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(54) **AIR CONDITIONING DEVICE**

(57) When defrost operation is initiated in any one of a plurality of air conditioners, the defrost initiation conditions are modified for the other air conditioners apart from the air conditioner that has initiated defrost operation.

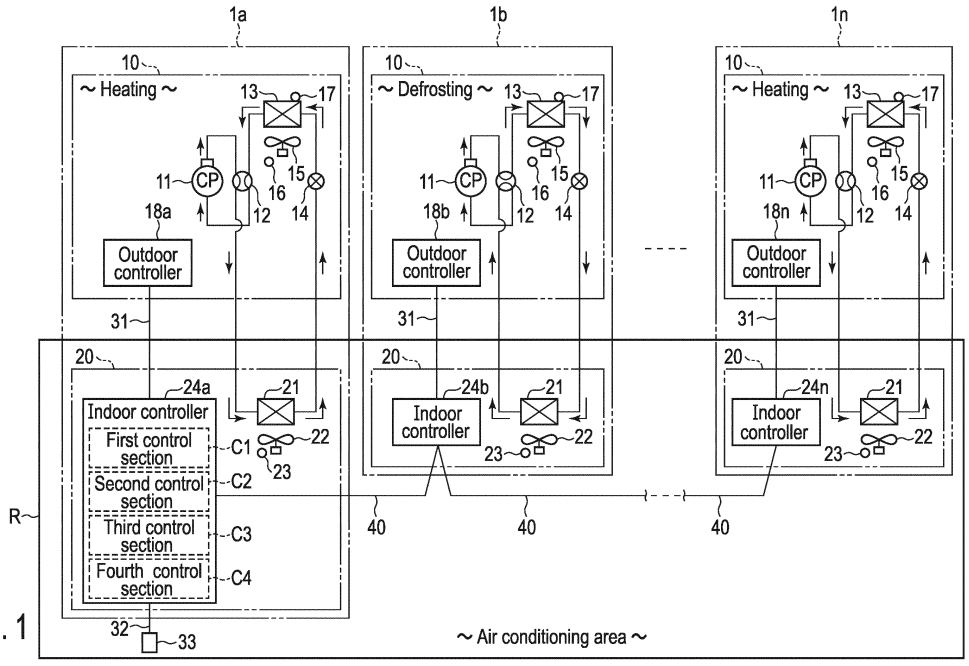

FIG. 1

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Description

Technical Field

[0001] Embodiments described herein relate generally to an air conditioning apparatus comprising air conditioners.

Background Art

[0002] In an air conditioner comprising a heat-pump-type refrigerating cycle which sequentially connects a compressor, a four-way valve, an outdoor heat exchanger, a decompression device, and an indoor heat exchanger by piping and circulates a refrigerant to draw heat from outdoor air and heat indoor air, frost gradually attaches on the surface of the outdoor heat exchanger functioning as an evaporator with progress of the heating and, when a frost dosage increases, a heat amount drawn from the outdoor air decreases and a heating capacity decreases.

[0003] As a measure, a defrosting operation of monitoring a frosting condition of the outdoor heat exchanger from temperature of the outdoor heat exchanger and the like, directly supplying a discharge refrigerant (high-temperature refrigerant) of the compressor to the outdoor heat exchanger when a frost dosage increases, and defrosting the outdoor heat exchanger with the heat of the high-temperature refrigerant is executed.

Citation List

Patent Literature

[0004] Patent Literature 1: JP 2010-121798 A

Summary of Invention

Technical Problem

[0005] In an air conditioning apparatus air-conditioning the same air conditioning area with a plurality of air conditioners, when a plurality of air conditioners simultaneously start a defrosting operation, a heating capacity becomes slightly short, the indoor temperature of the air conditioning area decreases, which may give discomfort to a resident.

[0006] The embodiments described herein aim to provide an air conditioning apparatus capable of suppressing decrease in an indoor temperature caused by defrosting as much as possible.

Solution to Problem

[0007] The air conditioning apparatus of claim 1 includes a plurality of air conditioners each including a heat-pump-type refrigerating cycle composed of a compressor, a four-way valve, an outdoor heat exchanger, a decompression device, and an indoor heat exchanger, and executing a defrosting operation for the outdoor heat exchanger when defrosting start conditions of the outdoor heat exchanger are met, and a controller, at start of defrosting of any one of the air conditioners, changing the defrosting start conditions of the air conditioners excluding the air conditioner starting defrosting.

Brief Description of Drawings

[0008]

FIG. 1 is a diagram showing a structure of an embodiment.

FIG. 2 is a flowchart showing control executed in relation to communication between a master unit and a slave unit in the embodiment.

FIG. 3 is a flowchart showing control which each of the master unit and the slave unit executes in the embodiment.

FIG. 4 is a chart showing execution of a defrosting operation of each air conditioner and a defrosting start condition according to the execution in the embodiment.

Mode for Carrying Out the Invention

[0009] One of embodiments will be described hereinafter with reference to the accompanying drawings.

[0010] As shown in FIG. 1, indoor units 20 of a plurality of air conditioners 1a, 1b, ... In configuring an air conditioning apparatus are arranged in the same air conditioning area R.

[0011] An air conditioner 1a serving as a master unit comprises a heat-pump-type refrigerating cycle formed by sequentially connecting a compressor 11, a four-way valve 12, an outdoor heat exchanger 13, a decompression device, for example, electric expansion valve 14, and an indoor heat exchanger 21 by piping.

[0012] At the cooling operation, a refrigerant discharged from the compressor 11 flows into the outdoor heat exchanger (condenser) 13 through the four-way valve 12, the refrigerant flowing out from the outdoor heat exchanger 13 flows into the indoor heat exchanger (evaporator) 21 through the electric expansion valve 14, and the refrigerant flowing out from the indoor heat exchanger 21 is sucked into the compressor 11 through the four-way valve 12.

