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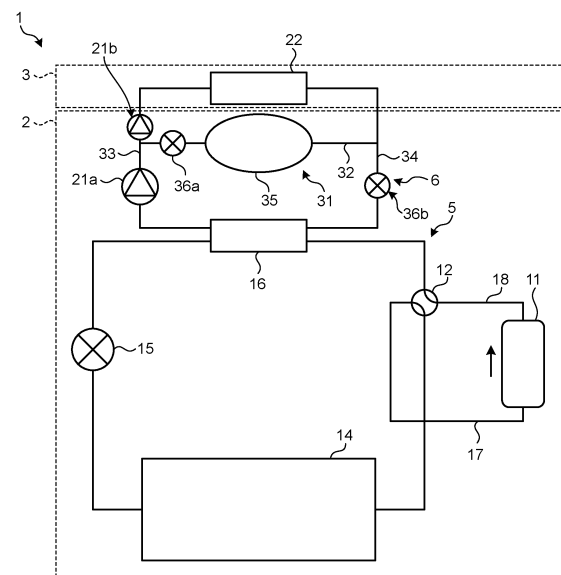
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(54) **AIR CONDITIONER**

(57) An air conditioner according to an embodiment includes a compressor that compresses a refrigerant, an indoor unit that performs heat exchange between air inside a room and the refrigerant, an outdoor unit that performs heat exchange between outdoor air and the refrigerant, a heat storage unit that performs heat exchange with the refrigerant, a room temperature sensor that detects an indoor temperature that is a temperature inside the room, and a control unit that drives the compressor based on a difference between the indoor temperature and a set temperature, and that also allows the heat storage unit to perform heat exchange when the difference of the set temperature falls below a predetermined value.

FIG.1A



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Description

Technical Field

[0001] The present disclosure relates to an air conditioner.

Background Art

[0002] Conventionally, in an air conditioner, air conditioning capacity is adjusted by operating a compressor at a rotational speed (frequency) in accordance with a temperature difference between a detected indoor temperature and a target indoor temperature (set temperature), and control is performed such that an indoor temperature approaches the set temperature. Specifically, in a case where the indoor temperature has approached the set temperature, control is performed such that the air conditioning capacity is reduced by decreasing the rotational speed of the compressor and the indoor temperature does not deviate from the vicinity of the set temperature.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Laid-open Patent Publication No. 2002-115923

Summary of invention

Technical Problem

[0004] However, in the above described conventional technology, when control is performed such that the indoor temperature approaching the set temperature does not deviate from the vicinity of the set temperature, there is a problem in that comfort is impaired due to a frequent occurrence of thermo off corresponding to a stop state of the compressor in a case where an air conditioning load falls below the air conditioning capacity at the time of operation of the compressor at the minimum rotational speed.

[0005] For example, in a case where the air conditioning load falls below the air conditioning capacity in a state of the compressor that is being operated at the minimum rotational speed, the compressor is stopped due to an inability to reduce the air conditioning capacity any more. Then, an air conditioning operation is restarted at the time of a deviation point of the set temperature after the indoor temperature is changed due to the stop of the air conditioning operation. In a case where this kind of intermittent operation is repeated, a variation in the indoor temperature with respect to the set temperature becomes large, and thus comfort is impaired.

[0006] Accordingly, the disclosed technology has been conceived in light of the circumstances described above

and an object thereof is to provide an air conditioner that suppresses a decrease in comfort.

Solution to Problem

[0007] In one aspect of the disclosed embodiment, an air conditioner includes a compressor that compresses a refrigerant, an indoor unit that performs heat exchange between air inside a room and the refrigerant, an outdoor unit that performs heat exchange between outdoor air and the refrigerant, a heat storage unit that performs heat exchange with the refrigerant, a room temperature sensor that detects an indoor temperature that is a temperature inside the room, and a control unit that drives the compressor based on a difference between the indoor temperature and a set temperature, and that also allows the heat storage unit to perform heat exchange when the difference falls below a predetermined value.

Advantageous Effects of Invention

[0008] It is possible to suppress a decrease in comfort.

Brief Description of Drawings

[0009]

FIG. 1A is a circuit diagram illustrating one example of an air conditioner according to an embodiment.

FIG. 1B is a circuit diagram illustrating one example of the air conditioner according to the embodiment.

FIG. 2 is a block diagram illustrating one example of the air conditioner according to the embodiment.

FIG. 3 is a flowchart illustrating an example of an operation of the air conditioner according to the embodiment.

FIG. 4 is an explanation diagram for explaining a relationship between a temperature of a heat storage material and an amount of stored heat.

FIG. 5 is an explanation diagram for explaining an example of operating the air conditioner according to the embodiment.

FIG. 6 is an explanation diagram for explaining a reduction in the capacity using the stored heat.

FIG. 7 is an explanation diagram for explaining an example of operating a conventional air conditioner.

FIG. 8 is a circuit diagram illustrating one example of an air conditioner according to a modification.

Embodiments for Carrying Out the Invention

[0010] In the following, preferred embodiments of an air conditioner will be described in detail below with reference to the accompanying drawings. Furthermore, components that are the same as those in the embodiments are assigned the same reference numerals, and repeated explanation will be omitted. In addition, the air conditioner described below in the embodiment is only

one example and is not limited by the embodiment. Moreover, each of the embodiments can be used in any appropriate combination as long as they do not conflict with each other.

[0011] FIG. 1A is a circuit diagram illustrating one example of an air conditioner according to the embodiment. As illustrated in FIG. 1A, an air conditioner 1 includes an outdoor unit 2 and an indoor unit 3. The outdoor unit 2 is installed in an outdoor location. The indoor unit 3 is installed in an interior of a room that is cooled and heated by the air conditioner 1. The air conditioner 1 further includes a refrigerant circuit 5 and a water circuit 6.

[0012] In the refrigerant circuit 5, a flow channel through which a refrigerant circulates is formed. The refrigerant contained in the refrigerant circuit 5 is, for example, R290 (propane). However, the refrigerant contained in the refrigerant circuit 5 is not limited to R290, and may also be, for example, R32, R1234yf, or the like.

[0013] In the water circuit 6, a flow channel through which a heat medium (water in the explanation below) circulates as another refrigerant is formed. Furthermore, the heat medium circulating through the water circuit 6 may be an antifreeze liquid, or the like.

[0014] The refrigerant circuit 5 is arranged in an interior portion of the outdoor unit 2. The refrigerant circuit 5 includes a compressor 11, a four-way valve 12, an outdoor heat exchanger 14, an expansion valve 15, and an intermediate heat exchanger 16.

[0015] The compressor 11 includes an intake pipe 17 and a discharge pipe 18. The compressor 11 compresses a low pressure gas phase refrigerant that is supplied via the intake pipe 17, and discharges a high pressure gas phase refrigerant that has been generated as a result of the low pressure gas phase refrigerant being compressed via the discharge pipe 18.

[0016] The four-way valve 12 is a valve to which four liquid pipes connected to the intake pipe 17 and the discharge pipe 18 that are included in the compressor 11, connected to the intermediate heat exchanger 16, and connected to the outdoor heat exchanger 14 are connected, and that is used to switch the flow directions of the refrigerant in the refrigerant circuit 5 between heating operation time and cooling operation time. As in the example illustrated in the drawing, at the heating operation time, the four-way valve 12 switches the flow directions of the refrigerant such that the refrigerant received from the discharge pipe 18 is allowed to flow into the liquid pipe that is connected to the intermediate heat exchanger 16 and the refrigerant received from the liquid pipe that is connected to the outdoor heat exchanger 14 is allowed to flow into the intake pipe 17. At the cooling operation time, the four-way valve 12 switches the flow directions of the refrigerant such that the refrigerant received from the discharge pipe 18 is allowed to flow into the liquid pipe that is connected to the outdoor heat exchanger 14 and the refrigerant received from the liquid pipe that is connected to the intermediate heat exchanger 16 is allowed to flow into the intake pipe 17.

In a description below, the state of the four-way valve 12 that has been switched the heating operation time or the cooling operation is referred to as a heating mode or a cooling mode, respectively.

[0017] The outdoor heat exchanger 14 is connected to the expansion valve 15. The intermediate heat exchanger 16 is connected to the expansion valve 15.

[0018] The water circuit 6 includes pumps 21a and 21b, and an indoor heat exchanger 22. The pumps 21a and 21b are arranged in an interior portion of the outdoor unit 2. The pump 21a is connected to the intermediate heat exchanger 16 through a heat storage circuit 31 that will be described later. The pump 21b is connected between the heat storage circuit 31 and the indoor heat exchanger 22. The pump 21a is a pump that allows water supplied from the intermediate heat exchanger 16 to circulate through the heat storage circuit 31 and the water circuit 6. The pump 21b is a pump that allows water supplied from the heat storage circuit 31 to circulate through the indoor heat exchanger 22. The indoor heat exchanger 22 is arranged in the interior portion of the indoor unit 3. The indoor heat exchanger 22 is connected to a heat storage unit 35 and the intermediate heat exchanger 16.

[0019] The water circuit 6 included in the air conditioner 1 further includes the heat storage circuit 31. The heat storage circuit 31 is arranged in the interior portion of the outdoor unit 2. In the heat storage circuit 31, a heat storage purpose flow channel 32 is formed. A first flow channel 33 that is disposed between the intermediate heat exchanger 16 and the indoor heat exchanger 22 and that is included in the water circuit 6 is connected to a second flow channel 34 that is disposed between the indoor heat exchanger 22 and the intermediate heat exchanger 16 via the heat storage purpose flow channel 32.

[0020] The first flow channel 33 disposed between the pump 21a and the indoor heat exchanger 22 is connected to the second flow channel 34 that is disposed between the indoor heat exchanger 22 and the intermediate heat exchanger 16 via the heat storage purpose flow channel 32. The heat storage circuit 31 includes the heat storage unit 35 and an electromagnetic valve 36a. The second flow channel 34 includes an electromagnetic valve 36b.

[0021] A heat storage material is filled in the interior portion of the heat storage unit 35. The heat storage unit 35 stores therein heat received from water in a case where the temperature of the water flowing through the heat storage purpose flow channel 32 is higher than the temperature of the heat storage unit 35. Furthermore, the heat storage unit 35 releases the stored heat to water in a case where the temperature of the water flowing through the heat storage purpose flow channel 32 is lower than the temperature of the heat storage unit 35.

