



(11) **EP 4 160 118 A1**

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

(43) Date of publication:
05.04.2023 Bulletin 2023/14

(21) Application number: **21814271.9**

(22) Date of filing: **26.04.2021**

(51) International Patent Classification (IPC):
F25B 45/00 ^(2006.01) **F25B 1/00** ^(2006.01)
F24F 11/32 ^(2018.01)

(52) Cooperative Patent Classification (CPC):
F24F 11/32; F25B 1/00; F25B 45/00

(86) International application number:
PCT/JP2021/016678

(87) International publication number:
WO 2021/241108 (02.12.2021 Gazette 2021/48)

(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

(30) Priority: **29.05.2020 JP 2020094409**

(71) Applicant: **Panasonic Intellectual Property Management Co., Ltd.**
Osaka-shi, Osaka 540-6207 (JP)

(72) Inventors:
• **MAEKAWA, Naoki**
Osaka 540-6207 (JP)
• **SHIGETA, Akihiro**
Osaka 540-6207 (JP)
• **HASHIMOTO, Shunichi**
Osaka 540-6207 (JP)

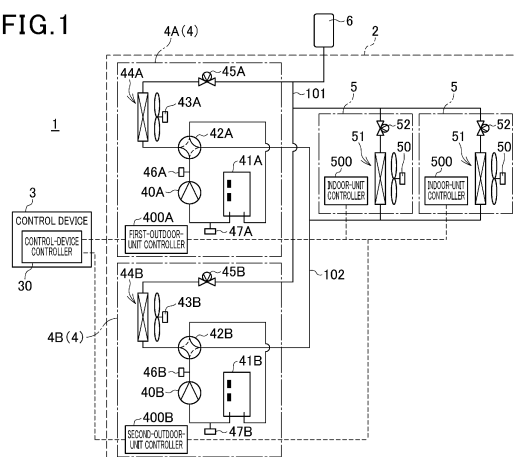
(74) Representative: **Eisenführ Speiser**
Patentanwälte Rechtsanwälte PartGmbB
Postfach 31 02 60
80102 München (DE)

(54) **AIR CONDITIONING SYSTEM**

(57) An object is to make it possible to perform refrigerant recovery in a rapid manner by using pump-down operation of outdoor units 4 even in the case in which a large amount of refrigerant that exceeds a storable amount of the outdoor unit 4 is charged in an air conditioner 2.

An air conditioning system 1 includes: an air conditioner 2 including an indoor unit 5 and a plurality of outdoor units 4 connected to the indoor unit 5; and a control-device controller 30 that controls the air conditioner 2, and the control-device controller 30 alternately executes first control in which one of the outdoor units 4 is caused to execute pump-down operation and in which another one of the outdoor units 4 is put into a state where refrigerant is allowed to be recovered by a refrigerant recovery machine 6 and second control in which the outdoor unit 4 that executes the pump-down operation in the first control is put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6 and in which the outdoor unit 4 that is put, in the first control, into the state where the refrigerant is allowed to be recovered is caused to execute pump-down operation.

FIG. 1



Description

[Technical Field]

[0001] The present invention relates to air conditioning systems.

[Background Art]

[0002] Techniques have been known for recovering refrigerant charged in an air conditioner having an indoor unit and an outdoor unit (see, for example, Patent Literature 1). Patent Literature 1 discloses a technique to store refrigerant in an outdoor unit by pump-down operation, and recover the stored refrigerant by a refrigerant recovery machine.

[Citation List]

[Patent Literature]

[0003] [Patent Literature 1]
Japanese Patent Laid-Open No. 2000-199660

[Summary of Invention]

[Technical Problem]

[0004] Unfortunately, in Patent Literature 1, in the case in which a large amount of refrigerant that exceeds a storable amount of the outdoor unit is charged in the air conditioner, it is not possible to recover the refrigerant charged in the air conditioner in a rapid manner because the refrigerant is recovered through the refrigerant recovery machine without performing pump-down operation.

[0005] Hence, an object of the present invention is to provide an air conditioning system capable of performing refrigerant recovery in a rapid manner by using pump-down operation of outdoor units even in the case in which a large amount of refrigerant that exceeds a storable amount of the outdoor unit is charged in the air conditioner.

[Solution to Problem]

[0006] To achieve the above object, an aspect of the present invention is an air conditioning system including: an air conditioner including an indoor unit and a plurality of outdoor units connected to the indoor unit; and a controller that controls the air conditioner, in which the controller alternately executes first control in which one of the outdoor units is caused to execute pump-down operation and in which another one of the outdoor units is put into a state where refrigerant is allowed to be recovered by a refrigerant recovery machine and second control in which the outdoor unit that executes the pump-down operation in the first control is put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine.

erant recovery machine and in which the outdoor unit that is put, in the first control, into the state where the refrigerant is allowed to be recovered is caused to execute pump-down operation.

[0007] Note that this specification includes the entire contents of Japanese Patent Application No. 2020-094409 filed on May 29, 2020.

[Advantageous Effect of Invention]

[0008] With the present invention, it is possible to perform refrigerant recovery in a rapid manner by using pump-down operation of outdoor units even in the case in which a large amount of refrigerant that exceeds a storable amount of the outdoor unit is charged in the air conditioner.

[Brief Description of Drawings]

[0009]

[Figure 1] Figure 1 is a diagram showing the configuration of an air conditioning system according to a first embodiment.

[Figure 2] Figure 2 is a block diagram showing the control configuration of a control device, outdoor units, and indoor units.

[Figure 3] Figure 3 is a flowchart showing the operation of the control device.

[Figure 4] Figure 4 is a flowchart showing the operation of the control device in a first process.

[Figure 5] Figure 5 is a flowchart showing the operation of the control device in a second process.

[Figure 6] Figure 6 is a flowchart showing the operation of the control device in a third process.

[Figure 7] Figure 7 is a diagram showing the configuration of an air conditioning system according to a second embodiment.

[Figure 8] Figure 8 is a flowchart showing the operation of a control device.

[Description of Embodiments]

[0010] A first aspect of the invention is an air conditioning system including: an air conditioner including an indoor unit and a plurality of outdoor units connected to the indoor unit; and a controller that controls the air conditioner, in which the controller alternately executes first control in which one of the outdoor units is caused to execute pump-down operation and in which another one of the outdoor units is put into a state where refrigerant is allowed to be recovered by a refrigerant recovery machine and second control in which the outdoor unit that executes the pump-down operation in the first control is put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine and in which the outdoor unit that is put, in the first control, into the state where the refrigerant is allowed to be recovered

is caused to execute pump-down operation.

[0011] This configuration makes it possible to execute pump-down operation with a plurality of outdoor units, and also while one of the outdoor units is executing the pump-down operation, another outdoor unit can be, in parallel, put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine. Thus, in the air conditioning system, even in the case in which a large amount of refrigerant that exceeds a storable amount of the outdoor unit is charged in the air conditioner, it is possible to perform refrigerant recovery in a rapid manner by using the pump-down operation of the outdoor units.

[0012] In a second aspect of the invention, the outdoor units each have a compressor and a high-pressure sensor that detects the pressure of the refrigerant discharged by the compressor, and the controller, in a case in which a detection value of the high-pressure sensor exceeds a specified threshold, switches between execution of the first control and execution of the second control.

[0013] This configuration makes it possible to switch the outdoor units that execute pump-down operation before effects of the refrigerant stored by the pump-down operation occur on the discharge side of the compressor. Thus, in the air conditioning system, even in the case in which a large amount of refrigerant that exceeds a storable amount of the outdoor unit is charged in the air conditioner, it is possible to switch control before the capacity within which the outdoor unit can perform pump-down operation is exceeded and perform refrigerant recovery in a rapid manner by using the pump-down operation of the outdoor units.

[0014] In a third aspect of the invention, the outdoor units each have a compressor and a low-pressure sensor that detects the pressure of the refrigerant flowing into the compressor, and the controller, in a case in which a detection value of the low-pressure sensor is smaller than or equal to a specified threshold, finishes execution of the first control and the second control.

[0015] With this configuration, it is possible to finish the first control and the second control at an appropriate time at which refrigerant recovery by pump-down operation is finished, and thus possible to prevent unnecessary pump-down operation of the outdoor units.

[0016] In a fourth aspect of the invention, the controller, in a case in which the number of the outdoor units included in the air conditioner is three or more, selects two or more of the outdoor units in descending order of the performance of the outdoor units as the outdoor units that execute pump-down operation in either the first control or the second control and executes the first control and the second control with the selected two or more outdoor units.

[0017] With this configuration, in the case in which the air conditioner includes three or more outdoor units, it is possible to cause the outdoor units capable of storing refrigerant in a more rapid manner to execute pump-down operation. Thus, in the case in which the air con-

ditioner includes three or more outdoor units, it is possible to perform refrigerant recovery in a rapid manner and efficiently by using the pump-down operation of outdoor units.

[0018] Hereinafter, embodiments of an air conditioning system 1 according to the present invention will be described with reference to the drawings.

[First Embodiment]

[0019] First, a description will be given of a first embodiment.

[0020] Figure 1 is a diagram showing the configuration of an air conditioning system 1 according to the first embodiment.

[0021] The air conditioning system 1 is a system installed at large buildings and facilities such as schools. As shown in Figure 1, the air conditioning system 1 includes an air conditioner 2 and a control device 3.

[0022] The air conditioner 2 includes two outdoor units 4, a first outdoor unit 4A and a second outdoor unit 4B, and two indoor units 5.

[0023] The first outdoor unit 4A and the second outdoor unit 4B have the same or a similar configuration including their control configurations. Hence, in the following description, when the corresponding constituents in the first outdoor unit 4A and the second outdoor unit 4B are not discriminated, identifiers, such as "first" and "second", are omitted in the names of the constituents, and also, only numerals are used for the symbols of the constituents and the suffixes A and B are omitted. For example, when a first compressor 40A and a second compressor 40B are not discriminated, they are referred to as a "compressor 40". In addition, for example, when a first-outdoor-unit controller 400A and a second-outdoor-unit controller 400B are not discriminated, they are referred to as an "outdoor-unit controller 400". In contrast, when the corresponding constituents in the first outdoor unit 4A and the second outdoor unit 4B are discriminated, the names of the constituents in the first outdoor unit 4A will have the identifier "first" and their symbols will have the suffix A, and the names of the constituents in the second outdoor unit 4B will have the identifier "second" and their symbol will have the suffix B. Note that the drawings include symbols that allow the constituents of the first outdoor unit 4A and the second outdoor unit 4B to be discriminated.

