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(54) **AIR-CONDITIONING SYSTEM**

(57) An air conditioning system (1) is provided with a display portion (21) which informs a user of operational states of air conditioners (10). The display portion (21) is configured to show, during a rotation operation, a rotation sign (S1) indicating that the rotation operation is being performed. This configuration allows for avoiding causing the user to worry about the air conditioner unnecessarily when the air conditioner is deactivated during the rotation operation.

FIG.7A

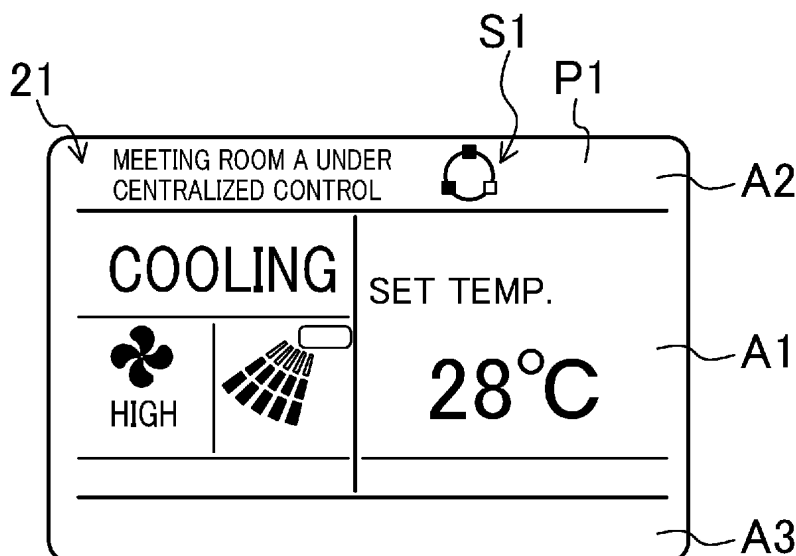
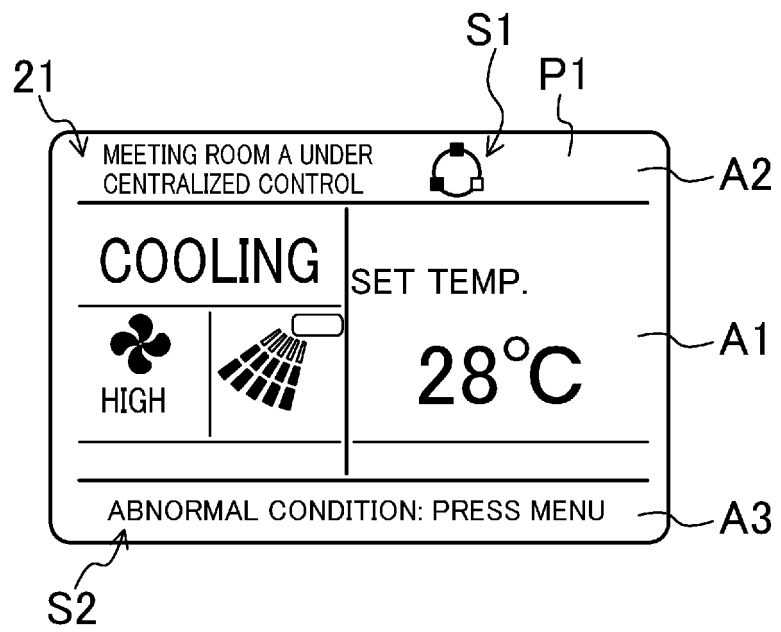


FIG.7B



Description

TECHNICAL FIELD

[0001] The present invention relates to an air conditioning system, particularly to an air conditioning system which performs a rotation operation in which at least one, but not all, of a plurality of air conditioners is deactivated sequentially.

BACKGROUND ART

[0002] An air conditioning system performing a rotation operation has been known as an example of an air conditioning system which conditions the air in a room or any other spaces.

[0003] For example, an air conditioner system disclosed by Patent Document 1 includes three air conditioners and a central controller for controlling these air conditioners. The air conditioning system performs a rotation operation in which at least one, but not all, of the plurality of air conditioners is deactivated sequentially. Specifically, for example, this air conditioning system repeats sequentially an operation in which a first air conditioner is deactivated and the rest of the air conditioners are activated, an operation in which a second air conditioner is deactivated and the rest of the air conditioners are activated, and an operation in which a third air conditioner is deactivated and the rest of the air conditioners are activated. As a result, cumulative operation time of each of the air conditioners is shortened, thereby increasing life of each of the air conditioners as compared with the case where all the air conditioners are operated continuously.

CITATION LIST

PATENT DOCUMENT

[0004] [Patent Document 1] Japanese Unexamined Patent Publication No. 2006-275458

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0005] During the rotation operation, at least one, but not all, of the air conditioners is deactivated sequentially as described above. Thus, each of the air conditioners located in a room is deactivated intermittently and repeatedly. If a user or any other person does not know that the rotation operation is being performed, he or she may misrecognize that the air conditioner has stopped due to some abnormal condition or any other causes. This may lead to a problem of causing the user or any other person to worry about the air conditioner unnecessarily.

[0006] In view of the foregoing, it is therefore an object of the present invention to avoid causing the user to worry

about the air conditioner unnecessarily when the air conditioner is deactivated during the rotation operation.

SOLUTION TO THE PROBLEM

[0007] A first aspect of the present disclosure is directed to an air conditioning system including a plurality of air conditioners (10) each having an indoor unit (12) and an outdoor unit (11), the air conditioning system performing a rotation operation in which at least one, but not all, of the plurality of air conditioners (10) is deactivated sequentially. The air conditioning system includes a display portion (21) which informs a user of an operational state of each of the air conditioners (10), and the display portion (21) is configured to show, during the rotation operation, a rotation sign (S1) indicating that the rotation operation is being performed.

[0008] According to the first aspect of the present disclosure, when the rotation operation is performed, at least one, but not all, of the plurality of air conditioners (10) is deactivated sequentially such that the active air conditioner (10) changes sequentially. According to the present invention, when the rotation operation is performed, the display portion (21) shows a sign (S1) indicating that the rotation operation is being performed. Thus, even if at least one, but not all, of the air conditioners (10) is deactivated, a user is able to tell immediately that the air conditioner is deactivated due to the rotation operation.

[0009] A second aspect of the present disclosure is an embodiment of the first aspect of the present disclosure. In the second aspect, the display portion (21) is configured to show, if an abnormal condition occurs in the air conditioner (10), an abnormal condition sign (S2) indicating that the abnormal condition has occurred in the air conditioner (10).

[0010] According to the second aspect of the present disclosure, the display portion (21) shows the abnormal condition sign (S2) if an abnormal condition occurs in the air conditioner (10). Thus, a user or any other person is able to tell immediately that the abnormal condition has occurred in the air conditioner (10).

[0011] A third aspect of the present disclosure is an embodiment of the second aspect of the present disclosure. In the third aspect, if the air conditioner (10) stops due to an abnormal condition during the rotation operation, a backup operation is performed to activate at least one or all of the deactivated air conditioners (10), and the display portion (21) is configured to keep the rotation sign (S1) shown even after the rotation operation is switched to the backup operation so as to show both of the rotation and abnormal condition signs (S1) and (S2).

[0012] According to the third aspect of the present disclosure, a backup operation is performed if at least one, but not all, of the air conditioners (10) stops due to an abnormal condition during the rotation operation. In the backup operation, at least one of the air conditioners (10) which have been inactive during the rotation operation

is activated. This allows for avoiding in advance a decrease in air conditioning capability of the air conditioning system due to the abnormal stop of the air conditioner (10).

[0013] During the backup operation, the display portion (21) shows the abnormal condition sign (S2). If the abnormal condition sign (S2) is not shown during the backup operation, a user cannot recognize whether the air conditioner (10) has stopped due to the rotation operation or some abnormal condition. According to the present invention, on the other hand, the display portion (21) shows the abnormal condition sign (S2) during the backup operation. Thus, the user is able to tell immediately that the air conditioner (10) has stopped due to some abnormal condition.

[0014] Further, during the backup operation, the display portion (21) shows both of the abnormal condition and rotation signs (S2) and (S1). On the other hand, for example, if at least one, but not all, of the air conditioners (10) stops due to the abnormal condition during a normal operation (an operation in which all the air conditioners (10) are instructed to be active), the rotation sign (S1) is not shown, and only the abnormal condition sign (S2) appears. Thus, a user or any other person is able to recognize immediately whether the air conditioner (10) has stopped due to the abnormal condition during the rotation operation or the normal operation.

[0015] The normal operation is performed under the conditions where an indoor air conditioning load is higher than that during the rotation operation. Thus, if the air conditioner (10) stops due to an abnormal condition during the normal operation, the entire air conditioning capability of the air conditioning system tends to be insufficient relative to the indoor air conditioning load. For this reason, during the normal operation, the air conditioner (10) that has stopped due to the abnormal condition needs to be recovered quickly. On the other hand, according to the present invention, the abnormal stop of the air conditioner (10) during the normal operation is immediately recognizable as described above. This allows for quick recovery of the air conditioner (10) even during the normal operation.

[0016] A fourth aspect of the present disclosure is an embodiment of the second or third aspect of the present disclosure. In the fourth aspect, if an abnormal condition occurs in the deactivated air conditioner (10) during the rotation operation, the display portion (21) keeps the rotation sign (S1) shown so as to show both of the rotation and abnormal condition signs (S1) and (S2).

[0017] According to the fourth aspect of the present disclosure, if an abnormal condition occurs in the deactivated air conditioner (10) during the rotation operation, the display portion (21) shows the abnormal condition sign (S2). Thus, a user is able to tell immediately that some abnormal condition has occurred in the air conditioner (10) during the rotation operation. At this time, the display portion (21) shows both of the abnormal condition and rotation signs (S2) and (S1). On the other hand, for

example, if at least one, but not all, of the air conditioners (10) stops due to an abnormal condition during a normal operation (an operation in which all the air conditioners (10) are instructed to be active), for example, the rotation sign (S1) is not shown, and only the abnormal condition sign (S2) appears. Thus, a user or any other person is able to recognize immediately whether the abnormal condition has occurred in the air conditioner (10) during the rotation operation or the normal operation.

ADVANTAGES OF THE INVENTION

[0018] According to the first aspect of the present disclosure, the rotation sign (S1) allows a user to tell immediately that the rotation operation is being performed. As a result, when the air conditioners (10) are deactivated sequentially during the rotation operation, the user would not misrecognize that the air conditioner (10) has stopped due to an abnormal condition. This allows for avoiding causing the user to worry about the air conditioner unnecessarily.

