(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 180 742 A1

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

(43) Date of publication:
17.05.2023 Bulletin 2023/20

(21) Application number: **20944786.1**

(22) Date of filing: **07.07.2020**

(51) International Patent Classification (IPC):
F25B 13/00 *(2006.01)* ***F25B 1/00*** *(2006.01)*
F25B 41/00 *(2021.01)*

(52) Cooperative Patent Classification (CPC):
F25B 1/00; F25B 13/00

(86) International application number:
PCT/JP2020/026569

(87) International publication number:
WO 2022/009312 (13.01.2022 Gazette 2022/02)

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

(71) Applicant: **MITSUBISHI ELECTRIC CORPORATION**
Chiyoda-ku
Tokyo 100-8310 (JP)

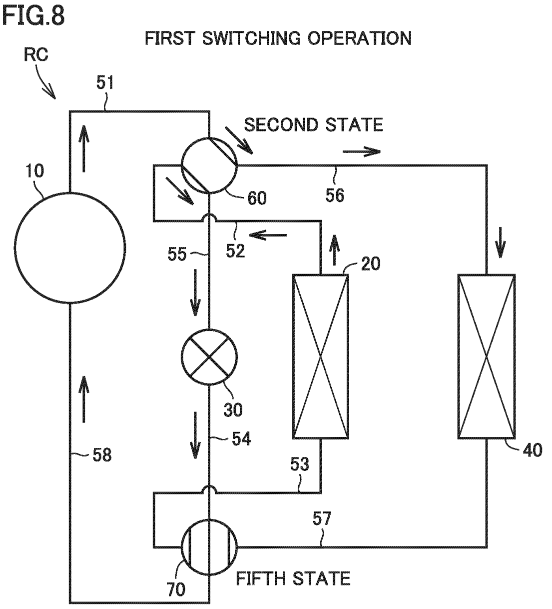
(72) Inventor: **NAKAJIMA, Komei**
Tokyo 1008310 (JP)

(74) Representative: **Pfenning, Meinig & Partner mbB**
Patent- und Rechtsanwälte
Joachimsthaler Straße 10-12
10719 Berlin (DE)

(54) **REFRIGERATION CYCLE DEVICE**

(57) A refrigeration cycle apparatus includes a compressor (10), a first heat exchanger (20), a decompressing device (30), a second heat exchanger (40), a first switching valve (60), a second switching valve (70), and a controller. The first switching valve is switched to one of a first state and a second state. In the first state, a discharge port of the compressor is connected to the first heat exchanger. In the second state, the discharge port of the compressor is connected to the second heat exchanger. The second switching valve is switched to one of a third state, a fourth state, and a fifth state. In the third state, a suction port of the compressor is connected to the second heat exchanger. In the fourth state, the suction port of the compressor is connected to the first heat exchanger. In the fifth state, the suction port of the compressor is connected to the decompressing device. When switching to a second cooling operation to bring the first and second switching valves into the second and fourth states, respectively, is requested during a first cooling operation to bring the first and second switching valves into the first and third states, respectively, the controller performs a first switching operation to bring the first switching valve into the second state and bring the second switching valve into the fifth state, and thereafter switches the first switching operation to the second cooling operation.

FIG.8



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a refrigeration cycle apparatus.

BACKGROUND ART

[0002] Japanese Patent Laying-Open No. 2005-134099 (PTL 1) discloses a refrigeration cycle apparatus including a refrigerant circuit that includes a compressor, a first heat exchanger, a decompressing device, a second heat exchanger, and a flow path switching valve. In this refrigeration cycle apparatus, the state of the flow path switching valve is switched to thereby allow switching between the first operation and the second operation. In the first operation, refrigerant circulates through the compressor, the first heat exchanger, the decompressing device, and the second heat exchanger sequentially in this order. In the second operation, refrigerant circulates through the compressor, the second heat exchanger, the decompressing device, and the first heat exchanger sequentially in this order.

CITATION LIST

PATENT LITERATURE

[0003] PTL 1: Japanese Patent Laying-Open No. 2005-134099

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0004] The pressure distribution of the refrigerant is different between the first operation and the second operation. Specifically, in the first operation, high-pressure refrigerant is distributed in the first heat exchanger and low-pressure refrigerant is distributed in the second heat exchanger. In contrast, in the second operation, high-pressure refrigerant is distributed in the second heat exchanger and low-pressure refrigerant is distributed in the first heat exchanger. Thus, when the operation is switched from one to the other between the first operation and the second operation, the pressure distribution of the refrigerant collapses. This leads to a concern that such a distribution collapse may increase the time required for the refrigeration cycle to stabilize after the operation is switched.

[0005] The present disclosure has been made in order to solve the above-described problems. An object of the present disclosure is to reduce the time required for a refrigeration cycle to stabilize after an operation is switched in a refrigeration cycle apparatus switchable between a first operation and a second operation. In the first operation, refrigerant circulates in order of a compressor, a first heat exchanger, a decompressing device, and a second heat exchanger. In the second operation, refrigerant circulates in order of the compressor, the second heat exchanger, the decompressing device, and the first heat exchanger.

SOLUTION TO PROBLEM

[0006] A refrigeration cycle apparatus according to the present disclosure is a refrigeration cycle apparatus switchable between a first operation and a second operation. In the first operation, refrigerant circulates in order of a compressor, a first heat exchanger, a decompressing device, and a second heat exchanger. In the second operation, the refrigerant circulates in order of the compressor, the second heat exchanger, the decompressing device, and the first heat exchanger. The refrigeration cycle apparatus includes: a first switching valve connected to a discharge port of the compressor, one port of the first heat exchanger, one port of the second heat exchanger, and one port of the decompressing device; a second switching valve connected to a suction port of the compressor, the other port of the first heat exchanger, the other port of the second heat exchanger, and the other port of the decompressing device; and a controller configured to control the first switching valve and the second switching valve.

[0007] The first switching valve is configured to be switchable to one of a first state and a second state. In the first state, the discharge port of the compressor is connected to the one port of the first heat exchanger, and the one port of the second heat exchanger is connected to the one port of the decompressing device. In the second state, the discharge port of the compressor is connected to the one port of the second heat exchanger, and the one port of the first heat exchanger is connected to the one port of the decompressing device.

[0008] The second switching valve is configured to be switchable to one of a third state, a fourth state, and a fifth state. In the third state, the other port of the first heat exchanger is connected to the other port of the decompressing device, and the other port of the second heat exchanger is connected to the suction port of the compressor. In the fourth state, the other port of the second heat exchanger is connected to the other port of the decompressing device, and the other port of the first heat exchanger is connected to the suction port of the compressor. In the fifth state, the other port of the decompressing device is connected to the suction port of the compressor, and the other port of the first heat exchanger is disconnected from the other port of the second heat exchanger.

[0009] The controller is configured to set the first switching valve to the first state and set the second switching valve to the third state during the first operation, and set the first switching valve to the second state and set the second switching valve to the fourth state during the second operation.

[0010] When switching to the second operation is requested during the first operation, the controller is configured to perform a first switching operation to bring the first switching valve into the second state and bring the second switching valve into the fifth state, and switch an operation of the refrigeration cycle apparatus to the second operation after performing the first switching operation.

ADVANTAGEOUS EFFECTS OF INVENTION

[0011] According to the present disclosure, the time required for the refrigeration cycle to stabilize after switching of the operation can be reduced in the refrigeration cycle apparatus switchable between the first operation and the second operation. In the first operation, refrigerant circulates in order of the compressor, the first heat exchanger, the decompressing device, and the second heat exchanger. In the second operation, refrigerant circulates in order of the compressor, the second heat exchanger, the decompressing device, and the first heat exchanger.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

Fig. 1 is a diagram schematically showing an example of an overall configuration of a refrigeration cycle apparatus according to a present first embodiment.
Fig. 2 is a perspective view showing an example of an internal structure of a second switching valve.
Fig. 3 is a diagram showing a rotational position of a valve body when the second switching valve is in a third state.
Fig. 4 is a diagram showing the rotational position of the valve body when the second switching valve is in a fourth state.
Fig. 5 is a diagram showing a rotational position of the valve body when the second switching valve is in a fifth state.
Fig. 6 is a diagram (first diagram) showing a state during a first cooling operation of a refrigerant circuit.
Fig. 7 is a diagram (first diagram) showing a state during a second cooling operation of the refrigerant circuit.
Fig. 8 is a diagram (first diagram) showing a state during a first switching operation of the refrigerant circuit.
Fig. 9 is a diagram (first diagram) showing a state during a second switching operation of the refrigerant circuit.
Fig. 10 is a diagram showing an example of transition of an operation state of the refrigeration cycle apparatus.
Fig. 11 is a diagram (second diagram) showing a state during the first cooling operation of the refrigerant circuit.
Fig. 12 is a diagram (second diagram) showing a state during the first switching operation of the refrigerant circuit.
Fig. 13 is a diagram (second diagram) showing a state during the second cooling operation of the refrigerant circuit.
Fig. 14 is a diagram (second diagram) showing a state during the second switching operation of the refrigerant circuit.
Fig. 15 is a diagram (third diagram) showing a state during the first cooling operation of the refrigerant circuit.
Fig. 16 is a diagram (third diagram) showing a state during the first switching operation of the refrigerant circuit.
Fig. 17 is a diagram (third diagram) showing a state during the second cooling operation of the refrigerant circuit.
Fig. 18 is a diagram (third diagram) showing a state during the second switching operation of the refrigerant circuit.
Fig. 19 is a diagram (first diagram) showing a configuration example of a first air blower and a second air blower.
Fig. 20 is a diagram (second diagram) showing a configuration example of the first air blower and the second air blower.
Fig. 21 is a diagram (third diagram) showing a configuration example of the first air blower and the second air blower.
Fig. 22 is a diagram (fourth diagram) showing a configuration example of the first air blower and the second air blower.
Fig. 23 is a diagram (fifth diagram) showing a configuration example of the first air blower and the second air blower.
Fig. 24 is a diagram (sixth diagram) showing a configuration example of the first air blower and the second air blower.

DESCRIPTION OF EMBODIMENTS

[0013] The following describes embodiments of the present disclosure in detail with reference to the accompanying drawings. While a plurality of embodiments will be described below, it has been originally intended at the time of filing of the present application to appropriately combine the configurations described in the embodiments. In the accompanying drawings, the same or corresponding components are denoted by the same reference characters, and description thereof will not be repeated.

First Embodiment

[Description of Configuration]

[0014] Fig. 1 is a diagram schematically showing an example of an overall configuration of a refrigeration cycle apparatus 1 according to the present first embodiment. Refrigeration cycle apparatus 1 includes a refrigerant circuit RC, a first air blower 80, a second air blower 90, and a controller 100. Refrigerant circuit RC includes a compressor 10, a first heat exchanger 20, a decompressing device 30, a second heat exchanger 40, pipes 51 to 58, a first switching valve 60, and a second switching valve 70.

[0015] In refrigerant circuit RC, compressor 10, first heat exchanger 20, decompressing device 30, and second heat exchanger 40 are connected by pipes 51 to 58, first switching valve 60, and second switching valve 70 to thereby form a circulation flow path through which refrigerant circulates. Inside refrigerant circuit RC, refrigerant involving a phase change, such as carbon dioxide or R410A, circulates.

[0016] Compressor 10 has a suction port connected to pipe 58, and a discharge port connected to pipe 51. Compressor 10 suctions low-pressure refrigerant from pipe 58, compresses the suctioned refrigerant, and then discharges the compressed refrigerant as high-pressure refrigerant to pipe 51. The rotation speed of compressor 10 is adjusted in response to a command from controller 100. Compressor 10 discharges refrigerant at a flow rate corresponding to the rotation speed. The flow rate of the refrigerant circulating through refrigeration cycle apparatus 1 is controlled by adjusting the rotation speed (the discharge flow rate) of compressor 10.

[0017] First heat exchanger 20 and second heat exchanger 40 each are a heat exchanger having a flow path through which refrigerant flows. In each of first heat exchanger 20 and second heat exchanger 40, heat is exchanged between the refrigerant flowing through the flow path and the air outside the flow path.

[0018] Decompressing device 30 decompresses high-pressure refrigerant. Examples of decompressing device 30 usable herein include a device having a valve body capable of adjusting a degree of opening in response to a command from controller 100, such as an electronic control type expansion valve.

[0019] First switching valve 60 is a four-way valve having: a port connected to the discharge port of compressor 10 via pipe 51; a port connected to one port of first heat exchanger 20 via pipe 52; a port connected to one port of second heat exchanger 40 via pipe 56; and a port connected to one port of decompressing device 30 via pipe 55.

[0020] First switching valve 60 is switched to one of the first state and the second state in response to a command from controller 100.

[0021] When first switching valve 60 is in the first state, pipe 51 is connected to pipe 52, and pipe 56 is connected to pipe 55. Thereby, the discharge port of compressor 10 is connected to one port of first heat exchanger 20, and one port of second heat exchanger 40 is connected to one port of decompressing device 30. Note that Fig. 1 illustrates the case where first switching valve 60 is set in the first state.

[0022] When first switching valve 60 is in the second state, pipe 51 is connected to pipe 56, and pipe 52 is connected to pipe 55. Thereby, the discharge port of compressor 10 is connected to one port of second heat exchanger 40, and one port of first heat exchanger 20 is connected to one port of decompressing device 30.

[0023] Second switching valve 70 is a four-way valve having: a port connected to the suction port of compressor 10 via pipe 58; a port connected to the other port of first heat exchanger 20 via pipe 53; a port connected to the other port of second heat exchanger 40 via pipe 57; and a port connected to the other port of decompressing device 30 via pipe 54.

[0024] Second switching valve 70 is switched to one of the third state, the fourth state, and the fifth state in response to a command from controller 100.

[0025] When second switching valve 70 is in the third state, pipe 53 is connected to pipe 54 and pipe 57 is connected to pipe 58. Thereby, the other port of first heat exchanger 20 is connected to the other port of decompressing device 30, and the other port of second heat exchanger 40 is connected to the suction port of compressor 10. Note that Fig. 1 illustrates the case where second switching valve 70 is set in the third state.