[0013] At the heating operation, the refrigerant discharged from the compressor 11 flows into the indoor heat exchanger (condenser) 21 through the four-way valve 12, the refrigerant flowing out from the indoor heat exchanger 21 flows into the outdoor heat exchanger (evaporator) 13 through the electric expansion valve 14, and the refrigerant flowing out from the outdoor heat exchanger 13 is sucked into the compressor 11 through the four-way valve 12, as represented by arrows, by change of the flow path of the four-way valve 12. At the defrosting operation for the outdoor heat exchanger 13 in the heat-

ing operation, the same flow of the refrigerant as that at the cooling operation is formed by return of the flow path of four-way valve 12.

[0014] An outdoor fan 15 sucking outdoor air and passing the outdoor air to the outdoor heat exchanger 13 is arranged in the vicinity of the outdoor heat exchanger 13, and an outside air temperature sensor 16 detecting an outside air temperature To is arranged in a suction air path of the outdoor fan 15. An indoor fan 22 sucking the indoor air of the air conditioning area and passing the air through the indoor heat exchanger 21 is arranged in the vicinity of the indoor heat exchanger 21, and an indoor temperature sensor 23 detecting a temperature (referred to as an indoor temperature) Ta of the indoor air is arranged in a suction path of the indoor fan 22.

[0015] The compressor 11, the four-way valve 12, the outdoor heat exchanger 13, the electric expansion valve 14, the outdoor fan 15, and the outside air temperature sensor 16 are accommodated in an outdoor unit 10 together with an outdoor controller 18a, and the indoor unit 21, the indoor fan 22, and the indoor temperature sensor 23 are accommodated in the indoor unit 20 together with an indoor controller 24a. The outdoor controller 18a and the indoor controller 24a are interconnected through a serial signal line 31 synchronous with a power supply voltage, and a remote control-type operator (simply referred to as a remote controller) 33 for the operation and for operating condition setting is connected to the indoor controller 24a through a cable 32. The remote controller 33 is attached onto a wall surface of the air conditioning area or the like and can easily be controlled by the user.

[0016] The outdoor controller 18a is composed of a microcomputer and peripheral circuits thereof, controls the compressor 11, the four-way valve 12, the electric expansion valve 14, and the outdoor fan 15 in response to instructions from the indoor controller 24a, and sends data such as the detection temperature (referred to as an outside air temperature) To of the outside air temperature sensor 16 and the detection temperature (referred to as a heat exchanger temperature) Te of a heat exchange temperature sensor 17 to the indoor controller 24a by a serial signal line 31.

[0017] The indoor controller 24a is composed of a microcomputer and peripheral circuits thereof and controls the operation of the air conditioner 1a in accordance with control of the remote controller 33, the operating condition set by the remote controller 33, data transmitted from the outdoor controller 18a, and the like. In addition, the indoor controller 24a preliminarily stores defrosting start conditions for the outdoor heat exchanger 13 in an internal memory and executes a defrosting operation for the outdoor heat exchanger 13 when the defrosting start conditions are met.

[0018] The defrosting start conditions include a first defrosting start condition that a difference ΔTe (= Teo - Te) between the heat exchanger temperature Te of the outdoor heat exchanger 13 (detection temperature of the heat exchange temperature sensor 17) and a reference value Teo determined depending on the heat exchanger temperature Te of the outdoor heat exchanger 13 at the start of heating, is higher than or equal to a threshold value A, and a second defrosting start condition that the heat exchanger temperature Te of the outdoor heat exchanger 13 after passage of a certain time t2 from the start of heating is lower than a predetermined limit value Tex. The threshold value A is a value selected depending on an outside air temperature To and, for example, 6°C are selected in a case where To $\geq$ 0°C and, for example, 4°C are selected in a case where 0°C > To $\geq$ -10°C and, for example, 2°C are selected in a case where To < -10°C.

[0019] A bus line 40 for control and for data transmission is connected between the indoor controller 24a and indoor controllers 24b to 24n.

[0020] Air conditioners 1b to 1n are merely different from the air conditioner 1a with respect to a feature of including outdoor controllers 18b to 24n and the indoor controllers 24b to 24n and the basic structure thereof is the same as that of the air conditioner 1a.

[0021] The indoor controllers 24b to 24n are composed of microcomputers and peripheral circuits thereof and totally control the operations of the air conditioners in response to the data transmitted from the respective outdoor controllers 18b to 18n and the instruction from the indoor controller 24a.

[0022] In addition, the indoor controllers 24b to 24n preliminarily store defrosting start conditions for the respective outdoor heat exchangers 13 in internal memories, and execute the defrosting operation for the respective outdoor heat exchangers 13 together with the outdoor controllers 18b to 18n when the defrosting start conditions are met. The defrosting start conditions are the same as the defrosting start conditions (first defrosting start condition and second defrosting start condition) of the indoor controller 24a.

[0023] When a group control mode of controlling the air conditioners 1a, 1b, ... In as one group is set with the remote controller 33, the air conditioner 1a and the indoor controller 24a function as the master unit which is the center of the control, and the remaining air conditioners 1b to 1n and the indoor controllers 24b to 24n function as slave units following the instructions of the master unit.

[0024] The indoor controller 24a of the air conditioner 1a comprises a first control section C1, a second control section C2, a third control section C3, and a fourth control section C4 as main functions relating to the linkage of the master unit and the slave units.

[0025] The first control section C1 executes communication with the indoor controllers 24a to 24n regularly as needed through the data bus line 40. Presence or absence of the defrosting start conditions, the operation state, and the like can be mutually recognized by the master unit and the slave units by this communication.

[0026] When the defrosting start conditions for the air conditioner of any one of the air conditioners 1a to 1n have been met and the air conditioner starts the defrosting operation, the second control section C2 changes the

defrosting start conditions of the air conditioners other than the air conditioner (i.e., the air conditioner where the defrosting start conditions have been met) to the direction of being met later than usual ("later defrosting" mode).

[0027] When the air conditioner where the defrosting start conditions have been met starts defrosting and the defrosting operation is ended, after changing the direction of being met later by the second control section C2, the third control section C3 changes the defrosting start conditions of the air conditioner which are changed in the direction of being later to a direction of being met earlier than usual ("earlier defrosting" mode).

[0028] When the defrosting start conditions of the air conditioner which are changed in the direction of being met later by the second control section C2 are met and the air conditioner starts the defrosting operation, the fourth control section C4 reduces a rise capacity to restart heating of the air conditioner after the defrosting operation is ended.

