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(54) **Air conditioner and method of controlling the air conditioner**

Klimagerät und Steuerverfahren dafür

Dispositif de conditionnement d'air et méthode pour sa commande

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Description

[0001] The present invention relates to an air conditioner using a replacing refrigerant which has a saturated pressure higher than that of HCFC (hydrochlorofluorocarbon) 22 (hereinafter, referred to as R22) at the same temperature, that is, an alternative refrigerant operating at a high pressure as a refrigerant replacing with the R22.

[0002] JP-A-06/249,485 describes a system comprising air conditioning and ventilation systems in which the direction of airflow from the ventilation system is controlled according to the relative air temperature between the room and the external air supply and the operating mode of the air conditioning unit. Thus, the incoming air from the ventilation system is directed to the ceiling unless the air conditioning unit is operating in a cooling mode and the incoming air from outside is cooler than the temperature of the air at the ceiling of the room. Under this circumstance, the incoming air is directed by the ventilation system towards the floor. US-4,709,554 describes an air conditioning apparatus which monitors the refrigerant temperature at a pipeline near the outside heat exchanger as well as the room temperature, for controlling operations for room warming and defrosting.

[0003] Air conditioners such as room air conditioners and the like, which circulate a refrigerant in a refrigerating cycle and cool or/and heat room air by the condensing action and evaporating action of the refrigerant, are now one of the necessary articles in homes, buildings and the like

[0004] As a refrigerant used in the aforesaid air conditioners, there is used at preset R22 which is nontoxic, noninflammable and thermally and chemically stable.

[0005] Incidentally, in the conventional air conditioners using R22 as the refrigerant, when heating is started by operating the air conditioners, a compressor is driven in the state that a room air supply louver is set to a position where it is usually directed in heating operation (position where blowout air is directed toward the floor (downward) in a room)) as shown in the flowchart of heating operation in FIG. 15. At the time, the operation of an indoor fan is stopped so as not to supply cool air into the room (step S1) until the temperature T of an indoor heat exchanger increases and exceeds a heat exchange (condense) possible temperature T₀ ($T \geq T_0$) (determination at step S2 is NO).

[0006] When the temperature T of the indoor heat exchanger increases as a time elapse after the start of the operation, exceeds the heat exchange possible temperature T₀ and reaches the state that hot air can be blown out ($T \geq T_0$, the determination at step S2 is YES), the operation of the indoor fan is started so that ordinary operation is carried out (step S3).

[0007] On the other hand, in the air conditioner, frost in the fresh air sometimes deposits on the outside surface of an outdoor heat exchanger as an evaporator during heating operation and the deposited frost is one of

the reasons for hindering the evaporating action of the outdoor heat exchanger. To cope with this problem, the air conditioners temporarily carry out operation for removing the frost deposited on the outdoor heat exchanger, that is, so-called defrosting operation during heating operation.

[0008] The defrosting operation of the air conditioners is such that, a four-way valve which is turned ON, for example in heating operation, is reversed to be turned OFF thereby reversing the circulating direction of the refrigerant from that in the heating. Then, an expansion valve as a flow regulating valve (electronic control valve) is controlled to keep opening of the expansion valve constant by a predetermined opening thereby stopping the operation of the indoor fan and an outdoor fan.

[0009] That is, the gaseous refrigerant of high temperature and high pressure which is discharged from a compressor is introduced into the outdoor heat exchanger and liquefied by radiating heat from the refrigerant in the outdoor heat exchanger. At the time, the frost deposited on the outside surface of the outdoor heat exchanger is removed by being heated by the heat radiated from the refrigerant. Further, the liquid refrigerant condensed and liquefied in the outdoor heat exchanger flows into the indoor heat exchanger through the expansion valve and evaporated and vaporized in the indoor heat exchanger. The vaporized refrigerant (gaseous refrigerant) is returned to the compressor again so that the above operation cycle is repeated.

[0010] When the defrosting operation is carried out in the air conditioners using R22 as the refrigerant, the difference between a discharge pressure P_d, which is discharged from the compressor and reaches the expansion valve through the indoor heat exchanger (condenser), and a suction pressure, which is sucked into the compressor from the expansion valve through the indoor heat exchanger (evaporator), is only about 20 kg/cm² as shown in FIG. 16. Therefore, even if an abrupt pressure change arises when the four-way valve is reversed, the noise and vibration caused to the piping and the like of the four-way valve by the pressure change is such a degree as not to almost affect the environment.

[0011] Since there is a possibility that the ozone layer is destroyed by R22 which has been used as the refrigerant in the conventional air conditioners, it is formally determined to disuse R22 in the future and air conditioners using a refrigerant which replaces the R22 have been studied and developed.

[0012] There is contemplated an air conditioner using an alternative refrigerant having a saturated pressure (condensed pressure) higher than that of R22 at the same temperature (for example, the saturated pressure at 50° C is 2500 Pa or higher at 50° C) as an alternative refrigerant replacing the R22.

[0013] However, when the conventional air conditioners use the alternative refrigerant whose saturated pressure is higher than that of R22 at the same temperature, since the pressure on a high pressure side, namely, a

discharge pressure abruptly increases, the pressure on the high pressure side abnormally increases during the operation stop period of the indoor fan until the indoor fan starts the operation at the start of the above heating operation. Note, the high pressure side is the system from the compressor to the expansion valve through the condenser (the indoor heat exchanger in heating operation) and the system from the expansion valve to the compressor through the evaporator (outdoor heat exchanger in heating operation) is called a low pressure side.

[0014] As a result, the reliability of the compressor is adversely affected and there is a danger that the respective components of the air conditioner, such as respective heat exchangers, piping may be damaged. In addition, when an oil such as an ester oil or the like which has good compatibility and a high relative dielectric constant is used as the lubricant (refrigerating machine oil) of the compressor, the refrigerant dissolves in the lubricant in the compressor according to the pressure on the high pressure side abruptly increases whereby the oil level of the lubricant rises. As a result, even the winding portion of the motor in the compressor is dipped in the lubricant by the rise of the oil level, thereby increasing a leakage current.

[0015] For example, FIG. 17 is a graph showing an example of the change of the pressure P on the high pressure side, the height H of an oil level and a leakage current I after heating operation starts in the air conditioners using an alternative refrigerant having a saturated pressure higher than that of the conventional R22 at the same temperature (when the operation of the indoor fan stops) wherein the abscissa represents a period of time t elapsed from the start of the heating operation. According to FIG. 17, it can be found that the pressure P on the high pressure side abruptly and abnormally increases just after the start of the heating operation and, in accordance with the increase of the pressure P, the height H of the oil level and the amount of the leakage current I increase.

[0016] On the other hand, the aforesaid abnormal pressure increase on the high pressure side causes a problem also in the defrosting operation. That is, FIG. 18 shows the relationship between a discharge pressure Pd' and a suction pressure Ps' which correspond to those shown in FIG. 16 when, for example, a refrigerant having a saturated pressure of 2500 kPa or higher at 50° C is used as an alternative refrigerant having a saturated pressure higher than that of R22 at the same temperature. According to FIG. 18, the difference between the discharge pressure Pd' and the suction pressure Ps' reaches up to about 30 kg/cm² due to the abnormal increase of the discharge pressure Pd' in the defrosting operation. Therefore, the noise and vibration generated from the piping and the like of the four-way valve by the abrupt pressure change when the four-way valve is reversed are increased whereby there is a possibility that the environment is adversely affected by the

increases of the noise and vibration.

SUMMARY OF THE INVENTION

[0017] The present invention is directed to overcome the foregoing problems.

[0018] Accordingly, it is an object of the present invention to provide an air conditioner using an alternative refrigerant having a saturated pressure higher than that of R22 at the same temperature, wherein the air conditioner is capable of maintaining the capability and reliability of a compressor to a high level, preventing the breakdown of heat exchangers and the like and providing a comfortable heating space by suppressing an abrupt and abnormal pressure increase on a high pressure side.

[0019] Another object of the present invention is to provide an air conditioner using an alternative refrigerant having a saturated pressure higher than that of R22 at the same temperature such as, for example, an alternative refrigerant having a saturated pressure of 2500 kPa or higher at 50° C, wherein the air conditioner is capable of reducing the noise and vibration generated from the piping and the like of a four-way valve when the valve is reversed in defrosting operation by reducing the difference between a discharge pressure and a suction pressure so as to restrain the abnormal increase of the discharge pressure.

[0020] One of the reasons why the pressure on a high pressure side abruptly increases from the start of heating operation when an alternative refrigerant having a saturated pressure higher than that of R22 at the same temperature such as, for example, an alternative refrigerant having a saturated pressure of 2500 kPa or higher at 50° C is used is that a heat exchange action is not carried out by an indoor heat exchanger because the operation of an indoor fan is stopped. However, when the indoor fan is ordinarily operated, since cool air flow subjected to heat exchange in an indoor heat exchanger which does not reach a heat exchange possible state flows into a room, one aspect of a present invention is arranged such that an air flow is directed upward toward a ceiling side in the room at the start of heating operation and when, for example, the temperature of the indoor heat exchanger increases and reaches the heat exchange possible state, the air flow is directed downward toward a floor side in the room. With the above setting, the heating operation can be started without sacrificing the comfortable state in the room while avoiding the abrupt pressure increase on the high pressure side.

[0021] On the other hand, since another aspect of a present invention also provides means for reducing the difference between a discharge pressure and a suction pressure (for example, means for turning OFF the operation of a compressor for a predetermined period of time before a four-way valve is reversed, means for increasing or decreasing the opening of an expansion system by a predetermined amount of opening from the

predetermined time before the four-way valve is reversed, and the like) when the four-way valve is reversed at the start of defrosting operation, an abrupt pressure change can be suppressed when the four-way valve is reversed. Therefore, the noise and vibration generated from the piping and like of the four-way valve when the defrosting operation starts can be reduced.

[0022] That is, to achieve the such objects, according to one aspect of the present invention, there is provided an air conditioner having a refrigerant circulation cycle constituted by sequentially connecting a compressor, an indoor heat exchanger having an indoor fan disposed in a room, an expansion system and an outdoor heat exchanger having an outdoor fan disposed out of the room so as to carry out air conditioning operation including at least heating operation in the room by circulating the refrigerant in the refrigerant circulation cycle, in which an alternative refrigerant having a saturated pressure higher than a saturated pressure of HCFC22 at the same temperature is used as the refrigerant, characterized by comprising means for regulating a vertical direction of air flow blown out from the indoor fan and control means for controlling the regulation means at a start of the heating operation so as to direct the air flow upward toward a ceiling side in the room and, when the indoor heat exchanger reaches a state capable of executing heat exchange operation, for controlling the regulation means so as to direct the air flow downward toward a floor side in the room.

[0023] This aspect of the present invention has an arrangement that the regulation means is adapted to regulate a vertical blowout angle of the air flow blown out from the indoor fan thereby regulating the vertical direction thereof.

[0024] In preferred embodiment of this aspect, there is provided an air conditioner characterized by further comprising temperature sensing means for detecting at least one of the temperature of the indoor heat exchanger and the blowout temperature thereof and characterized in that said control means is adapted to control the regulation means in response to the signal detected by the temperature sensing means.

[0025] This aspect of the present invention has an arrangement that the air conditioning operation includes cooling operation in the room and said direction of the air flow set at the start of the heating operation is substantially the same as a vertical direction set in the cooling operation.

[0026] This aspect of the present invention has an arrangement that the conditioner according to claim 1, characterized in that the alternative refrigerant is any one of a refrigerant containing not less than 80% of the composition of HFC32 and HFC125, a refrigerant containing not less than 80% of the composition of HFC143a and HFC125 and a refrigerant containing not less than 45% of the composition of HFC32.

[0027] In order to achieve the such objects, according to one aspect of the present invention, there is provided

a method of controlling an air conditioner having a refrigerant circulation cycle constituted by sequentially connecting a compressor, an indoor heat exchanger having an indoor fan disposed in a room, an expansion system and an outdoor heat exchanger having an outdoor fan disposed out of the room so as to carry out air conditioning operation including at least heating operation in the room by circulating the refrigerant in the refrigerant circulation cycle, in which an alternative refrigerant having a saturated pressure higher than a saturated pressure of HCFC22 at the same temperature is used as the refrigerant, the method characterized by comprising the steps of regulating a vertical direction of air flow blown out from the indoor fan at a start of the heating operation so as to direct the air flow upward toward a ceiling side in the room and regulating, when the indoor heat exchanger reaches a state capable of executing heat exchange operation, the vertical direction of air flow blown out from the indoor fan so as to direct the air flow downward toward a floor side in the room.