[0026] When second switching valve 70 is in the fourth state, pipe 57 is connected to pipe 54, and pipe 53 is connected to pipe 58. Thereby, the other port of second heat exchanger 40 is connected to the other port of decompressing device 30, and the other port of first heat exchanger 20 is connected to the suction port of compressor 10.

[0027] When second switching valve 70 is in the fifth state, pipe 54 is connected to pipe 58, and pipe 53 and pipe 57 are disconnected from each other. Thereby, the suction port of compressor 10 is connected to the other port of decompressing device 30, and the other port of first heat exchanger 20 and the other port of second heat exchanger 40 are disconnected from each other.

[0028] Fig. 2 is a perspective view showing an example of the internal structure of second switching valve 70. Second switching valve 70 includes: a container 71 having a hollow cylindrical shape and provided with four ports connected to respective pipes 53, 54, 57, and 58; and a valve body 72 having a cylindrical shape and accommodated in container 71. Valve body 72 is configured to be rotatable about a rotation axis 76 in response to a command from controller 100.

[0029] Fig. 3 is a diagram showing the rotational position of valve body 72 when second switching valve 70 is in the third state. Fig. 4 is a diagram showing the rotational position of valve body 72 when second switching valve 70 is in the fourth state. Fig. 5 is a diagram showing the rotational position of valve body 72 when second switching valve 70 is in the fifth state.

[0030] As shown in Figs. 3 to 5, three flow paths 73, 74 and 75 independent of each other are provided inside valve body 72. When second switching valve 70 is in the third state, as shown in Fig. 3, pipes 54 and 53 are connected to each other through flow path 73 of valve body 72, and pipes 57 and 58 are connected to each other through flow path 74 of valve body 72. Thereby, the other port of first heat exchanger 20 is connected to the other port of decompressing device 30, and the other port of second heat exchanger 40 is connected to the suction port of compressor 10.

[0031] When second switching valve 70 is in the fourth state, as shown in Fig. 4, pipes 54 and 57 are connected to each other through flow path 74 of valve body 72, and pipes 53 and 58 are connected to each other through flow path 73 of valve body 72. Thereby, the other port of second heat exchanger 40 is connected to the other port of decompressing device 30, and the other port of first heat exchanger 20 is connected to the suction port of compressor 10.

[0032] When second switching valve 70 is in the fifth state, as shown in Fig. 5, pipes 54 and 58 are connected to each other through flow path 75 of valve body 72, whereas pipes 53 and 57 are disconnected from each other by valve body 72. Thereby, the suction port of compressor 10 is connected to the other port of decompressing device 30, and the other port of first heat exchanger 20 and the other port of second heat exchanger 40 are disconnected from each other.

[0033] Referring back to Fig. 1, first air blower 80 is configured to be capable of blowing air on the indoor side as a target to be cooled (the air will be hereinafter simply referred to as "indoor air"), in response to a command from controller 100. Further, first air blower 80 is configured to be capable of switching the supply destination of the indoor air between first heat exchanger 20 and second heat exchanger 40.

[0034] Second air blower 90 is configured to be capable of blowing air on the outdoor side as a target not to be cooled (the air will be hereinafter simply referred to as "outdoor air"), in response to a command from controller 100. Further, second air blower 90 is configured to be capable of switching the supply destination of the outdoor air between first heat exchanger 20 and second heat exchanger 40.

[0035] Controller 100 is configured to include a central processing unit (CPU), a memory, and an input/output port through which various signals are input and output. Based on signals from each sensor and device, a program stored in the memory, and the like, controller 100 controls each device (compressor 10, decompressing device 30, first switching valve 60, second switching valve 70, first air blower 80, second air blower 90, and the like) of refrigeration cycle apparatus 1. Note that the control performed by controller 100 is not limited to processing by software and may be performed by dedicated hardware (an electronic circuit).

[First and Second Cooling Operations]

[0036] In refrigeration cycle apparatus 1, the states of first switching valve 60 and second switching valve 70 are switched to thereby allow switching between the first cooling operation and the second cooling operation.

[0037] Fig. 6 is a diagram showing the state during the first cooling operation of refrigerant circuit RC. During the first cooling operation, controller 100 operates compressor 10, and also, brings first switching valve 60 into the first state and brings second switching valve 70 into the third state.

[0038] During the first cooling operation, the refrigerant circulates through compressor 10, first heat exchanger 20, decompressing device 30, and second heat exchanger 40 sequentially in this order, so that first heat exchanger 20 functions as a condenser and second heat exchanger 40 functions as an evaporator. More specifically, the high-temperature and high-pressure refrigerant discharged from compressor 10 flows into first heat exchanger 20 through first switching valve 60. The high-temperature and high-pressure refrigerant exchanges heat with the outside air in first heat exchanger 20, and thus, decreases in temperature and flows out of first heat exchanger 20. The refrigerant flowing out of first heat exchanger 20 is decompressed by decompressing device 30, turns into low-temperature and low-pressure refrigerant, and then, flows into second heat exchanger 40. The low-temperature and low-pressure refrigerant exchanges heat with the outside air in second heat exchanger 40, and thus, rises in temperature and flows out of second heat exchanger 40. The refrigerant flowing out of second heat exchanger 40 is suctioned into compressor 10 through second switching valve 70.

[0039] Thus, during the first cooling operation, the high-pressure refrigerant is distributed through pipes 51 and 52, first heat exchanger 20, and pipes 53 and 54, and the low-pressure refrigerant is distributed through pipes 55 and 56, second heat exchanger 40, and pipes 57 and 58.

[0040] During the first cooling operation, controller 100 controls first air blower 80 and second air blower 90 such that the supply destination of the indoor air is set to second heat exchanger 40 and the supply destination of the outdoor air is set to first heat exchanger 20. This facilitates exchange of heat between first heat exchanger 20 functioning as a condenser and the outdoor air not to be cooled, and also facilitates exchange of heat between second heat exchanger 40 functioning as an evaporator and the indoor air to be cooled. Thereby, the indoor air to be cooled can be efficiently cooled. Note that Fig. 1 illustrates the state during the first cooling operation.

[0041] Fig. 7 is a diagram showing the state during the second cooling operation of refrigerant circuit RC. During the second cooling operation, controller 100 operates compressor 10, and also, brings first switching valve 60 into the second state and brings second switching valve 70 into the fourth state.

[0042] During the second cooling operation, the refrigerant circulates through compressor 10, second heat exchanger 40, decompressing device 30, and first heat exchanger 20 sequentially in this order, and thus, second heat exchanger 40 functions as a condenser and first heat exchanger 20 functions as an evaporator. More specifically, the high-temperature and high-pressure refrigerant discharged from compressor 10 flows into second heat exchanger 40 through first switching valve 60. The high-temperature and high-pressure refrigerant exchanges heat with the outside air in second heat exchanger 40, and thus, decreases in temperature and flows out of second heat exchanger 40. The refrigerant flowing out of second heat exchanger 40 is decompressed by decompressing device 30, turns into low-temperature and low-pressure refrigerant, and then, flows into first heat exchanger 20. The low-temperature and low-pressure refrigerant exchanges heat with the outside air in first heat exchanger 20, and thus, rises in temperature and flows out of first heat exchanger 20. The refrigerant flowing out of first heat exchanger 20 is suctioned into compressor 10 through second switching valve 70.

[0043] Thus, during the second cooling operation, the high-pressure refrigerant is distributed through pipes 51 and 56, second heat exchanger 40, and pipes 57 and 54, and the low-pressure refrigerant is distributed through pipes 55 and 52, first heat exchanger 20, and pipes 53 and 58.

[0044] Further, during the second cooling operation, controller 100 controls first air blower 80 and second air blower 90 such that the supply destination of the indoor air is set to first heat exchanger 20 and the supply destination of the outdoor air is set to second heat exchanger 40. This facilitates exchange of heat between second heat exchanger 40 functioning as a condenser and the outdoor air not to be cooled, and also facilitates exchange of heat between first heat exchanger 20 functioning as an evaporator and the indoor air to be cooled. Thereby, also during the second cooling operation, the indoor air to be cooled can be efficiently cooled.

[0045] During the first cooling operation, for example, when the temperature of the refrigerant inside second heat exchanger 40 functioning as an evaporator becomes equal to or lower than 0 °C, frost forms on second heat exchanger 40, which makes it difficult for air to flow therethrough, with the result that the heat exchange efficiency in second heat exchanger 40 may deteriorate. Thus, when frost forms on second heat exchanger 40 during the first cooling operation (for example, when the temperature of the refrigerant in second heat exchanger 40 detected by a sensor (not shown) falls below a reference value close to 0 °C), controller 100 determines that switching to the second cooling operation is requested, and then, switches the operation to the second cooling operation. Thereby, second heat exchanger 40 functioning as an evaporator comes to function as a condenser, and thereby, frost forming on second heat exchanger 40 can be removed.

[0046] Further, in the present embodiment, the supply destination of the indoor air is set to first heat exchanger 20 functioning as an evaporator during the second cooling operation, and therefore, cold air can be delivered to the indoor side also during the second cooling operation.

[0047] During the second cooling operation, when frost forms on first heat exchanger 20 functioning as a condenser (for example, when the temperature of the refrigerant in first heat exchanger 20 detected by a sensor (not shown) falls below a reference value close to 0 °C), controller 100 determines that switching to the first cooling operation is requested, and then, switches the operation to the first cooling operation. Thereby, first heat exchanger 20 functioning as an evaporator comes to function as a condenser, and thereby, frost forming on first heat exchanger 20 can be removed.

[First and Second Switching Operations]

[0048] As described above, during the first cooling operation, the high-pressure refrigerant is distributed in first heat exchanger 20, and the low-pressure refrigerant is distributed in second heat exchanger 40. In contrast, during the second cooling operation, the high-pressure refrigerant is distributed in second heat exchanger 40, and the low-pressure refrigerant is distributed in first heat exchanger 20. Thus, when the operation is switched from one to the other between the first cooling operation and the second cooling operation, the pressure distribution of the refrigerant collapses. This leads to a concern that such a distribution collapse may increase the time required for the refrigeration cycle to stabilize after the operation is switched.

[0049] In view of such a problem, when switching to the second cooling operation is requested during the first cooling operation, controller 100 according to the present embodiment performs the "first switching operation" to bring first switching valve 60 into the second state and bring second switching valve 70 into the fifth state. Then, after the first switching operation is performed for a certain time period, controller 100 switches the operation of refrigeration cycle apparatus 1 to the second cooling operation.

[0050] Fig. 8 is a diagram showing the state during the first switching operation of refrigerant circuit RC. As shown in Fig. 8, during the first switching operation, controller 100 operates compressor 10, and also, brings first switching valve 60 into the second state and brings second switching valve 70 into the fifth state.

[0051] The first switching operation is performed before the first cooling operation is switched to the second cooling operation. Thereby, the refrigerant inside first heat exchanger 20 in which the pressure is raised high during the first cooling operation is recovered into compressor 10, so that the inside of first heat exchanger 20 can be set in the low pressure state. Also, the high-pressure refrigerant from compressor 10 is supplied into second heat exchanger 40 in which the pressure is reduced low during the first cooling operation, so that the inside of second heat exchanger 40 can be set in the high pressure state. In other words, before switching to the second cooling operation, the inside of first heat exchanger 20 can be set in the low pressure state in advance and the inside of second heat exchanger 40 can be set in the high pressure state in advance.

[0052] In particular, during the first switching operation, second switching valve 70 is brought into the fifth state, and thereby, the other port of first heat exchanger 20 and the other port of second heat exchanger 40 are disconnected from each other by second switching valve 70. This can prevent the high-pressure refrigerant and the low-pressure refrigerant from being mixed and equalized in pressure. Thus, as compared with the case where the first cooling operation is simply switched to the second cooling operation, the inside of first heat exchanger 20 can be set in the low pressure state in the early stage, and the inside of second heat exchanger 40 can be set in the high pressure state in the early stage.

[0053] Further, during the first switching operation, controller 100 stops blowing of air by first air blower 80 and second air blower 90. Thus, during the first switching operation, blowing of air into first heat exchanger 20 and second heat exchanger 40 is stopped. Accordingly, the inside of first heat exchanger 20 can be set in the low pressure state in the earlier stage, and the inside of second heat exchanger 40 can be set in the high pressure state in the earlier stage.

[0054] After performing the first switching operation for a certain time period, controller 100 switches the operation of refrigeration cycle apparatus 1 to the second cooling operation. This can reduce the time required for the refrigeration cycle to stabilize after switching to the second cooling operation.

[0055] Further, when switching to the first cooling operation is requested during the second cooling operation, controller 100 according to the present embodiment performs the "second switching operation" to bring first switching valve 60 into the first state and bring second switching valve 70 into the fifth state. Then, after performing the second switching operation for a certain time period, controller 100 switches the operation to the first cooling operation.

[0056] Fig. 9 is a diagram showing the state during the second switching operation of refrigerant circuit RC. As shown in Fig. 9, during the second switching operation, controller 100 operates compressor 10, and also, brings first switching valve 60 into the first state and brings second switching valve 70 into the fifth state.

[0057] The second switching operation is performed before the second cooling operation is switched to the first cooling operation. Thereby, the refrigerant inside second heat exchanger 40 in which the pressure is raised high during the second cooling operation is recovered into compressor 10, so that the inside of second heat exchanger 40 can be set in the low pressure state. Also, the high-pressure refrigerant from compressor 10 is supplied into first heat exchanger 20 in which the pressure is reduced low during the second cooling operation, so that the inside of first heat exchanger 20 can be set in the high pressure state. In other words, before switching to the first cooling operation, the inside of second heat exchanger 40 can be set in the low pressure state in advance and the inside of first heat exchanger 20 can be set in the high pressure state in advance.

[0058] In particular, during the second switching operation, second switching valve 70 is brought into the fifth state, and thereby, the other port of first heat exchanger 20 and the other port of second heat exchanger 40 are disconnected from each other by second switching valve 70. This can prevent the high-pressure refrigerant and the low-pressure refrigerant from being mixed and equalized in pressure. Therefore, the inside of second heat exchanger 40 can be set in the low pressure state in the early stage, and the inside of first heat exchanger 20 can be set in the high pressure state in the early stage.