[Control of Master Unit]

[0029] The control which the indoor controller 24a of the master unit executes in relation to the communication with the slave units will be described with reference to a flowchart of FIG. 2. Steps S1, S2 ... in the flowchart will be simply referred to as S1, S2 ...

[0030] When the start control of the heating operation is executed with the remote controller 33 (YES in S1), the indoor controller 24a instructs the indoor controllers 24b to 24n to start the heating operation (S2) and instructs the indoor controllers 24b to 24n of a target indoor temperature (also referred to as a setting temperature) Ts set with the remote controller 33 (S3). Then, after the heating operation is started, the indoor controller 24a monitors a "defrosting" notice (i.e., a notice that the defrosting start conditions have been met) of the indoor controller 24a and the indoor controllers 24b to 24n (S4). When the "defrosting" notice is not sent (NO in S4), the indoor controller 24a monitors an "end of defrosting" notice (i.e., a notice that the defrosting operation is ended) of the indoor controller 24a and the indoor controller 24b to 24n (S6). When the "end of defrosting" notice is not sent (NO in S6), the indoor controller 24a monitors a stop control of the remote controller 33 (S8) .

[0031] When the stop control is not made (NO in S8), the indoor controller 24a returns to S3 and repeats the same processes as those described above. When the stop control is made (YES in S8), the indoor controller 24a indicates the indoor controllers 24b to 24n to stop the heating operation (S9).

[0032] When the "defrosting" notice is sent from either of the indoor controller 24a and the indoor controllers 24b to 24n in the determination of S4 (YES in S4), the indoor controller 24a notifies all the indoor controllers 24b to 24n that are the slave units of "defrosting" (S5) and shifts to the determination in S8.

[0033] When the "end of defrosting" notice is sent from either of the indoor controller 24a and the indoor controllers 24b to 24n in the determination of S6 (YES in S6), the indoor controller 24a notifies all the indoor controllers 24b to 24n that are the slave units of the "end of defrosting" notice (S7) and shifts to the determination of S8.

[Control of Master Unit and Slave Units]

[0034] The control executed by each of the master unit and the slave units will be described with reference to a flowchart of FIG. 3. An example of the defrosting operation executed by the air conditioners 1a to 1c and an example on how the defrosting start conditions of the air conditioner 1a are varied with the execution of the defrosting operation of the air conditioners 1a to 1c are shown in FIG. 4.

[0035] When the instruction of starting the heating operation is sent (YES in S11), the indoor controller 24a and the indoor controllers 24b to 24n start the heating operation of each air conditioner (S12) and control each heating capacity (operation frequency F of each compressor 11) in accordance with a difference ΔT between the target indoor temperature Ts set with the remote controller 33 and the indoor temperature Ta detected by the indoor temperature sensor 23 (S13). After a certain time t1 (for example, 15 minutes) has elapsed since the start of the heating operation (YES in S14), the indoor controllers 24a to 24n update and store in the internal memories a value obtained by subtracting a predetermined value, for example, 2°C from the current heat exchanger temperature Te of each outdoor heat exchanger 13 as a reference value Teo (= Te - 2°C) of each defrosting start condition (S15). Then, the indoor controllers 24a to 24n monitor the "defrosting" notice (S16).

[0036] For example, when the defrosting start conditions are met in the indoor controller 24b of the slave unit, the indoor controller 24b notifies the indoor controller 24a of the master unit of "defrosting". The indoor controller 24a of the master unit which receives the "defrosting" notice notifies all the indoor controllers 24b to 24n of the slave units of "defrosting" (YES in S4, and S5).

[0037] The control executed by the indoor controller 24a representing the indoor controllers 24a to 24n which have received the "defrosting" notice will be described below.

[0038] When the "defrosting" notice is not sent (NO in S16) and the "end of defrosting" notice is not sent (NO in S18), the indoor controller 24a bypasses to shift to the determination in S20 without executing the "later defrosting" mode setting process of S17 and the "earlier defrosting" mode setting process of S19 and monitors whether the difference ΔTe (= Teo - Te)between the reference value Teo (= Te - 2°C) and the current heat exchanger temperature Te of the outdoor heat exchanger 13 as stored in S15 is more than or equal to the threshold value A or not (S20). Since the "later defrosting" mode setting process of S17 and the "earlier defrosting" mode setting

process of S19 are not executed, the setting of the "normal defrosting" mode is continued.

[0039] When the difference ΔTe is not more than or equal to the threshold value A (NO in S20; when defrosting is little), the indoor controller 24a monitors whether a certain time, for example, 40 minutes have elapsed after the start of the heating operation and whether the current heat exchanger temperature Te of the outdoor heat exchanger 13 is lower than a predetermined limit value (for example, -20°C) Tex or not (S21). When the certain time, i.e., 40 minutes have not elapsed after the start of the heating operation or when the current heat exchanger temperature Te of the outdoor heat exchanger 13 is not lower than the limit value (NO in S21), the indoor controller 24a shifts to determination of the stop instruction of S29 of a subsequent stage.

[0040] When the heating operation continues, for example, more than 40 minutes while the outside air temperature To is low to, for example, approximately -20°C, frost of the outdoor heat exchanger 13 may not be able to be removed by executing the defrosting operation and, therefore, the determination of S21 is adopted as the defrosting start condition to deal with such a low outside air temperature environment.

[0041] When the difference ΔTe is more than or equal to the threshold value A (YES in S20) or when the certain time, i.e., 40 minutes have elapsed since the start of the heating operation and the heat exchanger temperature Te is lower than the limit value Tex (YES in S21), the indoor controller 24a starts the defrosting operation of the air conditioner 1a (S22) and notifies all the indoor controllers 24b to 24n of the slave units of "defrosting" (S23) by determining that defrosting for the outdoor heat exchanger 13 is necessary. A high-temperature refrigerant discharged from the compressor 11 is directly supplied to the outdoor heat exchanger 13 through the four-way valve 12 directly, and the frost attached onto the surface of the outdoor heat exchanger 13 is removed by the heat of the high-temperature refrigerant, by the start of the defrosting operation.