[0019] According to the second aspect of the present disclosure, an abnormal condition that has occurred in the air conditioner (10) is immediately recognizable, thereby allowing for quick recovery of the air conditioner (10).

[0020] According to the third aspect of the present disclosure, when the rotation operation is switched to the backup operation, a user is able to tell immediately that the air conditioner (10) has stopped due to an abnormal condition.

[0021] Further, a user is able to recognize with reliability whether the air conditioner (10) has stopped due to an abnormal condition during the rotation operation or the normal operation. Thus, if the air conditioner (10) stops due to the abnormal condition during the normal operation, the stopped air conditioner (10) is quickly recoverable, which allows for handling the air conditioning load with reliability. In addition, a user or any other person is allowed to take measures suitable for each of the operations so as to cope with the abnormal stop of the air conditioner (10).

[0022] According to the fourth aspect of the present disclosure, an abnormal condition that has occurred in the deactivated air conditioner (10) during the rotation operation is immediately recognizable. Further, a user is able to recognize with reliability whether the abnormal condition has occurred in the air conditioner (10) during the rotation operation or the normal operation. Thus, if the air conditioner (10) stops due to the abnormal condition during the normal operation, the stopped air conditioner (10) is quickly recoverable, which allows for handling the air conditioning load with reliability. As a result, a user or any other person is able to take measures suitable for each of the operations so as to cope with the abnormal condition that has occurred in the air conditioner (10).

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

[FIG. 1] FIG. 1 is a schematic view illustrating a general configuration for an air conditioning system.

[FIG. 2] FIG. 2 is a refrigerant circuit diagram illustrating a general configuration for an air conditioner.

[FIG. 3] FIG. 3 is a front view of a remote controller.

[FIG. 4] FIG. 4 is a flowchart illustrating a rotation operation of the air conditioning system.

[FIG. 5] FIG. 5 is a timing chart illustrating the rotation operation of the air conditioning system.

[FIG. 6] FIGS. 6(A) and 6(B) are front views of a display portion of the remote controller, wherein FIG. 6(A) illustrates a home screen which appears when an abnormal condition has occurred in the air conditioner in a normal operation, and FIG. 6(B) illustrates an abnormal condition information screen which appears when an abnormal condition has occurred in the air conditioner.

[FIG. 7] FIGS. 7(A) and 7(B) are front views of the display portion of the remote controller, wherein FIG. 7(A) illustrates a home screen which appears during a rotation operation, and FIG. 7(B) illustrates a home screen which appears when an abnormal condition has occurred in the air conditioner during the rotation operation.

[FIG. 8] FIG. 8 is a flowchart illustrating an operation performed when an abnormal condition has occurred in the air conditioner during a normal operation.

[FIG. 9] FIG. 9 is a flowchart illustrating an operation performed when an abnormal condition has occurred in the active air conditioner during the rotation operation.

[FIG. 10] FIG. 10 is a flowchart illustrating an operation performed when an abnormal condition has occurred in the deactivated air conditioner during the rotation operation.

DESCRIPTION OF EMBODIMENTS

[0024] Embodiments will be described in detail below with reference to the drawings. In the drawings, like reference characters designate identical or corresponding components in drawings, and description of components designated by like reference characters may not be repeated.

[0025] FIG. 1 illustrates an exemplary configuration for an air conditioning system (1) according to the embodiment. The air conditioning system (1) includes a plurality of air conditioners (10) for conditioning the air in a room, and a remote controller (20). In this example, the plurality of air conditioners (10) include first to third air conditioners (10a-10c), and are arranged in the same room. The air conditioning system (1) performs a rotation operation in which at least one, but not all, of the first to third air con-

ditioners (10a-10c) is deactivated sequentially. The rotation operation will be described in detail later.

<Air Conditioner>

[0026] FIG. 2 illustrates an exemplary configuration for each of the air conditioners (10). The air conditioner (10) includes an outdoor unit (11) and an indoor unit (12). The outdoor and indoor units (11) and (12) are connected together through a liquid communication pipe (13) and a gas communication pipe (14). In the air conditioner (10), the outdoor and indoor units (11) and (12), the liquid communication pipe (13) and the gas communication pipe (14) form a refrigerant circuit (30).

«Refrigerant Circuit»

[0027] The refrigerant circuit (30) is a closed circuit filled with a refrigerant, and includes a compressor (31), a four-way switching valve (32), an outdoor heat exchanger (33), an expansion valve (34) and an indoor heat exchanger (35). The outdoor unit (11) includes the compressor (31), the four-way switching valve (32), the outdoor heat exchanger (33) and the expansion valve (34), and the indoor unit (12) includes an indoor heat exchanger (35). Further, the outdoor unit (11) includes an outdoor fan (36) and an outdoor controller (41), and the indoor unit (12) includes an indoor fan (37), an indoor controller (42) and an indoor temperature sensor (50).

[0028] In the refrigerant circuit (30), the compressor (31) has a discharge end connected to a first port of the four-way switching valve (32), and a suction end connected to a second port of the four-way switching valve (32). Further, in the refrigerant circuit (30), the outdoor heat exchanger (33), the expansion valve (34) and the indoor heat exchanger (35) are arranged in this order from a third port to a fourth port of the four-way switching valve (32). The outdoor fan (36) is arranged near the outdoor heat exchanger (33), and the indoor fan (37) is arranged near the indoor heat exchanger (35).

[0029] The compressor (31) is configured to compress and discharge the refrigerant, and have its capacity variable. For example, the compressor (31) is a hermetic scroll or rotary compressor.

[0030] The four-way switching valve (32) is switchable between a first state (indicated by the solid curves in FIG. 1) where the first port communicates with the third port and the second port communicates with the fourth port, and a second state (indicated by the broken curves in FIG. 1) where the first port communicates with the fourth port and the second port communicates with the third port.

[0031] The outdoor fan (36) supplies outdoor air to the outdoor heat exchanger (33). The outdoor heat exchanger (33) allows the outdoor air transported by the outdoor fan (36) to exchange heat with the refrigerant. For example, the outdoor heat exchanger (33) is configured as a cross-fin type fin-and-tube heat exchanger.

[0032] The expansion valve (34) is configured to adjust the pressure of the refrigerant, and have its degree of opening adjustable. For example, the expansion valve (34) is configured as an electronic expansion valve.

[0033] The indoor fan (37) supplies indoor air to the indoor heat exchanger (35). The indoor heat exchanger (35) allows the indoor air transported by the indoor fan (37) to exchange heat with the refrigerant. For example, the indoor heat exchanger (35) is configured as a cross-fin type fin-and-tube heat exchanger.

«Indoor Temperature Sensor»

[0034] The indoor temperature sensor (50) is arranged in the indoor unit (12) upstream of the indoor heat exchanger (35) (upstream in the flow direction of the air), and is configured to detect the temperature of the air sucked into the indoor unit (12). Thus, the temperature detected by the indoor temperature sensor (50) is substantially equal to an indoor air temperature. The indoor air temperature detected by the indoor temperature sensor (50) is sent to the indoor controller (42).

«Outdoor and Indoor Controllers»

[0035] Each of the outdoor and indoor controllers (41) and (42) includes a CPU, a memory and any other suitable elements, and the controllers are electrically connected to each other through wires to communicate with each other. Further, the outdoor and indoor controllers (41) and (42) are also connected electrically to, and communicate with, a control portion (23) of the remote controller (20) through wires. The outdoor controller (41) controls the operation of the compressor (31), the four-way switching valve (32), the expansion valve (34) and the outdoor fan (36) provided in the outdoor unit (11). The indoor controller (42) controls the operation of the indoor fan (37) provided in the indoor unit (12). In this way, the operation of the refrigerant circuit (30), the outdoor fan (36) and the indoor fan (37) is controlled to control the operation of the air conditioner (10).

[0036] The memory (not shown) of the indoor controller (42) stores a target temperature which is set previously relative to the indoor air temperature.

<Remote Controller>

[0037] A configuration for the remote controller (20) will be described with reference to FIGS. 1, 3, 6 and 7. The remote controller (20) includes a display portion (21), an operating portion (22) and a control portion (23).

[0038] As illustrated in FIG. 3, the display portion (21) is arranged in an upper half portion of a front surface of the remote controller (20). The display portion (21) is constituted of a liquid crystal display. Various types of buttons (22a-22f) serving as the operating portion (22) are arranged in a lower half portion of the front surface of the remote controller (20). Specifically, the remote controller

(20) has a doughnut-shaped cursor button (22a) arranged at a center portion in its width direction, and a menu/confirm button (22b) arranged inside the cursor button (22a). In addition, an operate/stop button (22c), a cancel button (22d), an air volume/air direction button (22e) and a switch operation button (22f) are arranged around the cursor button (22a).

[0039] The control portion (23) is constituted of a CPU, a memory and any other suitable elements, and is electrically connected to the first to third air conditioners (10a-10c) through electric wires. The control portion (23) controls the operational state of each of the first to third air conditioners (10a-10c) in response to an action given to the operating portion (22). The memory (not shown) of the control portion (23) stores the order of operation and operating time of the air conditioners (10) during the rotation operation.

[0040] The display portion (21) shows switchably a home screen (P1) and a menu screen (not shown) which appears when the menu/confirm button (22b) is pressed with the home screen (P1) shown on the display portion (21). The home screen (P1) includes a center region (A1) located at its center portion in the vertical direction, an upper region (A2) located above the center region (A1), and a lower region (A3) located below the center region (A1). The center region (A1) shows an operation mode, an air volume, an air direction, a set temperature and any other suitable information. The upper region (A2) shows an area being air-conditioned. The upper region (A2) also shows a rotation sign (S1) (see FIGS. 7(A) and 7(B)) indicating that the rotation operation which will be described in detail later is being performed. The upper region (A2) of the home screen (P1) does not show anything but the rotation sign (S1) in a portion thereof where the rotation sign (S1) will be shown. That is, the display portion (21) ensures a region dedicated to the rotation sign (S1). The lower region (A3) shows an abnormal condition sign (S2) indicating that an abnormal condition has occurred in the air conditioner (10) (see FIGS. 6(A) and 7(B)).