[0059] Further, during the second switching operation, controller 100 stops blowing of air by first air blower 80 and second air blower 90. Thereby, during the second switching operation, blowing of air into first heat exchanger 20 and second heat exchanger 40 is stopped. Accordingly, the inside of second heat exchanger 40 can be set in the low pressure state in the earlier stage, and the inside of first heat exchanger 20 can be set in the high pressure state in the earlier stage.

[0060] After performing the second switching operation for a certain time period, controller 100 switches the operation of refrigeration cycle apparatus 1 to the first cooling operation. This can reduce the time required for the refrigeration cycle to stabilize after switching to the first cooling operation.

[0061] Fig. 10 is a diagram showing an example of transition of the operation state of refrigeration cycle apparatus 1 controlled by controller 100. In Fig. 10, the horizontal axis represents time while the vertical axis represents, sequentially from the top, the state of compressor 10, the state of first switching valve 60, the state of second switching valve 70, the supply destination of indoor air, and the supply destination of outdoor air.

[0062] Before time t1, the first cooling operation is performed. During the first cooling operation, controller 100 brings first switching valve 60 into the first state and brings second switching valve 70 into the third state. Further, controller 100 controls first air blower 80 such that the supply destination of the indoor air is set to second heat exchanger 40, and controls second air blower 90 such that the supply destination of the outdoor air is set to first heat exchanger 20.

[0063] When switching to the second cooling operation is requested at time t1 during the first cooling operation, controller 100 switches the operation of refrigeration cycle apparatus 1 from the first cooling operation to the first switching operation. Specifically, controller 100 switches first switching valve 60 from the first state to the second state, and switches second switching valve 70 from the third state to the fifth state. Further, controller 100 stops blowing of the indoor air by first air blower 80 and stops blowing of the outdoor air by second air blower 90.

[0064] At time t2 at which a certain time period has elapsed since the start of the first switching operation, controller 100 switches the operation of refrigeration cycle apparatus 1 from the first switching operation to the second cooling operation. Specifically, controller 100 switches second switching valve 70 from the fifth state to the fourth state while maintaining first switching valve 60 in the second state.

Further, controller 100 controls first air blower 80 to switch the supply destination of the indoor air from second heat exchanger 40 to first heat exchanger 20, and also controls second air blower 90 to switch the supply destination of the outdoor air from first heat exchanger 20 to second heat exchanger 40.

[0065] When switching to the first cooling operation is requested at time t3 during the second cooling operation, controller 100 switches the operation of refrigeration cycle apparatus 1 from the second cooling operation to the second switching operation. Specifically, controller 100 switches first switching valve 60 from the second state to the first state, and switches second switching valve 70 from the fourth state to the fifth state. Further, controller 100 stops blowing of the indoor air by first air blower 80 and also stops blowing of the outdoor air by second air blower 90.

[0066] At time t4 at which a certain time period has elapsed since the start of the second switching operation, controller 100 switches the operation of refrigeration cycle apparatus 1 from the second switching operation to the first cooling operation. Specifically, controller 100 switches second switching valve 70 from the fifth state to the third state while maintaining first switching valve 60 in the first state. Further, controller 100 controls first air blower 80 to switch the supply destination of the indoor air from first heat exchanger 20 to second heat exchanger 40, and also controls second air blower 90 to switch the supply destination of the outdoor air from second heat exchanger 40 to first heat exchanger 20.

[0067] Also at and after time t5, switching similar to that performed until time t5 is performed.

[0068] As described above, when switching to the second cooling operation is requested during the first cooling operation, controller 100 according to the present embodiment performs the "first switching operation" to bring first switching valve 60 into the second state and bring second switching valve 70 into the fifth state, for a certain time period before switching to the second cooling operation. Thus, as compared with the case where the first cooling operation is simply switched to the second cooling operation, the high-pressure refrigerant and the low-pressure refrigerant can be prevented from being mixed and equalized in pressure during switching of the operation, and also, the operation can be switched to the second cooling operation after the distribution state close to the pressure distribution in the second cooling operation is achieved in advance in the early stage. This can reduce the time required for the refrigeration cycle to stabilize after switching to the second cooling operation. As a result, wasteful energy consumed to stabilize the refrigeration cycle after switching to the second cooling operation can be reduced, to thereby allow energy saving for refrigeration cycle apparatus 1.

[0069] Further, when switching to the first cooling operation is requested during the second cooling operation, controller 100 according to the present embodiment performs the "second switching operation" to bring first switching valve 60 into the first state and bring second switching valve 70 into the fifth state, for a certain time period before switching to the first cooling operation. Thereby, as compared with the case where the second cooling operation is simply switched to the first cooling operation, the high-pressure refrigerant and the low-pressure refrigerant can be prevented from being mixed and equalized in pressure during switching of the operation, and also, the operation can be switched to the first cooling operation after the distribution state close to the pressure distribution in the first cooling operation is achieved in advance in the early stage. This can reduce the time required for the refrigeration cycle to stabilize after switching to the first cooling operation. As a result, wasteful energy consumed to stabilize the refrigeration cycle after switching to the first cooling operation can be reduced, to thereby allow energy saving for refrigeration cycle apparatus 1.

Second Embodiment

[0070] Figs. 11 to 14 each schematically show an example of the configuration of a refrigerant circuit RCa of a refrigeration cycle apparatus according to the present second embodiment. Refrigerant circuit RCa according to the present second embodiment is obtained by adding a decompressing device 32 and a third heat exchanger 42 to refrigerant circuit RC according to the first embodiment. Other configurations of refrigerant circuit RCa are the same as those of refrigerant circuit RC. Further, other configurations and operations of the refrigeration cycle apparatus according to the present second embodiment are the same as those of refrigeration cycle apparatus 1 shown in Fig. 1 described above.

[0071] Decompressing device 32 and third heat exchanger 42 are disposed between second switching valve 70 and the suction port of compressor 10.

[0072] Decompressing device 32 decompresses the refrigerant from second switching valve 70 and outputs the decompressed refrigerant to third heat exchanger 42. Examples of decompressing device 32 usable herein include a device having a valve body capable of adjusting the degree of opening in response to a command from controller 100, such as an electronic control type expansion valve.

[0073] Third heat exchanger 42 exchanges heat between the refrigerant decompressed by decompressing device 32 and the outside air.

[0074] Fig. 11 is a diagram showing the state during the first cooling operation of refrigerant circuit RCa. Fig. 12 is a diagram showing the state during the first switching operation of refrigerant circuit RCa. Fig. 13 is a diagram showing the state during the second cooling operation of refrigerant circuit RCa. Fig. 14 is a diagram showing the state during the second switching operation of refrigerant circuit RCa.

[0075] The states of compressor 10, first switching valve 60, second switching valve 70, first air blower 80, and second air blower 90 during each operation are controlled basically in the same manner as that in the above-described first embodiment.

[0076] In refrigerant circuit RCa according to the present second embodiment, however, due to addition of decompressing device 32, during each operation, high-pressure refrigerant is distributed in the circuit extending from the discharge port of compressor 10 to decompressing device 30, medium-pressure refrigerant is distributed in the circuit extending from decompressing device 30 to decompressing device 32, and low-pressure refrigerant is distributed in the circuit extending from decompressing device 32 to the suction port of compressor 10.

[0077] Further, as shown in Fig. 11, refrigerant circuit RCa according to the present second embodiment is configured such that indoor air is blown through second heat exchanger 40 and third heat exchanger 42 sequentially in this order during the first cooling operation. In other words, during the first cooling operation, second heat exchanger 40 and third heat exchanger 42 function as evaporators, and the indoor air flows through second heat exchanger 40 and thereafter is blown to third heat exchanger 42.

[0078] In this way, in the present second embodiment, the indoor air is blown through second heat exchanger 40 and third heat exchanger 42 sequentially in this order during the first cooling operation. Thus, among second heat exchanger 40 and third heat exchanger 42 each functioning as an evaporator during the first cooling operation (i.e., a heat exchanger on which frost may form), second heat exchanger 40 functioning as a condenser after switching to the second cooling operation can be positively covered with frost, and third heat exchanger 42 functioning as an evaporator also after switching to the second cooling operation can be less likely to be covered with frost. As a result, when the operation is thereafter switched to the second cooling operation for defrosting, only second heat exchanger 40 significantly covered with frost can be defrosted, so that an efficient defrosting operation can be performed.

[0079] Further, in refrigerant circuit RCa according to the present second embodiment, the indoor air is blown through first heat exchanger 20 and third heat exchanger 42 sequentially in this order during the second cooling operation, as shown in Fig. 13. In other words, during the second cooling operation, first heat exchanger 20 and third heat exchanger 42 function as evaporators, and the indoor air flows through first heat exchanger 20 and thereafter is blown to third heat exchanger 42.

[0080] In this way, in the present second embodiment, the indoor air is blown through first heat exchanger 20 and third heat exchanger 42 sequentially in this order during the second cooling operation. Thus, among first heat exchanger 20 and third heat exchanger 42 each functioning as an evaporator during the second cooling operation (i.e., a heat exchanger on which frost may form), first heat exchanger 20 functioning as a condenser after switching to the first cooling operation can be positively covered with frost, and third heat exchanger 42 functioning as an evaporator also after switching to the first cooling operation can be less likely to be covered with frost. As a result, when the operation is thereafter switched to the first cooling operation for defrosting, only first heat exchanger 20 significantly covered with frost can be defrosted, so that an efficient defrosting operation can be performed.

[0081] In refrigerant circuit RCa according to the present second embodiment, an adsorbent (a desiccant material or the like) that adsorbs moisture in air may be applied onto the surfaces of first heat exchanger 20 and second heat exchanger 40. Thereby, moisture in air is adsorbed in first heat exchanger 20 or second heat exchanger 40, so that third heat exchanger 42 can be prevented from being covered with frost.

[0082] For example, during the second cooling operation in which first heat exchanger 20 functions as an evaporator, the moisture in the indoor air is adsorbed by the adsorbent of first heat exchanger 20 when the indoor air flows through first heat exchanger 20. Thus, the indoor air flowing through first heat exchanger 20 and thereafter blown to third heat exchanger 42 is dried. As a result, third heat exchanger 42 can be less likely to be covered with frost.

[0083] Further, the operation is thereafter switched to the first cooling operation to cause first heat exchanger 20 to function as a condenser, and thereby, moisture contained in the adsorbent of first heat exchanger 20 can be released to outdoor air. As a result, the adsorbent of first heat exchanger 20 is dried. Accordingly, when the operation is again switched to the second cooling operation to cause first heat exchanger 20 to function as an evaporator, moisture in the indoor air can be adsorbed again by the adsorbent of first heat exchanger 20.

Third Embodiment

[0084] Figs. 15 to 18 each schematically show an example of the configuration of a refrigerant circuit RCb of a refrigeration cycle apparatus according to the present third embodiment. Refrigerant circuit RCb according to the present third embodiment is obtained by adding a fourth heat exchanger 44 to refrigerant circuit RCa according to the above-described second embodiment. Other configurations of refrigerant circuit RCb are the same as those of refrigerant circuit RCa. Further, other configurations and operations of the refrigeration cycle apparatus according to the present third embodiment are the same as those of refrigeration cycle apparatus 1 shown in Fig. 1 described above.

[0085] Fourth heat exchanger 44 is disposed between the discharge port of compressor 10 and first switching valve 60. Fourth heat exchanger 44 exchanges heat between the refrigerant discharged from compressor 10 and outside air.

[0086] Fig. 15 is a diagram showing the state during the first cooling operation of refrigerant circuit RCb. Fig. 16 is a diagram showing the state during the first switching operation of refrigerant circuit RCb. Fig. 17 is a diagram showing the state during the second cooling operation of refrigerant circuit RCb. Fig. 18 is a diagram showing the state during the second switching operation of refrigerant circuit RCb.

[0087] The states of compressor 10, first switching valve 60, second switching valve 70, first air blower 80, and second air blower 90 during each operation are controlled basically in the same manner as that in the above-described second embodiment.

[0088] In the case where frost or moisture adheres to the condenser when first heat exchanger 20 or second heat exchanger 40 functions as a condenser, the heat exchange efficiency of the condenser changes according to the amount of adherence of frost or moisture. Further, since the heat exchanger is used as a condenser, the amount of adherence of frost or moisture may change in accordance with the operation, so that the high pressure inside the condenser changes from moment to moment.

[0089] In view of the above-described point, in refrigerant circuit RCb according to the present third embodiment, fourth heat exchanger 44 is additionally disposed between the discharge port of compressor 10 and first switching valve 60. Thereby, even when the heat exchanger performance of first heat exchanger 20 or second heat exchanger 40 changes, the high pressure can be stably maintained at a constant value.

[0090] Further, as shown in Fig. 15, refrigerant circuit RCb according to the present third embodiment is configured such that, during the first cooling operation, the outdoor air flows through first heat exchanger 20 and thereafter is blown to third heat exchanger 42. This can facilitate exchange of heat by fourth heat exchanger 44 serving as a condenser.

[Configuration Examples of First Air Blower 80 and Second Air Blower 90]

[0091] The following describes configuration examples of first air blower 80 and second air blower 90 used in the refrigeration cycle apparatus according to each of the above-described first to third embodiments.

[0092] Figs. 19 and 20 each are a diagram showing a configuration example of first air blower 80 and second air blower 90 suitable for the refrigeration cycle apparatus according to the above-described first embodiment. Note that Fig. 19 shows the state during the first cooling operation (see Fig. 6) according to the first embodiment, and Fig. 20 shows the state during the second cooling operation (see Fig. 7) according to the first embodiment.

[0093] First air blower 80 includes a fan 81, an air path 82, and an air path switch 83. Fan 81 operates in response to a command from controller 100, and blows indoor air into air path 82. Air path 82 allows communication between the indoor space to be cooled and each of first heat exchanger 20 and second heat exchanger 40. Air path switch 83 is configured to be capable of switching a supply destination of the indoor air between first heat exchanger 20 and second heat exchanger 40 by switching the path in air path 82 in response to a command from controller 100. Note that the state of air path switch 83 is switched, for example, by driving a motor (not shown).