[0024] The indoor units 5 are each connected in parallel to the two outdoor units 4 with refrigerant pipes 101 and 102. The air conditioner 2 has a refrigeration cycle formed by the two outdoor units 4, the two indoor units 5, and the refrigerant pipes 101 and 102. Then, the air conditioner 2 runs the refrigerant compressed by the outdoor units 4 between the outdoor units 4 and the indoor units 5 and air-conditions air-conditioning rooms with the indoor units 5 installed, by using the indoor units 5.

[0025] The outdoor unit 4 includes a compressor 40, a gas-liquid separator 41, a four-way valve 42, an outdoor

heat exchanger 44 having an outdoor blower fan 43, and an electromagnetic valve 45.

[0026] The suction side of the compressor 40 is connected to the gas-liquid separator 41 that supplies the compressor 40 with gas refrigerant, and the discharge side of the compressor 40 is connected to the four-way valve 42. The four-way valve 42 is connected to the outdoor heat exchanger 44 having the outdoor blower fan 43. The outdoor heat exchanger 44 is configured to exchange heat between the air sent from the outdoor blower fan 43 and the refrigerant. The outdoor heat exchanger 44 is connected to the electromagnetic valve 45. The electromagnetic valve 45 is located on the refrigerant pipe 101.

[0027] The outdoor unit 4 also includes a high-pressure sensor 46 and a low-pressure sensor 47. The high-pressure sensor 46, which is located on the discharge side of the compressor 40 and between the compressor 40 and the outdoor heat exchanger 44, detects the pressure of the refrigerant discharged from the compressor 40. The high-pressure sensor 46 outputs detection values to an outdoor-unit controller 400. The low-pressure sensor 47, which is located on the suction side of the compressor 40 and between the compressor 40 and the gas-liquid separator 41, detects the pressure of the refrigerant flowing into the compressor 40. The low-pressure sensor 47 outputs detection values to the outdoor-unit controller 400.

[0028] The indoor unit 5 includes an indoor heat exchanger 51 having an indoor blower fan 50, and an indoor expansion valve 52. The indoor expansion valve 52 has one end connected to the indoor heat exchanger 51 and the other end connected to the refrigerant pipe 101.

[0029] The refrigerant pipe 101 is connected to one refrigerant recovery machine 6. The refrigerant recovery machine 6 recovers refrigerant from the air conditioner 2 by recovering the refrigerant from the refrigerant pipe 101.

[0030] The control device 3 is a device that controls the air conditioner 2. The control device 3 of the present embodiment controls the outdoor units 4 included in the air conditioner 2.

[0031] Next, a description will be given of the control configurations of the control device 3, the outdoor units 4, and the indoor units 5.

[0032] Figure 2 is a block diagram showing the control configurations of the control device 3, the outdoor units 4, and the indoor units 5.

[0033] First, the control configuration of the control device 3 will be described.

[0034] The control device 3 includes a control-device controller 30, a control-device communication unit 31, a control-device input unit 32, and a control-device display unit 33.

[0035] The control-device controller 30 includes a control-device processor 310, which is a processor such as a CPU or an MPU that executes programs, and a control-device storage unit 320 and controls each unit in the con-

trol device 3. The control-device controller 30 executes various processes by cooperation of hardware and software so that the control-device processor 310 reads a control program 321 stored in the control-device storage unit 320 and execute processes.

[0036] The control-device storage unit 320 has a storage area to store programs to be executed by the control-device processor 310 and data to be processed by the control-device processor 310. The control-device storage unit 320 stores the control program that the control-device processor 310 executes, setting data related to various kinds of setting of the control device 3, and other various kinds of data. The control-device storage unit 320 has a nonvolatile storage area to store programs and data in a nonvolatile manner. The control-device storage unit 320 may include a volatile storage area configured to serve as a work area that temporarily stores programs to be executed by the control-device processor 310 and data to be processed.

[0037] The control-device communication unit 31, including communication hardware conforming to a specified communication standard, communicates with each of the first outdoor unit 4A and the second outdoor unit 4B under control of the control-device controller 30.

[0038] The control-device input unit 32, including input means such as an operation switch, a touch panel, a mouse, and a keyboard provided on the control device 3, detects the user's operations on the input means and outputs detection results to the control-device controller 30. The control-device controller 30 executes processes associated with the operations on the input means, based on the input from the control-device input unit 32.

[0039] The control-device display unit 33, including LEDs and a display panel, executes turning on/flash-ing/turning off of the LEDs in specified modes, displaying information on the display panel, and other operations under control of the control-device controller 30.

[0040] Next, a description will be given of the control configuration of the outdoor unit 4.

[0041] The outdoor unit 4 includes the outdoor-unit controller 400.

[0042] The outdoor-unit controller 400 includes an outdoor-unit processor 410, which is a processor such as a CPU or an MPU that executes programs, and an outdoor-unit storage unit 420 and controls each unit in the outdoor unit 4. The outdoor-unit controller 400 executes various processes by cooperation of hardware and software so that the outdoor-unit processor 410 reads a control program stored in the outdoor-unit storage unit 420 and execute processes.

[0043] The outdoor-unit storage unit 420 has a storage area to store programs to be executed by the outdoor-unit processor 410 and data to be processed by the outdoor-unit processor 410. The outdoor-unit storage unit 420 stores the control program that the outdoor-unit processor 410 executes, setting data for performing various kinds of setting of the outdoor unit 4, and other various kinds of data. The outdoor-unit storage unit 420 has a

nonvolatile storage area to store programs and data in a nonvolatile manner. The outdoor-unit storage unit 420 may include a volatile storage area configured to serve as a work area that temporarily stores programs to be executed by the outdoor-unit processor 410 and data to be processed.

[0044] The outdoor-unit controller 400 is connected to the compressor 40, the four-way valve 42, the outdoor blower fan 43, the high-pressure sensor 46, and the low-pressure sensor 47. The outdoor-unit controller 400 controls driving of the compressor 40, the four-way valve 42, the outdoor blower fan 43, and the electromagnetic valve 45, based on detection values of the high-pressure sensor 46 and the low-pressure sensor 47. The outdoor-unit controller 400 controls driving of the compressor 40, the four-way valve 42, the outdoor blower fan 43, and the electromagnetic valve 45, based on control signals received from the control device 3. The outdoor-unit controller 400 transmits detection values outputted by the high-pressure sensor 46 and the low-pressure sensor 47 to the control device 3 through an outdoor-unit communication unit 401.

[0045] The outdoor unit 4 includes the outdoor-unit communication unit 401. The outdoor-unit communication unit 401, including communication hardware conforming to a specified communication standard, communicates with the control device 3 and the indoor units 5 under control of the outdoor-unit controller 400.

[0046] Next, a description will be given of the control configuration of the indoor unit 5.

[0047] The indoor unit 5 includes an indoor-unit controller 500.

[0048] The indoor-unit controller 500 includes an indoor-unit processor 510, which is a processor such as a CPU or an MPU that executes programs, and an indoor-unit storage unit 520 and controls each unit in the indoor unit 5. The indoor-unit controller 500 executes various processes by cooperation of hardware and software so that the indoor-unit processor 510 reads a control program stored in the indoor-unit storage unit 520 and execute processes.

[0049] The indoor-unit storage unit 520 has a storage area to store programs to be executed by the indoor-unit processor 510 and data to be processed by the indoor-unit processor 510. The indoor-unit storage unit 520 stores the control program that the indoor-unit processor 510 executes, setting data related to various kinds of setting of the indoor unit 5, and other various kinds of data. The indoor-unit storage unit 520 has a nonvolatile storage area to store programs and data in a nonvolatile manner. The indoor-unit storage unit 520 may include a volatile storage area configured to serve as a work area that temporarily stores programs to be executed by the indoor-unit processor 510 and data to be processed.

[0050] The indoor-unit controller 500 is connected to the indoor blower fan 50 and the indoor expansion valve 52. The indoor-unit controller 500 controls driving of the indoor blower fan 50 and the indoor expansion valve 52,

based on control signals received from the outdoor units 4 and control signals received from a not-illustrated remote controller.

[0051] An indoor-unit communication unit 501, including communication hardware conforming to a specified communication standard, communicates with the outdoor units 4 under control of the indoor-unit controller 500. The indoor-unit communication unit 501 includes, in addition to the communication hardware of the communication standard to communicate with the outdoor unit 4, communication hardware of a communication standard to communicate with the not-illustrated remote controller and communicates with the remote controller.

[0052] Next, a description will be given of the operation of the air conditioning system 1 related to recovering the refrigerant charged in the air conditioner 2. In particular, the operation of the control device 3 will be described.

[0053] Figure 3 is a flowchart showing the operation of the control device 3.

[0054] The control-device controller 30 determines whether to move the operation mode of the control device 3 to a refrigerant recovery mode (step SA1).

[0055] The refrigerant recovery mode is an operation mode related to recovery of the refrigerant charged in the air conditioner 2. For example, the control-device controller 30, when the control-device input unit 32 receives an operation for an instruction to start refrigerant recovery by the refrigerant recovery machine 6, determines in step SA1 that the operation mode of the control device 3 is to be moved to the refrigerant recovery mode.

[0056] In the case in which the control-device controller 30 determines that the operation mode of the control device 3 is to be moved to the refrigerant recovery mode (step SA1: YES), the control-device controller 30 moves the operation mode of the control device 3 from a mode other than the refrigerant recovery mode to the refrigerant recovery mode (step SA2).

[0057] Next, the control-device controller 30 executes a first process (step SA3).

[0058] Figure 4 is a flowchart showing the operation of the control device 3 in the first process.

[0059] The control-device controller 30 places the first electromagnetic valve 45A into the closed state (step SB1).

