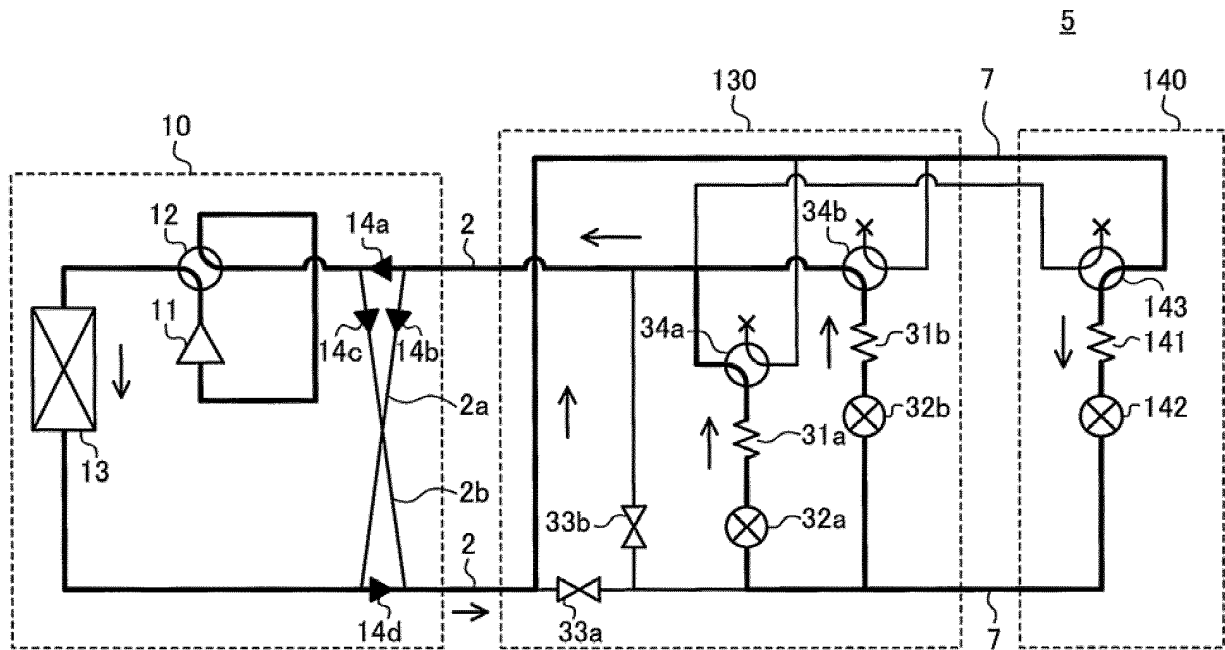


FIG. 19

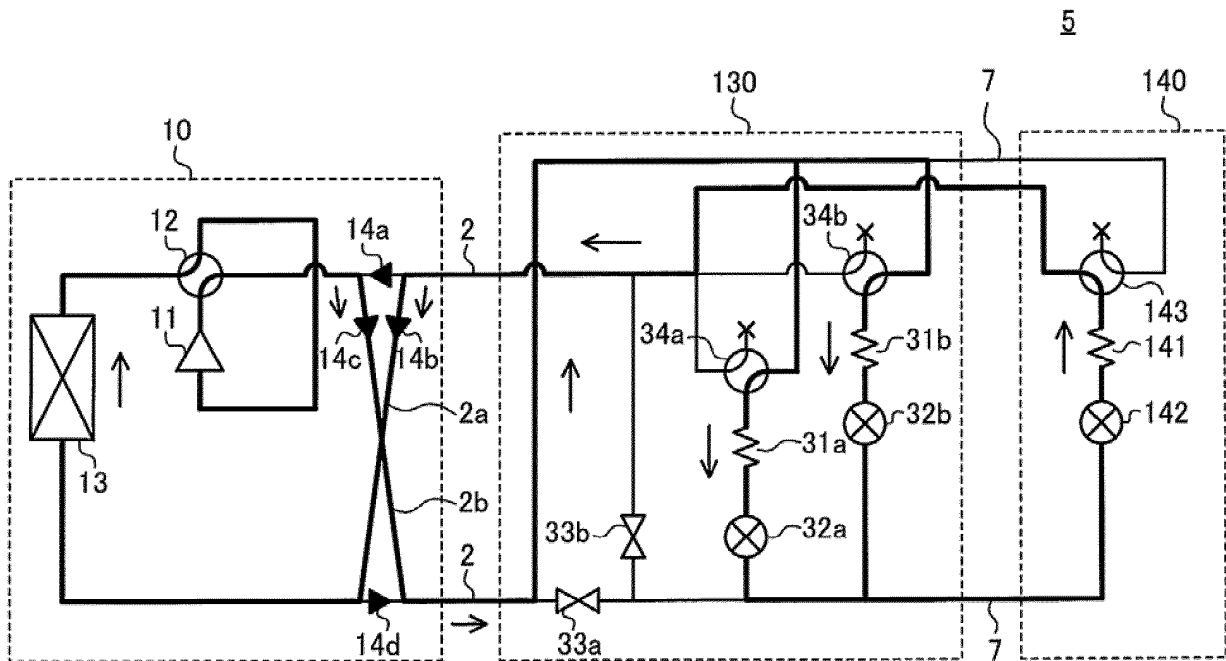


FIG. 20

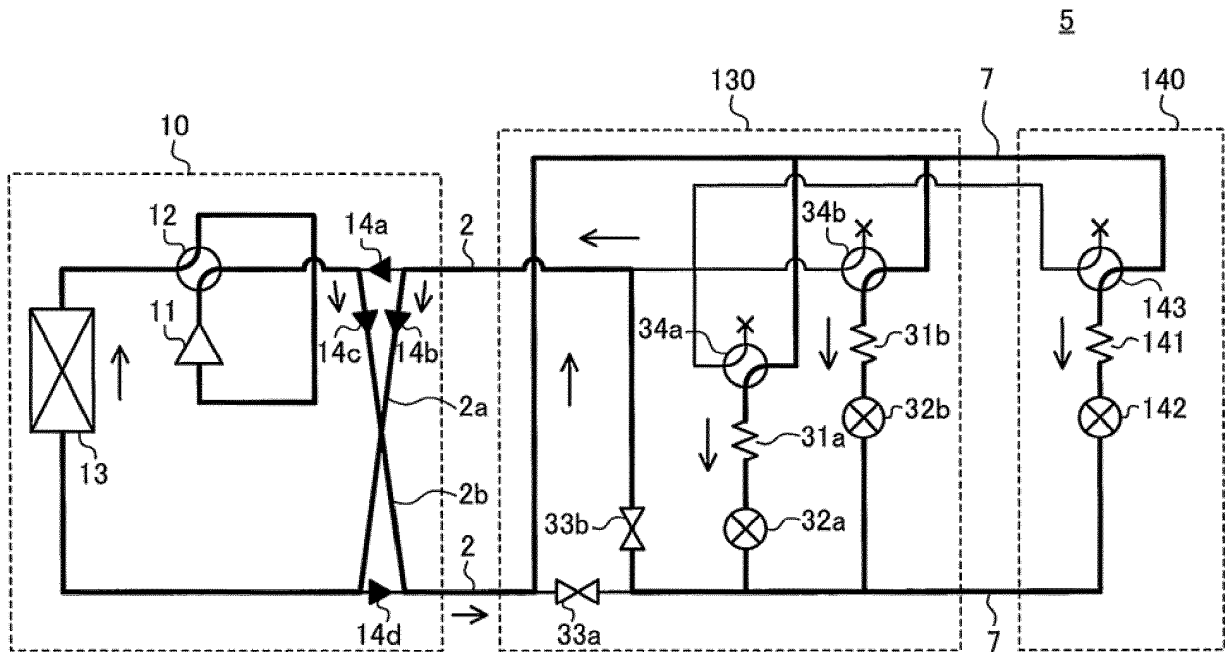


FIG. 21

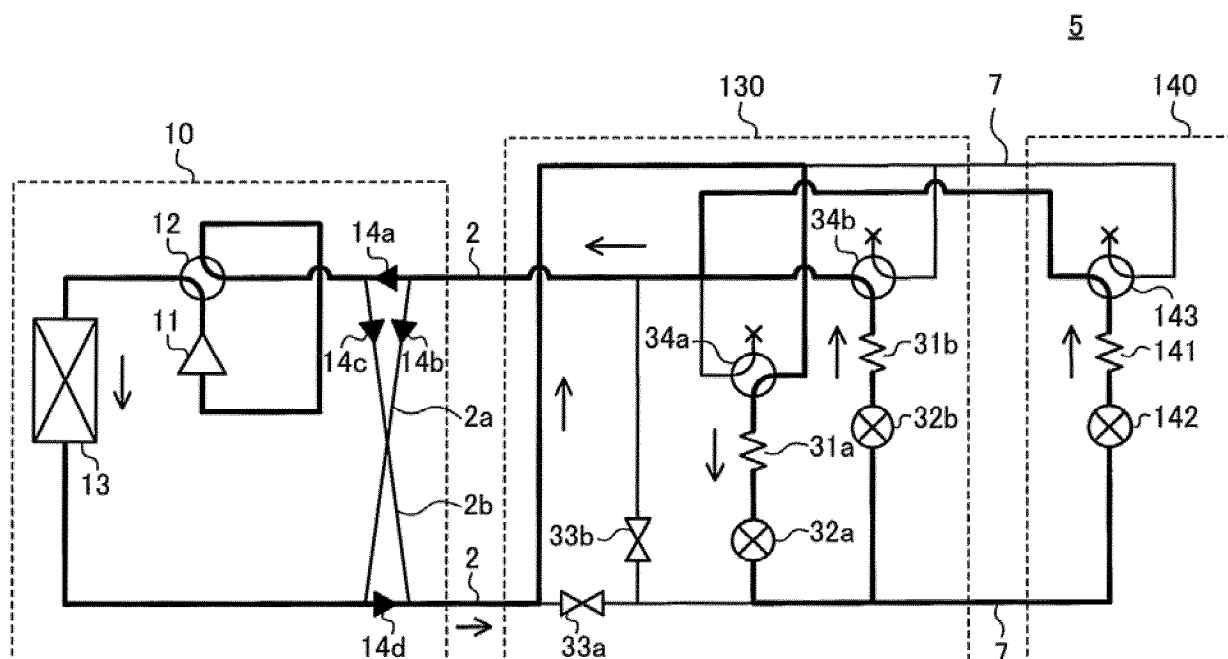


FIG. 22

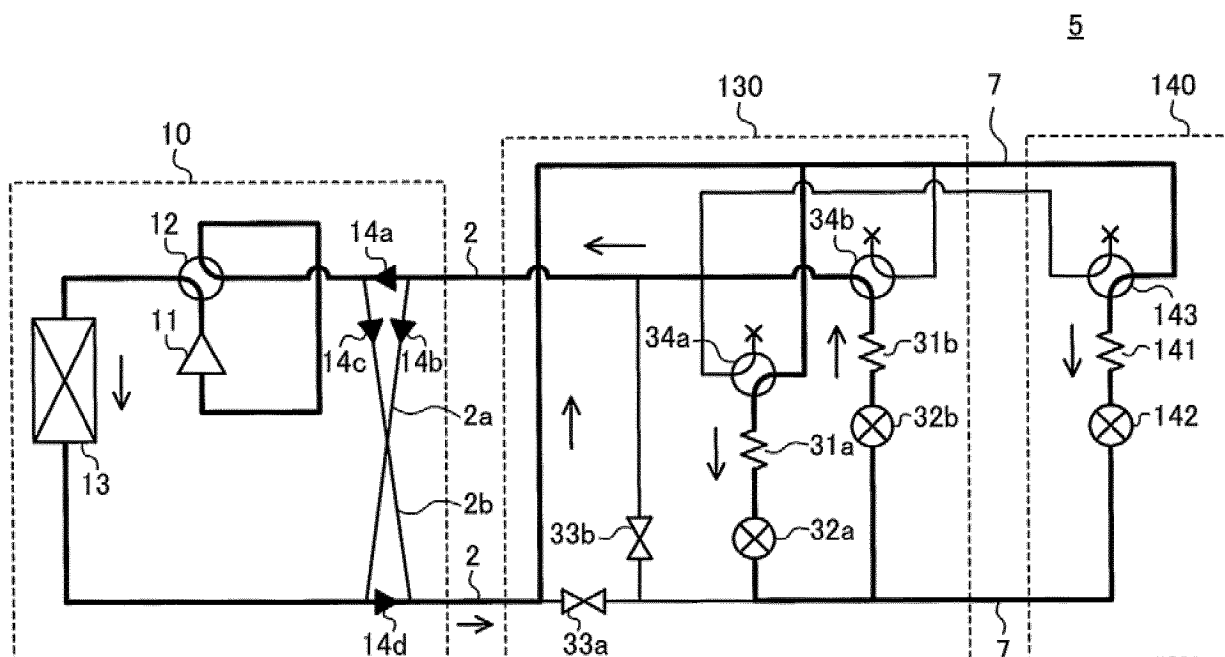


FIG. 23

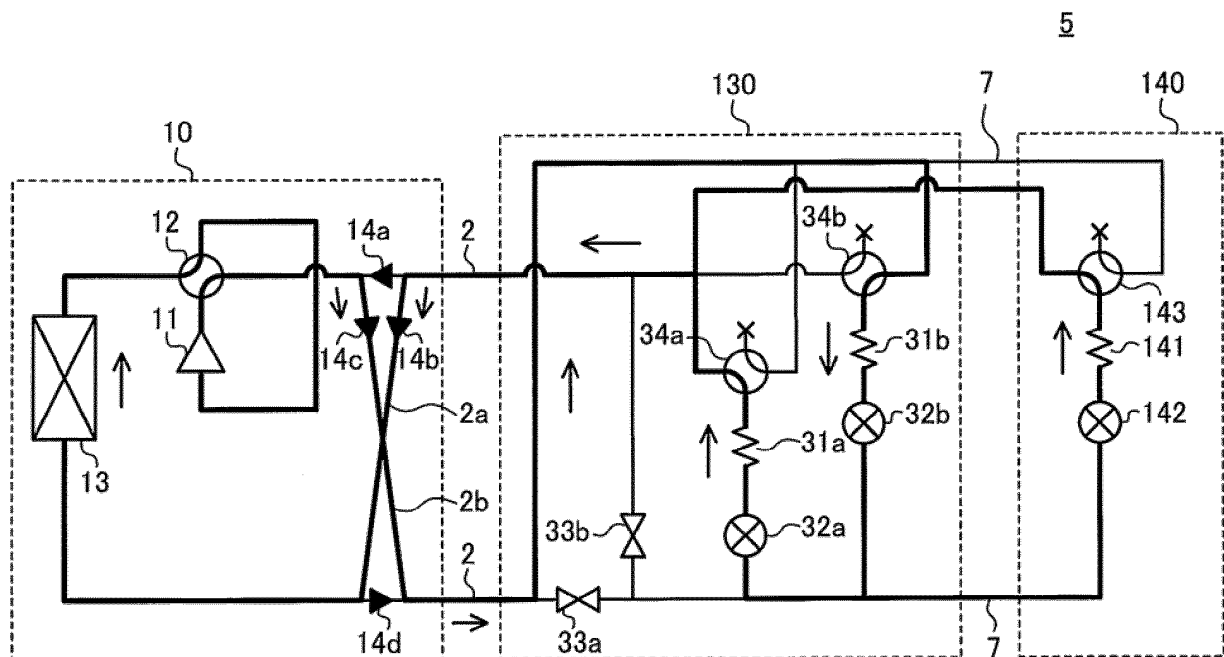