[0094] Second air blower 90 includes a fan 91, an air path 92, and an air path switch 83 that is shared between first air blower 80 and second air blower 90. Fan 91 operates in response to a command from controller 100, and blows outdoor air into air path 92. Air path 92 allows communication between the outdoor space not to be cooled and each of first heat exchanger 20 and second heat exchanger 40. Air path switch 83 is configured to be capable of switching a supply destination of the outdoor air between first heat exchanger 20 and second heat exchanger 40 by switching the path in air path 92 in response to a command from controller 100.

[0095] During the first cooling operation, air path switch 83 is brought into the state shown in Fig. 19 while fans 81 and 91 are operated, and thereby, the supply destination of the indoor air can be set to second heat exchanger 40, and the supply destination of the outdoor air can be set to first heat exchanger 20. During the second cooling operation, air path switch 83 is brought into the state shown in Fig. 20 while fans 81 and 91 are operated, and thereby, the supply destination of the indoor air can be set to first heat exchanger 20 and the supply destination of the outdoor air can be set to second heat exchanger 40.

[0096] Figs. 21 and 22 each are a diagram showing a configuration example of a first air blower 80A and a second air blower 90A suitable for the refrigeration cycle apparatus according to the above-described second embodiment. Note that Fig. 21 shows the state during the first cooling operation (see Fig. 11) according to the second embodiment, and Fig. 22 shows the state during the second cooling operation (see Fig. 13) according to the second embodiment.

[0097] First air blower 80A is obtained by adding air paths 82a and 82b and air path switches 83a and 83b to the above-described first air blower 80. Second air blower 90A is obtained by adding air paths 92a and 92b and air path switches 83a and 83b, which are shared between second air blower 90A and first air blower 80A, to the above-described second air blower 90.

[0098] Air path 82a is formed to supply the air having passed through first heat exchanger 20 to third heat exchanger 42. Air path 82b is formed to supply the air having passed through second heat exchanger 40 to third heat exchanger 42. Air path 92a is formed to supply the air having passed through first heat exchanger 20 to the outdoors. Air path 92b is formed to supply the air having passed through second heat exchanger 40 to the outdoors.

[0099] Air path switch 83a is configured to be capable of switching, between air paths 82a and 92a, the supply destination of the air having passed through first heat exchanger 20, in response to a command from controller 100. Air path switch 83b is configured to be capable of switching, between air paths 82b and 92b, the supply destination of the air having passed through second heat exchanger 40, in response to a command from controller 100. Note that the states of air path switches 83a and 83b are switched, for example, by driving a motor (not shown).

[0100] During the first cooling operation, air path switches 83, 83a, and 83b are brought into the states shown in Fig. 21 while fans 81 and 91 are operated, and thereby, the supply destination of the outdoor air can be set to first heat exchanger 20 while the indoor air is blown through second heat exchanger 40 and third heat exchanger 42 sequentially in this order. During the second cooling operation, air path switches 83, 83a and 83b are brought into the states shown in Fig. 22 while fans 81 and 91 are operated, and thereby, the supply destination of the outdoor air can be set to second heat exchanger 40 while the indoor air is blown through first heat exchanger 20 and third heat exchanger 42 sequentially in this order.

[0101] Figs. 23 and 24 each are a diagram showing a configuration example of first air blower 80A and second air blower 90B suitable for the refrigeration cycle apparatus according to the above-described third embodiment. Note that Fig. 23 shows the state during the first cooling operation (see Fig. 15) according to the third embodiment, and Fig. 24 shows the state during the second cooling operation (see Fig. 17) according to the third embodiment.

[0102] First air blower 80A is the same as first air blower 80A shown in Fig. 21 described above. Second air blower 90B is obtained by replacing air paths 92a and 92b of second air blower 90A shown in Fig. 21 with air paths 92c and 92d, respectively.

[0103] Air path 92c is formed to supply the air having passed through first heat exchanger 20 to fourth heat exchanger 44. Air path 92d is formed to supply the air having passed through second heat exchanger 40 to fourth heat exchanger 44.

[0104] During the first cooling operation, air path switches 83, 83a, and 83b are brought into the states shown in Fig. 23 while fans 81 and 91 are operated, and thereby, the outdoor air can be blown through first heat exchanger 20 and fourth heat exchanger 44 sequentially in this order while the indoor air is blown through second heat exchanger 40 and third heat exchanger 42 sequentially in this order. During the second cooling operation, air path switches 83, 83a, and 83b are brought into the states shown in Fig. 24 while fans 81 and 91 are operated, and thereby, the outdoor air can be blown through second heat exchanger 40 and fourth heat exchanger 44 sequentially in this order while the indoor air is blown through first heat exchanger 20 and third heat exchanger 42 sequentially in this order.

[0105] It should be understood that the embodiments disclosed herein are illustrative and non-restrictive in every respect. The scope of the present disclosure is defined by the terms of the claims, rather than the description above, and is intended to include any modifications within the meaning and scope equivalent to the terms of the claims.

REFERENCE SIGNS LIST

[0106] 1 refrigeration cycle apparatus, 10 compressor, 20 first heat exchanger, 30, 32 decompressing device, 40 second heat exchanger, 42 third heat exchanger, 44 fourth heat exchanger, 51 to 58 pipe, 60 first switching valve, 70 second switching valve, 71. container, 72 valve body, 73 to 75 flow path, 76 rotation axis, 80, 80A, first air blower, 81, 91 fan, 82, 82a, 82b, 92, 92a, 92b, 92c, 92d air path, 83, 83a, 83b air path switch, 90, 90A, second air blower, 100 controller, RC, RCa, RCb refrigerant circuit.

Claims

1. A refrigeration cycle apparatus switchable between a first operation and a second operation, the first operation being an operation in which refrigerant circulates in order of a compressor, a first heat exchanger, a decompressing device, and a second heat exchanger, and the second operation being an operation in which the refrigerant circulates in order of the compressor, the second heat exchanger, the decompressing device, and the first heat exchanger, the refrigeration cycle apparatus comprising:

a first switching valve connected to a discharge port of the compressor, one port of the first heat exchanger, one port of the second heat exchanger, and one port of the decompressing device;

a second switching valve connected to a suction port of the compressor, the other port of the first heat exchanger, the other port of the second heat exchanger, and the other port of the decompressing device; and

a controller configured to control the first switching valve and the second switching valve, wherein

the first switching valve is configured to be switchable to one of a first state and a second state,

in the first state, the discharge port of the compressor is connected to the one port of the first heat exchanger, and the one port of the second heat exchanger is connected to the one port of the decompressing device, and

in the second state, the discharge port of the compressor is connected to the one port of the second heat exchanger, and the one port of the first heat exchanger is connected to the one port of the decompressing device,

the second switching valve is configured to be switchable to one of a third state, a fourth state, and a fifth state,

in the third state, the other port of the first heat exchanger is connected to the other port of the decompressing device, and the other port of the second heat exchanger is connected to the suction port of the compressor,

in the fourth state, the other port of the second heat exchanger is connected to the other port of the decompressing device, and the other port of the first heat exchanger is connected to the suction port of the compressor, and

in the fifth state, the other port of the decompressing device is connected to the suction port of the compressor, and the other port of the first heat exchanger is disconnected from the other port of the second heat exchanger,

the controller is configured to

set the first switching valve to the first state and set the second switching valve to the third state during the first operation, and

set the first switching valve to the second state and set the second switching valve to the fourth state during the second operation, and

when switching to the second operation is requested during the first operation, the controller is configured to

perform a first switching operation to bring the first switching valve into the second state and bring the second switching valve into the fifth state, and

switch an operation of the refrigeration cycle apparatus to the second operation after performing the first switching operation.

2. The refrigeration cycle apparatus according to claim 1, wherein

when switching to the first operation is requested during the second operation, the controller is configured to

perform a second switching operation to bring the first switching valve into the first state and bring the second switching valve into the fifth state, and

switch the operation of the refrigeration cycle apparatus to the first operation after performing the second switching operation.

3. The refrigeration cycle apparatus according to claim 2, further comprising an air blower configured to be capable of blowing air to the first heat exchanger and the second heat exchanger, wherein

the controller is configured to control the air blower to stop blowing air to the first heat exchanger and the second heat exchanger during the first switching operation and the second switching operation.

4. The refrigeration cycle apparatus according to claim 3, wherein

the air blower comprises a first air blower configured to be capable of switching a supply destination of indoor air to be cooled to one of the first heat exchanger and the second heat exchanger, and

the controller is configured to control the first air blower to

set the supply destination of the indoor air to the second heat exchanger during the first operation, and

set the supply destination of the indoor air to the first heat exchanger during the second operation.

5. The refrigeration cycle apparatus according to claim 4, wherein

the air blower comprises a second air blower configured to be capable of switching a supply destination of outdoor air not to be cooled to one of the first heat exchanger and the second heat exchanger, and

the controller is configured to control the second air blower to

set the supply destination of the outdoor air to the first heat exchanger during the first operation, and

set the supply destination of the outdoor air to the second heat exchanger during the second operation.

6. The refrigeration cycle apparatus according to claim 4 or 5, further comprising a second decompressing device and a third heat exchanger that are disposed between the second switching valve and the suction port of the compressor.

7. The refrigeration cycle apparatus according to claim 6, wherein the indoor air is blown in order of the second heat exchanger and the third heat exchanger during the first operation, and blown in order of the first heat exchanger and the third heat exchanger during the second operation.

8. The refrigeration cycle apparatus according to claim 7, wherein the first heat exchanger and the second heat exchanger each have a surface onto which an adsorbent serving to adsorb moisture in air is applied.

9. The refrigeration cycle apparatus according to any one of claims 6 to 8, further comprising a fourth heat exchanger disposed between the discharge port of the compressor and the first switching valve.

FIG.1

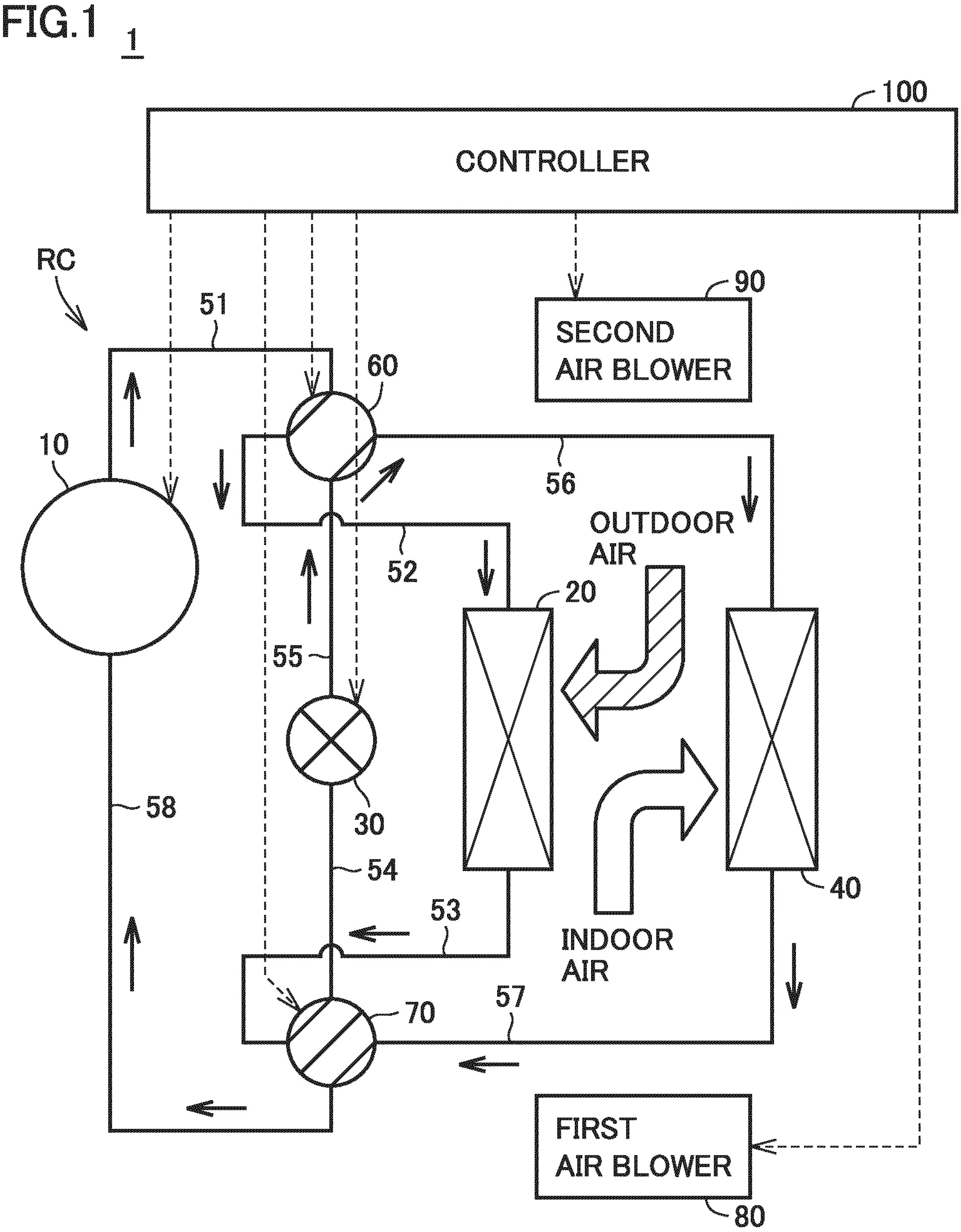

1
CONTROLLER
100
RC
51
60
SECOND
AIR BLOWER
90
10
56
OUTDOOR
AIR
52
20
55
30
58
54
53
40
INDOOR
AIR
70
57
FIRST
AIR BLOWER
80

