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(54) AIR-CONDITIONING SYSTEM

(57) An air conditioning system (100) includes a refrigerant cycle (RC), a power feed unit (40), a controller (60), and a determining unit (90). The refrigerant cycle (RC) includes an outdoor unit (10) and a plurality of indoor units (30). The outdoor unit (10) includes a compressor (11). In a case where a power source for at least one indoor unit of the plurality of indoor units (30) is interrupted, the power feed unit (40) feeds power from an auxiliary power source to the at least one indoor unit. The controller (60) controls at least the compressor (11). In the case where the power source for the at least one indoor unit of the plurality of indoor units (10) is interrupted, the determining unit (90) makes one of a determination to stop the compressor (11) and a determination to cause the compressor (11) to continue operating. The determining unit (90) transmits to the controller (60) an instruction corresponding to the determination that has been made.

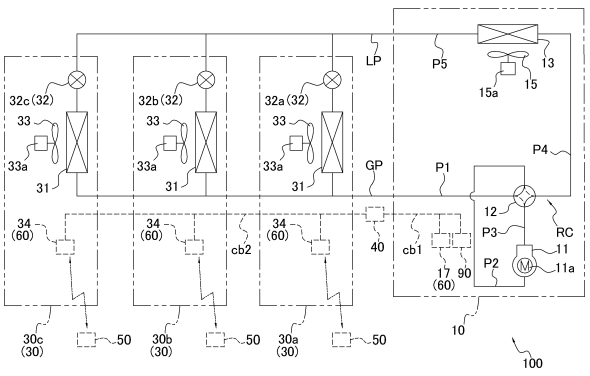

FIG. 1

EP 3 978 817 A1

Description

TECHNICAL FIELD

[0001] This disclosure relates to an air conditioning system capable of performing an air conditioning operation even if a power source for one or some of indoor units is interrupted.

BACKGROUND ART

[0002] PTL 1 (Japanese Patent Application Laid-Open Publication No. 2013-40698) discloses an air conditioner capable of performing an air conditioning operation even if a power source for one or some of indoor units is interrupted.

SUMMARY OF INVENTION

< Technical Problem >

[0003] An air conditioning system may include a power feed unit for feeding power to an indoor unit for which a power source has been interrupted. However, the power that can be fed by such a power feed unit is limited. There is a possibility that a problem arises, such as breakage of a compressor in an outdoor unit or an overflow of drain water in an indoor unit.

< Solution to Problem >

[0004] An air conditioning system according to a first aspect includes a refrigerant cycle, a power feed unit, a controller, and a determining unit. The refrigerant cycle includes an outdoor unit and a plurality of indoor units. The outdoor unit includes a compressor. In a case where a power source for at least one indoor unit of the plurality of indoor units is interrupted, the power feed unit feeds power from an auxiliary power source to the at least one indoor unit. The controller controls at least the compressor. In the case where the power source for the at least one indoor unit of the plurality of indoor units is interrupted, the determining unit makes one of a determination to stop the compressor and a determination to cause the compressor to continue operating. The determining unit transmits to the controller an instruction corresponding to the determination that has been made.

[0005] An air conditioning system according to a second aspect is the air conditioning system according to the first aspect, in which the determining unit makes the determination on the basis of at least one of a degree of wetness of refrigerant sucked by the compressor or a prediction of the degree of wetness, and an amount of drain water in the at least one indoor unit of the plurality of indoor units or a prediction of the amount of drain water.

[0006] An air conditioning system according to a third aspect is the air conditioning system according to the second aspect, in which the determining unit makes the determination on the basis of the amount of drain water in the at least one indoor unit of the plurality of indoor units or the prediction of the amount of drain water, and a power feed capacity of the power feed unit.

[0007] An air conditioning system according to a fourth aspect is the air conditioning system according to any one of the first aspect to the third aspect, in which the controller causes at least the compressor to perform an oil return operation or a defrosting operation in the refrigerant cycle. The determining unit determines whether to continue the oil return operation or the defrosting operation in a case where the power feed unit feeds power from the auxiliary power source to the at least one indoor unit.

[0008] An air conditioning system according to a fifth aspect is the air conditioning system according to the fourth aspect, in which, in a case where the determining unit determines not to continue the oil return operation when the controller is causing the refrigerant cycle to perform the oil return operation, the controller stops the compressor.

[0009] An air conditioning system according to a sixth aspect is the air conditioning system according to the fifth aspect, in which the controller stops the compressor on the basis of a degree of wetness of refrigerant sucked by the compressor.

[0010] An air conditioning system according to a seventh aspect is the air conditioning system according to the fourth aspect, in which the plurality of indoor units each include an expansion valve. The controller groups the plurality of indoor units into at least two groups. In a case where the determining unit determines to continue the oil return operation when the controller is causing the refrigerant cycle to perform the oil return operation, the controller sequentially performs first group closing control and second group closing control. In the first group closing control, the expansion valve of an indoor unit belonging to a first group is closed, and the expansion valve of an indoor unit belonging to a second group is opened. In the second group closing control, the expansion valve of the indoor unit belonging to the first group is opened, and the expansion valve of the indoor unit belonging to the second group is closed.

[0011] An air conditioning system according to an eighth aspect is the air conditioning system according to any one of the fourth aspect to the seventh aspect, in which the outdoor unit further includes a four-way switching valve. In a case where the determining unit determines not to continue the defrosting operation when the controller is causing the refrigerant cycle to perform the defrosting operation, the controller stops the compressor.

[0012] An air conditioning system according to a ninth aspect is the air conditioning system according to the seventh aspect, in which the outdoor unit further includes a four-way switching valve. In a case where the determining unit determines to continue the defrosting operation when the controller is causing the refrigerant cycle

to perform the defrosting operation, the controller switches the four-way switching valve.

[0013] An air conditioning system according to a tenth aspect is the air conditioning system according to the ninth aspect, in which, when the controller switches the four-way switching valve, at least one of the plurality of expansion valves is open and the compressor is operating.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

[Fig. 1] Fig. 1 is a schematic configuration diagram of an air conditioning system 100 according to an embodiment.

[Fig. 2] Fig. 2 is a diagram illustrating a control process of an operation of the entire air conditioning system 100.

[Fig. 3] Fig. 3 is a flowchart of M/T control during an oil return operation.

[Fig. 4] Fig. 4 is a flowchart of M/T control during a defrosting operation.

[Fig. 5] Fig. 5 is a schematic configuration diagram of an air conditioning system 100 according to modification example A.

[Fig. 6] Fig. 6 is a flowchart of M/T control during an oil return operation in modification example A.

[Fig. 7] Fig. 7 is a flowchart of M/T control during a defrosting operation in modification example B.

[Fig. 8] Fig. 8 is a schematic configuration diagram of an air conditioning system 100 according to modification example C.

[Fig. 9] Fig. 9 is a flowchart of M/T control during an operation of an air conditioning system 100 in modification example D.

DESCRIPTION OF EMBODIMENTS

(1) Configuration of Air Conditioning System 100

[0015] Fig. 1 is a schematic configuration diagram of an air conditioning system 100 according to the present embodiment. The air conditioning system 100 is a system for implementing air conditioning, such as cooling and heating, in a target space included in a structure, such as a house, a building, a factory, or a public facility.

[0016] The air conditioning system 100 includes a refrigerant circuit RC in which refrigerant circulates. The air conditioning system 100 performs a vapor-compression refrigeration cycle by causing refrigerant to circulate in the refrigerant circuit RC, thereby cooling or heating a target space. Refrigerant such as R410A, R32, or ammonia is sealed in the refrigerant circuit RC.

[0017] The air conditioning system 100 mainly includes one outdoor unit 10 serving as a heat source unit, a plurality of (three in Fig. 1) indoor units 30 (30a, 30b, 30c) serving as use units, one power feed unit 40, a plurality of (three in Fig. 1) remote controllers 50, and a controller 60. The refrigerant circuit RC of the air conditioning system 100 is constituted by the outdoor unit 10 and the individual indoor units 30 that are connected by a gas connection pipe GP and a liquid connection pipe LP. In other words, the air conditioning system 100 is a multi-type (multi-tenant) air conditioning system in which the plurality of indoor units 30 are connected to an identical refrigerant system.

(1-1) Outdoor Unit 10

[0018] The outdoor unit 10 is an outdoor unit installed outdoors (outside a target space). The outdoor unit 10 mainly includes a plurality of refrigerant pipes (first to fifth pipes P1 to P5), a compressor 11, a four-way switching valve 12, an outdoor heat exchanger 13, an outdoor fan 15, an outdoor-unit control unit 17, and a determining unit 90.

