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(54) **AIR CONDITIONER**

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EP 2 615 388 B1

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Description

TECHNICAL FIELD

[0001] The present invention relates to an air conditioner that includes an indoor heat exchanger, an outdoor heat exchanger, a four-way valve, and a compressor and that is capable of melting frost deposited onto the outdoor heat exchanger.

BACKGROUND ART

[0002] Conventionally, a heat pump type air conditioner has been known that performs defrosting by switching a four-way valve from heating cycle to cooling cycle when an outdoor heat exchanger is frosted in a heating operation. This defrosting method has a defect in that users' sense of being heated is lost because cool air is gradually released from an indoor unit though an indoor fan is stopped. As an indoor heat exchanger is then cooled by the cooling cycle, it takes much time until heating capacity thereof is fully exercised after return from the cooling cycle to the heating cycle.

[0003] On the other hand, an air conditioner has been known that performs defrosting, while remaining in heating cycle, when an outdoor heat exchanger is frosted. This defrosting method, involving no loss of the sense of being heated, has a defect in that the defrosting takes much time because the outdoor heat exchanger is supplied with only a small quantity of heat. The defrosting takes particularly much time under conditions of low temperature of outside air, low output of a compressor and/or the like. As measures against these, an air conditioner disclosed in Patent Literature 1 has a bypass tube for directly supplying an outdoor heat exchanger with a portion of refrigerant, outputted from a compressor and having a high temperature, without passing it through an indoor heat exchanger when defrosting for the outdoor heat exchanger is performed. Patent Literature 2 discloses an air conditioner according to the preamble of claim 1.

CITATION LIST

Patent Literature

[0004]

PTL 1: JP 2009-145032 A
PTL 2: JP 2010-145020 A

SUMMARY OF INVENTION

Technical Problem

[0005] As described above, both benefits and defects are caused whether the cooling cycle or the heating cycle is performed in the defrosting of the outdoor heat exchanger. That is, assignment of priority to the heating capacity causes decrease in capacity for the defrosting of the outdoor heat exchanger, while assignment of priority to the defrosting capacity causes decrease in the heating capacity. Accordingly, it is desired to more efficiently perform heating of inside of a room and the defrosting of the outdoor heat exchanger.

[0006] The invention has been made in consideration of such problems the prior arts have and an object of the invention to more efficiently perform heating of inside of a room and defrosting of an outdoor heat exchanger.

Solution to Problem

[0007] In order to achieve the object, according to the first aspect of the invention, there is provided an air conditioner according to claim 1.

Advantageous Effects of Invention

[0008] When the outdoor heat exchanger is frosted, in the invention, the heating of inside of the room and the defrosting of the outdoor heat exchanger can efficiently be performed by selection and performance of either the defrosting with the heating cycle or the defrosting with the cooling cycle on the basis of the indoor wall temperature.

BRIEF DESCRIPTION OF DRAWINGS

[0009] The above aspects and features of the present invention will become more apparent from the following description of preferred embodiments thereof with reference to the accompanying drawings, and wherein:

Fig. 1 is a diagram showing a configuration of an air conditioner in accordance with an embodiment 1 of the invention;
Fig. 2 is a schematic diagram showing operations and flow of refrigerant in a heating cycle/defrosting operation of the air conditioner of Fig. 1;
Fig. 3 is a schematic diagram showing operations and flow of the refrigerant in a cooling cycle/defrosting operation of the air conditioner of Fig. 1;
Fig. 4 is a flow chart showing flow for determining manner of defrosting operation of the air conditioner of Fig. 1; and
Fig. 5 is a schematic diagram showing a configuration of an air conditioner in accordance with an embodiment 2 of the invention.

DESCRIPTION OF EMBODIMENTS

[0010] In a first aspect, the invention provides an air conditioner according to claim 1.

[0011] When the outdoor heat exchanger is frosted, in this configuration, heating of inside of the room and the defrosting of the outdoor heat exchanger can efficiently be performed by the selection and performance of either the defrosting with the heating cycle or the defrosting with the cooling cycle on the basis of the indoor wall temper-

ature.

[0012] In a second aspect, the air conditioner further has heating means for heating the outdoor heat exchanger in the defrosting with the heating cycle. Thus defrosting capacity of the air conditioner in the defrosting with the heating cycle is increased.

[0013] In a third aspect, the air conditioner further has heat storage means for storing waste heat from the compressor and supplying the waste heat to the refrigerant in the defrosting with the heating cycle. Thus the defrosting capacity of the air conditioner is increased and the waste heat from the compressor is effectively utilized.

[0014] In a fourth aspect, the air conditioner further has human detecting means for detecting whether any or no human beings exist in the room, and the defrosting means performs the defrosting with the heating cycle when the human detecting means detects any human beings or performs the defrosting with the cooling cycle when the human detecting means detects no human being. Those operations make it possible to perform the defrosting of the outdoor heat exchanger while preventing the loss of users' sense of being heated.

[0015] Hereinbelow, embodiments of the invention will be described with reference to the drawings. The invention is not restricted by the embodiments below.

[0016] Fig. 1 shows a configuration of an air conditioner including a refrigeration cycle device in accordance with an embodiment 1 of the invention, and the air conditioner is composed of an outdoor unit 2 and an indoor unit 4 that are connected to each other through refrigerant pipes.

[0017] As shown in Fig. 1, a compressor 6, a four-way valve 8, a strainer 10, an expansion valve 12, and an outdoor heat exchanger 14 are provided in the outdoor unit 2, an indoor heat exchanger 16 is provided in the indoor unit 4, and those elements configure an refrigerating cycle by being connected to one another through refrigerant pipes.

[0018] In more detail, the compressor 6 and the indoor heat exchanger 16 are connected through a refrigerant pipe 18 in which the four-way valve 8 is provided, and the indoor heat exchanger 16 and the expansion valve 12 are connected through a refrigerant pipe 20 in which the strainer 10 is provided. The expansion valve 12 and the outdoor heat exchanger 14 are connected through a refrigerant pipe 22, and the outdoor heat exchanger 14 and the compressor 6 are connected through a refrigerant pipe 24.

[0019] The four-way valve 8 is placed in middle part of the refrigerant pipe 24, and an accumulator 26 for separation into liquid phase refrigerant and vapor phase refrigerant is provided in the refrigerant pipe 24 on refrigerant intake side of the compressor 6. The compressor 6 and the refrigerant pipe 22 are connected through a refrigerant pipe 28, and the refrigerant pipe 28 is provided with a first solenoid valve 30.

[0020] A heat storage tank 32 is provided around the compressor 6, inside of the heat storage tank 32 is provided with a heat-storage heat exchanger 34 and is filled with latent heat storage material (e.g., ethylene glycol aqueous solution) 36 for heat exchange with the heat-storage heat exchanger 34, and a heat storage device is composed of the heat storage tank 32, the heat-storage heat exchanger 34, and the heat storage material 36. The heat storage material 36 stores waste heat from the compressor 6.

