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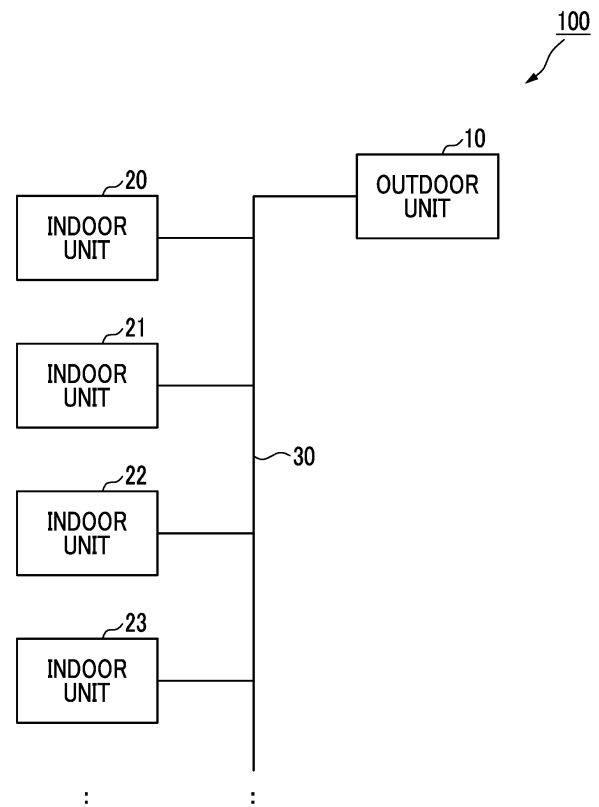
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(54) **AIR CONDITIONER AND CONTROL METHOD**

(57) Provided is an air conditioner with which a fan can be stopped during thermo-OFF in a space heating operation, and thermo-ON can be set at an appropriate timing. The air conditioner is a multi-type air conditioner which comprises an outdoor unit, a plurality of indoor units, and a control device, and which is connected to a temperature sensor provided in a room, wherein: when thermo-OFF is set, the fan is stopped, and a temperature measured by the temperature sensor in the room is stored; when the temperature measured by the temperature sensor in the room after the fan has been stopped drops by at least a prescribed temperature below the stored temperature, the operation of the fan is restarted; and when a prescribed time has elapsed since the operation of the fan was restarted, a determination as to whether to return from thermo-OFF to thermo-ON is made on the basis of a temperature measured by a temperature sensor of the indoor unit.

FIG. 1



Description

Technical Field

[0001] The present invention relates to an air conditioner and a control method. The present disclosure claims priority based on Japanese Patent Application No. 2022-114905, filed in Japan on July 19, 2022, the content of which is incorporated herein by reference.

Background Art

[0002] As illustrated in Fig. 1, a multi-type air conditioner 100 including a plurality of indoor units 20, 21, 22, and 23 for one outdoor unit 10 is provided. In the multi-type air conditioner 100, since a refrigerant sent out by the outdoor unit 10 is shared by the indoor units 20 to 23, in a case where the refrigerant is excessively accumulated in an indoor heat exchanger of the indoor unit 20, for example, the amount of the refrigerant supplied to the indoor units 21 to 23 is reduced, and the air conditioning capacity of the indoor units 21 to 23 deteriorates. For example, in a case of a thermostat OFF state (the thermostat OFF state means that an indoor temperature reaches a set temperature and the operation state in which heat exchange between the refrigerant flowing through the indoor heat exchanger of the indoor unit 20 and the indoor air is unnecessary) during heating operation of the indoor unit 20, a gas refrigerant supplied to the indoor heat exchanger is condensed and liquefied, and the refrigerant is accumulated in the indoor heat exchanger of the indoor unit 20. This is because, in the multi-type air conditioner 100, even in a case of the thermostat OFF state, the refrigerant is supplied to the indoor heat exchanger and is condensed by operation of a fan or the like. Although the indoor heat exchanger of the indoor unit 20 in the thermostat OFF state does not require a refrigerant, in order to prevent the refrigerant from being excessively accumulated, in the multi-type air conditioner 100, in a case of the thermostat OFF state during the heating operation, the fan of the indoor unit 20 performing the heating operation is operated to prevent condensation of the refrigerant. Specifically, (1) the fan is stopped or (2) the fan is operated intermittently. In a case where the fan is stopped, heat exchange in the indoor heat exchanger is suppressed, and the condensation of the gas refrigerant supplied to the indoor heat exchanger can be prevented. Even in the intermittent operation of the fan, the condensation of the gas refrigerant can be suppressed as compared with a case where the fan is continuously operated. However, in a case where the refrigerant condensation prevention operation of (1) or (2) is performed, the condensation amount of the refrigerant can be reduced, but the comfort of the air conditioning may be impaired. For example, (1) in a case where the fan is stopped, a suction temperature of the indoor unit 20 is not a temperature that accurately reflects an indoor temperature, so that the timing for setting the thermostat

ON state (restarting the heating) is not appropriate, and the comfort may be impaired. (2) In a case where the fan is operated intermittently, the accuracy of the suction temperature is improved as compared with the control of stopping the fan, but overheating may occur during the operation of the fan, and the comfort may be impaired.

[0003] PTL 1 discloses a control method of a fan to prevent the overheating that occurs in a case where the fan is operated intermittently. PTL 1 does not disclose the control of restarting the heating operation at an appropriate timing even in a case where a fan is stopped in the thermostat OFF state.

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. 2004-144377

Summary of Invention

Technical Problem

[0005] Even in a case where the fan is stopped in the thermostat OFF state, there is a demand for a control method that makes it possible to restart the heating operation (thermostat ON state) at an appropriate timing.

[0006] The present disclosure provides an air conditioner and a control method capable of solving the above-described problems.

Solution to Problem

[0007] According to an aspect of the present disclosure, there is provided a multi-type air conditioner including: an outdoor unit; a plurality of indoor units; and a control device, in which the outdoor unit and the plurality of indoor units are connected to each other by a refrigerant pipe, the indoor unit includes an indoor heat exchanger, a fan, and a first temperature sensor, and is connected to a second temperature sensor provided in a room that is an air conditioning target, and the control device includes means for stopping the fan in a case where the indoor unit that executes heating operation is in a thermostat OFF state in which an indoor temperature reaches a set temperature and heat exchange in the indoor heat exchanger is unnecessary, means for storing a temperature measured by the second temperature sensor in a case of the thermostat OFF state as a standard temperature, means for restarting the operation of the fan in a case where the temperature measured by the second temperature sensor is decreased by a predetermined temperature or more from the standard temperature after the fan is stopped, and means for determining whether or not to switch from the thermostat OFF state to a thermostat ON state in which heat exchange is performed in the indoor heat exchanger based on a tem-

perature measured by the first temperature sensor in a case where a predetermined time elapses after restarting the operation of the fan.

[0008] According to another aspect of the present disclosure, there is provided a control method of a multi-type air conditioner including an outdoor unit, a plurality of indoor units, and a control device, in which the outdoor unit and the plurality of indoor units are connected to each other by a refrigerant pipe, and the indoor unit includes an indoor heat exchanger, a fan, and a first temperature sensor, and is connected to a second temperature sensor provided in a room that is an air conditioning target, the control method including: a step of stopping the fan in a case where the indoor unit that executes heating operation is in a thermostat OFF state in which an indoor temperature reaches a set temperature and heat exchange in the indoor heat exchanger is unnecessary; a step of storing a temperature measured by the second temperature sensor in a case of the thermostat OFF state as a standard temperature; a step of restarting the operation of the fan in a case where the temperature measured by the second temperature sensor is decreased by a predetermined temperature or more from the standard temperature after the fan is stopped; and a step of determining whether or not to switch from the thermostat OFF state to a thermostat ON state in which heat exchange is performed in the indoor heat exchanger based on a temperature measured by the first temperature sensor in a case where a predetermined time elapses after restarting the operation of the fan.

Advantageous Effects of Invention

[0009] According to the air conditioner and the control method, even in a case where the fan is stopped in the thermostat OFF state, the thermostat ON state can be set at an appropriate timing.

Brief Description of Drawings

[0010]

Fig. 1 is a schematic diagram of a multi-type air conditioner according to an embodiment.