[0019] The first pipe P1 is a refrigerant pipe that connects the gas connection pipe GP and the four-way switching valve 12. The second pipe P2 is a suction pipe that connects the four-way switching valve 12 and a suction port (not illustrated) of the compressor 11. The third pipe P3 is a discharge pipe that connects a discharge port (not illustrated) of the compressor 11 and the four-way switching valve 12. The fourth pipe P4 is a refrigerant pipe that connects the four-way switching valve 12 and a gas side of the outdoor heat exchanger 13. The fifth pipe P5 is a refrigerant pipe that connects a liquid side of the outdoor heat exchanger 13 and the liquid connection pipe LP.

[0020] The compressor 11 is a mechanism that sucks and compresses low-pressure gas refrigerant and discharges resultant refrigerant. The compressor 11 has an enclosed structure including a compressor motor 11a built therein. In the compressor 11, a compression element (not illustrated) of a rotary type, a scroll type, or the like accommodated in a compressor casing (not illustrated) is driven by the compressor motor 11a serving as a drive source. While operating, the compressor motor 11a is inverter-controlled and the number of rotations thereof is adjusted in accordance with a situation. When being driven, the compressor 11 sucks refrigerant through the suction port, compresses the refrigerant, and discharges the refrigerant through the discharge port.

[0021] The four-way switching valve 12 is a valve for switching a direction in which refrigerant flows in the refrigerant circuit RC. The four-way switching valve 12 is individually connected to the first pipe P1, the second pipe P2, the third pipe P3, and the fourth pipe P4. During a cooling operation, the four-way switching valve 12 switches a flow path such that the first pipe P1 and the second pipe P2 are connected to each other and that the third pipe P3 and the fourth pipe P4 are connected to each other (see solid lines in the four-way switching valve 12 in Fig. 1). During a heating operation, the four-way switching valve 12 switches a flow path such that the first

pipe P1 and the third pipe P3 are connected to each other and that the second pipe P2 and the fourth pipe P4 are connected to each other (see broken lines in the four-way switching valve 12 in Fig. 1).

[0022] The outdoor heat exchanger 13 is a heat exchanger that functions as a condenser or radiator for refrigerant during a cooling operation and that functions as an evaporator or heat absorber for refrigerant during a heating operation. The outdoor heat exchanger 13 includes a heat transfer tube (not illustrated) through which refrigerant flows, and a heat transfer fin (not illustrated) that increases a heat transfer area. The outdoor heat exchanger 13 is disposed such that refrigerant in the heat transfer tube and an air flow generated by the outdoor fan 15 are capable of exchanging heat during an operation.

[0023] The outdoor fan 15 is, for example, a propeller fan. The outdoor fan 15 is connected to an output shaft of an outdoor fan motor 15a and is driven in conjunction with the outdoor fan motor 15a. When being driven, the outdoor fan 15 generates an air flow that flows into the outdoor unit 10 from the outside and flows out of the outdoor unit 10 after passing through the outdoor heat exchanger 13.

[0024] The outdoor-unit control unit 17 is a microcomputer constituted by a CPU, a memory, and so forth. The outdoor-unit control unit 17 controls operations of individual actuators of the outdoor unit 10. The outdoor-unit control unit 17 is connected to indoor-unit control units 34 (described below) of the respective indoor units 30 via communication lines cb1 and cb2 and the power feed unit 40, and transmits a signal thereto or receives a signal therefrom.

[0025] The determining unit 90 is a microcomputer constituted by a CPU, a memory, and so forth. The determining unit 90 is capable of communicating with the outdoor-unit control unit 17. The determining unit 90 determines, in a case where the power feed unit 40 operates, whether to continue an oil return operation or a defrosting operation. An operation of the determining unit 90 will be described below.

(1-2) Indoor Units 30

[0026] The indoor units 30 (30a, 30b, 30c) are indoor units installed in a target space. The indoor units 30 constitute the refrigerant circuit RC together with the outdoor unit 10. The indoor units 30 each mainly include an indoor heat exchanger 31, an expansion valve 32 (32a, 32b, 32c), an indoor fan 33, and an indoor-unit control unit 34.

[0027] The indoor heat exchanger 31 is a heat exchanger that functions as an evaporator or heat absorber for refrigerant during a cooling operation and that functions as a condenser or radiator for refrigerant during a heating operation. The indoor heat exchanger 31 is, for example, a cross-finned tube heat exchanger. A liquid side of the indoor heat exchanger 31 is connected to a refrigerant pipe extending to the expansion valve 32 (32a, 32b, 32c). A gas side of the indoor heat exchanger 31 is connected to a refrigerant pipe extending to the gas connection pipe GP. The indoor heat exchanger 31 is disposed such that refrigerant in a heat transfer tube (not illustrated) and an air flow generated by the indoor fan 33 are capable of exchanging heat during an operation.

[0028] The expansion valve 32 (32a, 32b, and 32c) is an electric valve capable of adjusting the opening degree thereof. During an operation, the expansion valve 32 is adjusted in the opening degree as appropriate in accordance with a situation, and decompresses refrigerant in accordance with the opening degree. Each indoor unit 30 includes one expansion valve 32. Specifically, the indoor unit 30a includes the expansion valve 32a, the indoor unit 30b includes the expansion valve 32b, and the indoor unit 30c includes the expansion valve 32c. The opening degrees of the expansion valves 32a, 32b, and 32c are adjusted as appropriate in accordance with operation statuses of the indoor units 30a, 30b, and 30c, respectively.

[0029] The expansion valve 32 is connected to a refrigerant pipe extending to the liquid side of the indoor heat exchanger 31 and a refrigerant pipe extending to the liquid connection pipe LP. The liquid connection pipe LP connects the fifth pipe P5 of the outdoor unit 10 and the individual expansion valves 32. One end of the liquid connection pipe LP is connected to the fifth pipe P5. The other end of the liquid connection pipe LP branches off in accordance with the number of expansion valves 32 and is individually connected to the expansion valves 32.

The indoor fan 33 is, for example, a fan such as a turbofan, a sirocco fan, a cross-flow fan, or a propeller fan. The indoor fan 33 is connected to an output shaft of an indoor fan motor 33a. The indoor fan 33 is driven in conjunction with the indoor fan motor 33a. When being driven, the indoor fan 33 generates an air flow that is sucked into the indoor unit 30 and is blown out to a target space after passing through the indoor heat exchanger 31.

[0030] The indoor-unit control unit 34 is a microcomputer constituted by a CPU, a memory, and so forth. The indoor-unit control unit 34 controls operations of individual actuators of the indoor unit 30. Each indoor-unit control unit 34 is connected to the outdoor-unit control unit 17 via the communication lines cb1 and cb2 and the power feed unit 40, and transmits a signal thereto or receives a signal therefrom. The indoor-unit control unit 34 wirelessly communicates with the remote controller 50.

[0031] The indoor-unit control unit 34 of each indoor unit 30 is connected to the expansion valve 32 of the indoor unit 30 via a communication line (not illustrated) and is capable of adjusting the opening degree of the expansion valve 32.

(1-3) Power Feed Unit 40

[0032] The power feed unit 40 is connected to the outdoor-unit control unit 17 and the individual indoor-unit control units 34 via the communication lines cb1 and cb2.

Specifically, the communication line cb1 connects the power feed unit 40 and the outdoor-unit control unit 17, whereas the communication line cb2 branches off in accordance with the number of indoor-unit control units 34 and connects the power feed unit 40 and the individual indoor-unit control units 34. The communication line cb1 is connected to the communication line cb2 via the power feed unit 40.

[0033] Each indoor unit 30 is connected to an external commercial power source (not illustrated) installed in the structure. During a normal operation, the indoor units 30 are operated by power fed from the commercial power source. The power feed unit 40 is an auxiliary power source for feeding, in a case where the commercial power source for at least one of the plurality of indoor units 30 is interrupted, in other words, in a case where power feed from the commercial power source to at least one indoor unit 30 is stopped, power to the indoor unit 30 for which the commercial power source (hereinafter simply referred to as a "power source") is interrupted. The communication line cb2 transmits power fed from the power feed unit 40 to the individual indoor units 30, in addition to a signal transmitted and received between the outdoor-unit control unit 17 and the individual indoor-unit control units 34.

(1-4) Remote Controller 50

[0034] The remote controller 50 is a device including a remote-controller control unit (not illustrated) that includes a microcomputer constituted by a CPU, a memory, and so forth, and a remote-controller input unit (not illustrated) that includes an input key for inputting various commands to the air conditioning system 100.

[0035] The number of remote controllers 50 included in the air conditioning system 100 is identical to the number of indoor units 30. The remote controllers 50 are associated with the indoor units 30 in a one-to-one relationship. Each remote controller 50 wirelessly communicates with the indoor-unit control unit 34 of the corresponding indoor unit 30 by using an infrared ray, a radio wave, and the like. In response to input of a command to the remote-controller input unit by a user, a manager, or the like, the remote controller 50 transmits a predetermined signal to the indoor-unit control unit 34 in accordance with the input command.

