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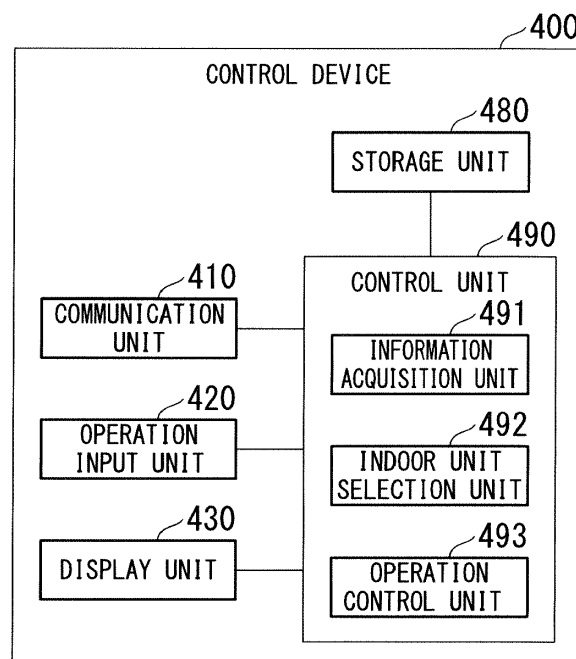
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(54) **AIR CONDITIONING SYSTEM, CONTROL DEVICE, CONTROL METHOD, AND PROGRAM**

(57) A control device includes an information acquisition unit, an indoor unit selection unit and an operation control unit. The information acquisition unit is configured to acquire temperature information of an indoor unit indicating at least one of a temperature of the indoor unit and a temperature of an indoor space in which the indoor

unit is installed. The indoor unit selection unit is configured to determine whether to allow the indoor unit to perform a defrost operation on the basis of the temperature information. The operation control unit is configured to control the indoor unit according to the determination of the indoor unit selection unit.

FIG. 3



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an air conditioning system, a control device, a control method, and a program.

Description of Related Art

[0002] When an air conditioning system performs a defrost operation, it is conceivable that cold air is released from an indoor unit, lowering the room temperature.

[0003] Japanese Unexamined Patent Application, First Publication No. 2007-205615 (hereinafter, referred to as Patent Literature 1) discloses related art. In an air conditioner disclosed in Patent Literature 1, a throttle device of a specific indoor unit is closed to prevent cold air from being released from the specific indoor unit into a room during a defrost operation.

SUMMARY OF THE INVENTION

[0004] It is described in Patent Literature 1 that specific indoor units for which information indicating that a throttle device is closed during a defrost operation is stored in advance as throttle device closure setting information close their throttle devices during the defrost operation. In such a method in which predetermined specific indoor units close their throttle devices, it is not possible to suppress release of cold air from indoor units other than the predetermined specific indoor units during the defrost operation, thus lowering the room temperature. It is conceivable that this lowering of the room temperature may make people in the room feel uncomfortable.

[0005] To reduce such discomfort, there is a need to be able to more flexibly restrict release of cold air from indoor units during the defrost operation, without being limited to some predetermined indoor units.

[0006] The present invention provides an air conditioning system, a control device, a control method, and a program which can more flexibly restrict release of cold air from indoor units during a defrost operation, without being limited to some predetermined indoor units.

[0007] According to a first aspect of the present invention, a control device includes an information acquisition unit configured to acquire temperature information of an indoor unit indicating at least one of a temperature of the indoor unit and a temperature of an indoor space in which the indoor unit is installed, an indoor unit selection unit configured to determine whether to allow the indoor unit to perform a defrost operation on the basis of the temperature information, and an operation control unit configured to control the indoor unit according to the determination of the indoor unit selection unit.

[0008] The information acquisition unit may be config-

ured to acquire the temperature information of each of a plurality of indoor units included in an air conditioning system main unit; the indoor unit selection unit may be configured to select an indoor unit which is allowed to perform a defrost operation on the basis of the temperature information; and the operation control unit may be configured to allow the indoor unit selected by the indoor unit selection unit to perform the defrost operation.

[0009] An air conditioning system may include: an air conditioning system main unit including a plurality of indoor units; and the control device described above.

[0010] The operation control unit may be configured to fully close an expansion valve of an indoor unit that the indoor unit selection unit has excluded from targets for the defrost operation.

[0011] The air conditioning system may further include a storage unit configured to store a threshold temperature value set for each of the indoor units, and the indoor unit selection unit may be configured to select an indoor unit for which a temperature indicated by the temperature information is higher than the threshold temperature value as a target for the defrost operation.

[0012] According to a second aspect of the present invention, a control method includes acquiring temperature information of an indoor unit indicating at least one of a temperature of the indoor unit and a temperature of an indoor space in which the indoor unit is installed, determining whether to allow the indoor unit to perform a defrost operation on the basis of the temperature information, and controlling the indoor unit according to the determination.

[0013] The acquiring temperature information may include acquiring the temperature information of each of a plurality of indoor units included in an air conditioning system main unit; the determining whether to allow the indoor unit may include selecting an indoor unit which is allowed to perform a defrost operation on the basis of the temperature information; and the controlling the indoor unit may include allowing the indoor unit, selected as an indoor unit which is allowed to perform the defrost operation, to perform the defrost operation.

[0014] According to a third aspect of the present invention, a program causes a computer to acquire temperature information of an indoor unit indicating at least one of a temperature of the indoor unit and a temperature of an indoor space in which the indoor unit is installed, to determine whether to allow the indoor unit to perform a defrost operation on the basis of the temperature information, and to control the indoor unit according to the determination.

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which is allowed to perform the defrost operation, to perform the defrost operation.

[0015] According to the air conditioning system, the control device, the control method, and the program described above, it is possible to more flexibly restrict release of cold air from indoor units during the defrost operation, without being limited to some predetermined indoor units.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

FIG. 1 is a schematic block diagram showing a functional configuration of an air conditioning system according to an embodiment of the present invention. FIG. 2 is a schematic configuration diagram showing an exemplary device configuration of an air conditioning system main unit according to the embodiment.

FIG. 3 is a schematic block diagram showing a functional configuration of a control device according to the embodiment.

FIG. 4 is a flowchart showing an exemplary processing procedure in which the air conditioning system according to the embodiment performs a defrost operation.

FIG. 5 is a diagram showing a first example of grouping of indoor units according to the embodiment.

FIG. 6 is a diagram showing a first example of defrost operation patterns according to the embodiment.

FIG. 7 is a diagram showing a second example of defrost operation patterns according to the embodiment.

FIG. 8 is a diagram showing a second example of grouping of indoor units according to the embodiment.

FIG. 9 is a diagram showing a third example of defrost operation patterns according to the embodiment.

DETAILED DESCRIPTION OF THE INVENTION

(Embodiments)

[0017] Hereinafter, embodiments of the present invention will be described, but the embodiments described below do not limit the invention according to the claims. In addition, not all combinations of features described in the embodiments are necessarily essential to the solution of the invention.

[0018] FIG. 1 is a schematic block diagram showing a functional configuration of an air conditioning system according to an embodiment of the present invention. As shown in FIG. 1, the air conditioning system 1 includes an air conditioning system main unit 100 and a control device 400.

[0019] The air conditioning system main unit 100 op-

erates under the control of the control device 400 and adjusts the air temperature of an indoor space which is a target for temperature adjustment. However, the target for temperature adjustment by the air conditioning system main unit 100 is not limited to an indoor space. For example, the air conditioning system main unit 100 may adjust the air temperature of an outdoor space, like an outdoor spot air conditioner.