[0041] The display portion (21) shows an abnormal condition information screen (P2) (see FIG. 6(B)) when the menu/confirm button (22b) is pressed with the abnormal condition sign (S2) being shown on the home screen (P1). The abnormal condition information screen (P2) shows an abnormal condition code for identifying a cause of the abnormal condition in the air conditioner (10), a contact address of a dealer or a maintenance agency, and model names of the indoor and outdoor units for identifying the indoor and outdoor units in which an abnormal condition has occurred.

[0042] When the menu/confirm button (22b) is pressed and held with the home screen (P1) being shown, the display portion (21) shows a rotation operation setting screen (not shown) for changing the settings of the rotation operation. That is, when the menu/confirm button (22b) is pressed for a relatively short time period T_s with the home screen (P1) being shown, the home screen

(P1) is switched to the menu screen (not shown). On the other hand, when the menu/confirm button (22b) is pressed for a time period T1 longer than Ts with the home screen (P1) being shown, the home screen (P1) is switched to the rotation operation setting screen (not shown). On the rotation operation setting screen, a user is allowed to change settings to permit or prohibit the execution of the rotation operation, and/or setting times during the rotation operation (T0, T1 and T2 described in detail later). Specifically, when a user or a maintenance person presses the menu/confirm button (22b) continuously for a time period not shorter than T1, a screen which allows for switching various settings of the rotation operation appears.

[0043] If an abnormal condition occurs in at least one, but not all, of the air conditioners (10) during a normal operation in which all the air conditioners (10) are active, the display portion (21) shows the abnormal condition sign (S2) on the home screen (P1), but does not show the rotation sign (S1).

[0044] When the rotation operation is performed, the display portion (21) shows the rotation sign (S1) on the home screen (P1). If an abnormal condition occurs in the air conditioner (10) during the rotation operation, the display portion (21) keeps showing the rotation sign (S1) so as to show both of the rotation and abnormal condition signs (S1) and (S2). Details of the signs (S1, S2) shown by the display portion (21) will be described in detail later.

<Operation Mechanism of Air Conditioner>

[0045] A fundamental operation mechanism of each of the air conditioners (10) will be described below. The air conditioner (10) conditions the air in the room such that the indoor air temperature detected by the indoor temperature sensor (50) approaches a previously set target temperature. Specifically, the air conditioner (10) performs cooling and heating operations.

«Cooling Operation»

[0046] During the cooling operation, the outdoor and indoor controllers (41) and (42) set the four-way switching valve (32) to the first state (indicated by the solid curves in FIG. 1), and drives the compressor (31), the outdoor fan (36) and the indoor fan (37). Thus, in the refrigerant circuit (30), the outdoor heat exchanger (33) functions as a condenser and the indoor heat exchanger (35) functions as an evaporator. Specifically, a high-pressure refrigerant compressed by the compressor (31) flows into the outdoor heat exchanger (33) and dissipates heat to the outdoor air in the outdoor heat exchanger (33) to condense. The refrigerant condensed in the outdoor heat exchanger (33) has its pressure reduced by the expansion valve (34), flows into the indoor heat exchanger (35), and then absorbs heat from the indoor air in the indoor heat exchanger (35) to evaporate. Thus, the indoor air is cooled. The refrigerant evaporated in the indoor heat

exchanger (35) is sucked into, and recompressed in, the compressor (31).

«Heating Operation»

[0047] During the heating operation, the outdoor and indoor controllers (41) and (42) set the four-way switching valve (32) to the second state (indicated by broken curves in FIG. 1), and drives the compressor (31), the outdoor fan (36) and the indoor fan (37). Thus, in the refrigerant circuit (30), the indoor heat exchanger (35) functions as a condenser and the outdoor heat exchanger (33) functions as an evaporator. Specifically, a high-pressure refrigerant compressed by the compressor (31) flows into the indoor heat exchanger (35) and dissipates heat to the indoor air in the indoor heat exchanger (35) to condense. Thus, the indoor air is heated. The refrigerant condensed in the indoor heat exchanger (35) has its pressure reduced by the expansion valve (34), flows into the outdoor heat exchanger (33), and then absorbs heat from the indoor air in the outdoor heat exchanger (33) to evaporate. The refrigerant evaporated in the outdoor heat exchanger (33) is sucked into, and recompressed in, the compressor (31).

<Inactive/Active Air Conditioners>

[0048] In this air conditioning system (1), each of the air conditioners (10) is either inactive or active. Specifically, the memory (not shown) of the indoor controller (42) of the air conditioner (10) stores a deactivation bit value representing whether the air conditioner (10) is inactive or not. The deactivation bit value is "1" when the air conditioner (10) is inactive, or is "0" when the air conditioner (10) is not inactive (i.e., when the air conditioner (10) is active).

[0049] In the inactive air conditioner (10), the outdoor and indoor controllers (41) and (42) stop the operation of the compressor (31), the outdoor fan (36) and the indoor fan (37). On the other hand, in the active air conditioner (10), basically, the outdoor and indoor controllers (41) and (42) operate the compressor (31), the outdoor fan (36) and the indoor fan (37). However, even in the active air conditioner (10), the compressor (31) and the fans (36, 37) may be stopped if the indoor air temperature reaches a target temperature range (a so-called "thermo-off" operation may be performed).

[0050] Further, in this example, the control portion (23) of the remote controller (20) sets the air conditioner (10) to be either inactive or active.

[0051] Specifically, the control portion (23) sends a deactivation command (e.g., an instruction code including the deactivation bit value of "1") to the air conditioner (10) selected as the one to be deactivated among the plurality of air conditioners (10). In the air conditioner (10) to which the deactivation command is sent, the CPU (not shown) of the indoor controller (42) sets the deactivation bit value stored in the memory (not shown) of the indoor controller

(42) to be "1" upon receiving the deactivation command from the control portion (23). In this way, the air conditioner (10) is selected as the one to be deactivated.

[0052] Further, the control portion (23) sends a reset deactivation command (e.g., an instruction code including the deactivation bit value of "0") to the air conditioner (10) selected as the one to be activated among the plurality of air conditioners (10). In the air conditioner (10) to which the reset deactivation command is sent, the CPU of the indoor controller (42) sets the deactivation bit value stored in the memory of the indoor controller (42) to be "0" upon receiving the reset deactivation command from the control portion (23). In this way, the air conditioner (10) is selected as the one to be activated.

<Rotation Operation>

[0053] The rotation operation will be described with reference to FIG. 4. If a rotation start action (an action to instruct the start of the rotation operation) is given to the operating portion (22) of the remote controller (20), the air conditioning system (1) performs the following processing (an initial operation, a partial deactivation operation and a transition operation).

[0054] In this example, the memory (not shown) of the control portion (23) of the remote controller (20) stores information about the order of operation of the air conditioners (10) during the rotation operation (such as the number of the air conditioners to be deactivated and the order of selection of the air conditioners to be deactivated). The memory of the control portion (23) also stores information about operation time during the rotation operation (such as an initial operation time period T0, a partial deactivation time period T1 and a transition operation time period T2). For example, the initial operation time period T0 and the transition operation time period T2 are set to be 0.5 hours, and the partial deactivation time period T1 is set as appropriate in the range of 2.5 to 95.5 hours.

[0055] First, an initial operation is performed in Step ST11. During the initial operation, the indoor air is conditioned by the predetermined number of air conditioners (10) of the plurality of air conditioners (10). Note that the number of the active air conditioners (10) during the initial operation is larger than the number of the active air conditioners (10) during the partial deactivation operation. Specifically, the control portion (23) selects the air conditioner (10) to be activated among the plurality of air conditioners (10) based on the predetermined operation order. The air conditioner (10) selected as the one to be activated performs the cooling and heating operations (these operations will be hereinafter collectively referred to as an "air conditioning operation").

[0056] Then, in Step ST12, the control portion (23) determines whether the predetermined initial operation time period T0 has passed from the start of the initial operation. Specifically, the control portion (23) starts to measure time elapsed after the air conditioner (10) to be acti-

vated is selected in Step ST11 so as to determine whether the initial operation time period T0 has passed or not. If the initial operation time period T0 has passed, the process proceeds to Step ST13.

[0057] Then, in Step ST13, the partial deactivation operation is performed. During the partial deactivation operation, at least one (but not all) predetermined air conditioner (10) among the plurality of air conditioners (10) is deactivated, while the rest of the air conditioners (10) condition the indoor air. Specifically, the control portion (23) selects the air conditioner (10) to be deactivated from the active air conditioners (10) among the plurality of air conditioners (10) based on the predetermined operation order. The air conditioner (10) selected as the one to be deactivated stops the air conditioning operation.

[0058] Then, in Step ST14, the control portion (23) determines whether the predetermined partial deactivation time period T1 has passed from the start of the partial deactivation operation. Specifically, the control portion (23) starts to measure time elapsed after the air conditioner (10) to be deactivated is selected in Step ST13 so as to determine whether the partial deactivation time period T1 has passed or not. If the partial deactivation time period T1 has passed, the process proceeds to Step ST15.

[0059] In Step ST15, the transition operation is performed. During the transition operation, the air conditioner (10) which will be deactivated next among the plurality of air conditioners (10) continues the air conditioning operation, while at least one or all of the inactive air conditioners (10) resume the air conditioning operation. Specifically, the control portion (23) selects the air conditioner (10) as the one to be activated from the inactive air conditioners (10) among the plurality of air conditioners (10) based on the predetermined operation order. The air conditioner (10) selected as the one to be activated resumes the air conditioning operation.

[0060] Then, in Step ST16, the control portion (23) determines whether the predetermined transition operation time period T2 has passed from the start of the transition operation. Specifically, the control portion (23) starts to measure time elapsed after the air conditioner (10) to be activated is selected in Step (ST15) so as to determine whether the transition operation time period T2 has passed or not. If the transition operation time period T2 has passed, the process proceeds to Step ST13.

[0061] By repeating the above-described processing, at least one, but not all, of the plurality of air conditioners (10) is deactivated sequentially. Further, if a rotation finish action (an action to instruct the end of the rotation operation) is given to the operating portion (22) of the remote controller (20), the control portion (23) of the remote controller (20) selects all the plurality of air conditioners (10) as those to be activated, and finishes the processing for the rotation operation. Thus, the rotation operation is finished.

<Specific Examples of Rotation Operation>

[0062] Referring to FIG. 5, the rotation operation will be described more specifically below. In this example, one of the first to third air conditioners (10a-10c) is selected as the one to be deactivated during the partial deactivation operation so that the first to third air conditioners (10a-10c) are deactivated one by one sequentially from the first air conditioner (10a). Further, during the initial operation, all the first to third air conditioners (10a-10c) are selected as those to be activated.