[0021] The refrigerant pipe 20 and the heat-storage heat exchanger 34 are connected through a refrigerant pipe 38, the heat-storage heat exchanger 34 and the refrigerant pipe 24 are connected through a refrigerant pipe 40, and the refrigerant pipe 38 is provided with a second solenoid valve 42.

[0022] A blower fan (not shown), upper-lower vanes (not shown), and left-right vanes (not shown), in addition to the indoor heat exchanger 16, are provided in the indoor unit 4, and the indoor heat exchanger 16 performs heat exchange between indoor air taken by the blower fan into the indoor unit 4 and the refrigerant flowing in the indoor heat exchanger 16, so that the air heated by the heat exchange is blown into the room in a heating operation, or so that the air cooled by the heat exchange is blown into the room in a cooling operation. The upper-lower vanes alter direction of the air, blown off from the indoor unit 4, to upper or lower direction as required and the left-right vanes alter the direction of the air, blown off from the indoor unit 4, to leftward or rightward direction as required.

[0023] Furthermore, an outdoor heat exchanger temperature sensor 44 for detecting temperature in the outdoor heat exchanger 14 is provided in the air conditioner in accordance with the embodiment. The temperature in the outdoor heat exchanger 14 corresponds to quantity of frost deposited on the outdoor heat exchanger 14, and thus the frost (quantity of frost) deposited on the outdoor heat exchanger 14 can be detected on the basis of the temperature detected by the outdoor heat exchanger temperature sensor 44. The outdoor heat exchanger temperature sensor 44 outputs a signal, corresponding to the detected temperature, to a control device for the air conditioner.

[0024] An indoor wall temperature sensor 46 for detecting temperature of a wall in the room and a motion sensor 48 for detecting presence of any human beings in the room are provided in the indoor unit 4. The indoor wall temperature sensor 46 is a sensor that detects the temperature of the wall in the room where the indoor unit 4 is provided and may be an infrared sensor, for instance. The indoor wall temperature sensor 46 outputs a signal, corresponding to the detected temperature, to the control device for the air conditioner. A temperature sensor for detecting temperature of an intake port may be substituted for the indoor wall temperature sensor 46, on condition that the indoor wall temperature can accurately be reckoned from the temperature of the intake port of the indoor unit 4.

[0025] The motion sensor 48 is a sensor that detects

the presence of any human beings (users) in the room and may be an infrared sensor, an ultrasonic sensor, an illuminance sensor or the like, for instance. Upon detection of the presence of any human beings in the room, the motion sensor 48 outputs a signal to the control device (not shown) for the air conditioner.

[0026] The control device for the air conditioner is configured so as to receive the signals outputted from the outdoor heat exchanger temperature sensor 44, the indoor wall temperature sensor 46, and the motion sensor 48 that have been described above, so as to control the compressor 6, the four-way valve 8, the expansion valve 12, the solenoid valves 30, 42, the blower fan, the upper-lower vanes, the left-right vanes and the like on the basis of the received signals, and so as to perform various operations.

[0027] Hereinbelow, a defrosting operation in accordance with the invention will be described.

[0028] The defrosting operation is an operation for melting frost that adheres onto the outdoor heat exchanger 14, and the control device for the air conditioner in accordance with the invention selects either the heating cycle or the cooling cycle according to conditions and performs the defrosting operation with the selected cycle. In other words, the control device functions as defrosting means. Hereinbelow, the defrosting operation in which the heating cycle is selected will be referred to as "heating cycle/defrosting operation". The defrosting operation with the selection of the cooling cycle will be referred to as "cooling cycle/defrosting operation". The selection of the cycle will be described later.

[0029] The term "heating cycle" used herein refers to a cycle in which the refrigerant moves from the compressor 6 through the four-way valve 8 to the indoor heat exchanger 16, that is, a cycle in which heating is performed and the term "cooling cycle" refers to a cycle in which the refrigerant moves from the indoor heat exchanger 16 through the four-way valve 8 to the compressor 6, that is, a cycle in which cooling is performed.

[0030] Initially, the heating cycle/defrosting operation will be described with reference to Fig. 2. In the drawing, solid arrows designate flow of the refrigerant that relates to heating and dashed arrows designate flow of the refrigerant that relates to defrosting. In addition, functions of components of the air conditioner will be described.

[0031] With the deposition of frost on the outdoor heat exchanger 14 and growth of the deposited frost (to a specified quantity of frost), increase in draft resistance through the outdoor heat exchanger 14 causes decrease in airflow and decrease in the temperature in the outdoor heat exchanger 14 to a predetermined temperature (temperature that requires defrosting, which will be referred to as "defrosting requiring temperature"). Upon detection of the defrosting requiring temperature by the outdoor heat exchanger temperature sensor 44 and fulfillment of conditions (details thereof will be described later) for performance of the heating cycle/defrosting operation, the heating cycle/defrosting operation is started.

[0032] Once the heating cycle/defrosting operation is started, the control device for the air conditioner exerts control for opening the first solenoid valve 30 and the second solenoid valve 42 and controls the four-way valve 8 so as to perform the heating cycle. Thus a portion of the vapor phase refrigerant outputted from a discharge port of the compressor 6 flows into the refrigerant pipe 18 and the remainder thereof flows into the refrigerant pipe 28.

[0033] In the heating cycle without the defrosting, that is, an ordinary heating operation, for reference, both the first solenoid valve 30 and the second solenoid valve 42 are controlled so as to be closed.

[0034] As shown in Fig. 2, the vapor phase refrigerant having entered the refrigerant pipe 18 from the compressor 6 passes through the four-way valve 8, reaches the indoor heat exchanger 16, and undergoes heat exchange therein with indoor air through the indoor heat exchanger 16. The refrigerant condensed with heat thereof taken by the heat exchange flows in the refrigerant pipe 20, splits at between the indoor heat exchanger 16 and the strainer 10 in the refrigerant pipe 20, and flows into the refrigerant pipes 22 and 38. The refrigerant flowing in the refrigerant pipe 38 passes through the second solenoid valve 42, enters the heat-storage heat exchanger 34, and assumes vapor phase by absorbing heat from the heat storage material 36 and being evaporated. The refrigerant having vapor-phased passes through the refrigerant pipe 40, merges into the refrigerant flowing in the refrigerant pipe 24, and enters an intake port of the compressor 6 through the accumulator 26.