Fig. 2 is a schematic diagram illustrating an example of a refrigerant circuit of the multi-type air conditioner according to the embodiment.

Fig. 3 is a diagram illustrating an example of a control device of an indoor unit according to the embodiment.

Fig. 4 is a diagram illustrating an example of a room provided with the indoor unit according to the embodiment.

Fig. 5 is a diagram illustrating an example of setting related to fan control according to the embodiment.

Fig. 6A is a first diagram illustrating an example of the fan control according to the embodiment.

Fig. 6B is a second diagram illustrating an example of

the fan control according to the embodiment.

Fig. 6C is a third diagram illustrating an example of the fan control according to the embodiment.

Fig. 7 is a flowchart illustrating an example of control of the fan according to the embodiment.

Description of Embodiments

<Embodiment>

[0011] Hereinafter, an air conditioner and a control method according to an embodiment of the present disclosure will be described with reference to Figs. 1 to 7.

(Configuration)

[0012] Fig. 1 is a schematic diagram illustrating an example of a multi-type air conditioner according to the embodiment. The multi-type air conditioner is an air conditioner in which a plurality of indoor units are connected to one outdoor unit. An air conditioner 100 in Fig. 1 is a multi-type air conditioning system including an outdoor unit 10 and a plurality of indoor units 20, 21, 22, and 23. The outdoor unit 10 and each of the indoor units 20 to 23 are connected to each other by a refrigerant pipe 30 through which a refrigerant passes. The number of the outdoor unit 10, the indoor unit 20, and the like is not limited to the number illustrated in Fig. 1. For example, the number of the indoor units 20 or the like may be two or three, or five or more. The number of the outdoor units 10 may be two or more.

[0013] Fig. 2 illustrates a schematic configuration of a refrigerant circuit of the multi-type air conditioner 100 in a case where one outdoor unit 10, two indoor units 20 (20 and 21), and the like are provided. As illustrated in Fig. 2, the outdoor unit 10 includes a compressor 11, a four-way valve 12, an outdoor heat exchanger 13, and a control device 14. The discharge side of the compressor 11 and the four-way valve 12 are connected to each other by a pipe 34, the four-way valve 12 and the outdoor heat exchanger 13 are connected to each other by a pipe 32, and the four-way valve 12 and the suction side of the compressor 11 are connected to each other by a pipe 33. The four-way valve 12 and the joint 3A are connected to each other by a pipe 35. The outdoor heat exchanger 13 and the joint 3B are connected to each other by a pipe 31. The control device 14 performs control of the compressor 11.

[0014] The indoor unit 20 includes an indoor heat exchanger 201, an expansion valve 202, a fan 203, a temperature sensor 204, and a control device 40. A pipe 36 connects the joint 3A and the indoor heat exchanger 201, a pipe 37 connects the indoor heat exchanger 201 and the joint 3B, and the expansion valve 202 is provided in the pipe 37. The fan 203 is provided in the vicinity of a suction port of the indoor unit 20, suctions the indoor air, and sends the indoor air to the indoor heat exchanger 201. The temperature sensor 204 is provided in the

vicinity of the suction port of the indoor unit 20 and measures an indoor temperature. Whether to set the thermostat OFF state or to set the thermostat ON state in a case where the indoor unit 20 is performing heating operation is determined by a temperature difference between the set temperature for heating of the indoor unit 20 and the temperature measured by the temperature sensor 204. For example, the control device 40 determines that the heating operation is in the thermostat OFF state in a case where the temperature measured by the temperature sensor 204 reaches the set temperature, and determines that the heating operation is in the thermostat ON state in a case where the temperature measured by the temperature sensor 204 is decreased by a predetermined value or more from the set temperature for the heating. The control device 40 controls the expansion valve 202 and the fan 203 in accordance with the thermostat ON state and the thermostat OFF state (described later).

[0015] The configuration of the indoor unit 21 is the same as the configuration of the indoor unit 20. The indoor unit 21 includes an indoor heat exchanger 211, an expansion valve 212, a fan 213, a temperature sensor 214, and a control device 41. A pipe 38 connects the joint 3A and the indoor heat exchanger 211, a pipe 39 connects the indoor heat exchanger 211 and the joint 3B, and the expansion valve 212 is provided in the pipe 39. The control device 41 performs control of the expansion valve 212 and the fan 213.

[0016] In a case where the heating operation is performed by the multi-type air conditioner 100, the four-way valve 12 is set for the heating operation, and the high-temperature and high-pressure gas refrigerant discharged from the compressor 11 is supplied to the indoor heat exchanger 201 of the indoor unit 20 through the pipe 34, the four-way valve 12, and the pipes 35 and 36, and is supplied to the indoor heat exchanger 211 of the indoor unit 21 through the pipes 34, 35, and 38. The refrigerant supplied to the indoor heat exchanger 201 is condensed by being heat-exchanged with the air sent by the fan 203, is depressurized by the expansion valve 202, and is supplied to the outdoor heat exchanger 13 through the pipes 37 and 31. Similarly, in the indoor unit 21, the refrigerant supplied to the indoor heat exchanger 211 is condensed by being heat-exchanged with the air sent by the fan 213, is depressurized by the expansion valve 212, and is supplied to the outdoor heat exchanger 13 through the pipes 39 and 31. The refrigerant supplied to the outdoor heat exchanger 13 is vaporized by heat exchange with the outside air, and the vaporized refrigerant is suctioned into the compressor 11 through the pipe 32, the four-way valve 12, and the pipe 33.

[0017] As described with reference to Fig. 2, in the multi-type air conditioner 100, since the refrigerant is shared by the indoor units 20 and 21, for example, in a case where the refrigerant is excessively accumulated in the indoor heat exchanger 201 in the indoor unit 20, the amount of the refrigerant supplied to the indoor unit 21 is

reduced. Therefore, for example, in a case where the indoor unit 20 is in the thermostat OFF state during the heating operation in the indoor units 20 and 21, the control device 40 performs control of suppressing the refrigerant from being excessively accumulated in the indoor heat exchanger 201. Specifically, the control device 40 narrows the opening degree of the expansion valve 202 to reduce the amount of the refrigerant flowing into the indoor heat exchanger 201, and performs another control of the fan 203, which is not the stop or the intermittent operation of the fan in the related art, that is, the control of appropriately detecting the indoor temperature while stopping the fan for a long time. Details of the fan control according to the present embodiment will be described later. After the thermostat OFF state, in a case where the indoor temperature decreases and is in the thermostat ON state, the control device 40 returns the opening degree of the expansion valve 202 and operates the fan 203 as usual.

(Fan Control)

[0018] Next, fan control according to the present embodiment will be described with reference to Figs. 3 to 6C. Hereinafter, the fan control in a case where the indoor unit 20 is in the thermostat OFF operation state will be described as an example, but the same applies to other indoor units 21 and the like.

[0019] Fig. 3 is a diagram illustrating an example of a control device of an indoor unit according to the embodiment.

[0020] The control device 40 is a computer device, such as a microcomputer. As illustrated in the drawing, the control device 40 includes a sensor information acquisition unit 401, a setting receiving unit 402, a timer 403, a storage unit 404, a control unit 405, and a communication unit 406. The control device 40 performs various controls related to the indoor unit 20, but the function of controlling the fan 203 will be described in the present specification.