(1-5) Controller 60

[0036] In the air conditioning system 100, the outdoor-unit control unit 17 of the outdoor unit 10 and the indoor-unit control units 34 of the individual indoor units 30 (30a, 30b, 30c) are connected to each other via the communication lines cb1 and cb2 and the power feed unit 40, and thus the controller 60 is constituted. The controller 60 controls an operation of the air conditioning system 100.

(2) Operation of Air Conditioning System 100

[0037] When an operation start command is input to any one of the remote controllers 50 and control related to a cooling operation or a heating operation is executed by the controller 60, the four-way switching valve 12 is switched to a predetermined state, and the compressor 11 and the outdoor fan 15 are activated. After that, the indoor unit 30 corresponding to the remote controller 50 to which the operation start command has been input enters an operating state (a state in which the indoor fan 33 is operated).

(2-1) Cooling Operation

[0038] During a cooling operation, the four-way switching valve 12 is switched to a cooling cycle state (a state indicated by the solid lines in the four-way switching valve 12 in Fig. 1). When the individual actuators are activated in this state, refrigerant is sucked into the compressor 11 through the second pipe P2 and is compressed. The refrigerant discharged from the compressor 11 passes through the third pipe P3, the four-way switching valve 12, and the fourth pipe P4, and then flows into the outdoor heat exchanger 13.

[0039] The refrigerant flowed into the outdoor heat exchanger 13 exchanges heat with an air flow generated by the outdoor fan 15 and condenses (or radiates heat). The refrigerant flowed out of the outdoor heat exchanger 13 passes through the fifth pipe P5 and the liquid connection pipe LP and flows into the individual indoor units 30.

[0040] The refrigerant flowed into each indoor unit 30 flows into the expansion valve 32. The refrigerant flowed into the expansion valve 32 is decompressed in accordance with the opening degree of the expansion valve 32. The refrigerant flowed out of the expansion valve 32 flows into the indoor heat exchanger 31, exchanges heat with an air flow generated by the indoor fan 33, and evaporates (or absorbs heat). The refrigerant flowed out of the indoor heat exchanger 31 passes through the gas connection pipe GP and flows into the outdoor unit 10. The refrigerant flowed into the outdoor unit 10 passes through the first pipe P1, the four-way switching valve 12, and the second pipe P2, is sucked into the compressor 11 again, and is compressed.

(2-2) Heating Operation

[0041] During a heating operation, the four-way switching valve 12 is switched to a heating cycle state (a state indicated by the broken lines in the four-way switching valve 12 in Fig. 1). When the individual actuators are activated in this state, refrigerant is sucked into the compressor 11 through the second pipe P2 and is compressed. The refrigerant discharged from the compressor 11 passes through the third pipe P3, the four-way switching valve 12, the first pipe P1, and the gas connec-

tion pipe GP, and then flows into each indoor unit 30. The refrigerant flowed into the indoor unit 30 flows into the indoor heat exchanger 31, exchanges heat with an air flow generated by the indoor fan 33, and condenses (or radiates heat). The refrigerant flowed out of the indoor heat exchanger 31 flows into the expansion valve 32 and is decompressed in accordance with the opening degree of the expansion valve 32. The refrigerant flowed out of the expansion valve 32 passes through the liquid connection pipe LP and flows into the outdoor unit 10.

[0042] The refrigerant flowed into the outdoor unit 10 passes through the fifth pipe P5 and flows into the outdoor heat exchanger 13. The refrigerant flowed into the outdoor heat exchanger 13 exchanges heat with an air flow generated by the outdoor fan 15, and evaporates (or absorbs heat). The refrigerant flowed out of the outdoor heat exchanger 13 passes through the fourth pipe P4, the four-way switching valve 12, and the second pipe P2, is sucked into the compressor 11 again, and is compressed.

(2-3) Oil Return Operation

[0043] An oil return operation is an operation of causing refrigerant to circulate to return lubricating oil distributed in the refrigerant circuit RC into the compressor 11. In the oil return operation, the expansion valves 32 are opened to cause the refrigerant to circulate. During the oil return operation, the indoor fans 33 may be stopped.

(2-4) Defrosting Operation

[0044] A defrosting operation is an operation of melting frost generated in the outdoor heat exchanger 13 due to a heating operation. During the defrosting operation, the four-way switching valve 12 is switched to a cooling cycle state. During the defrosting operation, the indoor fans 33 are stopped.

(3) Normal Control Mode and M/T Control Mode

[0045] Fig. 2 illustrates a control process of an operation of the entire air conditioning system 100. As illustrated in Fig. 2, the entire air conditioning system 100 operates in a normal control mode or a multi-tenant control mode (hereinafter referred to as an "M/T control mode").

[0046] In the normal control mode, normal operation control, which is adopted also in an existing system formed of one outdoor unit and one indoor unit, is performed. In the normal control mode, power sources for all the indoor units 30 of the air conditioning system 100 are not interrupted, and power is fed from an external power source. In the normal control mode, the air conditioning system 100 starts an air conditioning operation and shifts from a stopped state to a steady state (a state in which normal operation control is being performed), or strops an air conditioning operation and shifts from a steady state to a stopped state, in response to an operation of the remote controller 50 or the like. At a transition from a steady state to a stopped state, an oil return operation and a defrosting operation are performed if necessary. The air conditioning system 100 that is operating in the normal control mode shifts to the M/T control mode in a case where the power source for at least one of the indoor units 30 is interrupted (see the solid-line arrow in Fig. 2). In the M/T control mode, at least one indoor unit 30 is in an operation stop state with the power source therefor being interrupted. In the M/T control mode, the indoor unit 30 for which the power source has been interrupted (hereinafter referred to as a "power-source-interrupted indoor unit 30") is fed with auxiliary power from the power feed unit 40.

(4) Details of M/T Control Mode

[0047] A description will be given of operations of the controller 60 and the determining unit 90 in a case where a power-source-interrupted indoor unit 30 occurs in each operation.

(4-1) Oil Return Operation

[0048] Fig. 3 is a flowchart of the M/T control mode in a case where a power-source-interrupted indoor unit 30 occurs during an oil return operation. The determining unit 90 determines whether to continue the oil return operation on the basis of the number of power-source-interrupted indoor units 30, a remaining time of the oil return operation, power that can be fed by the power feed unit, or the like (S101).

[0049] If the determining unit 90 determines to continue the oil return operation (YES in S101), the controller 60 continues the oil return operation (S102). On the other hand, if the determining unit 90 determines not to continue the oil return operation (NO in S101), the controller 60 acquires the degree of wetness of the refrigerant sucked by the compressor 11 (S103). Subsequently, the controller 60 determines whether to stop the compressor 11 on the basis of the acquired degree of wetness of the refrigerant (S104). If the controller 60 determines not to stop the compressor 11 (NO in S104), the controller 60 returns to step S103. On the other hand, if the controller 60 determines to stop the compressor 11 (YES in S104), the controller stops the compressor 11.

(4-2) Defrosting Operation

[0050] Fig. 4 is a flowchart in a case where a power-source-interrupted indoor unit 30 occurs during a defrosting operation. The determining unit 90 determines whether to continue the defrosting operation on the basis of the number of power-source-interrupted indoor units 30, a remaining time of the defrosting operation, power that can be fed by the power feed unit, or the like (S201).

[0051] If the determining unit 90 determines to continue the defrosting operation (YES in S201), the controller 60

continues the defrosting operation (S202). On the other hand, if the determining unit 90 determines not to continue the defrosting operation (NO in S201), the controller 60 stops the compressor 11.

[0052] In the case of continuing the defrosting operation (S202), the defrosting operation is performed similarly to the normal control mode. For example, during a heating operation, the expansion valves 32 are closed and then the four-way switching valve 12 is switched to a cooling cycle state. Subsequently, the expansion valves 32 are opened. Accordingly, it is possible to suppress the occurrence of a situation in which a user hears noise caused by switching of the four-way switching valve.

(5) Features

(5-1)

[0053] The determining unit 90 determines whether to continue an oil return operation or a defrosting operation. Thus, even if a power-source-interrupted indoor unit 30 occurs during execution of an oil return operation or a defrosting operation, the oil return operation or the defrosting operation can be continued if it is considered that the air conditioning system 100 will not be damaged.

(5-2)

[0054] If the determining unit 90 determines not to continue an oil return operation or a defrosting operation, the controller 60 stops the compressor 11. Thus, as a result of stopping the operation of the entire air conditioning system 100 in response to the occurrence of a power-source-interrupted indoor unit 30, damaging of the air conditioning system 100 can be suppressed.

(5-3)

[0055] The controller 60 stops the compressor 11 on the basis of the degree of wetness of the refrigerant sucked by the compressor 11. Thus, it is possible to suppress suction of a large amount of liquid refrigerant by the compressor 11 and reduce damaging of the compressor 11.

(6) Modification Examples

[0056] Hereinafter, modification examples of the above-described embodiment will be described. A plurality of embodiments may be combined.