[0063] At time t0, a rotation start action is given to the operating portion (22) of the remote controller (20) to activate all the first to third air conditioners (10a-10c). For example, the control portion (23) of the remote controller (20) sends the reset deactivation command to all the first to third air conditioners (10a-10c). Thus, the three air conditioners (10a-10c) condition the indoor air during the initial operation.

[0064] Then, at time t1 after the lapse of the initial operation time period T0, the first air conditioner (10a) is selected as the one to be deactivated from the active first to third air conditioners (10a-10c). For example, the control portion (23) sends the deactivation command to the first air conditioner (10a). Thus, during the first partial deactivation operation, the two air conditioners (10b, 10c) other than the first air conditioner (10a) condition the indoor air.

[0065] Then, at time t2 after the lapse of the partial deactivation time period T1, the first air conditioner (10a) being inactive is selected as the one to be activated. For example, the control portion (23) sends the reset deactivation command to the first air conditioner (10a). Thus, during the first transition operation, the second air conditioner (10b) which will be deactivated next continues the air conditioning operation, and the first inactive air conditioner (10a) resumes the air conditioning operation. The third air conditioner (10c) also continues the air conditioning operation. Thus, the three air conditioners (10a-10c) condition the indoor air.

[0066] Then, at time t3 after the lapse of the transition operation time period T2, the second air conditioner (10b) is selected as the one to be deactivated from the first to third active air conditioners (10a-10c). Thus, during the second partial deactivation operation, the two air conditioners (10a, 10c) other than the second air conditioner (10b) condition the indoor air.

[0067] Then, at time t4 after the lapse of the partial deactivation time period T1, the second air conditioner (10b) being inactive is selected as the one to be activated. Thus, during the second transition operation, the third air conditioner (10c) which will be deactivated next continues the air conditioning operation, and the second inactive air conditioner (10b) resumes the air conditioning operation. The first air conditioner (10a) also continues the air conditioning operation. Thus, the three air conditioners (10a-10c) condition the indoor air.

[0068] Then, at time (t5) after the lapse of the transition

operation time period T2, the third air conditioner (10c) is selected as the one to be deactivated from the first to third active air conditioners (10a-10c). Thus, during the third partial deactivation operation, the two air conditioners (10a, 10b) other than the third air conditioner (10c) condition the indoor air.

[0069] Then, at time t6 after the lapse of the partial deactivation time period T1, the third air conditioner (10c) being inactive is selected as the one to be activated. Thus, during the third transition operation, the first air conditioner (10a) which will be deactivated next continues the air conditioning operation, and the third inactive air conditioner (10c) resumes the air conditioning operation. The second air conditioner (10b) also continues the air conditioning operation. Thus, the three air conditioners (10a-10c) condition the indoor air.

[0070] Then, at time t7 after the lapse of the transition operation time period T2, the first air conditioner (10a) is selected again as the one to be deactivated from the first to third active air conditioners (10a-10c). Thus, during the fourth partial deactivation operation, the two air conditioners (10b, 10c) other than the first air conditioner (10a) condition the indoor air.

[0071] As can be seen in the foregoing, at least one, but not all, of the plurality of air conditioners (10) is deactivated sequentially to level the operation times of the plurality of air conditioners (10). Further, a decrease in air conditioning capability of the air conditioning system (1) during the beginning of the rotation operation is reducible by performing the initial operation during the beginning of the rotation operation. Further, by performing the transition operation between the partial deactivation operations during the rotation operation, the active air conditioner (10) which will be deactivated next is switched to be inactive after the inactive air conditioner (10) is switched to be active. This allows for reducing a decrease in air conditioning capability of the air conditioning system (1) due to the switching of the air conditioner (10) from the inactive state to the active state.

<Operation Performed If an Abnormal Condition Occurs in the Air Conditioner during the Normal Operation>

[0072] The air conditioning system (1) is configured to be able to perform a normal operation in which all the air conditioners (10) are activated. The normal operation is selected, for example, when an indoor air conditioning load is very high.

[0073] During the normal operation, the deactivation bit values of all the air conditioners (10) are "0," and thus all the air conditioners (10) are not selected as inactive ones. Thus, all the air conditioners (10) perform the normal or heating operation. How the air conditioner system operates if an abnormal condition occurs in one of the air conditioners (10) during the normal operation will be described below with reference to the flowchart of FIG. 8.

[0074] If an abnormal condition occurs in one of the air conditioners (10) during the normal operation (Step

ST21), the process proceeds to Step ST22. Note that the abnormal condition in the air conditioner (10) may be, for example, a state where the high pressure of the refrigerant circuit (30) has exceeded a predetermined value. In Step ST22, the indoor and outdoor controllers (42) and (41) stop the air conditioner (10) in which the abnormal condition has occurred. Then, in Step ST23, the display portion (21) shows the abnormal condition sign (S2) in the lower region (A3) on the home screen (P1) (see FIG. 6(A)). At this time, the display portion (21) does not show the rotation sign (S1) in the upper region (A2) on the home screen (P1). Note that Steps ST22 and ST23 may be performed simultaneously or in a reverse order.

[0075] Then, in Step ST24, if the abnormal condition in the air conditioner (10) is resolved, the process proceeds to Step ST25. In Step ST25, as illustrated in FIG. 3, the abnormal condition sign (S2) on the display portion (21) disappears, and thus is not shown. Then, when the process proceeds to Step ST26, the air conditioner (10) in which the abnormal condition has been resolved is activated, and thus the normal operation is resumed.

[0076] If the air conditioner (10) stops due to an abnormal condition during the normal operation as described above, the display portion (21) does not show the rotation sign (S1), but shows the abnormal condition sign (S2) only as illustrated in FIG. 6(A). This allows a user or any other person to recognize immediately that the air conditioner (10) has stopped due to the abnormal condition during the normal operation. If the user or any other person presses the menu/confirm button (22b) in the state shown in FIG. 6(A), the abnormal condition information screen (P2) shown in FIG. 6(B) appears. The abnormal condition in the air conditioner (10) is immediately resolvable by the user or any other person by checking the abnormal condition information screen (P2).

<Operation Performed if an Abnormal Condition Occurs in the Air Conditioner during the Rotation Operation>

[0077] How the air conditioning system operates if an abnormal condition occurs in the air conditioner (10) during the above-described rotation operation will be described in detail below.

«Operation Performed if an Abnormal Condition Occurs in the Active Air Conditioner»

[0078] First, how the air conditioning system operates if an abnormal condition occurs in the active air conditioner (10) (i.e., the deactivation bit value is "0") during the rotation operation will be described below with reference to the flowchart of FIG. 8.

[0079] When the rotation operation is performed, the display portion (21) first shows the rotation sign (S1) in the upper region (A2) on the home screen (P1) in Step ST31. Then, if an abnormal condition occurs in the active air conditioner (10) in Step ST32, the process proceeds to Step ST33. In Step ST33, the indoor and outdoor con-

trollers (42) and (41) stop the operation of the air conditioner (10) in which the abnormal condition has occurred.

[0080] A backup operation is performed after Step ST33. Specifically, in Step ST34, the indoor and outdoor controllers (42) and (41) operate the air conditioner (10) being inactive during the rotation operation (i.e., the deactivation bit value is "1"). More specifically, in the example shown in FIG. 5, if the second air conditioner (10b) stops due to the abnormal condition during the partial deactivation operation for a period t1-t2, for example, the deactivation bit value of the pausing first air conditioner (10a) is set to be "0" so as to activate the first and third air conditioners (10a) and (10c). Thus, if the air conditioner (10) stops due to the abnormal condition, the other inactive air conditioner (10) is activated during the backup operation. This allows for handling the indoor air conditioning load with reliability.

[0081] During the backup operation, the display portion (21) shows the abnormal condition sign (S2) in Step ST35. During the rotation operation before the backup operation, the rotation sign (S1) is shown as illustrated in FIG. 7(A). The display portion (21) keeps the rotation sign (S1) shown even after the rotation operation is switched to the backup operation so as to show both of the rotation and abnormal condition signs (S1) and (S2) (see FIG. 7(B)). Note that Steps ST34 and ST35 may be performed simultaneously or in a reverse order.

[0082] Then, if the abnormal condition in the air conditioner (10) has been resolved in Step ST36, the process proceeds to Step ST37. In Step ST37, as illustrated in FIG. 7(A), the abnormal condition sign (S2) on the display portion (21) disappears, and thus is not shown. Then, the rotation operation is resumed when the process proceeds to Step ST38.

<<Operation Performed if an Abnormal Condition Occurs in the Inactive Air Conditioner>

[0083] Now, how the air conditioning system operates if an abnormal condition occurs in the inactive air conditioner (10) (i.e., the deactivation bit value is "1") during the rotation operation will be described with reference to the flowchart of FIG. 10.

[0084] When the rotation operation is performed, the display portion (21) first shows the rotation sign (S1) in the upper region (A2) on the home screen (P1) in Step ST41. Then, if an abnormal condition occurs in the inactive air conditioner (10) in Step ST42, the process proceeds to Step ST43.

[0085] When the process proceeds to Step ST43, a continuous operation is performed to allow the rest of the air conditioners (10) to be continuously active. Specifically, in Step ST43, the deactivation bit values of the air conditioners (10) other than the air conditioner (10) stopped due to an abnormal condition remain "0." Thus, these air conditioners (10) are not deactivated. In this way, the air conditioners (10) other than the air conditioner (10) stopped due to the abnormal condition are

continuously active during the continuous operation, which allows for handling the indoor air conditioning load with reliability. The continuous operation is performed continuously until the abnormal condition in the air conditioner (10) is resolved.

[0086] During the continuous operation, the display portion (21) shows the abnormal condition sign (S2) in Step ST44. During the rotation operation before the continuous operation, the rotation sign (S1) is shown as illustrated in FIG. 7(A). The display portion (21) keeps the rotation sign (S1) shown even after the rotation operation is switched to the continuous operation so as to show both of the rotation and abnormal condition signs (S1) and (S2) (see FIG. 7(B)). Note that Steps ST43 and ST44 may be performed simultaneously or in a reverse order.

[0087] Then, if the abnormal condition in the air conditioner (10) is resolved in Step ST45, the process proceeds to Step ST46. In Step ST46, the abnormal condition sign (S2) on the display portion (21) disappears, and thus is not shown as illustrated in FIG. 7(A). Then, the rotation operation is resumed when the process proceeds to Step ST47.