[0022] The electromagnetic valve 36a is opened such that the first flow channel 33 and the second flow channel 34 are connected by way of the heat storage purpose flow channel 32, or is closed the heat storage purpose flow channel 32 such that the first flow channel 33 and the

second flow channel 34 are not connected. The electromagnetic valve 36b is opened such that a portion between the indoor heat exchanger 22 and the heat storage unit 35 is connected to the intermediate heat exchanger 16 by way of the second flow channel 34, or is closed such that a portion between the indoor heat exchanger 22 and the heat storage unit 35 is not connected to the intermediate heat exchanger 16.

[0023] In this way, in the water circuit 6, the indoor heat exchanger 22 and the heat storage unit 35 are connected in parallel. In addition, in the water circuit 6, it is possible to control the flow channel of water contained in the circuit by the movements of the pumps 21a and 21b and the opening and closing of the electromagnetic valves 36a and 36b.

[0024] For example, in the water circuit 6, it is possible to allow water to circulate between the intermediate heat exchanger 16 and the indoor heat exchanger 22 by operating the pumps 21a and 21b to close the electromagnetic valve 36a and open the electromagnetic valve 36b. Furthermore, in the water circuit 6, it is possible to allow the water received from the intermediate heat exchanger 16 to circulate between the indoor heat exchanger 22 and the heat storage unit 35 by operating the pumps 21a and 21b to open the electromagnetic valves 36a and 36b. In the water circuit 6, it is possible to allow the water to circulate between the intermediate heat exchanger 16 and the heat storage unit 35 by operating the pump 21a to stop the pump 21b and open the electromagnetic valves 36a and 36b. Furthermore, in the water circuit 6, it is possible to allow the water to circulate between the heat storage unit 35 and the indoor heat exchanger 22 by stopping the pump 21a, operating the pump 21b, opening the electromagnetic valve 36a, and closing the electromagnetic valve 36b.

[0025] Moreover, the water circuit 6 may be constituted such that the indoor heat exchanger 22 and the heat storage unit 35 are connected in series. FIG. 1B is a circuit diagram illustrating one example of the air conditioner according to the embodiment, and is, more specifically, one example of a water circuit 6a in which the indoor heat exchanger 22 and the heat storage unit 35 are connected in series.

[0026] As illustrated in FIG. 1B, the water circuit 6a includes a pump 21c and the indoor heat exchanger 22. The pump 21c is arranged in an interior portion of an outdoor unit 2a. The pump 21c is connected between the intermediate heat exchanger 16 and the indoor heat exchanger 22. The pump 21c is a pump that allows the water supplied from the intermediate heat exchanger 16 to circulate through the indoor heat exchanger 22. The indoor heat exchanger 22 is connected to the intermediate heat exchanger 16 via a second flow channel 34a and a heat storage circuit 31a.

[0027] The second flow channel 34a includes an electromagnetic valve 36c. The heat storage circuit 31a is arranged in the interior portion of the outdoor unit 2a. In the heat storage circuit 31a, a heat storage purpose flow

channel 32a is formed. The heat storage purpose flow channel 32a includes an electromagnetic valve 36d and the heat storage unit 35.

[0028] In this way, in the water circuit 6a in which the indoor heat exchanger 22 and the heat storage unit 35 are connected in series, it is possible to control the flow channel of the water contained in the circuit due to the opening and closing of the electromagnetic valves 36c and 36d. For example, in the water circuit 6a, it is possible to allow water to circulate between the intermediate heat exchanger 16 and the indoor heat exchanger 22 by opening the electromagnetic valve 36c and closing the electromagnetic valve 36d. Furthermore, in the water circuit 6a, it is possible to allow the water received from the intermediate heat exchanger 16 to sequentially circulate through the indoor heat exchanger 22 and the heat storage unit 35 in this order by closing the electromagnetic valve 36c and opening the electromagnetic valve 36d.

[0029] Furthermore, in a description below, the pumps 21a, 21b, and 21c are collectively referred to as a pump 21 in a case where the pumps 21a, 21b, and 21c are not distinguished each other. In a similar manner, the electromagnetic valves 36a, 36b, 36c, and 36d are collectively referred to as an electromagnetic valve 36 in a case where the electromagnetic valves 36a, 36b, 36c, and 36d are not distinguished each other.

[0030] FIG. 2 is a block diagram illustrating one example of the air conditioner 1 according to the embodiment. As illustrated in FIG. 2, the air conditioner 1 is electrically connected to the compressor 11, the four-way valve 12, the electromagnetic valve 36, an outdoor fan 41, an indoor fan 42, a room temperature sensor 37, the pump 21, and a heat storage unit sensor 38, and includes a control device 43 that performs control of each of the units.

[0031] The outdoor fan 41 is arranged in an interior portion of the outdoor unit 2. The outdoor fan 41 is controlled by the control device 43, and sends outside air such that the outside air is thermally brought into contact with the outdoor heat exchanger 14. The indoor fan 42 is arranged in an interior portion of the indoor unit 3. The indoor fan 42 is controlled by the control device 43, and sends air inside a room such that the air inside the room is thermally brought into contact with the indoor heat exchanger 22, and also, the air inside the room that has been thermally brought into contact with the indoor heat exchanger 22 is blown into the interior of the room from the indoor unit 3.

[0032] The room temperature sensor 37 is a temperature sensor that detects an indoor temperature that is a temperature inside the room. The heat storage unit sensor 38 is various kinds of sensors related to detection of an amount of stored heat that has been stored in the heat storage unit 35. For example, the heat storage unit sensor 38 is a temperature sensor for detecting the temperature of the heat storage unit 35, a temperature sensor for detecting the temperature of the water flowing through

the heat storage circuit 31, a flow rate detection sensor for detecting the flow rate of the water flowing through the heat storage circuit 31, or the like.

[0033] The control device 43 is a computer as one example of the control unit, and includes a storage device 44 and a CPU 45. The storage device 44 stores therein a computer program installed in the control device 43, and stores therein the information that is used by the CPU 45. The CPU 45 performs information processing by executing the computer program installed in the control device 43, and controls the operation of the air conditioner 1.

[0034] The control device 43 controls the compressor 11, the four-way valve 12, the electromagnetic valve 36, the outdoor fan 41, the indoor fan 42, and the pump 21 in response to a reception of setting content set by the operating unit (not illustrated) (a heating operation or a cooling operation and the set temperature thereof) and the detection result obtained by the room temperature sensor 37 and the heat storage unit sensor 38. The storage device 44 stores therein the minimum compressor rotational speed at the time at which the compressor 11 is driven. The minimum compressor rotational speed is a value unique to the compressor 11, and is the lowest rotational speed that is predetermined as the specification of the air conditioner 1 indicating, for example, the minimum rotational speed allowable as the specification of the compressor 11, or the like. The compressor 11 is not able to appropriately compress a low pressure gas phase refrigerant at a compressor rotational speed that is lower than the minimum compressor rotational speed, but is able to appropriately compress the low pressure gas phase refrigerant at a compressor rotational speed that is equal to or greater than the minimum compressor rotational speed.

[0035] The operation of the air conditioner 1 performed under the control of the control device 43 includes the cooling operation and the heating operation.

[Cooling operation]

[0036] The cooling operation is performed when, for example, the air conditioner 1 is operated by a user. The control device 43 controls the four-way valve 12 when the air conditioner 1 performs the cooling operation, and switches the four-way valve 12 to the cooling mode. The control device 43 calculates the rotational speed of the compressor 11 on the basis of a temperature difference between the set temperature that has been set by the user and the room temperature inside a room, and controls the compressor 11, so that the control device 43 compresses, at the calculated rotational speed, the low pressure gas phase refrigerant that has been supplied via the intake pipe 17. The low pressure gas phase refrigerant changes its state to the high pressure gas phase refrigerant as a result of the low pressure gas phase refrigerant being compressed by the compressor 11. The compressor 11 discharges the high pressure gas phase refrigerant to the discharge pipe 18. The four-way

valve 12 supplies the high pressure gas phase refrigerant that has been discharged to the discharge pipe 18 to the outdoor heat exchanger 14 as a result of the four-way valve 12 being changed to the cooling mode.

[0037] The control device 43 controls the outdoor fan 41, and sends outside air such that the outside air is brought into thermally contact with the outdoor heat exchanger 14. The outdoor heat exchanger 14 performs heat exchange between the high pressure gas phase refrigerant supplied from the four-way valve 12 and the outside air, cools the high pressure gas phase refrigerant, and heats the outside air. The high pressure gas phase refrigerant changes its state to the high pressure liquid phase refrigerant that is in a supercooled state. In other words, the outdoor heat exchanger 14 functions as a condenser when the air conditioner 1 performs the cooling operation. The outdoor heat exchanger 14 further supplies the high pressure liquid phase refrigerant to the expansion valve 15.

[0038] The expansion valve 15 adjusts the flow rate of the refrigerant flowing from the outdoor heat exchanger 14 to the intermediate heat exchanger 16, and expands the high pressure liquid phase refrigerant supplied from the outdoor heat exchanger 14. The high pressure liquid phase refrigerant changes its state to the low pressure gas-liquid two phase refrigerant that is in a state in which the degree of humidity is high as a result of the high pressure liquid phase refrigerant being expanded. The expansion valve 15 further supplies the low pressure gas-liquid two phase refrigerant to the intermediate heat exchanger 16.

[0039] The intermediate heat exchanger 16 performs heat exchange between the low pressure gas-liquid two phase refrigerant supplied from the expansion valve 15 and the water circulating through the water circuit 6, and heats the low pressure gas-liquid two phase refrigerant. The low pressure gas-liquid two phase refrigerant changes its state to the low pressure gas phase refrigerant as a result of the low pressure gas-liquid two phase refrigerant being heated by the intermediate heat exchanger 16. In other words, the intermediate heat exchanger 16 functions as an evaporator when the air conditioner 1 performs the cooling operation. The intermediate heat exchanger 16 further supplies the low pressure gas phase refrigerant to the four-way valve 12. The four-way valve 12 supplies the low pressure gas phase refrigerant supplied from the intermediate heat exchanger 16 to the compressor 11 via the intake pipe 17 as a result of the four-way valve 12 being switched to the cooling mode.

[0040] The control device 43 controls the electromagnetic valve 36 when the air conditioner 1 performs the cooling operation, and prevents water from flowing through the heat storage purpose flow channel 32. The pump 21 supplies the water cooled by the intermediate heat exchanger 16 to the indoor heat exchanger 22, and allows the water to circulate through the water circuit 6. The indoor heat exchanger 22 heats the water by per-

forming heat exchange between the water supplied from the pump 21 and the air inside a room in which the indoor unit 3 is installed, and cools the air inside the room. The heated water is supplied to the intermediate heat exchanger 16 as a result of the water circulating through the water circuit 6. The control device 43 controls the indoor fan 42, and sends the air inside the room such that the air inside the room is brought into thermally contact with the indoor heat exchanger 22, and also, the air cooled by the indoor heat exchanger 22 is blown into the interior of the room. In other words, the indoor unit 3 cools the interior of the room as a result of the indoor heat exchanger 22 cooling the air inside the room.