[0028] In order to achieve the such objects, according to another aspect of the present invention, there is provided an air conditioner having a refrigerant circulation cycle constituted by sequentially connecting a compressor, a four-way valve, an indoor heat exchanger having an indoor fan disposed in a room, an expansion system and an outdoor heat exchanger having an outdoor fan disposed out of the room so as to carry out air conditioning operation including at least heating operation in the room and defrosting operation therein, in which an alternative refrigerant having a saturated pressure higher than a saturated pressure of HCFC22 at the same temperature is used as the refrigerant and the heating operation is executed by operating the compressor at an operating frequency and rotating the indoor fan and outdoor fan while connecting a discharge side of the compressor of the refrigerant circulation cycle to the indoor heat exchanger through the four-way valve and a suction side of the compressor thereof to the outdoor heat exchanger therethrough, characterized by comprising means for controlling the four-way valve at a start of the defrosting operation during the heating operation so as to reversely connect the discharge side of the compressor to the outdoor heat exchanger and the suction side thereof to the indoor heat exchanger, respectively, means for setting the operating frequency of the compressor to a predetermined frequency for the defrosting operation, stopping the rotation of the indoor fan and the outdoor fan, and setting an opening of the expansion system to a predetermined opening for the defrosting operation, said set of the operating frequency of the compressor to the predetermined frequency, stop of the rotation of the indoor fan and the outdoor fan and set the opening of the expansion system to the predetermined opening being substantially at a same time with the reversely connection of the four-way valve, and means for reducing a difference between a discharge side pressure in the refrigerant circulation cycle and a

suction side pressure therein when the four-way valve is reversely connected.

[0029] This another aspect of the present invention has an arrangement that the reduction means is adapted to stop the operation of the compressor at a time before a predetermined period of time from the start of the reverse control of the control means so as to keep the stop of the operation of the compressor until the start of the reverse control thereof.

[0030] In preferred embodiment, the reduction means includes means for setting the operating frequency of the compressor lower than the defrosting operation frequency when the four-way valve is reversely connected.

[0031] In preferred embodiment, the reduction means has means for increasing the opening of the expansion system by a predetermined amount as compared with the opening thereof during the heating operation for a predetermined period of time before the reverse control of the control means starts so as to keep the increased opening of the expansion system until the reverse control thereof starts.

[0032] This another aspect of the present invention has an arrangement that the reduction means has means for increasing a number of rotation of the indoor fan by a predetermined number as compared with a number of rotation thereof during the heating operation for a predetermined period of time before the reverse control of the control means starts so as to keep the increased number of rotation of the indoor fan until the reverse control thereof starts.

[0033] This another aspect of the present invention has an arrangement that the alternative refrigerant is any one of a refrigerant containing not less than 80% of the composition of HFC32 and HFC125, a refrigerant containing not less than 80% of the composition of HFC143a and HFC125 and a refrigerant containing not less than 45% of the composition of HFC32.

[0034] In order to achieve the such objects, according to another aspect of the present invention, there is provided a method of controlling an air conditioner having a refrigerant circulation cycle constituted by sequentially connecting a compressor, four-way valve, an indoor heat exchanger having an indoor fan disposed in a room, an expansion system and an outdoor heat exchanger having an outdoor fan disposed out of the room so as to carry out air conditioning operation including at least heating operation in the room and defrosting operation therein, in which an alternative refrigerant having a saturated pressure higher than a saturated pressure of HCFC22 at the same temperature is used as the refrigerant and the heating operation is executed by operating the compressor at an operating frequency and rotating the indoor fan and outdoor fan while connecting a discharge side of the compressor of the refrigerant circulation cycle to the indoor heat exchanger through the four-way valve and a suction side of the compressor thereof to the outdoor heat exchanger therethrough, the method characterized by comprising the steps of con-

trolling the four-way valve at a start of the defrosting operation during the heating operation so as to reversely connect the discharge side of the compressor to the outdoor heat exchanger and the suction side thereof to the indoor heat exchanger, respectively, setting the operating frequency of the compressor to a predetermined frequency for the defrosting operation substantially at a same time with the reversely connection of the four-way valve, stopping the rotation of the indoor fan and the outdoor fan substantially at a same time with the reversely connection of the four-way valve, setting an opening of the expansion system to a predetermined opening for the defrosting operation substantially at a same time with the reversely connection of the four-way valve, and reducing a difference between a discharge side pressure in the refrigerant circulation cycle and a suction side pressure therein when the four-way valve is reversely connected.

[0035] As described above, according to the air conditioner according to one aspect of the present invention, since the air flow is directed upward toward the ceiling side at the start of the heating operation (the air flow is directed in the cooling operation, the air flow blown out from the blowout grille is sucked into the suction grille in the short circuit fashion, or other similar positions), and when, for example, the temperature of the indoor heat exchanger increases and permits heat exchange, the air flow is directed downward toward the floor side, which permits to start the heating operation without sacrificing the comfortable state in the room while avoiding the abrupt pressure increase on the high pressure side. That is, since the pressure gradually increases on the high pressure side, the capability and reliability of the compressor can be maintained and the breakdown of the heat exchangers and the other components of the air conditioner.

[0036] According to the air conditioner of another aspect of the present invention, since the difference between the discharge pressure and the suction pressure is reduced when the four-way valve is reversed at the start of the defrosting operation, the abrupt pressure change can be suppressed when the four-way valve is reversed. Therefore, since the noise and vibration generated from the piping and other components of the four-way valve when it is reversed in the defrosting operation can be reduced, making it possible to provide the easily usable air conditioner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] Other objects and aspects of the present invention will become apparent from the following description of embodiments with reference to the accompanying drawings in which:

FIG. 1 is a view showing the arrangement of the refrigerating cycle of an air conditioner according to a first embodiment of the present invention;

FIG. 2 is a longitudinal sectional view showing the schematic arrangement of an indoor unit in FIG. 1; FIG. 3 is a control system view of the air conditioner as a whole including the indoor unit and an outdoor unit;

FIG. 4 is a schematic flowchart showing an example of operation from the start of heating operation to ordinary heating operation in the first embodiment; FIG. 5 is a graph showing an example of the change of the pressure P_A on a high pressure side, the height H_A of an oil level and a leakage current I_A when the abscissa represents the period of time t elapsed from the start of heating operation in the air conditioner of the embodiment using an alternative refrigerant having a saturated pressure higher than that of R22 at the same temperature;

FIG. 6 is a schematic flowchart showing an example of operation for defrosting executed in heating operation in a second embodiment;

FIG. 7 is a sequential diagram of a compressor, a four-way valve, an indoor fan, an outdoor fan and a PMV in heating operation and defrosting operation when the abscissa represents a timing axis according to the second embodiment;

FIG. 8 is a sequential diagram of a compressor, a four-way valve, an indoor fan, an outdoor fan and a PMV in heating operation and defrosting operation in a first modification of the second embodiment when the abscissa represents a timing axis;

FIG. 9 is a sequential diagram of a compressor, a four-way valve, an indoor fan, an outdoor fan and a PMV in heating operation and defrosting operation in a second modification of the second embodiment when the abscissa represents a timing axis;

FIG. 10 is a sequential diagram of a compressor, a four-way valve, an indoor fan, an outdoor fan and a PMV in heating operation and defrosting operation in a third modification of the second embodiment when the abscissa represents a timing axis;

FIG. 11 is a sequential diagram of a compressor, a four-way valve, an indoor fan, an outdoor fan and a PMV in heating operation and defrosting operation in a fourth modification of the second embodiment when the abscissa represents a timing axis;

FIG. 12 is a sequential diagram of a compressor, a four-way valve, an indoor fan, an outdoor fan and a PMV in heating operation and defrosting operation in a fifth modification of the second embodiment when the abscissa represents a timing axis;

FIG. 13 is a sequential diagram of a compressor, a four-way valve, an indoor fan, an outdoor fan and a PMV in heating operation and defrosting operation in a sixth modification of the second embodiment when the abscissa represents a timing axis.

FIG. 14 is a sequential diagram of a compressor, a four-way valve, an indoor fan, an outdoor fan and a PMV in heating operation and defrosting operation in other modification of the second embodiment

when the abscissa represents a timing axis;

FIG. 15 is a schematic flowchart showing an example of operation from the start of heating operation to ordinary heating operation in a conventional air conditioner;

FIG. 16 is a graph showing the difference between a discharge pressure P_d and a suction pressure P_s in the defrosting operation executed by an air conditioner using R22 as a refrigerant when the abscissa represents a timing axis;

FIG. 17 is a graph showing an example of the change of the pressure P on a high pressure side, the height H of an oil level and a leakage current I when the abscissa represents the period of time t elapsed from the start of heating operation in an air conditioner using an alternative refrigerant having a saturated pressure higher than that of conventional R22 at the same temperature; and

FIG. 18 is a graph showing the difference between a discharge pressure P_d' and a suction pressure P_s' when the abscissa represents a time elapsed from the start of defrosting operation in an air conditioner which carries out the defrosting operation using an alternative refrigerant having a saturated pressure of 2500 kPa or higher at 50° C.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] Preferred embodiments of the present invention will now be described with reference to the accompanying drawings.

(First Embodiment)

[0039] FIG. 1 is a view showing the arrangement of the refrigerating cycle of an air conditioner according to a first embodiment. In the refrigerating cycle of the air conditioner arranged as described above, an alternative refrigerant having a saturated pressure higher than that of R22 at the same temperature such as, for example, an alternative refrigerant having a saturated temperature of 2500 kPa or higher at 50° C is used. Note, alternative refrigerants which do not particularly destroy the ozone layer as such an alternative refrigerant are a refrigerant containing 80% or more of the composition of R32 (CH_2F_2) and R125 (CHF_2CF_3), a refrigerant containing 80% or more of the composition of R143a (CH_3CF_3) and R125 (CHF_2CF_3) and a refrigerant containing 45% or more of the composition of R32 (CH_2F_2).

[0040] As shown in FIG. 1, an air conditioner 1 constitutes a refrigerating cycle which circulates a refrigerant by sequentially and annularly connecting a compressor 2, a four-way valve 3 having a function for switching a refrigerant flow passage, an indoor heat exchanger 4 having an indoor fan 4a, an electronic control valve (PMV) 5 as an expansion valve and an outdoor heat exchanger 6 having an outdoor fan 6a through a

pipe 7.

[0041] As apparent from the refrigerating cycle, the air conditioner 1 carries out cooling operation by switching the four-way valve 3 (four-way valve 3 OFF) when the indoor fan 4a and the outdoor fan 6a are in operation thereby circulating the alternative refrigerant (hereinafter, the alternative refrigerant is described easily as only "refrigerant") in the direction of the solid arrows in FIG. 1 (compressor 2 → four-way valve 3 → outdoor heat exchanger 6 (condensing action) → PMV 5 → indoor heat exchanger 4 (evaporating and cooling action) → four-way valve 3 → compressor 2 → ...) and further carries out heating operation by switching the four-way valve 3 (four-way valve 3 → ON) so as to circulate the refrigerant in the direction of the broken arrows in the drawing (compressor 2 → four-way valve 3 → indoor heat exchanger 4 (condensing and heating action) → expansion valve 5 → outdoor heat exchanger 6 (evaporating action) → four-way valve 3 → compressor 2 → ...). In addition, the air conditioner 1 can execute defrosting operation by stopping the indoor fan 4a and the outdoor fan 6a and, simultaneously, switching the four-way valve 3 in the heating operation so as to circulate the refrigerant in the direction opposite to that in the heating operation (in the direction of the solid arrows in FIG. 1).

[0042] The compressor 2, the four-way valve 3, the PMV 5, the outdoor heat exchanger 6 and the outdoor fan 6a are disposed to an outdoor unit located to the outside of a room. The outdoor unit includes an evaporation temperature sensor 9 disposed to the outdoor heat exchanger 6 for detecting the refrigerant evaporating temperature of the outdoor heat exchanger 6 and an open air temperature sensor 10 provided with the outdoor heat exchanger 6 itself or in the vicinity thereof and has a function for controlling the outdoor components as a whole including the compressor 2 and the like according to the signals and the like detected by the evaporation temperature sensor 9 and the open air temperature sensor 10.

[0043] The indoor heat exchanger 4 and the indoor fan 4a are provided to an indoor unit disposed in the room. The indoor unit includes a room temperature sensor 11 for detecting the temperature in the room and a heat exchanger temperature sensor 12 disposed to the indoor heat exchanger 4 for detecting the refrigerant condensing temperature of the indoor heat exchanger 4 and has a function for controlling the indoor side components as a whole including the indoor heat exchanger 4 and the indoor fan 4a on the basis of the signals and the like detected by the room temperature sensor 11 and the heat exchanger temperature sensor 12, respectively. The room temperature sensor 11 is disposed in the vicinity of the indoor heat exchanger 4 in the indoor unit (for example, on a windward side).

[0044] FIG. 2 shows the schematic arrangement of the indoor unit in FIG. 1. According to FIG. 2, the indoor unit 15 including the indoor heat exchanger 4 and the indoor fan 4a is formed to an substantially rectangular

shape as a whole and disposed on, for example, a wall in the room so that the longitudinal direction thereof which corresponds to the direction of the rotary shaft of the indoor fan 4a is located along the horizontal direction of the room.

[0045] The indoor unit 15 includes a main body casing 16 and a front panel 17 mounted on the front surface of the main body casing 16 which is opposite to the side of the casing where it is provided on the wall in the room. A suction grille 18 is disposed to the front surface of the front panel 17 and a blowout grille 19 as a blowout port is attached to the lower portion of the front panel 17 on the front floor side thereof (the lower side in the drawing). An airway 21 is formed in the fan casing 20 of the main body casing 16 to communicate the suction grille 18 with the blowout grille 19.