[0021] The sensor information acquisition unit 401 acquires the temperature measured by the temperature sensor provided in a room that is an air conditioning target, in addition to the temperature measured by the temperature sensor 204. Here, a description will be made with reference to Fig. 4. Fig. 4 illustrates a room A in which the indoor unit 20 is provided. The room A is provided with the indoor unit 20, a remote controller 50 of the indoor unit 20, a refrigerant detector 60, and temperature sensors Th3 and Th4. The temperature sensor 204 is provided near the suction port of the indoor unit 20, a temperature sensor Th1 is provided in the remote controller 50, and a temperature sensor Th2 is provided in the refrigerant detector 60. The indoor unit 20 is provided at an upper part of the room A. The remote controller 50 is provided at a height of about 1 m from the floor. The refrigerant detector 60 is provided in the vicinity of the floor (at a position of 0.3 m or less from the floor) in order to detect

the refrigerant that has leaked from the indoor unit 20 (the refrigerant is heavier than air and thus is accumulated in the vicinity of the floor). Accordingly, the temperature sensor 204 measures the temperature at the upper part of the room A and in the vicinity of the ceiling, the temperature sensor Th1 measures the temperature in the vicinity of 1 m from the floor, and the temperature sensor Th2 measures the temperature at a lower part of the room A and in the vicinity of the floor. The temperature sensors Th3 and Th4 are, for example, remote thermistors and can be provided at any positions. In the example in Fig. 4, the temperature sensor Th3 is provided at the upper part of the room A at a position away from the indoor unit 20, and the temperature sensor Th4 is provided at the lower part of the room A at a position away from the refrigerant detector 60. The positions of the temperature sensors Th3 and Th4 are merely examples, and the temperature sensors may be provided at other positions. The number of the temperature sensors including the temperature sensors Th1 and Th2 is optional. For example, only the temperature sensor Th1 may be provided in the remote controller 50, or only the temperature sensor Th1 and the temperature sensor Th2 may be provided. It is preferable that the temperature sensor of the room A is provided at a height different from the temperature sensor 204 of the indoor unit 20, and in a case where a plurality of sensors are provided as illustrated in the drawing, it is preferable that the plurality of sensors are provided at different heights so that a temperature distribution in a height direction of the room A can be detected. Further, the temperature sensors may be provided at positions separated from each other even at the same height so that the temperature distribution of the entire room can be detected. It is desirable to stop the operation of the fan 203 and suppress the condensation of the refrigerant during the thermostat OFF state of the heating operation. However, in a case where the fan 203 is stopped, there is a problem that the indoor temperature cannot be grasped. For example, since warm air rises and cold air descends, a situation may occur in which the temperature at the foot is actually decreased even though the temperature measured by the temperature sensor 204 of the indoor unit 20 is high during the thermostat OFF state. However, since the temperature measured by the temperature sensor 204 satisfies the set temperature of the room A, a time elapses in which the foot remains cooled without being in the thermostat ON state, and the comfort is impaired. Therefore, in the present embodiment, the temperature measured at various positions in the room A is used for the fan control, in addition to the temperature measured by the temperature sensor 204 provided in the vicinity of the suction port of the indoor unit 20. For example, even in a case where there is no change in the temperature measured by the temperature sensor 204, it is considered that the indoor temperature is decreased by about 1°C in a case where the temperature measured by the temperature sensor Th1 is decreased by 1°C. The temperature sensors Th1

to Th4 are communicably connected to the control device 40. The sensor information acquisition unit 401 acquires the temperatures measured by the temperature sensors Th1 to Th4 in addition to the temperature measured by the temperature sensor 204.

[0022] The setting receiving unit 402 acquires various kinds of setting information input by a user from the remote controller or the like. For example, the setting receiving unit 402 acquires the setting of the weighting for the temperature measured by the temperature sensors Th1 to Th4. Fig. 5 illustrates setting examples of weighting for the temperature sensors. Setting Example 1 is a setting example in which the weighting is uniformly given to the temperatures measured by the temperature sensors Th1 to Th4. Setting Example 2 is a setting example in which the temperatures measured by the temperature sensors Th2 and Th3 provided in the vicinity of the floor are given priority. Setting Example 3 is a setting example in which the temperatures measured by the temperature sensors Th3 and Th4 are given priority. For example, it is considered to set as in Setting Example 3 in a case where the user of the room A spends a long time in a space of a side (left side of the paper surface) provided with the temperature sensors Th3 and Th4, or in a case where the temperatures measured by the temperature sensors Th1 and Th2 are considered not to reflect the temperature of the room A due to the influence of sunlight from a window W, a device that releases heat present nearby, or the like. Setting Example 4 is a setting example in which the temperatures measured by the temperature sensors Th1 and Th4 are given priority. For example, it is considered to set as in Setting Example 4 in a case where the temperature at a certain height position is desired to be used as a guide for using a bed in the room A as a bedroom. Setting Example 5 is a setting example in which only the temperature measured by the temperature sensor Th1 is used. For example, Setting Example 5 is a setting example in a case where the refrigerant detector 60 and the temperature sensors Th3 and Th4 are not provided. Similarly, in Setting Example 6, the setting in which the foot temperature is given priority in a case where only the temperature sensors Th1 and Th2 are provided, in Setting Example 7, the setting in which the temperature of the region where the person is present (from the middle part to the lower part of the room) is given priority, and in Setting Example 8, the setting in which the temperature at the middle part of the room is given priority are made. The control using Setting Examples 6 to 8 will be described later with reference to Figs. 6A to 6C. The setting receiving unit 402 acquires setting of the weighting as illustrated in Fig. 5 and records the setting in the storage unit 404.

[0023] The timer 403 measures the time.

[0024] The storage unit 404 stores various kinds of information such as a measurement value of the temperature acquired by the sensor information acquisition unit 401 and various kinds of setting information acquired by the setting receiving unit 402. The storage unit 404

stores various programs that realize functions of the control device 40.

[0025] The control unit 405 performs control of the indoor unit 20 and control of the air conditioner 100 in cooperation with the outdoor unit 10. For example, the control unit 405 controls the opening degree of the expansion valve 202 and the rotation speed of the fan 203. The control of the fan 203 in a case of the thermostat OFF state will be described. In a case of the thermostat OFF state, the control unit 405 stops the fan 203 once. In a case where the fan 203 is stopped, the control unit 405 decides a timing of executing determination of whether or not to set the thermostat ON state (hereinafter, may be referred to as operation necessity determination) by monitoring the temperatures measured by the temperature sensors Th1 to Th4. For example, in a situation where it is considered that the temperature of the room A is decreased, the control unit 405 determines that it is necessary to execute the operation necessity determination. In a case where the temperatures measured by the temperature sensors Th1 to Th4 do not change for a predetermined time, the control unit 405 determines that there is a possibility that the temperature sensors Th1 to Th4 cannot accurately measure the room temperature, and decides to execute the operation necessity determination. In a case where the execution of the operation necessity determination is decided, the control unit 405 operates the stopped fan 203 for a predetermined time. In a case where the fan 203 is operated for a predetermined time, the air in the room A is stirred and homogenized, so that the temperature of the room A can be accurately measured by the temperature sensor 204. In a case where the fan 203 is operated to accurately measure the temperature of the room A, the control unit 405 performs the operation necessity determination. For example, whether or not to set the thermostat ON state is decided by whether or not the temperature measured by the temperature sensor 204 is decreased by a predetermined value or more from the set temperature. In a case where it is determined as a result of the operation necessity determination to set the thermostat ON state, the control unit 405 executes the thermostat ON operation in cooperation with the outdoor unit 10. For example, the compressor 11 restarts the operation, and the control unit 405 controls the fan 203 and the expansion valve 202 in the thermostat ON state. In a case where it is determined not to set the thermostat ON state, the fan control in the thermostat OFF state is repeated.

[0026] Here, examples of the fan control will be described with reference to Figs. 6A to 6C. The set temperature of the room A is 27°C, and the condition for deciding execution of the operation necessity determination is that the temperature is decreased by 2°C. It is assumed that the temperature sensors provided in the room A are the temperature sensor Th1 of the remote controller 50 and the temperature sensor Th2 of the refrigerant detector 60. It is assumed that the temperature measured by the temperature sensor 204, the tem-

perature measured by the temperature sensor Th1 of the remote controller 50, and the temperature measured by the temperature sensor Th2 of the refrigerant detector 60 are represented by the upper, middle, and lower parts, respectively. In the examples of Figs. 6A to 6C, the temperatures at the upper, middle, and lower parts of the fan 203 immediately before the stop of the operation are 28°C, 25°C, and 20°C, respectively.

[0027] In the example of Fig. 6A, the temperatures at the upper, middle, and lower parts 10 minutes after the fan 203 is stopped are 28°C, 24°C, and 18°C, respectively. In this case, for example, as in Setting Example 6 of Fig. 5, in a case where the foot temperature is set to be given priority, since the foot temperature (temperature at the lower part) is decreased by 2°C from the stop of the fan 203, the control unit 405 decides that it is necessary to execute the operation necessity determination. That is, the control unit 405 operates the fan 203 for a predetermined time and performs the operation necessity determination. Then, in a case where the thermostat ON condition is satisfied, the thermostat ON state is set.