[0035] On the other hand, a part of the condensed refrigerant having split at between the indoor heat exchanger 16 and the strainer 10 in the refrigerant pipe 20 passes through the strainer 10 for preventing foreign matter from getting into the expansion valve 12, enters the expansion valve 12, and is expanded (decompressed). The refrigerant decompressed by the expansion valve 12 passes through the refrigerant pipe 22, reaches the outdoor heat exchanger 14, and undergoes heat exchange therein with outside air. The refrigerant having undergone the heat exchange in the outdoor heat exchanger 14 with the outside air flows through the refrigerant pipe 24, the four-way valve 8, and the accumulator 26 and enters the intake port of the compressor 6.

[0036] The strainer 10 is provided between a part of the refrigerant pipe 20 that bifurcates to the refrigerant pipe 38 and the expansion valve 12, whereas function of preventing foreign matter from getting into the expansion valve 12 can be maintained even if he strainer 10 is provided between the indoor heat exchanger 16 and the bifurcating part for the refrigerant pipe 38 in the refrigerant pipe 20.

[0037] The strainer 10, however, causes pressure loss and thus the former of above locations facilitates flow of the refrigerant toward the refrigerant pipe 38 in the bifurcating part of the refrigerant pipe 20 for the refrigerant pipe 38 and increases quantity of circulation through a

bypass pipe system extending from the refrigerant pipe 38 through the heat-storage heat exchanger 34 to the refrigerant pipe 40. Even on conditions of high temperature of the heat storage material 36 and extremely great heat exchange capacity of the heat-storage heat exchanger 34, large quantity of circulation through the heat-storage heat exchanger 34 create difficulty in an occurrence of a phenomenon that it become impossible to heat exchange in a latter half part of the heat-storage heat exchanger 34 due to the latter half part superheated. Consequently, In such conditions, there are advantages that sufficient quantity of the heat exchange in the heat-storage heat exchanger 34 and sufficient defrosting capacity are attained.

[0038] The liquid phase refrigerant from the outdoor heat exchanger 14 and the vapor phase refrigerant with high temperature from the heat-storage heat exchanger 34 merge each other immediately before entering the accumulator 26, and thus the evaporation of the liquid phase refrigerant is facilitated. Consequently, it prevents the liquid phase refrigerant from passing through the accumulator 26 and returning to the compressor 6 and leads to improvement in reliability of the compressor 6.

[0039] The vapor phase refrigerant outputted from the discharge port of the compressor 6 and entering the refrigerant pipe 28 flows through the refrigerant pipe 28 and the solenoid valve 30, merges into the refrigerant flowing in the refrigerant pipe 22, heats the outdoor heat exchanger 14, condenses into liquid phase, thereafter flows through the refrigerant pipe 24, and enters the intake port of the compressor 6 via the four-way valve 8 and the accumulator 26.

[0040] With such a heating cycle/defrosting operation, the temperature of the outdoor heat exchanger 14, that was below freezing point at start of the operation due to the deposition of frost, is increased by melting of the frost while a heating capacity is ensured. The heating cycle/defrosting operation is ended once the outdoor heat exchanger temperature sensor 44 detects a temperature (e.g., 8°C) which is higher than the defrosting requiring temperature and at which frost cannot exist.

[0041] Subsequently, the cooling cycle/defrosting operation will be described with reference to Fig. 3.

[0042] Upon detection of the defrosting requiring temperature by the outdoor heat exchanger temperature sensor 44 and fulfillment of conditions (details thereof will be described later) for performance of the cooling cycle/defrosting operation, the cooling cycle/defrosting operation is started.

[0043] Once the cooling cycle/defrosting operation is started, the control device for the air conditioner exerts control for closing the first solenoid valve 30 and the second solenoid valve 42 and controls the four-way valve 8 so as to perform the cooling cycle.

[0044] Thus the vapor phase refrigerant outputted from the discharge port of the compressor 6 flows through the refrigerant pipe 18, the four-way valve 8, and the refrigerant pipe 24 and enters the outdoor heat exchanger 14. The vapor phase refrigerant condenses therein by frost taking heat thereof through the outdoor heat exchanger 14. The frost is melted by the heat.

[0045] The liquid phase refrigerant condensed with the heat thereof taken by the melting of the frost, enters the refrigerant pipe 22, is expanded by the expansion valve 12, enters the indoor heat exchanger 16 via the strainer 10, and takes heat from indoor air through the indoor heat exchanger 16. The refrigerant having vapor-phased by taking the heat flows through the refrigerant pipe 18, the four-way valve 8, the refrigerant pipe 24, and the accumulator 26 and thus enters the intake port of the compressor 6.

[0046] With such a cooling cycle/defrosting operation, the temperature of the outdoor heat exchanger 14, that was below the freezing point at start of the operation because of the deposition of the frost, is increased by the melting of the frost faster than with the heating cycle/defrosting operation, though the heating capacity is not exercised. The cooling cycle/defrosting operation is ended once the outdoor heat exchanger temperature sensor 44 detects a temperature which is higher than the defrosting requiring temperature and at which frost cannot exist.

[0047] Hereinbelow, a method (conditions) of selection between the heating cycle/defrosting operation and the cooling cycle/defrosting operation for the defrosting of the outdoor heat exchanger 14 will be described with reference to Fig. 4.

[0048] The control device for the air conditioner selects either the heating cycle/defrosting operation or the cooling cycle/defrosting operation in accordance with a flow chart shown in Fig. 4.

[0049] In a step S10, initially, the control device determines whether the defrosting of the outdoor heat exchanger 14 is required or not. Specifically, it is determined that the defrosting is required, if the temperature detected by the outdoor heat exchanger temperature sensor 44 as described above is lower than the defrosting requiring temperature. If the defrosting is required, the flow proceeds to a step S20. If not, the flow proceeds to RETURN and goes back to START.

[0050] In a step S20, subsequently, the control device determines whether the indoor wall temperature detected by the indoor wall temperature sensor 46 is lower than a specified wall temperature or not.

[0051] When a heating operation is stopped under condition of a low indoor wall temperature, specifically, the temperature of the indoor air sharply decreases because a large quantity heat of the indoor air having a small heat capacity is taken by the wall having a large heat capacity or because heat is not transferred from the wall to the indoor air. Thus users' sense of being heated is lost.

[0052] When a heating operation is stopped under condition of a high indoor wall temperature, by contrast, the temperature of the indoor air does not sharply decrease because a large quantity heat of the indoor air is not taken by the wall or because heat is transferred from the wall to the indoor air. Thus users' sense of being heated is

prevented from being lost when the heating is stopped.

[0053] If the indoor wall temperature is higher than the specified wall temperature, therefore, the flow proceeds to a step S50 and the cooling cycle/defrosting operation is performed. If the indoor wall temperature is lower than the specified wall temperature, on the other hand, the flow proceeds to a step S30.

[0054] In the step S30, initially, the control device determines through the motion sensor 48 whether any or no human beings exist in the room.

[0055] Specifically, the heating cycle/defrosting operation is required to be performed so that users' sense of being heated is not lost, when any human beings (users) exist in the room, or the cooling cycle/defrosting operation can be performed, when no human beings exist in the room.