[0046] The indoor heat exchanger 4 which is bent to, for example, an inverted-V-shape is disposed in the airway 21 and the indoor fan 4a which is composed of, for example, a transverse fan is also arranged in the airway 21 downstream of the indoor heat exchanger 4 in an air supply direction. The room air which is sucked from the suction grille 18 into the main body casing 16 is subjected to heat exchange in the indoor heat exchanger 4 and temperature-regulated air for cooling or heating is supplied again into the room from the blowout grille 19 by the indoor fan 4a whereby to carry out cooling operation or heating operation.

[0047] The indoor fan 4a is arranged as a blower together with the fan casing 20 and a nose 25 which is fixed to the rear side wall of a drain pan 26 for receiving a drain from the indoor heat exchanger 4.

[0048] Disposed inwardly of the blowout grille 19 are an upward/downward (vertically) air flow regulating louver 27 for regulating the vertical blowout angle of the blowout air (air flow) w in the room space which is blown from the blowout grille 19 from upward toward a ceiling side of the room space to downward toward a floor side thereof (hereinafter, the direction of the ceiling side and the direction of the floor side referred to as an up direction and down direction). A rightward/ leftward (horizontal) air flow direction regulating louver 28 is provided for regulating the blowout angle in a horizontal direction (rightward and leftward) along the rotary shaft of the fan.

[0049] The vertical air flow regulating louver 27 includes a pair of upper and lower lateral louvers 27a, 27b composed of, for example, a thin board and lateral louvers 27a, 27b are arranged along the longitudinal direction of the blowout grille 19 which is substantially in parallel with the rotary shaft of the fan over the substantially entire length thereof in parallel with each other with a predetermined interval defined therebetween in the up and down direction. Further, the respective lateral louvers 27a, 27b are swung vertically (upward and downward) by a swing system about an axis (swing axis) along the above longitudinal direction and the upward/downward swing angle of the lateral louvers 27a, 27b is suitably controlled by the louver motor of the swing sys-

tem which will be described later thereby controlling the blowout angle of the blowout air w in the upward/downward direction.

[0050] FIG. 3 shows the control system of the air conditioner 1 as a whole including the indoor unit 15 and the outdoor unit 30.

[0051] According to FIG. 3, the indoor unit 15 includes an indoor control unit 31 having, for example, a micro-computer mounted thereon for controlling the entire indoor unit 15. An AC power supply S and a remote control unit R are connected to the indoor control unit 31, respectively.

[0052] The indoor unit 15 further includes the room temperature sensor 11 and the heat exchanger temperature sensor 12 which are described above, a fan motor 32 for rotating the indoor fan 4a, a speed control circuit 33 for variably controlling the rotational speed of the fan motor 32, a louver motor (LM) 34 for swinging the upward/downward air flow direction regulating louver 27 (lateral louvers 27a, 27b) by turning the lateral louvers 27a, 27b about the swing axis and a louver drive circuit 35 for driving the LM 34 while controlling its rotating angle. The room temperature sensor 11, the heat exchanger temperature sensor 12, the speed control circuit 34 and the louver drive circuit 35 are connected to the indoor control unit 31, respectively.

[0053] The indoor control unit 31 previously stores at least one of the heat exchange (condensation) possible temperature T0 of the indoor heat exchanger 4 in heating operation, the pressure P0 on a high pressure side corresponding to the heat exchange possible temperature T0 and the period of time t0 from the time at which heating operation starts to the time which permits the indoor heat exchanger 4 to carry out the heat exchange (condensation) in an inner memory and controls the speed control circuit 33 and the louver drive circuit 35 in accordance with the signals detected by the room temperature sensor 11 and the heat exchanger temperature sensor 12 and the outdoor information signal and the like supplied from the outdoor unit 30 (outdoor control unit).

[0054] On the other hand, the outdoor unit 30 includes an outdoor control unit 40 on which, for example, a microcomputer is mounted for controlling the outdoor unit 30 as a whole and a memory (EEPROM) 41 which is interconnected to the outdoor control unit 40 and can store information data and the like which are necessary to control the outdoor control unit 40. An AC power supply line L is connected to the outdoor control unit 40 through the indoor control unit 31.

[0055] The outdoor unit 30 further includes a compressor motor (CM) 42 for driving the compressor 2 in rotation and an inverter circuit 43 for converting an AC power supplied from the AC power supply S through the AC power supply line L into a direct current once and smoothing the direct current and thereafter converting the direct current into the an AC power again thereby driving the CM 42 in rotation. The inverter circuit 43 can

regulate a cooling/heating capability in a wide range by controlling the rotation frequency of the CM 42 in accordance with the control signal from the outdoor control unit 40.

[0056] The outdoor unit 30 further includes a fan motor (FM) 44 for driving the outdoor fan 6a in rotation, a fan drive circuit 45 for driving the FM 44 while variably controlling the rotational speed thereof, the four-way valve (4V) 3, the PMV 5 and the open air temperature sensor 10 which are described above. The outdoor control unit 40 controls the drive of the fan drive circuit 45, the turning ON/OFF of the four-way valve 3 and the opening of the PMV 5 in accordance with the signals detected by the evaporation temperature sensor 9 and the open air temperature sensor 10 and the indoor information signal supplied from the indoor unit 15 (the indoor control unit 31).

[0057] Next, overall operation of the embodiment and in particular operation of the indoor unit when heating operation starts will be described.

[0058] When heating operation is started by operating the air conditioner 1, the indoor control unit 31 controls the rotation of the LM 34 through the louver drive circuit 35 so as to set the angular position of the lateral louvers 27a and 27b to a position where the blowout air w is directed in the ceiling direction (upward) in the room space (for example, a horizontal position which is substantially in parallel with a ceiling surface or a floor surface (or a horizontal position which is directed in an upper direction toward the ceiling than the above horizontal position)) or a position where the blowout air w is sucked into the suction grille 18 in a short circuit fashion (short-circuit position where the louvers are directed in an upper direction toward the ceiling than the above horizontal position) (refer to the positions of the lateral louvers 27a' and 27b' shown by the broken lines and blowout air w1 (horizontal position of the louver) and blowout air w2 (short circuit position of the louver) shown by the broken arrows, respectively in FIG. 2).

[0059] In this state, the outdoor control unit 40 switches the four-way valve 3 to an ON mode and drives the CM 42 in rotation through the inverter circuit 43 thereby starting the compressor 2 and the outdoor control unit 40 drives the FM 44 in rotation through the fan drive circuit 45 so as to drive the FM 44 and the outdoor fan 6a.

[0060] On the other hand, in accordance with the compressor start information supplied from the outdoor control unit 40, the indoor control unit 31 drives the FM 32 in rotation through the speed control circuit 45 so as to start operation of the indoor fan 4a (the indoor fan is turned ON) substantially simultaneously with the start of the compressor 2. As a result, heat exchange is carried out on the indoor side through the indoor heat exchanger 4 by the operation of the indoor fan 4a from the start of heating operation (refer to step S10 in FIG. 4).

[0061] At that time, the indoor control unit 31 always refers to the signal detected by the heat exchanger temperature sensor 12 and determines whether the temper-

ature T of the indoor heat exchanger 4 based on the detected signal increases and exceeds the heat exchange possible temperature T_0 ($T \geq T_0$) or not (step S11).

[0062] That is, when the temperature T of the indoor heat exchanger 4 detected by the heat exchanger temperature sensor 12 does not exceed the heat exchange possible temperature T_0 ($T < T_0$), the determination of the indoor control unit 31 at step S11 is NO and the indoor control unit 31 repeats the determination process at step S11. At that time, because $T < T_0$, although the air blown out from the blowout grille 19 by the operation of the indoor fan 4a is cold air, since the angular position of the lateral louvers 27a and 27b is set to the horizontal position or the short circuit position, the cold blowout air is blown upward toward the ceiling in the room space or blown so as to be sucked into the suction grille 18 in the short circuit fashion as shown as the blowout air w1 and the blowout air w2 in FIG. 2. As a result, the room space is not cooled as a whole and the temperature of the room space is less changed.

[0063] Whereas, when the temperature T of the indoor heat exchanger 4 exceeds the heat exchange possible temperature T_0 ($T \geq T_0$), since the result of determination at step S11 is YES, the indoor control unit 31 controls the rotation of the LM 34 through the louver drive circuit 35 and sets the angular position of the lateral louvers 27a and 27b to the position which is used in an ordinary heating operation, that is, the position where blowout air is directed toward the floor in the room (downward) (refer to the positions of the lateral louvers 27a and 27b shown by the solid lines in FIG. 2), by which ordinary heating operation is carried out. That is, the air blown out from the blowout grille 19 by the operation of the indoor fan 4a is hot air because $T \geq T_0$, and since the hot air is blown toward the floor in the room (downward) as shown by the solid arrows w0, the room space is heated (step S12).

[0064] FIG. 5 is a graph showing an example of the change of the pressure P_A on the high pressure side, the height H_A of the oil level and the leakage current I_A when the abscissa represents the period of time t elapsed from the start of the heating operation in the above operation for starting the heating operation.

[0065] That is, according to the arrangement, even if the air conditioner uses the alternative refrigerant whose saturated pressure is higher than that of R22 at the same temperature, since the indoor fan 4a has been operated from just after the start of the heating operation and the heat exchange has been carried out by the indoor heat exchanger 4 from just after the start of the heating operation, the pressure P_A on the high pressure side gradually increases as shown in FIG. 5. As a result, since the maximum pressure (peak) of the pressure P_A on the high pressure side is lower than the conventional maximum pressure, there can be avoided the adverse affect to the reliability, life and the like of the compressor 2, the indoor heat exchanger 4 and the like which is

caused by the abrupt increase and high peak of the pressure P_A on the high pressure side.

[0066] Since the pressure P_A on the high pressure side gradually increases as shown in FIG. 5, the refrigerant does not excessively dissolve into a lubricant and the oil level rises only slightly as compared with the conventional one (refer to the height H_A of the oil level). Therefore, the peak of the leakage current I_A which is caused by the rise of the oil level can be greatly lowered as compared with the conventional peak of the leakage current.

[0067] Note, when the lateral louvers 27a' and 27b' is set to the short circuit position in the arrangement, since the suction temperature of the indoor heat exchanger 4 is increased, a period of time which is necessary before ordinary heating operation (operation carried out with the louver directed downward) starts can be shortened.

[0068] Although the angular position of the lateral louvers 27a and 27b is set in accordance with the temperature T of the indoor heat exchanger 4 detected by the heat exchanger temperature sensor 12 in the arrangement, the present invention is not limited thereto but the angular position of the lateral louvers 27a and 27b may be controlled by recognizing that the temperature T of the indoor heat exchanger 4 exceeds the heat exchange possible temperature T_0 on the basis of the change of the room temperature detected by the room temperature sensor 11 in correspondence to the change of the temperature T . Further, the angular position of the lateral louvers 27a and 27b may be controlled by the period of time elapsed from the start of the heating operation based on the period of time t_0 from the time at which the heating operation starts to the time which permits the indoor heat exchanger 4 to carry out the heat exchange. Furthermore, the angular position of the lateral louvers 27a and 27b may be controlled based on the pressure value on the high pressure side which is determined from the temperature T of the indoor heat exchanger 4 with reference to the pressure P_0 on the high pressure side in the state that the indoor heat exchanger 4 can carry out the heat exchange (condensation).

[0069] Note, since the air is blown upward toward the ceiling and sucked into the suction grille 18 while the lateral louvers 27a and 27b are directed to the horizontal position or the short circuit position, there is a possibility that the room temperature detected by the room temperature sensor 11 is sensed as if it exceeds an actual room temperature. Therefore, while the lateral louvers 27a and 27b are directed to the horizontal position or the short circuit position, the room temperature detected by the room temperature sensor 11 may be corrected by adding the temperature increase resulting from the air which is blown out upward toward ceiling so as to operate the indoor control unit 31 based on the corrected room temperature. Otherwise, while the lateral louvers 27a and 27b are directed to the horizontal position or the short circuit position, the indoor control unit 31 may be operated by making the room temperature de-

tected by the room temperature sensor 11 ineffective. With the above arrangement, the malfunction caused by the operation of the indoor control unit 31 based on a value detected by the room temperature sensor 1 which is different from an actual room temperature can be avoided, whereby the reliability of the air conditioner can be more improved.

(Second Embodiment)

[0070] Since the arrangement of the air conditioner of a second embodiment is substantially the same as that shown in FIG. 1 to FIG. 3, the description thereof is omitted. That is, since the air conditioner 1 of the second embodiment has a feature in the control operation when defrosting is carried out, overall operation thereof which emphasizes defrosting control will be described below in detail with reference to FIG. 6 and the other operation is omitted. Note, a refrigerant used here is not R22 but an alternative refrigerant whose saturated pressure is higher than that of R22 at the same temperature such as, for example, an alternative refrigerant having a saturated pressure of 2500 kPa at 50° C.

[0071] When it is supposed that the air conditioner 1 carries out heating operation, a compressor 2 is driven at a predetermined constant operating frequency (number of rotation) and a four-way valve 3 is switched to an ON mode. Note, the operating frequency (number of rotation) is referred to as a heating operation frequency, hereinafter.