[0020] FIG. 2 is a schematic configuration diagram showing an exemplary device configuration of the air conditioning system main unit 100. In the example of FIG. 2, the air conditioning system main unit 100 includes an outdoor unit 200 and a plurality of indoor units 300. The outdoor unit 200 includes a compressor 211, an accumulator 212, a four-way valve 221, an outdoor heat exchanger 231, an outdoor expansion valve 232, a receiver tank 241, a supercooling heat exchanger 251, and a supercooling side expansion valve 252. Each of the indoor units 300 includes an indoor heat exchanger 311, an indoor unit side expansion valve 312, an indoor heat exchanger inlet temperature sensor 391, an indoor heat exchanger temperature sensor 392, and an indoor heat exchanger outlet temperature sensor 393.

[0021] The number of outdoor units 200 included in the air conditioning system main unit 100 is not limited to one shown in FIG. 2 and may be two or more.

[0022] In addition, the installation location of the compressor 211, the accumulator 212, the four-way valve 221, the receiver tank 241, the supercooling heat exchanger 251, and the supercooling side expansion valve 252 is not limited to the outdoor unit 200. For example, some or all of the compressor 211, the accumulator 212, the four-way valve 221, the receiver tank 241, the supercooling heat exchanger 251, and the supercooling side expansion valve 252 may be installed outside the outdoor unit 200 and may be configured, for example, as devices separate from the outdoor unit 200.

[0023] In a heating cycle, a gaseous refrigerant compressed by the compressor 211 flows into the indoor heat exchanger 311 via the four-way valve 221. The gaseous refrigerant flowing into the indoor heat exchanger 311 is condensed by dissipating heat through heat exchange with indoor air. This heat dissipation warms the indoor air.

[0024] The refrigerant that has become liquid by condensation flows into the outdoor unit 200 via the indoor unit side expansion valve 312.

[0025] In the outdoor unit 200, the refrigerant flows into the receiver tank 241 via the supercooling heat exchanger 251. A marginal refrigerant for coping with changes in operating conditions is stored in the receiver tank 241. The refrigerant flowing out of the receiver tank 241 is depressurized by the outdoor expansion valve 232 and then flows into the outdoor heat exchanger 231.

[0026] The refrigerant flowing into the outdoor heat exchanger 231 evaporates by absorbing heat through heat exchange with outdoor air. The refrigerant which has turned into gas by evaporation flows into the compressor 211 via the four-way valve 221 and the accumulator 212

and is compressed therein. The accumulator 212 separates the refrigerant flowing into the accumulator 212 into a liquid refrigerant and a gaseous refrigerant and allows only the gaseous refrigerant to flow into the compressor 211. This is to avoid capacity degradation and failure of the compressor 211 due to the liquid refrigerant flowing into the compressor 211.

[0027] Operation in the heating cycle will be referred to as heating operation. The operation referred to here is an operation of the air conditioning system main unit 100.

[0028] Switching between the heating and cooling cycles is performed by switching the connection relationship between pipes by the four-way valve 221.

[0029] In the cooling cycle, the gaseous refrigerant compressed by the compressor 211 flows into the outdoor heat exchanger 231 via the four-way valve 221. The gaseous refrigerant flowing into the outdoor heat exchanger 231 is condensed by dissipating heat through heat exchange with outdoor air. The refrigerant that has become liquid by condensation flows into the receiver tank 241 via the outdoor expansion valve 232.

[0030] The refrigerant flowing out of the receiver tank 241 is supercooled by the supercooling heat exchanger 251 and then flows into the indoor unit 300. The supercooling heat exchanger 251 performs supercooling of the refrigerant to prevent the refrigerant from evaporating in pipes between the outdoor unit 200 and the indoor unit 300. Specifically, a part of the liquid refrigerant flowing out of the receiver tank 241 is depressurized by the supercooling side expansion valve 252 and then flows into the supercooling heat exchanger 251 and is evaporated in the supercooling heat exchanger 251. This evaporating refrigerant exchanges heat with the refrigerant flowing into the indoor unit 300 from the receiver tank 241 via the supercooling heat exchanger 251 and thus deprives the refrigerant flowing into the indoor unit 300 of evaporation heat. This supercools the refrigerant flowing into the indoor unit 300 from the receiver tank 241 via the supercooling heat exchanger 251.

[0031] The refrigerant that has flowed into the supercooling heat exchanger 251 from the receiver tank 241 via the supercooling side expansion valve 252 evaporates in the supercooling heat exchanger 251 to become a gas and then flows into the compressor 211 via the accumulator 212 and is compressed therein.

[0032] However, the supercooling heat exchanger 251 and the supercooling side expansion valve 252 are not essential for the air conditioning system main unit 100. For example, when it is not necessary to be concerned about the evaporation of the refrigerant, such as when the distance between the pipes between the outdoor unit 200 and the indoor unit 300 is short, the air conditioning system main unit 100 may not include the supercooling heat exchanger 251 and the supercooling side expansion valve 252.

[0033] The refrigerant flowing into the indoor unit 300 is decompressed by the indoor unit side expansion valve

312 and then flows into the indoor heat exchanger 311.

[0034] The refrigerant flowing into the indoor heat exchanger 311 evaporates by absorbing heat through heat exchange with the indoor air. This heat absorption cools the indoor air.

[0035] The refrigerant which has turned into a gas by evaporation flows into the compressor 211 via the four-way valve 221 and the accumulator 212 and is compressed therein.

[0036] Operation in the cooling cycle is referred to as cooling operation.

[0037] When the outdoor unit is cooled in the heating operation such that frost adheres thereto, the operation efficiency of the air conditioning system main unit 100 decreases. In this case, the air conditioning system main unit 100 defrosts by performing a defrost operation under the control of the control device 400. The operation of the air conditioning system main unit 100 during the defrost operation is similar to the operation thereof during the cooling operation. However, in the case of the defrost operation, the indoor unit 300 stops blowing to avoid lowering the room temperature as much as possible.

[0038] The control device 400 selects indoor units 300 which are allowed to participate in the defrost operation.

The control device 400 closes the indoor unit side expansion valve 312 of each indoor unit 300 which is determined not to be participating in the defrost operation to block the inflow of a refrigerant into the indoor unit 300. This suppresses evaporation of the refrigerant in the indoor unit 300, thereby suppressing a decrease in the room temperature due to evaporation of the refrigerant.

[0039] The indoor heat exchanger inlet temperature sensor 391 measures the inlet temperature of the indoor heat exchanger 311 during the cooling cycle. In the heating cycle, the direction in which the refrigerant flows is opposite to that in the cooling cycle and therefore the indoor heat exchanger inlet temperature sensor 391 measures the outlet temperature of the indoor heat exchanger 311. The indoor heat exchanger temperature sensor 392 is installed in the indoor heat exchanger 311 in a region where the liquid level of the refrigerant is located. In the cooling cycle, the indoor heat exchanger temperature sensor 392 measures the evaporation temperature of the refrigerant. In the heating cycle, the indoor heat exchanger temperature sensor 392 measures the condensation temperature of the refrigerant.

[0040] The indoor heat exchanger outlet temperature sensor 393 measures the outlet temperature of the indoor heat exchanger 311 during the cooling cycle. In the heating cycle, the direction in which the refrigerant flows is opposite to that in the cooling cycle and therefore the indoor heat exchanger outlet temperature sensor 393 measures the inlet temperature of the indoor heat exchanger 311. Temperatures measured by the indoor heat exchanger inlet temperature sensor 391, the indoor heat exchanger temperature sensor 392, and the indoor heat exchanger outlet temperature sensor 393 are referred to when the control device 400 selects indoor units 300

which are allowed to participate in the defrosting.