[Heating operation]

[0041] The heating operation is performed when, for example, the air conditioner 1 is operated by the user. The control device 43 controls the four-way valve 12 when the air conditioner 1 performs the heating operation, and switches the four-way valve 12 to the heating mode. The control device 43 calculates a rotational speed on the basis of a temperature difference between the set temperature that has been set by the user and the room temperature inside the room, and controls the compressor 11, so that the control device 43 compresses, at the calculated rotational speed, the low pressure gas phase refrigerant that has been supplied via the intake pipe 17. The low pressure gas phase refrigerant changes its state to the high pressure gas phase refrigerant as a result of the low pressure gas phase refrigerant being compressed by the compressor 11. The compressor 11 discharges the high pressure gas phase refrigerant to the discharge pipe 18. The four-way valve 12 supplies the high pressure gas phase refrigerant that has been discharged to the discharge pipe 18 to the intermediate heat exchanger 16 as a result of the four-way valve 12 being switched to the heating mode.

[0042] The intermediate heat exchanger 16 performs heat exchange between the high pressure gas phase refrigerant supplied from the four-way valve 12 and the water circulating through the water circuit 6, heats the water, and cools the high pressure gas phase refrigerant. The high pressure gas phase refrigerant changes its state to the high pressure liquid phase refrigerant that is in a supercooled state as a result of the high pressure gas phase refrigerant being cooled by the intermediate heat exchanger 16. In other words, the intermediate heat exchanger 16 functions as a condenser when the air conditioner 1 performs the heating operation. The intermediate heat exchanger 16 further supplies the high pressure liquid phase refrigerant to the expansion valve 15.

[0043] The expansion valve 15 adjusts the flow rate of the refrigerant flowing from the intermediate heat exchanger 16 to the outdoor heat exchanger 14, and expands the high pressure liquid phase refrigerant supplied from the outdoor heat exchanger 14. The high pressure

liquid phase refrigerant changes its state to the low pressure gas-liquid two phase refrigerant that is in a state in which the degree of humidity is high as a result of the high pressure liquid phase refrigerant being expanded.

5 The expansion valve 15 further supplies the low pressure gas-liquid two phase refrigerant to the outdoor heat exchanger 14.

[0044] The control device 43 controls the outdoor fan 41, and sends outside air such that the outside air is brought into thermally contact with the outdoor heat exchanger 14. The outdoor heat exchanger 14 performs heat exchange between the low pressure gas-liquid two phase refrigerant supplied from the expansion valve 15 and the low pressure gas-liquid two phase refrigerant, and cools the outside air. The low pressure gas-liquid two phase refrigerant changes its state to the low pressure gas phase refrigerant that is in a state in which the degree of humidity is low. In other words, the outdoor heat exchanger 14 functions as a condenser when the air conditioner 1 performs the heating operation. The outdoor heat exchanger 14 further supplies the low pressure gas phase refrigerant to the four-way valve 12. As a result of the four-way valve 12 being switched to the heating mode, the four-way valve 12 supplies the low pressure gas phase refrigerant supplied from the outdoor heat exchanger 14 to the intake pipe 17, and supplies the low pressure gas phase refrigerant to the compressor 11 via the intake pipe 17.

[0045] The pump 21 supplies the water heated by the intermediate heat exchanger 16 to the indoor heat exchanger 22, and allows the water to circulate through the water circuit 6. The indoor heat exchanger 22 cools the water by performing heat exchange between the water supplied from the pump 21 and the air inside the room in which the indoor unit 3 has been installed, and heats the air inside the room. The heated water is supplied to the intermediate heat exchanger 16 by allowing the water to circulate through the water circuit 6. The control device 43 controls the indoor fan 42, and sends the air inside the room such that the air inside the room is brought into thermally contact with the indoor heat exchanger 22, and also, the air heated by the outdoor unit 2 is blown into the interior of the room. In other words, the indoor unit 3 heats the interior of the room as a result of the indoor heat exchanger 22 heating the air inside the room.

[0046] The control device 43 switches among a heating only operation, a heating and heat storage operation, and a heat storage heating operation when the air conditioner 1 performs the heating operation on the basis of the temperature difference between the set temperature and the room temperature inside the room.

[0047] Here, the heating only operation is, for example, an operation mode for allowing the water heated by the intermediate heat exchanger 16 to circulate through only the indoor heat exchanger 22 by operating the pumps 21a and 21b, blocking the electromagnetic valve 36a, and releasing the electromagnetic valve 36b. In this operation mode, output power (amount of heat) trans-

ferred from the refrigerant circuit 5 disposed on the outdoor unit 2 side via the intermediate heat exchanger 16 is output to the interior of the room from the indoor heat exchanger 22 without any change.

[0048] Furthermore, the heating and heat storage operation is, for example, an operation mode for allowing the water received from the intermediate heat exchanger 16 to circulate through the indoor heat exchanger 22 and the heat storage unit 35 by operating the pumps 21a and 21b and opening the electromagnetic valves 36a and 36b. In this operation mode, output power (amount of heat) transferred from the refrigerant circuit 5 disposed on the outdoor unit 2 side via the intermediate heat exchanger 16 is output to the indoor heat exchanger 22 and the heat storage unit 35.

[0049] Furthermore, the heat storage heating operation is, for example, an operation mode for allowing the water to circulate between the heat storage unit 35 and the indoor heat exchanger 22 by stopping the pump 21a, operating the pump 21b, opening the electromagnetic valve 36a, and closing the electromagnetic valve 36b. Furthermore, in this operation mode, drive of the compressor 11 is stopped, and a refrigeration cycle in the refrigerant circuit 5 is stopped. Accordingly, in this operation mode, the heat stored by the heat storage unit 35 is output from the indoor heat exchanger 22 while stopping the refrigeration cycle in the refrigerant circuit 5.

[0050] In the following, the switching operation among the heating only operation, the heating and heat storage operation, and the heat storage heating operation that are controlled by the control device 43 will be described in detail. FIG. 3 is a flowchart illustrating an example of the operation performed by the air conditioner 1 according to the embodiment.

[0051] As illustrated in FIG. 3, when the heating operation for driving the compressor 11 performed on the basis of a temperature difference between the indoor temperature and the set temperature is started, the control device 43 determines whether or not the heating capacity of the air conditioner 1 exceeds the air conditioning load on the basis of the temperature difference (Step S1). The heating capacity may be restated as an amount of heat exchange between a refrigerant and air performed in the indoor heat exchanger 22. Moreover, it is assumed that the operation mode at the time of the start of the heating operation is the heating only operation.

[0052] For example, in a case where the temperature difference between the indoor temperature and the set temperature falls below a predetermined value (for example, a temperature difference of one degree) after the heating operation performed by driving the compressor 11 is continued in a predetermined period of time that is set in advance, the control device 43 determines the heating capacity exceeds the air conditioning load. Furthermore, in a case where an amount of change in the temperature difference decreased per unit of time exceeds the predetermined value on the basis of a temporal change in the temperature difference between the

indoor temperature and the set temperature, the control device 43 may determine that the heating capacity exceeds the air conditioning load.

[0053] If the heating capacity of the air conditioner 1 does not exceed the air conditioning load (No at Step S1), the control device 43 returns the process at Step S1, and continues the heating only operation without any change.

[0054] If the heating capacity of the air conditioner 1 exceeds the air conditioning load (Yes at Step S1), The control device 43 decreases the rotational speed of the compressor 11 by the predetermined value that is set in advance in order to decrease the heating capacity in the air conditioner 1 (Step S2).

[0055] Then, the control device 43 determines whether or not the rotational speed of the compressor 11 is matched with the minimum compressor rotational speed that is stored in the storage device 44 (Step S3). If the rotational speed of the compressor 11 is not matched with the minimum compressor rotational speed (No at Step S3), that is, in a case where the rotational speed of the compressor 11 is greater than the minimum compressor rotational speed, the control device 43 returns to the process at Step S1. Therefore, in a case where the rotational speed of the compressor 11 is greater than the minimum compressor rotational speed, the control device 43 continues the heating only operation.

[0056] If the rotational speed of the compressor 11 is matched with the minimum compressor rotational speed (Yes at Step S3), the control device 43 switches the operation mode to the heating and heat storage operation (Step S4). In this way, in a case where the heating capacity of the air conditioner 1 exceeds the air conditioning load in spite of decreasing the heating capacity to the lowest level by driving the compressor 11 at the minimum compressor rotational speed, the control device 43 switches the operation mode to the heating and heat storage operation. As a result of this, the output power (amount of heat) transferred from the refrigerant circuit 5 disposed on the outdoor unit 2 side via the intermediate heat exchanger 16 is accordingly output to the indoor heat exchanger 22 and the heat storage unit 35. Therefore, in the air conditioner 1, it is possible to store heat in the heat storage unit 35 by using some output power received from the outdoor unit 2 side, and it is also possible to further reduce the heating capacity by the indoor heat exchanger 22. As a result of this, it is possible to prevent occurrence of shutdown caused by an increase in the heating capacity and the indoor temperature. Therefore, in the air conditioner 1, it is possible to suppress a situation in which comfort is impaired caused by large fluctuations in the indoor temperature due to repeated intermittent operation.

[0057] Subsequently, the control device 43 determines whether or not the amount of heat (amount of stored heat) stored by the heat storage unit 35 is equal to or greater than the heat storage limit amount of the heat storage unit 35 on the basis of the detection result obtained by the heat storage unit sensor 38 (Step S5).

[0058] There are some determination methods for determining whether or not the amount of stored heat is equal to or greater than the heat storage limit amount performed by the control device 43 on the basis of the detection result obtained by the heat storage unit sensor 38 as follows.

[0059] First, the heat storage material temperature of the heat storage unit 35 does not exceed an indoor condensation temperature, so that there is a determination method for determining that the amount of stored heat is equal to or greater than the heat storage limit amount in a case where the temperature difference between the heat storage material temperature in the heat storage unit 35 and the indoor side condensation temperature is equal to or less than the threshold. The threshold of the temperature difference used in this determination method may be set to, for example, 1°C.

[0060] Furthermore, it is possible to determine that the heat storage to be performed in the heat storage unit 35 has been completed if heat exchange is not performed in the heat storage unit 35 anymore, so that there is a determination method for determining that the amount of stored heat is equal to or greater than the heat storage limit amount in a case where the temperature difference between the water at an inlet port of the heat storage unit 35 and at an outlet port of the heat storage unit 35 is equal to or less than the threshold. The threshold of the temperature difference used in this determination method may be set to, for example, 1°C.