[0072] An indoor fan 4a is operated (turned ON) at a predetermined constant number of rotation and an outdoor fan 6a is also operated (turned ON) at a predetermined constant number of rotation. Further, a PMV 5 is controlled to a constant opening based on the control in the heating operation (superheat (SH) control).

[0073] That is, in the heating operation, the refrigerant of high temperature and high pressure (alternative refrigerant) compressed by the compressor 2 is guided into an indoor heat exchanger 4 through the four-way valve 3 as shown by the solid lines and heats the interior of a room by radiating heat in accordance with the rotation of the indoor fan 4a. The refrigerant condensed by heating the interior of the room is expanded by the PMV 5 and its pressure is reduced and then guided into an outdoor heat exchanger 6. The refrigerant which has absorbed heat from the open air in the outdoor heat exchanger 6 in accordance with the number of rotation of the outdoor fan 6a and has evaporated is supplied to the compressor 2 again through the four-way valve 3 and compressed therein and guided into the indoor heat exchanger 4 again through the four-way valve 3 as the refrigerant of high temperature and high pressure. The heating operation is carried out by repeating the above heating cycle (refer to step S20 in FIG. 6).

[0074] In the above heating operation, an outdoor control unit 40 always determines whether the evaporating temperature T_e , which is detected by the evapo-

ration temperature sensor 9, of the refrigerant having evaporated in the outdoor heat exchanger 6 continues the state that it is lower than a predetermined temperature T_s (for example, -2 ° C) ($T_e < T_s$) for a predetermined period of time (for example, 30 minutes) or not (step S21) and when it does not continue the state, that is, the state " $T_e < T_s$ " is continued for the predetermined period of time (the result of determination at step S21 is NO), it is determined that the defrosting operation need not be carried out and the operation at step S20, that is, the heating operation is repeated.

[0075] On the other hand, when the result of determination at step S21 is YES, that is, " $T_e < T_s$ " is continued longer than the predetermined period of time, the indoor control unit 31 and the outdoor control unit 40 carry out the defrosting operation.

[0076] At that time, the outdoor control unit 40 first stops the CM 42 through the inverter circuit 43 so as to stop the rotation of the compressor 2 (compressor 2 is turned OFF at step S22). When a predetermined period of time elapses after the compressor 2 is stopped, the outdoor control unit 40 reverses the four-way valve 3 in the ON mode to an OFF mode thereby reversing the circulating direction of the refrigerant from that in the heating operation and controls the PMV 5 so that it maintains a predetermined opening (opening for defrosting). The outdoor control unit 40 controls the FM 44 through the fan drive circuit 45 simultaneously with the reverse of the four-way valve 3 so as to stop the operation of the outdoor fan 6a. The indoor control unit 31 controls the FM 32 through the speed control circuit 33 at the same time the four-way valve 3 is reversed (simultaneously with the stop of the outdoor fan 6a) so that the operation of the indoor fan 4a is stopped (step S23).

[0077] As a result, the defrosting operation is started. That is, the gaseous refrigerant of high temperature and high pressure discharged from the compressor 2 is guided into the outdoor heat exchanger 6 through the four-way valve 3 in the OFF mode and radiated and liquefied in the outdoor heat exchanger 6. At that time, frost deposited on the outside surface of the outdoor heat exchanger 6 is removed by being heated by the radiation of the refrigerant. Further, the liquid refrigerant having been condensed and liquefied by the outdoor heat exchanger 6 is supplied into the indoor heat exchanger 4 through the PMV 5 and evaporated and vaporized by absorbing heat by natural convection in the indoor heat exchanger 4. The vaporized refrigerant (gaseous refrigerant) is returned into the compressor 2 again so as to repeat the aforesaid operation cycle (step S24).

[0078] On the other hand, the outdoor control unit 40 determines whether the evaporating temperature T_e of the refrigerant which is evaporated in the outdoor heat exchanger 6 and detected by an evaporation temperature sensor 9 exceeds a predetermined temperature T_u (for example, 5° C, $T_e > T_u$) or not (based on the value of the evaporating temperature T_e of the refrigerant (step S25), and when the result of determination is NO

($T_e \leq T_u$), the defrosting operation is repeated at step S24. Whereas, when the result of determination at step S25 is YES, that is, when " $T_e > T_u$ ", the indoor control unit 31 determines that the defrosting has been finished and returns to the processing at step S20 so as to repeat the above heating operation.

[0079] FIG. 7 is a sequential view showing the sequence of the air conditioner 1 (the compressor 2, the four-way valve 3, the indoor fan 4a, the outdoor fan 6a and the PMV 5) in the heating operation and the defrosting operation shown by the flowchart in FIG. 6. As shown in FIG. 7, since the defrosting operation is started by setting the compressor 2 to the OFF mode before the defrosting operation starts and reversing the four-way valve 3 by setting the discharge pressure and suction pressure in the compressor 2 to zero in the arrangement, the difference between the discharge pressure and the suction pressure as a whole is reduced and the change of the pressure at which the four-way valve 3 is reversed is gradually occurred. Therefore, the noise and vibration caused to the piping and other components of the four-way valve 3 when the four-way valve 3 is reversed can be reduced to such a degree as not to almost affect the environment.

[0080] Note, when it is determined that the defrosting has been finished and the process returns to step S20 to repeat the heating operation, the outdoor control unit 40 may increase the operating frequency of the compressor 2 from the defrosting frequency to the above heating operation frequency while continuously operating the compressor 2 by controlling the inverter circuit 43 and the CM 42. Further, the outdoor control unit 40 may stop the operation of the compressor 2 once by controlling the inverter circuit 43 and the CM 42 and increase the operating frequency of the compressor 2 to the above heating operation frequency after a predetermined period of time elapses (refer to the sequence of the operating frequency of the compressor shown by the broken line in FIG. 7).

[0081] Although the difference between the discharge pressure and the suction pressure as a whole is reduced by setting the compressor 2 to the OFF mode before the defrosting operation starts in the arrangement, the present invention is not limited thereto but various modifications may be contemplated.

[0082] For example, as shown in the sequential diagram of FIG. 8, a first modification starts the defrosting operation in such a manner that the outdoor control unit 40 gradually lowers the operating frequency of the compressor 2 in the processing at step S22 in FIG. 6 and reverses the four-way valve 3 at the time the operating frequency is made lower than the defrosting frequency (the operating frequency at the time: H_{min}). Even if the above arrangement is employed, the discharge pressure is sufficiently lowered because the operating frequency of the compressor 2 is sufficiently lowered as compared with the heating operation frequency and the defrosting frequency when defrosting operation starts

likewise the aforesaid case of the compressor 2 $\rightarrow$ OFF. Thus, the difference between the discharge pressure and the suction pressure is reduced. Consequently, the noise and vibration caused to the piping and the like of the four-way valve 3 when it is reversed can be reduced to such a degree as not to almost affect the environment. Further, in the arrangement of the modification, since the operating frequency of the compressor 2 is gradually lowered and the compressor 2 is not set to the OFF mode, the degree of the difference between the discharge pressure and the suction pressure at the start of the defrosting operation (when the four-way valve 3 is reversed) is small as compared with the case of "the compressor 2 $\rightarrow$ OFF control". On the contrary, however, since the compressor 2 is driven at all times until the defrosting operation starts, the heating operation can be continuously carried out in the above period. Therefore, the modification has an effect that the comfortable state obtained by heating before the defrosting operation starts is not injured. It is noted that the operating frequency H_{min} may be set to "0Hz".

[0083] FIG. 9 is a sequential diagram showing a second modification. According to FIG. 9, the outdoor control unit 40 may start the defrosting operation in such a manner that the operating frequency of the compressor 2 is gradually lowered in the processing at step S22 in FIG. 6, the operating frequency is maintained for a predetermined period of time in the state that the operating frequency is caused to substantially coincide with the defrosting frequency and the four-way valve 3 is reversed while maintaining the operating frequency. When the second modification is arranged as described above, since the operating frequency of the compressor 2 at the start of the defrosting is maintained to a constant defrosting frequency which is sufficiently lower than the operating frequency in the heating operation without being changed, the suction pressure can be increased and the discharge pressure can be lowered and thus the difference between discharge pressure and the suction pressure can be reduced. Therefore, the noise and vibration caused to the piping and other components of the four-way valve 3 when it is reversed can be reduced to such a degree as not to almost affect the environment.

[0084] Since the compressor 2 is driven at all times until the defrosting operation starts also in the second modification likewise the first modification, the heating operation can be continuously carried out during the period. Therefore, the modification has an effect that comfortable state obtained by heating before the start of the defrosting operation is not injured.

[0085] FIG. 10 is a sequential diagram showing a third modification. According to FIG. 10, the outdoor control unit 40 starts to gradually lower the operating frequency of the compressor 2 in the processing at step S22 in FIG. 6 and increases the opening of the PMV 5 from the opening based on the SH control by a predetermined amount of opening (opening "up"). When the operating frequency reaches the defrosting frequency, the outdoor

control unit 40 reverses the four-way valve 3 to the OFF mode thereby reversing the circulating direction of the refrigerant from that in the heating operation and more increases the opening of the PMV 5 so as to maintain the increased opening in the defrosting operation. Further, the operation of the outdoor fan 6a is turned OFF simultaneously with the reverse of the four-way valve 3 and the operation of the indoor fan 4a is turned OFF under the control of the indoor control unit 31 and so that the defrosting operation starts.

[0086] According to the arrangement of the third modification, since the opening of the PMV 5 is more increased from the opening based on the SH control by the predetermined amount before the defrosting starts, the liquefied refrigerant is contained in the refrigerant gas supplied into the compressor 2 through the PMV 5 and the outdoor heat exchanger 6 (evaporator) in the period of time from the time at which the PMV 5 is opened to the time at which the defrosting starts (liquid back state). The liquefied refrigerant is removed from the refrigerant gas containing the refrigerant through a not shown accumulator and only the refrigerant gas is sucked into the compressor 2.

[0087] That is, according to the arrangement of the third modification, since the liquid back state is created by carrying out the heating operation by increasing the opening of the PMV 5 by the predetermined amount before the defrosting operation and the liquid component is separated through the accumulator so as to reduce the amount of the refrigerant gas circulating in the heating cycle, the discharge pressure can be temporarily lowered (during the period of time until the defrosting operation starts). Therefore, the difference between the discharge pressure and the suction pressure is reduced and the pressure is gradually changed when the four-way valve 3 is reversed likewise the aforesaid second embodiment and the respective modifications. As a result, the noise and vibration caused to the piping and other components of the four-way valve 3 when it is reversed can be reduced to such a degree as not to almost affect the environment.

[0088] FIG. 11 is a sequential diagram showing a fourth modification. According to FIG. 11, the outdoor control unit 40 starts to gradually lower the operating frequency of the compressor 2 in the processing at step S22 in FIG. 6 and more reduces the opening of the PMV 5 from the opening based on the SH control by a predetermined amount of opening (opening "down"). When the operating frequency reaches the defrosting frequency, the outdoor control unit 40 reverses the four-way valve 3 to the OFF mode thereby reversing the circulating direction of the refrigerant from that in the heating and more increases the opening of the PMV 5 so as to keep the increased opening during the defrosting operation. Further, the operation of the outdoor fan 6a is turned OFF simultaneously with the reverse of the four-way valve 3 and the operation of the indoor fan 4a is turned OFF under the control of the indoor control unit

31 whereby to start the defrosting operation.

[0089] According to the arrangement of the fourth modification, since the opening of the PMV 5 is closed from the opening based on the SH control by the predetermined amount, the amount of the refrigerant gas circulating in the heating cycle is reduced during the period of time from the time at which the PMV 5 is closed to the time at which defrosting starts. Therefore, the discharge pressure can be lowered in the period until the defrosting operation starts. As a result, the difference between the discharge pressure and the suction pressure is reduced and the pressure is gradually changed when the four-way valve 3 is reversed likewise the aforesaid second embodiment and respective modifications. Thus, a noise and vibration suppressing effect similar to that of the second embodiment and respective modifications can be obtained.

[0090] FIG. 12 is a sequential diagram showing a fifth modification. According to FIG. 12, the outdoor control unit 40 starts to gradually lower the operating frequency of the compressor 2 in the processing at step S22 in FIG. 6. The indoor control unit 31 increases the number of rotation of the indoor fan 4a by a predetermined number ("up") through the speed control circuit 33 and the fan motor 32 simultaneously with the start of the reduction of the operating frequency carried out by the outdoor control unit 40. When the operating frequency reaches the defrosting frequency, the outdoor control unit 40 reverses the four-way valve 3 to the OFF mode thereby reversing the circulating direction of the refrigerant from that in the heating and more increases the opening of the PMV 5 so as to maintain the opening during the defrosting operation. Further, the operation of the outdoor fan 6a is turned OFF simultaneously with the reverse of the four-way valve 3. Then, the indoor control unit 31 turns OFF the operation (rotation) of the indoor fan 4a through the speed control circuit 33 and the FM 32 simultaneously with the reverse of the four-way valve 3 (simultaneously with the turning OFF of the operation of the outdoor fan 6a) so that the defrosting operation starts.