[0028] In the example of Fig. 6B, the temperatures at the upper, middle, and lower parts 10 minutes after the fan 203 is stopped are 28°C, 24°C, and 17°C, respectively. In this case, for example, as in Setting Example 7 of Fig. 5, in a case where the temperature of the region where the person is present (from the middle part to the lower part of the room) is set to be given priority, since the average value of the temperatures at middle and lower parts is decreased by 2°C from the stop of the fan 203, the control unit 405 decides that it is necessary to execute the operation necessity determination. The control unit 405 operates the fan 203 for a predetermined time and performs the operation necessity determination. In a case where the weighting for the foot temperature that is given priority as in Setting Example 6 of Fig. 5 is set, the operation of the fan 203 and the operation necessity determination are executed before the temperature distribution illustrated in Fig. 6B is detected.

[0029] In the example of Fig. 6C, the temperatures at the upper, middle, and lower parts 10 minutes after the fan 203 is stopped are 28°C, 23°C, and 16°C, respectively. In this case, for example, as in Setting Example 8 of Fig. 5, in a case where the temperature at the middle part of the room is set to be given priority, since the temperature at the middle part is decreased by 2°C from the stop of the fan 203, the operation necessity determination is executed after the fan 203 is operated for a predetermined time.

[0030] As described above, the control unit 405 decides the timing of executing the operation necessity determination based on the transition (degree of decrease) of the temperature measured by the plurality of temperature sensors, and operates the fan 203 for the predetermined time only in a case where the operation necessity determination is necessary to be executed, and continues to stop the fan 203 in other times.

[0031] The communication unit 406 communicates

with the control device 14 of the outdoor unit 10. For example, the communication unit 406 transmits the temperature measured by the temperature sensor 204, a determination result of the operation necessity determination by the control unit 405, and the like to the control device 14 of the outdoor unit 10. The communication unit 406 receives information indicating the operation state of various sensors, a compressor, and the like provided in the outdoor unit 10 from the control device 14.

(Operation)

[0032] Next, the fan control in the thermostat OFF state will be described with reference to Fig. 7.

[0033] Fig. 7 is a flowchart illustrating an example of the control of the fan according to the embodiment.

[0034] As a premise, it is assumed that the weighting for the temperature sensors Th1 to Th4 is set in advance, and the storage unit 404 stores a weighting setting table of the temperature sensors Th1 to Th4 illustrated in Fig. 5. First, predetermined thermostat OFF condition is satisfied (step S1). For example, in a case where the temperature measured by the temperature sensor 204 reaches the set temperature, the thermostat OFF condition is satisfied. Then, the control device 40 starts the control in the thermostat OFF state. For example, the control unit 405 narrows the opening degree of the expansion valve 202 and performs the fan control according to the present embodiment. Specifically, the control unit 405 records the temperature measured by the temperature sensor of the other device (step S2). The control unit 405 records each of the temperatures measured by the temperature sensors Th1 to Th4 acquired by the sensor information acquisition unit 401 in the storage unit 404. These temperatures are the temperatures at the start of the thermostat OFF state. For example, at the start of the thermostat OFF state, in a case where the set temperature is 27°C, the temperature measured by the temperature sensor 204 is 28°C, and the temperature measured by the temperature sensor Th1 of the remote controller is 25°C (25°C is recorded). The control unit 405 stops the fan 203 (step S3). Accordingly, it is possible to suppress the gas refrigerant from being condensed by the indoor heat exchanger 201 and the liquid refrigerant from being accumulated in the indoor heat exchanger 201. Steps S2 and S3 in Fig. 7 are executed substantially at the same time. The order of steps S2 and S3 may be reversed.

[0035] Next, the control unit 405 determines whether or not the temperature measured by the temperature sensor of the other device is decreased by the predetermined temperature or more (step S4). For example, in a case where only the temperature sensor Th1 is used as in Setting Example 5 of Fig. 5, the control unit 405 determines whether or not the temperature measured by the temperature sensor Th1 is decreased by the predetermined temperature (for example, 2°C or the like) or more from the temperature recorded in step S2. In a case where weighting is set for the plurality of sensors, for

example, a weighted average of the temperatures measured by the respective sensors may be obtained, and the determination in step S4 may be performed by the temperature. In a case where the weighting is set as in Setting Example 1 of Fig. 5, the control unit 405 determines whether or not the average value of the temperatures measured by the temperature sensors Th1 to Th4 is decreased by the predetermined temperature or more from the temperature recorded in step S2. For example, in a case where the weighting is set as in Setting Example 4 of Fig. 5, the control unit 405 determines whether or not the temperature calculated by $((\text{the temperature measured by the temperature sensor Th1}) \times 1 + (\text{the temperature measured by the temperature sensor Th2}) \times 0 + (\text{the temperature measured by the temperature sensor Th3}) \times 0 + (\text{the temperature measured by the temperature sensor Th4}) \times 0.5) / (1 + 0 + 0 + 0.5)$ is decreased by the predetermined temperature or more from the temperature recorded in step S2. In a case where the calculated temperature is decreased by the predetermined temperature or more from the standard temperature recorded in step S2 (step S4; Yes), the control unit 405 determines that it is necessary to execute the operation necessity determination and operates the fan 203 (step S6). For example, in a case of the weighting of Setting Example 8 in which the set temperature is 27°C, the control unit 405 activates the fan 203 in a case where the temperature measured by the temperature sensor Th1 of the remote controller 50 after the predetermined time has elapsed (for example, 10 minutes) is 23°C.

[0036] In a case where the calculated temperature is not decreased by the predetermined temperature or more from the standard temperature (step S4; No), the control unit 405 determines whether or not the fan 203 is stopped for the predetermined time or longer based on the time measured by the timer 403 (step S5). The state in which the fan 203 is stopped for the predetermined time or longer is a situation in which the temperatures measured by the temperature sensors Th1 to Th4 or the temperature calculated in accordance with the weighting of Fig. 5 do not satisfy the condition of step S4 for the predetermined time or longer. In a case where the predetermined time or longer has elapsed from the thermostat OFF state, the indoor temperature is expected to be decreased to some extent. Nevertheless, in a case where the temperatures measured by the temperature sensors Th1 to Th4 (in a case of Setting Example 4, the temperatures measured by the temperature sensors Th1 and Th4) is not decreased, the temperature sensor Th1 and the like may not be able to accurately measure the temperature of the room A. For example, in a case where the temperature sensor Th1 is exposed to sunlight, a temperature higher than the ambient air temperature (actual indoor temperature) may be measured even after 30 minutes or longer has elapsed from the thermostat OFF state. In this case, since it is considered that the reliability of the temperatures measured by the temperature sensors Th1 to Th4 is low, the fan 203 is operated to

stir and homogenize the air in the room A, and the temperature of the room A is measured by the temperature sensor 204 of the indoor unit 20. In a case where the fan 203 is stopped for the predetermined time or longer (step S5; Yes), the control unit 405 determines that it is necessary to execute the operation necessity determination, and operates the fan 203 (step S6). In a case where the fan 203 is not stopped for the predetermined time or longer (step S5; No), the processing after step S4 is repeated.

[0037] Next, the control unit 405 determines whether or not the predetermined time (for example, several minutes) has elapsed since the operation of the fan 203 is restarted based on the time measured by the timer 403 (step S7). The predetermined time in step S7 is a time required for the air in the room A to be homogenized. The predetermined time in step S7 and the predetermined time in step S5 may be the same as or different from each other. In a case where the predetermined time has not elapsed (step S7; No), the control unit 405 waits while operating the fan 203 until the predetermined time elapses.