[0088] As can be seen in the foregoing, if an abnormal condition occurs in the air conditioner (10) during the rotation operation, the display portion (21) keeps the rotation sign (S1) shown so as to show both of the rotation and abnormal condition signs (S1) and (S2) as illustrated in FIG. 7(B). This allows a user or any other person to recognize immediately that the abnormal condition has occurred in the air conditioner (10) during the rotation operation. If the user or any other person presses the menu/confirm button (22b) in the state shown in FIG. 7(B), the abnormal condition information screen (P2) shown in FIG. 6(B) appears. The abnormal condition in the air conditioner (10) is immediately resolvable by the user by checking the abnormal condition information screen (P2).

-Advantages of Embodiments-

[0089] In the above-described embodiments, when the rotation operation is performed, the display portion (21) shows the rotation sign (S1) as shown in FIG. 7(A). If the rotation sign (S1) is not shown and each of the air conditioners (10) is deactivated intermittently due to the rotation operation, a user may possibly misrecognize that the air conditioner (10) has stopped due to some abnormal condition. However, with the rotation sign (S1) shown as illustrated in FIG. 7(A), such misrecognition by the user is avoidable. This allows for avoiding causing the user to worry about the air conditioners unnecessarily.

[0090] In the above-described embodiments, the display portion (21) shows the abnormal condition sign (S2) together with the rotation sign (S1) if an abnormal condition occurs in the air conditioner (10) during the rotation operation. If this abnormal condition sign (S2) is not shown, the user cannot recognize whether the air conditioner (10) has stopped due to the rotation operation or

some abnormal condition. On the other hand, since the display portion (21) shows the abnormal condition sign (S2) as shown in FIG. 7(B), the user is able to tell immediately that the air conditioner (10) has stopped due to some abnormal condition.

[0091] According to the above-described embodiments, if an abnormal condition occurs in the air conditioner (10) during the normal operation, the display portion (21) does not show the rotation sign (S1) but shows the abnormal condition sign (S2) only. On the other hand, if an abnormal condition occurs in the air conditioner (10) during the rotation operation, the display portion (21) shows both of the rotation and abnormal condition signs (S1) and (S2). This allows the user to recognize immediately during which types of operation the abnormal condition has occurred in the air conditioner (10).

[0092] If one or some of the air conditioners (10) which are all active during the above-described normal operation stops due to an abnormal condition, the air conditioning capability tends to be insufficient relative to the indoor air conditioning load. Thus, a user or any other person needs to recognize immediately that one or some of the air conditioners (10) has stopped due to the abnormal condition during the normal operation. In the present embodiment, a user or any other person is able to recognize immediately the abnormal condition that has occurred in the air conditioner (10) during the normal operation, which needs to be handled with a high degree of urgency. Thus, the air conditioners (10) are quickly recoverable, which allows for resolving the insufficient air conditioning capability of the air conditioning system (1) immediately.

[0093] As can be seen in the foregoing, according to the present embodiment, an abnormal condition that has occurred during two different operations (normal and rotation operations) having different degrees of urgency is recognizable with reliability. Thus, a user or any other person is able to take suitable measures immediately to resolve the abnormal condition occurred in each of the operations.

«Other Embodiments»

[0094] In the embodiments described above, the rotation sign (S1) shown on the display portion (21) is constituted of a figure. However, the rotation sign (S1) shown on the display portion (21) is not limited to the figure, and may be constituted of a letter, a number, a symbol, or any other types of sign as long as it indicates that the rotation operation is being performed. Further, the abnormal condition sign (S2) shown on the display portion (21) is constituted of letters, but it may be a number, a symbol, a figure or any other types of sign as long as it indicates that an abnormal condition has occurred in the air conditioner (10).

[0095] In the embodiments described above, the display portion (21) is provided in the remote controller (20). However, the display portion (21) may be provided in, for

example, a decorative panel or any other parts of the indoor unit (12) of each of the air conditioners (10).

[0096] The numbers of the inactive and active air conditioners during the rotation operation according to the above-described embodiments are merely examples. For example, if the number of the air conditioners (10) is five, the rotation operation may be performed such that three of them are active and two of them are inactive. Also in this case, the above-described backup operation may be performed. That is, if one of the three operating air conditioners stops due to an abnormal condition, the backup operation may be performed such that one of the two inactive air conditioners is activated, or all the two inactive air conditioners are activated.

[0097] In the embodiments described above, the description has been made on an example in which the control portion (23) of the remote controller (20) sends the deactivation command and the reset deactivation command to each of the plurality of air conditioners (10). However, the air conditioning system may be configured such that the deactivation command is circulated through the plurality of air conditioners (10). That is, the air conditioning system may be configured such that each of the plurality of air conditioners (10) sets the other air conditioners (10) to be inactive or active. For example, the air conditioning system may be configured such that the air conditioner (10) is set to be inactive upon receiving the deactivation command, switches itself from the inactive state to the active state after the lapse of the partial deactivation time period T1 from when it was set to be inactive, and then sends the deactivation command to the air conditioner (10) which is previously determined as a destination of the deactivation command after the lapse of the transition operation time period T2. Also in this configuration, the control portion (23) of the remote controller (20) sends the deactivation command to any one of the plurality of air conditioners (10) to start the rotation operation. That is, the control portion (23) of the remote controller (20) allows for deactivating at least one, but not all, of the plurality of air conditioners (10) sequentially.

[0098] In the embodiments described above, the description has been made on an example in which each of the air conditioners (10) has a single outdoor unit (11) and a single indoor unit (12). However, each of the air conditioners (10) may have a single outdoor unit (11) and two or more indoor units (12).

[0099] The embodiments described above are merely illustrative ones in nature, and do not intend to limit the scope of the present invention or applications or uses thereof.

INDUSTRIAL APPLICABILITY

[0100] As can be seen in the foregoing, the present invention is useful for an air conditioning system which performs a rotation operation in which at least one, but not all, of a plurality of air conditioners is deactivated sequentially.

DESCRIPTION OF REFERENCE CHARACTERS

[0101]

5	1	Air Conditioning System
	10	Air Conditioner
	11	Outdoor Unit
	12	Indoor Unit
	21	Display Portion
10	S1	Rotation Sign
	S2	Abnormal Condition Sign

Claims

- 15 1. An air conditioning system comprising a plurality of air conditioners (10) each having an indoor unit (12) and an outdoor unit (11), the air conditioning system performing a rotation operation in which at least one, but not all, of the plurality of air conditioners (10) is deactivated sequentially, wherein
 20 the air conditioning system comprises a display portion (21) which informs a user of an operational state of each of the air conditioners (10), and
 25 the display portion (21) is configured to show, during the rotation operation, a rotation sign (S1) indicating that the rotation operation is being performed.
- 30 2. The air conditioning system of claim 1, wherein the display portion (21) shows, if an abnormal condition occurs in the air conditioner (10), an abnormal condition sign (S2) indicating that the abnormal condition has occurred in the air conditioner (10).
- 35 3. The air conditioning system of claim 2, wherein if the air conditioner (10) stops an abnormal condition during the rotation operation, a backup operation is performed to activate at least one or all of the deactivated air conditioners (10), and
 40 the display portion (21) is configured to keep the rotation sign (S1) shown even after the rotation operation is switched to the backup operation so as to show both of the rotation and abnormal condition signs (S1) and (S2).
- 45 4. The air conditioning system of claim 2 or 3, wherein if an abnormal condition occurs in the deactivated air conditioner (10) during the rotation operation, the display portion (21) keeps the rotation sign (S1) shown so as to show both of the rotation and abnormal condition signs (S1) and (S2).
- 50
- 55