[0056] If any human beings exist in the room, therefore, the flow proceeds to a step S40 and the heating cycle/defrosting operation is performed. If no human beings exist in the room, on the other hand, the flow proceeds to the step S50 and the cooling cycle/defrosting operation is performed.

[0057] The heating cycle/defrosting operation and the cooling cycle/defrosting operation are ended once the temperature detected by the outdoor heat exchanger temperature sensor 44 exceeds the defrosting requiring temperature and reaches a temperature at which frost cannot exist.

[0058] When the outdoor heat exchanger 14 is frosted, in the embodiment, the heating of inside of the room and the defrosting of the outdoor heat exchanger 14 can efficiently be performed by the selection and performance of either the heating cycle/defrosting operation or the cooling cycle/defrosting operation on the basis of the indoor wall temperature.

[0059] If the indoor wall temperature is higher than the specified temperature, the defrosting with the cooling cycle is performed because a large quantity heat is not taken from the indoor air by the wall. If the indoor wall temperature is lower than the specified temperature, on the other hand, the defrosting is performed while decrease in the temperature in the room is suppressed by the performance of the defrosting with the heating cycle, because a large quantity of heat is taken from the indoor air by the wall. Those operations make it possible to perform the defrosting of the outdoor heat exchanger 14 while suppressing the decrease in the temperature in the room, that is, while preventing loss of users' sense of being heated.

[0060] In the heating cycle/defrosting operation, the heat storage device, which composed of the heat storage tank 32, the heat-storage heat exchanger 34, and the heat storage material 36,stores waste heat from the compressor 6 and supplies the waste heat to the refrigerant. Thus the defrosting capacity is increased and the waste heat from the compressor 6 can effectively be utilized.

[0061] When the outdoor heat exchanger 14 is frosted and when no human beings (users) exist in the room, the cooling cycle/defrosting operation is performed. This makes it possible to complete the defrosting in a short period of time without loss of users' sense of being heated, as a matter of course.

[0062] Though the invention has been described above with reference to the embodiment, the invention is not limited thereto.

[0063] For instance, the air conditioner of the embodiment 1 has the heat storage device that makes use of the waste heat from the compressor and that is composed of the heat storage tank 32, the heat-storage heat exchanger 34, and the heat storage material 36, whereas the invention is not limited to the air conditioner having the heat storage device.

[0064] For example, an air conditioner (embodiment 2 of the invention) shown in Fig. 5 is conceivable. In the air conditioner shown in Fig. 5, the heat storage tank 32, the heat-storage heat exchanger 34, the heat storage material 36, the refrigerant pipes 38, 40 and the second solenoid valve 42 are removed from the air conditioner shown in Fig. 1, and a refrigerant pipe 50 is provided that connects a part of the refrigerant pipe 28, which positioned between the first electromagnetic sensor 30 and a part where the refrigerant pipes 28, 22 merge, with a part of the refrigerant pipe 24 positioned between the four-way valve 8 and the accumulator 26.

[0065] When the heating cycle/defrosting operation is performed in the air conditioner shown in Fig. 5, the first solenoid valve 30 is controlled so as to be opened and the four-way valve 8 is controlled so as to perform the heating cycle. In the heating cycle without the defrosting, that is, the ordinary heating operation, for reference, the first solenoid valve 30 is controlled so as to be closed.

[0066] Vapor phase refrigerant having entered the refrigerant pipe 18 from the compressor 6 passes through the four-way valve 8, reaches the indoor heat exchanger 16, and undergoes heat exchange therein with indoor air by the indoor heat exchanger 16. The refrigerant condensed into liquid phase with heat thereof taken by the heat exchange enters the refrigerant pipe 20, passes through the strainer 10, and reaches the expansion valve 12. The refrigerant decompressed by the expansion valve 12 passes through the refrigerant pipe 22 and enters the outdoor heat exchanger 14.

[0067] On the other hand, vapor phase refrigerant outputted from the discharge port of the compressor 6 and entering the refrigerant pipe 28 flows through the refrigerant pipe 28 and the first solenoid valve 30, a portion thereof flows toward the outdoor heat exchanger 14, and the remainder enters the refrigerant pipe 50. The refrigerant flowing toward the outdoor heat exchanger 14 merges refrigerant flowing in the refrigerant pipe 22, enters the outdoor heat exchanger 14, and undergoes heat exchange with outside air. The refrigerant having undergone the heat exchange in the outdoor heat exchanger 14 with the outside air flows through the refrigerant pipe 24, the four-way valve 8, and the accumulator 26 and enters the intake port of the compressor 6.

[0068] The refrigerant having entered the refrigerant pipe 50 merges the refrigerant flowing in the refrigerant pipe 24, passes through the accumulator 26, and enters the intake port of the compressor 6.

[0069] When the cooling cycle/defrosting operation is performed, the first solenoid valve 30 is controlled so as to be closed and the four-way valve 8 is controlled so as to perform the cooling cycle.

[0070] Vapor phase refrigerant having entered the refrigerant pipe 24 from the compressor 6 passes through the four-way valve 8, enters the outdoor heat exchanger 14, and undergoes heat exchange with the outside air. The refrigerant condensed with heat thereof taken by the heat exchange enters the refrigerant pipe 22 and reaches the expansion valve 12. The refrigerant decompressed by the expansion valve 12 passes through the refrigerant pipe 20, enters the indoor heat exchanger 16, and undergoes heat exchange therein with indoor air. The refrigerant having vapor-phased by the heat exchange enters the refrigerant pipe 18, thereafter passes through the four-way valve 8 and the accumulator 26, and enters the intake port of the compressor 6.

[0071] Also by such an air conditioner as shown in Fig. 5, the heating of the inside of the room and the defrosting of the outdoor heat exchanger 14 can efficiently be performed.

[0072] A heater (not shown) for heating the outdoor heat exchanger 14 may be provided in the air conditioner shown in Fig. 5, for instance. The air conditioner shown in Fig. 5, which is configured so as not to have a heat storage device, is inferior to the air conditioner shown in Fig. 1 in the defrosting capacity and requires longer defrosting time than the air conditioner of Fig. 1 does. Therefore, the heater for subsidiarily supplying heat to the outdoor heat exchanger 14 in the heating cycle/defrosting operation is provided therein in order to supplement the defrosting capacity. Thus the defrosting capacity equal to that of the air conditioner shown in Fig. 1 and having the heat storage device can be attained.

[0073] Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such Changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

INDUSTRIAL APPLICABILITY

[0074] The invention is capable of efficiently performing the heating of inside of a room and the defrosting of the outdoor heat exchanger, when the outdoor heat exchanger is frosted, by the selection of either the heating cycle/defrosting operation or the cooling cycle/defrosting operation on the basis of the indoor wall temperature, and thus can be applied not only to such an air conditioner composed of an outdoor unit and an indoor unit as in the embodiment but also to an integrated type air conditioner in which an outdoor unit and an indoor unit are integrated.