(6-1) Modification Example A

[0057] In the above-described embodiment, in the case of continuing an oil return operation at the occurrence of a power-source-interrupted indoor unit 30, the oil return operation is simultaneously performed for all the indoor units 30 (30a to 30c). Alternatively, the indoor units 30 may be grouped into a plurality of groups, and an oil return operation may be sequentially performed for the individual groups. In Fig. 5, the indoor units 30 are grouped into a first group G1 (30a, 30b) and a second group (30c).

[0058] As illustrated in Fig. 6, if the determining unit 90 determines to continue an oil return operation (YES in S101), the controller 60 performs first group closing control (S102-1). In the first group closing control, the expansion valves 32 (32a, 32b) of the indoor units 30 (30a, 30b) belonging to the first group G1 are closed, and the expansion valve 32 (32c) of the indoor unit 30 (30c) belonging to the second group G2 is opened. In this state, the oil return operation is performed.

[0059] Subsequently, the controller 60 performs second group closing control (S 102-2). In the second group closing control, the expansion valves 32 (32a, 32b) of the indoor units 30 (30a, 30b) belonging to the first group G1 are opened, and the expansion valve 32 (32c) of the indoor unit 30 (30c) belonging to the second group G2 is closed. In this state, the oil return operation is performed.

(6-2) Modification Example B

[0060] In the above-described embodiment, in the case of continuing a defrosting operation at the occurrence of a power-source-interrupted indoor unit 30, the defrosting operation is performed similarly to the normal control mode. Alternatively, in the M/T control mode, a defrosting operation different from that in the normal control mode may be performed.

[0061] For example, as illustrated in Fig. 7, if the determining unit 90 determines to continue a defrosting operation during a heating operation (YES in S201), the controller 60 switches the four-way switching valve 12 to a cooling cycle state with the expansion valves of the indoor units 30 kept open (S202-1).

[0062] With this configuration, an operation of closing the expansion valves is omitted for noise processing, and thus power fed to the expansion valves 32 by the power feed unit 40 is reduced.

(6-3) Modification Example C

[0063] The outdoor unit 10 may further include other elements not illustrated in Fig. 1. Fig. 8 is a schematic configuration diagram of an air conditioning system 100 according to the present modification example. In Fig. 8, the outdoor unit 10 further includes an oil separator 14, an expansion valve 16, a receiver 18, and an accumulator 19.

[0064] The oil separator 14 is attached to the third pipe P3. The oil separator 14 removes, from highpressure gas refrigerant discharged from the compressor 11, lubricating oil mixed in the refrigerant.

[0065] The expansion valve 16 is attached to the fifth

pipe P5. The expansion valve 16 is an electric valve capable of adjusting the opening degree thereof. While the air conditioning system 100 is operating, the expansion valve 16 is adjusted in the opening degree as appropriate in accordance with a situation, and decompresses refrigerant in accordance with the opening degree.

[0066] The receiver 18 is attached to the fifth pipe P5. The receiver 18 is attached between the expansion valve 16 and the liquid connection pipe LP. The receiver 18 temporarily stores refrigerant to absorb a change in the amount of refrigerant in the outdoor heat exchanger 13 and the indoor heat exchangers 31 in accordance with an operation status of the air conditioning system 100. The receiver 18 may include a mechanism for removing water and a foreign substance contained in the refrigerant circulating in the refrigerant circuit RC.

[0067] The accumulator 19 is attached to the second pipe P2. The accumulator 19 separates gas-liquid mixed refrigerant flowing in the refrigerant circuit RC into gas refrigerant and liquid refrigerant, and transfers only the gas refrigerant to the suction port of the compressor 11.

[0068] In Fig. 8, the outdoor unit 10 does not need to include the receiver 18 or the accumulator 19. The details described in the embodiment and modification examples A and B can also be applied to the air conditioning system 100 illustrated in Fig. 8.

(6-4) Modification Example D

[0069] Fig. 9 illustrates an operation of an air conditioning system 100 according to modification example D.

[0070] During any operation, the M/T control mode starts when a power-source-interrupted indoor unit 30 occurs (S300). Subsequently, the controller 60 acquires the degree of wetness of the refrigerant sucked by the compressor 11 (S301). Subsequently, the determining unit 90 determines whether the acquired degree of wetness of the refrigerant or a future prediction of the degree of wetness based thereon is abnormal (S302). If the acquired degree of wetness or the future prediction of the degree of wetness is abnormal (YES in S302), the determining unit 90 transmits an instruction to stop the compressor 11 to the controller 60 (S305). This is for preventing breakage of the compressor 11. If the degree of wetness or the like is normal (NO in S302), the controller 60 acquires information on the opening degree of the expansion valve of the power-source-interrupted indoor unit 30 (S303). The determining unit 90 derives, from the acquired information on the opening degree, the amount of drain water in the power-source-interrupted indoor unit 30 or a future prediction of the amount of drain water. Subsequently, the determining unit 90 determines, on the basis of the derived value, whether there is a possibility of overflow of drain water in the power-source-interrupted indoor unit 30 (S304). If there is a possibility of overflow of drain water (YES in S304), the determining unit 90 transmits an instruction to stop the compressor 11 to the controller 60 (S305). This is for preventing overflow of drain water in the power-source-interrupted indoor unit 30. If there is no possibility of overflow of drain water (NO in S304), the process proceeds to step S100 or step S200 in the above-described embodiment or modification examples.

[0071] The details described in the embodiment and modification examples A to C can also be applied to the air conditioning system 100 described by using the flowchart in Fig. 9.

<Conclusion>

[0072] The embodiment of the present disclosure has been described above. It is to be understood that the embodiment and the details can be variously changed without deviating from the gist and scope of the present disclosure described in the claims.

REFERENCE SIGNS LIST

[0073]

10	outdoor unit
11	compressor
12	four-way switching valve
30	indoor unit
32	expansion valve
40	power feed unit
60	controller
90	determining unit
100	air conditioning system
RC	refrigerant circuit (refrigerant cycle)

CITATION LIST

PATENT LITERATURE

[0074] [PTL 1] Japanese Patent Application Laid-Open Publication No. 2013-40698

Claims

1. An air conditioning system comprising:

a refrigerant cycle (RC) including an outdoor unit (10) and a plurality of indoor units (30), the outdoor unit including a compressor (11);
a power feed unit (40) that, in a case where a power source for at least one indoor unit of the plurality of indoor units is interrupted, feeds power from an auxiliary power source to the at least one indoor unit;
a controller (60) that controls at least the compressor; and
a determining unit (90) that, in the case where the power source for the at least one indoor unit of the plurality of indoor units is interrupted,

makes one of
a determination to stop the compressor, and
a determination to cause the compressor to continue operating, and
transmits to the controller an instruction corresponding to the determination that has been made.

2. The air conditioning system according to Claim 1, wherein

the determining unit makes the determination on the basis of at least one of a degree of wetness of refrigerant sucked by the compressor or a prediction of the degree of wetness, and
an amount of drain water in the at least one indoor unit of the plurality of indoor units or a prediction of the amount of drain water.

3. The air conditioning system according to Claim 2, wherein

the determining unit makes the determination on the basis of
the amount of drain water in the at least one indoor unit of the plurality of indoor units or the prediction of the amount of drain water, and
a power feed capacity of the power feed unit.

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

the controller causes at least the compressor to perform an oil return operation or a defrosting operation in the refrigerant cycle, and
the determining unit determines whether to continue the oil return operation or the defrosting operation in a case where the power feed unit feeds power from the auxiliary power source to the at least one indoor unit.

5. The air conditioning system according to Claim 4, wherein
in a case where the determining unit determines not to continue the oil return operation when the controller is causing the refrigerant cycle to perform the oil return operation, the controller stops the compressor.

6. The air conditioning system according to Claim 5, wherein
the controller stops the compressor on the basis of a degree of wetness of refrigerant sucked by the compressor.

7. The air conditioning system according to Claim 4, wherein

the plurality of indoor units each include an expansion valve (32),
the controller groups the plurality of indoor units into at least two groups (G1, G2),
in a case where the determining unit determines to continue the oil return operation when the controller is causing the refrigerant cycle to perform the oil return operation, the controller sequentially performs
first group closing control of closing the expansion valve of an indoor unit belonging to a first group (G1) and opening the expansion valve of an indoor unit belonging to a second group (G2), and
second group closing control of opening the expansion valve of the indoor unit belonging to the first group and closing the expansion valve of the indoor unit belonging to the second group.

8. The air conditioning system according to any one of Claims 4 to 7, wherein

the outdoor unit further includes a four-way switching valve (12), and
in a case where the determining unit determines not to continue the defrosting operation when the controller is causing the refrigerant cycle to perform the defrosting operation, the controller stops the compressor.