[0041] However, each indoor unit 300 need not include all of the indoor heat exchanger inlet temperature sensor 391, the indoor heat exchanger temperature sensor 392, and the indoor heat exchanger outlet temperature sensor 393. The indoor unit 300 may include only some of the indoor heat exchanger inlet temperature sensor 391, the indoor heat exchanger temperature sensor 392, and the indoor heat exchanger outlet temperature sensor 393. Further, the indoor unit 300 may include a room temperature sensor for measuring the room temperature in addition to or in place of some or all of the indoor heat exchanger inlet temperature sensor 391, the indoor heat exchanger temperature sensor 392, and the indoor heat exchanger outlet temperature sensor 393.

[0042] In the following description, the indoor heat exchanger inlet temperature sensor 391, the indoor heat exchanger temperature sensor 392, the indoor heat exchanger outlet temperature sensor 393, and the room temperature sensor are collectively referred to as temperature sensors. It is not necessary for all indoor units 300 to have temperature sensors of the same types. That is, different temperature sensors may be provided for the indoor units 300.

[0043] The control device 400 controls the air conditioning system main unit 100 to adjust the room temperature. In particular, during the defrost operation, the control device 400 selects indoor units 300 which are allowed to participate in the defrost operation.

[0044] The control device 400 is configured, for example, using a computer such as a microcomputer.

[0045] The installation position of the control device 400 is not limited to a specific position. For example, the control device 400 may be installed inside the outdoor unit 200 or may be installed inside the indoor unit(s) 300 or may be configured as a device separate from both the outdoor unit 200 and the indoor unit(s) 300.

[0046] FIG. 3 is a schematic block diagram showing a functional configuration of the control device 400. As shown in FIG. 3, the control device 400 includes a communication unit 410, an operation input unit 420, a display unit 430, a storage unit 480, and a control unit 490. The control unit 490 includes an information acquisition unit 491, an indoor unit selection unit 492, and an operation control unit 493.

[0047] The communication unit 410 communicates with other devices. In particular, the communication unit 410 receives sensor signals indicating temperature measurement values obtained by the indoor heat exchanger inlet temperature sensor 391, the indoor heat exchanger temperature sensor 392, and the indoor heat exchanger outlet temperature sensor 393. Further, the communication unit 410 transmits control signals to each part of the air conditioning system main unit 100.

[0048] The operation input unit 420 includes, for example, an input device such as a push button and receives a user operation. All or a part of the operation input unit 420 may be arranged on a remote controller.

[0049] The display unit 430 includes, for example, a display device such as a liquid crystal panel or a lamp or a combination thereof and displays various information. For example, the display unit 430 may include an operation indicator lamp and may turn on the operation indicator lamp during operation of the air conditioning system 1. The display unit 430 may also include an abnormality display lamp and may turn on the abnormality indication lamp when an abnormality has occurred. Further, the display unit 430 may display the operation mode of the cooling operation or the heating operation and a set temperature on the liquid crystal panel.

[0050] All or a part of the display unit 430 may be arranged on the remote controller.

[0051] The storage unit 480 stores various types of information. The storage unit 480 is configured using a storage device included in the control device 400. In particular, the storage unit 480 stores, for each indoor unit 300, a threshold temperature value that the indoor unit selection unit 492 uses to select the indoor unit 300 which is allowed to participate in the defrost operation.

[0052] The indoor units 300 which are allowed to participate in the defrost operation are also referred to as indoor units 300 which are allowed to perform a defrost operation or indoor units 300 that are targets for the defrost operation.

[0053] The control unit 490 controls each part of the control device 400 to perform various processes. The control unit 490 is configured, for example, by a central processing unit (CPU) included in the control device 400 reading and executing a program from the storage unit 480.

[0054] The information acquisition unit 491 acquires temperature information of each of the plurality of indoor units 300. Specifically, the information acquisition unit 491 reads temperature information from sensor signals of the temperature sensors of the plurality of indoor units 300 received by the communication unit 410. The temperature information referred to here is information indicating at least one of the temperature of each indoor unit 300 and the temperature of an indoor space in which the indoor unit 300 is installed.

[0055] As described above, the temperature sensors collectively refer to the indoor heat exchanger inlet temperature sensor 391, the indoor heat exchanger temperature sensor 392, the indoor heat exchanger outlet temperature sensor 393, and the room temperature sensor. The temperature measurement values of the indoor heat exchanger inlet temperature sensor 391, the indoor heat exchanger temperature sensor 392, and the indoor heat exchanger outlet temperature sensor 393 correspond to examples of the temperatures of the indoor unit 300. The temperature measurement value of the room temperature sensor corresponds to an example of the temperature of the indoor space in which the indoor unit 300 is installed.

[0056] The indoor unit selection unit 492 selects indoor units 300 which are allowed to perform the defrost operation.

ation on the basis of the temperature information acquired by the information acquisition unit 491. Specifically, the indoor unit selection unit 492 selects indoor units 300 whose temperature indicated by the temperature information is higher than a threshold temperature value stored in the storage unit 480 as targets for the defrost operation.

[0057] The operation control unit 493 controls each part of the air conditioning system main unit 100 such that each unit thereof operates. Specifically, the operation control unit 493 generates a control signal for each part of the air conditioning system main unit 100 and transmits the generated control signal to a corresponding portion of the air conditioning system main unit 100 via the communication unit 410.

[0058] In particular, the operation control unit 493 causes each indoor unit 300 selected by the indoor unit selection unit 492 to perform a defrost operation. That is, during the defrost operation, the operation control unit 493 controls the air conditioning system main unit 100 such that the air conditioning system main unit 100 performs the defrost operation using each indoor unit 300 selected by the indoor unit selection unit 492.

[0059] Meanwhile, the operation control unit 493 fully closes indoor unit side expansion valves 312 of indoor units 300 that the indoor unit selection unit 492 has excluded from being targets for the defrost operation. As described above, fully closing the indoor unit side expansion valves 312 blocks the inflow of the refrigerant into the indoor units 300, thereby suppressing the evaporation of the refrigerant in the indoor heat exchangers 311. This can suppress a decrease in the room temperature due to evaporation of the refrigerant.

[0060] Next, the operation of the air conditioning system 1 will be described with reference to FIG. 4.

[0061] FIG. 4 is a flowchart showing an exemplary processing procedure in which the air conditioning system 1 performs a defrost operation. The air conditioning system 1 repeats the procedure of FIG. 4 during the defrost operation.

(Step S101)

[0062] The control unit 490 determines whether the mode of the defrost operation has been set to a normal mode or a number-of-units control mode. The mode of the defrost operation is set in advance, for example, by the user.

[0063] Upon determining that the mode of the defrost operation is the normal mode, the procedure proceeds to step S111. On the other hand, upon determining that the mode of the defrost operation is the number-of-units control mode, the procedure proceeds to step S121.

(Step S111)

[0064] The operation control unit 493 controls the air conditioning system main unit 100 to perform the defrost

operation using all indoor units 300.

[0065] After step S111, the procedure of FIG. 4 ends.

(Step S121)

[0066] The control unit 490 starts a loop L11 for performing processing for each indoor unit 300. Hereinafter, an indoor unit 300 to be processed in the loop L11 is referred to as a target indoor unit.

[0067] After step S121, the procedure proceeds to step S122.