FIG.2

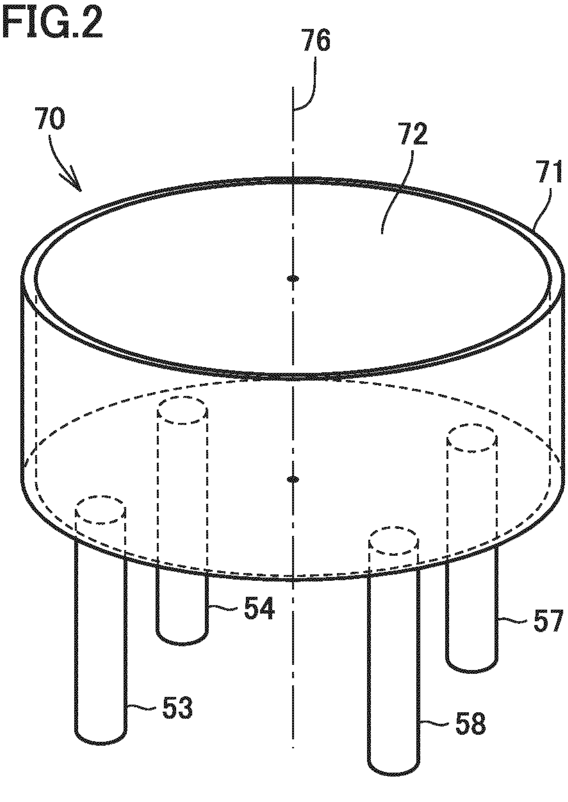
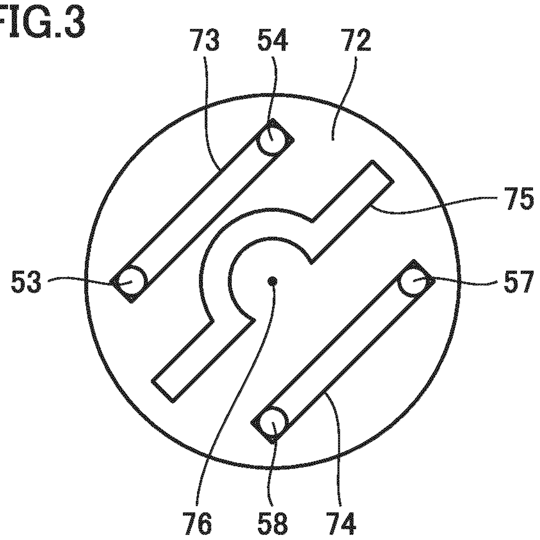
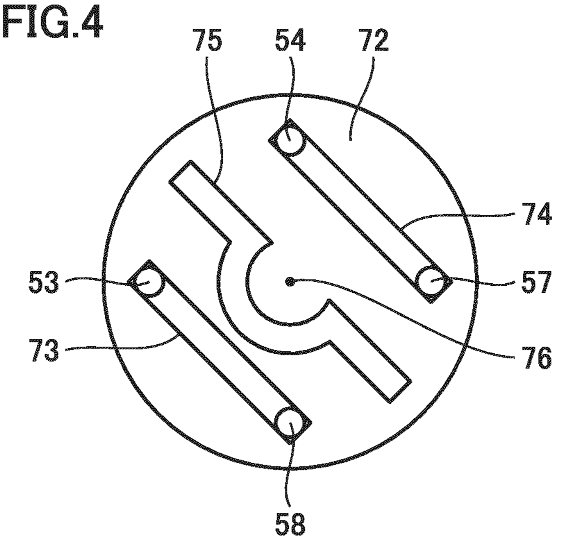