[0060] In step SB1, the control-device controller 30 transmits a control signal to place the first electromagnetic valve 45A into the closed state to the first outdoor unit 4A through the control-device communication unit 31. When the first-outdoor-unit controller 400A receives the control signal through the first outdoor-unit communication unit 401A, the first-outdoor-unit controller 400A places the first electromagnetic valve 45A into the closed state. Also in the following steps, when placing the first electromagnetic valve 45A into the closed state, the control-device controller 30 transmits the same or a similar control signal to the first outdoor unit 4A.

[0061] The control-device controller 30 places the first four-way valve 42A into the state of a cooling cycle (step

SB2).

[0062] In step SB2, the control-device controller 30 transmits a control signal to place the first four-way valve 42A into the state of a cooling cycle to the first outdoor unit 4A through the control-device communication unit 31. When the first-outdoor-unit controller 400A receives the control signal through the first outdoor-unit communication unit 401A, the first-outdoor-unit controller 400A places the first four-way valve 42A into the state of a cooling cycle.

[0063] The control-device controller 30 starts driving the first compressor 40A (step SB3).

[0064] In step SB3, the control-device controller 30 transmits a control signal to start driving the first compressor 40A to the first outdoor unit 4A through the control-device communication unit 31. When the first-outdoor-unit controller 400A receives the control signal through the first outdoor-unit communication unit 401A, the first-outdoor-unit controller 400A starts driving the first compressor 40A. Also in the following steps, the control-device controller 30 transmits the same or a similar control signal to the first outdoor unit 4A to start driving the first compressor 40A.

[0065] The control-device controller 30 drives the first compressor 40A in step SB3 to cause the first outdoor unit 4A to execute pump-down operation. The first outdoor unit 4A executes the pump-down operation to store the refrigerant charged in the air conditioner 2 in the section of the refrigerant pipe 101 between the first compressor 40A and the first electromagnetic valve 45A.

[0066] The control-device controller 30 determines whether the detection value of the first high-pressure sensor 46A has exceeded a specified threshold (step SB4). This specified threshold is appropriately determined by tests, simulations, or the like conducted in advance, based on the viewpoint of not causing effects of the pump-down operation on the discharge side of the first compressor 40A.

[0067] In the case in which the control-device controller 30 determines that the detection value of the first high-pressure sensor 46A is smaller than or equal to the specified threshold (step SB4: NO), the control-device controller 30 executes the process in step SB4 again.

[0068] In the case in which the control-device controller 30 determines that the detection value of the first high-pressure sensor 46A has exceeded the specified threshold (step SB4: YES), the control-device controller 30 stops driving the first compressor 40A (step SB5). In other words, the control-device controller 30 causes the first outdoor unit 4A to stop the pump-down operation.

[0069] In step SB5, the control-device controller 30 transmits a control signal to stop driving the first compressor 40A to the first outdoor unit 4A through the control-device communication unit 31. When the first-outdoor-unit controller 400A receives the control signal through the first outdoor-unit communication unit 401A, the first-outdoor-unit controller 400A stops driving the first compressor 40A. Also in the following steps, the control-

device controller 30 transmits the same or a similar control signal to the first outdoor unit 4A to stop driving the first compressor 40A.

[0070] Next, the control-device controller 30 places the second electromagnetic valve 45B into the closed state and also places the indoor expansion valves 52 into the closed state (step SB6).

[0071] In step SB6, the control-device controller 30 transmits a control signal to place the second electromagnetic valve 45B into the closed state to the second outdoor unit 4B through the control-device communication unit 31. When the second-outdoor-unit controller 400B receives the control signal through the second outdoor-unit communication unit 401B, the second-outdoor-unit controller 400B places the second electromagnetic valve 45B into the closed state. Also in the following steps, the control-device controller 30 transmits the same or a similar control signal to the second outdoor unit 4B to place the second electromagnetic valve 45B into the closed state.

[0072] In step SB6, the control-device controller 30 also transmits a control signal to place the indoor expansion valves 52 into the closed state to the outdoor unit 4 through the control-device communication unit 31. When the outdoor-unit controller 400 receives the control signal through the outdoor-unit communication unit 401, the outdoor-unit controller 400 transmits the control signal to all of the indoor units 5. When the indoor-unit controllers 500 receive the control signal through the indoor-unit communication units 501, the indoor-unit controllers 500 place the indoor expansion valves 52 into the closed state.

[0073] Next, the control-device controller 30 places the first electromagnetic valve 45A into the open state (step SB7).

[0074] In step SB7, the control-device controller 30 transmits a control signal to place the first electromagnetic valve 45A into the open state to the first outdoor unit 4A through the control-device communication unit 31. When the first-outdoor-unit controller 400A receives the control signal through the first outdoor-unit communication unit 401A, the first-outdoor-unit controller 400A places the first electromagnetic valve 45A into the open state. Also in the following steps, when placing the first electromagnetic valve 45A into the open state, the control-device controller 30 transmits the same or a similar control signal to the first outdoor unit 4A.

[0075] Because the first electromagnetic valve 45A is put into the open state in step SB7, the refrigerant stored by the pump-down operation of the first outdoor unit 4A is released into the section of the refrigerant pipe 101 from the first compressor 40A to the indoor expansion valves 52 and the second electromagnetic valve 45B. The released refrigerant is recovered by the refrigerant recovery machine 6 connected to the refrigerant pipe 101.

[0076] After the control-device controller 30 places the first electromagnetic valve 45A into the open state, the

control-device controller 30 places the second four-way valve 42B into the state of a cooling cycle (step SB8).

[0077] In step SB8, the control-device controller 30 transmits a control signal to place the second four-way valve 42B into the state of a cooling cycle to the second outdoor unit 4B through the control-device communication unit 31. When the second-outdoor-unit controller 400B receives the control signal through the second outdoor-unit communication unit 401B, the second-outdoor-unit controller 400B places the second four-way valve 42B into the state of a cooling cycle.

[0078] Next, the control-device controller 30 starts driving the second compressor 40B (step SB9).

[0079] In step SB9, the control-device controller 30 transmits a control signal to start driving the second compressor 40B to the second outdoor unit 4B through the control-device communication unit 31. When the second-outdoor-unit controller 400B receives the control signal through the second outdoor-unit communication unit 401B, the second-outdoor-unit controller 400B starts driving the second compressor 40B. Also in the following steps, the control-device controller 30 transmits the same or a similar control signal to the second outdoor unit 4B to start driving the second compressor 40B.

[0080] The control-device controller 30 drives the second compressor 40B in step SB9 to cause the second outdoor unit 4B to execute pump-down operation. The second outdoor unit 4B executes the pump-down operation to store the refrigerant charged in the air conditioner 2 in the section of the refrigerant pipe 101 between the second compressor 40B and the second electromagnetic valve 45B.

[0081] The control-device controller 30 determines whether the detection value of the second high-pressure sensor 46B has exceeded a specified threshold (step SB10). This specified threshold is appropriately determined by tests, simulations, or the like conducted in advance, based on the viewpoint of not causing effects of the pump-down operation on the discharge side of the second compressor 40B.

[0082] In the case in which the control-device controller 30 determines that the detection value of the second high-pressure sensor 46B is smaller than or equal to the specified threshold (step SB10: NO), the control-device controller 30 executes the process in step SB10 again.

[0083] In the case in which the control-device controller 30 determines that the detection value of the second high-pressure sensor 46B exceeds the specified threshold (step SB10: YES), the control-device controller 30 stops the second compressor 40B (step SB11). In other words, the second outdoor unit 4B stops executing the pump-down operation.

[0084] In step SB11, the control-device controller 30 transmits a control signal to stop driving the second compressor 40B to the second outdoor unit 4B through the control-device communication unit 31. When the second-outdoor-unit controller 400B receives the control signal through the second outdoor-unit communication unit

401B, the second-outdoor-unit controller 400B stops driving the second compressor 40B. Also in the following steps, the control-device controller 30 transmits the same or a similar control signal to the second outdoor unit 4B to stop driving the second compressor 40B.

[0085] Next, the control-device controller 30 determines whether the detection value of the first high-pressure sensor 46A is smaller than or equal to a specified threshold (step SB12). This specified threshold may be the same value as the specified threshold that is compared with the detection value in step SB4 or may be a different value. This specified threshold is appropriately determined by tests, simulations, or the like conducted in advance, based on the same viewpoint as the specified threshold used in the comparison in step SB4.

[0086] In the case in which the control-device controller 30 determines that the detection value of the first high-pressure sensor 46A is larger than the specified threshold (step SB12: NO), the control-device controller 30 executes the process in step SB12 again.

[0087] In the case in which the control-device controller 30 determines that the detection value of the first high-pressure sensor 46A is smaller than or equal to the specified threshold (step SB12: YES), the control-device controller 30 places the first electromagnetic valve 45A into the closed state (step SB13).

[0088] Next, the control-device controller 30 places the second electromagnetic valve 45B into the open state (step SB14).

[0089] In step SB14, the control-device controller 30 transmits a control signal to place the second electromagnetic valve 45B into the open state to the second outdoor unit 4B through the control-device communication unit 31. When the second-outdoor-unit controller 400B receives the control signal through the second outdoor-unit communication unit 401B, the second-outdoor-unit controller 400B places the second electromagnetic valve 45B into the open state. Also in the following steps, when placing the second electromagnetic valve 45B into the open state, the control-device controller 30 transmits the same or a similar control signal to the second outdoor unit 4B.

[0090] Because the second electromagnetic valve 45B is put into the open state in step SB14, the refrigerant stored by the pump-down operation of the second outdoor unit 4B is released into the section of the refrigerant pipe 101 from the second compressor 40B to the indoor expansion valves 52 and the first electromagnetic valve 45A. The released refrigerant is recovered by the refrigerant recovery machine 6.

[0091] Returning to explanation of the flowchart shown in Figure 3, the control-device controller 30, after executing the first process, continues to execute a second process.

[0092] Figure 5 is a flowchart showing the operation of the control device 3 in the second process.

[0093] The control-device controller 30 starts driving the first compressor 40A (step SC1). In other words, the

control-device controller 30 causes the first outdoor unit 4A to start executing pump-down operation.