REFERENCE SIGNS LIST

[0075]

2 outdoor unit
4 indoor unit
6 compressor
8 four-way valve
10 strainer
12 expansion valve
14 outdoor heat exchanger
16 indoor heat exchanger
18 refrigerant pipe
20 refrigerant pipe
22 refrigerant pipe
24 refrigerant pipe
26 accumulator
28 refrigerant pipe
30 first solenoid valve
32 heat storage tank
34 heat-storage heat exchanger
36 heat storage material
38 refrigerant pipe
40 refrigerant pipe
42 second solenoid valve
44 frost quantity detecting means (outdoor heat exchanger temperature sensor)
46 indoor wall temperature detecting means (indoor wall temperature sensor)
48 human detecting means (motion sensor)

Claims

1. An air conditioner that includes an outdoor heat exchanger (14), an indoor heat exchanger (16), a four-way valve (8), and a compressor (6) and that performs defrosting by melting frost, deposited on the outdoor heat exchanger (14), by refrigerant heated by the compressor (6),
wherein the air conditioner comprises an indoor temperature detecting means (46) for detecting an indoor temperature,
characterized in that the indoor temperature detecting means (46) are formed by indoor wall temperature detecting means (46) for detecting an indoor wall temperature and that there are provided defrosting means for performing the defrosting by selecting either a heating cycle or a cooling cycle on the basis of the indoor wall temperature detected by the indoor wall temperature detecting means (46) and controlling the four-way valve (8) so as to allow the selected cycle to be performed, when it is determined that the defrosting is required, wherein the defrosting means performs the defrosting with the

cooling cycle on condition that the indoor wall temperature is higher than a specified temperature or performs the defrosting with the heating cycle on condition that the indoor wall temperature is lower than the specified temperature, when it is determined that the defrosting is required.

2. The air conditioner according to claim 1, further comprising heating means for heating the outdoor heat exchanger (14) in the defrosting with the heating cycle.

3. The air conditioner according to claim 1, further comprising heat storage means for storing waste heat from the compressor (6) and supplying the waste heat to the refrigerant in the defrosting with the heating cycle.

4. The air conditioner according to any one of claims 1 through 3, further comprising human detecting means (48) for detecting whether any or no human beings exist in a room, wherein the defrosting means performs the defrosting with the heating cycle when the human detecting means (48) detects any human beings or performs the defrosting with the cooling cycle when the human detecting means (48) detects no human beings.

Patentansprüche

1. Klimagerät, welches einen Außen-Wärmetauscher (14), einen InnenWärmetauscher (16), ein Vierwegeventil (8) sowie einen Kompressor (6) einschließt und einen Abtauvorgang durchführt, indem Frost, der sich auf dem Außen-Wärmetauscher (14) abgelagert hat, mithilfe von Kältemittel, das durch den Kompressor (6) erwärmt worden ist, zum Schmelzen gebracht wird,
wobei das Klimagerät eine Innentemperatur-Detektionseinrichtung (46) zum Ermitteln einer Innentemperatur umfasst,
dadurch gekennzeichnet, dass die Innentemperatur-Detektionseinrichtung (46) durch eine Innenwandtemperatur-Detektionseinrichtung (46) zum Ermitteln einer Innenwandtemperatur gebildet wird und dass eine Abtaueinrichtung vorgesehen ist, um den Abtauvorgang durchzuführen, indem basierend auf der durch die Innenwandtemperatur-Detektionseinrichtung (46) ermittelten Innenwandtemperatur entweder ein Heizzyklus oder ein Kühlzyklus ausgewählt wird und das Vierwegeventil (8) derart gesteuert wird, dass die Durchführung des ausgewählten Zyklus erlaubt wird, wenn festgestellt wird, dass der Abtauvorgang erforderlich ist,
wobei die Abtaueinrichtung unter der Bedingung, dass die Innenwandtemperatur höher als eine spezifizierte Temperatur ist, den Abtauvorgang mit dem Kühlzyklus durchführt, oder unter der Bedingung, dass die Innenwandtemperatur niedriger als die spezifizierte Temperatur ist, den Abtauvorgang mit dem Heizzyklus durchführt, wenn festgestellt wird, dass der Abtauvorgang erforderlich ist.

2. Klimagerät nach Anspruch 1, weiter umfassend eine Heizeinrichtung zum Erwärmen des Außen-Wärmetauschers (14) bei der Durchführung des Abtauvorgangs mit dem Heizzyklus.

3. Klimagerät nach Anspruch 1, weiter umfassend eine Wärmespeichereinrichtung zum Speichern von Abwärme aus dem Kompressor (6) und zum Bereitstellen der Abwärme an das Kältemittel bei der Durchführung des Abtauvorgangs mit dem Heizzyklus.

4. Klimagerät nach einem der Ansprüche 1 bis 3, weiter umfassend eine Personendetektionseinrichtung (48) zum Ermitteln, ob sich in einem Raum Menschen aufhalten oder nicht, wobei die Abtaueinrichtung den Abtauvorgang mit dem Heizzyklus durchführt, wenn die Personendetektionseinrichtung (48) ermittelt, dass Menschen in dem Raum anwesend sind, oder den Abtauvorgang mit dem Kühlzyklus durchführt, wenn die Personendetektionseinrichtung (48) ermittelt, dass keine Menschen anwesend sind.

Revendications

1. Climatiseur qui renferme un échangeur thermique extérieur (14), un échangeur thermique intérieur (16), un distributeur à quatre voies (8) ainsi qu'un compresseur (6) et qui effectue une opération de dégivrage laquelle consiste à faire fondre du givre déposé sur l'échangeur thermique extérieur (14) à l'aide d'agent réfrigérant ayant été réchauffé par le compresseur (6),
le climatiseur comprenant un dispositif de détection de température intérieure (46) destiné à déterminer une température intérieure, **caractérisé en ce que** le dispositif de détection de température intérieure (46) est formé par un dispositif de détection de température de paroi intérieure (46) destiné à déterminer une température de paroi intérieure et **en ce qu'**il est prévu un dispositif de dégivrage en vue d'effectuer l'opération de dégivrage, laquelle consiste à sélectionner, sur la base de la température de paroi intérieure déterminée par le dispositif de détection de température de paroi intérieure (46), soit un cycle de chauffage soit un cycle de refroidissement, et **en ce que** le distributeur à quatre voies (8) est commandé de manière à permettre la réalisation du cycle sélectionné quand l'opération de dégivrage a été déterminée comme étant nécessaire.
le dispositif de dégivrage effectuant l'opération de

dégivrage prévoyant le cycle de refroidissement à condition que la température de paroi intérieure soit supérieure à une température spécifiée, ou effectuant l'opération de dégivrage prévoyant le cycle de chauffage à condition que la température de paroi intérieure soit inférieure à la température spécifiée, et ce quand l'opération de dégivrage a été déterminée comme étant nécessaire.