[0038] In a case where the predetermined time has elapsed (step S7; Yes), the control unit 405 determines (operation necessity determination) whether or not the thermostat ON condition is satisfied (step S8). The thermostat ON condition is that the temperature measured by the temperature sensor 204 is lower than the set temperature by a predetermined temperature (for example, 1°C) or more. The control unit 405 acquires the temperature measured by the temperature sensor 204 through the sensor information acquisition unit 401 after the operation of the fan 203 is restarted and the predetermined time has elapsed, and compares the acquired temperature with the set temperature for the heating of the room A. The control unit 405 determines that the thermostat ON condition is satisfied when the temperature measured by the temperature sensor 204 is decreased by the predetermined temperature or more from the set temperature for the heating, and determines that the thermostat ON condition is not satisfied otherwise. In a case where the thermostat ON condition is not satisfied (step S8; No), the processing is repeated from step S2. That is, in a case where the control unit 405 determines that the thermostat ON condition is not satisfied, the control unit 405 records the temperatures measured by the temperature sensors Th1 to Th4 in the storage unit 404 and stops the fan 203 again. Then, the control unit 405 performs determination in step S4 on the basis of the temperature recorded at this time (instead of at the start of the thermostat OFF state), and performs determination in step S5 on the basis of the time at which the fan 203 is stopped at this time. In this way, the control unit 405 repeatedly executes steps S2 to S7 until the thermostat ON condition in step S8 is satisfied. Then, in a case where the thermostat ON condition is satisfied (step S8; Yes), the control unit 405 executes the thermostat ON control (step S9). For example, the control unit 405 returns the

opening degree of the expansion valve 202 to the opening degree before the thermostat OFF state and operates the fan 203. In the outdoor unit 10, the control device 14 restarts the operation of the compressor 11.

[0039] As described above, according to the present embodiment, the fan 203 is stopped in a case where the indoor unit 20 of the multi-type air conditioner 100 is in the thermostat OFF state during the heating operation. Accordingly, it is possible to prevent the condensation of the refrigerant and accumulation of the refrigerant in the indoor heat exchanger 201. As described with reference to Fig. 7, according to the present embodiment, even in a case where the fan 203 is stopped during the thermostat OFF state, the timing of setting thermostat ON state can be accurately determined by operating the fan 203 for only the predetermined time in a case where the conditions in step S4 or step S5 are satisfied. Accordingly, the comfort of the air conditioning can be improved as compared with the stop or the intermittent operation of the fan in the related art. For example, since the fan is stopped for a long time, the room is not overheated as in the case of the intermittent operation of the fan in the related art, and the room can be appropriately in the thermostat ON state. Therefore, it is possible to avoid a situation in which the foot are cooled but the room is not in the thermostat ON state.

[0040] The processing in Fig. 7 is a function realized by the processor provided in the control device 40 reading out and executing the program from the storage unit 404.

[0041] In addition, the components of the above-mentioned embodiment can be appropriately replaced with well-known components without departing from the scope of the present invention. The scope of the present invention is not limited to the above-mentioned embodiment, and the present invention can include various changes without departing from the scope of the present invention.

<Additional Notes>

[0042] The air conditioner and the control method described in each embodiment are understood, for example, as follows.

[0043]

(1) An air conditioner 100 according to a first aspect is a multi-type air conditioner including: an outdoor unit 10; a plurality of indoor units 20 to 23; and a control device 40, in which the outdoor unit 10 and the plurality of indoor units 20 to 23 are connected to each other by a refrigerant pipe, the indoor unit 20 includes an indoor heat exchanger 201, a fan 203, and a first temperature sensor 204, and is connected to second temperature sensors Th1 to Th4 provided in a room A that is an air conditioning target, and the control device 40 includes means (control unit 405, step S3) for stopping the fan 203 in a case where the indoor unit 20 that executes heating operation is in a

thermostat OFF state in which an indoor temperature reaches a set temperature and heat exchange in the indoor heat exchanger 201 is unnecessary, means (control unit 405, step S2) for storing temperatures measured by the second temperature sensors Th1 to Th4 in a case of the thermostat OFF state as a standard temperature, means (control unit 405, step S6) for restarting the operation of the fan 203 in a case where the temperatures measured by the second temperature sensors Th1 to Th4 is decreased by a predetermined temperature or more from the standard temperature after the fan is stopped (control unit 405, step S4), and means (control unit 405, step S8) for determining whether or not to switch from the thermostat OFF state to a thermostat ON state in which heat exchange is performed in the indoor heat exchanger based on a temperature measured by the first temperature sensor 204 in a case where a predetermined time elapses after restarting the operation of the fan 203 (control unit 405, step S7). Accordingly, even in a case where the fan is stopped for a long time in the thermostat OFF state, the thermostat ON state can be set at an appropriate timing. The comfort of the air conditioning can be maintained.

(2) The air conditioner 100 according to a second aspect is the air conditioner 100 of (1), in which the means for restarting the operation of the fan determines whether or not a predetermined time has elapsed while the fan is kept stopped after the fan is stopped, and restarts the operation of the fan in a case where the predetermined time has elapsed. Accordingly, the reliability of the temperature sensors Th1 to Th4 is evaluated, and in a case where it is considered that the reliability is decreased, the operation necessity determination can be performed.

(3) The air conditioner 100 according to a third aspect is the air conditioner of (1) to (2), in which a plurality of the second temperature sensors are provided, and the means for restarting the operation of the fan restarts the operation of the fan in a case where a reference temperature calculated from temperatures measured by the plurality of second temperature sensors is decreased by a predetermined temperature or more from the standard temperature. Accordingly, it is possible to determine whether or not to perform the operation necessity determination based on the temperature of the room calculated by using the plurality of sensors provided in the room.

(4) The air conditioner 100 according to a fourth aspect is the air conditioner of (1) to (3), in which the control device further includes means (setting receiving unit 402) for setting weighting for the temperatures measured by the plurality of second temperature sensors, and the means (control unit 405) for restarting the operation of the fan calculates the reference temperature by adding a weight based on the setting of the weighting to each of the tempera-

tures measured by a plurality of the first temperature sensors.

Accordingly, it is possible to perform weighting on the temperature measured by the temperature sensor provided at various positions in the room and determine whether or not to perform the operation necessity determination. For example, by setting to give priority to the temperature at the foot, the thermostat ON state can be set before the foot are cooled during the thermostat OFF state.

(5) The air conditioner 100 according to a fifth aspect is the air conditioner of (1) to (4), in which the plurality of second temperature sensors are provided at different heights.

Accordingly, the temperature at various heights in the room can be measured, and the result can be used for the switching control of the heating operation from the thermostat OFF state to the thermostat ON state.

(6) The air conditioner 100 according to a sixth aspect is the air conditioner of (1) to (5), in which the second temperature sensor is provided at a height of 0.3 m or less from a floor.

Accordingly, the temperature in the vicinity of the floor that is easily cooled during the heating operation can be measured.

(7) The air conditioner 100 according to a seventh aspect is the air conditioner of (1) to (6), in which the second temperature sensor is provided in a remote controller of the indoor unit.

Accordingly, the temperature at a certain height position in the room can be measured.

(8) A control method according to an eighth aspect is a control method of a multi-type air conditioner including an outdoor unit, a plurality of indoor units, and a control device, in which the outdoor unit and the plurality of indoor units are connected to each other by a refrigerant pipe, and the indoor unit includes an indoor heat exchanger, a fan, and a first temperature sensor, and is connected to a second temperature sensor provided in a room that is an air conditioning target, the control method including: a step of stopping the fan in a case where the indoor unit that executes heating operation is in a thermostat OFF state in which an indoor temperature reaches a set temperature and heat exchange in the indoor heat exchanger is unnecessary; a step of storing a temperature measured by the second temperature sensor in a case of the thermostat OFF state as a standard temperature; a step of restarting the operation of the fan in a case where the temperature measured by the second temperature sensor is decreased by a predetermined temperature or more from the standard temperature after the fan is stopped; and a step of determining whether or not to switch from the thermostat OFF state to a thermostat ON state in which heat exchange is performed in the indoor heat exchanger based on a temperature

measured by the first temperature sensor in a case where a predetermined time elapses after restarting the operation of the fan.

Industrial Applicability

[0044] According to the air conditioner and the control method, even in a case where the fan is stopped in the thermostat OFF state, the thermostat ON state can be set at an appropriate timing.