FIG.1

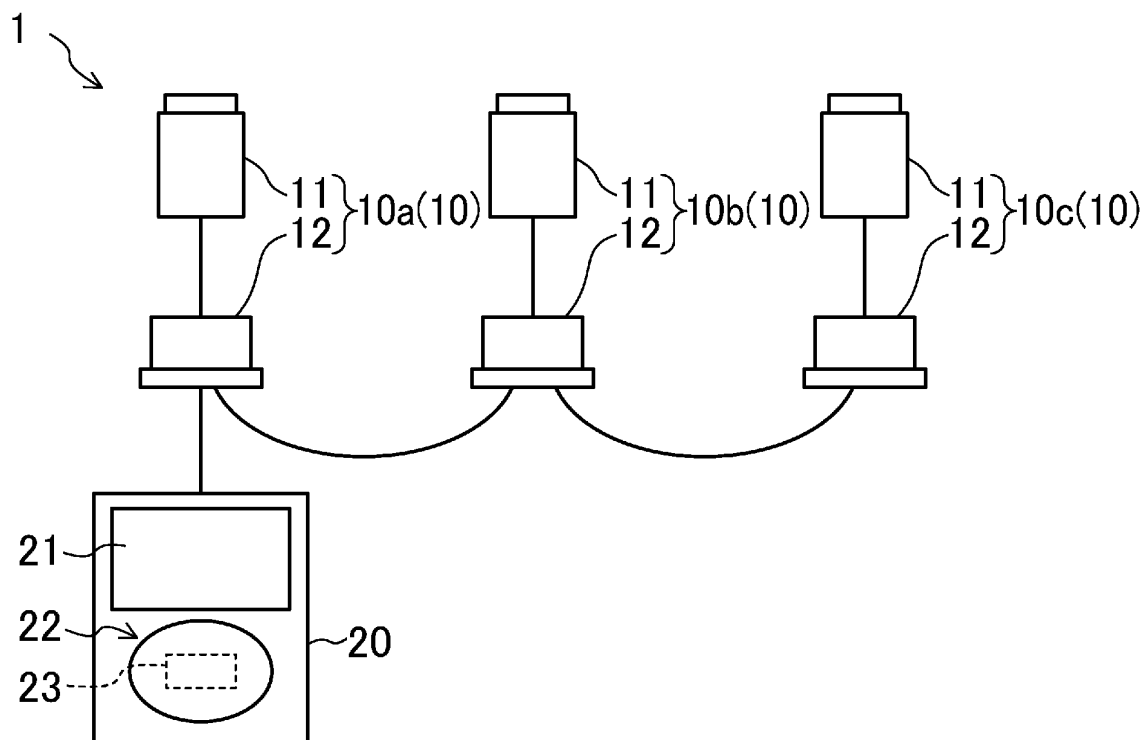


FIG.2

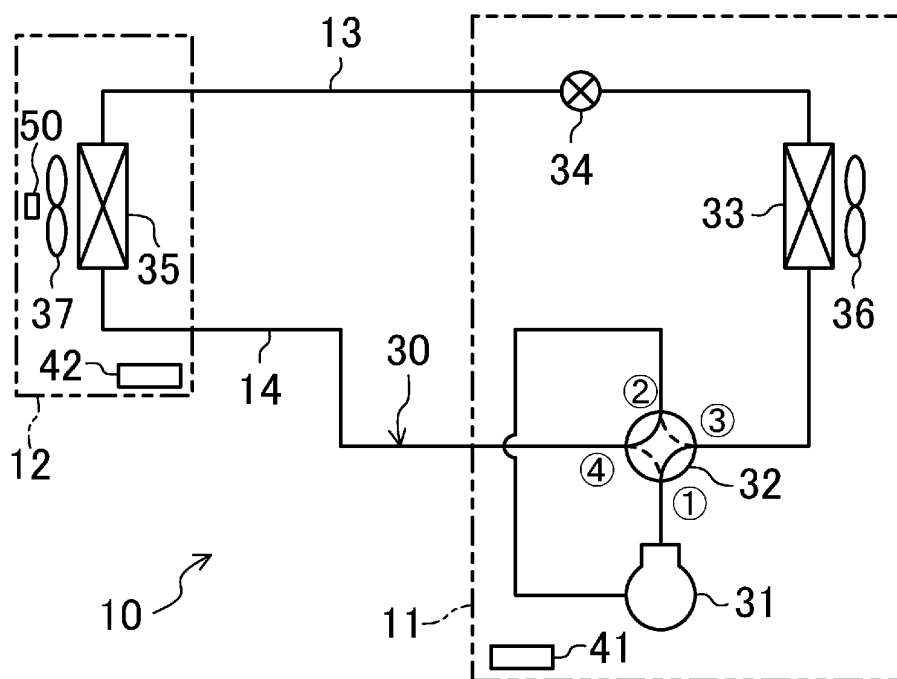


FIG.3

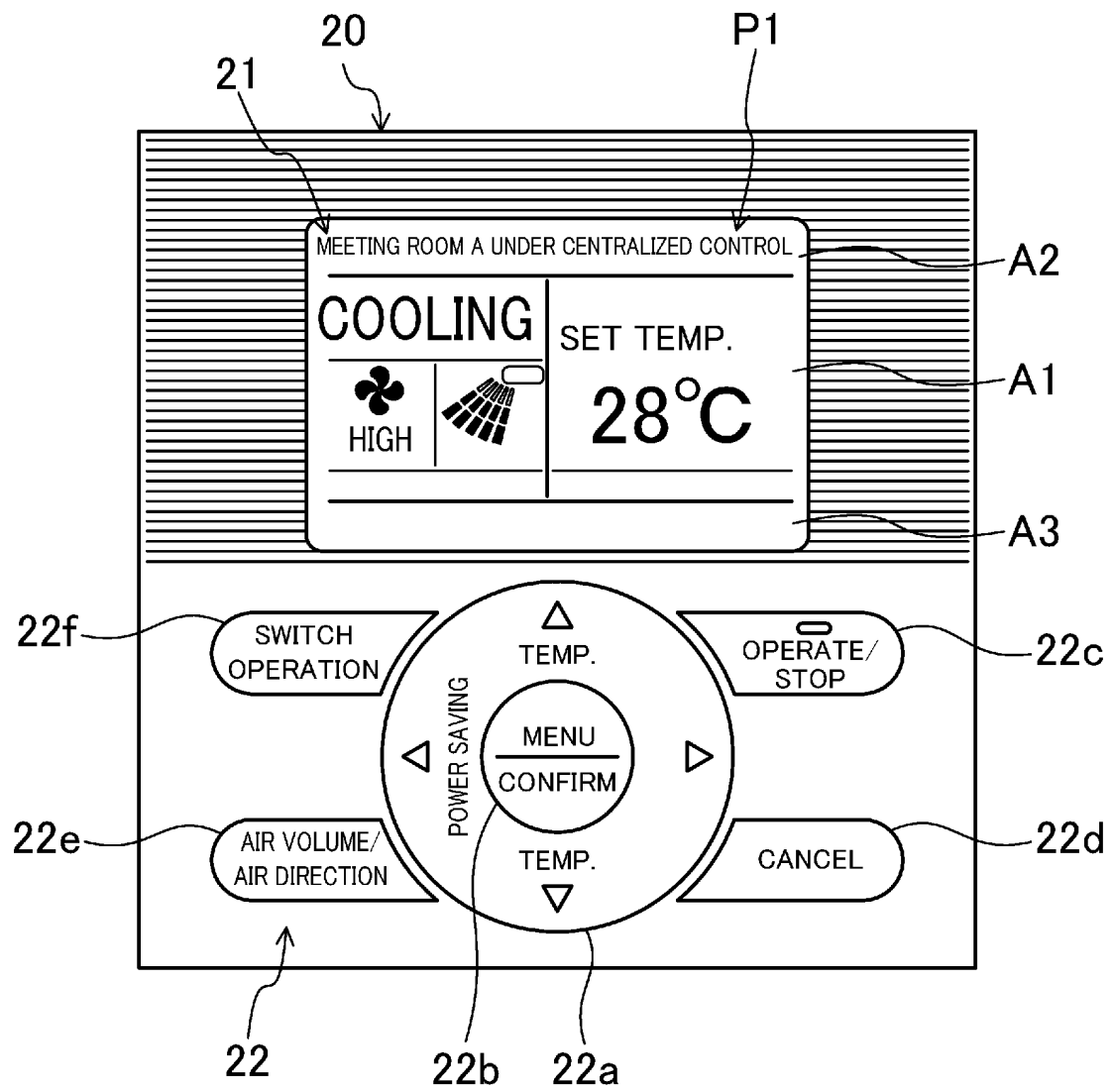


FIG.4

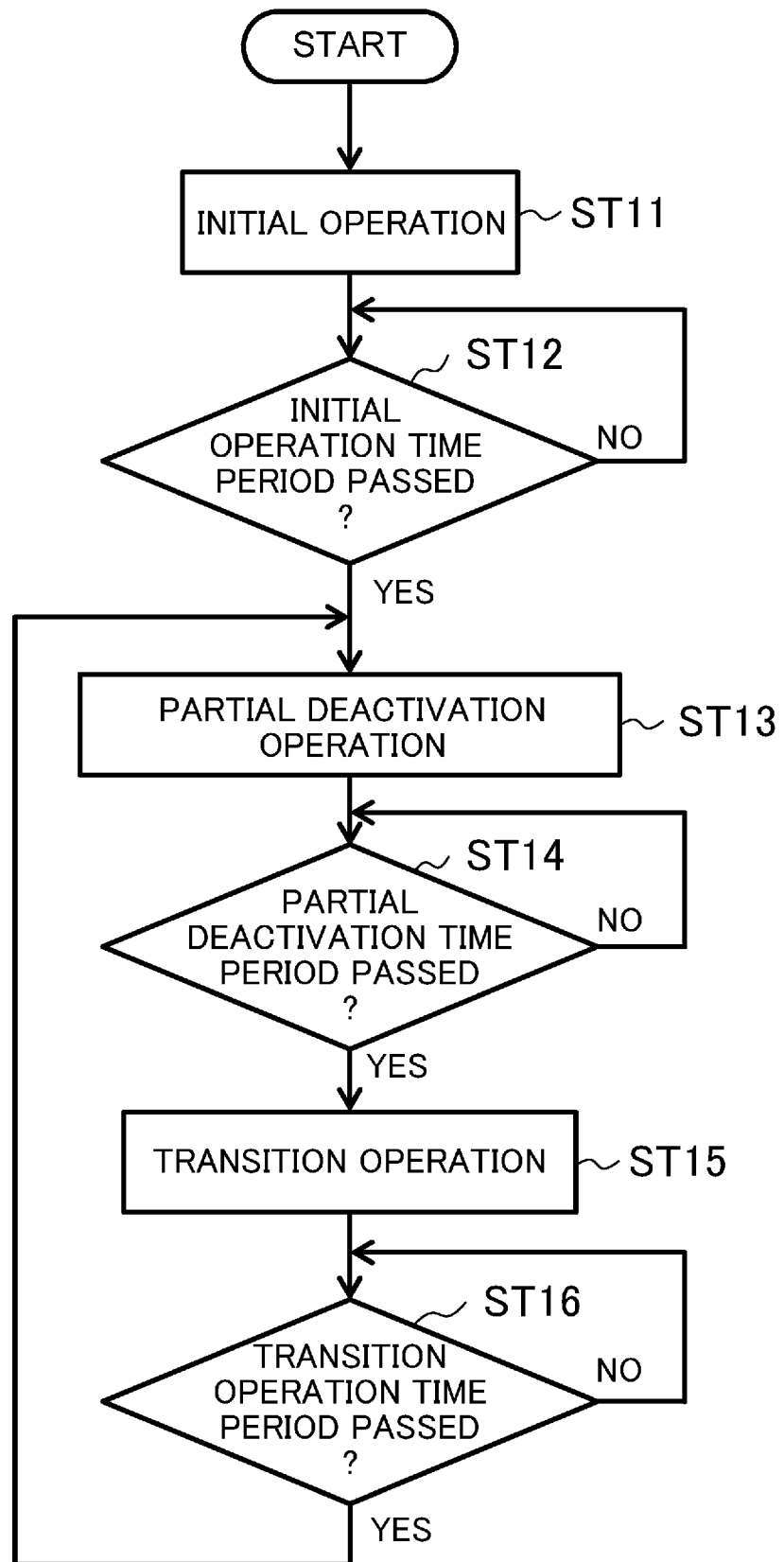


FIG.5

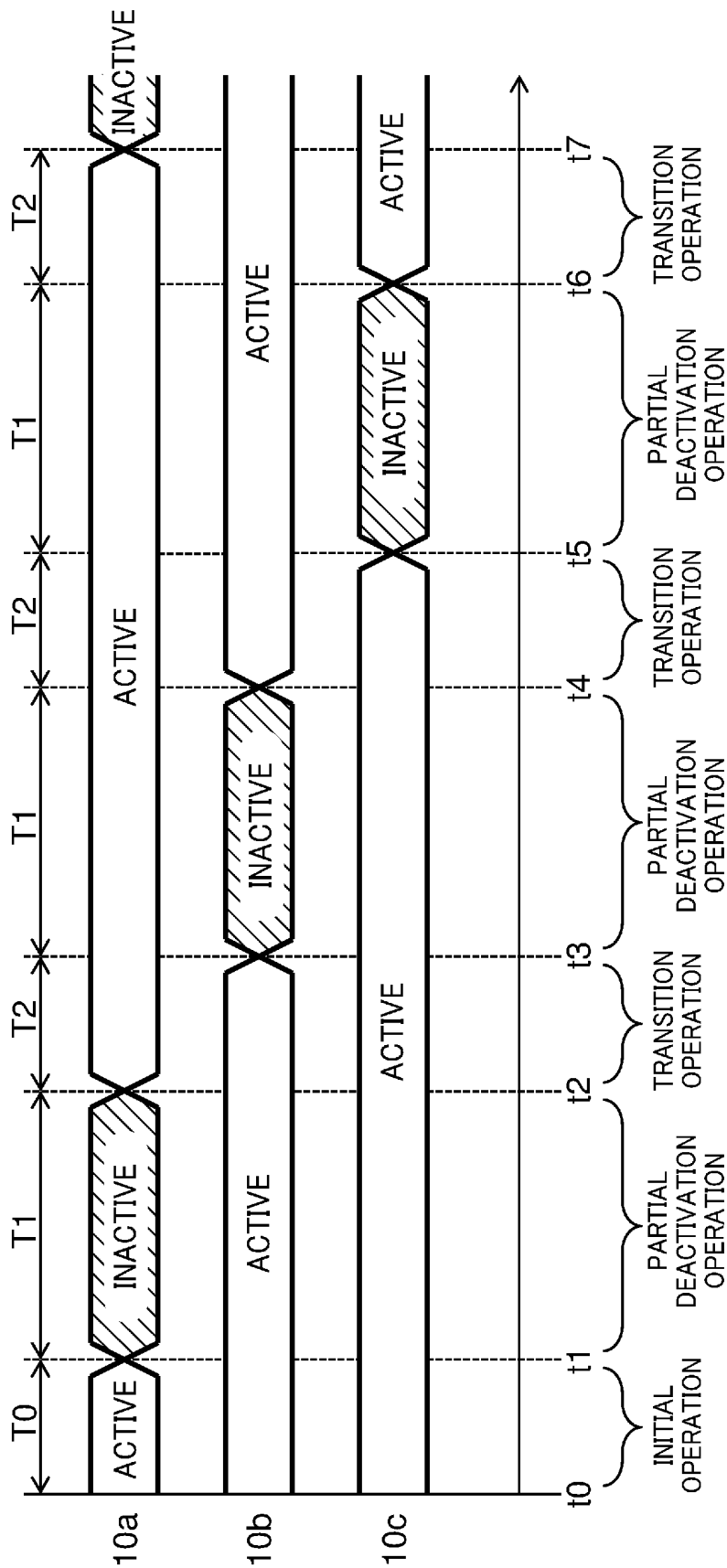


FIG.6A

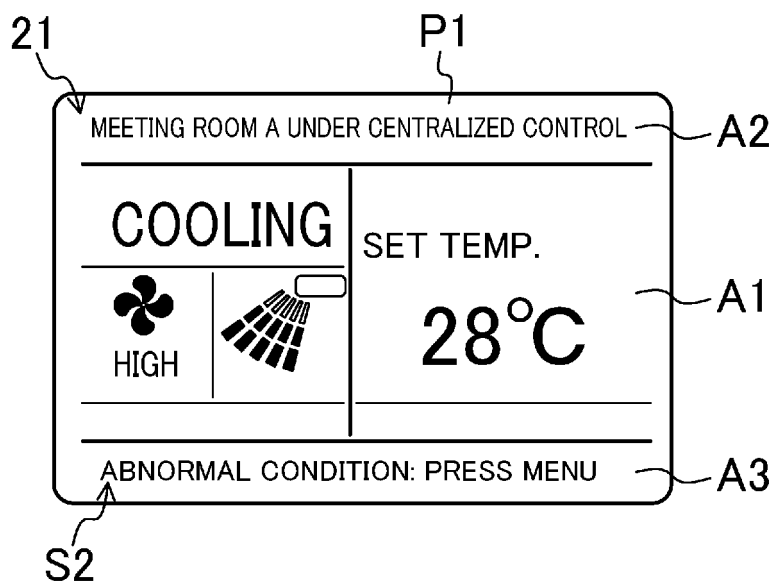


FIG.6B

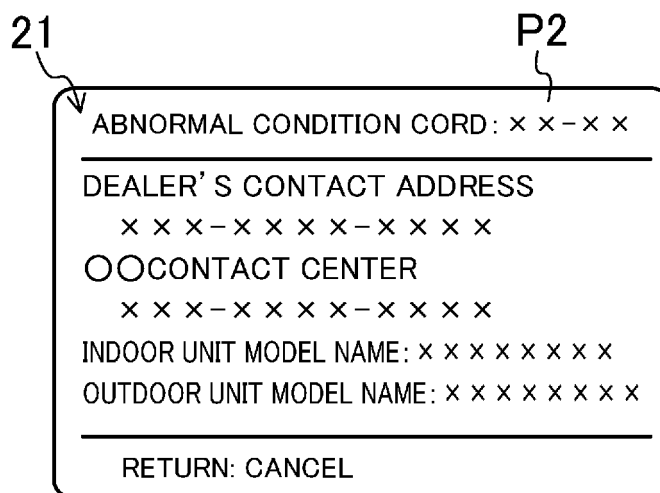


FIG.7A

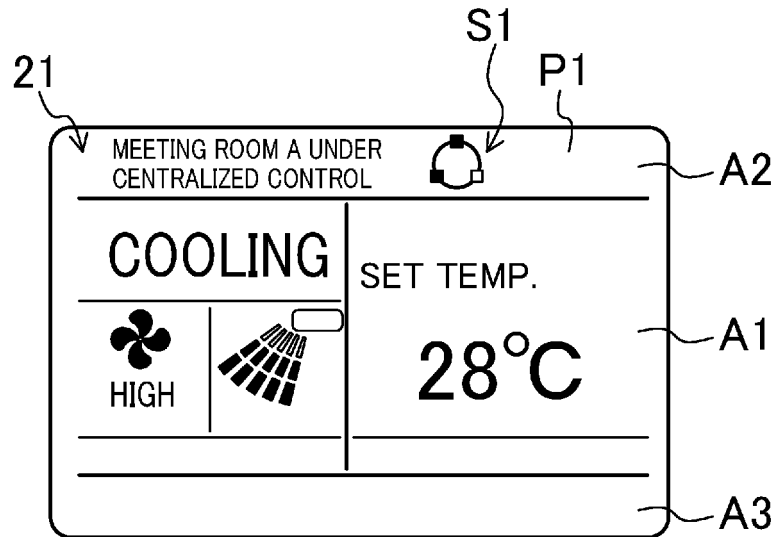


FIG.7B

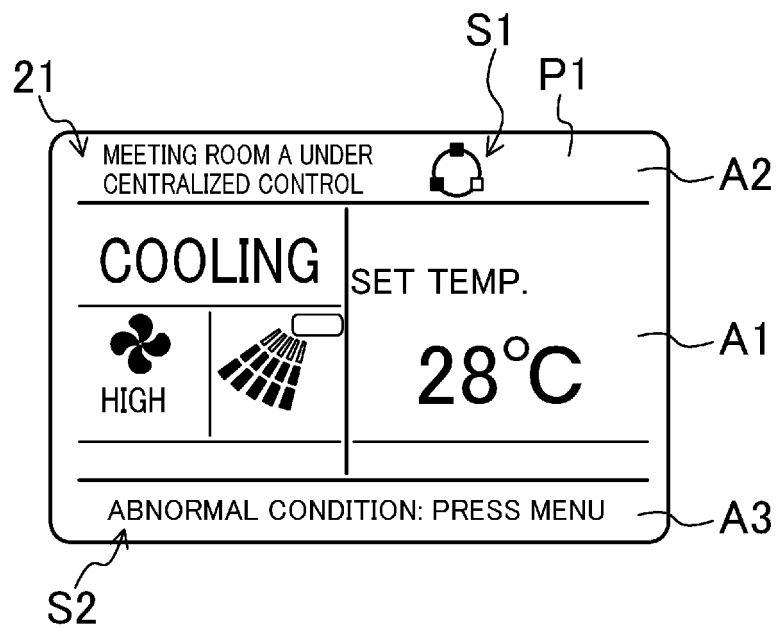


FIG.8

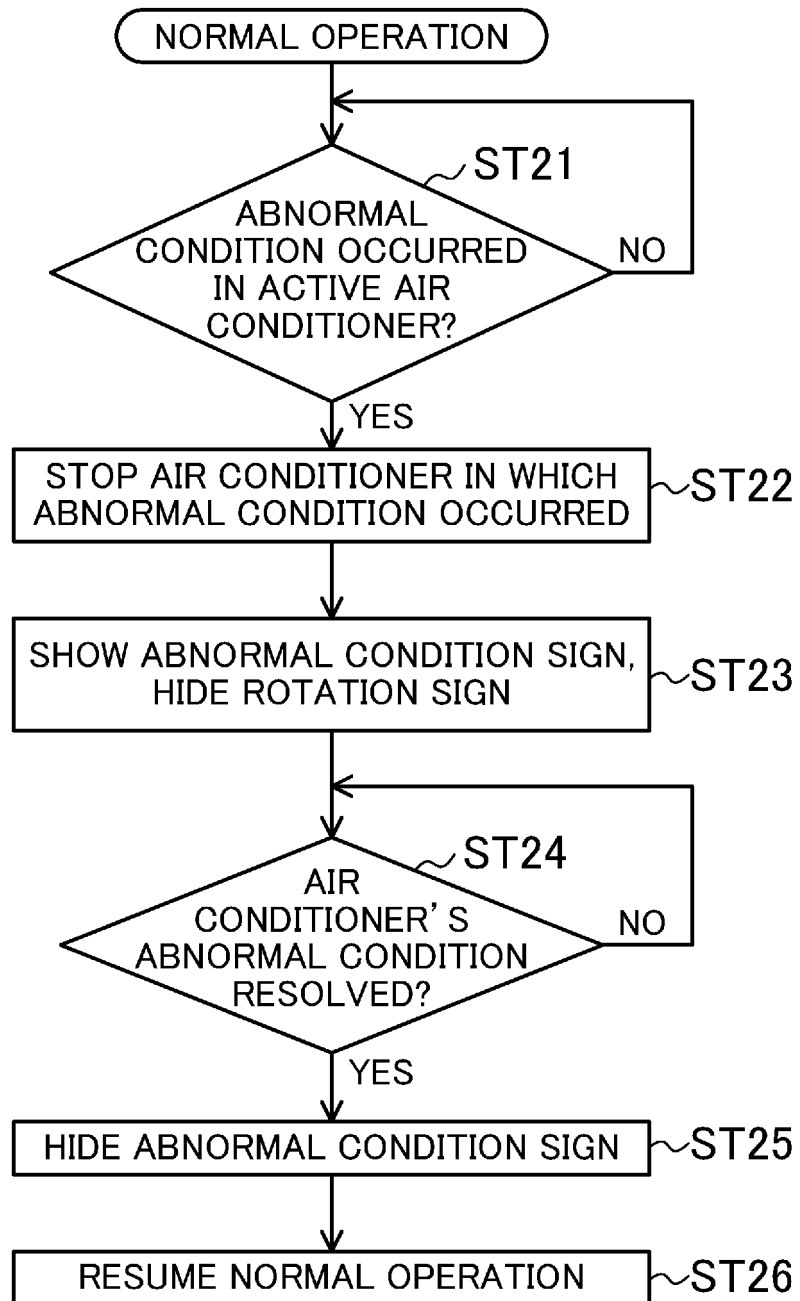


FIG.9

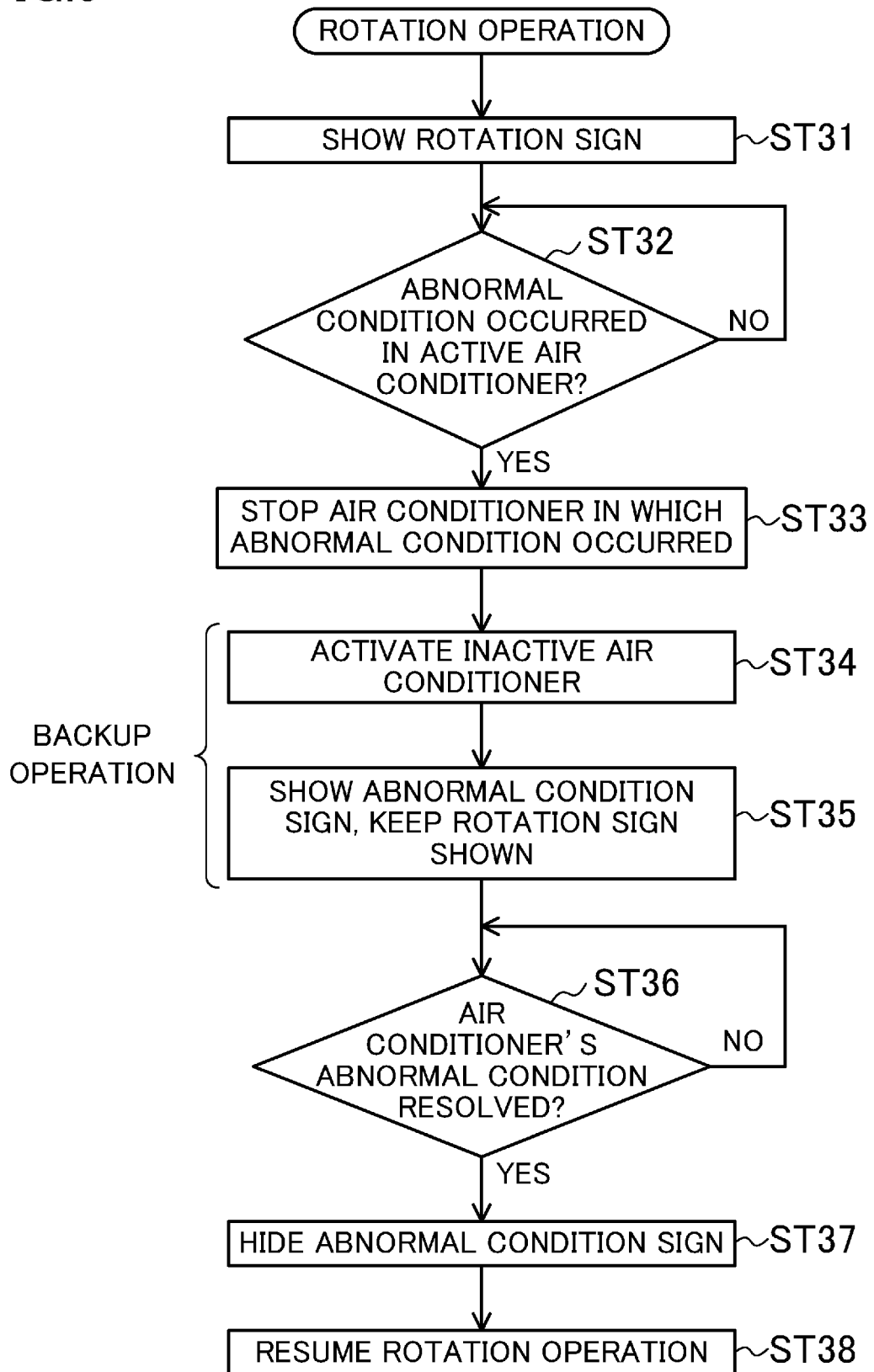
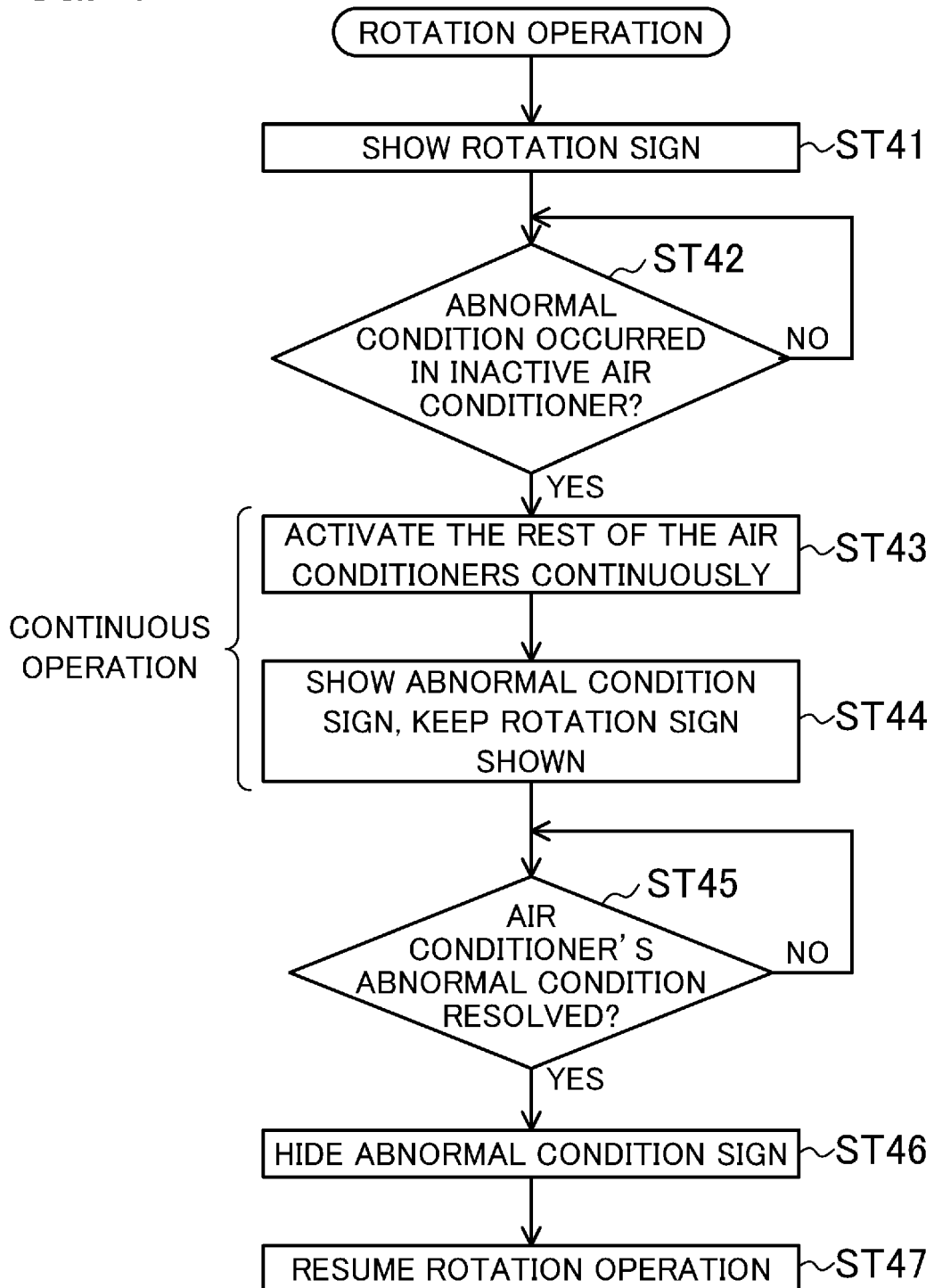


FIG.10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/004232

A. CLASSIFICATION OF SUBJECT MATTER