[0042] After the start of the defrosting operation, the indoor controller 24a waits for the end-of-defrosting conditions determined based on, for example, the heat exchanger temperature Te of the outdoor heat exchanger 13 being met (S24).

[0043] When the end-of-defrosting conditions are met (YES in S24), the indoor controller 24a ends the defrosting operation of the air conditioner 1a and notifies all the indoor controllers 24b to 24n of the slave units of "end of defrosting" (S25). Then, since the setting of the "normal defrosting" mode that the reference value Teo and the limit value Tex are not changed continues at this time (YES in S26), the indoor controller 24a bypasses to restart the heating operation without executing a shift cancellation process of next S27 (S28). At the restart of the heating operation, since the setting of the "normal defrosting" mode continues at this time (YES in S29), the indoor controller 24a bypasses to monitor the instruction of stopping the heating operation without executing a capacity reduction process of S30 (S31). When the stop instruction is not sent (NO in S31), the indoor controller 24a returns to S16 and repeats the same processes as those described above.

[0044] When the "defrosting" notice is sent in the determination of S16 (YES in S16), the indoor controller 24a stores in the internal memory a value obtained by subtracting a predetermined value, for example, 1°C from the original reference value Teo updated and stored in S15 as a new reference value Teo (= original Teo - 1°C) and stores in the internal memory a value obtained by subtracting a predetermined value, for example, 1°C from the limit value Tex for the heat exchanger temperature Te of the outdoor heat exchanger 13 as a new limit value Tex (= original Tex - 1°C) (S17). That is, the defrosting start conditions are changed to the direction where the conditions are met later than usual. The "later defrosting" mode is set by this change.

[0045] Then, the indoor controller 24a monitors whether the difference ΔTe (= new Teo - Te) between the newly stored reference value Teo (= original Teo - 1°C) and the heat exchanger temperature Te of the outdoor heat exchanger 13 at this time is more than or equal to threshold value A (S20). When the difference ΔTe is not more than or equal to the threshold value A (NO in S20), the indoor controller 24a monitors whether the certain time, i.e., 40 minutes have elapsed since the start of the heating operation and the heat exchanger temperature Te of the outdoor heat exchanger 13 at this time is lower than the new limit value Tex (= original Tex - 1°C) stored in S17 or not (S21).

[0046] When the difference ΔTe is more than or equal to the threshold value A (YES in S20) or when the certain time of 40 minutes has elapsed since the start of the heating operation and the heat exchanger temperature Te is lower than the limit value Tex (YES in S21), i.e., when the defrosting start conditions have been met, the indoor controller 24a starts the defrosting operation of the air conditioner 1a (S22) and notifies the indoor controllers 24b to 24n of the slave units of "defrosting" (S23) even if the defrosting operation of the air conditioner 1b where the defrosting start conditions have been met earlier and which is in the defrosting operation is still continuing. After the start of the defrosting operation, the indoor controller 24a waits for the end-of-defrosting conditions being met (S24).

[0047] When the end-of-defrosting conditions are met (YES in S24), the indoor controller 24a ends the defrosting operation of the air conditioner 1a and notifies all the indoor controllers 24b to 24n of the slave units of "end of defrosting" (S25). Then, since the reference value Teo and the limit value Tex are changed at this time and the "later defrosting" mode is set (NO in S26), the indoor controller 24a cancels the change of the reference value Teo and the limit value Tex, returns to the normal defrosting mode (S27), and restarts the heating operation (S28).

[0048] At the restart of the heating operation, since the previous defrosting operation is the "later defrosting" mode (NO in S29), the indoor controller 24a suppresses an operation frequency F of the compressor 11 to approximately 80% of the normal level and reduces the rise capacity to restart heating for a predetermined time (S30).

[0049] Then, the indoor controller 24a monitors the instruction of stopping the heating operation (S31). When the stop instruction is not sent (NO in S31), the indoor controller 24a shifts to the determination of S16. When the stop instruction is sent (YES in S31), the indoor controller 24a stops the heating operation (S32).

[0050] As described above, when the defrosting start conditions are met at the air conditioner 1b and the air conditioner 1b starts the defrosting operation, the defrosting start conditions of all the air conditioners 1a and 1c to 1n other than the air conditioner 1b are changed to the direction of being met later than usual (-1°C) and, therefore, even if the air conditioner 1b starts the defrosting operation the air conditioners 1a and 1c to 1n do not start the defrosting operation simultaneously. Therefore, decrease in the indoor temperature Ta of the air conditioning area caused by the defrosting can be suppressed as much as possible, and discomfort is not provided to a resident.

[0051] Since the indoor controller of the air conditioner which has received the "defrosting" notice merely shifts the reference value Teo of the defrosting start conditions and the limit value Tex in each indoor controller, control of the indoor controllers 24a to 24n cannot be complicated.

[0052] The indoor controllers 24b to 24n of the slave units may merely notify the indoor controller 24a of the master unit of the "defrosting" notice, and a notice of identification information such as an address indicating which air conditioner is the own air conditioner is unnecessary. When receiving the "defrosting" notice from any one of the slave units, the indoor controller 24a of the master unit only transfers the notice to all the slave units, and a notice of the identification information such as the address indicating which air conditioner is the air conditioner where the defrosting start conditions are met is unnecessary.

[0053] Since the timing of starting the defrosting of the air conditioners 1a to 1n is only shifted by the change of the defrosting start conditions, the defrosting operation of any one of the air conditioners is not prohibited and, thus, inconvenience that frost on the outdoor heat exchanger 13 of each of the air conditioners remains unremoved and is in so-called a frosting state does not occur.

[0054] In contrast, when the air conditioner 1b where the defrosting start conditions have been met earlier and which has started the defrosting operation ends the defrosting operation and the "end of defrosting" notice is issued by the indoor controller 24b (YES in S18), the indoor controller 24a stores in the internal memory a value obtained by adding a predetermined value, for example, 1 degree C to the original reference value Teo updated and stored in S15 as a new reference value Teo (= original Teo + 1°C), and stores in original reference value Teo updated and stored in S15 and stores in the internal memory a value obtained by adding a predetermined value, for example, 1 degree C to the limit value Tex predetermined for the heat exchanger temperature Te of the outdoor heat exchanger 13 as a new reference value Tex (= original Tex + 1°C) (S19). That is, the defrosting start conditions are changed to the direction of being met earlier than usual. The "earlier defrosting" mode is thereby set.