Reference Signs List

[0045]

10: outdoor unit
 11: compressor
 12: four-way valve
 13: outdoor heat exchanger
 14: control device
 20: indoor unit
 201: indoor heat exchanger
 202: expansion valve
 203: fan
 204: temperature sensor
 21: indoor unit
 211: indoor heat exchanger
 212: expansion valve
 213: fan
 214: temperature sensor
 22: indoor unit
 23: indoor unit
 30 to 39: pipe
 3A, 3B: joint
 40, 41: control device
 401: sensor information acquisition unit
 402: setting receiving unit
 403: timer
 404: storage unit
 405: control unit
 406: communication unit
 100, 100a: air conditioner
 A: room

Claims

1. A multi-type air conditioner comprising:

an outdoor unit;
 a plurality of indoor units; and
 a control device,
 wherein the outdoor unit and the plurality of indoor units are connected to each other by a refrigerant pipe,
 the indoor unit includes an indoor heat exchanger, a fan, and a first temperature sensor, and is connected to a second temperature sensor pro-

vided in a room that is an air conditioning target, and
 the control device includes

means for stopping the fan in a case where the indoor unit that executes heating operation is in a thermostat OFF state in which an indoor temperature reaches a set temperature and heat exchange in the indoor heat exchanger is unnecessary,
 means for storing a temperature measured by the second temperature sensor in a case of the thermostat OFF state as a standard temperature,
 means for restarting the operation of the fan in a case where the temperature measured by the second temperature sensor is decreased by a predetermined temperature or more from the standard temperature after the fan is stopped, and
 means for determining whether or not to switch from the thermostat OFF state to a thermostat ON state in which heat exchange is performed in the indoor heat exchanger based on a temperature measured by the first temperature sensor in a case where a predetermined time elapses after restarting the operation of the fan.

2. The air conditioner according to Claim 1, wherein the means for restarting the operation of the fan determines whether or not a predetermined time has elapsed while the fan is kept stopped after the fan is stopped, and restarts the operation of the fan in a case where the predetermined time has elapsed.

3. The air conditioner according to Claim 1 or 2,

wherein a plurality of the first temperature sensors are provided, and
 the means for restarting the operation of the fan restarts the operation of the fan in a case where a reference temperature calculated from temperatures measured by a plurality of the second temperature sensors is decreased by a predetermined temperature or more from the standard temperature.

4. The air conditioner according to Claim 3,

wherein the control device further includes means for setting weighting for the temperatures measured by the plurality of second temperature sensors, and
 the means for restarting the operation of the fan calculates the reference temperature by adding a weight based on the setting of the weighting to each of the temperatures measured by the plur-

ality of second temperature sensors.

5. The air conditioner according to Claim 3,
wherein the plurality of second temperature sensors
are provided at different heights. 5
6. The air conditioner according to Claim 1 or 2,
wherein the second temperature sensor is provided
at a height of 0.3 m or less from a floor. 10
7. The air conditioner according to Claim 1 or 2,
wherein the second temperature sensor is provided
in a remote controller of the indoor unit.
8. A control method of a multi-type air conditioner in- 15
cluding an outdoor unit, a plurality of indoor units, and
a control device, in which the outdoor unit and the
plurality of indoor units are connected to each other
by a refrigerant pipe, and the indoor unit includes an 20
indoor heat exchanger, a fan, and a first temperature
sensor, and is connected to a second temperature
sensor provided in a room that is an air conditioning
target, the control method comprising:

a step of stopping the fan in a case where the 25
indoor unit that executes heating operation is in
a thermostat OFF state in which an indoor tem-
perature reaches a set temperature and heat
exchange in the indoor heat exchanger is un-
necessary; 30
a step of storing a temperature measured by the
second temperature sensor as a standard tem-
perature in a case of the thermostat OFF state;
a step of restarting the operation of the fan in a
case where the temperature measured by the 35
second temperature sensor is decreased by a
predetermined temperature or more from the
standard temperature after the fan is stopped;
and
a step of determining whether or not to switch 40
from the thermostat OFF state to a thermostat
ON state in which heat exchange is performed in
the indoor heat exchanger based on a tempera-
ture measured by the first temperature sensor in
a case where a predetermined time elapses 45
after restarting the operation of the fan.