(Step S122)

[0068] The information acquisition unit 491 acquires temperature information of the target indoor unit.

[0069] After step S122, the procedure proceeds to step S123.

(Step S123)

[0070] The indoor unit selection unit 492 determines whether or not a temperature indicated by the temperature information obtained in step S122 is equal to or lower than a threshold temperature value.

[0071] Upon determining that the temperature indicated by the temperature information is equal to or lower than the threshold temperature value (step S123: YES), the procedure proceeds to step S131. Upon determining that the temperature indicated by the temperature information is higher than the threshold temperature value (step S123: NO), the procedure proceeds to step S141.

(Step S131)

[0072] The operation control unit 493 fully closes the indoor unit side expansion valve 312 of the target indoor unit.

[0073] After step S131, the procedure proceeds to step S151.

(Step S141)

[0074] The operation control unit 493 brings the indoor unit side expansion valve 312 of the target indoor unit into an open state.

[0075] After step S141, the procedure proceeds to step S151.

(Step S151)

[0076] The control unit 490 performs a terminating procedure of the loop L11. Specifically, the control unit 490 determines whether or not the processing of the loop L11 has been performed for all indoor units 300. Upon determining that there is an unprocessed indoor unit 300, the procedure returns to step S122 to continue the processing of the loop L11 for the unprocessed indoor unit 300.

Upon determining that the processing of the loop L11 has been performed for all indoor units 300, the loop L11 ends and the procedure proceeds to step S152.

(Step S152)

[0077] The operation control unit 493 controls the air conditioning system main unit 100 to perform the defrost operation. Indoor units 300 having their indoor unit side expansion valves 312 open are targets for the defrost operation. On the other hand, indoor units 300 having their indoor unit side expansion valves 312 fully closed are excluded from the targets for the defrost operation.

[0078] After step S152, the procedure of FIG. 4 ends.

[0079] The indoor units 300 may be divided into a plurality of groups and the indoor unit selection unit 492 may perform the selection of indoor units 300 based on temperature only for indoor units 300 belonging to some of the groups. All indoor units 300 belonging to a group which is not a target for selection may be allowed to participate in the defrost operation or may be excluded from the targets for the defrost operation. This point will now be described with reference to FIGS. 5 to 7.

[0080] FIG. 5 is a diagram showing a first example of grouping of indoor units 300. FIG. 5 shows an example when the air conditioning system main unit 100 includes four indoor units 300. In FIG. 5, the four indoor units 300 are denoted by reference signs 300-1, 300-2, 300-3, and 300-4 to distinguish them from each other. The indoor unit 300-1 and the indoor unit 300-2 belong to group A and the indoor unit 300-3 and the indoor unit 300-4 belong to group B.

[0081] However, the number of indoor units 300 included in the air conditioning system main unit 100 may be two or more. The number of groups may also be two or more. The number of indoor units 300 belonging to one group may be one or more. The groups may be fixed or variable.

[0082] FIG. 6 is a diagram showing a first example of defrost operation patterns. FIG. 6 shows an example when indoor units 300 which are not targets for selection by the indoor unit selection unit 492 are excluded from the defrost operation.

[0083] In FIG. 6, the horizontal axis represents time and operation patterns of the groups A and B over time are shown in FIG. 6.

[0084] The indoor units 300 belonging to the group A are targets for selection by the indoor unit selection unit 492 during a period from time T11 to T12. The control device 400 performs the procedure of FIG. 4 for the indoor units 300 belonging to the group A and selects indoor units 300 which are allowed to participate in the defrost operation. On the other hand, during the period from time T11 to T12, the indoor units 300 belonging to the group B are not targets for the defrost operation. The indoor units 300 belonging to the group B perform blowing with their indoor unit side expansion valves 312 fully closed. Alternatively, the indoor units 300 belonging to

the group B may also stop blowing.

[0085] At time T12, the selection target of the indoor unit selection unit 492 is switched from the group A to the group B.

[0086] The indoor units 300 belonging to the group B are targets for selection by the indoor unit selection unit 492 during a period from time T12 to T13, similar to the indoor units 300 belonging to the group A during the period from time T11 to T12. Also, during the period from time T12 to T13, the indoor units 300 belonging to the group A are not targets for the defrost operation, similar to the indoor units 300 belonging to the group B during the period from time T11 to T12.

[0087] At time T13, the selection target of the indoor unit selection unit 492 is switched from the group B to the group A. As a result, during a period from time T13 to T14, the indoor units 300 belonging to the group A are targets for selection by the indoor unit selection unit 492 and the indoor units 300 belonging to the group B are not targets for the defrost operation, similar to the period from time T11 to T12.

[0088] In the example of FIG. 6, time zones in which the indoor units 300 are targets for selection by the indoor unit selection unit 492 and time zones in which the indoor units 300 are not targets for the defrost operation are switched on a group basis in the above manner. Since time zones that are not targets for the defrost operation are allocated to all indoor units 300, it is possible to reliably reduce the magnitude of the decrease of the room temperature as compared to when the indoor units 300 continue performing the defrost operation.

[0089] Further, since indoor units 300 which are targets for selection by the indoor unit selection unit 492 can be secured in any time zone, the air conditioning system main unit 100 can perform the defrost operation.

[0090] FIG. 7 is a diagram showing a second example of defrost operation patterns. FIG. 7 shows an example when all indoor units 300 that are not targets for selection by the indoor unit selection unit 492 are allowed to participate in the defrost operation.

[0091] In FIG. 7, the horizontal axis represents time and operation patterns of the groups A and B over time are shown in FIG. 7.

[0092] During a period from time T21 to T22, the indoor units 300 belonging to the group A are targets for selection by the indoor unit selection unit 492, similar to during the period from time T11 to T12 in FIG. 6.

[0093] On the other hand, during the period from time T21 to T22, all indoor units 300 belonging to the group B perform the defrost operation.

[0094] At time T22, the selection target of the indoor unit selection unit 492 is switched from the group A to the group B.

[0095] The indoor units 300 belonging to the group B are targets for selection by the indoor unit selection unit 492 during a period from time T22 to T23, similar to the indoor units 300 belonging to the group A during the period from time T21 to T22. During the period from time

T22 to T23, all indoor units 300 belonging to the group A perform the defrost operation, similar to the indoor units 300 belonging to the group B during the period from time T21 to T22.

[0096] At time T23, the selection target of the indoor unit selection unit 492 is switched from the group B to the group A. As a result, during a period from time T23 to T24, the indoor units 300 belonging to the group A are targets for selection by the indoor unit selection unit 492 and all indoor units 300 belonging to the group B perform the defrost operation, similar to during the period from time T21 to T22.

[0097] In the example of FIG. 7, time zones in which the indoor units 300 are targets for selection by the indoor unit selection unit 492 and time zones in which the indoor units 300 are targets for the defrost operation are switched on a group basis in the above manner. Time zones that are targets for selection by the indoor unit selection unit 492 are allocated to all indoor units 300 and an indoor unit is excluded from the targets for the defrost operation when a temperature indicated by corresponding temperature information is equal to or lower than a threshold temperature value. From this point, in the example of FIG. 7, it is possible to perform temperature adjustment reflecting the setting of the threshold temperature value. For example, a heat exchanger in an indoor space for which a high threshold temperature value has been set by the user is a target for selection by the indoor unit selection unit 492, such that the defrost operation time is shortened and the magnitude of the decrease of the room temperature can be reduced.

[0098] In addition, since indoor units 300 participating in the defrost operation can be secured in any time zone, the air conditioning system main unit 100 can reliably continue the defrost operation.