FIG.3



THIRD STATE

FIG.4



FOURTH STATE

FIG.5

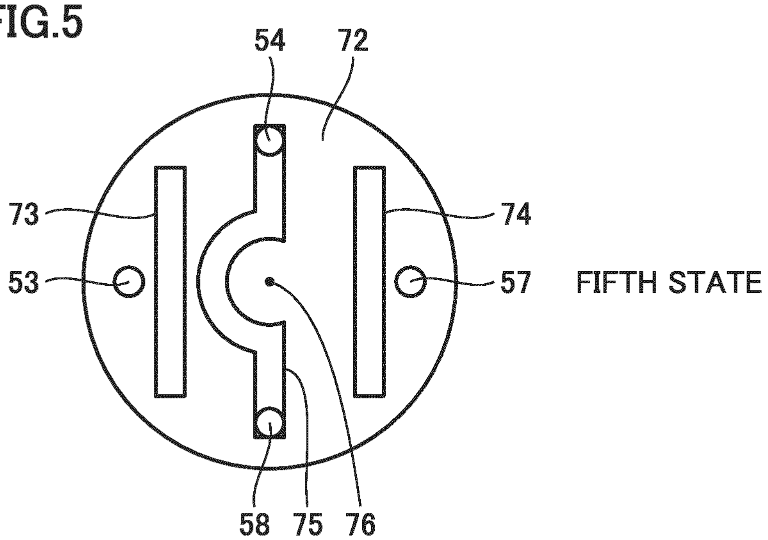


FIG.6

FIRST COOLING OPERATION

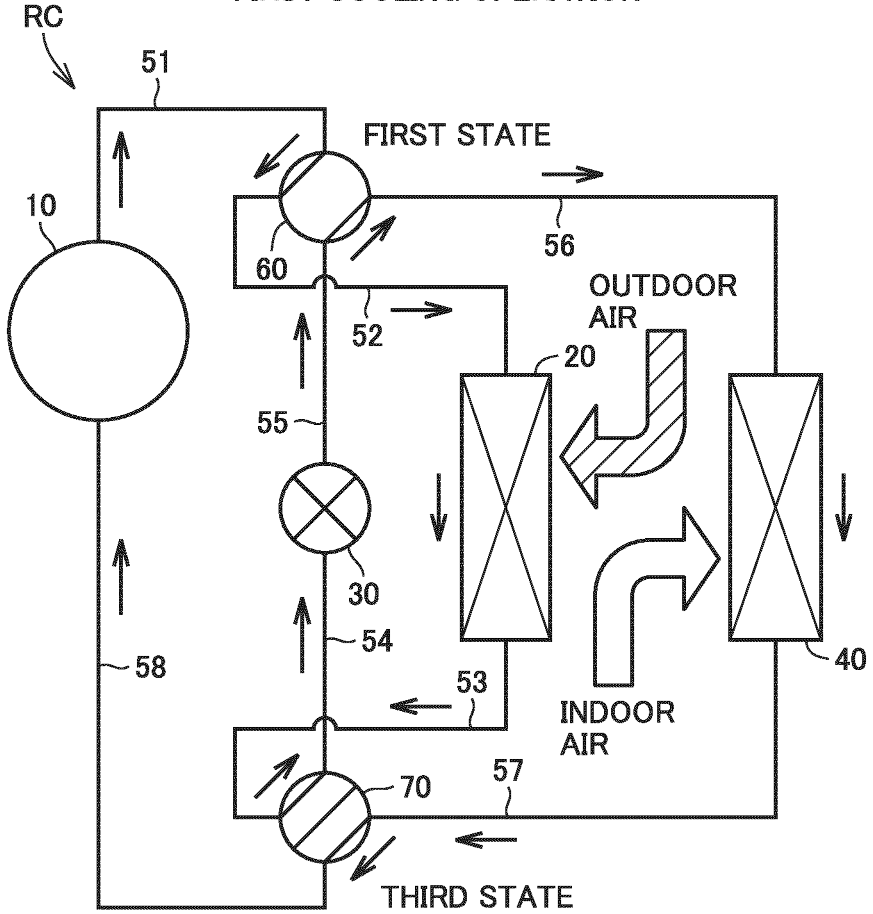


FIG.7

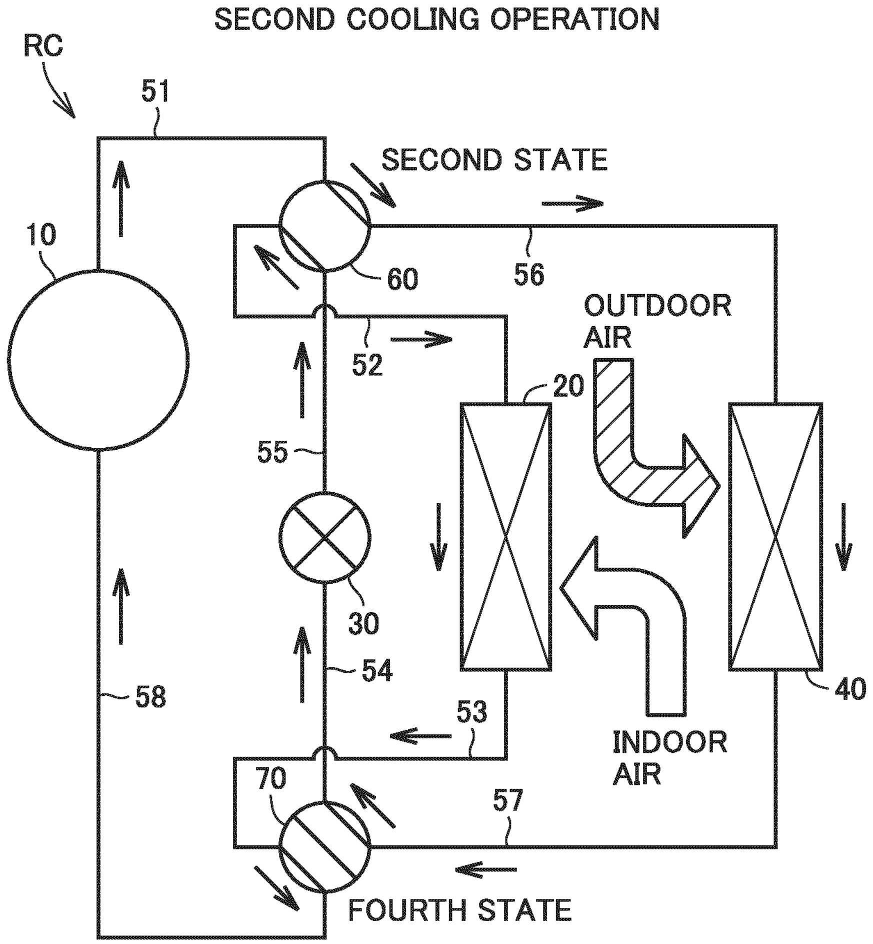

SECOND COOLING OPERATION
RC
51
SECOND STATE
10
60
56
OUTDOOR AIR
52
20
55
30
54
58
53
40
INDOOR AIR
70
57
FOURTH STATE

FIG.8

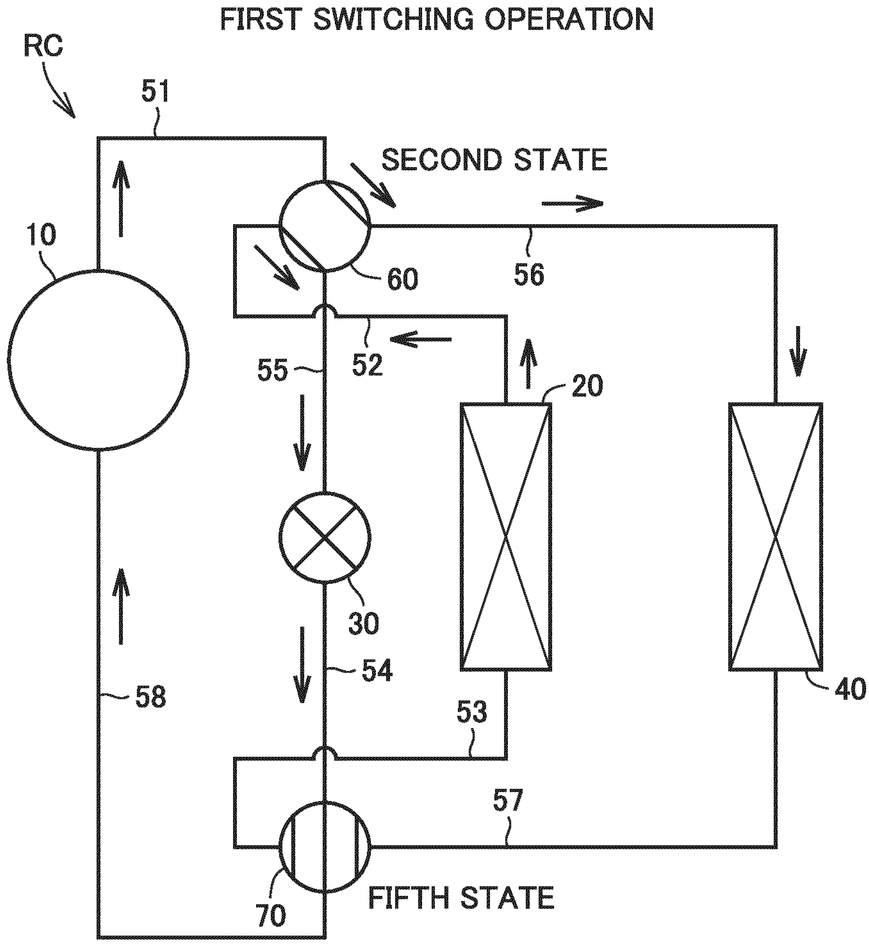

FIRST SWITCHING OPERATION
RC
51
SECOND STATE
10
60
56
55
52
20
30
54
58
53
40
57
70
FIFTH STATE

FIG.9

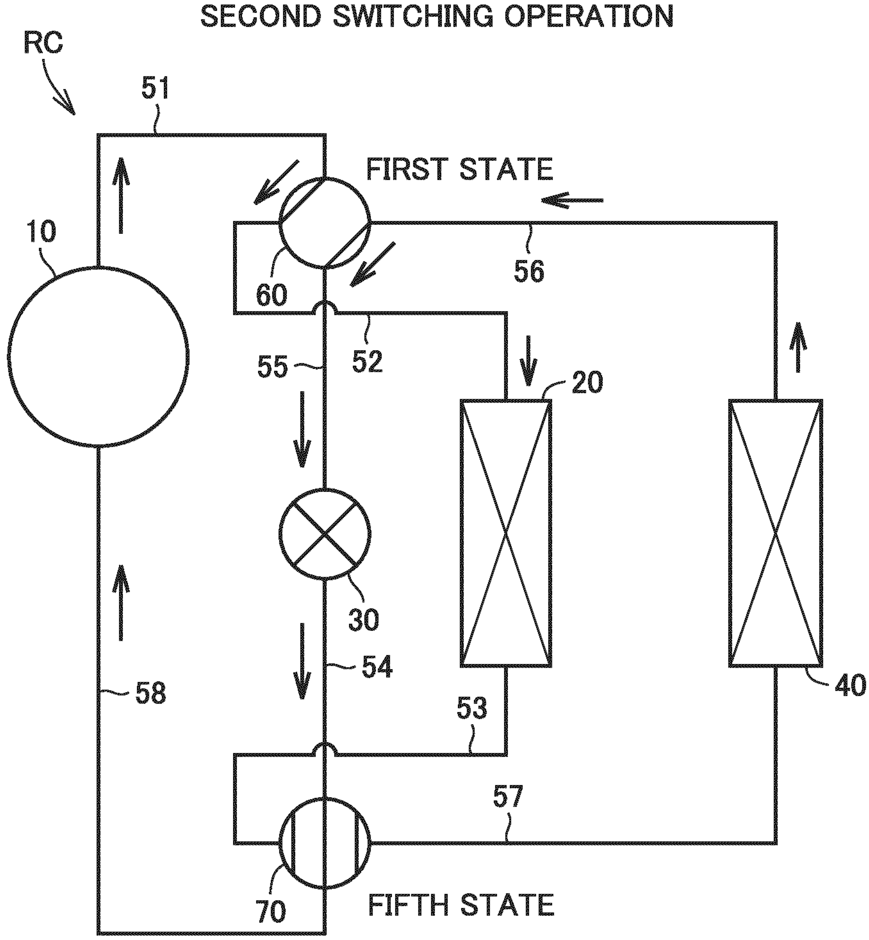
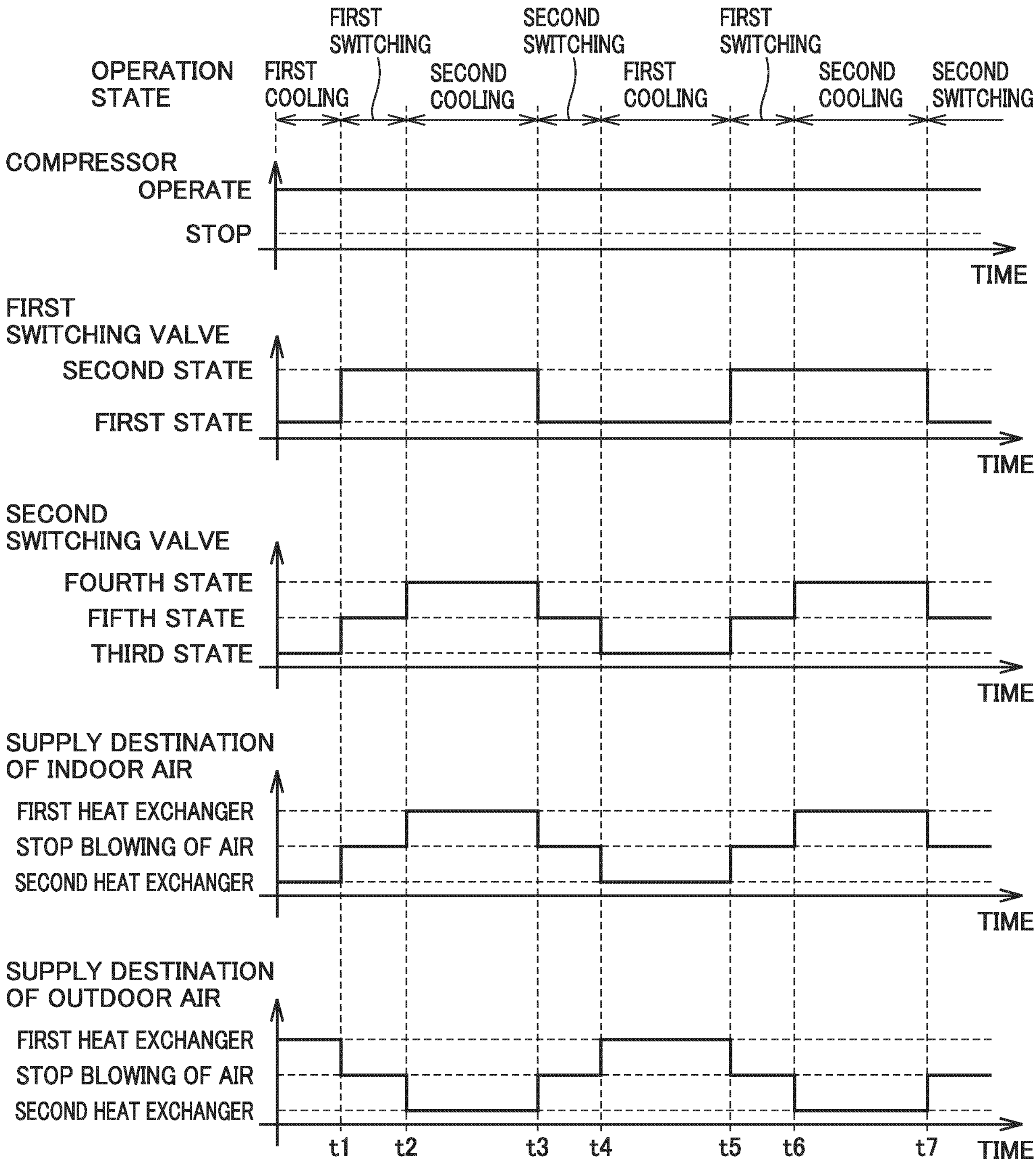

SECOND SWITCHING OPERATION
RC
51
FIRST STATE
10
60
56
55
52
20
30
54
58
53
40
57
70
FIFTH STATE

FIG.10



OPERATION STATE
FIRST COOLING
FIRST SWITCHING
SECOND COOLING
SECOND SWITCHING
FIRST COOLING
FIRST SWITCHING
SECOND COOLING
SECOND SWITCHING
COMPRESSOR
OPERATE
STOP
TIME
FIRST SWITCHING VALVE
SECOND STATE
FIRST STATE
TIME
SECOND SWITCHING VALVE
FOURTH STATE
FIFTH STATE
THIRD STATE
TIME
SUPPLY DESTINATION OF INDOOR AIR
FIRST HEAT EXCHANGER
STOP BLOWING OF AIR
SECOND HEAT EXCHANGER
TIME
SUPPLY DESTINATION OF OUTDOOR AIR
FIRST HEAT EXCHANGER
STOP BLOWING OF AIR
SECOND HEAT EXCHANGER
t1
t2
t3
t4
t5
t6
t7
TIME

FIG.11

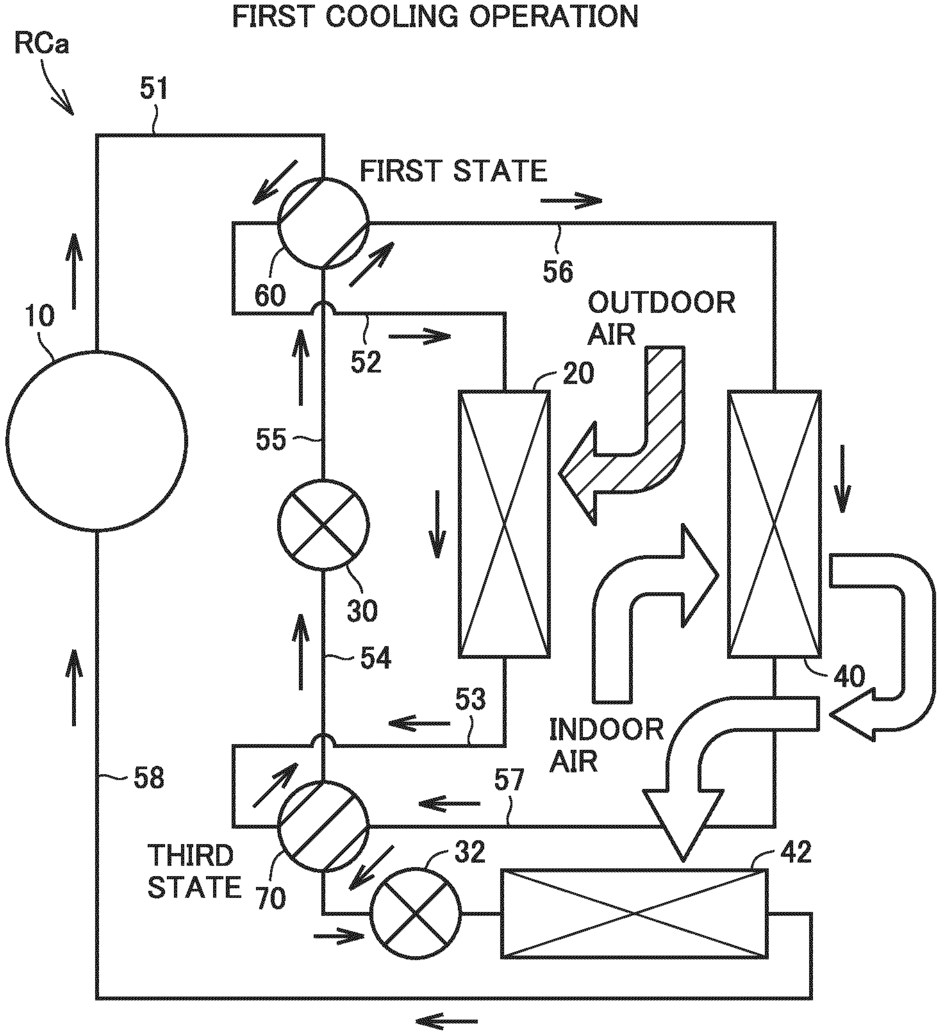

FIRST COOLING OPERATION
RCa
51
FIRST STATE
56
60
10
52
OUTDOOR
AIR
20
55
30
54
53
40
INDOOR
AIR
58
57
THIRD
STATE
70
32
42