[0055] Then, the indoor controller 24a monitors whether the difference ΔTe (= new Teo - Te) between the newly stored reference value Teo and the heat exchanger temperature Te of the outdoor heat exchanger 13 at this time is more than or equal to threshold value A (S20). When the difference ΔTe is not more than or equal to the threshold value A (NO in S20), the indoor controller 24a monitors whether the certain time, i.e., 40 minutes have elapsed since the start of the heating operation and the heat exchanger temperature Te of the outdoor heat exchanger 13 at this time is lower than the new limit value Tex (= original Tex + 1°C) stored in S19 or not (S21).

[0056] When the air conditioner 1b where the defrosting start conditions have been met earlier and which has started the defrosting operation ends the defrosting operation and restarts heating, the defrosting start conditions of the air conditioners 1a and 1c to 1n where the "later defrosting" mode is set may be met at the same time as the time when the defrosting start conditions of the air conditioner 1b are met again.

[0057] For this reason, when the air conditioner 1b where the defrosting start conditions have been met earlier and which has started the defrosting operation ends the defrosting operation, the defrosting start conditions of the air conditioners 1a and 1c to 1n where the "later defrosting" mode is set are changed to the direction of being met earlier than usual. Thus, the timing of meeting the defrosting start conditions of the air conditioners 1a and 1c to 1n can be shifted to the early time when the defrosting start conditions of the air conditioner 1b restarting heating are met again, by changing the "later defrosting" mode to the "earlier defrosting" mode in the air conditioners 1a and 1c to 1n. That is, the possibility that defrosting of a plurality of air conditioners may start at the same timing can be lowered.

[0058] In addition, the air conditioner 1b where the defrosting start conditions have been met earlier may still be executing the defrosting operation at the timing at which any one of the air conditioners 1a and 1c to 1n in the "later defrosting" mode starts the defrosting operation and, in this case, defrosting operations of the plurality of air conditioners may be executed at the same time. When the plurality of air conditioners end the defrosting operations and restart heating, the progress condition of frost of the outdoor heat exchangers 13 of the respective air conditioners may agree and defrosting of the plurality of

air conditioners may be started again at the same timing.

[0059] For this reason, when any one of the air conditioners 1a and 1c to 1n in the "later defrosting" mode start the defrosting operation, ends the defrosting operation, and restarts heating, the operation frequency F of the compressor 11 is suppressed to approximately 80% of the normal level and the rise capacity to restart heating is reduced. As a result, even if a plurality of air conditioners execute the defrosting operation at the same time, the progress condition of frost of the outdoor heat exchangers 13 of the respective air conditioners can be made different. That is, the possibility that defrosting of a plurality of air conditioners may start at the same timing can be lowered.

[Modified Example]

[0060] In the embodiment, the reference value Teo and the limit value Tex of the defrosting start conditions are shifted by -1°C as "later defrosting" mode, and the reference value Teo and the limit value Tex of the defrosting start conditions are shifted by +1°C as the earlier defrosting mode, but the value for shifting is not limited to -1°C, but can be approximately selected in accordance with the capacity of the outdoor heat exchanger 13, the capacity of the the heat-pump-type refrigerating cycle, and the like.

[0061] In the embodiment, the first defrosting start condition that the difference ΔTe (= Teo - Te)between the heat exchanger temperature Te and the reference value Teo is more than or equal to the threshold value A, but an outside air temperature To which the outside air temperature sensor 16 detects may be added to the first defrosting start condition.

[0062] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Reference Signs List

[0063] 1a, 1b, ... In ... air conditioner, 10 ... outdoor unit, 11 ... compressor, 13 ... outdoor heat exchanger, 18a, 18b, ... 18n ... outdoor controller, 20 ... indoor unit, 24a, 24b, ... 24n ... indoor controller, 33 ... remote controller, 40 ... bus line.

Claims

1. An air conditioning apparatus, **characterized by** comprising:

a plurality of air conditioners each comprising a heat-pump-type refrigerating cycle composed of a compressor, a four-way valve, an outdoor heat exchanger, a decompression device, and an indoor heat exchanger, and executing a defrosting operation for the outdoor heat exchanger when defrosting start conditions of the outdoor heat exchanger are met; and

a controller, at start of defrosting of any one of the air conditioners, changing the defrosting start conditions of the air conditioners excluding the air conditioner starting defrosting.

2. The air conditioning apparatus of claim 1, **characterized in that**
when the defrosting start conditions of any one of the air conditioners are met, the controller changes the defrosting start conditions of the air conditioners excluding the air conditioner starting defrosting to a state of being met later than usual.

3. The air conditioning apparatus of claim 2, **characterized in that**
when the air conditioner where the defrosting start conditions have been met starts defrosting and ends the defrosting operation, after the change of the state of being met later, the controller changes the defrosting start conditions of the air conditioner which are changed in the state of being later to a state of being earlier than usual.

4. The air conditioning apparatus of claim 2 or 3, **characterized in that**
when the defrosting start conditions of the air conditioner which are changed in the state of being met later are met and the air conditioner starts the defrosting operation, the controller reduces a rise capacity to restart heating of the air conditioner after the defrosting operation is ended.