[0091] According to the arrangement of the fifth modification, since the number of rotation of the indoor fan 4a is increased by the predetermined number before the defrosting starts, the amount of condensation (amount of radiation) of the indoor heat exchanger 4 (condenser) is increased during the period from the time when the number of rotation of the indoor fan 4a increases to the time when the defrosting starts. Therefore, the discharge pressure can be lowered in the period until the defrosting operation starts. As a result, the difference between the discharge pressure and the suction pressure is reduced and the pressure is gradually changed when the four-way valve 3 is reversed likewise the aforesaid second embodiment and the respective modifications. Thus, a noise and vibration suppressing effect similar to that of the second embodiment and respective modifications can be obtained.

[0092] FIG. 13 is a sequential diagram showing a sixth modification. According to FIG. 13, the outdoor control unit 40 starts to gradually lower the operating frequency of the compressor 2 in the processing at step S22 in FIG. 6 and reduces the number of rotation of the outdoor fan 6a ("down") through the fan drive circuit 45 and the FM 44. When the operating frequency reaches the defrosting frequency, the outdoor control unit 40 reverses the four-way valve 3 to the OFF mode thereby reversing the circulating direction of the refrigerant from that during heating operation and more increases the opening of the PMV 5 so as to keep the increased opening during the defrosting operation. Further, the outdoor control unit 40 turns OFF the operation (rotation) of the outdoor fan 6a through the fan drive circuit 45 and the FM 44 simultaneously with the reverse of the four-way valve 3 and turns OFF the operation of the indoor fan 4a under the control of the indoor control unit 31 whereby to start the defrosting operation.

[0093] According to the arrangement of the sixth modification, since the number of rotation of the outdoor fan 6a is reduced by the predetermined number before the defrosting operation starts, the amount of evaporation (amount heat absorption) of the outdoor heat exchanger 6 (evaporator) is reduced during the period from the time at which the number of rotation of the outdoor fan 6a is reduced to the time at which the defrosting operation starts. Therefore, although the suction pressure is lowered in the period of time until the defrosting operation starts, the amount of circulation of the refrigerant can be reduced in the heating cycle. The reduction of the amount of circulation of the refrigerant permits the discharge pressure to be lowered, and since the lowered amount of the discharge pressure is greater than the lowered amount of the suction pressure, the difference between the discharge pressure and the suction pressure is reduced likewise the aforesaid second embodiment and the respective modifications. Therefore, the pressure is gradually changed when the four-way valve 3 is reversed and a noise and vibration suppressing effect similar to that of the second embodiment and respective modifications can be obtained.

[0094] Although the embodiments show the various types of control for reducing the difference between the discharge pressure and the suction pressure by the flowchart in FIG. 6 and the sequential diagrams in FIG. 7 to FIG. 13, the embodiments may be executed by combining the various types of control shown in FIG. 7 to FIG. 13. That is, it is possible to execute the embodiments by combining any one of the frequency controls of the compressor 2 shown in FIG. 7 to FIG. 9, any one of the opening controls of the PMV 5 shown in FIG. 10 and FIG. 11, the number of rotation control of the indoor fan 4a shown in FIG. 12 and the number of rotation control of the outdoor fan 6a shown in FIG. 13, respectively. For example, FIG. 14 shows a sequential diagram which is executed by combining the turning-OFF control of the compressor 2 (FIG. 7), the opening increase control of

the PMV 5 (FIG. 10), the increase of the number of rotation of the indoor fan 4a (FIG. 12) and the decrease of the number of rotation of the outdoor fan 6a (FIG. 13), respectively.

[0095] The embodiments executed by combining the various types of control result in a multiplied effect, whereby a great noise and vibration suppressing effect can be obtained.

[0096] Although the embodiments use the refrigerant having the saturated pressure of 2500 kPa or more at 50 ° C as the alternative refrigerant, the present invention is not limited thereto but any refrigerant may be used so long as it has a saturated pressure higher than that of R22 at the same temperature and does not destroy the ozone layer.

[0097] Moreover, in the above embodiments, the lateral louvers 27a, 27b are swung vertically by the drive of the same louver motor. However, the present invention is not limited to this structure but may apply to a structure such that each of the lateral louvers 27a, 27b is individually swung vertically by each drives of the individual louver motors.

Claims

1. An air conditioner (1) having a refrigerant circulation cycle constituted by sequentially connecting a compressor (2), an indoor heat exchanger (4) having an indoor fan (4a) disposed in a room, an expansion system (5) and an outdoor heat exchanger (6) having an outdoor fan (6a) disposed out of the room so as to carry out air conditioning operation including at least heating operation in the room by circulating the refrigerant in the refrigerant circulation cycle, in which an alternative refrigerant having a saturated pressure higher than a saturated pressure of HCFC22 at the same temperature is used as the refrigerant, comprising
means for regulating (27a, 27b, 34, 35) a vertical direction of air flow blown out from the indoor fan;

characterized by

- control means (31) for controlling the regulation means at a start of the heating operation so as to direct the air flow upward toward a ceiling side in the room and, when the indoor heat exchanger reaches a state capable of executing heat exchange operation, for controlling the regulation means (27a, 27b, 34, 35) so as to direct the air flow downward toward a floor side in the room.
2. An air conditioner according to claim 1, **characterized in that** said regulation means is adapted to regulate a vertical blowout angle of the air flow blown out from the indoor fan thereby regulating the vertical direction thereof.

3. An air conditioner according to claim 2, **characterized by** further comprising temperature sensing means (12) for detecting at least one of the temperature of the indoor heat exchanger and the blowout temperature thereof and **characterized in that** said control means is adapted to control the regulation means in response to the signal detected by the temperature sensing means. 5
4. An air conditioner according to claim 2, **characterized in that** said air conditioning operation includes cooling operation in the room and said direction of the air flow set at the start of the heating operation is substantially the same as a vertical direction set in the cooling operation. 10
5. An air conditioner according to claim 2, **characterized in that** said air conditioning operation includes cooling operation in the room, that said indoor fan (4a) and the indoor heat exchanger (4) are provided in an indoor unit (15) arranged in the room, and that said indoor unit includes a suction grille (18) for sucking room air and supplying the sucked air into the indoor heat exchanger and a blowout grille (19) for blowing out air whose temperature is controlled by the indoor heat exchanger into the room through the indoor fan, said regulation means (27a, 27b) being disposed adjacently to the blowout grille and regulating the vertical direction of the air flow blown out from the blowout grille, and **characterized in that** said vertical direction of the air flow set at the start of the heating operation is upward as compared with a vertical direction of the air flow set in the cooling operation so that the air flow blown out from the blowout grille is sucked into the suction grille in a short-circuit fashion. 20 25 30 35
6. An air conditioner according to claim 5, **characterized in that** said regulation means (27a, 27b, 34, 35) includes a pair of louvers (27a, 27b) each having a swing axis so arranged along a longitudinal direction of the blown out grille to be swingable around the swing axis vertically, said swing axis and longitudinal direction being substantially in parallel with a rotary shaft of the indoor fan, a louver motor (34) for swinging the pair of louvers around the swing axis at a predetermined angle, and means for driving (35) the louver motor while controlling a rotating angle of the louver motor according to the control of the control means whereby the air flow blown out therefrom is sucked into the suction grille. 40 45 50
7. An air conditioner according to claim 1, **characterized in that** said control means (31) is adapted to control the regulation means (27a, 27b, 34, 35) in accordance with a period of time elapsed from the start of the heating operation thereby directing the air flow upward toward the ceiling side or downward toward the floor side. 55
8. An air conditioner according to claim 3, **characterized in that** said control means (31) is adapted to control the regulation means (27a, 27b, 34, 35) in accordance with a pressure on a high pressure side of the indoor heat exchanger determined from the one of the temperature of the indoor heat exchanger and the blowout temperature thereof thereby directing the air flow upward toward the ceiling side or downward toward the floor side.
9. An air conditioner according to claim 1, **characterized by** further comprising a room temperature sensor (11) disposed adjacently to the indoor heat exchanger (4) for detecting a room temperature and means for correcting the room temperature detected by the room temperature sensor when the air flow is directed upward toward the ceiling side in the room.
10. An air conditioner according to claim 1, **characterized by** further comprising a room temperature sensor (11) disposed adjacently to the indoor heat exchanger (4) for detecting a room temperature and means for making the temperature detected by the room temperature sensor ineffective when the air flow is directed upward toward the ceiling side in the room.
11. An air conditioner according to claim 1, **characterized in that** said alternative refrigerant is any one of a refrigerant containing not less than 80% of the composition of HFC32 and HFC125, a refrigerant containing not less than 80% of the composition of HFC143a and HFC125 and a refrigerant containing not less than 45% of the composition of HFC32.
12. A method of controlling an air conditioner (1) having a refrigerant circulation cycle constituted by sequentially connecting a compressor (2), an indoor heat exchanger (4) having an indoor fan (4a) disposed in a room, an expansion system (5) and an outdoor heat exchanger (6) having an outdoor fan (6a) disposed out of the room so as to carry out air conditioning operation including at least heating operation in the room by circulating the refrigerant in the refrigerant circulation cycle, in which an alternative refrigerant having a saturated pressure higher than a saturated pressure of HCFC22 at the same temperature is used as the refrigerant, the method **characterized by** comprising the steps of:
 - regulating a vertical direction of air flow blown out from the indoor fan at a start of the heating operation so as to direct the air flow upward toward a ceiling side in the room; and
 - regulating, when the indoor heat exchanger

reaches a state capable of executing heat exchange operation, the vertical direction of air flow blown out from the indoor fan so as to direct the air flow downward toward a floor side in the room.

13. An air conditioner (1) having a refrigerant circulation cycle constituted by sequentially connecting a compressor (2), a four-way valve (3), an indoor heat exchanger (4) having an indoor fan (4a) disposed in a room, an expansion system (5) and an outdoor heat exchanger (6) having an outdoor fan (6a) disposed out of the room so as to carry out air conditioning operation including at least heating operation in the room and defrosting operation therein, in which an alternative refrigerant having a saturated pressure higher than a saturated pressure of HCFC22 at the same temperature is used as the refrigerant and the heating operation is executed by operating the compressor at an operating frequency and rotating the indoor fan (4a) and outdoor fan (6a) while connecting a discharge side of the compressor of the refrigerant circulation cycle to the indoor heat exchanger through the four-way valve (3) and a suction side of the compressor thereof to the outdoor heat exchanger (6) therethrough, **characterized by** comprising:

means for controlling (40) the four-way valve at a start of the defrosting operation during the heating operation so as to reversely connect the discharge side of the compressor to the outdoor heat exchanger and the suction side thereof to the indoor heat exchanger, respectively;

means for setting the operating frequency (40) of the compressor to a predetermined frequency for the defrosting operation, stopping the rotation of the indoor fan and the outdoor fan, and setting an opening of the expansion system to a predetermined opening for the defrosting operation, said set of the operating frequency of the compressor to the predetermined frequency, stop of the rotation of the indoor fan and the outdoor fan and set of the opening of the expansion system to the predetermined opening being substantially at a same time with the reversely connection of the four-way valve; and means for reducing a difference between a discharge side pressure in the refrigerant circulation cycle and a suction side pressure therein when the four-way valve is reversely connected.

14. An air conditioner according to claim 13, **characterized in that** said reduction means is adapted to stop the operation of the compressor at a time before a predetermined period of time from the start of the

reverse control of the control means so as to keep the stop of the operation of the compressor until the start of the reverse control thereof.

- 5 15. An air conditioner according to claim 13, **characterized in that** said reduction means includes means for setting the operating frequency of the compressor lower than the defrosting operation frequency when the four-way valve is reversely connected.
- 10 16. An air conditioner according to claim 13, **characterized in that** said reduction means comprises means for setting the operating frequency of the compressor to the defrosting operation frequency at a time before a predetermined period of time from the start of the reverse control of the control means so as to keep the defrosting operation frequency thereof until the start of the reverse control thereof.
- 15 17. An air conditioner according to claim 13, **characterized in that** said reduction means has means for increasing the opening of the expansion system by a predetermined amount as compared with the opening thereof during the heating operation for a predetermined period of time before the reverse control of the control means starts so as to keep the increased opening of the expansion system until the reverse control thereof starts.
- 20 18. An air conditioner according to claim 13, **characterized in that** said reduction means comprises means for decreasing the opening of the expansion system by a predetermined amount as compared with the opening thereof during the heating operation for a predetermined period of time before the reverse control of the control means starts so as to keep the decreased opening of the expansion system until the reverse control thereof starts.
- 25 19. An air conditioner according to claim 13, **characterized in that** said reduction means has means for increasing a number of rotation of the indoor fan by a predetermined number as compared with a number of rotation thereof during the heating operation for a predetermined period of time before the reverse control of the control means starts so as to keep the increased number of rotation of the indoor fan until the reverse control thereof starts.
- 30 20. An air conditioner according to claim 13, **characterized in that** said reduction means has means for decreasing a number of rotation of the outdoor fan by a predetermined number as compared with a number of rotation thereof during the heating operation for a predetermined period of time before the reverse control of the control means starts so as to keep the decreased number of rotation of the outdoor fan until the reverse control thereof starts.
- 35 40 45 50 55

21. An air conditioner according to claim 13, **characterized in that** said alternative refrigerant is any one of a refrigerant containing not less than 80% of the composition of HFC32 and HFC125, a refrigerant containing not less than 80% of the composition of HFC143a and HFC125 and a refrigerant containing not less than 45% of the composition of HFC32.