FIG.12

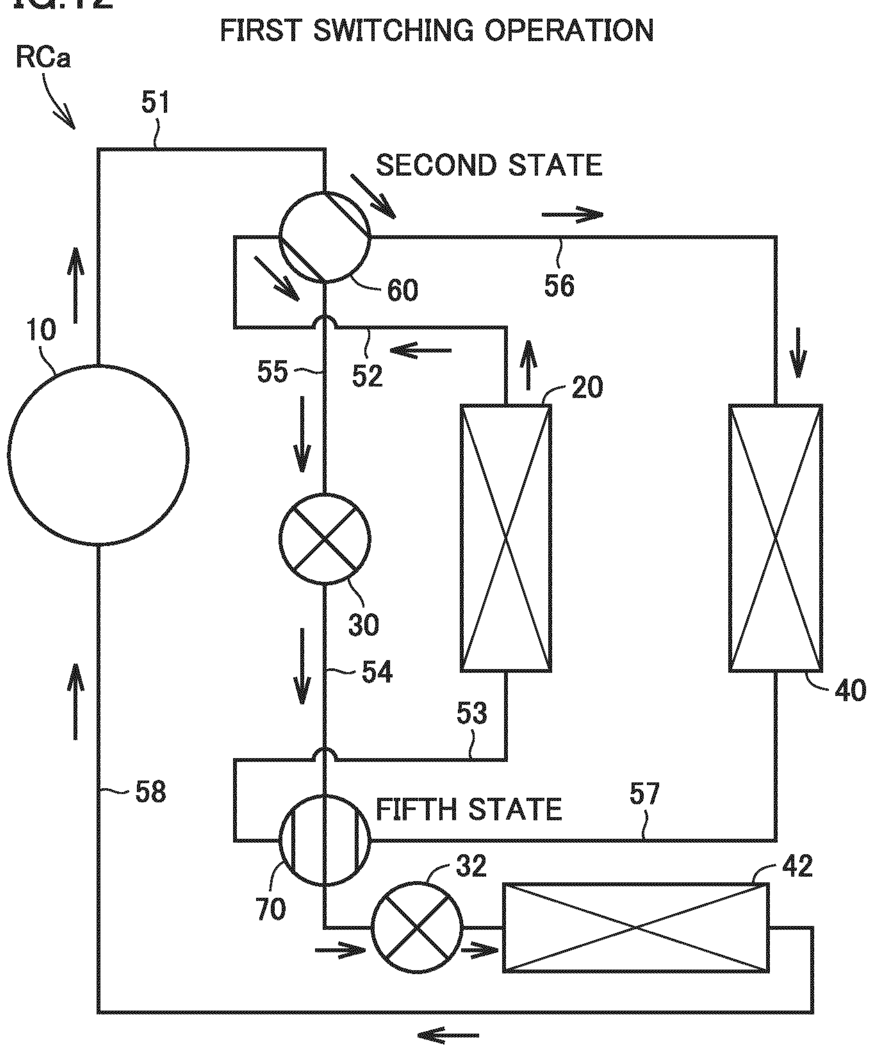

FIRST SWITCHING OPERATION
RCa
51
SECOND STATE
60
56
10
55
52
20
30
54
40
53
58
FIFTH STATE
57
32
42
70

FIG.13

SECOND COOLING OPERATION

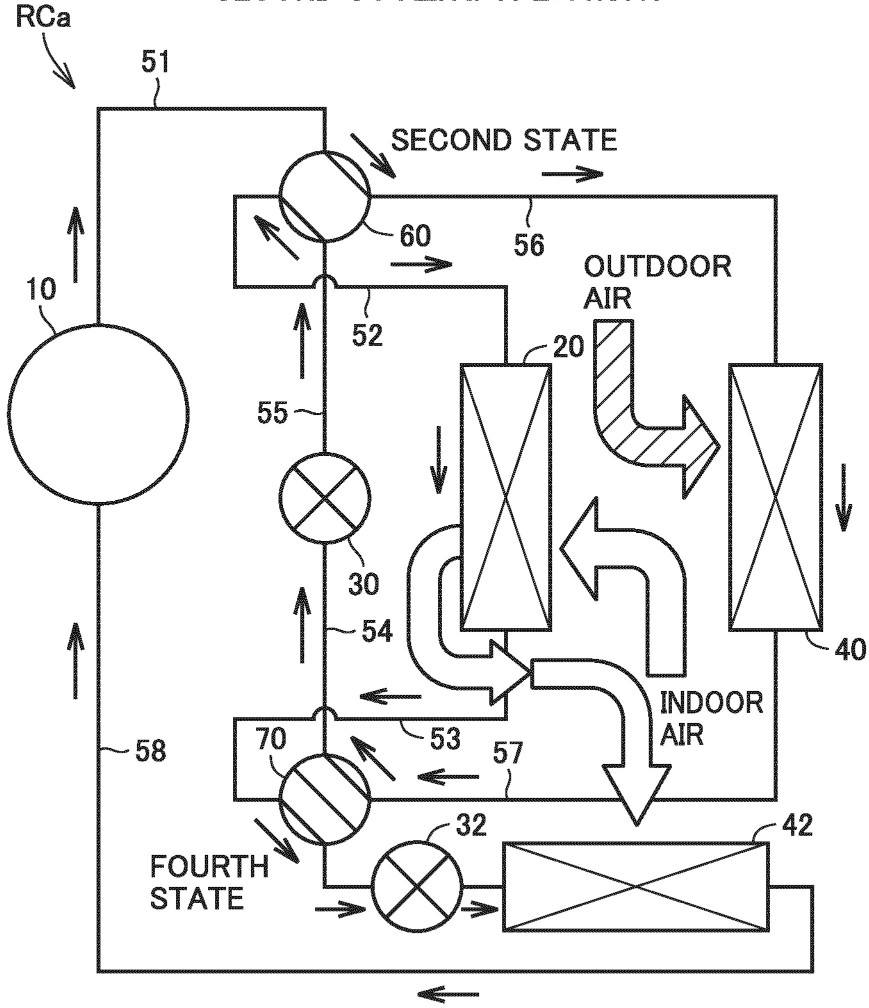


FIG.14

SECOND SWITCHING OPERATION

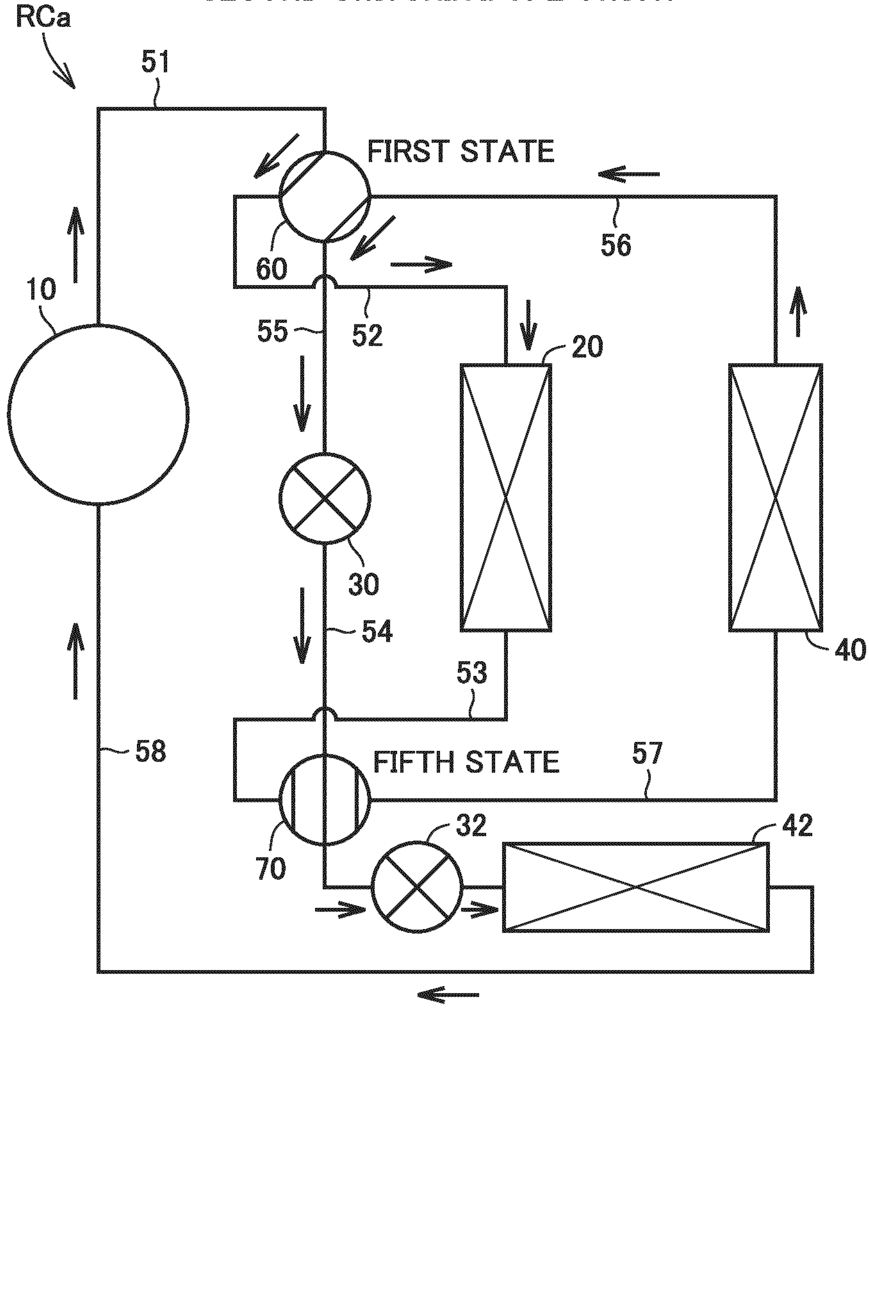


FIG.15

FIRST COOLING OPERATION

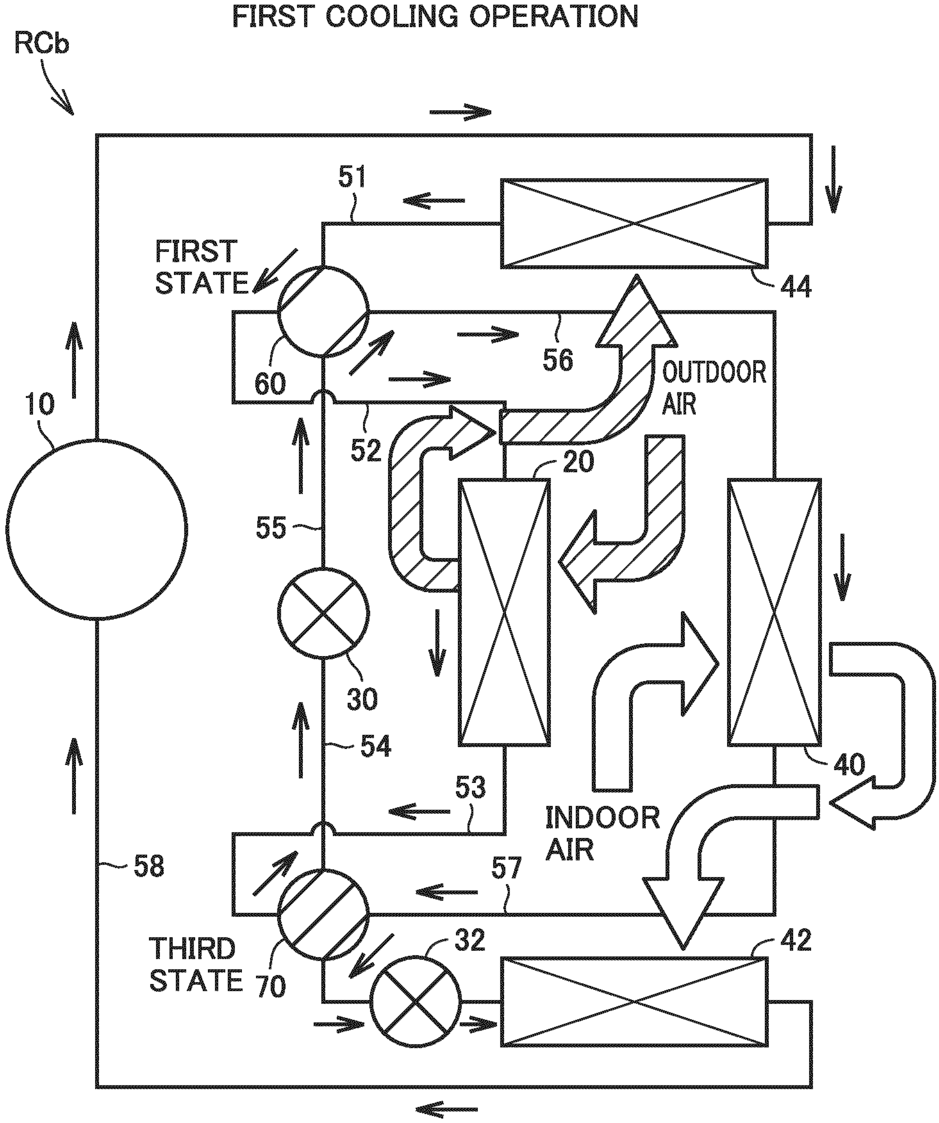


FIG.16

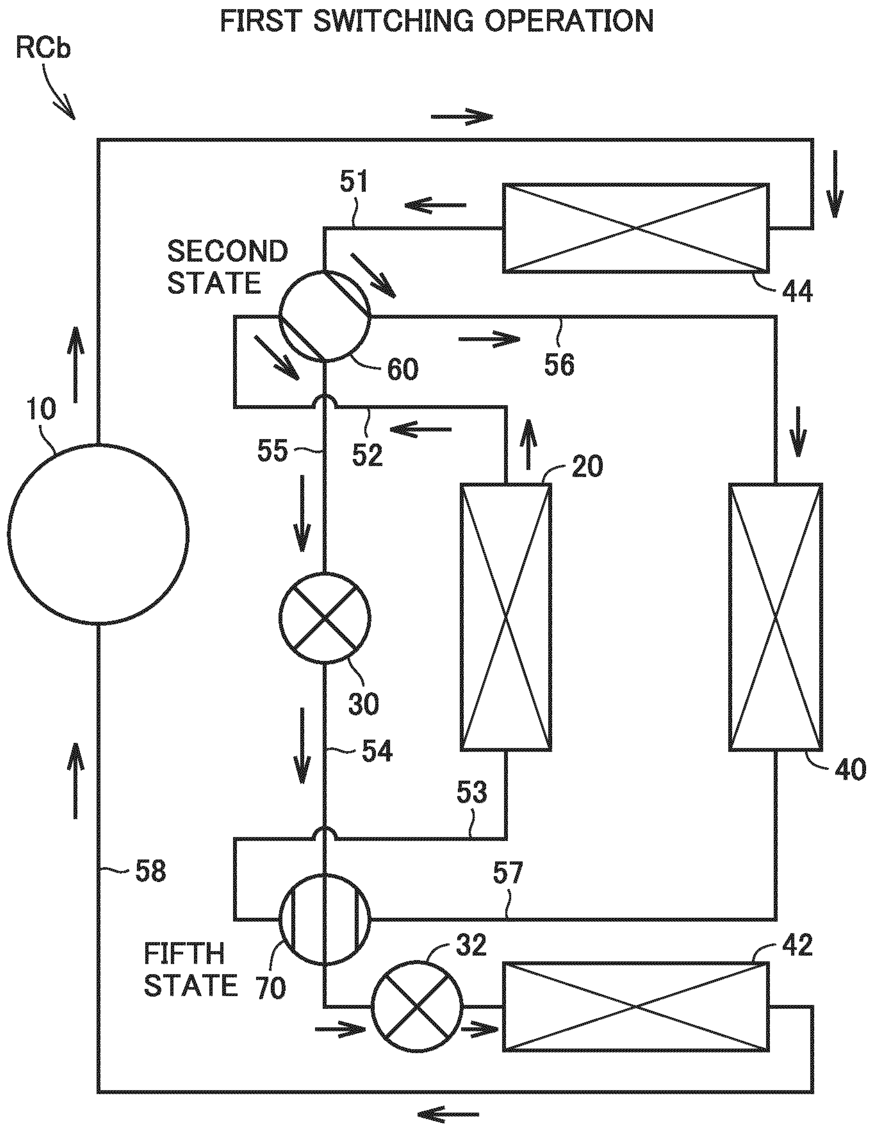

FIRST SWITCHING OPERATION
RCb
51
SECOND
STATE
44
60
56
10
55
52
20
30
54
40
53
58
57
FIFTH
STATE
70
32
42

FIG.17

SECOND COOLING OPERATION

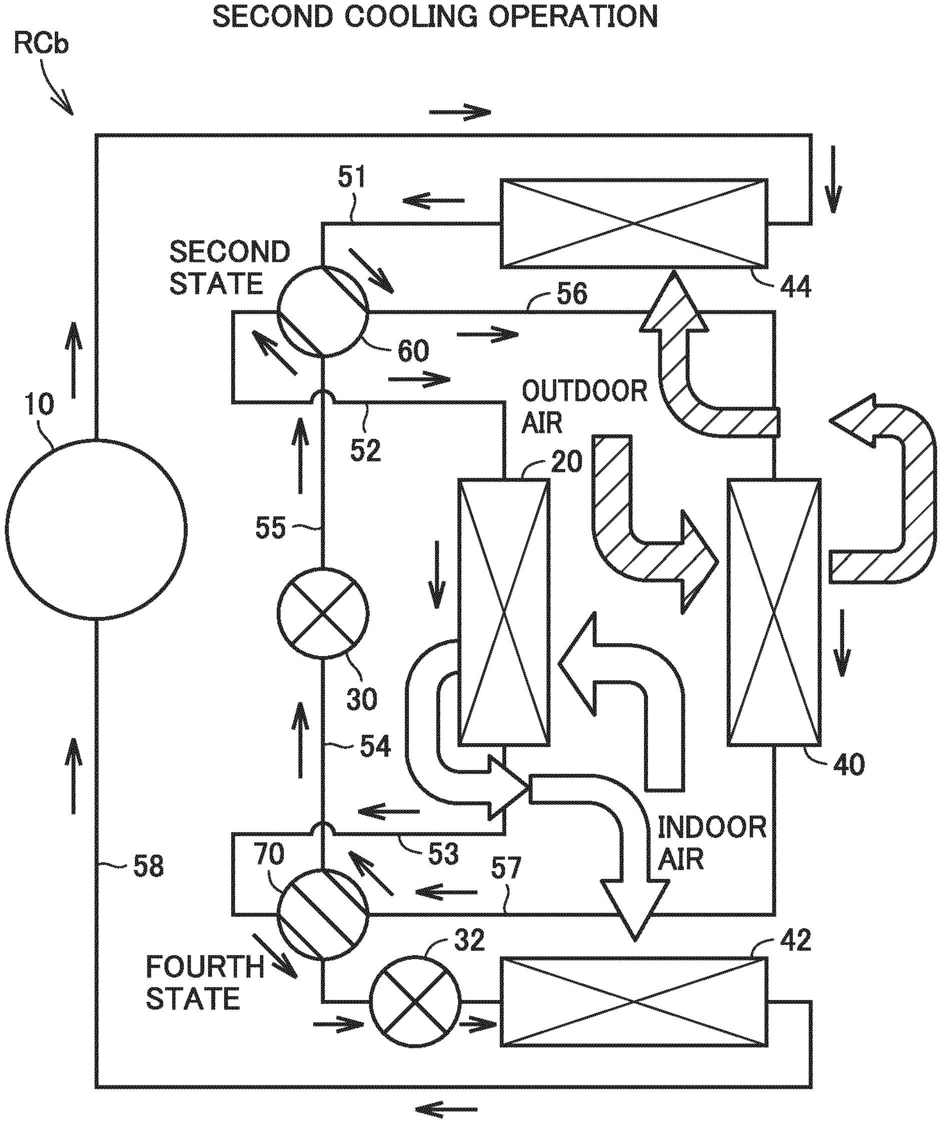


FIG.18

SECOND SWITCHING OPERATION

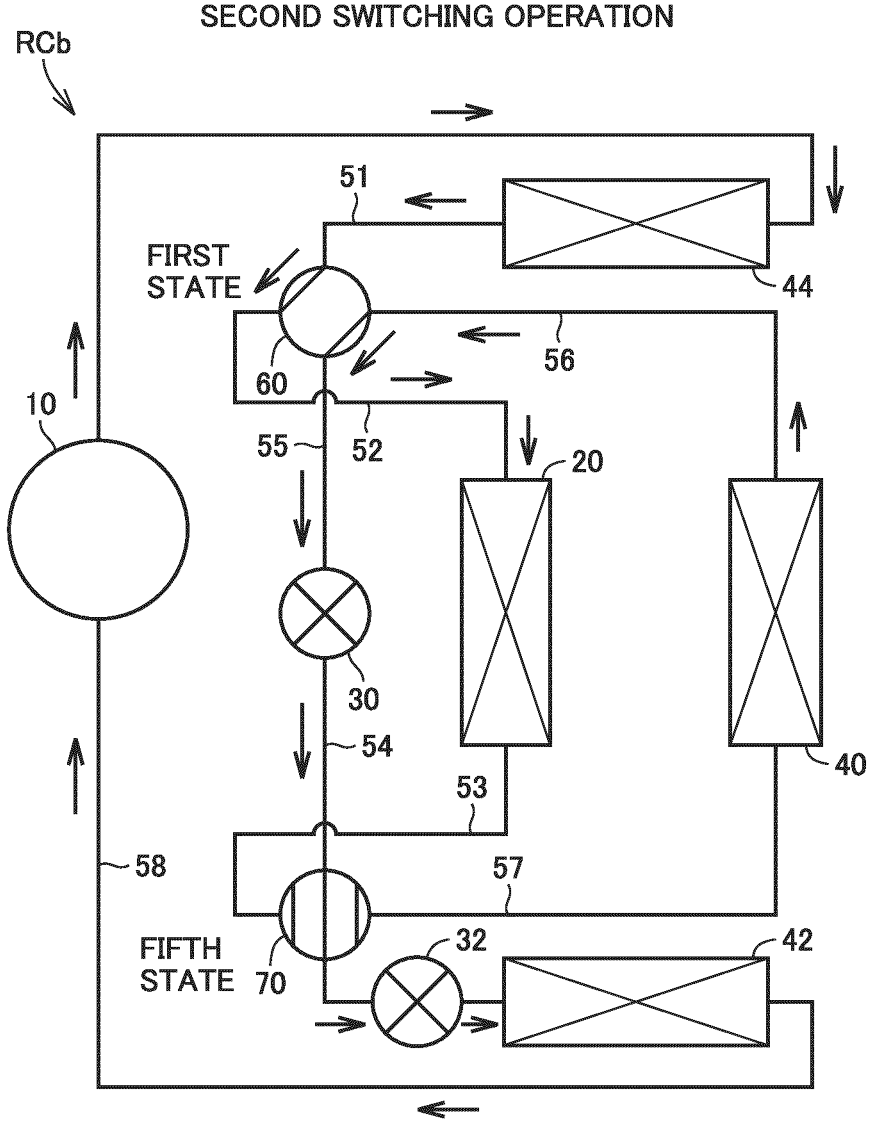


FIG.19

FIRST COOLING OPERATION

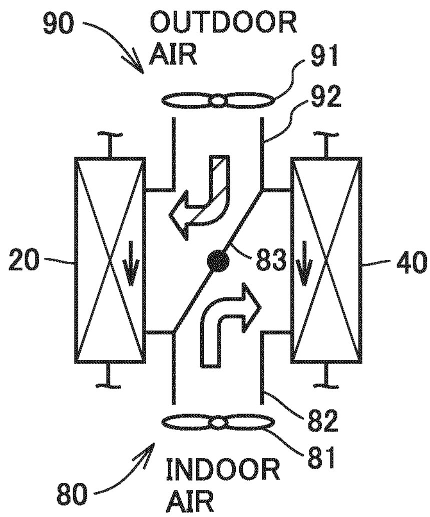


FIG.20

SECOND COOLING OPERATION

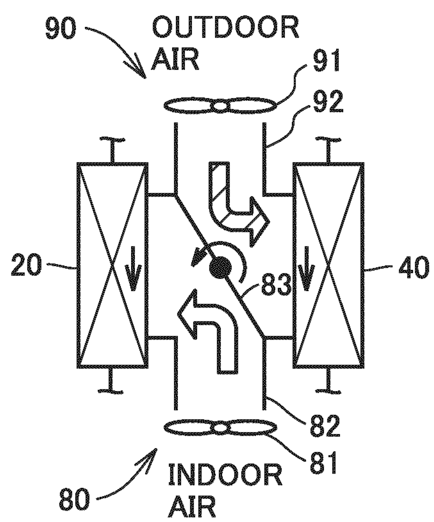


FIG.21

FIRST COOLING OPERATION

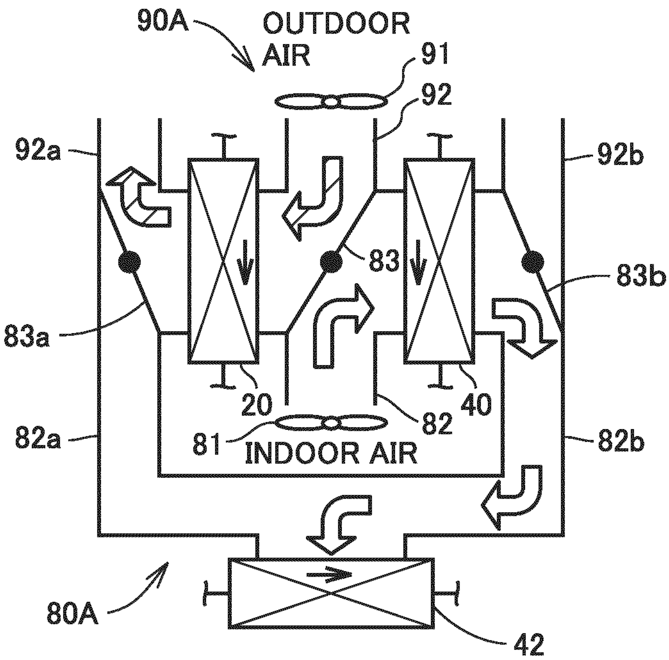


FIG.22

SECOND COOLING OPERATION

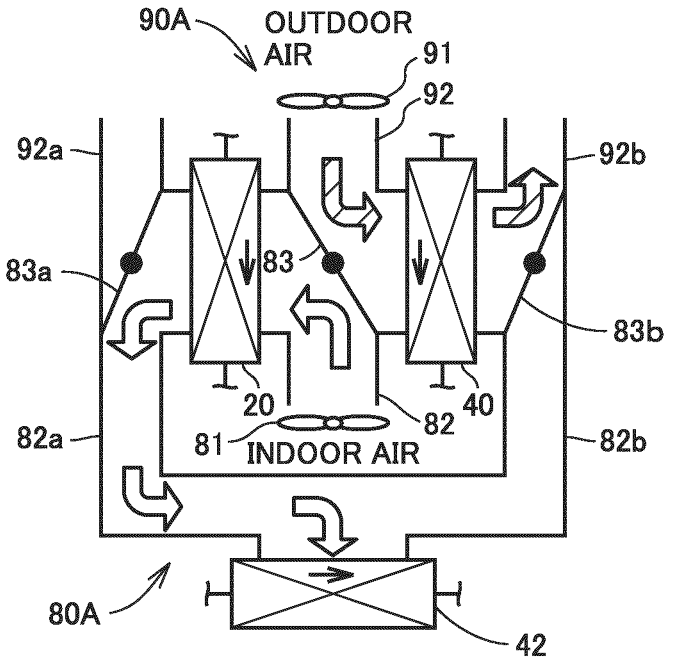


FIG.23

FIRST COOLING OPERATION

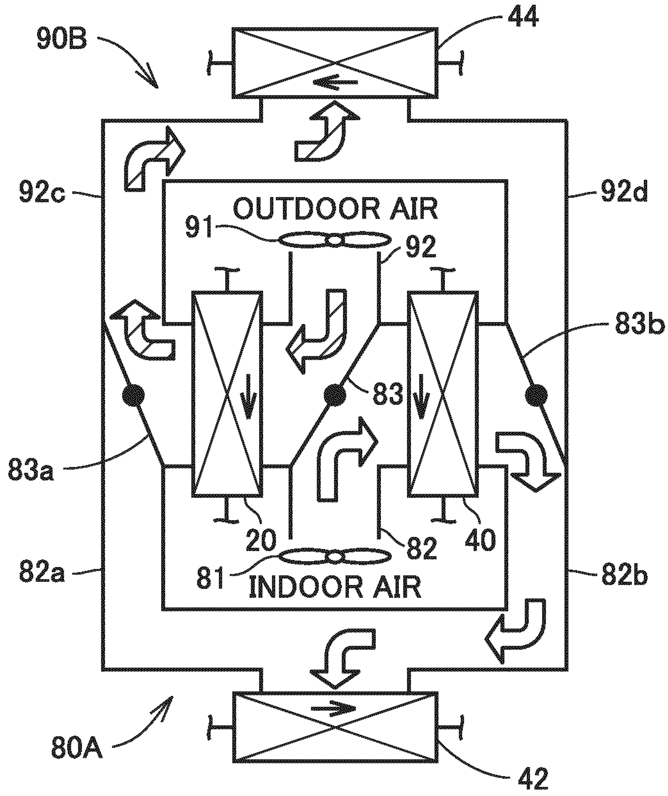
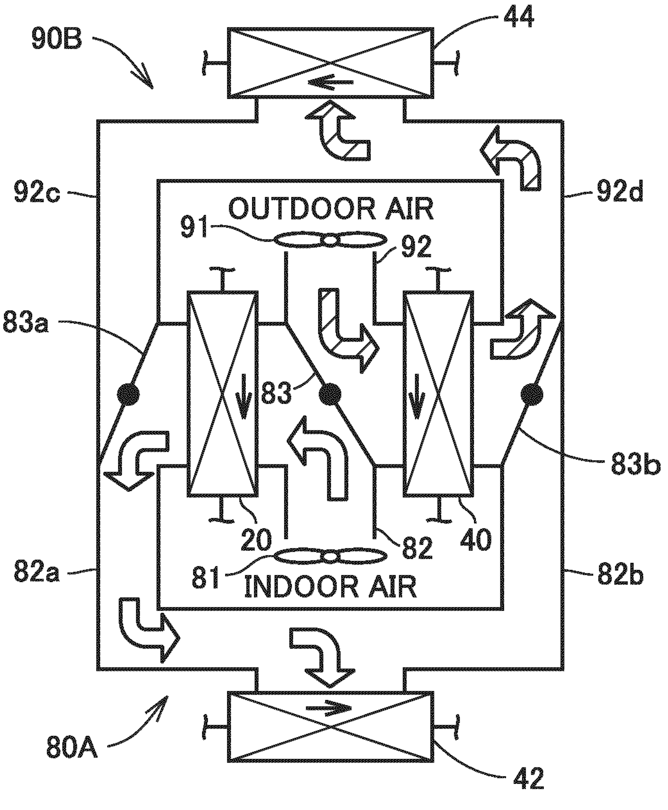


FIG.24

SECOND COOLING OPERATION



INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2020/026569

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. F25B13/00(2006.01)i, F25B41/04(2006.01)i, F25B1/00(2006.01)i
FI: F25B41/04 E, F25B41/04 C, F25B1/00 383, F25B1/00 391, F25B13/00 P, F25B13/00 361

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. F25B1/00, F25B13/00, F25B41/04

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2020
Registered utility model specifications of Japan	1996-2020
Published registered utility model applications of Japan	1994-2020

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 4-254158 A (DAIKIN INDUSTRIES, LTD.) 09 September 1992, entire text, all drawings	1-9
A	US 6817205 B1 (CARRIER CORPORATION) 16 November 2004, entire text, all drawings	1-9
A	JP 2015-75188 A (HITACHI APPLIANCES INC.) 20 April 2015, entire text, all drawings	1-9
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 165371/1983 (Laid-open No. 73071/1985) (TOSHIBA CORP.) 23 May 1985, entire text, all drawings	1-9

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02.09.2020	15.09.2020

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/026569

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 4-254158 A	09.09.1992	(Family: none)	
US 6817205 B1	16.11.2004	(Family: none)	
JP 2015-75188 A	20.04.2015	CN 104565440 A	
JP 60-73071 U1	23.05.1985	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2005134099 A **[0002] [0003]**