[0099] When indoor units 300 are divided into groups and indoor units 300 of a group which is not a target for selection by the indoor unit selection unit 492 are allowed to participate in the defrost operation as in the example of FIG. 7, an indoor unit 300 which is always a target for selection by the indoor unit selection unit 492 may further be provided. This point will now be described with reference to FIGS. 8 and 9.

[0100] FIG. 8 is a diagram showing a second example of grouping of indoor units 300. FIG. 8 shows an example when the air conditioning system main unit 100 includes five indoor units 300. In FIG. 8, the five indoor units 300 are denoted by reference signs 300-1, 300-2, 300-3, 300-4, and 300-5 to distinguish them from each other.

[0101] The indoor unit 300-1 and the indoor unit 300-2 belong to group A, and the indoor unit 300-3 and the indoor unit 300-4 belong to group B. Further, the indoor unit 300-5 belongs to group C.

[0102] FIG. 9 is a diagram showing a third example of defrost operation patterns. FIG. 9 shows an example when an indoor unit 300 which is always a target for selection by the indoor unit selection unit 492 is provided in addition to the operation patterns shown in FIG. 7.

[0103] The operation patterns of group A and group B in the example of FIG. 9 are similar to those of FIG. 7. On the other hand, the indoor unit 300-5 belonging to the group C is a target for selection by the indoor unit selection unit 492 in all time zones.

[0104] In the example of FIG. 9, temperature adjustment reflecting the setting of the threshold temperature value can be performed, similar to the case of FIG. 7. Further, similar to the case of FIG. 7, an indoor unit 300 participating in the defrost operation can be secured in any time zone and therefore the air conditioning system main unit 100 can reliably continue the defrost operation.

[0105] Further, in the example of FIG. 9, the indoor unit 300-5 belonging to the group C is excluded from the targets for the defrost operation in any time zone when a temperature indicated by the corresponding temperature information is equal to or lower than a threshold temperature value. For example, when a room temperature is used as the temperature information, the indoor unit 300-5 is excluded from the targets for the defrost operation if the temperature is equal to or lower than a threshold room temperature value (a threshold temperature value) set by the user, thus suppressing a decrease in the room temperature due to evaporation of the refrigerant. As a result, it is possible to expect that the room temperature of a room in which the indoor unit 300-5 is installed is maintained at a temperature close to the threshold value.

[0106] When there is a room for preferentially performing room temperature adjustment, by setting an indoor unit installed in the room such that the indoor unit is always a target for selection by the indoor unit selection unit 492, it is possible to particularly reduce the magnitude of the decrease of the room temperature from a set threshold value.

[0107] The control device 400 may control indoor units 300 through distributed processing. For example, control devices 400 may be provided respectively for the indoor units 300 and a control device 400 may determine whether to allow an indoor unit 300 provided with the control device 400 to participate in the defrost operation.

[0108] The configuration of each control device 400 may be similar to the configuration shown in FIG. 3. Then, each control device 400 can perform the procedure of FIG. 4 for an indoor unit 300 provided with the control device 400.

[0109] Specifically, the information acquisition unit 491 acquires temperature information of the indoor unit 300 in which the information acquisition unit 491 is provided. The indoor unit selection unit 492 determines whether to allow the indoor unit 300 in which the indoor unit selection unit 492 is provided to perform the defrost operation on the basis of the temperature information. The operation control unit 493 controls the indoor unit 300 in which the operation control unit 493 is provided according to the selection of the indoor unit selection unit 492. Thus, similar to when one control device 400 controls a plurality of indoor units 300, it is possible to select indoor units 300

which are allowed to participate in the defrost operation in the entire air conditioning system 1.

[0110] As described above, the information acquisition unit 491 acquires temperature information for each of the plurality of indoor units 300. The indoor unit selection unit 492 selects indoor units 300 which are allowed to perform the defrost operation on the basis of the temperature information. The operation control unit 493 allows the indoor units selected by the indoor unit selection unit 492 to perform the defrost operation.

[0111] Accordingly, in the air conditioning system 1, it is possible to more flexibly restrict release of cold air from indoor units during the defrost operation, without being limited to some predetermined indoor units. In particular, on the basis of a temperature measurement value indicated by the temperature information, the control device 400 can perform control to reduce deviation of the temperature measurement value from a set value.

[0112] Further, the operation control unit 493 fully closes indoor unit side expansion valves 312 of indoor units 300 that the indoor unit selection unit 492 has excluded from the targets for the defrost operation.

[0113] This blocks the inflow of the refrigerant into the indoor units 300 excluded from the targets for the defrost operation, such that it is possible to suppress evaporation of the refrigerant in the indoor units 300 and to suppress a decrease in the room temperature due to evaporation of the refrigerant.

[0114] Furthermore, the storage unit 480 stores a threshold temperature value set for each indoor unit 300. The indoor unit selection unit 492 selects an indoor unit 300 for which a temperature indicated by the temperature information is higher than the threshold temperature value as a target for the defrost operation.

[0115] Since the threshold temperature value can be set for each indoor unit 300, the control device 400 can perform control according to a situation such as the usage state of the room. For example, when the user sets a threshold temperature value, the control device 400 selects an indoor unit 300 which is a target for the defrost operation on the basis of the threshold temperature value, and therefore it is possible to control the indoor unit 300 according to the user's designation through setting of the threshold temperature value.

[0116] In addition, the information acquisition unit 491 acquires temperature information of the indoor unit 300. The indoor unit selection unit 492 determines whether to allow the indoor unit 300 to perform the defrost operation on the basis of the temperature information. The operation control unit 493 controls the indoor unit 300 according to the determination of the indoor unit selection unit 492.

[0117] As a result, the control device 400 can perform the process of selecting indoor units 300 which are targets for the defrost operation on the basis of the temperature information through distributed processing.

[0118] It is to be noted that a program for realizing some or all of the functions of the control unit 490 may be recorded on a computer readable recording medium and

the processing of each part may be performed by causing a computer system to read and execute the program recorded on the recording medium. The "computer system" referred to here includes an OS or hardware such as peripheral devices. When a WWW system is used, the "computer system" includes a website providing environment (or a display environment).

[0119] Further, the "computer readable recording medium" refers to a storage medium such as a flexible disk, a magneto-optical disk, a ROM, a portable medium such as a CD-ROM, or a hard disk provided in the computer system. Furthermore, the program described above may be one for realizing some of the functions described above and may also be one for realizing the functions described above in combination with a program already recorded on the computer system.

[0120] Although the embodiment of the present invention has been described in detail with reference to the drawings, the specific configuration is not limited to this embodiment and includes design changes or the like without departing from the scope of the present invention.

Claims

1. A control device comprising:

an information acquisition unit configured to acquire temperature information of an indoor unit indicating at least one of a temperature of the indoor unit and a temperature of an indoor space in which the indoor unit is installed;
an indoor unit selection unit configured to determine whether to allow the indoor unit to perform a defrost operation on the basis of the temperature information; and
an operation control unit configured to control the indoor unit according to the determination of the indoor unit selection unit.

2. A control device according to claim 1, wherein:

the information acquisition unit is configured to acquire the temperature information of each of a plurality of indoor units included in an air conditioning system main unit;
the indoor unit selection unit is configured to select an indoor unit which is allowed to perform a defrost operation on the basis of the temperature information; and
the operation control unit is configured to allow the indoor unit selected by the indoor unit selection unit to perform the defrost operation.

3. An air conditioning system comprising:

an air conditioning system main unit including a plurality of indoor units; and

the control device according to claim 2.