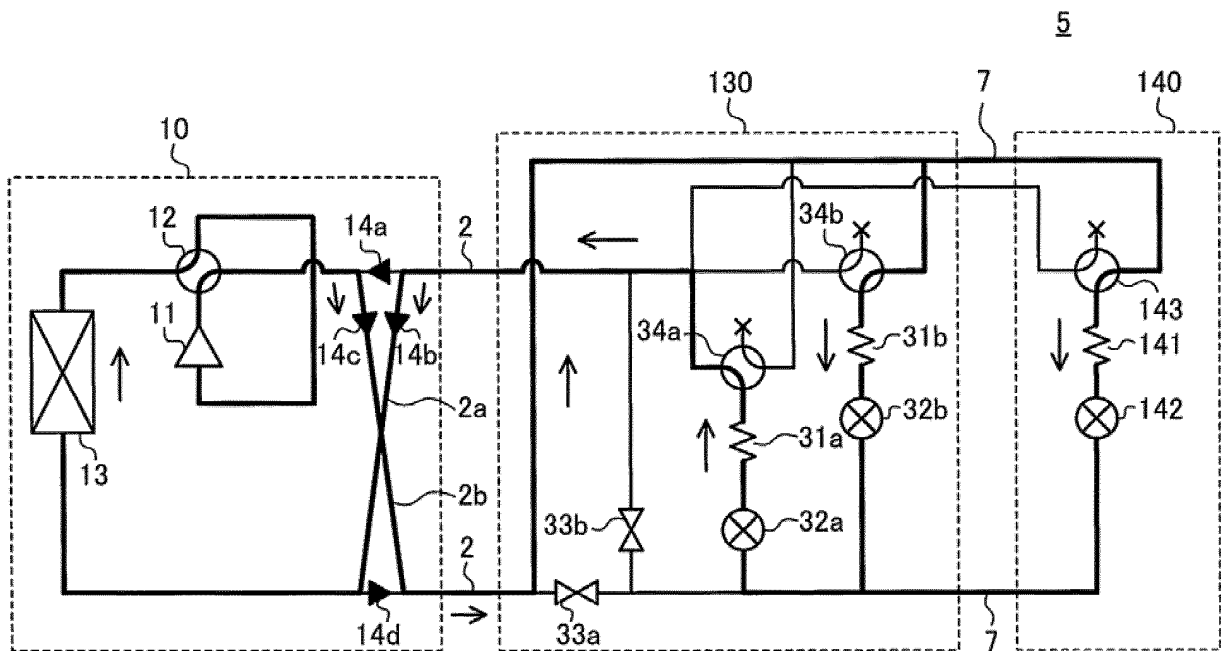


FIG. 24



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/082664

A. CLASSIFICATION OF SUBJECT MATTER

F24F11/02(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)

F24F11/02

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2016
Kokai Jitsuyo Shinan Koho	1971-2016	Toroku Jitsuyo Shinan Koho	1994-2016

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.
X A	WO 2012/172613 A1 (Mitsubishi Electric Corp.), 20 December 2012 (20.12.2012), paragraphs [0019] to [0065], [0109] to [0133]; fig. 1 to 2, 7 to 8 & US 2014/0137589 A1 paragraphs [0040] to [0121], [0192] to [0228]; fig. 1 to 2, 7 to 8 & EP 2722604 A1 & CN 103562648 A	1-2, 7 3-6
X A	JP 5-196267 A (Hitachi Air Conditioning & Refrigeration Co., Ltd.), 06 August 1993 (06.08.1993), paragraphs [0013] to [0015], [0020], [0023]; fig. 1, 4 to 5 (Family: none)	1-2, 7 3-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search
15 February 2016 (15.02.16)Date of mailing of the international search report
23 February 2016 (23.02.16)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2010049998 A [0010]
- WO 2011030429 A [0010]