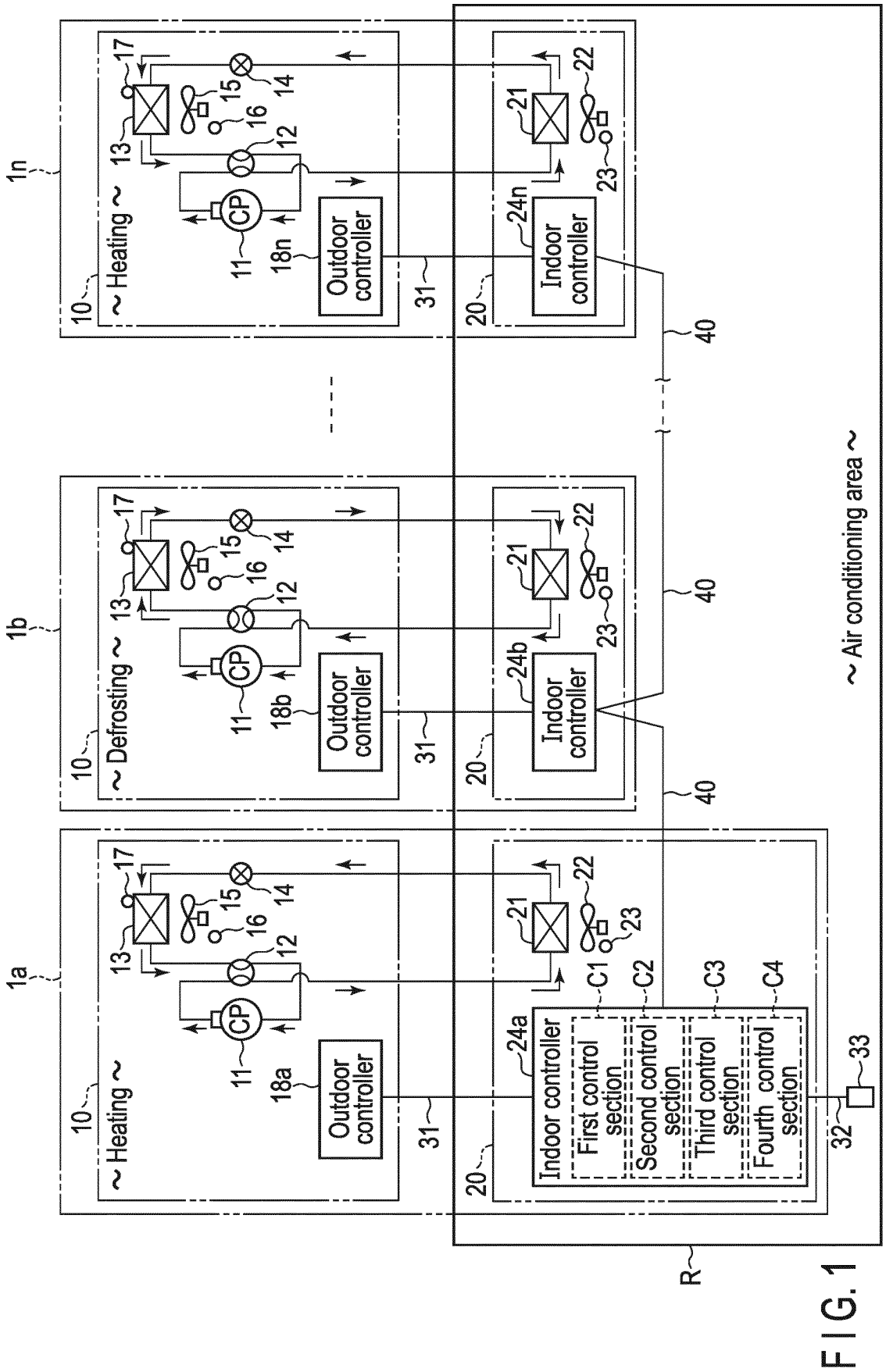
1a
1b
1n
10
~ Heating ~
~ Defrosting ~
11
12
13
14
15
16
17
18a
18b
18n
Outdoor controller
20
21
22
23
24a
24b
24n
Indoor controller
First control section
Second control section
Third control section
Fourth control section
C1
C2
C3
C4
31
32
33
40
R
~ Air conditioning area ~
CP

FIG. 1

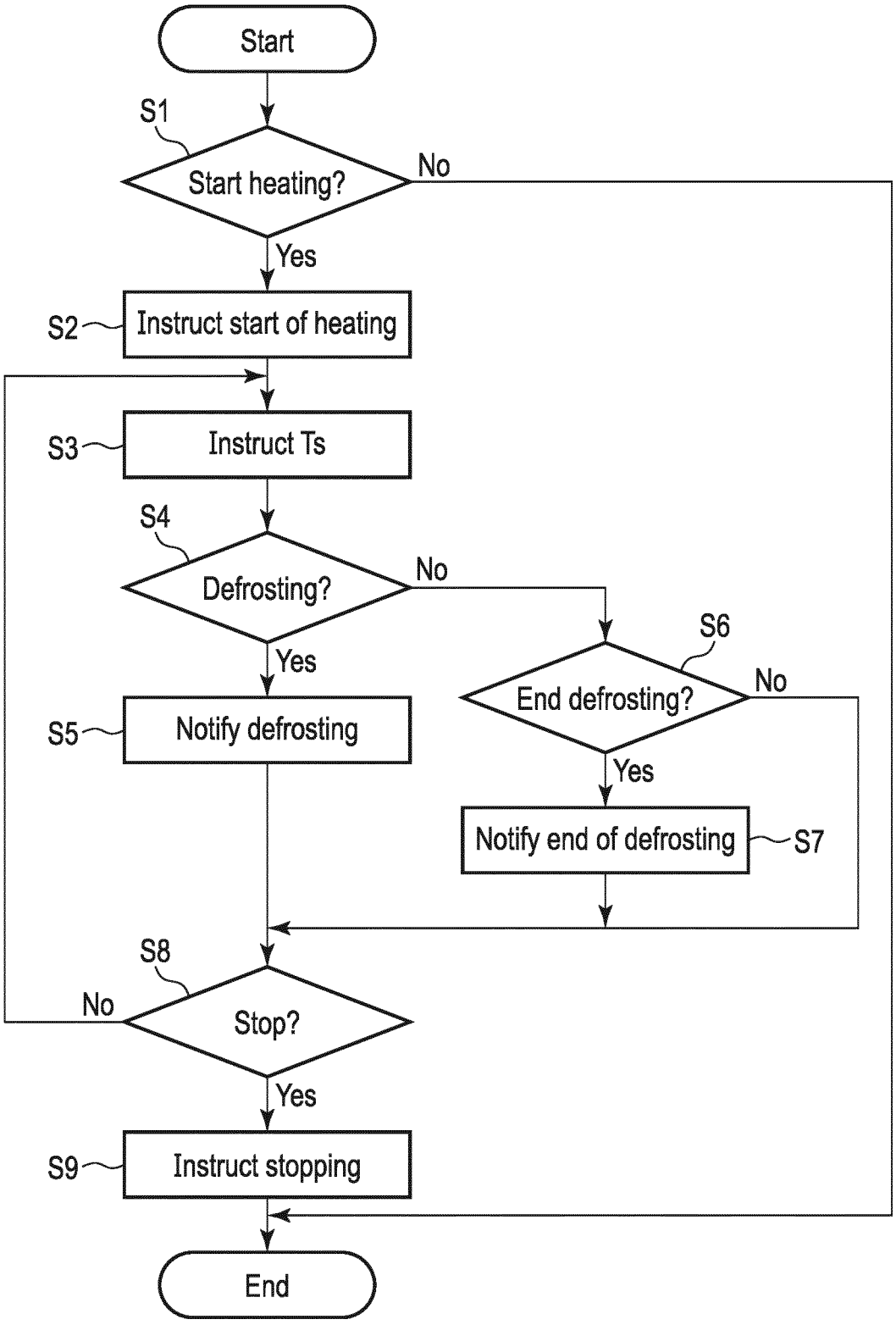
Start
S1
Start heating?
No
Yes
S2
Instruct start of heating
S3
Instruct Ts
S4
Defrosting?
No
Yes
S5
Notify defrosting
S6
End defrosting?
No
Yes
Notify end of defrosting
S7
S8
No
Stop?
Yes
S9
Instruct stopping
End