9. The air conditioning system according to Claim 7, wherein

the outdoor unit further includes a four-way switching valve (12), and
in a case where the determining unit determines to continue the defrosting operation when the controller is causing the refrigerant cycle to perform the defrosting operation, the controller switches the four-way switching valve.

10. The air conditioning system according to Claim 9, wherein
when the controller switches the four-way switching valve, at least one of the plurality of expansion valves is open and the compressor is operating.

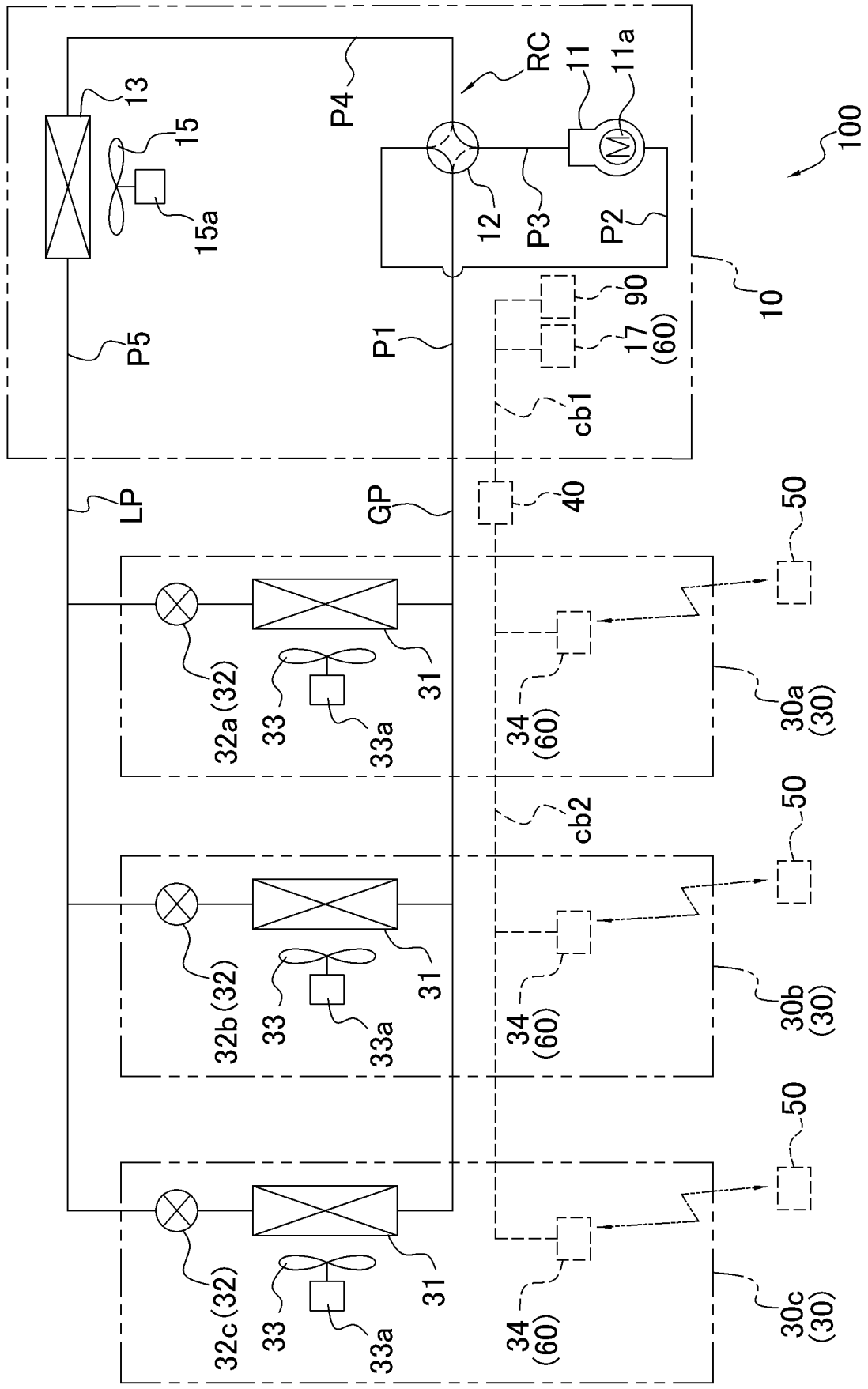
100
10
RC
11
11a
12
13
15
15a
P1
P2
P3
P4
P5
LP
GP
40
90
17
(60)
cb1
cb2
50
30a
(30)
30b
(30)
30c
(30)
31
32a (32)
32b (32)
32c (32)
33
33a
34
(60)

FIG. 1

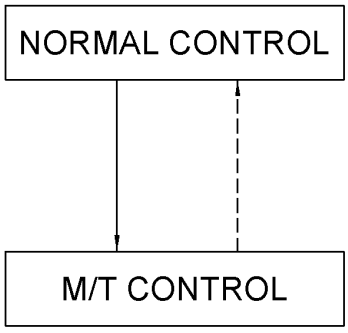
NORMAL CONTROL
M/T CONTROL

FIG. 2

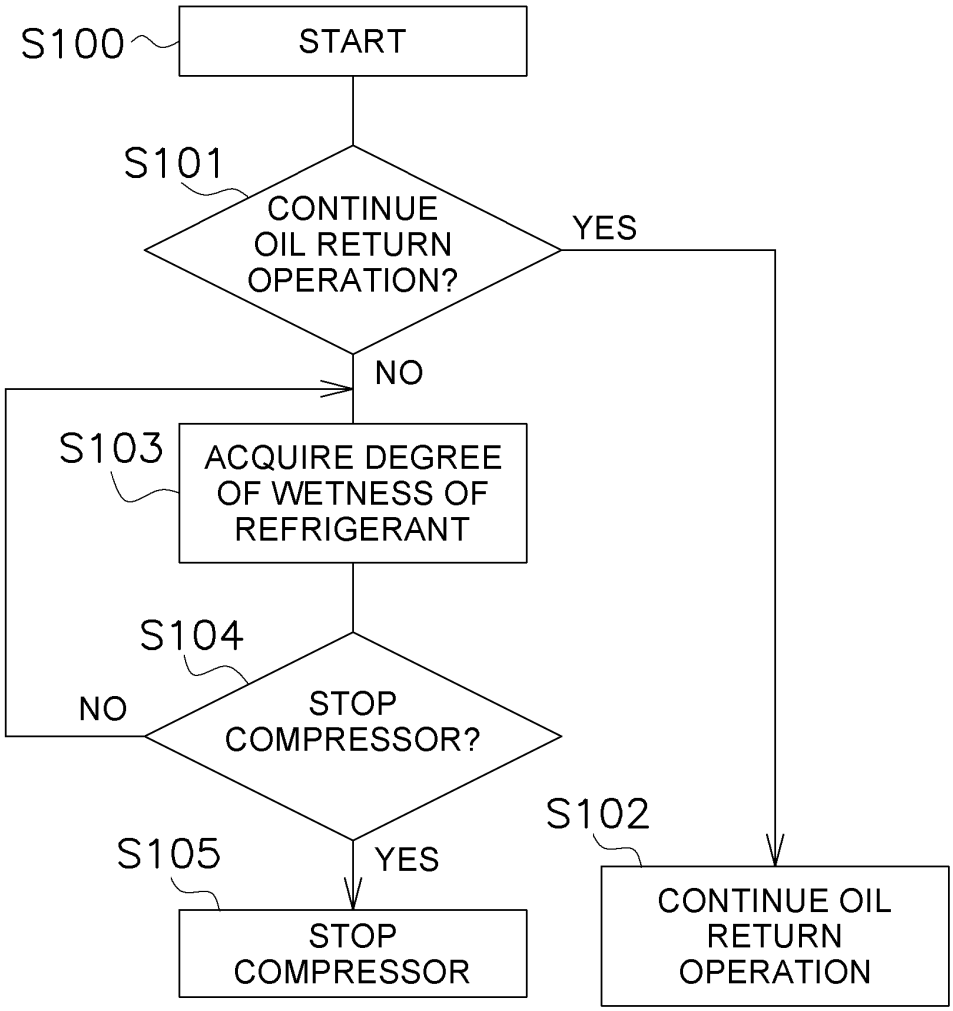
S100
START
S101
CONTINUE OIL RETURN OPERATION?
YES
NO
S103
ACQUIRE DEGREE OF WETNESS OF REFRIGERANT
S104
STOP COMPRESSOR?
NO
YES
S105
STOP COMPRESSOR
S102
CONTINUE OIL RETURN OPERATION