[0094] In step SC1, the second outdoor unit 4B is in a state where the second compressor 40B is stopped, and the second electromagnetic valve 45B is in the open state. In other words, in step SC2, the second outdoor unit 4B is in a state where the refrigerant stored by the pump-down operation is allowed to be recovered by the refrigerant recovery machine 6. Thus, in step SC1, the control-device controller 30 causes the first outdoor unit 4A to execute pump-down operation in a state where the refrigerant is allowed to be recovered from the second outdoor unit 4B. In the present embodiment, the control of causing the first outdoor unit 4A to execute pump-down operation and putting the second outdoor unit 4B into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6 corresponds to an example of first control.

[0095] The control-device controller 30 determines whether the detection value of the first high-pressure sensor 46A has exceeded a specified threshold (step SC2). This specified threshold may be the same value as the specified threshold that is compared with the detection value in step SB4 or may be a different value. This specified threshold is appropriately determined by tests, simulations, or the like conducted in advance, based on the same viewpoint as the specified threshold used in the comparison in step SB4.

[0096] In the case in which the control-device controller 30 determines that the detection value of the first high-pressure sensor 46A is smaller than or equal to the specified threshold (step SC2: NO), the control-device controller 30 executes the process in step SC2 again.

[0097] In the case in which the control-device controller 30 determines that the detection value of the first high-pressure sensor 46A exceeds the specified threshold (step SC2: YES), the control-device controller 30 stops driving the first compressor 40A (step SC3). In other words, the control-device controller 30 causes also the first outdoor unit 4A to stop the pump-down operation.

[0098] Next, the control-device controller 30 determines whether the detection value of the second high-pressure sensor 46B is smaller than or equal to a specified threshold (step SC4). This specified threshold may be the same value as the specified threshold that is compared with the detection value in step SB10 or may be a different value. This specified threshold is appropriately determined by tests, simulations, or the like conducted in advance, based on the same viewpoint as the specified threshold used in the comparison in step SB10.

[0099] In the case in which the control-device controller 30 determines that the detection value of the second high-pressure sensor 46B is larger than the specified threshold (step SC4: NO), the control-device controller 30 executes the process in step SC4 again.

[0100] In the case in which the control-device controller 30 determines that the detection value of the second high-pressure sensor 46B is smaller than or equal to the

specified threshold (step SC4: YES), the control-device controller 30 places the second electromagnetic valve 45B into the closed state (step SC5).

[0101] Next, the control-device controller 30 places the first electromagnetic valve 45A into the open state (step SC6). With this operation, the refrigerant stored by the pump-down operation of the first outdoor unit 4A is released into the section of the refrigerant pipe 101 from the first compressor 40A to the indoor expansion valves 52 and the second electromagnetic valve 45B. The released refrigerant is recovered by the refrigerant recovery machine 6.

[0102] The control-device controller 30 starts driving the second compressor 40B (step SC7). In other words, the control-device controller 30 causes the second outdoor unit 4B to execute the pump-down operation.

[0103] In step SC7, the first outdoor unit 4A is in a state where the first compressor 40A is stopped, and the first electromagnetic valve 45A is in the open state. In other words, in step SC7, the first outdoor unit 4A is in a state where the refrigerant stored by the pump-down operation is allowed to be recovered by the refrigerant recovery machine 6. Thus, in step SC7, the control-device controller 30 causes the second outdoor unit 4B to execute pump-down operation in the state where the refrigerant is allowed to be recovered in the first outdoor unit 4A. In the present embodiment, the control of causing the second outdoor unit 4B to execute pump-down operation and putting the first outdoor unit 4A into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6 corresponds to an example of second control.

[0104] The control-device controller 30 determines whether the detection value of the second high-pressure sensor 46B has exceeded a specified threshold (step SC8). This specified threshold may be the same value as the specified threshold that is compared with the detection value in step SB10 or may be a different value. This specified threshold is appropriately determined by tests, simulations, or the like conducted in advance, based on the same viewpoint as the specified threshold used in the comparison in step SB10.

[0105] In the case in which the control-device controller 30 determines that the detection value of the second high-pressure sensor 46B is smaller than or equal to the specified threshold (step SC8: NO), the control-device controller 30 executes the process in step SC8 again.

[0106] In the case in which the control-device controller 30 determines that the detection value of the second high-pressure sensor 46B exceeds the specified threshold (step SC8: YES), the control-device controller 30 stops driving the second compressor 40B (step SC9). In other words, the second outdoor unit 4B stops executing the pump-down operation.

[0107] Next, the control-device controller 30 determines whether the detection value of the first high-pressure sensor 46A is smaller than or equal to a specified threshold (step SC10). This specified threshold may be

the same value as the specified threshold that is compared with the detection value in step SB4 or may be a different value. This specified threshold is appropriately determined by tests, simulations, or the like conducted in advance, based on the same viewpoint as the specified threshold used in the comparison in step SB4.

[0108] In the case in which the control-device controller 30 determines that the detection value of the first high-pressure sensor 46A is larger than the specified threshold (step SC10: NO), the control-device controller 30 executes the process in step SC10 again.

[0109] In the case in which the control-device controller 30 determines that the detection value of the first high-pressure sensor 46A is smaller than or equal to the specified threshold (step SC10: YES), the control-device controller 30 places the first electromagnetic valve 45A into the closed state (step SC11).

[0110] Next, the control-device controller 30 places the second electromagnetic valve 45B into the open state (step SC12).

[0111] Returning to the explanation of the flowchart shown in Figure 3, after the control-device controller 30 executes the second process, the control-device controller 30 determines whether the detection values of the first low-pressure sensor 47A or the second low-pressure sensor 47B are smaller than or equal to specified thresholds (step SA5). These specified thresholds are appropriately determined by tests, simulations, or the like conducted in advance, based on the viewpoint of whether there is no refrigerant remaining in the section on the side to which the refrigerant is recovered by the pump-down operation of the outdoor units 4.

[0112] In the case in which the control-device controller 30 determines that the detection values of the first low-pressure sensor 47A or the second low-pressure sensor 47B are larger than the specified thresholds (step SA5: NO), the control-device controller 30 executes the second process again (step SA4). In other words, the control-device controller 30 repeats execution of the second process until the refrigerant charged in the air conditioner 2 is recovered by the refrigerant recovery machine 6.

[0113] Next, in the case in which the control-device controller 30 determines that the detection values of the first low-pressure sensor 47A or the second low-pressure sensor 47B are smaller than or equal to the specified thresholds (step SA5: YES), the control-device controller 30 executes a third process (step SA6).

[0114] Figure 6 is a flowchart showing the operation of the control device 3 in the third process.

[0115] The control-device controller 30 stops driving the first compressor 40A and stops driving the second compressor 40B (step SD1).

[0116] The control-device controller 30 places the first electromagnetic valve 45A into the open state and places the second electromagnetic valve 45B into the open state (step SD2).

[0117] As described above, the air conditioning system 1 includes an air conditioner 2 including indoor units 5

and a plurality of outdoor units 4 connected to the indoor units 5 and a control-device controller 30 that controls the air conditioner 2. The control-device controller 30 alternately executes first control in which one of the outdoor units 4 is caused to execute pump-down operation and in which another outdoor unit 4 is put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6 and second control in which the outdoor unit 4 that executes the pump-down operation in the first control is put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6 and in which the outdoor unit 4 that is put, in the first control, into the state where the refrigerant is allowed to be recovered is caused to execute pump-down operation.

[0118] This configuration makes it possible to execute pump-down operation with a plurality of outdoor units 4, and also, while one of the outdoor units 4 is executing the pump-down operation, another outdoor unit 4 can be, in parallel, put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6. Thus, in the air conditioning system 1, even in the case in which a large amount of refrigerant that exceeds a storable amount of the outdoor unit 4 is charged in the air conditioner 2, it is possible to perform refrigerant recovery in a rapid manner by using the pump-down operation of the outdoor units 4.

[0119] The outdoor unit 4 includes a compressor 40 and a high-pressure sensor 46 that detects the pressure of the refrigerant discharged by the compressor 40. When the detection value of the high-pressure sensor 46 exceeds a specified threshold, the control-device controller 30 switches between execution of the first control and execution of the second control.

[0120] This configuration makes it possible to switch the outdoor units 4 that execute pump-down operation before effects of the refrigerant stored by the pump-down operation occur on the discharge side of the compressor 40. Thus, in the air conditioning system 1, even in the case in which a large amount of refrigerant that exceeds a storable amount of the outdoor unit 4 is charged in the air conditioner 2, it is possible to switch control before the capacity within which the outdoor unit 4 can perform pump-down operation is exceeded and perform refrigerant recovery in a rapid manner by using the pump-down operation of the outdoor units 4.

[0121] The outdoor unit 4 includes the compressor 40 and the low-pressure sensor 47 that detects the pressure of the refrigerant flowing into the compressor 40. In a case in which the detection value of the low-pressure sensor 47 is smaller than or equal to a specified threshold, the control-device controller 30 stops execution of the first control and the second control.

[0122] With this configuration, it is possible to finish the first control and the second control at an appropriate time at which refrigerant recovery by pump-down operation is finished, and thus possible to prevent unnecessary pump-down operation of the outdoor units 4.

[Second Embodiment]

[0123] Next, a second embodiment will be described. In the second embodiment, the constituents the same as or similar to those in the first embodiment will be denoted by the same symbols, and detailed description thereof is omitted.

[0124] In the second embodiment, the number of outdoor units 4 included in an air conditioner 2 and the operation of a control device 3 are different, as compared with the first embodiment.

[0125] Figure 7 is a diagram showing the configuration of an air conditioning system 1 of the second embodiment.

[0126] The air conditioner 2 includes four outdoor units 4: a first outdoor unit 4A, a second outdoor unit 4B, a third outdoor unit 4C, and a fourth outdoor unit 4D. Although the second embodiment describes as an example a configuration in which the air conditioner 2 has four outdoor units 4, the number of outdoor units 4 included in the air conditioner 2 only needs to be three or more.