[0061] Furthermore, in a case where a temperature rises to a design allowable temperature of the heat storage material of the heat storage unit 35, it is determined that the heat storage has been completed, so that there is a determination method for determining that the amount of stored heat is equal to or greater than the heat storage limit amount in a case where the heat storage material temperature of the heat storage unit 35 is equal to or greater than the threshold.

[0062] FIG. 4 is an explanation diagram for explaining the relationship between a temperature of a heat storage material and an amount of stored heat. As illustrated in FIG. 4, there are a heat storage material with phase change and a heat storage material without phase change when heat is stored. G1 indicates the heat storage material that stores heat by sensible heat without phase change, whereas G2 indicates a heat storage material that stores heat by latent heat with phase change. In both of the graphs G1 and G2, the inclination of the graph is determined by the property (specific heat), but, in the graph G2, the temperature is not sometimes proportional to the amount of stored heat in the phase change. However, even in a case of a latent-heat heat storage material with phase change, it is possible to detect an amount of stored heat on the basis of the temperature to some extent. Therefore, in a case where the heat storage material temperature of the heat storage unit 35 rises to the threshold (for example, 55°C) corresponding to the design allowable temperature of the heat

storage material, it is possible to determine that the amount of stored heat is equal to or greater than the heat storage limit amount.

[0063] Furthermore, the control device 43 may calculate an amount of stored heat, and determine that the amount of stored heat is equal to or greater than the heat storage limit amount in a case where the calculated amount of stored heat is equal to or greater than the threshold. For example, the control device 43 calculates a heat storage heat exchange amount [W] from the temperature difference of the water between the inlet port of the heat storage unit 35 and the outlet port of the heat storage unit 35 and the flow rate (pump rotational speed, etc.) of the water. Then, the control device 43 calculates an amount of stored heat [kJ] from the heat storage heat exchange amount [W] and heat storage time [s]. Then, the control device 43 determines that the amount of stored heat is equal to or greater than the heat storage limit amount in a case where the calculated amount of stored heat [kJ] is equal to or greater than the threshold (for example, 1000 [kJ]).

[0064] In a case where the amount of stored heat is not equal to or greater than the heat storage limit amount (No at Step S5), the control device 43 returns to the process at Step S5, continues the heating and heat storage operation.

[0065] If the amount of stored heat is equal to or greater than the heat storage limit amount (Yes at Step S5), the control device 43 switches the operation mode to the heat storage heating operation (Step S6). As a result of this, in the air conditioner 1, the heat stored by the heat storage unit 35 is output from the indoor heat exchanger 22 while the refrigeration cycle in the refrigerant circuit 5 being stopped.

[0066] Then, the control device 43 determines whether or not the amount of heat (amount of stored heat) stored by the heat storage unit 35 is equal to or less than the predetermined amount of stored heat on the basis of the detection result obtained by the heat storage unit sensor 38 (Step S7).

[0067] There are determination methods for determining whether or not the amount of stored heat is equal to or less than the predetermined amount of stored heat performed by the control device 43 on the basis of the detection result obtained by the heat storage unit sensor 38 as follows.

[0068] First, there is a determination method for determining that the amount of stored heat is equal to or less than the predetermined amount of stored heat in a case where the heat storage material temperature becomes equal to or less than the threshold due to a decrease in the amount of stored heat in the heat storage unit 35. The threshold used in this determination method may be, for example, 35°C or the like in accordance with the heat storage material of the heat storage unit 35.

[0069] Furthermore, there is a determination method for determining that the amount of stored heat is equal to or less than the predetermined amount of stored heat in a

case where the temperature of the water received from the outlet port of the heat storage unit 35 becomes equal to or less than the threshold due to a decrease in heat that is obtained from the heat storage material of the heat storage unit 35. The threshold used in this determination method may be, for example, 35°C or the like in accordance with the heat storage material of the heat storage unit 35.

[0070] Furthermore, there is a determination method for determining that the amount of stored heat is equal to or less than the predetermined amount of stored heat in a case where the temperature of the water at the inlet port of the indoor heat exchanger 22 becomes equal to or less than the threshold as a result of discomfort even if heat exchange is performed on the indoor side. The threshold used in this determination method may be, for example, 35°C or the like in accordance with a room temperature, or the like.

[0071] Furthermore, there is a determination method for determining that the amount of stored heat is equal to or less than the predetermined amount of stored heat in a case where a temperature difference of the water between the inlet port of the indoor heat exchanger 22 and the outlet port of the indoor heat exchanger 22 becomes equal to or less than the threshold assuming a case in which heat exchange is not able to be performed on the indoor side (capacity is not secured). The threshold used in this determination method may be, for example, 35°C or the like.

[0072] Furthermore, the control device 43 may calculate a current amount of stored heat of the heat storage unit 35, and determine whether or not the calculated amount of stored heat is equal to or less than the threshold. Specifically, the control device 43 calculates the current amount of stored heat of the heat storage unit 35 by subtracting the amount of heat removed from the heat storage material during the heat storage heating operation from the amount of stored heat indicated before the heat storage operation. Then, the control device 43 determines whether or not the calculated amount of stored heat is equal to or less than the threshold (for example, 0 [kJ]).

[0073] If the amount of heat (amount of stored heat) accumulated by the heat storage unit 35 is not equal to or less than the predetermined amount of stored heat (No at Step S7), the control device 43 returns to the process at Step S7, and continues the heat storage heating operation.

[0074] If the amount of heat (amount of stored heat) accumulated by the heat storage unit 35 is equal to or less than the predetermined amount of stored heat (Yes at Step S7), the control device 43 ends the heat storage heating operation. Furthermore, if the control device 43 continues the heating operation after the end of the heat storage heating operation, the control device 43 returns to the process at Step S1.

[0075] FIG. 5 is an explanation diagram for explaining an example of an operation of the air conditioner accord-

ing to the embodiment. In FIG. 5, the first graph illustrated at the top indicates the relationship between the room temperature and the set temperature by indicating that the vertical axis is a temperature [°C], and the horizontal axis is operating hour [h] of the air conditioner 1. Furthermore, the second graph from the top indicates a temporal change in the compressor 11 by indicating that the vertical axis is a rotational speed [rpm] of the compressor 11, and the horizontal axis is the operating hour [h] of the air conditioner 1. Furthermore, the third graph from the top indicates a temporal change in the heat storage unit 35 by indicating that the vertical axis is an amount of stored heat [J] of the heat storage unit 35, and the horizontal axis is the operating hour [h] of the air conditioner 1. Furthermore, the fourth graph from the top indicates a temporal change in the heating capacity by indicating that the vertical axis is the heating capacity [W] of the air conditioner 1, and the horizontal axis is the operating hour [h] of the air conditioner 1.

[0076] As illustrated in FIG. 5, in a period of time between the start of the heating operation (t_0) and time (t_1) at which the room temperature reaches the set temperature (approaches to the predetermined value) and also the compressor 11 reaches the minimum rotational speed, a heating only operation is performed while adjusting the rotational speed of the compressor 11.

[0077] Then, in a period of time between the time (t_1) at which the compressor 11 reaches the minimum rotational speed and time (t_2) at which the heat storage unit 35 has completed the heat storage process (the amount of stored heat reaches the heat storage limit amount), the heating and heat storage operation is performed. In this heating and heat storage operation time (t_1 to t_2), the heating capacity of the air conditioner 1 is reduced by passing the surplus capacity to the heat to be stored in the heat storage unit 35. In other words, at the heating and heat storage operation time (t_1 to t_2), it is possible to reduce the heating capacity by using the stored heat. As a result of this, it is possible to prevent occurrence of shutdown caused by a rise in the heating capacity and the indoor temperature. Therefore, in the air conditioner 1, it is possible to suppress a situation in which comfort is impaired caused by large fluctuations in the indoor temperature due to repeated intermittent operation.

[0078] FIG. 6 is an explanation diagram for explaining a reduction in the capacity performed by using heat storage. As illustrated in FIG. 6, at the time of heating and heat storage operation time (t_1 to t_2), some of output power (amount of heat) of the outdoor unit 2 is used for heat to be stored in the heat storage unit 35. As a result of this, the output power from the indoor heat exchanger 22 (heating capacity) is reduced.

[0079] Then, in a period of time between time (t_2) at which the heat storage unit 35 completes the heat storage process (amount of stored heat reaches the heat storage limit amount) and time (t_3) at which the amount of the stored heat becomes equal to or less than the predetermined value (for example, 0 [J]), the heat storage

heating operation is performed. As a result of this, in the air conditioner 1, it is possible to continue the heating operation using the heat stored in the heat storage unit 35 without driving the compressor 11. Then, after time (t3) at which the amount of stored heat of the heat storage unit 35 reaches the predetermined value, the control device 43 performs the heating only operation or the heating and heat storage operation by restarting the compressor 11.

[0080] FIG. 7 is an explanation diagram for explaining an example of an operation performed by the air conditioner according to the conventional. In FIG. 7, the first graph at the top indicates the relationship between the room temperature and the set temperature by indicating that the vertical axis is a temperature [°C], and the horizontal axis is the operating hour [h] of a conventional air conditioner. Furthermore, the second graph from the top indicates a temporal change in the compressor by indicating that the vertical axis is a rotational speed [rpm] of the compressor included in the conventional air conditioner, and the horizontal axis is the operating hour [h] of the conventional air conditioner. Furthermore, the third graph from the top indicates a temporal change in the heating capacity by indicating that the vertical axis is the heating capacity [W] of the conventional air conditioner, and the horizontal axis is the operating hour [h] of the conventional air conditioner.

[0081] As illustrated in FIG. 7, in the conventional air conditioner, in a period of time between the heating operation start time (t10) and time (t11) at which the room temperature reaches the set temperature (approaches to the predetermined value) and also the compressor reaches the minimum rotational speed, the heating operation in which the rotational speed of the compressor is adjusted is operated. Then, in the conventional air conditioner, the heating operation in which the compressor is operated at the minimum rotational speed is continued, and, at time (t12) at which the room temperature reaches the upper limit of the set temperature range, drive of the compressor is stopped. As a result of the stop of driving of the compressor, the heating capacity in the conventional air conditioner becomes zero, and the room temperature decreases. Then, at time (t13) at which the room temperature reaches the lower limit of the set temperature range, the conventional air conditioner restarts the compressor. As a result of this, the room temperature again turns to rise.