FIG. 3

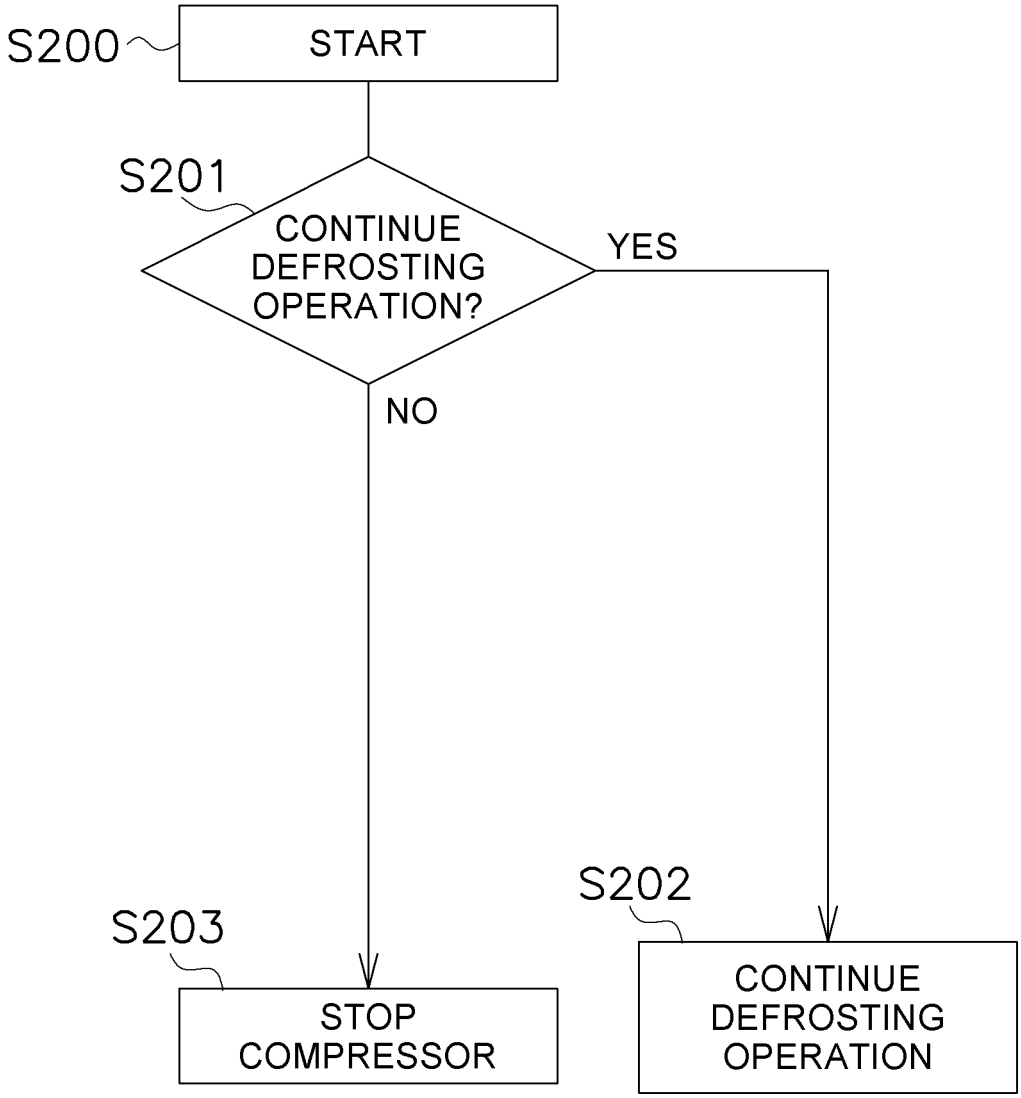
S200
START
S201
CONTINUE DEFROSTING OPERATION?
YES
NO
S202
CONTINUE DEFROSTING OPERATION
S203
STOP COMPRESSOR

FIG. 4

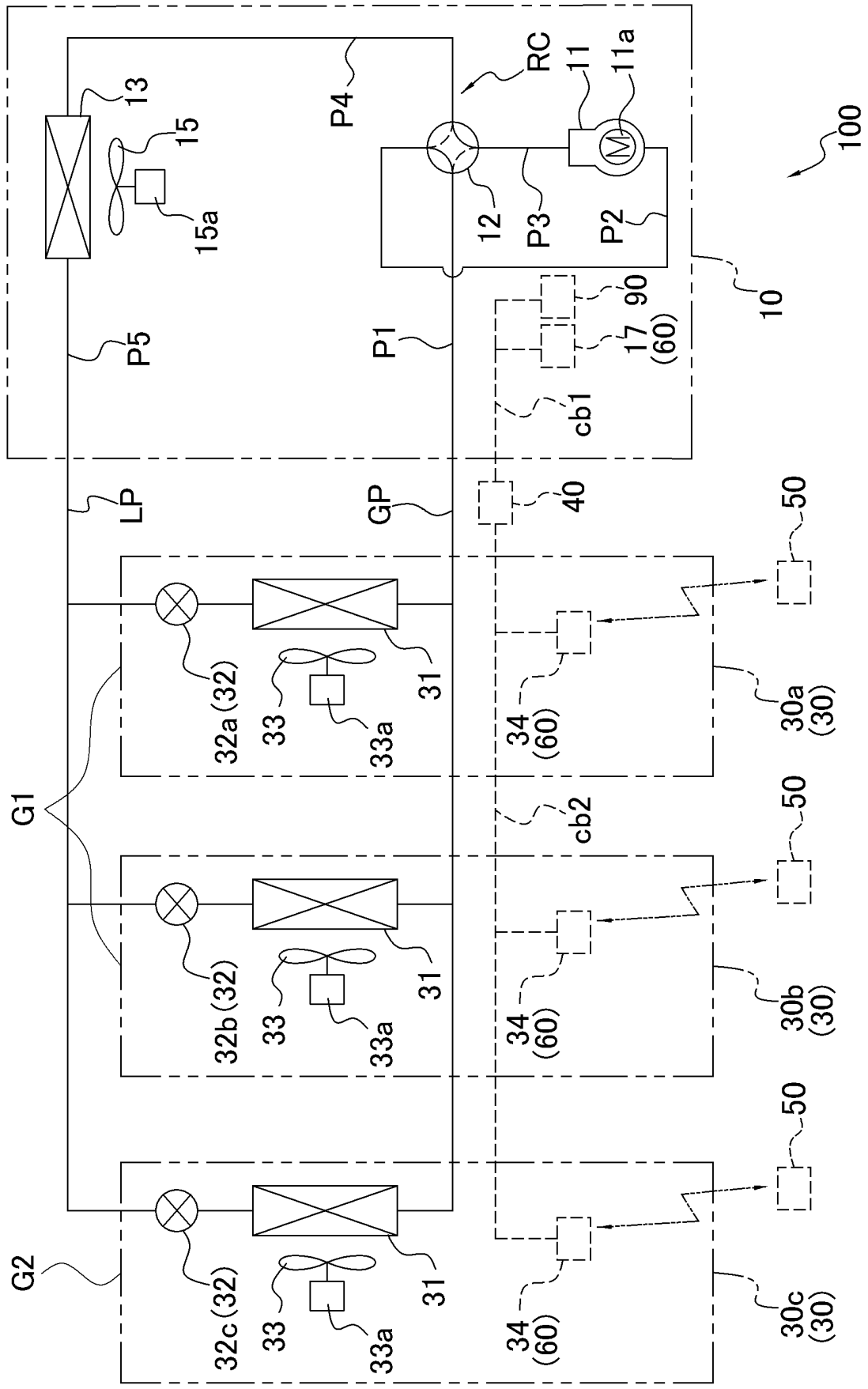
100
10
RC
11
11a
12
13
15
15a
P1
P2
P3
P4
P5
90
17
(60)
cb1
LP
GP
40
50
G1
G2
cb2
32a (32)
32b (32)
32c (32)
31
33
33a
34
(60)
30a
(30)
30b
(30)
30c
(30)