[0127] In the second embodiment, the plurality of outdoor units 4 included in the air conditioner 2 each have the same or a similar configuration including their control configurations. Hence, in the following description, when the corresponding constituents in the first outdoor unit 4A, the second outdoor unit 4B, the third outdoor unit 4C, and the fourth outdoor unit 4D are not discriminated, identifiers such as "first", "second", "third", and "fourth" are omitted in the names of the constituents, and also, only numerals are used for the symbols of the constituents and the suffixes A, B, C, and D are omitted. For example, when a first compressor 40A, a second compressor 40B, a third compressor 40C, and a fourth compressor 40D are not discriminated, they are referred to as a "compressor 40". In addition, for example, when a first-outdoor-unit controller 400A, a second-outdoor-unit controller 400B, a third outdoor-unit controller 400C, and a fourth outdoor-unit controller 400D are not discriminated, they are referred to as an "outdoor-unit controller 400". In contrast, when the corresponding constituents in the first outdoor unit 4A, the second outdoor unit 4B, the third outdoor unit 4C, and the fourth outdoor unit 4D are discriminated, the names of the constituents in the first outdoor unit 4A will have the identifier "first" and their symbols will have the suffix A. The names of the constituents in the second outdoor unit 4B will have the identifier "second" and their symbols will have the suffix B. The names of the constituents in the third outdoor unit 4C will have the identifier "third" and their symbols will have the suffix C. The names of the constituents in the fourth outdoor unit 4D will have the identifier "fourth" and their symbols will have the suffix D. Note that the drawings include symbols that allow the constituents of the first compressor 40A, the second compressor 40B, the third compressor 40C, and the fourth compressor 40D to be discriminated.

[0128] As in the first embodiment, indoor units 5 of the second embodiment are connected in parallel to the four

outdoor units 4 with refrigerant pipes 101 and 102.

[0129] Also as in the first embodiment, the outdoor unit 4 of the second embodiment includes a compressor 40, a gas-liquid separator 41, a four-way valve 42, an outdoor heat exchanger 44 having an outdoor blower fan 43, an electromagnetic valve 45, a high-pressure sensor 46, and a low-pressure sensor 47, and these units are connected as in the first embodiment.

[0130] Next, the operation of the control device 3 according to the second embodiment will be described.

[0131] Figure 8 is a flowchart showing the operation of the control device 3. In Figure 8, the same steps as in the flowchart shown in Figure 3 are denoted by the same step numbers, and detailed description thereof is omitted.

[0132] The control-device controller 30 selects two outdoor units 4 in descending order of the performance of the outdoor units 4 out of the first outdoor unit 4A to the fourth outdoor unit 4D as the outdoor units 4 that will execute pump-down operation (step SE1).

[0133] For example, in step SE1, the control-device controller 30 inquires of all of the outdoor units 4 included in the air conditioner 2 as to how much performance each outdoor unit 4 has. Note that the performance of the outdoor unit 4 is, for example, the horsepower of the compressor 40. After the control-device controller 30 inquires of all of the outdoor units 4 as to their performance, the control-device controller 30 selects two outdoor units 4 in descending order of the performance of the outdoor units 4.

[0134] Alternatively, for example, assume that the control-device storage unit 320 stores information indicating the performance of all of the outdoor units 4 included in the air conditioner 2. In this case, the control-device controller 30 refers to this information stored in the control-device storage unit 320 and selects two outdoor units 4 in descending order of the performance of the outdoor units 4.

[0135] The control-device controller 30, specifying the selected two outdoor units 4 as the outdoor units 4 that execute pump-down operation, executes the processes at and after step SA3.

[0136] For example, in the case in which the first outdoor unit 4A and the second outdoor unit 4B are selected in step SE1, the control-device controller 30 executes the same or similar operations as in Figures 3 to 6. Specifically, the control-device controller 30 alternately repeats first control in which the first outdoor unit 4A is caused to execute pump-down operation and in which the second outdoor unit 4B is put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6 and second control in which the second outdoor unit 4B is caused to execute pump-down operation and in which the first outdoor unit 4A is put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6. Note that during the execution of this first control and the second control, because the third outdoor unit 4C and the fourth outdoor unit 4D are not the outdoor units 4 that execute pump-

down operation, the third outdoor unit 4C and the fourth outdoor unit 4D are in a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6. Specifically, in the third outdoor unit 4C, the third compressor 40C is not driven, and the third electromagnetic valve 45C is in the open state. In the fourth outdoor unit 4D, the fourth compressor 40D is not driven, and the fourth electromagnetic valve 45D is in the open state. Stopping driving the third compressor 40C and the fourth compressor 40D and placing the third electromagnetic valve 45C and the fourth electromagnetic valve 45D into the open state are done at an appropriate time.

[0137] The above example is based on the case in which the control-device controller 30 selects the first outdoor unit 4A and the second outdoor unit 4B, but the control-device controller 30 executes the same or similar operations as in Figures 3 to 6 also in the case in which the control-device controller 30 selects a combination of other outdoor units 4,. In this case, one of the outdoor units 4 in the selected combination is designated as the control target instead of the first outdoor unit 4A shown in Figures 3 to 6, and the control-device controller 30 executes the operations shown in Figures 3 to 6. Also in this case, another outdoor unit 4 in the selected combination is designated as the control target instead of the second outdoor unit 4B shown in Figures 3 to 6, and the control-device controller 30 executes the operations shown in Figures 3 to 6. Note that the outdoor units 4 that are not selected as the outdoor units 4 that execute pump-down operation are put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6 during the execution of the first control and the second control.

[0138] Although the above description of the second embodiment is based on the configuration in which two outdoor units 4 are selected in descending order of the performance of the outdoor units 4, the number of outdoor units 4 that the control-device controller 30 selects only has to be two or more. In the case in which the number is two or more, the control-device controller 30 divides the selected two or more outdoor units 4 into two groups. Then, an outdoor unit 4 in one of the groups is designated as the control target instead of the first outdoor unit 4A shown in Figures 3 to 6, and the control-device controller 30 executes the operations shown in Figures 3 to 6. Also in this case, an outdoor unit 4 in another group is designated as the control target instead of the second outdoor unit 4B shown in Figures 3 to 6, and the control-device controller 30 executes the operations shown in Figures 3 to 6. Note that the outdoor units 4 that are not selected as the outdoor units 4 that execute pump-down operation are put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine 6 during the execution of the first control and the second control.

[0139] As has been described above, in the second embodiment, in the case in which the number of outdoor units 4 included in the air conditioner 2 is three or more, the control-device controller 30 selects two or more out-

door units 4 in descending order of the performance of the outdoor units 4 as the outdoor units 4 that execute pump-down operation in either the first control or the second control. Then, the control-device controller 30 executes the first control and the second control with the selected two or more outdoor units 4.

[0140] With this configuration, in the case in which the air conditioner 2 includes three or more outdoor units 4, it is possible to cause the outdoor units capable of storing refrigerant in a more rapid manner to execute pump-down operation. Thus, in the case in which the air conditioner 2 includes three or more outdoor units 4, it is possible to perform refrigerant recovery in a rapid manner and efficiently by using the pump-down operation of outdoor units 4.

[0141] The foregoing embodiments are aimed only at showing some aspects of the present invention and thus may be modified or applied as appropriate within the scope of the present invention.

[0142] Although the number of refrigerant recovery machines 6 connected to the refrigerant pipe 101 is one in the foregoing embodiments, the number of refrigerant recovery machines 6 is not limited to one but may be plural. The refrigerant recovery machine 6 may be a machine that can be disconnected from the refrigerant pipe 101 or may be a machine that cannot be disconnected from the refrigerant pipe 101. The position at which the refrigerant recovery machine 6 is connected is not limited to on a pipe connecting the outdoor units 4 with one another but may be at a service port in an outdoor unit 4. The position only has to be downstream of the electromagnetic valves 45 in the direction in which the refrigerant flows in the cooling cycle.

[0143] Although the foregoing embodiments are based on configurations in which the air conditioner 2 includes two indoor units 5, the number of indoor units 5 included in the air conditioner 2 is not limited to two but may be one or three or more.

[0144] Although the foregoing embodiments are based on configurations in which the control-device controller 30 controls the indoor units 5 via the outdoor units 4, the control-device controller 30 may control the indoor units 5 not via the outdoor units 4. In this case, the air conditioning system 1 is configured such that the control device 3 and the indoor units 5 are capable of communicating directly with each other.

[0145] Although the foregoing embodiments are based on configurations in which the control-device controller 30 controls the air conditioner 2, the configuration may be such that one of the outdoor-unit controllers 400 controls the air conditioner 2 by performing centralized control over the other outdoor units 4. In the case of this configuration, the outdoor-unit controller 400 that controls the air conditioner 2 corresponds to "a controller" in the present invention.

[0146] Functions of the control-device controller 30, the outdoor-unit controller 400, and the indoor-unit controller 500 may be implemented by a plurality of proces-

sors or semiconductor chips.

[0147] The units shown in Figures 1 and 2 are examples, and concrete configurations are not limited to any specific ones. Specifically, each unit does not necessarily have to have an individually corresponding piece of hardware, but it goes without saying that one processor may execute a program to implement the functions of each unit. In addition, part of the functions implemented by software in the foregoing embodiments may be implemented by hardware, or part of the functions implemented by hardware may be implemented by software. In addition, concrete detailed configurations of other parts in the control device 3, the outdoor unit 4, and the indoor unit 5 may be also modified as appropriate within a range not departing from the spirit of the present invention.

[0148] For example, the step units of the operations shown in Figures 3 to 6 and 8 were divided based on main processes to make it easy to understand the operation of each unit in the control device 3, and hence, the way of dividing process units and the names of the processes do not limit the present invention. The entire process may be divided into more step units according to the details of the processes. On the other hand, the entire process may be divided such that one step unit has more processes. The order of the steps may be exchanged as appropriate within a range that does not cause contradiction to the spirit of the present invention.

[Industrial Applicability]

[0149] As has been described above, the air conditioning system according to the present invention can be used for applications involving refrigerant recovery using pump-down operation.