4. The air conditioning system according to claim 3, wherein the operation control unit is configured to fully close an expansion valve of an indoor unit that the indoor unit selection unit has excluded from targets for the defrost operation. 5
5. The air conditioning system according to claim 3 or 4, further comprising a storage unit configured to store a threshold temperature value set for each of the indoor units, wherein the indoor unit selection unit is configured to select an indoor unit for which a temperature indicated by the temperature information is higher than the threshold temperature value as a target for the defrost operation. 10 15
6. A control method comprising:
 - acquiring temperature information of an indoor unit indicating at least one of a temperature of the indoor unit and a temperature of an indoor space in which the indoor unit is installed; 20
 - determining whether to allow the indoor unit to perform a defrost operation on the basis of the temperature information; and 25
 - controlling the indoor unit according to the determination.
7. A control method according to claim 6, wherein: 30
 - the acquiring temperature information includes acquiring the temperature information of each of a plurality of indoor units included in an air conditioning system main unit; 35
 - the determining whether to allow the indoor unit includes selecting an indoor unit which is allowed to perform a defrost operation on the basis of the temperature information; and
 - the controlling the indoor unit includes allowing the indoor unit selected as an indoor unit which is allowed to perform the defrost operation, to perform the defrost operation. 40
8. A program causing a computer to: 45
 - acquire temperature information of an indoor unit indicating at least one of a temperature of the indoor unit and a temperature of an indoor space in which the indoor unit is installed; 50
 - determine whether to allow the indoor unit to perform a defrost operation on the basis of the temperature information; and
 - control the indoor unit according to the determination. 55
9. A program according to claim 8, wherein:

the acquiring temperature information includes acquiring the temperature information of each of a plurality of indoor units included in an air conditioning system main unit;
 the determining whether to allow the indoor unit includes selecting an indoor unit which is allowed to perform a defrost operation on the basis of the temperature information; and
 the controlling the indoor unit includes allowing the indoor unit, selected as an indoor unit which is allowed to perform the defrost operation, to perform the defrost operation.