FIG. 2

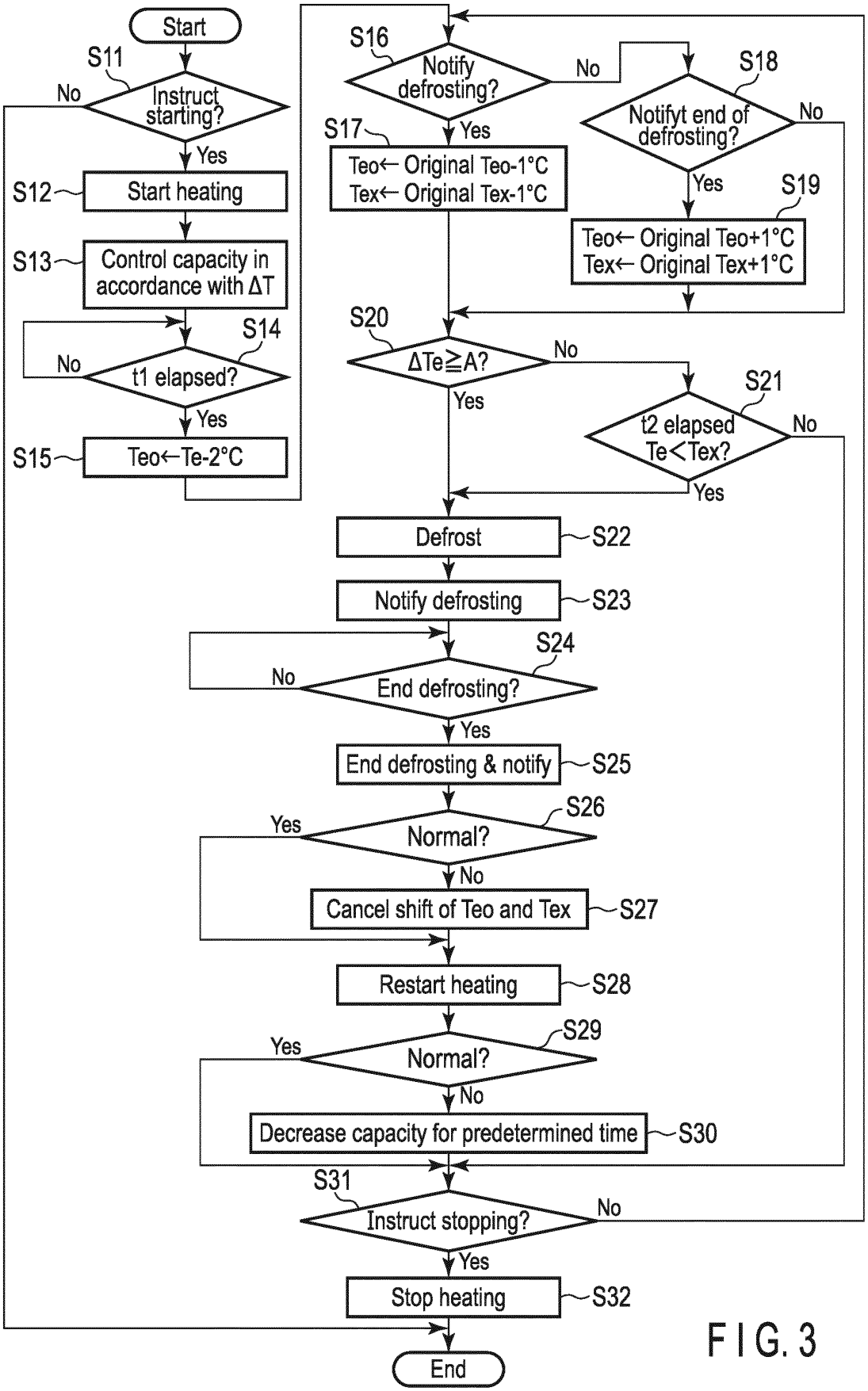
Start
S11
Instruct starting?
No
Yes
S12
Start heating
S13
Control capacity in accordance with ΔT
S14
t1 elapsed?
No
Yes
S15
Teo←Te-2°C
S16
Notify defrosting?
No
Yes
S17
Teo← Original Teo-1°C
Tex← Original Tex-1°C
S18
Notifyt end of defrosting?
No
Yes
S19
Teo← Original Teo+1°C
Tex← Original Tex+1°C
S20
ΔTe≧A?
No
Yes
S21
t2 elapsed Te<Tex?
No
Yes
Defrost
S22
Notify defrosting
S23
S24
End defrosting?
No
Yes
End defrosting & notify
S25
S26
Normal?
Yes
No
Cancel shift of Teo and Tex
S27
Restart heating
S28
S29
Normal?
Yes
No
Decrease capacity for predetermined time
S30
S31
Instruct stopping?
No
Yes
Stop heating
S32
End