22. A method of controlling an air conditioner (1) having a refrigerant circulation cycle constituted by sequentially connecting a compressor (2) including a discharge side for discharging the refrigerant and a suction side for sucking the refrigerant, four-way valve (3), an indoor heat exchanger (4) having an indoor fan (4a) disposed in a room, an expansion system (5) and an outdoor heat exchanger (6) having an outdoor fan (6a) disposed out of the room so as to carry out air conditioning operation including at least heating operation in the room and defrosting operation therein, in which an alternative refrigerant having a saturated pressure higher than a saturated pressure of HCFC22 at the same temperature is used as the refrigerant and the heating operation is executed by operating the compressor at an operating frequency and rotating the indoor fan and outdoor fan while connecting the discharge side of the compressor of the refrigerant circulation cycle to the indoor heat exchanger through the four-way valve (3) and the suction side of the compressor thereof to the outdoor heat exchanger therethrough, the method **characterized by** comprising the steps of:

controlling the four-way valve (3) at a start of the defrosting operation during the heating operation so as to reversely connect the discharge side of the compressor to the outdoor heat exchanger and the suction side thereof to the indoor heat exchanger, respectively; setting the operating frequency of the compressor (2) to a predetermined frequency for the defrosting operation substantially at a same time with the reversely connection of the four-way valve; stopping the rotation of the indoor fan (4a) and the outdoor fan (6a) substantially at a same time with the reversely connection of the four-way valve (3); setting an opening of the expansion system to a predetermined opening for the defrosting operation substantially at a same time with the reversely connection of the four-way valve; and reducing a difference between a discharge side pressure in the refrigerant circulation cycle and a suction side pressure therein when the four-way valve is reversed.

Patentansprüche

1. Klimaanlage (1) mit einem im Kreis umlaufenden Kühlmittel, welche gebildet wird durch ein aufeinander folgendes Verbinden eines Kompressors (2), eines im Innern liegenden Wärmeaustauschers (4) mit einem im Innern liegenden Ventilator (4a), der in einem Raum angeordnet ist, eines Expansions-systems (5) und eines im Freien liegenden Wärmeaustauschers (6) mit einem im Freien liegenden Ventilator (6a), der außerhalb des Raumes so angeordnet ist, dass er die Klimatisierungstätigkeit für die Luft durchführt, einschließlich mindestens eines Erhitzungsvorganges in dem Raum durch den Umlauf des Kühlmittels in dem Kühlmittelkreislauf, in welchem ein alternatives Kühlmittel mit einem Sättigungsdruck höher als der Sättigungsdruck von HCFC22 bei der gleichen Temperatur als das Kühlmittel eingesetzt wird,

wobei die Klimaanlage eine Einrichtung enthält für die Regulierung (27a, 27b, 34, 35) einer vertikalen Richtung eines Luftflusses, der aus dem im Innern liegenden Ventilator herausgeblasen wird;

gekennzeichnet durch,

eine Steuereinrichtung (31) für die Steuerung der Einrichtung für die Regulierung am Beginn des Erhitzungsvorganges, um so den Luftfluss aufwärts zu lenken in Richtung auf eine Seite der Decke in dem Raum und, wenn der im Innern liegende Wärmeaustauscher einen Zustand erreicht, der in der Lage ist den Vorgang des Wärmeaustausches auszuführen, für die Steuerung der Einrichtung für die Regulierung (27a, 27b, 34, 35), so dass der Luftfluss nach unten in Richtung auf eine Seite des Fußbodens in dem Raum gelenkt wird.

2. Klimaanlage gemäss Anspruch 1, **dadurch gekennzeichnet, dass** die Einrichtung für die Regulierung angepasst ist, um einen vertikalen Ausblaswinkel des Luftflusses zu regulieren, der von dem im Innern liegenden Ventilator ausgeblasen wird, wodurch die vertikale Richtung desselben reguliert wird.

3. Klimaanlage gemäss Anspruch 2, **dadurch gekennzeichnet, dass** sie weiterhin eine Einrichtung eines Temperatursensors (12) umfasst für den Nachweis von mindestens einer Temperatur des im Innern liegenden Wärmeaustauschers und der Ausblastemperatur desselben und **dadurch gekennzeichnet, dass** die Steuereinrichtung angepasst ist, um die Einrichtung für die Regulierung zu steuern in Antwort auf das Signal, das durch die Einrichtung des Temperatursensors nachgewiesen wird.

4. Klimaanlage gemäss Anspruch 2, **dadurch gekennzeichnet, dass** die Klimatisierungstätigkeit

für die Luft einen Kühlvorgang in dem Raum mit einschließt und dass die Richtung des Luftflusses, die am Beginn des Erhitzungsvorganges festgesetzt wird, im Wesentlichen die gleiche ist wie eine vertikale Richtung, die bei dem Kühlvorgang festgesetzt wird.

5. Klimaanlage gemäß Anspruch 2, **dadurch gekennzeichnet, dass** die Klimatisierungstätigkeit für die Luft einen Kühlvorgang in dem Raum mit einschließt und dass der im Innern liegende Ventilator (4a) und der im Innern liegende Wärmeaustauscher (4) in einer Innenraumeinheit (15) angeordnet sind, die in dem Raum aufgestellt ist, und dass diese Innenraumeinheit ein Ansauggitter (18) enthält, für das Ansaugen der Raumluft und für das Liefern der angesaugten Luft in den im Innern liegenden Wärmeaustauscher, und ein Ausblasgitter (19), für das Ausblasen der Luft, deren Temperatur von dem im Innern liegenden Wärmeaustauscher gesteuert wird, in den Raum hinein durch den im Innern liegenden Ventilator, wobei die Einrichtung für die Regulierung (27a, 27b) in der Nähe des Ausblasgitters angeordnet ist und die vertikale Richtung des Luftflusses, der aus dem Ausblasgitter herausgeblasen wird, reguliert, und **dadurch gekennzeichnet, dass** die vertikale Richtung des Luftflusses, die am Beginn des Erhitzungsvorganges festgesetzt wird, nach aufwärts gerichtet ist, im Vergleich mit einer vertikalen Richtung des Luftflusses bei dem Kühlvorgang, so dass der Luftfluss, der aus dem Ausblasgitter herausgeblasen wird, in das Sauggitter angesogen wird in der Art eines kurzen Arbeitskreises.
6. Klimaanlage gemäß Anspruch 5, **dadurch gekennzeichnet, dass** die Einrichtung für die Regulierung (27a, 27b, 34, 35) ein Paar von Luftklappen (27a, 27b) enthält, von denen eine jede eine Schwingachse aufweist, die so entlang einer längsverlaufenden Richtung des Ausblasgitters angeordnet ist, dass sie um die Schwingachse herum vertikal schwingfähig sind, wobei die Schwingachse und die längsverlaufende Richtung im Wesentlichen parallel verlaufen mit einer Drehwelle des im Innern liegenden Ventilators, einem Luftklappenmotor (34), um das Paar Luftklappen unter einem vorherbestimmten Winkel um die Schwingachse herum zu schwingen, und einer Antriebsvorrichtung (35) für den Luftklappenmotor, während ein Drehwinkel des Luftklappenmotors gesteuert wird gemäß der Steuerung der Steuereinrichtung, wodurch der von dort herausgeblasene Luftfluss in das Sauggitter angesogen wird.
7. Klimaanlage gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die Steuereinrichtung (31) angepasst ist, um die Einrichtung für die Regulierung

(27a, 27b, 34, 35) zu steuern gemäß einer Zeitdauer, die seit dem Beginn des Erhitzungsvorganges verstrichen ist, wodurch der Luftfluss nach oben in Richtung auf die Seite der Zimmerdecke oder nach unten in Richtung auf den Fußbodenseite gelenkt wird.

8. Klimaanlage gemäß Anspruch 3, **dadurch gekennzeichnet, dass** die Steuereinrichtung (31) angepasst ist, um die Einrichtung für die Regulierung (27a, 27b, 34, 35) zu steuern gemäß einem Druck auf einer Hochdruckseite des im Innern liegenden Wärmeaustauschers, bestimmt von der einen Temperatur des im Innern liegenden Wärmeaustauschers und der Ausblastemperatur desselben, wodurch der Luftfluss nach oben in Richtung auf die Seite der Zimmerdecke oder nach unten in Richtung auf die Fußbodenseite gelenkt wird.
9. Klimaanlage gemäß Anspruch 1, **dadurch gekennzeichnet, dass** sie weiter einen Raumtemperatursensor (11) enthält, der neben dem im Innern liegenden Wärmeaustauscher (4) für die Erfassung einer Raumtemperatur angeordnet ist, und Mittel für die Berichtigung der Raumtemperatur, die von dem Raumtemperatursensor erfasst wird, wenn der Luftfluss nach oben in Richtung auf die Seite der Zimmerdecke gelenkt wird.
10. Klimaanlage gemäß Anspruch 1, **dadurch gekennzeichnet, dass** sie weiter einen Raumtemperatursensor (11) enthält, der neben dem im Innern liegenden Wärmeaustauscher (4) für die Erfassung einer Raumtemperatur angeordnet ist, und Mittel, um die Temperatur, die von dem Raumtemperatursensor erfasst wird, unwirksam zu machen, wenn der Luftfluss nach oben in Richtung auf die Seite der Zimmerdecke in dem Raum gelenkt wird.
11. Klimaanlage gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das alternative Kühlmittel irgendein Kühlmittel ist, das nicht weniger als 80% der Verbindungszusammensetzung aus HFC32 und HFC125 enthält, ein Kühlmittel, das nicht weniger als 80% der Verbindungszusammensetzung aus HFC143a und HFC125 enthält und ein Kühlmittel, das nicht weniger als 45% der Verbindung aus HFC32 enthält.
12. Verfahren für die Steuerung einer Klimaanlage (1) mit einem im Kreis umlaufenden Kühlmittel welches gebildet wird durch ein aufeinander folgendes Verbinden eines Kompressors (2), eines im Innern liegenden Wärmeaustauschers (4) mit einem im Innern liegenden Ventilator (4a), der in einem Raum angeordnet ist, eines Expansionssystems (5) und eines im Freien liegenden Wärmeaustauschers (6) mit einem im Freien liegenden Ventilator (6a), der

außerhalb des Raumes so aufgestellt ist, dass er die Klimatisierungstätigkeit für die Luft durchführt, einschließlich mindestens eines Erhitzungsvorganges in dem Raum durch den Umlauf des Kühlmittels in dem Kühlmittelkreislauf, in welchem ein alternatives Kühlmittel mit einem Sättigungsdruck höher als der Sättigungsdruck von HCFC22 bei der gleichen Temperatur als das Kühlmittel eingesetzt wird, wobei das Verfahren **dadurch gekennzeichnet ist, dass** es die folgenden Schritte umfasst:

ein Regulieren einer vertikalen Richtung eines Luftflusses, der aus dem im Innern liegenden Ventilator herausgeblasen wird am Beginn des Erhitzungsvorganges, um so den Luftfluss aufwärts zu lenken in Richtung auf eine Seite einer Decke in dem Raum; und

ein Regulieren, wenn der im Innern liegende Wärmeaustauscher einen Zustand erreicht, der in der Lage ist, den Erhitzungsvorgang auszuführen, der vertikalen Richtung des Luftflusses, der aus dem im Innern liegenden Ventilator herausgeblasen wird, um so den Luftfluss nach unten zu lenken in Richtung auf eine Seite des Fußbodens in dem Raum.

13. Klimaanlage (1) mit einem im Kreis umlaufenden Kühlmittel, welche gebildet wird durch ein aufeinander folgendes Verbinden eines Kompressors (2), eines Vierwegeventils (3), eines im Innern liegenden Wärmeaustauschers (4) mit einem im Innern liegenden Ventilator (4a), der in einem Raum angeordnet ist, eines Expansionssystems (5) und eines im Freien liegenden Wärmeaustauschers (6) mit einem im Freien liegenden Ventilator (6a), der außerhalb des Raumes so angeordnet ist, dass er die Klimatisierungstätigkeit für die Luft durchführt, einschließlich mindestens eines Erhitzungsvorganges in dem Raum und eines Enteisungsvorganges in demselben, bei welchem ein alternatives Kühlmittel mit einem Sättigungsdruck höher als der Sättigungsdruck von HCFC22 bei der gleichen Temperatur eingesetzt wird als das Kühlmittel, und der Erhitzungsvorgang durchgeführt wird, indem der Kompressor bei einer Betriebsfrequenz betrieben wird und indem der im Innern liegende Ventilator (4a) und der im Freien liegende Ventilator (6a) in Rotation versetzt werden, während eine Entladungsseite des Kompressors des Kühlmittelkreislaufes mit dem im Innern liegenden Wärmeaustauscher durch das Vierwegeventil (3) verbunden ist und eine Ansaugseite des Kompressors desselben mit dem im Freien liegenden Wärmeaustauscher (6) durch dasselbe, **dadurch gekennzeichnet, dass** die Klimaanlage enthält:

eine Einrichtung für die Steuerung (40) des

Vierwegeventils am Beginn des Enteisungsvorganges während des Erhitzungsvorganges, so dass die Entladungsseite des Kompressors umgekehrt mit dem im Freien liegenden Wärmeaustauscher verbunden ist bzw. die Ansaugseite desselben mit dem im Innern liegenden Wärmeaustauscher;

ein Hilfsmittel für das Festsetzen der Betriebsfrequenz (40) des Kompressors auf eine vorherbestimmte Frequenz für den Enteisungsvorgang, für das Stoppen der Umdrehung des im Innern liegenden Ventilators und des im Freien liegenden Ventilators, und für das Festsetzen einer Öffnung eines Ausdehnungssystems auf eine vorherbestimmte Öffnung für den Enteisungsvorgang, wobei das Festsetzen der Betriebsfrequenz des Kompressors auf die vorherbestimmte Frequenz, das Stoppen der Umdrehung des im Innern liegenden Ventilators und des im Freien liegenden Ventilators, und das Festsetzen der Öffnung des Ausdehnungssystems auf die vorherbestimmte Öffnung im Wesentlichen zur gleichen Zeit mit der umgekehrten Verbindung des Vierwegeventils stattfindet; und

Mittel zur Verminderung eines Unterschiedes zwischen einem Druck an der Entladungsseite des im Kreis umlaufenden Kühlmittels und einem Druck an der Ansaugseite desselben, wenn das Vierwegeventil umgekehrt verbunden ist.