[Reference Signs List]

[0150]

| | |
|-----|---|
| 1 | air conditioning system |
| 2 | air conditioner |
| 3 | control device |
| 4 | outdoor unit |
| 4A | first outdoor unit (outdoor unit) |
| 4B | second outdoor unit (outdoor unit) |
| 4C | third outdoor unit (outdoor unit) |
| 4D | fourth outdoor unit (outdoor unit) |
| 5 | indoor unit |
| 6 | refrigerant recovery machine |
| 30 | control-device controller (controller) |
| 40 | compressor |
| 40A | first compressor (compressor) |
| 40B | second compressor (compressor) |
| 40C | third compressor (compressor) |
| 40D | fourth compressor (compressor) |
| 46 | high-pressure sensor |
| 46A | first high-pressure sensor (high-pressure sensor) |

| | |
|--------|--|
| 46B | second high-pressure sensor (high-pressure sensor) |
| 46C | third high-pressure sensor (high-pressure sensor) |
| 5 46D | fourth high-pressure sensor (high-pressure sensor) |
| 47 | low-pressure sensor |
| 47A | first low-pressure sensor (low-pressure sensor) |
| 47B | second low-pressure sensor (low-pressure sensor) |
| 10 47C | third low-pressure sensor (low-pressure sensor) |
| 47D | fourth low-pressure sensor (low-pressure sensor) |
| 15 400 | outdoor-unit controller (controller) |
| 400A | first-outdoor-unit controller (controller) |
| 400B | second-outdoor-unit controller (controller) |
| 400C | third-outdoor-unit controller (controller) |
| 400D | fourth-outdoor-unit controller (controller) |

Claims

1. An air conditioning system (1) comprising: an air conditioner (2) including an indoor unit (5) and a plurality of outdoor units (4) connected to the indoor unit; and a controller (30) that controls the air conditioner, **characterized in that**

30 the controller alternately executes first control in which one of the outdoor units is caused to execute pump-down operation and in which another one of the outdoor units is put into a state where refrigerant is allowed to be recovered by a refrigerant recovery machine (6) and second control in which the outdoor unit that executes the pump-down operation in the first control is put into a state where the refrigerant is allowed to be recovered by the refrigerant recovery machine and in which the outdoor unit that is put, in the first control, into the state where the refrigerant is allowed to be recovered is caused to execute pump-down operation.

45 2. The air conditioning system according to claim 1, wherein

the outdoor units each have a compressor (40) and a high-pressure sensor (46) that detects the pressure of the refrigerant discharged by the compressor, and the controller, in a case in which a detection value of the high-pressure sensor exceeds a specified threshold, switches between execution of the first control and execution of the second control.

3. The air conditioning system according to claim 1 or

2, wherein

the outdoor units each have a compressor (40)
and a low-pressure sensor (47) that detects the
pressure of the refrigerant flowing into the com- 5
pressor, and
the controller,
in a case in which a detection value of the low-
pressure sensor is smaller than or equal to a
specified threshold, finishes execution of the 10
first control and the second control.

4. The air conditioning system according to any one of
claims 1 to 3, wherein

the controller, 15
in a case in which the number of the outdoor
units included in the air conditioner is three or
more, selects two or more of the outdoor units
in descending order of the performance of the 20
outdoor units as the outdoor units that execute
pump-down operation in either the first control
or the second control and
executes the first control and the second control
with the selected two or more outdoor units. 25