FIG. 3

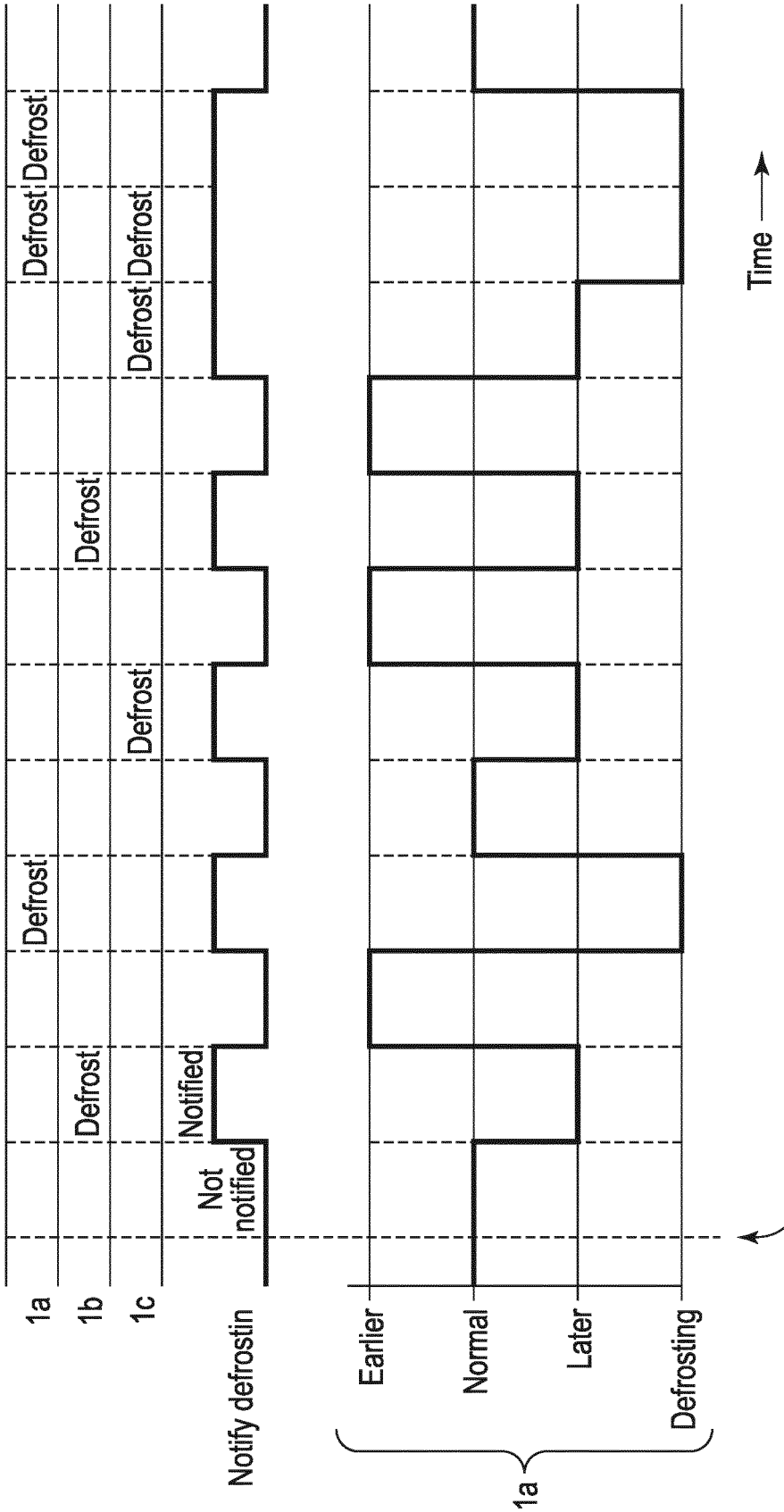
1a
1b
1c
Notify defrostin
Not notified
Notified
Defrost
Earlier
Normal
Later
Defrosting
1a
Start heating
Time

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2019/046651

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F25B47/02(2006.01)i, F24F11/41(2018.01)i, F24F11/42(2018.01)i, F24F11/46(2018.01)i, F24F11/86(2018.01)i
FI: F24F11/41 120, F24F11/41 100, F24F11/42, F24F11/46, F24F11/86, F25B47/02 570A, F25B47/02 570M

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. F25B47/02, F24F11/41, F24F11/42, F24F11/46, F24F11/86

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.
X Y	JP 2010-121798 A (MITSUBISHI ELECTRIC CORP.) 03 June 2010, paragraphs [0012]-[0051], fig. 1-4	1-2 4
Y	JP 1-107056 A (TOSHIBA CORP.) 24 April 1989, description, page 4, upper left column, line 14, to lower left column, line 11, fig. 5	4
A	JP 2002-327976 A (GAC CORP.) 15 November 2002	1-4
A	JP 2002-372282 A (GAC CORP.) 26 December 2002	1-4
A	JP 02-028056 A (TOSHIBA CORP.) 30 January 1990	1-4
A	WO 2018/042611 A1 (MITSUBISHI ELECTRIC CORP.) 08 March 2018	1-4

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

* Special categories of cited documents:
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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
31.01.2020	10.02.2020
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/JP2019/046651

Patent Documents referred to in the Report	Publication Date	Patent Family	Publication Date
JP 2010-121798 A	03.06.2010	US 2010/0125370 A1 paragraphs [0025]- [0064], fig. 1-4 EP 2187141 A2 EP 2336660 A1 CN 101737867 A CN 102705908 A	
JP 1-107056 A	24.04.1989	(Family: none)	
JP 2002-327976 A	15.11.2002	(Family: none)	
JP 2002-372282 A	26.12.2002	(Family: none)	
JP 02-028056 A	30.01.1990	(Family: none)	
WO 2018/042611 A1	08.03.2018	US 2019/0203994 A1 GB 2568404 A	

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 2010121798 A **[0004]**