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FIG. 1

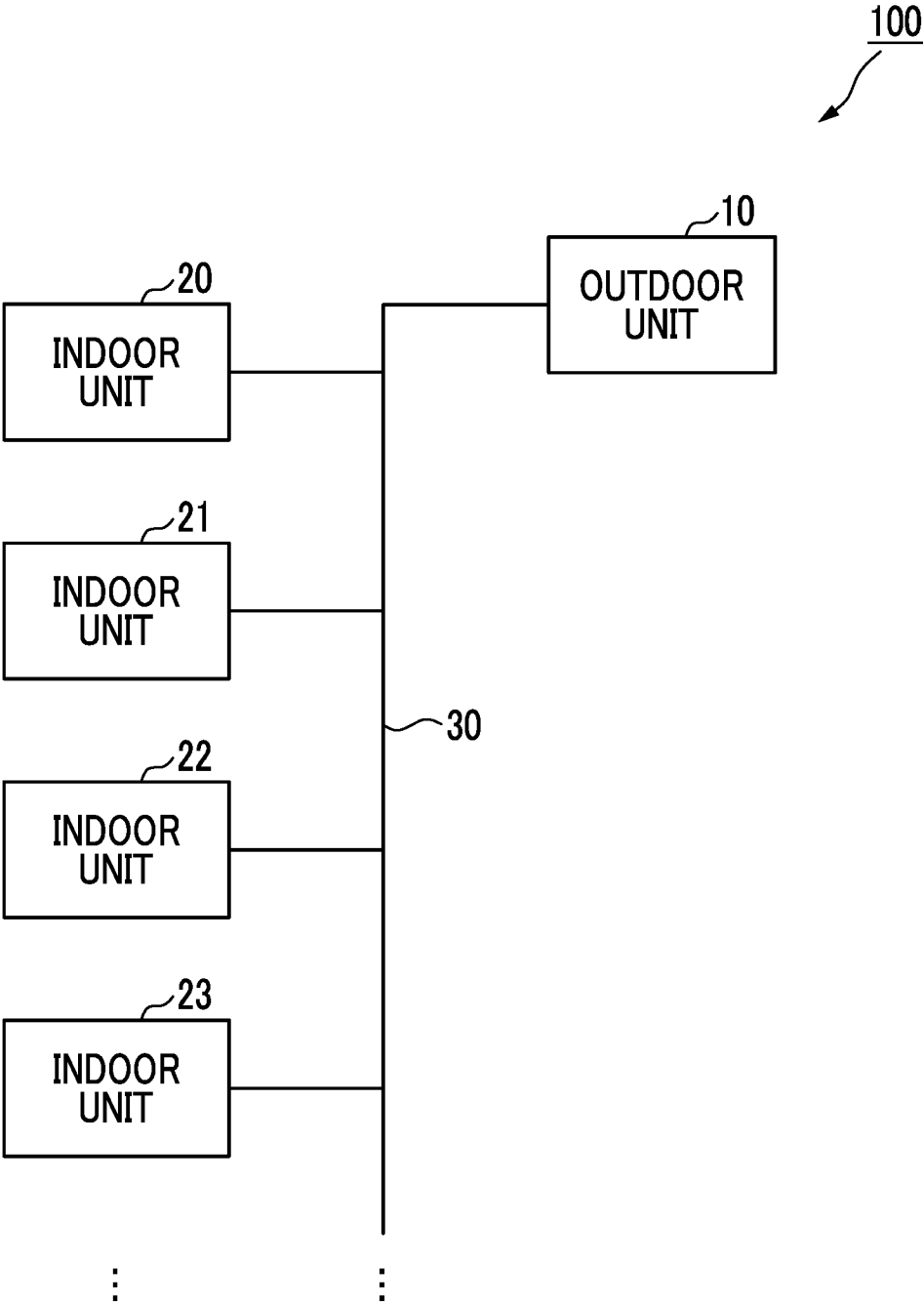


FIG. 2

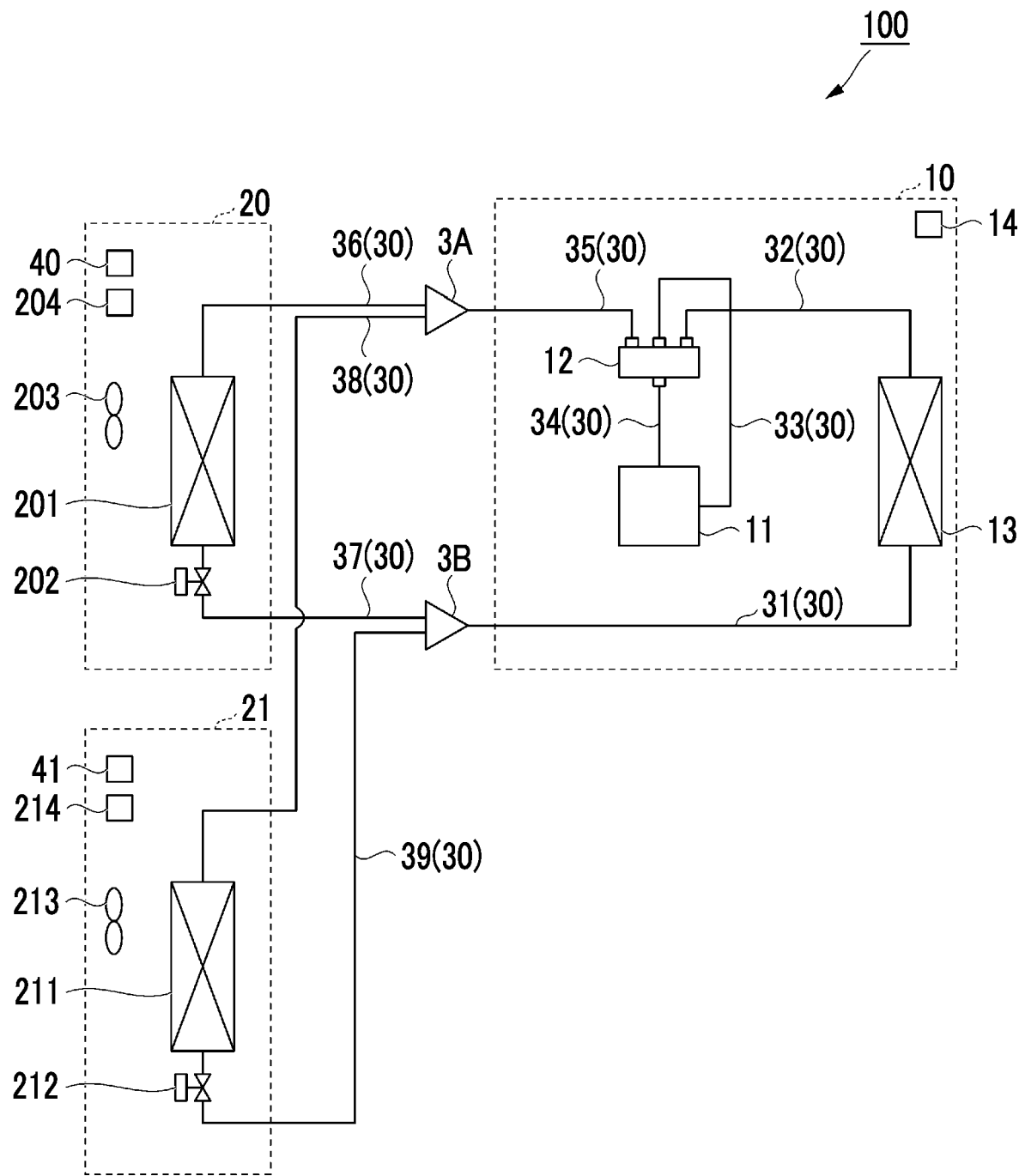


FIG. 3

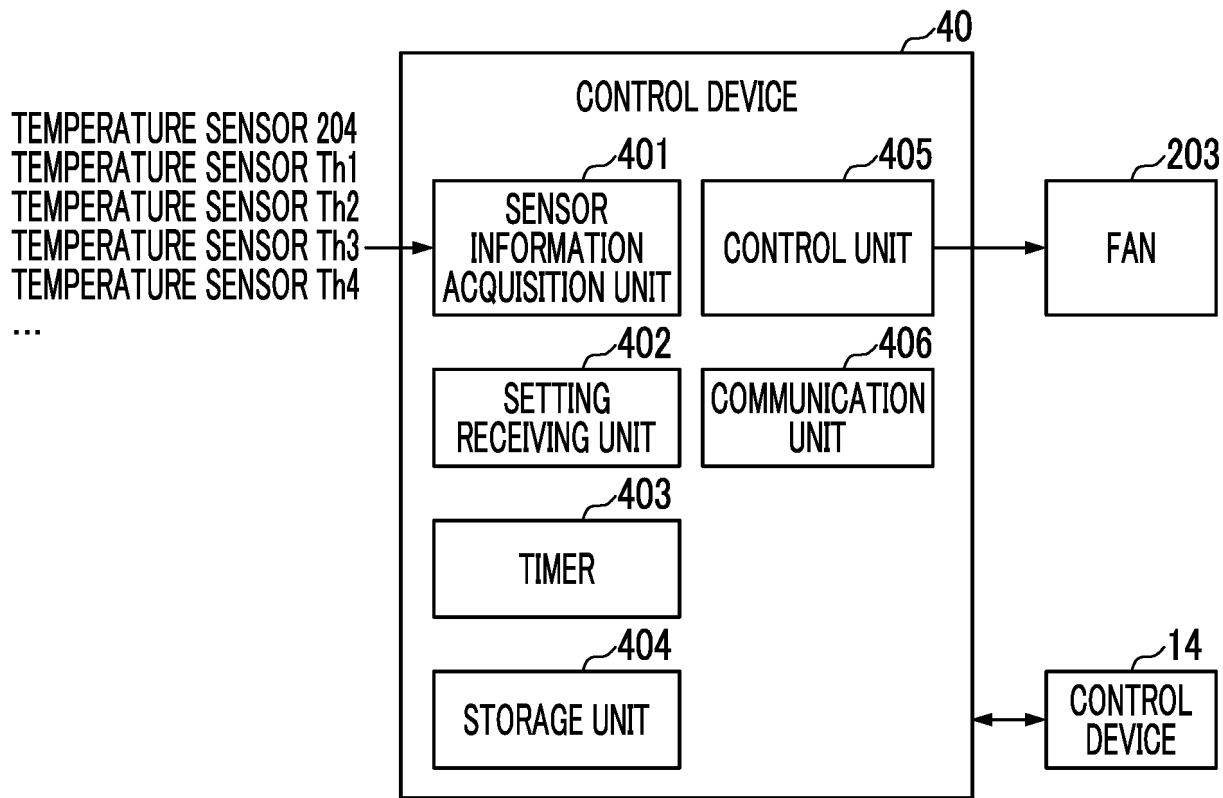


FIG. 4

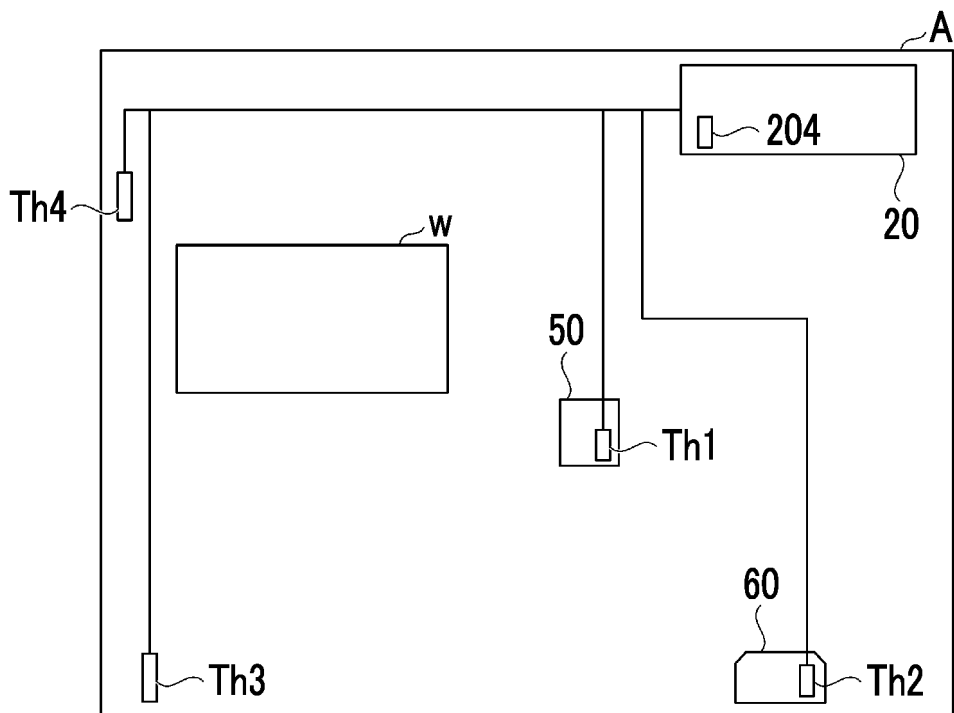


FIG. 5

	TEMPERATURE SENSOR Th1 (REMOTE CONTROLLER)	TEMPERATURE SENSOR Th2 (REFRIGERANT DETECTOR)	TEMPERATURE SENSOR Th3 (REMOTE THERMISTOR: FOOT)	TEMPERATURE SENSOR Th4 (REMOTE THERMISTOR: HIGH PLACE)
SETTING EXAMPLE 1	1	1	1	1
SETTING EXAMPLE 2	0	1	1	0
SETTING EXAMPLE 3	0.5	0.5	1	1
SETTING EXAMPLE 4	1	0	0	0.5
SETTING EXAMPLE 5	1	-	-	-
SETTING EXAMPLE 6	0	1	-	-
SETTING EXAMPLE 7	1	1	-	-
SETTING EXAMPLE 8	1	0	-	-

FIG. 6A

ROOM HEIGHT	TEMPERATURE SENSOR	DETECTION TEMPERATURE		DIFFERENCE
		IMMEDIATELY BEFORE STOP OF OPERATION	10 MINUTES HAS ELAPSED AFTER STOP	
UPPER PART	INDOOR UNIT	28.0	28.0	0.0
MIDDLE PART	REMOTE CONTROLLER	25.0	24.0	-1.0
LOWER PART	REFRIGERANT DETECTOR	20.0	18.0	-2.0

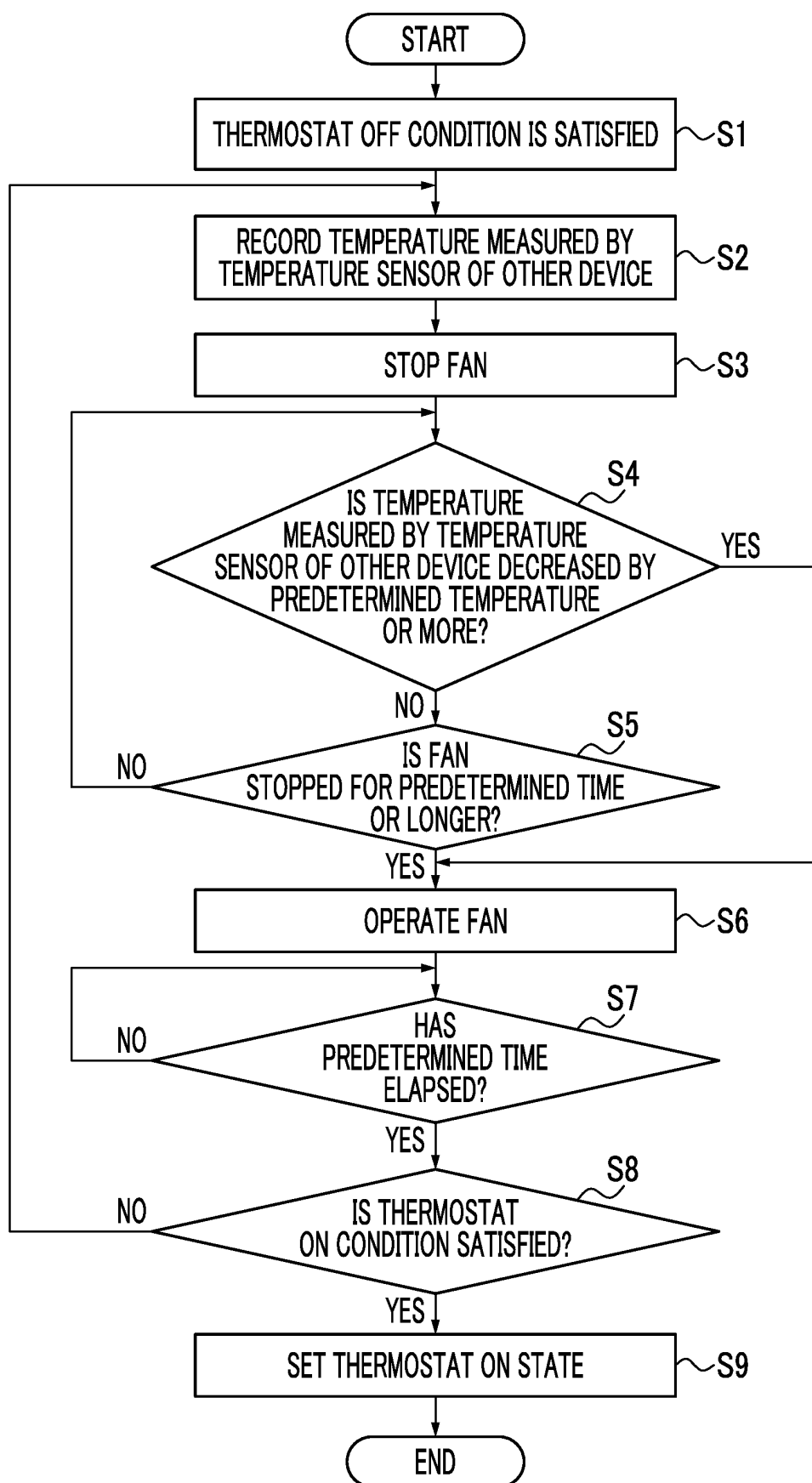
FIG. 6B

ROOM HEIGHT	TEMPERATURE SENSOR	DETECTION TEMPERATURE		DIFFERENCE
		IMMEDIATELY BEFORE STOP OF OPERATION	10 MINUTES HAS ELAPSED AFTER STOP	
UPPER PART	INDOOR UNIT	28.0	28.0	0.0
MIDDLE PART	REMOTE CONTROLLER	25.0	24.0	-1.0
LOWER PART	REFRIGERANT DETECTOR	20.0	17.0	-3.0

FIG. 6C

ROOM HEIGHT	TEMPERATURE SENSOR	DETECTION TEMPERATURE		DIFFERENCE
		IMMEDIATELY BEFORE STOP OF OPERATION	10 MINUTES HAS ELAPSED AFTER STOP	
UPPER PART	INDOOR UNIT	28.0	28.0	0.0
MIDDLE PART	REMOTE CONTROLLER	25.0	23.0	-2.0
LOWER PART	REFRIGERANT DETECTOR	20.0	16.0	-4.0

FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/026259