2. Climatiseur selon la revendication 1, lequel comprend en outre un dispositif de chauffage destiné à réchauffer l'échangeur thermique extérieur (14) lors de la réalisation de l'opération de dégivrage prévoyant le cycle de chauffage.

3. Climatiseur selon la revendication 1, lequel comprend en outre un dispositif accumulateur de chaleur destiné à accumuler de la chaleur perdue provenant du compresseur (6) et à fournir ladite chaleur perdue à l'agent réfrigérant lors de la réalisation de l'opération de dégivrage prévoyant le cycle de chauffage.

4. Climatiseur selon l'une quelconque des revendications 1 à 3, lequel comprend en outre un dispositif de détection de personnes (48) destiné à déterminer si des personnes se trouvent dans une pièce ou pas, le dispositif de dégivrage effectuant l'opération de dégivrage prévoyant le cycle de chauffage si le dispositif de détection de personnes (48) détermine la présence de personnes dans la pièce, ou effectuant l'opération de dégivrage prévoyant le cycle de refroidissement si le dispositif de détection de personnes (48) ne détecte la présence d'aucune personne.

Fig.1

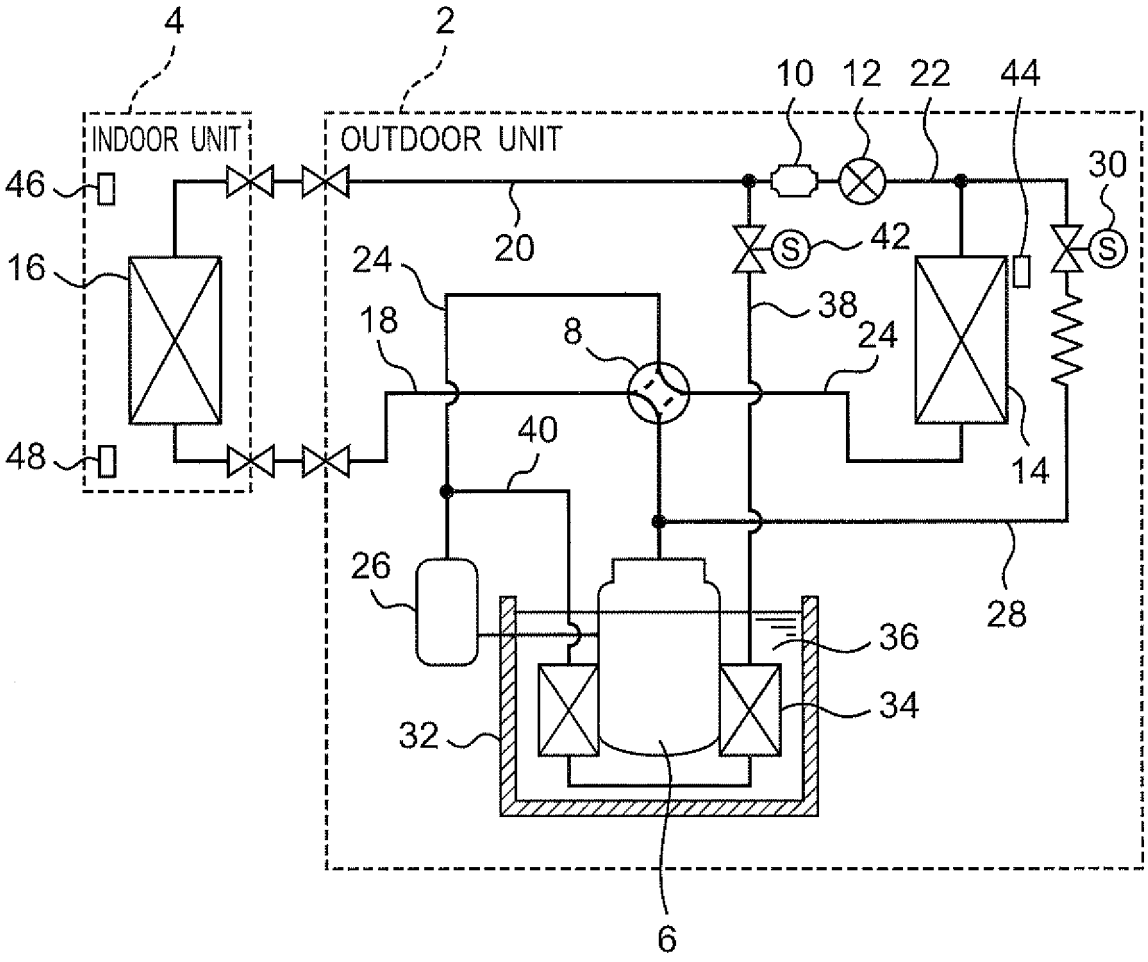

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INDOOR UNIT
OUTDOOR UNIT
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24
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14
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32
6