14. Klimaanlage gemäß Anspruch 13, **dadurch gekennzeichnet, dass** das Mittel zur Verminderung angepasst ist, um den Betrieb des Kompressors zu stoppen zu einer Zeit vor einer vorherbestimmten Zeitdauer von dem Beginn der umgekehrten Steuerung der Steuereinrichtung, um so die Beendigung des Kompressorbetriebes zu halten bis zu dem Start der umgekehrten Steuerung desselben.
15. Klimaanlage gemäß Anspruch 13, **dadurch gekennzeichnet, dass** das Mittel zur Verminderung ein Hilfsmittel enthält, um die Betriebsfrequenz des Kompressors niedriger einzustellen als die Betriebsfrequenz des Enteisungsvorganges, wenn das Vierwegeventil umgekehrt verbunden ist.
16. Klimaanlage gemäß Anspruch 13, **dadurch gekennzeichnet, dass** das Mittel zur Verminderung ein Hilfsmittel enthält um die Betriebsfrequenz des Kompressors auf die Betriebsfrequenz des Enteisungsvorganges einzustellen zu einer Zeit vor einer vorherbestimmten Zeitdauer von dem Beginn der umgekehrten Steuerung der Steuereinrichtung, um so die Betriebsfrequenz des Enteisungsvorganges

zu halten bis zu dem Start der umgekehrten Steuerung desselben.

17. Klimaanlage gemäss Anspruch 13, **dadurch gekennzeichnet, dass** das Mittel zur Verminderung ein Hilfsmittel enthält für die Erhöhung der Öffnung des Ausdehnungssystems um einen vorherbestimmten Betrag verglichen mit der Öffnung desselben während des Erhitzungsvorganges für eine vorherbestimmte Zeitdauer bevor die umgekehrte Steuerung der Steuereinrichtung startet, um so die erhöhte Öffnung des Ausdehnungssystems zu halten bis die umgekehrte Steuerung desselben startet.
18. Klimaanlage gemäss Anspruch 13, **dadurch gekennzeichnet, dass** das Mittel zur Verminderung ein Hilfsmittel enthält für die Verminderung der Öffnung des Ausdehnungssystems um einen vorherbestimmten Betrag verglichen mit der Öffnung desselben während des Erhitzungsvorganges für eine vorherbestimmten Zeitdauer bevor die umgekehrte Steuerung der Steuereinrichtung startet, um so die verminderte Öffnung des Ausdehnungssystems zu halten bis die umgekehrte Steuerung desselben startet.
19. Klimaanlage gemäss Anspruch 13, **dadurch gekennzeichnet, dass** das Mittel zur Verminderung Hilfsmittel enthält für die Erhöhung einer Umdrehungszahl des im Innern liegenden Ventilators um eine vorherbestimmte Zahl verglichen mit einer Umdrehungszahl desselben während des Erhitzungsvorganges für eine vorherbestimmte Zeitdauer bevor die umgekehrte Steuerung der Steuereinrichtung startet, um so die erhöhte Umdrehungszahl des im Innern liegenden Ventilators zu halten bis die umgekehrte Steuerung desselben startet.
20. Klimaanlage gemäss Anspruch 13, **dadurch gekennzeichnet, dass** das Mittel zur Verminderung Hilfsmittel enthält für die Verminderung einer Umdrehungszahl des im Freien liegenden Ventilators um eine vorherbestimmte Zahl verglichen mit einer Umdrehungszahl desselben während des Erhitzungsvorganges für eine vorherbestimmte Zeitdauer bevor die umgekehrte Steuerung der Steuereinrichtung startet, um so die verminderte Umdrehungszahl des im Freien liegenden Ventilators zu halten bis die umgekehrte Steuerung desselben startet.
21. Klimaanlage gemäss Anspruch 13, **dadurch gekennzeichnet, dass** das alternative Kühlmittel irgendein Kühlmittel ist, das nicht weniger als 80% der Verbindungszusammensetzung aus HFC32 und HFC125 enthält, ein Kühlmittel, das nicht weniger als 80% der Verbindungszusammensetzung

aus HFC143a und HFC125 enthält und ein Kühlmittel, das nicht weniger als 45% der Verbindung aus HFC32 enthält.

22. Verfahren für die Steuerung einer Klimaanlage (1) mit einem im Kreis umlaufenden Kühlmittel welches gebildet wird durch aufeinander folgendes Verbinden eines Kompressors (2), einschließlich einer Entladungsseite für das Entladen des Kühlmittels und einer Ansaugseite für das Ansaugen des Kühlmittels, eines Vierwegeventils (3), eines im Innern liegenden Wärmeaustauschers (4) mit einem im Innern liegenden Ventilator (4a), der in einem Raum angeordnet ist, eines Expansionssystems (5) und eines im Freien liegenden Wärmeaustauschers (6) mit einem im Freien liegenden Ventilator (6a), der außerhalb des Raumes angeordnet ist, dass er die Klimatisierungstätigkeit für die Luft durchführt, einschließlich mindestens eines Erhitzungsvorganges in dem Raum und eines Enteisungsvorganges in demselben, in welchem ein alternatives Kühlmittel mit einem Sättigungsdruck höher als der Sättigungsdruck von HCFC22 bei der gleichen Temperatur eingesetzt wird als das Kühlmittel, und der Erhitzungsvorgang ausgeführt durch Betreiben des Kompressors bei einer Betriebsfrequenz und durch eine Rotation des im Innern liegenden Ventilators und des im Freien liegenden Ventilators, während die Entladungsseite des Kompressors des Kühlmittelkreislaufes mit dem im Innern liegenden Wärmeaustauscher durch das Vierwegeventil (3) verbunden wird und die Ansaugseite des Kompressors desselben mit dem im Freien liegenden Wärmeaustauscher, Verfahren **dadurch gekennzeichnet, dass** es die folgenden Schritte aufweist:

Steuerung des Vierwegeventils (3) am Beginn des Enteisungsvorganges während des Erhitzungsvorganges, um so die Entladungsseite des Kompressors umgekehrt mit dem im Freien liegenden Wärmeaustauscher zu verbinden bzw. die Ansaugseite desselben mit dem im Innern liegenden Wärmeaustauscher;
 Festsetzen der Betriebsfrequenz des Kompressors (2) auf eine vorherbestimmte Frequenz für den Enteisungsvorgang im Wesentlichen zur gleichen Zeit mit der umgekehrten Verbindung des Vierwegeventils;
 Stoppen der Umdrehung des im Innern liegenden Ventilators (4a) und des im Freien liegenden Ventilators (6a) im Wesentlichen zur gleichen Zeit mit der umgekehrten Verbindung des Vierwegeventils (3);
 Festsetzen einer Öffnung des Ausdehnungssystems auf eine vorherbestimmte Öffnung für den Enteisungsvorgang im Wesentlichen zur gleichen Zeit mit der umgekehrten Verbindung des Vierwegeventils; und

Verminderung eines Unterschiedes zwischen einem Druck an der Entladungsseite in dem im Kreis umlaufenden Kühlmittel und einem Druck an der Ansaugseite desselben, wenn das Vierwegeventil umgekehrt ist.

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Revendications

1. Appareil de climatisation de l'air (1) ayant un cycle de circulation de réfrigérant constitué par un raccordement séquentiel d'un compresseur (2), d'un échangeur thermique interne (4) ayant un ventilateur interne (4a) disposé dans une pièce, un système d'expansion (5) et un échangeur thermique externe (6), ayant un ventilateur externe (6a) disposé hors de la pièce, pour effectuer l'opération de climatisation de l'air, comprenant au moins une opération de chauffage dans la pièce en circulant le réfrigérant dans le cycle de circulation du réfrigérant, dans lequel un réfrigérant de remplacement, ayant une pression saturée supérieure à une pression saturée de HCFC22 à la même température, est utilisé en tant que réfrigérant, comprenant
 - un moyen de régulation (27a, 27b, 34, 35) d'une direction verticale de courant d'air expulsé du ventilateur interne;
 - caractérisé par**
 - des moyens de commande (31) pour le contrôle du moyen de régulation à un démarrage de l'opération de chauffage de manière à diriger le courant d'air vers le haut en direction d'un côté de plafond dans la pièce et, quand l'échangeur thermique interne atteint un état capable d'exécuter l'opération d'échange thermique, pour le contrôle du moyen de régulation (27a, 27b, 34, 35), de manière à diriger le courant d'air vers le bas en direction d'un côté de plancher dans la pièce.
2. Appareillage de climatisation de l'air selon la revendication 1, **caractérisé en ce que** ledit moyen de régulation est adapté à réguler un angle d'expulsion vertical du courant d'air expulsé hors du ventilateur interne, en régulant ainsi sa direction verticale.
3. Appareillage de climatisation de l'air selon la revendication 2, **caractérisé en** comprenant en outre des moyens de détection de la température (12), pour la détection d'au moins une des températures de l'échangeur thermique interne et de sa température d'expulsion et **caractérisé en ce que** ledit moyen de contrôle est adapté au contrôle du moyen de régulation en réaction à un signal détecté par le moyen de détection de la température.
4. Appareillage de climatisation de l'air selon la revendication 2, **caractérisé en ce que** ladite opération de climatisation de l'air comprend une opération de

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refroidissement dans la pièce et **en ce que** ladite direction du courant d'air ajusté au démarrage de l'opération de chauffage est substantiellement la même qu'une direction verticale ajustée dans l'opération de refroidissement.

5. Appareillage de climatisation de l'air selon la revendication 2, **caractérisé en ce que** ladite opération de climatisation de l'air comprend une opération de refroidissement dans la pièce, **en ce que** ledit ventilateur interne (4a) et ledit échangeur thermique interne (4) sont prévus dans une unité interne (15), arrangée dans la pièce, et **en ce que** ladite unité interne comprend une grille d'aspiration (18), pour aspirer l'air de la pièce et pour fournir l'air aspiré à l'échangeur thermique interne, et une grille d'expulsion (19) pour expulser l'air dont la température est contrôlée par l'échangeur thermique interne dans la pièce à travers le ventilateur interne, lesdits moyens de régulation (27a, 27b) étant disposés d'une façon adjacente à la grille d'expulsion et régulant la direction verticale du courant d'air expulsé hors de la grille d'expulsion, et **caractérisé en ce que** ladite direction verticale du courant d'air ajustée au démarrage de l'opération de chauffage est vers le haut par comparaison à une direction verticale du courant d'air ajustée dans l'opération de refroidissement, de telle sorte que le courant d'air expulsé hors de la grille d'expulsion est aspiré dans la grille d'aspiration d'une façon en court-circuit.
6. Appareillage de climatisation de l'air selon la revendication 5, **caractérisé en ce que** ledit moyen de régulation (27a, 27b, 34, 35) comprend une paire de grilles d'aération (27a, 27b), chacune ayant un axe de pivotement arrangé le long d'une direction longitudinale de la grille d'expulsion pour pouvoir pivoter autour de l'axe de pivotement de manière verticale, ledit axe de pivotement et ladite direction longitudinale étant substantiellement parallèles à un arbre de rotation du ventilateur interne, un moteur de grille d'aération (34) pour faire pivoter la paire de grilles d'aération autour de l'axe de pivotement à un angle prédéterminé et un moyen d'entraînement (35) du moteur de la grille d'aération tout en contrôlant un angle de rotation du moteur de la grille d'aération, conformément au contrôle du moyen de contrôle, dans lequel le courant d'air qui en est expulsé est aspiré dans la grille d'aspiration.
7. Appareillage de climatisation de l'air selon la revendication 1, **caractérisé en ce que** ledit moyen de contrôle (31) est adapté au contrôle du moyen de régulation (27a, 27b, 34, 35), conformément à une période de temps écoulée depuis le démarrage de l'opération de chauffage, en dirigeant ainsi le courant d'air vers le haut en direction du côté de plafond ou vers le bas en direction du côté du plancher.