A. CLASSIFICATION OF SUBJECT MATTER**F24F 11/74**(2018.01)i; **F24F 11/86**(2018.01)i

FI: F24F11/74; F24F11/86

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)

F24F11/74; 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 1971-2023

Registered utility model specifications of Japan 1996-2023

Published registered utility model applications of Japan 1994-2023

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 8-21668 A (MITSUBISHI ELECTRIC CORP.) 23 January 1996 (1996-01-23) paragraphs [0042], [0043], fig. 13	1-8
A	JP 2003-287258 A (DAIKIN IND., LTD.) 10 October 2003 (2003-10-10) paragraphs [0013]-[0048], fig. 1-6	1-8
A	JP 11-101495 A (MITSUBISHI HEAVY IND., LTD.) 13 April 1999 (1999-04-13) entire text, all drawings	1-8
A	JP 2011-149615 A (MITSUBISHI ELECTRIC CORP.) 04 August 2011 (2011-08-04) entire text, all drawings	1-8

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

30 August 2023

Date of mailing of the international search report

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Name and mailing address of the ISA/JP

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Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/026259

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 8-21668 A	23 January 1996	(Family: none)	
JP 2003-287258 A	10 October 2003	EP 1491826 A1 paragraphs [0020]-[0078], fig. 1-6 CN 1643305 A WO 2003/083377 A1	
JP 11-101495 A	13 April 1999	(Family: none)	
JP 2011-149615 A	04 August 2011	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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- JP 2004144377 A [0004]