[0082] As is clear from a comparison of FIG. 6 and the first graph from the top illustrated in FIG. 7 indicating the relationship between the room temperature and the set temperature, in the air conditioner 1 according to the embodiment, a variation in the indoor temperature with respect to the set temperature is smaller than that in the conventional air conditioner. In this way, in the air conditioner 1 according to the embodiment, it is possible to suppress a decrease in comfort.

[0083] FIG. 8 is a circuit diagram illustrating one example of an air conditioner according to a modification. In the air conditioner 1 according to the modification, the

water circuit 6 included in the air conditioner 1 as described above is omitted, and the refrigerant circuit 5 is replaced with a refrigerant circuit 61 that is a different circuit. In the refrigerant circuit 61, the intermediate heat exchanger 16 included in the refrigerant circuit 5 in the air conditioner 1 according to the embodiment as described above is replaced with an indoor heat exchanger 62, and the other units are the same as those used in the refrigerant circuit 5 as described above. The indoor heat exchanger 62 is arranged in the interior portion of the indoor unit 3. The indoor fan 42 sends air inside a room such that the air inside the room is brought into thermally contact with the indoor heat exchanger 62, and also, the air inside the room that has been brought into thermally contact with the indoor heat exchanger 62 is blown into the interior of the room from the indoor unit 3.

[0084] The air conditioner according to the modification further includes a heat storage circuit 63. The indoor unit 3 is arranged in the interior portion of the outdoor unit 2. In the heat storage circuit 63, a heat storage purpose flow channel 64 is formed. A first flow channel 65 disposed between the expansion valve 15 and the indoor heat exchanger 62 included in the refrigerant circuit 61 is connected to a second flow channel 66 that is disposed between the indoor heat exchanger 62 and the four-way valve 12 by way of the heat storage purpose flow channel 64. The heat storage circuit 63 includes a heat storage unit 67 and an electromagnetic valve 68. A heat storage material is filled in the interior portion of the heat storage unit 67. The heat storage unit 67 is brought into thermally contact with the refrigerant flowing through the heat storage purpose flow channel 64. The electromagnetic valve 68 is opened such that the first flow channel 65 is brought into contact with the second flow channel 66, or is closed such that the first flow channel 65 is not brought into contact with the second flow channel 66.

[0085] As with the case of the air conditioner 1 according to the embodiment described above, the control device 43 controls the compressor 11, the four-way valve 12, the outdoor fan 41, and the indoor fan 42, and, furthermore, controls the electromagnetic valve 68, as with the case of the electromagnetic valve 36 included in the air conditioner 1 according to the embodiment described above. For example, the control device 43 controls opening and closing of the electromagnetic valve 68 such that the flow channel of the refrigerant conforms to the heating only operation or the heating and heat storage operation. As in the modification, the structure may be constituted such that the heat storage circuit 63 is included in the single refrigerant circuit 61.

[0086] In the above, the embodiment of the air conditioner has been described; however, the embodiment is not limited by the described content. Furthermore, the components described above includes one that can easily be thought of by those skilled in the art, one that is substantially the same, one that is within the so-called equivalents. In addition, the components described above may also be appropriately used in combination.

In addition, at least one of various omissions, replacements, and modifications of components may be made without departing from the scope of the embodiment.

[0087] As described above, the air conditioner 1 drives the compressor 11 that compresses the refrigerant, the indoor unit 3 that performs heat exchange between air inside a room and the refrigerant, the outdoor unit 2 that performs heat exchange outdoor air and the refrigerant, the heat storage unit 35 that performs heat exchange with the refrigerant, the room temperature sensor 37 that detects an indoor temperature that is a temperature inside the room, and the control device 43 that drives the compressor 11 on the basis of the difference between the indoor temperature and the set temperature, and that allows the heat storage unit 35 to perform heat exchange when the difference falls below the predetermined value.

[0088] As a result of this, the air conditioner 1 is constituted such that, in a case where the difference between the indoor temperature and the set temperature falls below the predetermined value, the heat exchange is performed in the heat storage unit 35, and excess heating capacity is passed to heat storage to be stored in the heat storage unit 35, so that it is possible to prevent occurrence of shutdown caused by a rise in the indoor temperature. Therefore, in the air conditioner 1, it is possible to suppress a situation in which comfort is impaired caused by large fluctuations in the indoor temperature due to repeated intermittent operation.

[0089] Furthermore, the air conditioner 1 includes the refrigerant circuit 5 that allows the first refrigerant to circulate, the water circuit 6 that allows the second refrigerant to circulate, and the intermediate heat exchanger 16 that performs heat exchange between the first refrigerant and the second refrigerant. In the air conditioner 1, the compressor 11 and the outdoor unit 2 are included in the refrigerant circuit 5. Furthermore, the indoor unit 3 and the heat storage unit 35 are included in the water circuit 6.

[0090] In this way, the air conditioner 1 may have a structure to allow the refrigerant that is used for the indoor unit 3 and the refrigerant that is used for the outdoor unit 2 to independently circulate. By using such a structure, for example, it is possible to suppress a situation in which the refrigerant that is used for the outdoor unit 2 leaks to the indoor unit 3 side.

[0091] Furthermore, the air conditioner 1 further includes the detection unit that detects the amount of stored heat accumulated by the heat storage unit 35, and, in a case where the detected amount of stored heat reaches the predetermined value when the control device 43 allows the heat storage unit 35 to perform heat exchange, the control device 43 stops drive of the compressor 11 and also allows the refrigerant flowing into the indoor unit 3 to be subjected to heat exchange in the heat storage unit 35. As a result of this, in the air conditioner 1, it is possible to implement an efficient heating operation performed by using heat stored in the heat storage unit 35 with the surplus heating capacity.

[0092] Furthermore, in the air conditioner 1, the indoor unit 3 and the heat storage unit 35 are connected in series in the water circuit 6a. By using the serial configuration, for example, as compared with a case of a parallel configuration, it is possible to reduce the number of the pumps 21 that are used to allow the refrigerant to circulate, and it is thus possible to operate at low cost.

[0093] Furthermore, in the air conditioner 1, the first refrigerant is R32 or R290 (propane). In the air conditioner 1, with a structure in which R32 or R290 (propane) is used for the refrigerant, it is possible to suppress a situation in which R290 leaks to the indoor unit 3 side by using the water circuit on the indoor unit 3 side. Furthermore, in the air conditioner 1, the second refrigerant is water or an antifreeze liquid.

[0094] Furthermore, the air conditioner 1 operates the compressor 11 at the minimum rotational speed, and also, allows the heat storage unit 35 to perform heat exchange when the difference between the indoor temperature and the set temperature falls below the predetermined value. As a result of this, in the air conditioner 1, the surplus capacity obtained at the time of an operation state of the compressor 11 at the minimum rotational speed is used for heat exchange performed in the heat storage unit 35, so that it is possible to further reduce the heating capacity.

Explanation of Reference

[0095]

- 1 air conditioner
- 2, 2a outdoor unit
- 3 indoor unit
- 5 refrigerant circuit
- 6, 6a water circuit
- 11 compressor
- 12 four-way valve
- 14 outdoor heat exchanger
- 15 expansion valve
- 16 intermediate heat exchanger
- 17 intake pipe
- 18 discharge pipe
- 21, 21a to 21c pump
- 22, 62 indoor heat exchanger
- 31, 31a, 63 heat storage circuit
- 32, 32a, 64 heat storage purpose flow channel
- 33, 33a, 65 first flow channel
- 34, 34a, 66 second flow channel
- 35, 67 heat storage unit
- 36, 36a to 36d, 68 electromagnetic valve
- 37 room temperature sensor
- 38 heat storage unit sensor
- 41 outdoor fan
- 42 indoor fan
- 43 control device
- 44 storage device
- 45 CPU

61 refrigerant circuit
G1, G2 graph
t0 to t3, t10 to t13 time

6. The air conditioner according to any one of claims 1 to 5, wherein the control unit operates the compressor at a minimum rotational speed, and also allows the heat storage unit to perform heat exchange when the difference falls below the predetermined value.

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Claims

1. An air conditioner comprising:

a compressor that compresses a refrigerant; 10
an indoor unit that performs heat exchange between air inside a room and the refrigerant;
an outdoor unit that performs heat exchange between outdoor air and the refrigerant;
a heat storage unit that performs heat exchange with the refrigerant; 15
a room temperature sensor that detects an indoor temperature that is a temperature inside the room; and
a control unit that drives the compressor based on a difference between the indoor temperature and a set temperature, and that also allows the heat storage unit to perform heat exchange when the difference falls below a predetermined value. 20 25

2. The air conditioner according to claim 1, further comprising:

a first refrigerant circuit that allows a first refrigerant to circulate; 30
a second refrigerant circuit that allows a second refrigerant to circulate; and
a heat exchanger that performs heat exchange between the first refrigerant and the second refrigerant, wherein 35
the compressor and the outdoor unit are included in the first refrigerant circuit, and
the indoor unit and the heat storage unit are included in the second refrigerant circuit. 40

3. The air conditioner according to claim 2, further comprising a detection unit that detects an amount of stored heat accumulated by the heat storage unit, wherein, in a case where the detected amount of stored heat becomes the predetermined value when the control unit allows the heat storage unit to perform heat exchange, the control unit stops drive of the compressor, and allows a refrigerant flowing into the indoor unit to be subjected to heat exchange in the heat storage unit. 45 50

4. The air conditioner according to claim 3, wherein the indoor unit and the heat storage unit are connected in series in the second refrigerant circuit. 55