FIG. 1

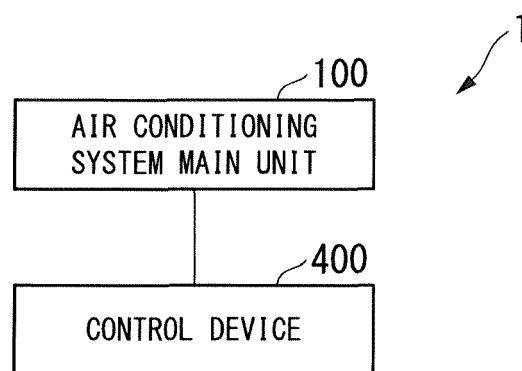


FIG. 2

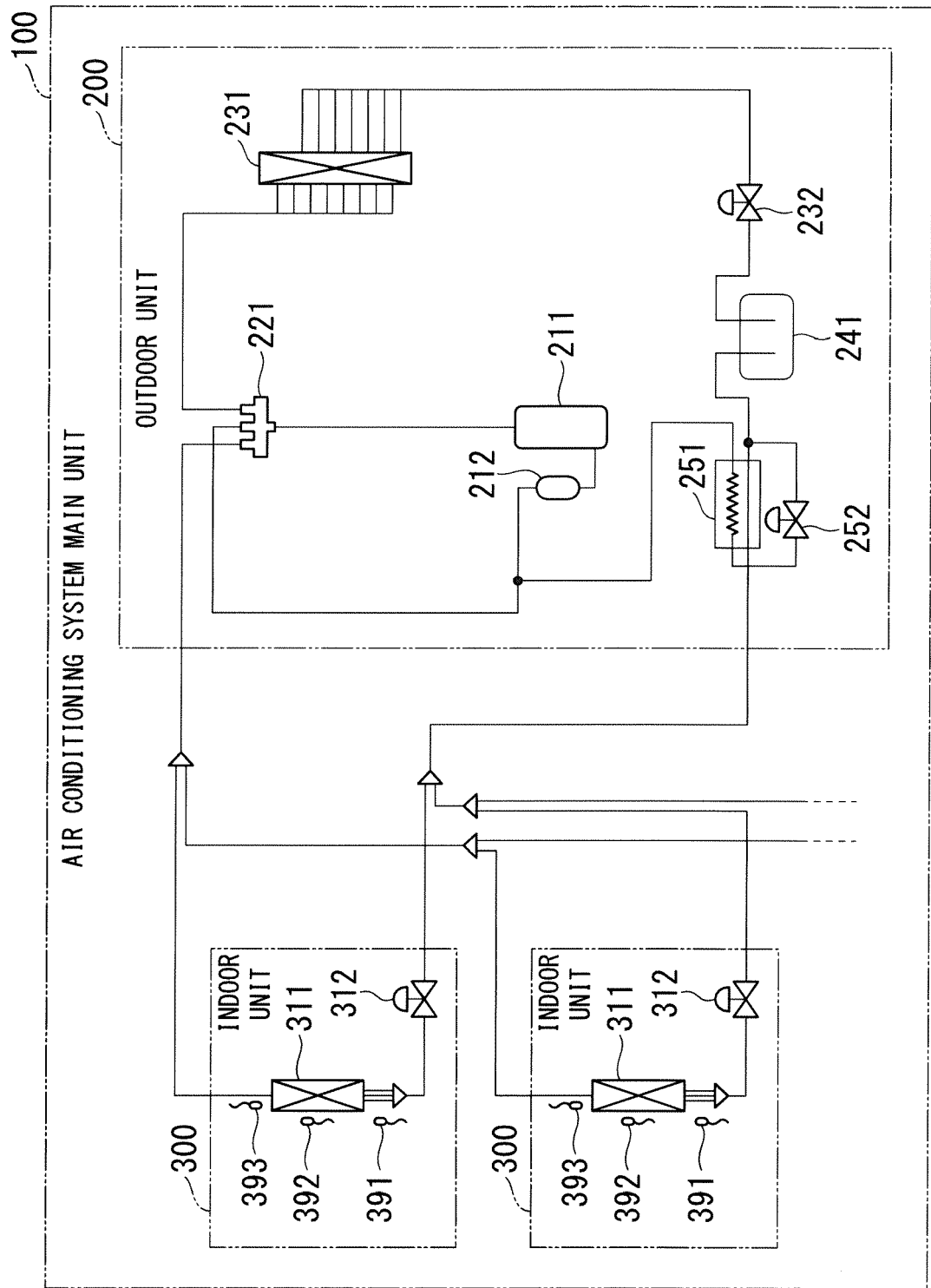


FIG. 3

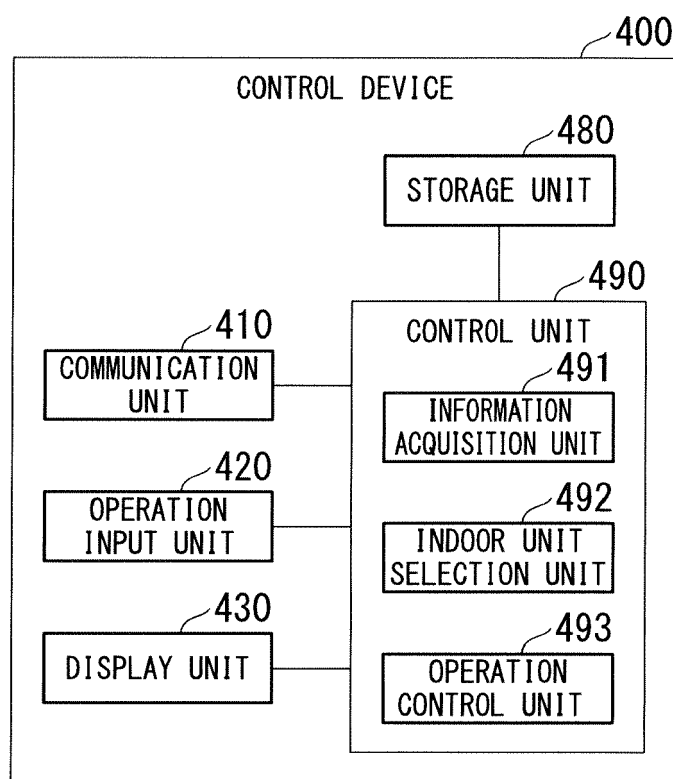


FIG. 4

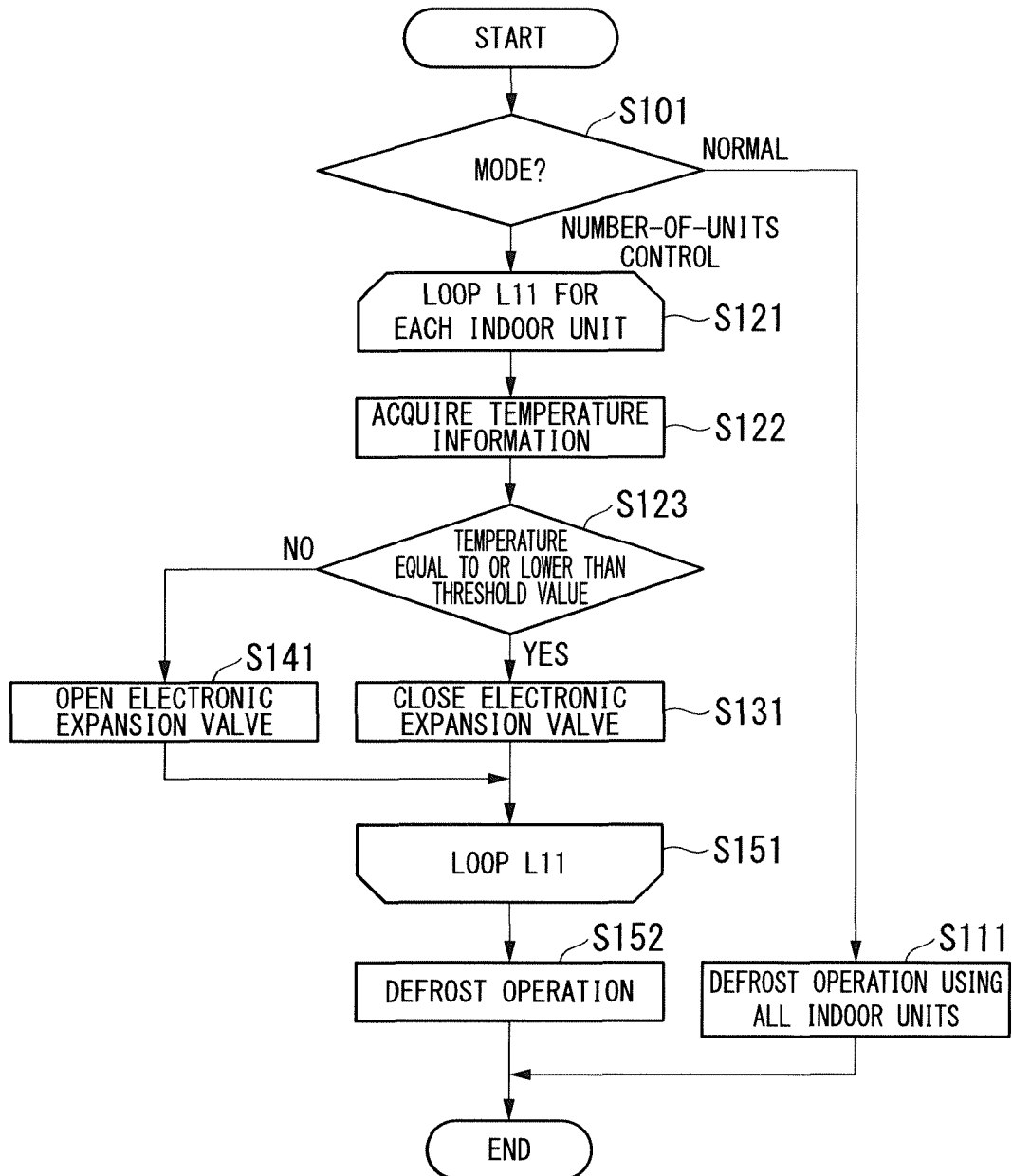


FIG. 5

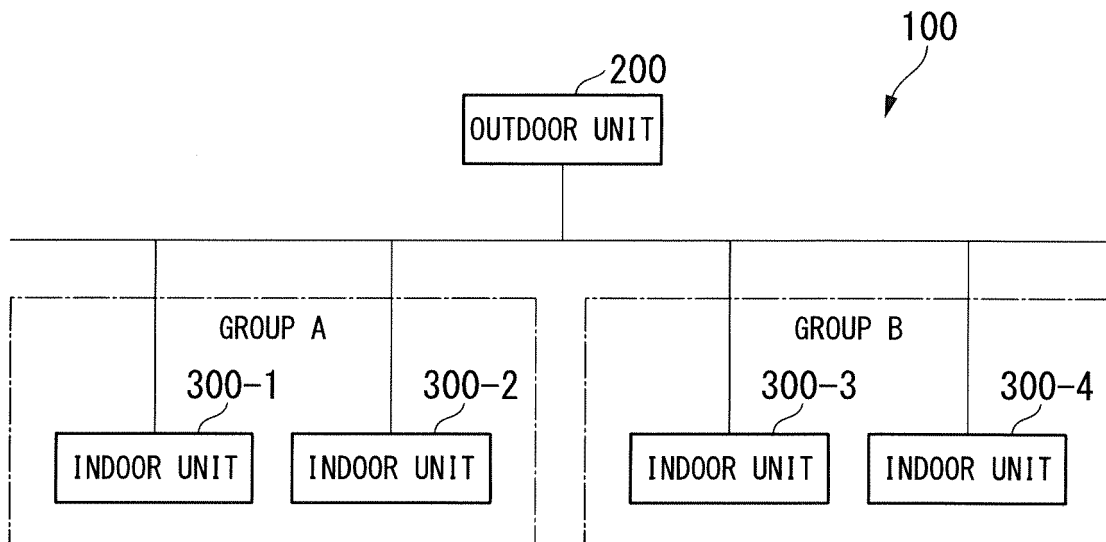