30

35

40

45

50

55

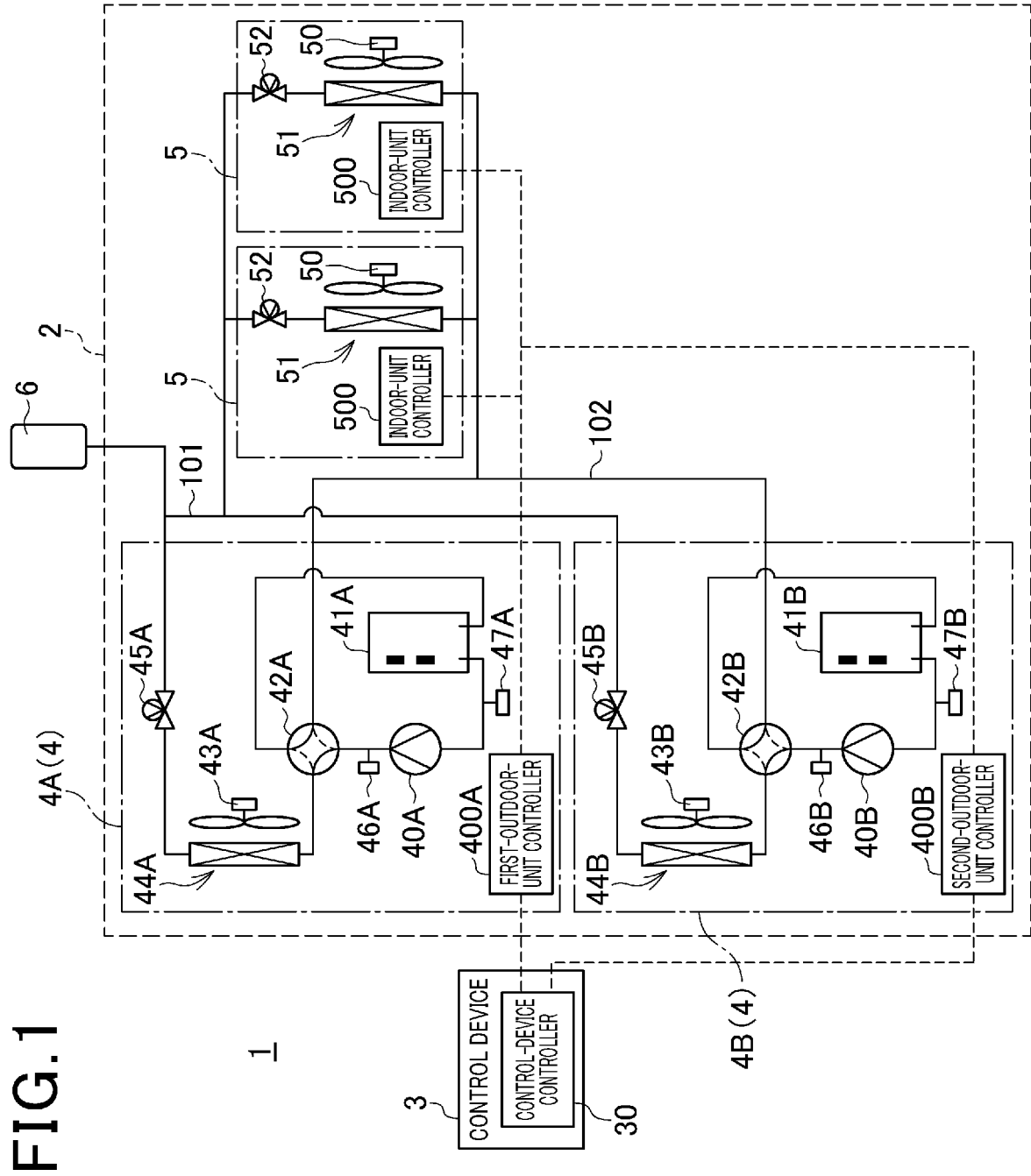


FIG.2

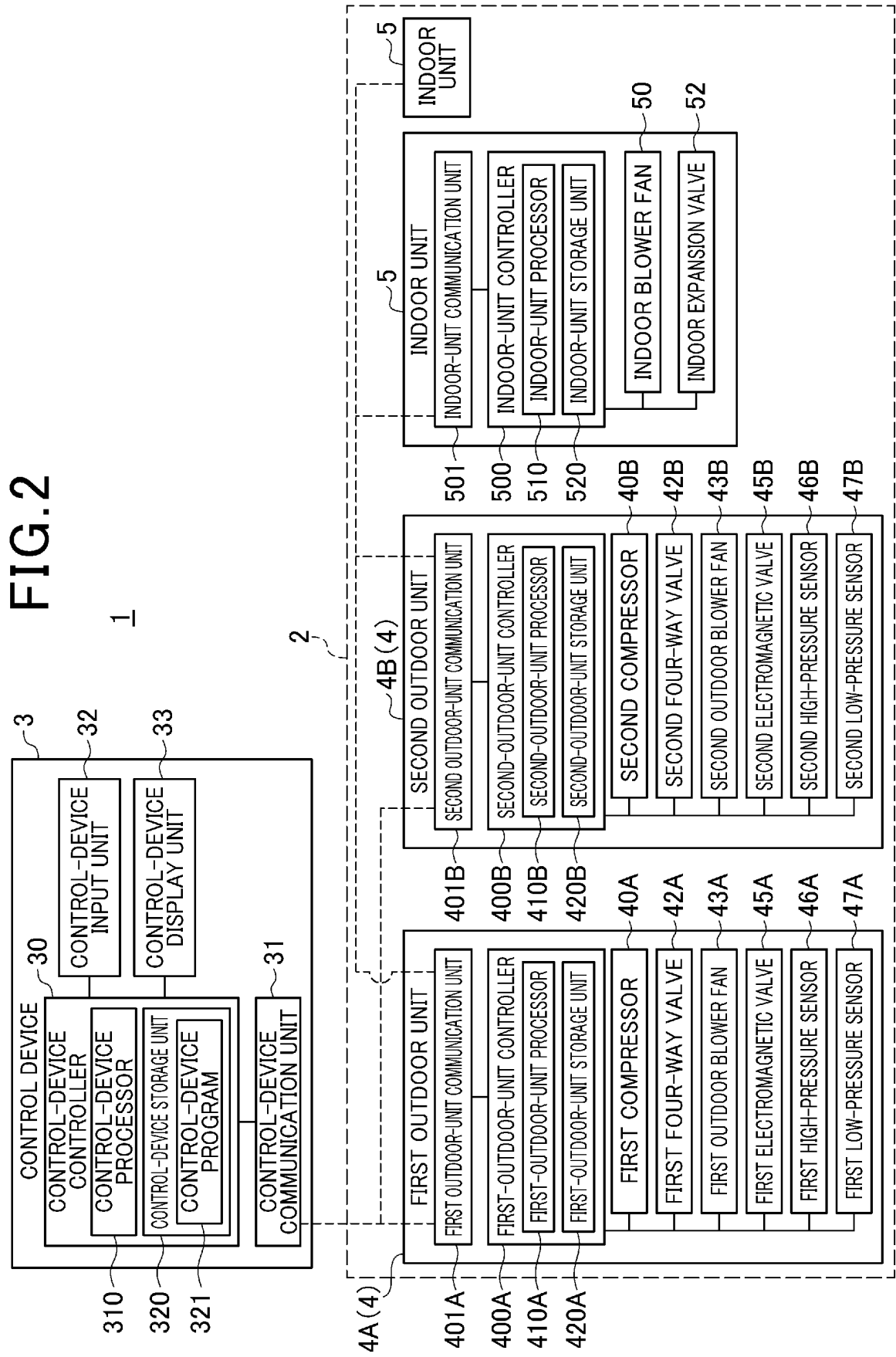


FIG. 3

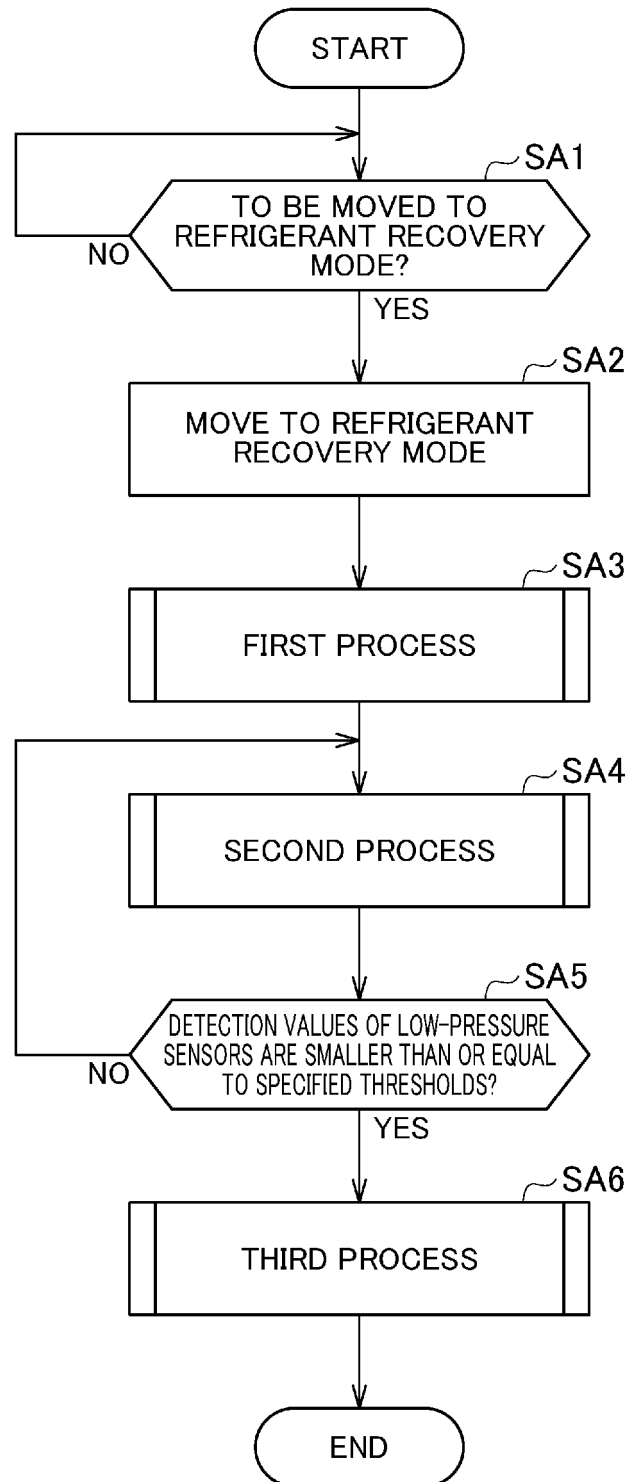


FIG.4

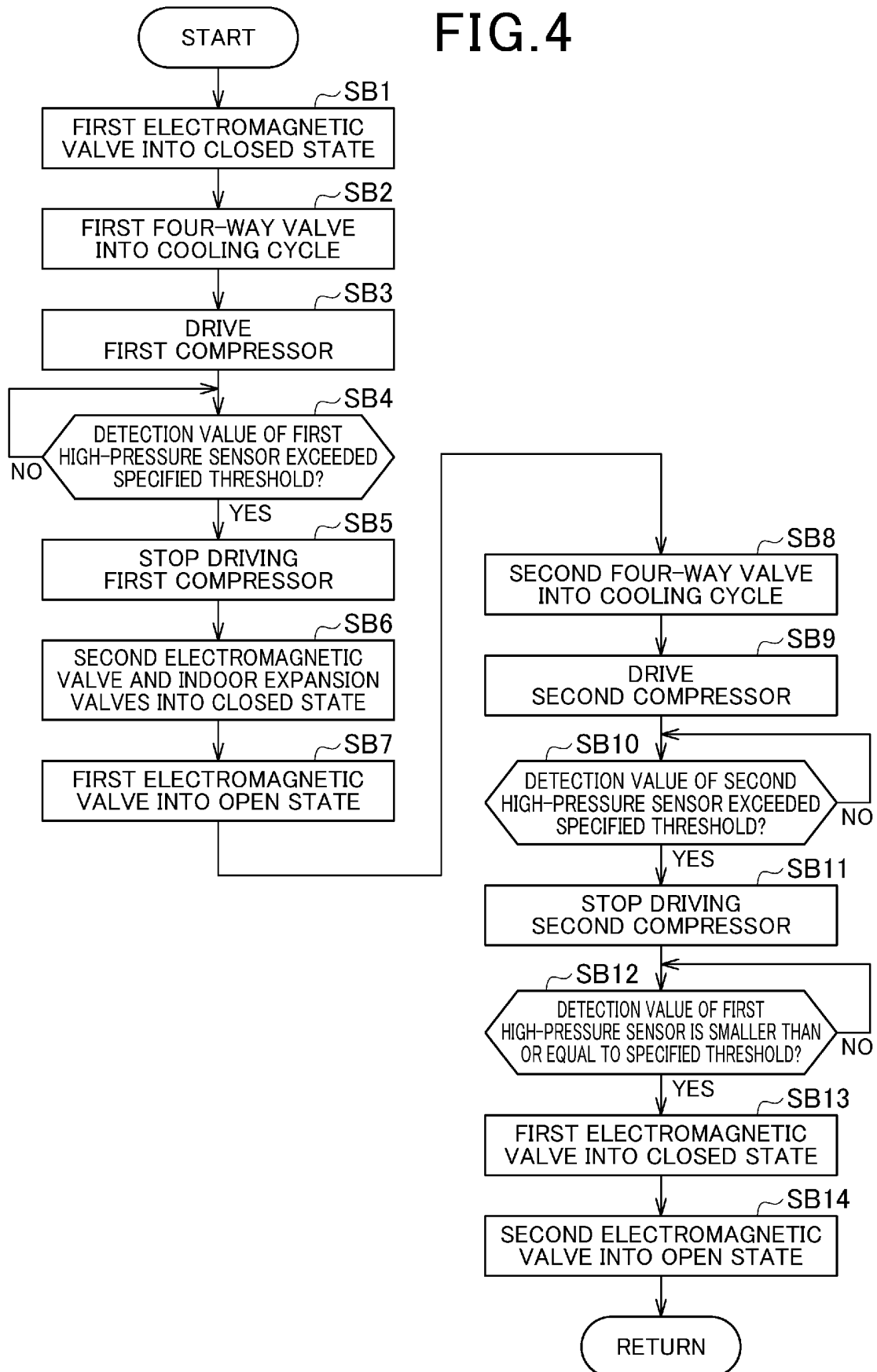


FIG.5

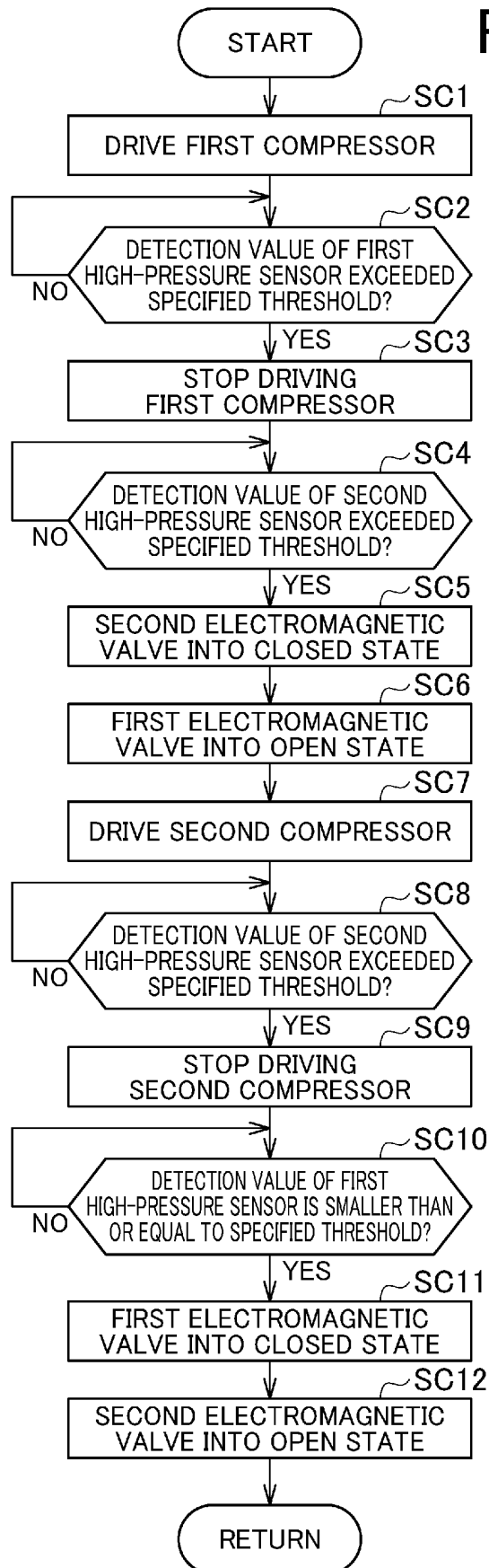


FIG.6

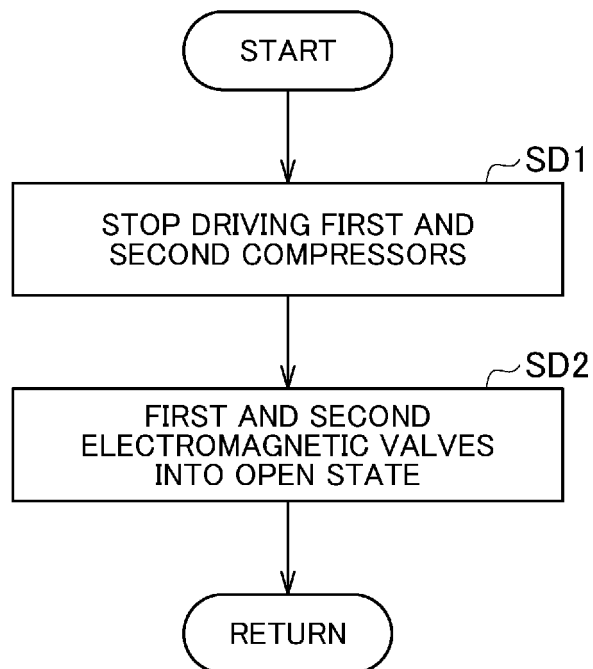


FIG. 7

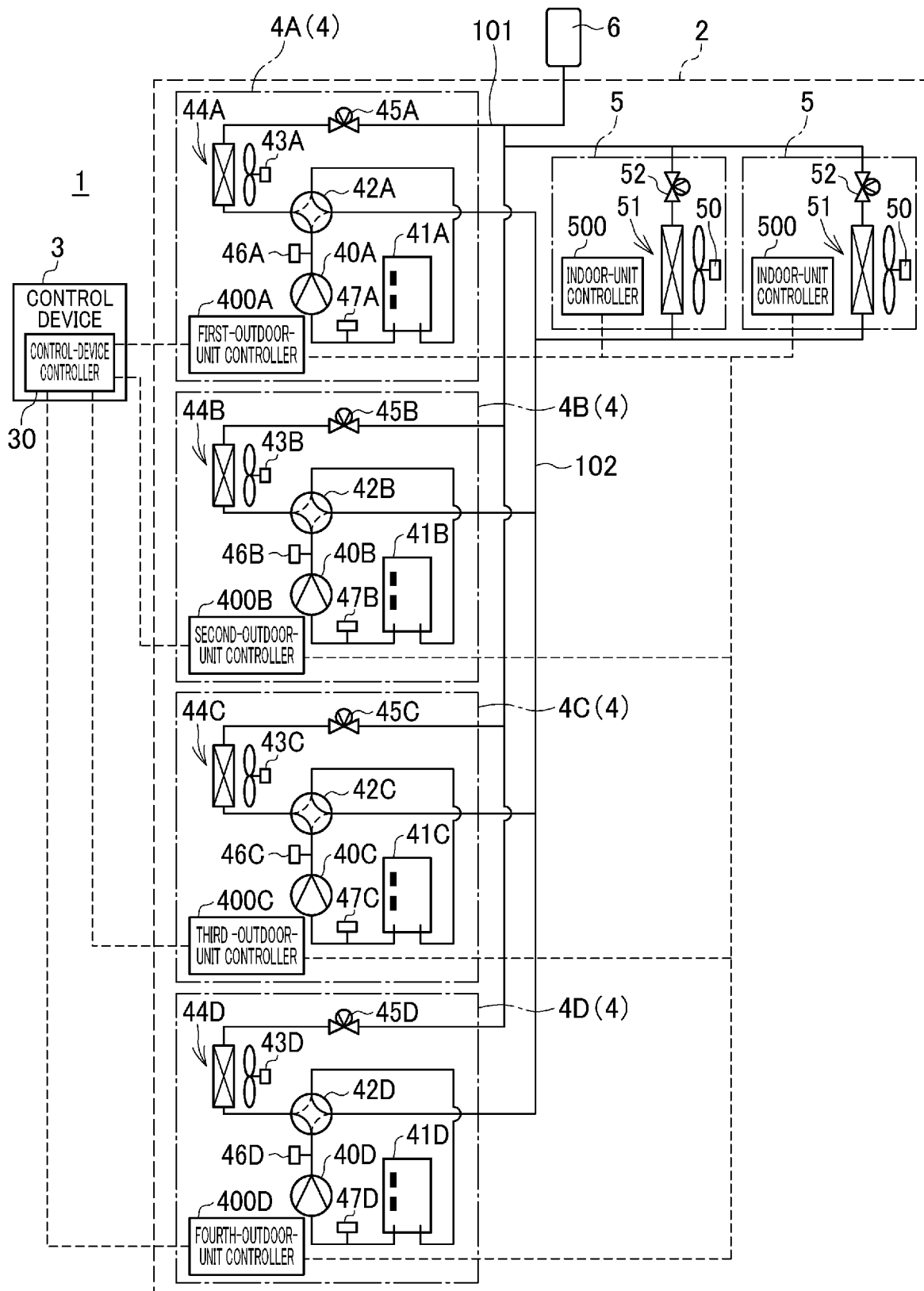
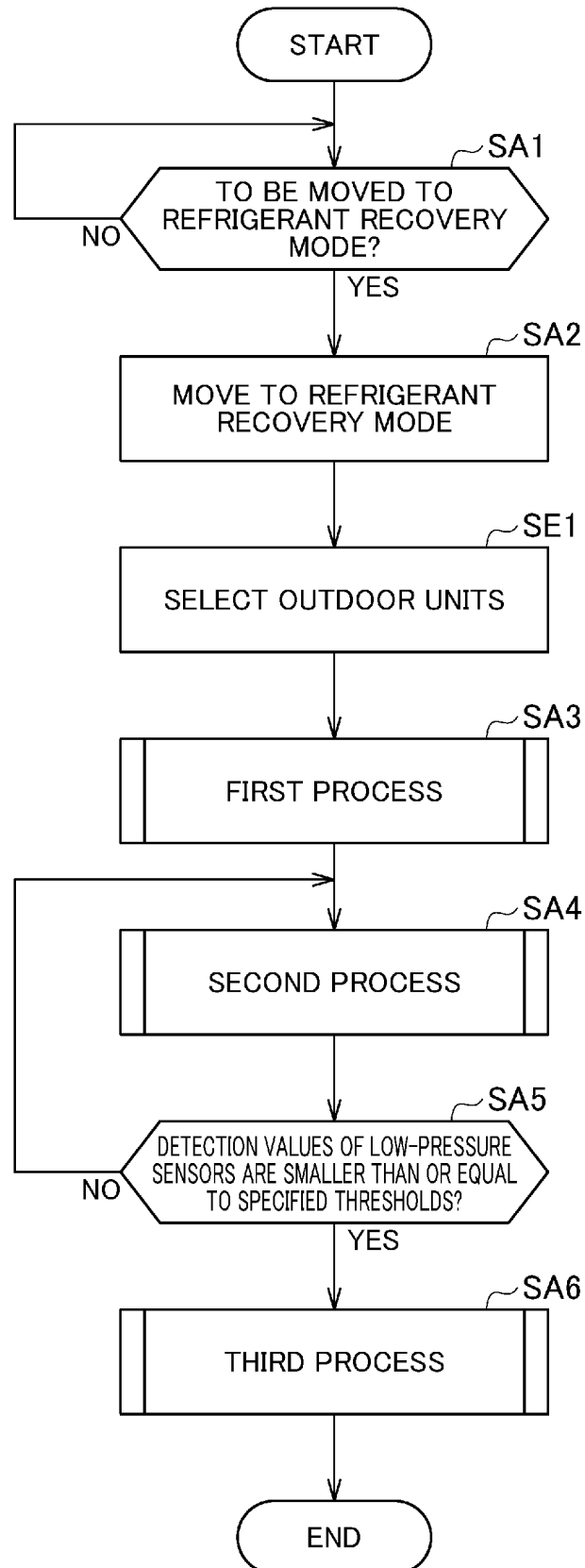


FIG. 8



5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/016678

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. F25B45/00 (2006.01) i, F25B1/00 (2006.01) i, F24F11/32 (2018.01) i
 FI: F25B45/00A, F24F11/32, F25B1/00391

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. F25B1/00-49/04, F24F1/00-13/32

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 1971-2021

Registered utility model specifications of Japan 1996-2021

Published registered utility model applications of Japan 1994-2021

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 2004-232934 A (FUJITSU GENERAL LIMITED) 19 August 2004 (2004-08-19), paragraphs [0020]-[0027], fig. 1, 2 | 1-4 |
| A | JP 2013-122364 A (MITSUBISHI ELECTRIC CORPORATION) 20 June 2013 (2013-06-20), paragraphs [0050]-[0063], fig. 7, 8 | 1-4 |
| A | WO 2016/157519 A1 (MITSUBISHI ELECTRIC CORPORATION) 06 October 2016 (2016-10-06), paragraph [0040] | 2-3 |
| A | JP 2019-143877 A (FUJITSU GENERAL LIMITED) 29 August 2019 (2019-08-29), paragraph [0072] | 3 |



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
18 June 2021

Date of mailing of the international search report
29 June 2021

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

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

5

INTERNATIONAL SEARCH REPORT
Information on patent family members

| |
|--|
| International application No. PCT/JP2021/016678 |
|--|

10

| | | |
|-------------------|-----------------|-----------------------------------|
| JP 2004-232934 A | 19 August 2004 | (Family: none) |
| JP 2013-122364 A | 20 June 2013 | (Family: none) |
| WO 2016/157519 A1 | 06 October 2016 | EP 3279580 A1 paragraph [0048] |
| JP 2019-143877 A | 29 August 2019 | (Family: none) |

15

20

25

30

35

40

45

50

55

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2000199660 A [0003]
- JP 2020094409 A [0007]