5. The air conditioner according to claim 3 or 4, wherein the first refrigerant is R290 (propane).

FIG.1A

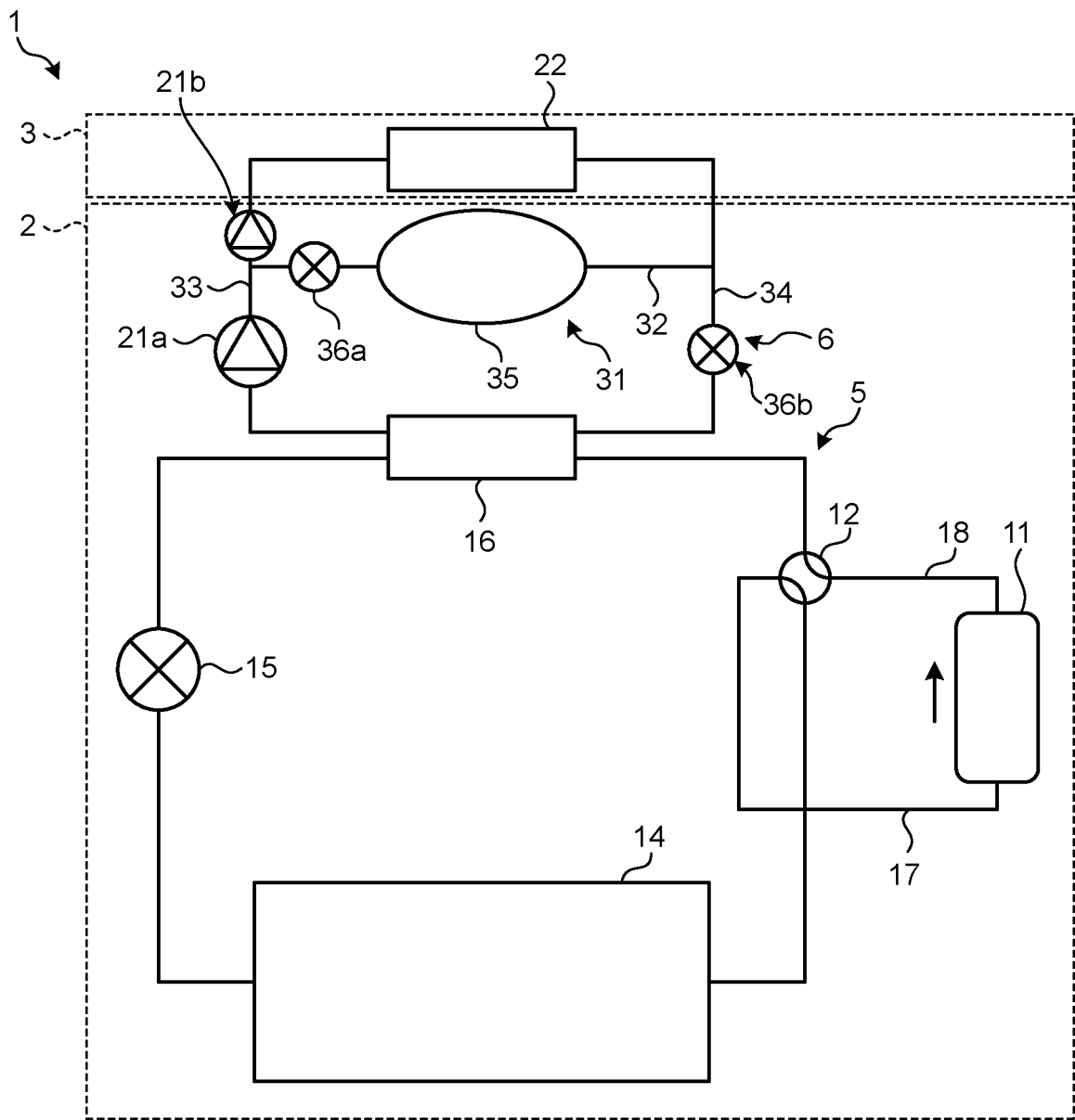


FIG.1B

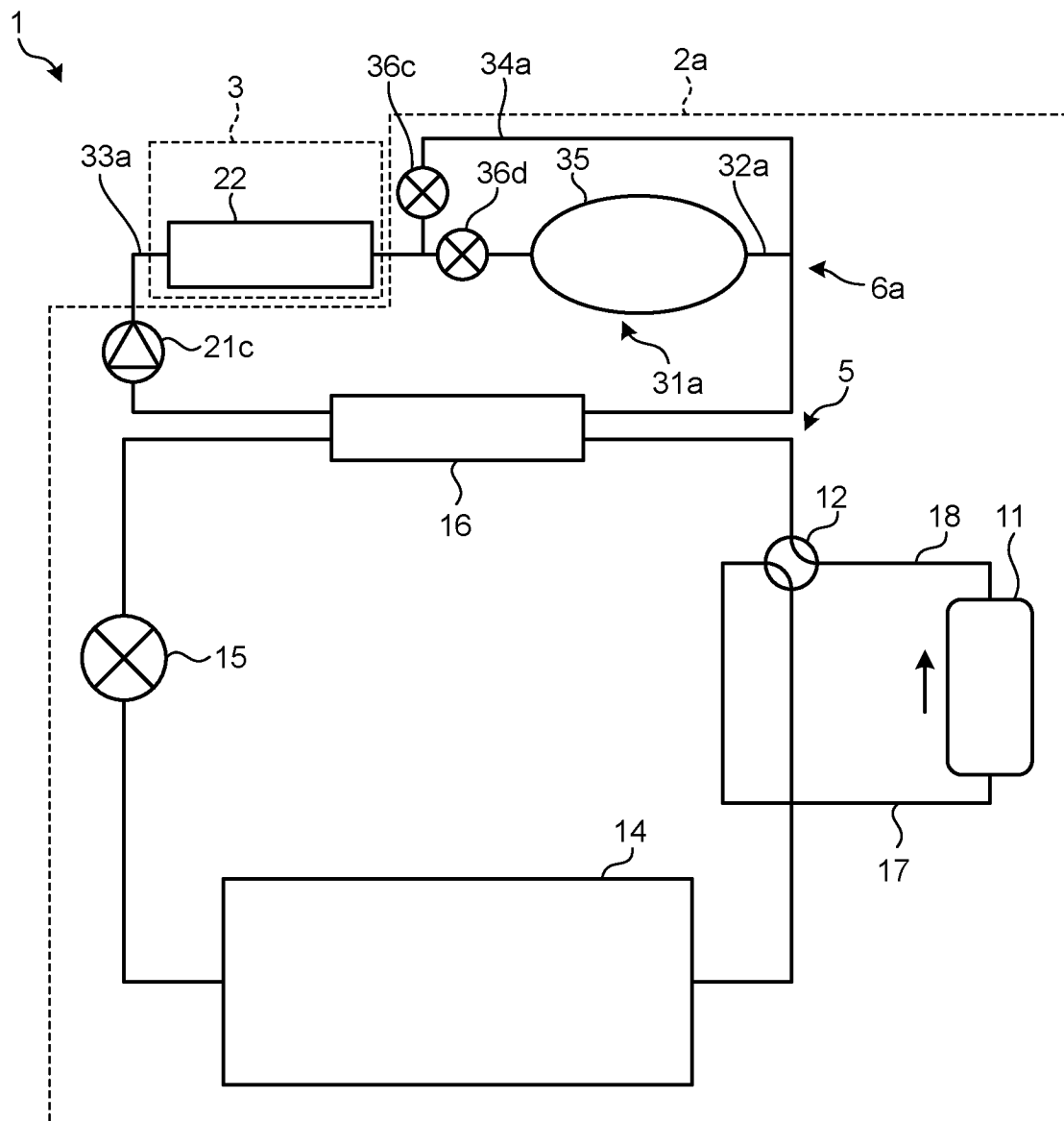


FIG.2

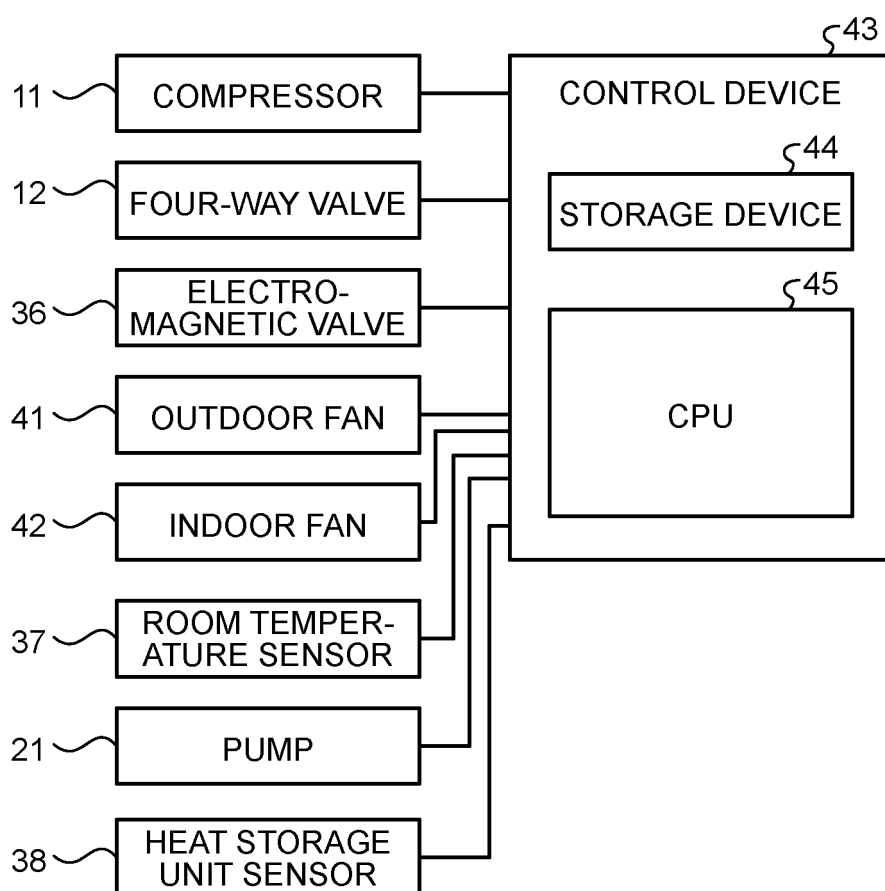


FIG.3

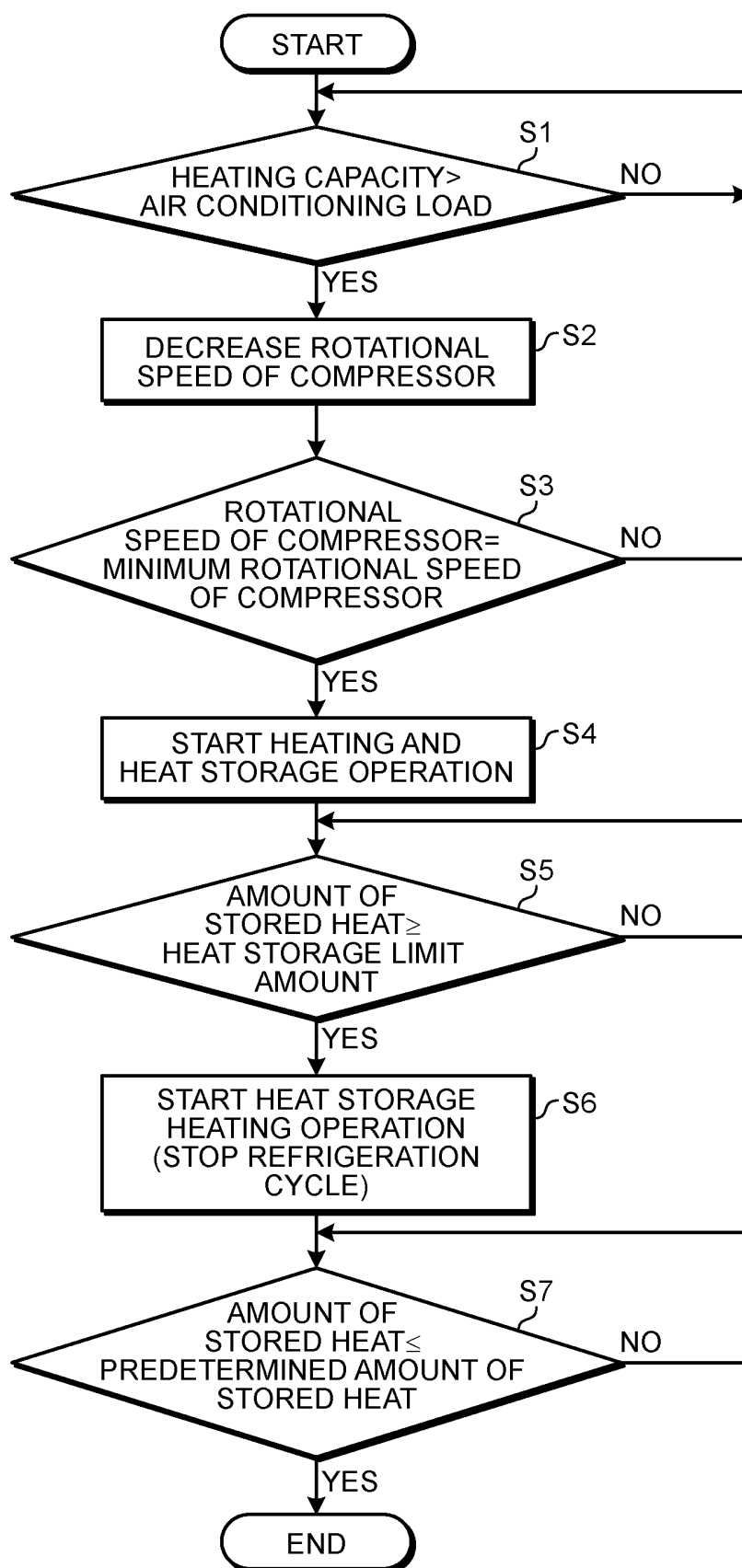


FIG.4

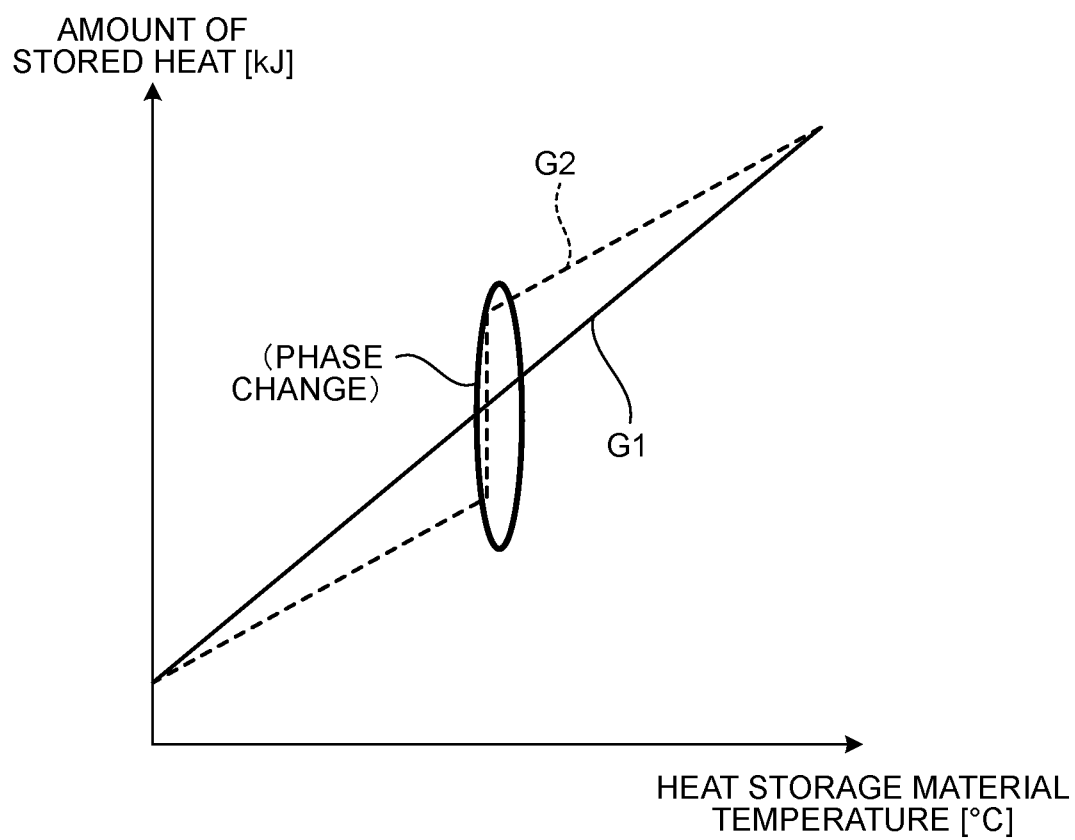


FIG.5

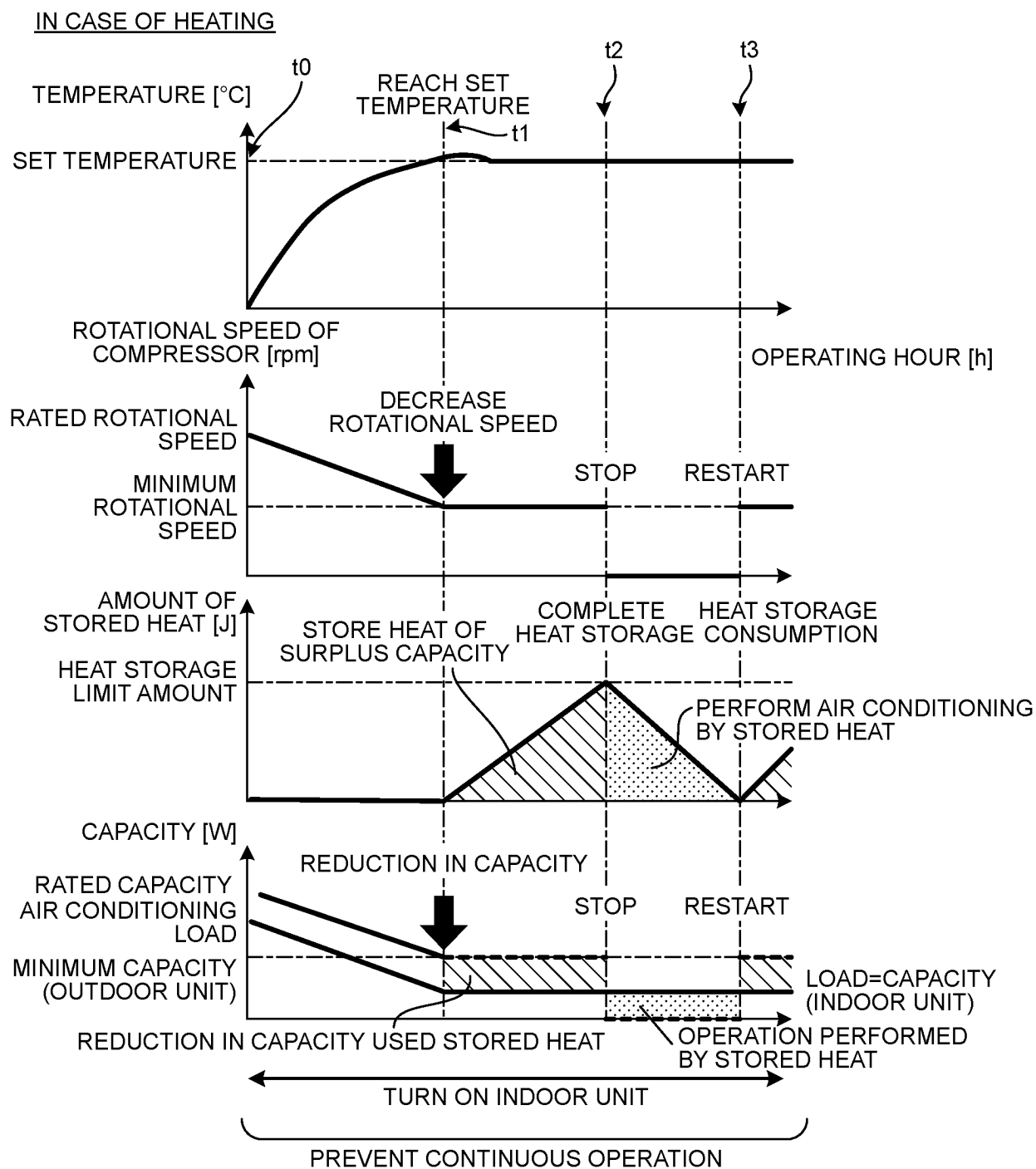


FIG.6

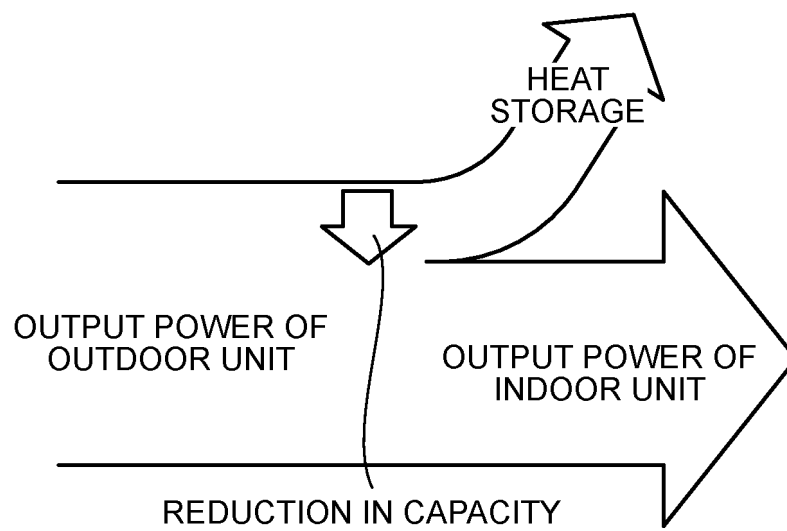


FIG.7

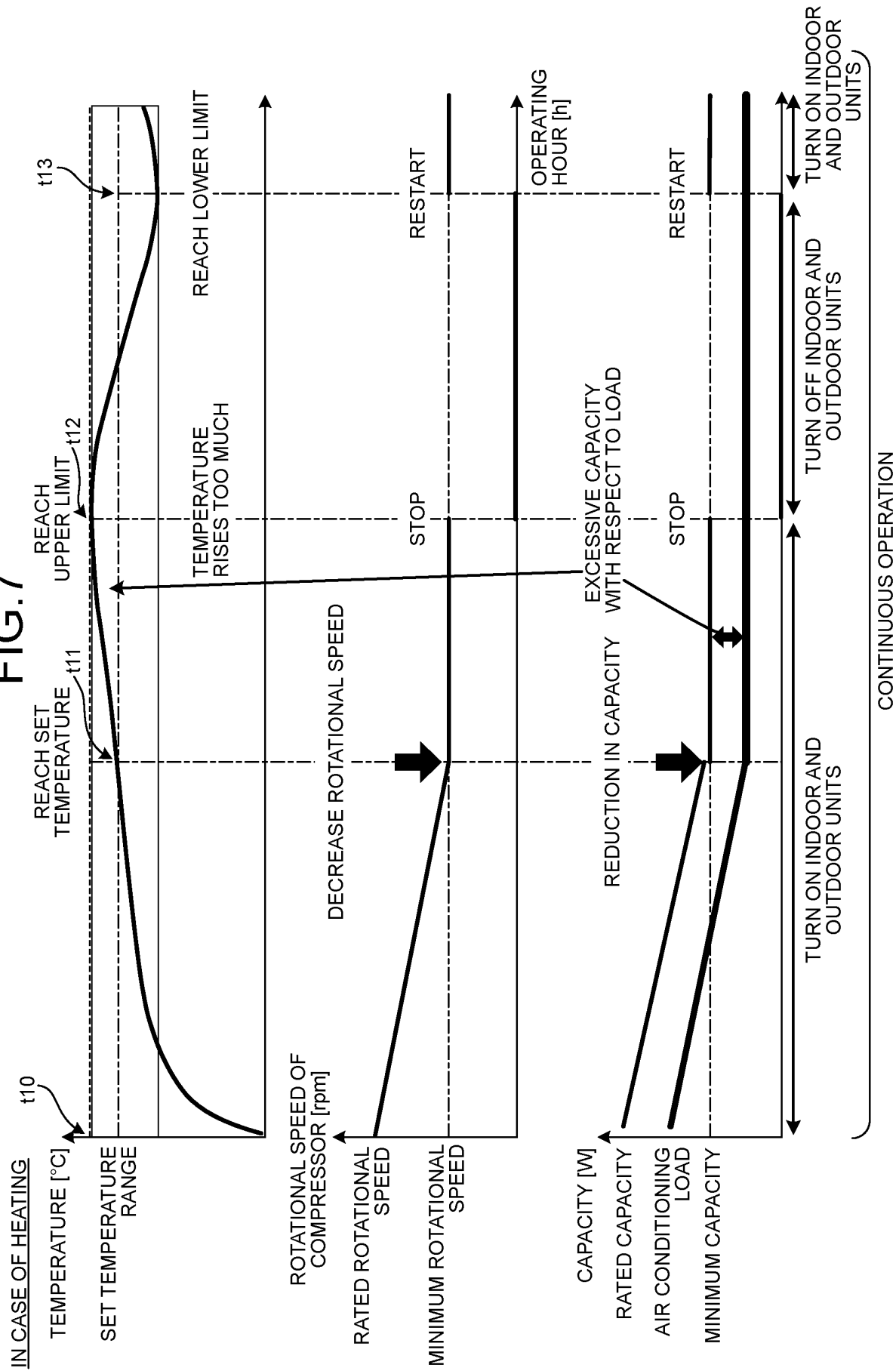
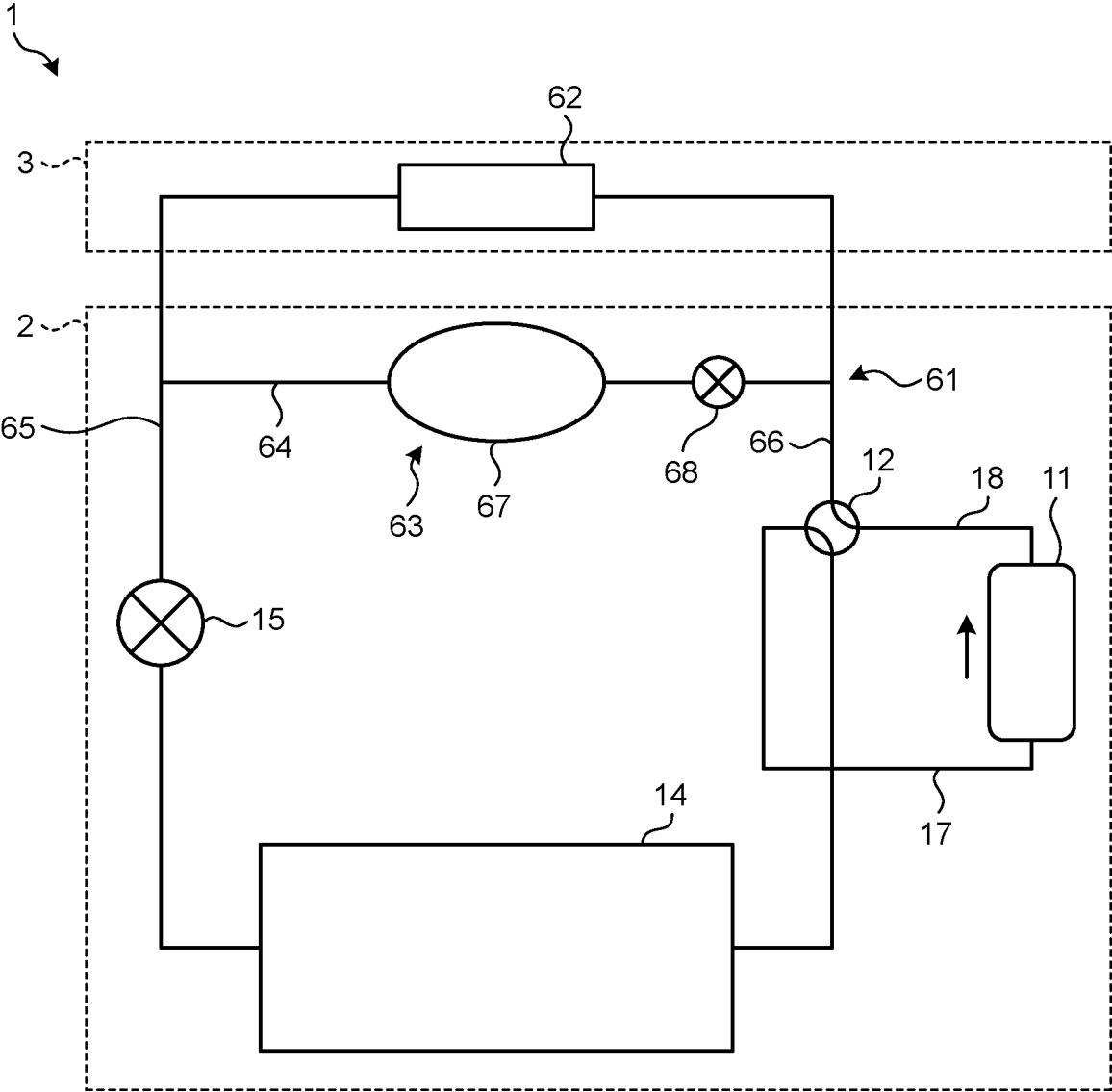


FIG.8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/012450

A. CLASSIFICATION OF SUBJECT MATTER

F25B 13/00(2006.01)i; **F24F 5/00**(2006.01)i; **F24F 11/86**(2018.01)i; **F24F 11/875**(2018.01)i
 Ft: F24F11/875; F24F11/86; F24F5/00 102C; F25B13/00 351

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)

F24F5/00; F24F11/00-11/89; F25B1/00-1/10; F25B13/00

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.