FIG. 6

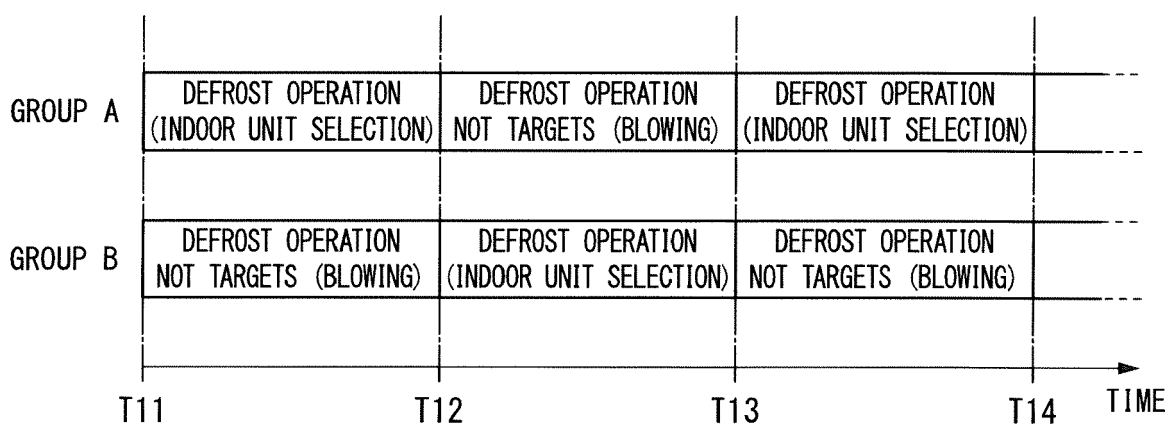


FIG. 7

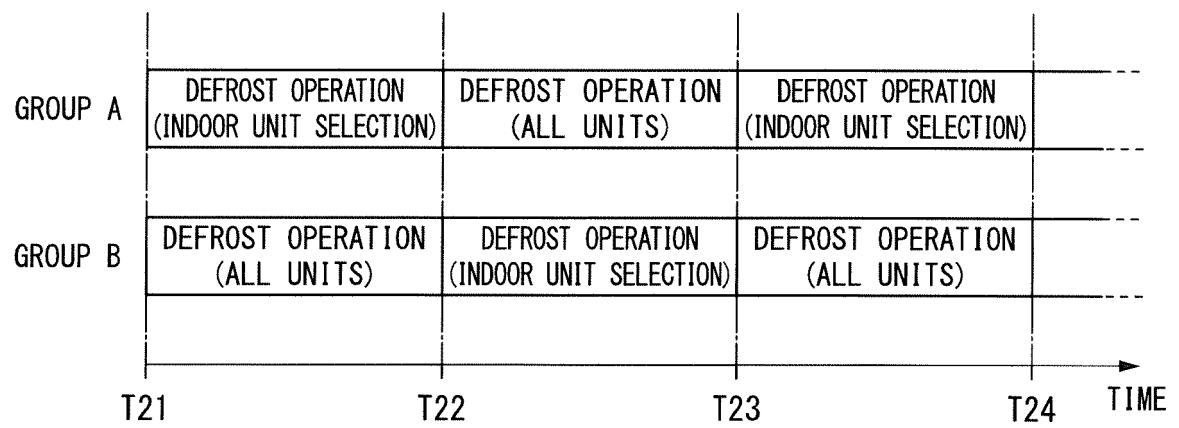


FIG. 8

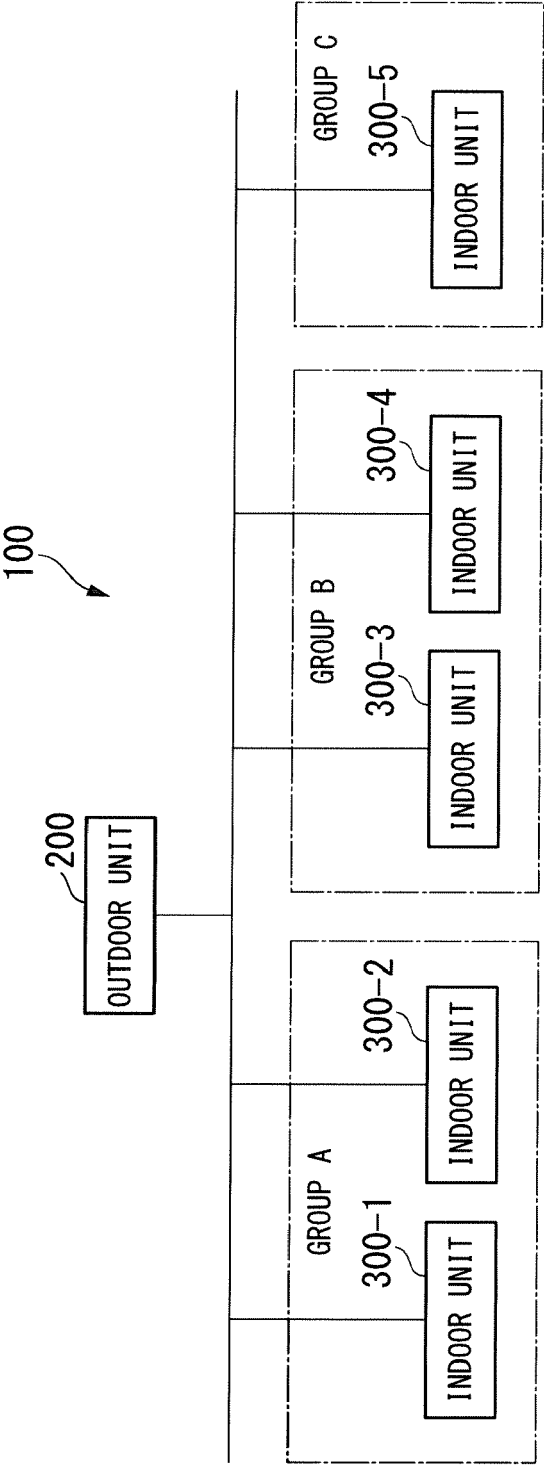
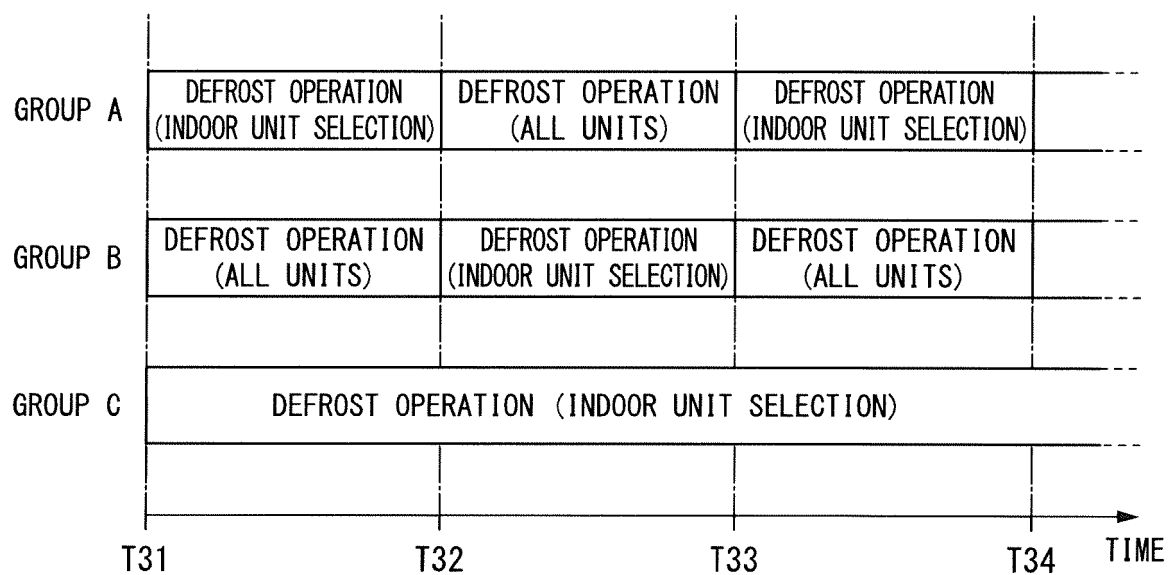


FIG. 9





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