FIG. 5

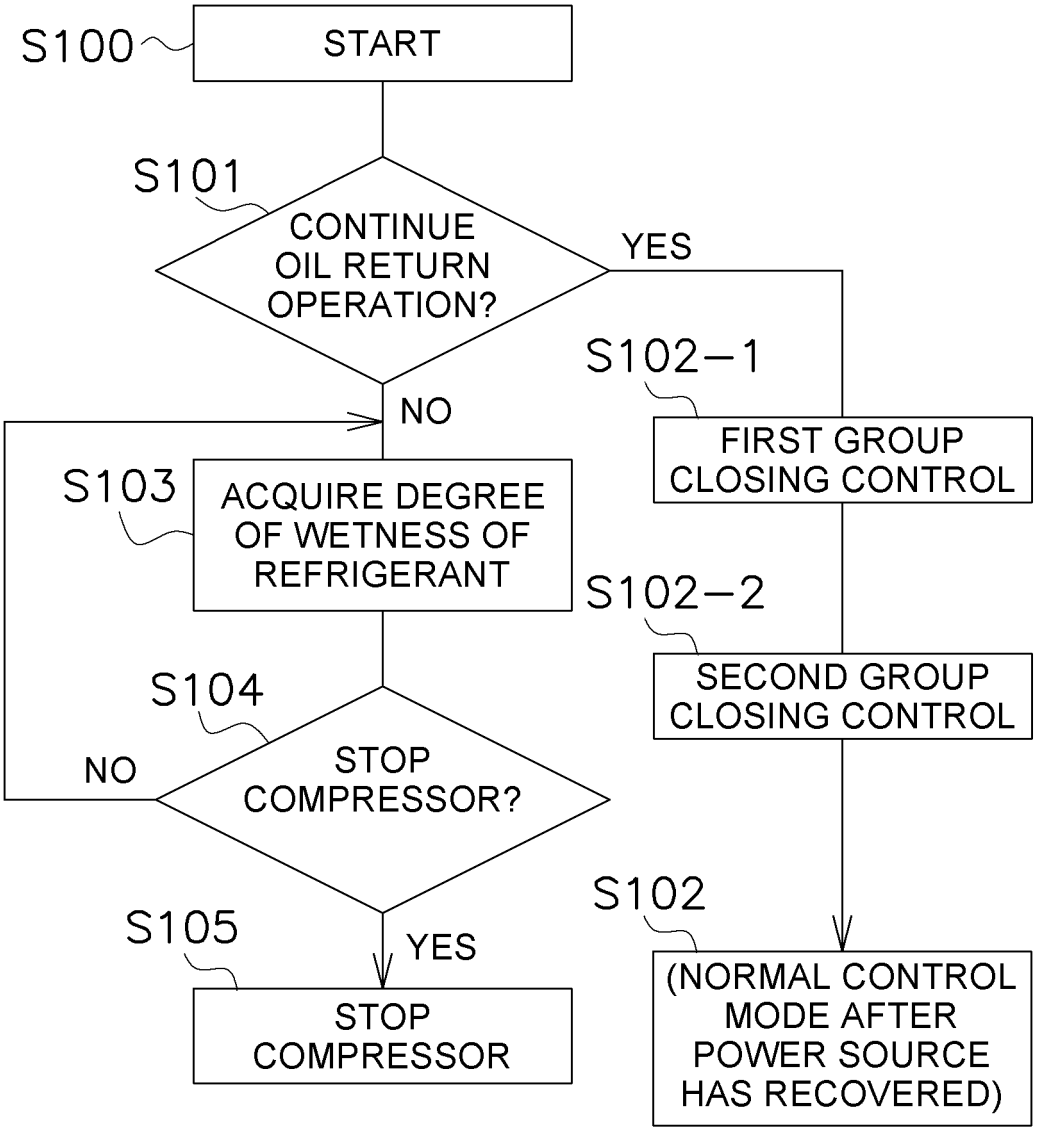
S100
START
S101
CONTINUE OIL RETURN OPERATION?
YES
NO
S102−1
FIRST GROUP CLOSING CONTROL
S103
ACQUIRE DEGREE OF WETNESS OF REFRIGERANT
S102−2
SECOND GROUP CLOSING CONTROL
S104
STOP COMPRESSOR?
NO
S102
(NORMAL CONTROL MODE AFTER POWER SOURCE HAS RECOVERED)
S105
YES
STOP COMPRESSOR

FIG. 6

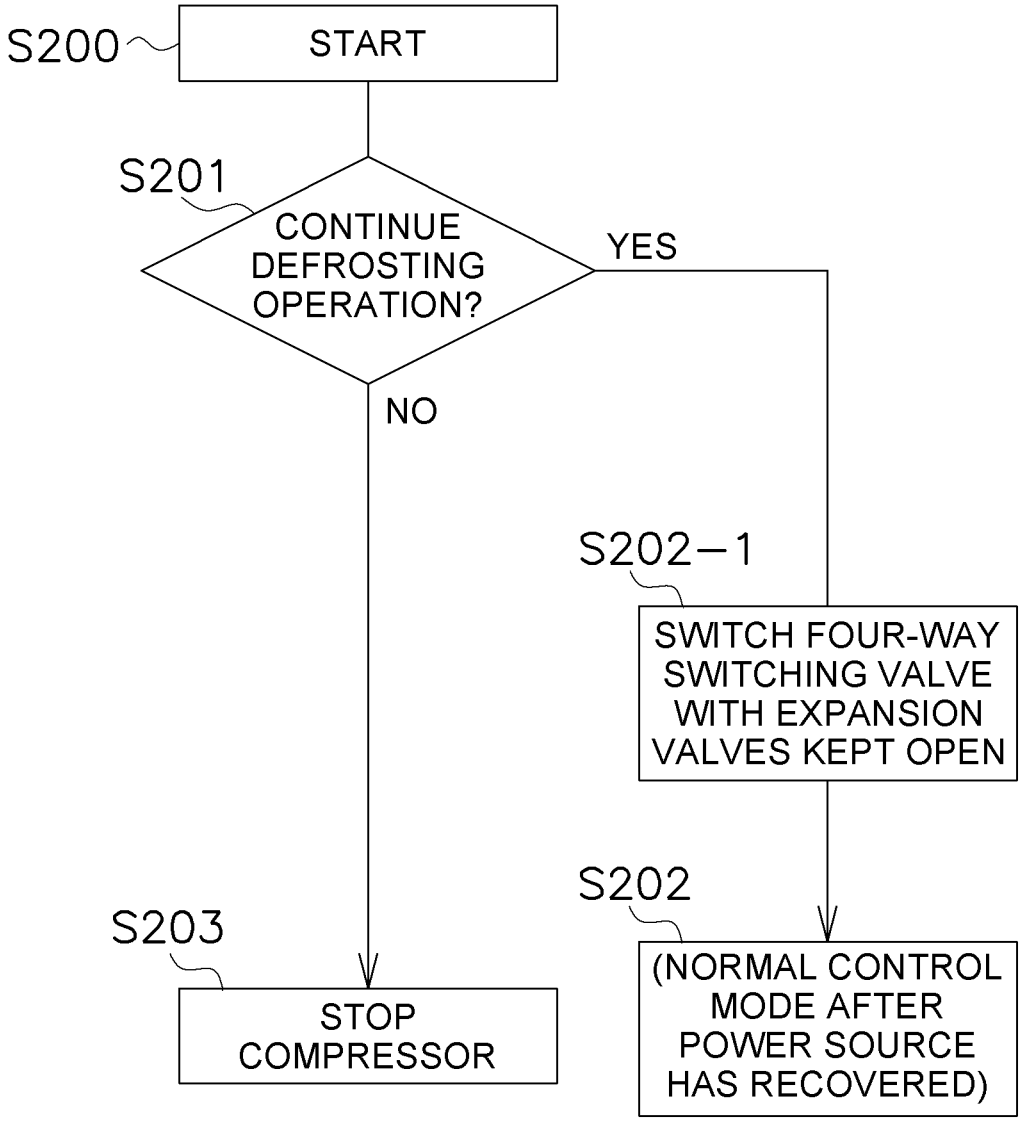
S200
START
S201
CONTINUE DEFROSTING OPERATION?
YES
NO
S202-1
SWITCH FOUR-WAY SWITCHING VALVE WITH EXPANSION VALVES KEPT OPEN
S202
(NORMAL CONTROL MODE AFTER POWER SOURCE HAS RECOVERED)
S203
STOP COMPRESSOR