F24F11/02(2006.01) i

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)

F24F11/02

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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 2005-156017 A (Hitachi, Ltd.), 16 June 2005 (16.06.2005), paragraphs [0010], [0026] to [0029]; fig. 1, 4 to 6 & EP 1536186 A1 & DE 602004001659 D & ES 2264076 T & CN 1621758 A	1-4
Y	JP 10-185240 A (Daikin Industries, Ltd.), 14 July 1998 (14.07.1998), paragraph [0074]; fig. 1, 5 (Family: none)	1-4
Y	JP 3-204538 A (Daikin Industries, Ltd.), 06 September 1991 (06.09.1991), page 5, lower right column, line 13 to page 6, lower left column, line 14; fig. 1, 5 (Family: none)	2-4

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

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Date of the actual completion of the international search
17 November, 2014 (17.11.14)Date of mailing of the international search report
25 November, 2014 (25.11.14)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/004232

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2013-160477 A (Mitsubishi Heavy Industries, Ltd.), 19 August 2013 (19.08.2013), paragraphs [0023] to [0025], [0034] to [0036] (Family: none)	3
A	JP 2012-137246 A (Mitsubishi Electric Corp.), 19 July 2012 (19.07.2012), paragraphs [0005] to [0009]; fig. 1 to 5 (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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