Fig.2

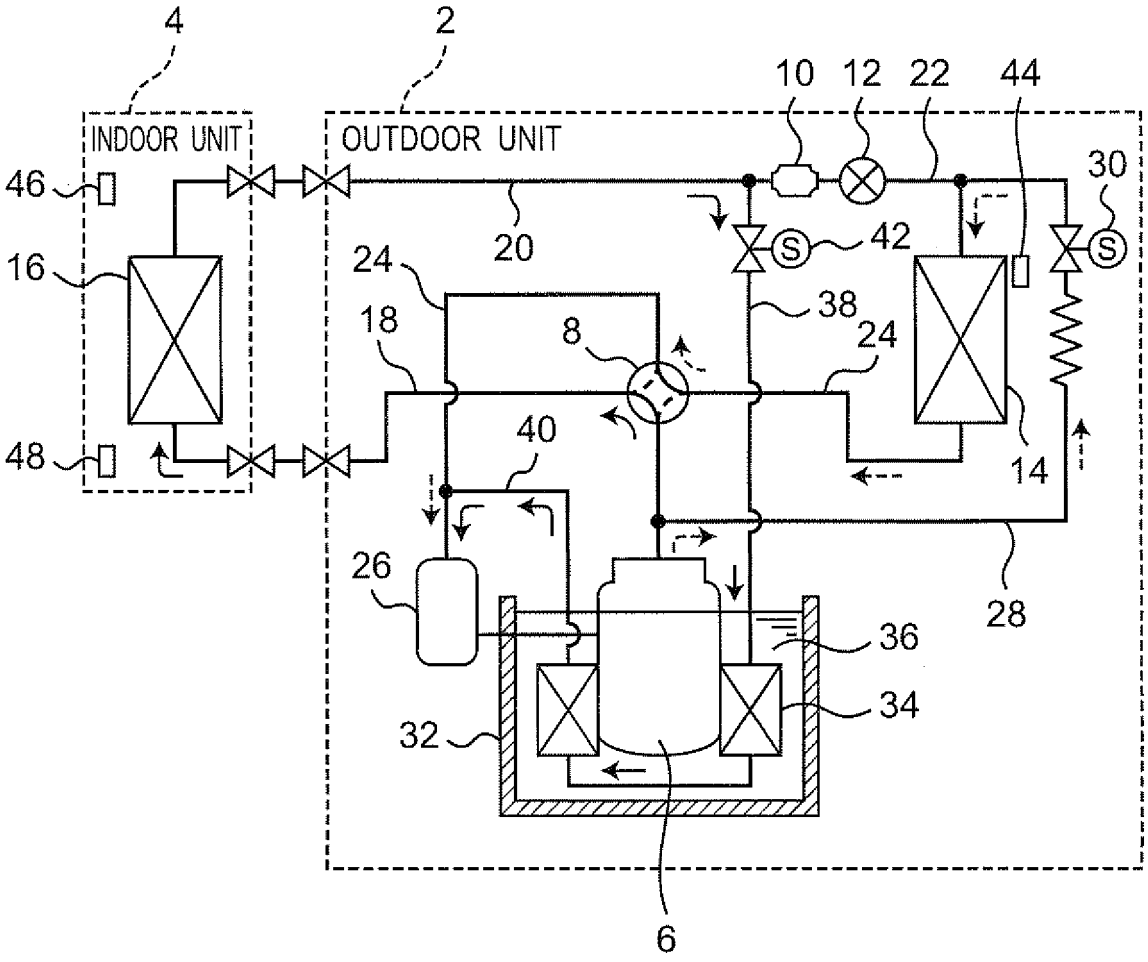

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Fig.3

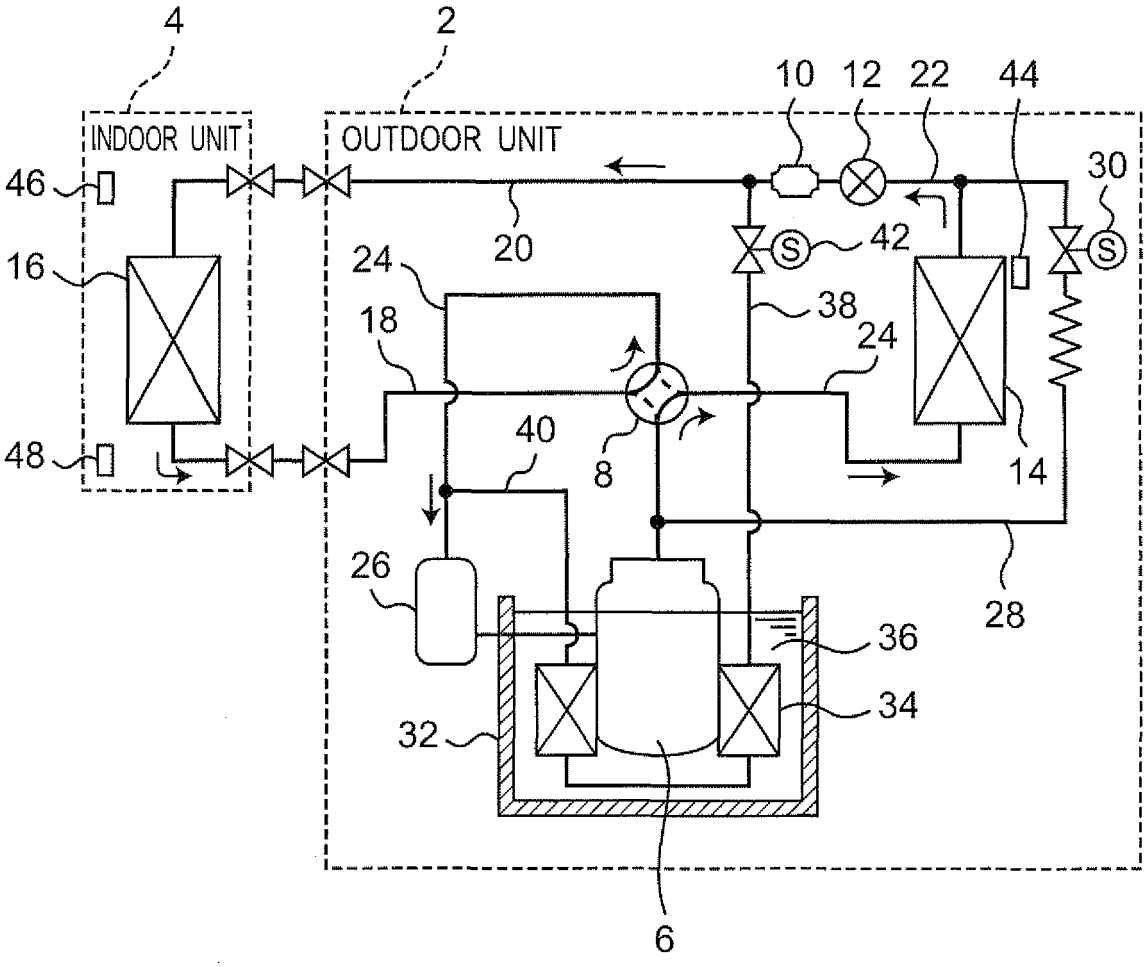

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Fig.4

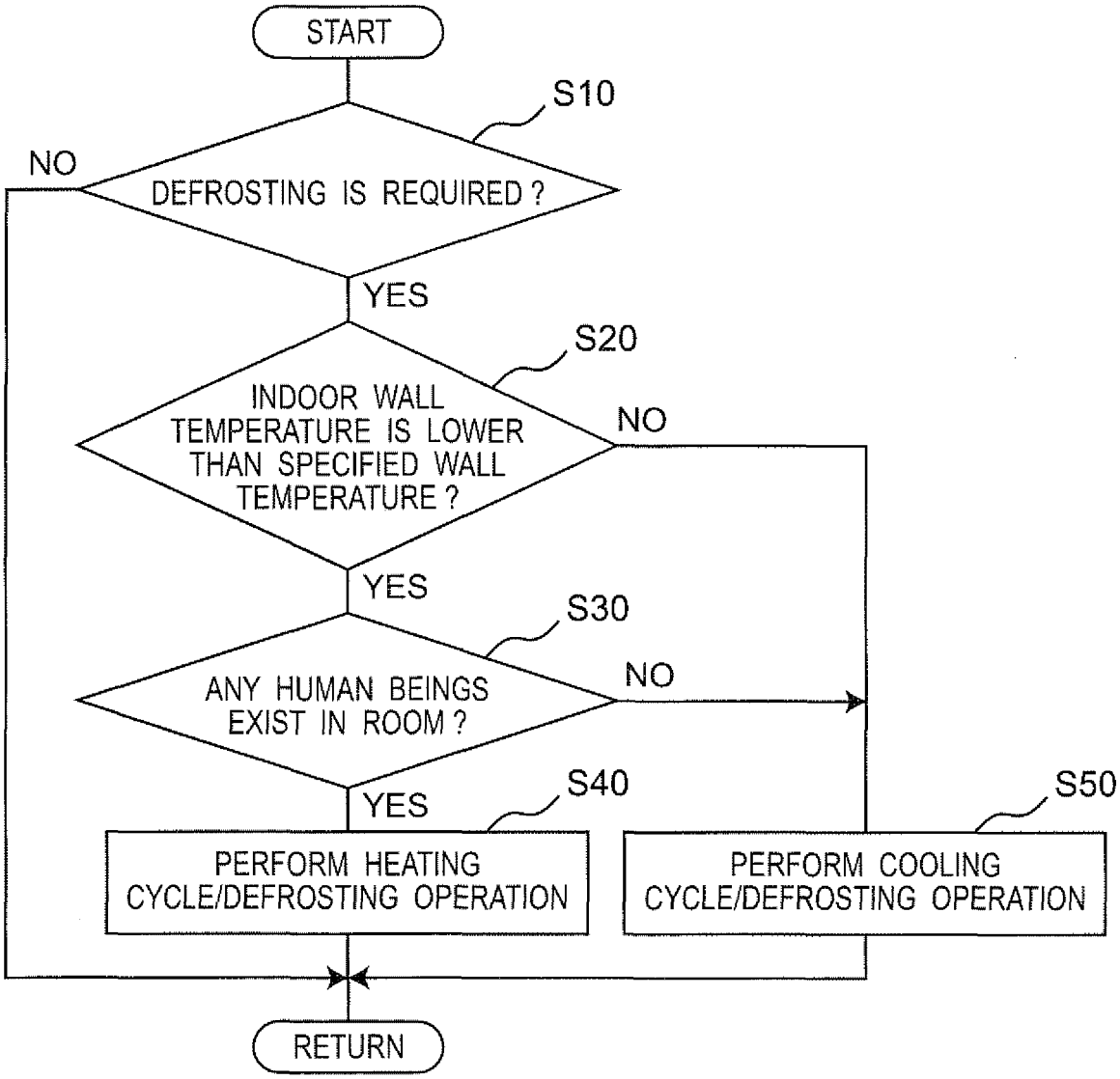
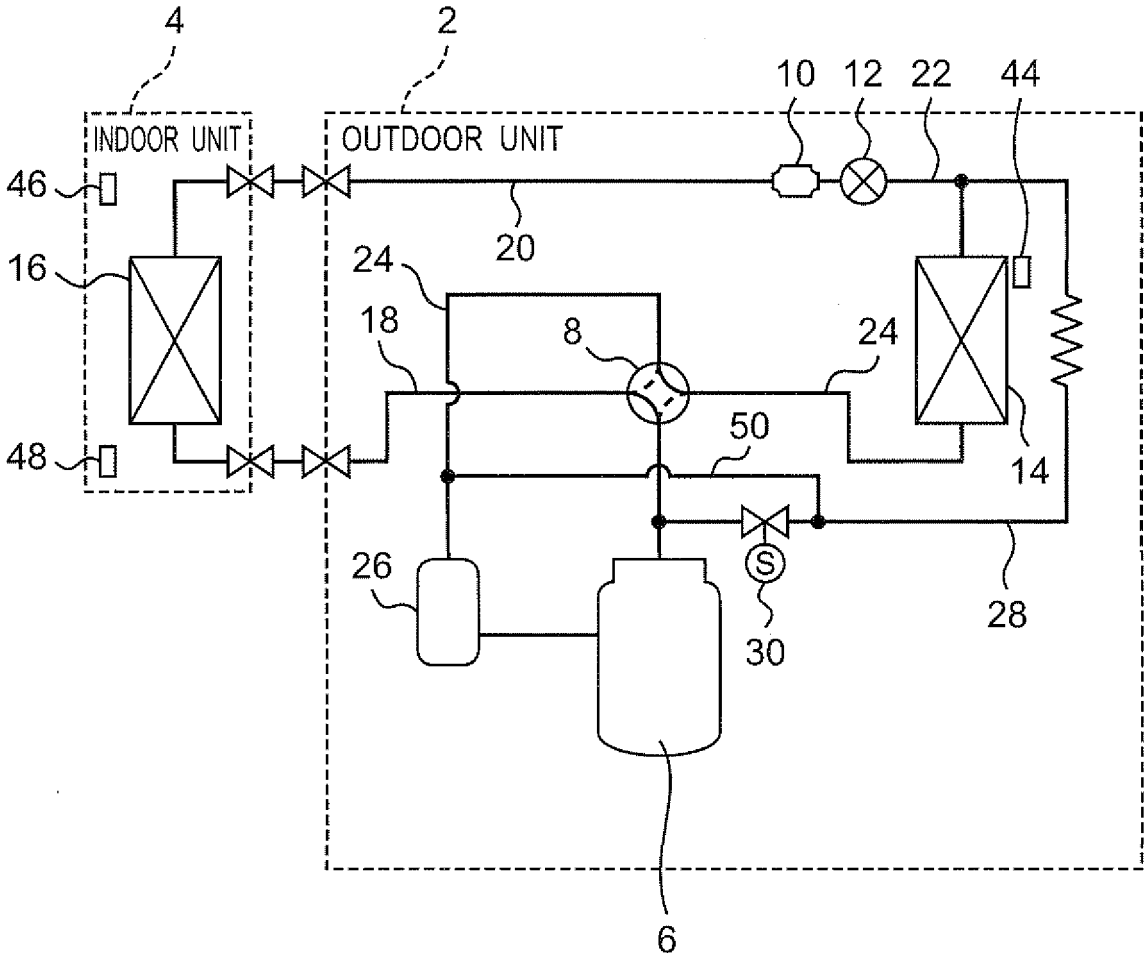

START
S10
DEFROSTING IS REQUIRED ?
NO
YES
S20
INDOOR WALL TEMPERATURE IS LOWER THAN SPECIFIED WALL TEMPERATURE ?
NO
YES
S30
ANY HUMAN BEINGS EXIST IN ROOM ?
NO
YES
S40
PERFORM HEATING CYCLE/DEFROSTING OPERATION
S50
PERFORM COOLING CYCLE/DEFROSTING OPERATION
RETURN

Fig.5


4
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INDOOR UNIT
OUTDOOR UNIT
10
12
22
44
46
16
48
20
24
18
8
24
50
14
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30
28
6

REFERENCES CITED IN THE DESCRIPTION

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