FIG. 7

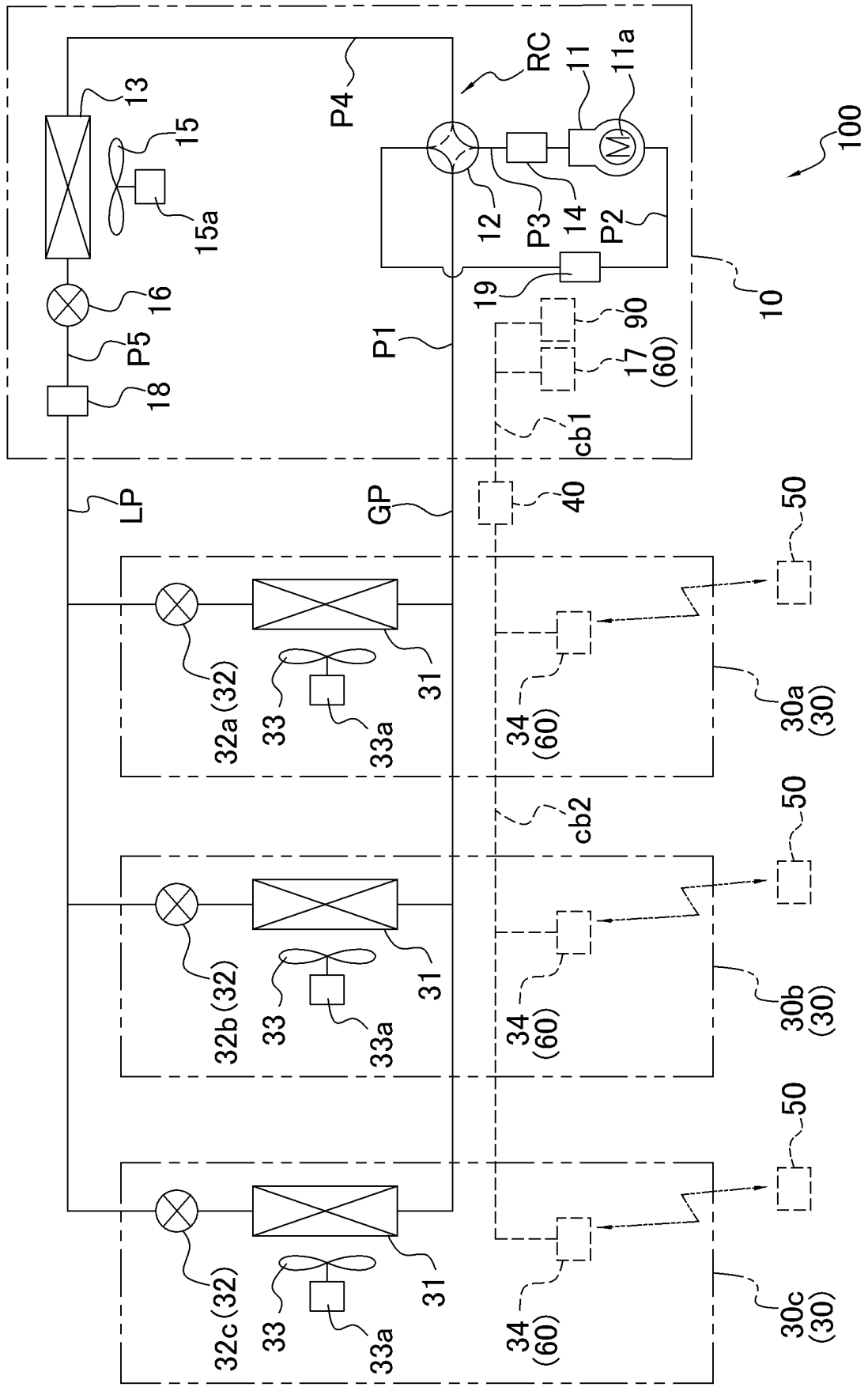
100
10
RC
11
11a
M
12
13
14
15
15a
16
17
18
19
90
(60)
P1
P2
P3
P4
P5
LP
GP
40
cb1
cb2
50
30a
(30)
30b
(30)
30c
(30)
31
32a (32)
32b (32)
32c (32)
33
33a
34
(60)

FIG. 8

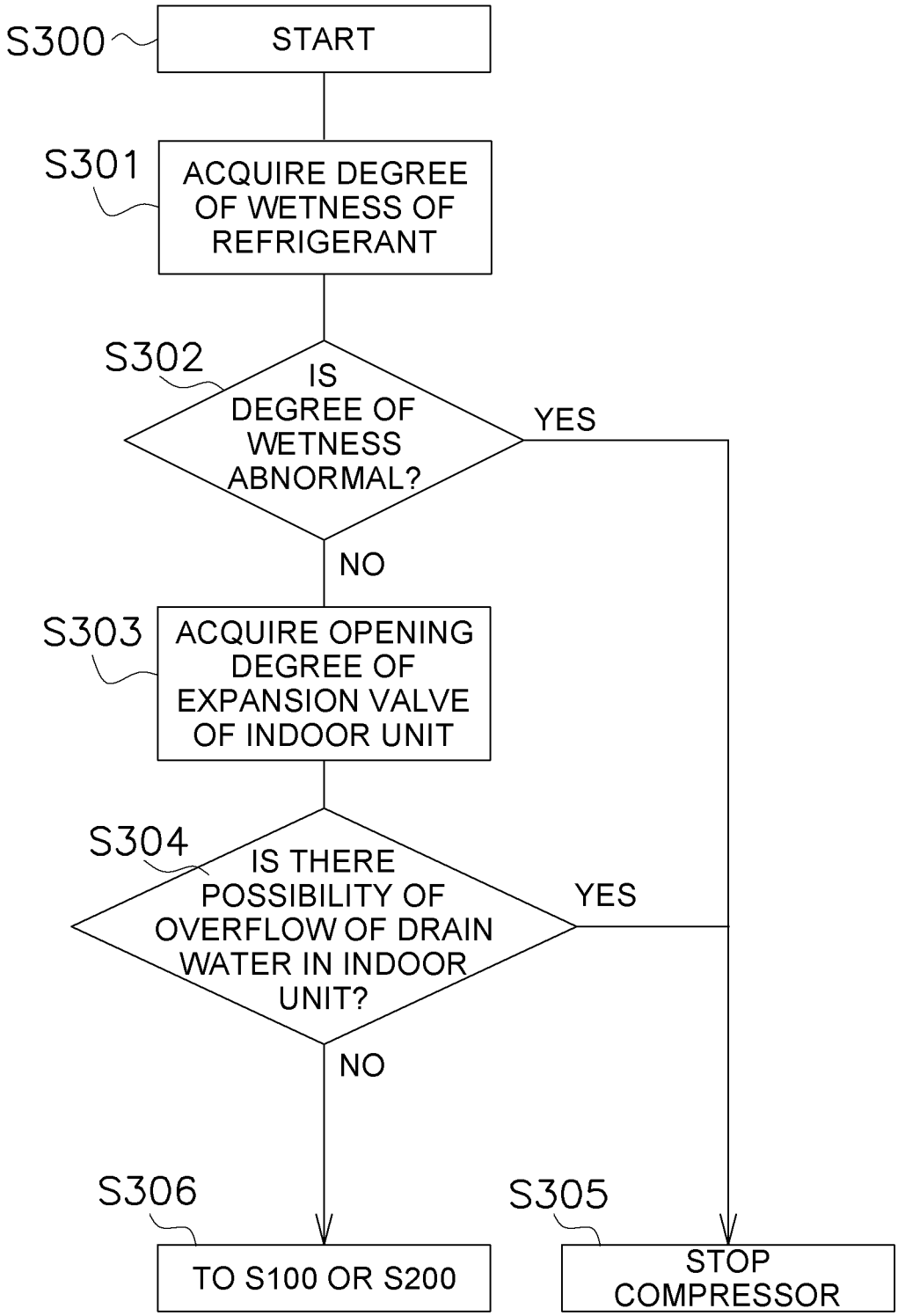
S300
START
S301
ACQUIRE DEGREE OF WETNESS OF REFRIGERANT
S302
IS DEGREE OF WETNESS ABNORMAL?
YES
NO
S303
ACQUIRE OPENING DEGREE OF EXPANSION VALVE OF INDOOR UNIT
S304
IS THERE POSSIBILITY OF OVERFLOW OF DRAIN WATER IN INDOOR UNIT?
YES
NO
S306
TO S100 OR S200
S305
STOP COMPRESSOR

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2020/015853

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F11/32(2018.01)i, F24F11/41(2018.01)i, F25B49/02(2006.01)i, F24F140/12(2018.01)n, F24F140/20(2018.01)n, F24F140/50(2018.01)n, F24F140/60(2018.01)n
FI: F24F11/32, F25B49/02D, F24F11/41100, F24F140:12, F24F140:50, F24F140:20, F24F140:60
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. F24F11/32, F24F11/41, F25B49/02, F24F140/12, F24F140/20, F24F140/50, F24F140/60

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.
Y	JP 2008-057868 A (DAIKIN INDUSTRIES, LTD.) 13.03.2008 (2008-03-13), paragraphs [0006]-[0033], fig. 1-5	1-10
Y	JP 2005-077056 A (MITSUBISHI ELECTRIC CORPORATION) 24.03.2005 (2005-03-24), paragraphs [0008]-[0022], fig. 1, 2	1-10
Y	JP 62-238947 A (HITACHI, LTD.) 19.10.1987 (1987-10-19), page 1, lower right column, line 8 to page 2, lower left column, line 13, fig. 1, 2	2-10
Y	JP 2017-096531 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 01.06.2017 (2017-06-01), paragraphs [0023]-[0060], fig. 1-7	7-10
A	CN 109631380 A (QINGDAO HAIER AIR-CONDITIONING ELECTRONICS CO., LTD.) 16.04.2019 (2019-04-16), entire text, all drawings	1-10

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

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"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
26.06.2020	07.07.2020
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/015853

JP 2008-057868 A	13.03.2008	WO 2008/029621 A1 paragraphs [0006]-[0036], fig. 1-5
JP 2005-077056 A	24.03.2005	(Family: none)
JP 62-238947 A	19.10.1987	(Family: none)
JP 2017-096531 A	01.06.2017	EP 3171091 A1 paragraphs [0026]-[0099], fig. 1-7
CN 109631380 A	16.04.2019	(Family: none)

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013040698 A **[0002] [0074]**