Y	JP 2016-125808 A (DAIKIN IND LTD) 11 July 2016 (2016-07-11) paragraphs [0027]-[0128], fig. 1-12	1-6
Y	WO 2012/111063 A1 (MITSUBISHI ELECTRIC CORPORATION) 23 August 2012 (2012-08-23) paragraph [0061]	1-6
Y	JP 10-292949 A (EBARA CORP) 04 November 1998 (1998-11-04) paragraphs [0016]-[0020], fig. 1	2-6
Y	JP 2003-130421 A (MITSUBISHI ELECTRIC CORPORATION) 08 May 2003 (2003-05-08) paragraphs [0021]-[0023], [0033], fig. 8	3-6
Y	JP 5-312362 A (MITSUBISHI ELECTRIC CORPORATION) 22 November 1993 (1993-11-22) paragraphs [0020]-[0021], fig. 1-2	3-6
Y	JP 2002-61980 A (TOKYO GAS CO LTD) 28 February 2002 (2002-02-28) paragraphs [0039]-[0041]	3-6

☒ 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

06 June 2023

Date of mailing of the international search report

20 June 2023

Name and mailing address of the ISA/JP

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Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-2474 A (MITSUBISHI ELECTRIC CORPORATION) 07 January 2000 (2000-01-07) paragraph [0061]	5-6
Y	JP 64-10068 A (DAIKIN IND LTD) 13 January 1989 (1989-01-13) p. 4, lower left column, lines 2-14, fig. 1	6

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2023/012450

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2016-125808 A	11 July 2016	US 2017/0336085 A1 paragraphs [0040]-[0180], fig. 1-12	
		US 2019/0170378 A1	
		WO 2016/103711 A1	
		EP 3222934 A1	
		EP 3492841 A1	
		CN 107110570 A	
WO 2012/111063 A1	23 August 2012	US 2013/0312443 A1 paragraph [0119]	
		EP 2677251 A1	
		CN 103370584 A	
JP 10-292949 A	04 November 1998	(Family: none)	
JP 2003-130421 A	08 May 2003	(Family: none)	
JP 5-312362 A	22 November 1993	US 53236181 A column 16, line 14 to column 17, line 19, fig. 11	
		KR 1993-0020105 A	
		CN 1076774 A	
JP 2002-61980 A	28 February 2002	(Family: none)	
JP 2000-2474 A	07 January 2000	(Family: none)	
JP 64-10068 A	13 January 1989	(Family: none)	

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2002115923 A [0003]