8. Appareillage de climatisation de l'air selon la revendication 3, **caractérisé en ce que** ledit moyen de contrôle (31) est adapté au contrôle du moyen de régulation (27a, 27b, 34, 35), en fonction d'une pression sur le côté haute pression de l'échangeur thermique interne, déterminée à partir de l'une des températures de l'échangeur thermique interne et de sa température d'expulsion, en dirigeant ainsi le courant d'air vers le haut en direction du côté de plafond ou vers le bas en direction du côté de plancher.
9. Appareillage de climatisation de l'air selon la revendication 1, **caractérisé en** comprenant en outre une sonde de température de la pièce (11), disposée de manière adjacente à l'échangeur thermique interne (4), pour détecter une température de la pièce et un moyen de correction de la température de la pièce détectée par la sonde de température de la pièce, quand le courant d'air est dirigé vers le haut en direction du côté de plafond dans la pièce.
10. Appareillage de climatisation de l'air selon la revendication 1, **caractérisé en** comprenant en outre une sonde de température de la pièce (11), disposée de manière adjacente à l'échangeur thermique interne (4), pour détecter une température de la pièce et un moyen pour mettre hors d'action la température détectée par la sonde de température de la pièce quand le courant d'air est dirigé vers le haut en direction du côté de plafond dans la pièce.
11. Appareillage de climatisation de l'air selon la revendication 1, **caractérisé en ce que** ledit réfrigérant de remplacement est un réfrigérant quelconque contenant non moins de 80% de la composition de HFC32 et de HFC125, un réfrigérant contenant non moins de 80% de la composition de HFC143a et de HFC125 et un réfrigérant contenant non moins de 45% de la composition de HFC32.
12. Appareillage de climatisation de l'air (1) ayant un cycle de circulation de réfrigérant constitué par un raccordement séquentiel d'un compresseur (2), d'un échangeur thermique interne (4), ayant un ventilateur interne (4a) disposé dans une pièce, un système d'expansion (5) et un échangeur thermique externe (6), ayant un ventilateur externe (6a) disposé hors de la pièce, de manière à effectuer l'opération de climatisation de l'air, comprenant au moins une opération de chauffage dans la pièce en circulant le réfrigérant dans le cycle de circulation du réfrigérant, dans lequel un réfrigérant de remplacement, ayant une pression saturée supérieure à une pression saturée de HCFC22 à la même température, est utilisé en tant que réfrigérant, la méthode étant **caractérisée en** comprenant les étapes:
- de régulation d'une direction verticale du courant d'air expulsé du ventilateur interne au démarrage de l'opération de chauffage, de manière à diriger le courant d'air vers le haut en direction d'un côté de plafond dans la pièce; et
- de régulation, quand l'échangeur thermique interne atteint un état capable d'effectuer l'opération d'échange thermique, de la direction verticale du courant d'air expulsé du ventilateur interne, de manière à diriger le courant d'air vers le bas en direction d'un côté de plancher dans la pièce.
13. Appareillage de climatisation de l'air (1) ayant un cycle de circulation de réfrigérant constitué par un raccordement séquentiel d'un compresseur (2), d'une vanne à quatre voies (3), d'un échangeur thermique interne (4) ayant un ventilateur interne (4a), disposé dans une pièce, un système d'expansion (5) et un échangeur thermique externe (6), ayant un ventilateur externe (6a) disposé hors de la pièce, de manière à effectuer l'opération de climatisation de l'air, comprenant au moins une opération de chauffage dans la pièce et de dégivrage en laquelle, dans laquelle un réfrigérant de remplacement ayant une pression saturée supérieure à une pression saturée de HCFC22 à la même température, est utilisé en tant que réfrigérant et dans laquelle l'opération de chauffage est effectuée en faisant fonctionner le compresseur à une fréquence de fonctionnement et en faisant tourner le ventilateur interne (4a) et le ventilateur externe (6a), tout en connectant un côté d'évacuation du compresseur du cycle de circulation du réfrigérant à l'échangeur thermique interne à travers la vanne à quatre voies (3) et un côté d'aspiration du compresseur de ce dernier à l'échangeur thermique externe (6) en passant au travers,
- caractérisé en** comprenant:
- un moyen de contrôle (40) de la vanne à quatre voies au démarrage de l'opération de dégivrage pendant l'opération de chauffage de manière à connecter en mode inverse le côté d'évacuation du compresseur à l'échangeur thermique externe et son côté d'aspiration à l'échangeur thermique interne, respectivement;
- un moyen de réglage de la fréquence de fonctionnement (40) du compresseur à une fréquence prédéterminée pour l'opération de dégivrage, l'arrêt de la rotation du ventilateur interne et du ventilateur externe, et le réglage d'une ouverture du système d'expansion à une ouverture prédéterminée pour l'opération de dégivrage, ledit réglage de la fréquence de fonctionnement du compresseur à la fréquence

prédéterminée, l'arrêt de la rotation du ventilateur interne et du ventilateur externe et le réglage de l'ouverture du système d'expansion à une ouverture prédéterminée étant substantiellement effectués au même moment que le connexion en mode inverse de la vanne à quatre voies; et

un moyen de réduction d'une différence entre une pression du côté d'évacuation dans le cycle de circulation du réfrigérant et une pression d'aspiration en son sein quand la vanne à quatre voies est raccordée en mode inverse.

14. Appareillage de climatisation de l'air selon la revendication 13, **caractérisé en ce que** ledit moyen de réduction est adapté à l'arrêt de l'opération du compresseur à un moment avant une période de temps prédéterminée à partir du démarrage du contrôle en mode inverse du moyen de contrôle, de manière à garder l'arrêt de l'opération du compresseur jusqu'au début de son contrôle en mode inverse.

15. Appareillage de climatisation de l'air selon la revendication 13, **caractérisé en ce que** ledit moyen de réduction comprend un moyen de réglage de la fréquence de fonctionnement du compresseur à un niveau inférieur à la fréquence de l'opération de dégivrage lorsque la vanne à quatre voies est connectée en mode inverse.

16. Appareillage de climatisation de l'air selon la revendication 13, **caractérisé en ce que** ledit moyen de réduction comprend un moyen de réglage de la fréquence de fonctionnement du compresseur à la fréquence de fonctionnement de dégivrage à un moment avant une période de temps prédéterminée, à partir du démarrage du contrôle en mode inverse du moyen de contrôle, de manière à garder la fréquence de fonctionnement de dégivrage de ce dernier jusqu'au démarrage du contrôle en mode inverse de ce dernier.

17. Appareillage de climatisation de l'air selon la revendication 13, **caractérisé en ce que** ledit moyen de réduction a un moyen pour augmenter l'ouverture du système d'expansion d'une quantité prédéterminée, par comparaison à son ouverture pendant l'opération de chauffage pour une période de temps prédéterminée, avant que le contrôle en mode inverse du moyen de contrôle ne démarre, de manière à garder l'ouverture accrue du système d'expansion jusqu'à ce que le contrôle en mode inverse démarre.

18. Appareillage de climatisation de l'air selon la revendication 13, **caractérisé en ce que** ledit moyen de réduction comprend un moyen de réduire l'ouvertu-

re du système d'expansion d'une quantité prédéterminée, par comparaison à son ouverture pendant l'opération de chauffage pour une période de temps prédéterminée, avant que le contrôle en mode inverse du moyen de contrôle ne démarre, de manière à garder l'ouverture réduite du système d'expansion jusqu'à ce que le contrôle en mode inverse démarre.

19. Appareillage de climatisation de l'air selon la revendication 13, **caractérisé en ce que** ledit moyen de réduction a un moyen pour augmenter un nombre de rotation du ventilateur interne d'un nombre prédéterminé, par comparaison à un nombre de rotation de ce dernier pendant la période de chauffage pour une période prédéterminée de temps, avant que le contrôle en mode inverse du moyen de contrôle ne démarre, de manière à garder le nombre accru de rotation du ventilateur interne jusqu'à ce que le contrôle en mode inverse de ce dernier démarre.

20. Appareillage de climatisation de l'air selon la revendication 13, **caractérisé en ce que** ledit moyen de réduction a un moyen pour réduire un nombre de rotation du ventilateur externe d'un nombre prédéterminé, par comparaison à un nombre de rotation de ce dernier pendant la période de chauffage pour une période prédéterminée de temps, avant que le contrôle en mode inverse du moyen de contrôle ne démarre, de manière à garder le nombre réduit de rotation du ventilateur externe jusqu'à ce que le contrôle en mode inverse de ce dernier démarre.

21. Appareillage de climatisation de l'air selon la revendication 13, **caractérisé en ce que** ledit réfrigérant de remplacement est un réfrigérant quelconque contenant non moins de 80% de la composition de HFC32 et de HFC125, un réfrigérant contenant non moins de 80% de la composition de HFC143a et de HFC125 et un réfrigérant contenant non moins de 45% de la composition de HFC32.

22. Méthode de contrôle d'un appareillage de climatisation de l'air (1) ayant un cycle de circulation du réfrigérant constitué par un raccordement séquentiel d'un compresseur (2), comprenant un côté d'évacuation pour l'évacuation du réfrigérant et un côté d'aspiration pour l'aspiration du réfrigérant, une vanne à quatre voies (3), un échangeur thermique interne (4), ayant un ventilateur interne (4a) disposé dans une pièce, un système d'expansion (5) et un échangeur thermique externe (6), ayant un ventilateur externe (6a) disposé hors de la pièce, de manière à effectuer l'opération de climatisation de l'air, comprenant au moins une opération de chauffage dans la pièce et une opération de dégivrage dans celle-ci, dans laquelle un réfrigérant de

remplacement, ayant une pression saturée supérieure à une pression saturée de HCFC22 à la même température, est utilisé en tant que réfrigérant et dans laquelle l'opération de chauffage est effectuée en faisant fonctionner le compresseur à une fréquence de fonctionnement et en faisant tourner le ventilateur interne et le ventilateur externe tout en raccordant le côté d'évacuation du compresseur du cycle de circulation du réfrigérant à l'échangeur thermique interne à travers la vanne à quatre voies (3) et le côté d'aspiration du compresseur de ce dernier à l'échangeur thermique externe au travers de ce dernier, la méthode étant **caractérisée en** comprenant les étapes:

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de contrôle de la vanne à quatre voies (3) à un démarrage de l'opération de dégivrage pendant l'opération de chauffage de manière à raccorder en mode inverse le côté d'évacuation du compresseur à l'échangeur thermique externe et son côté d'aspiration à l'échangeur thermique interne, respectivement;

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de réglage de la fréquence de fonctionnement du compresseur (2) à une fréquence prédéterminée pour l'opération de dégivrage substantiellement au même moment avec la connexion en mode inverse de la vanne à quatre voies;

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d'arrêt de la rotation du ventilateur interne (4a) et du ventilateur externe (6a) substantiellement au même moment avec la connexion en mode inverse de la vanne à quatre voies (3);

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de réglage d'une ouverture du système d'expansion à une ouverture prédéterminée pour l'opération de dégivrage substantiellement au même moment avec la connexion en mode inverse de la vanne à quatre voies ; et

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de réduction d'une différence entre une pression de côté d'évacuation dans le cycle de circulation du réfrigérant et d'une pression de côté d'aspiration dans celui-ci lorsque la vanne à quatre voies est inversée.

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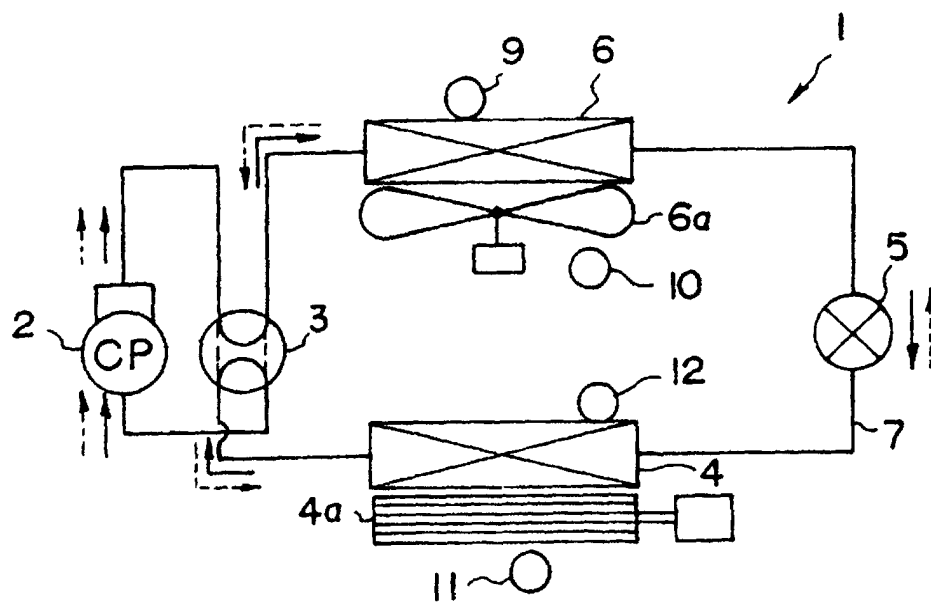


FIG. 1

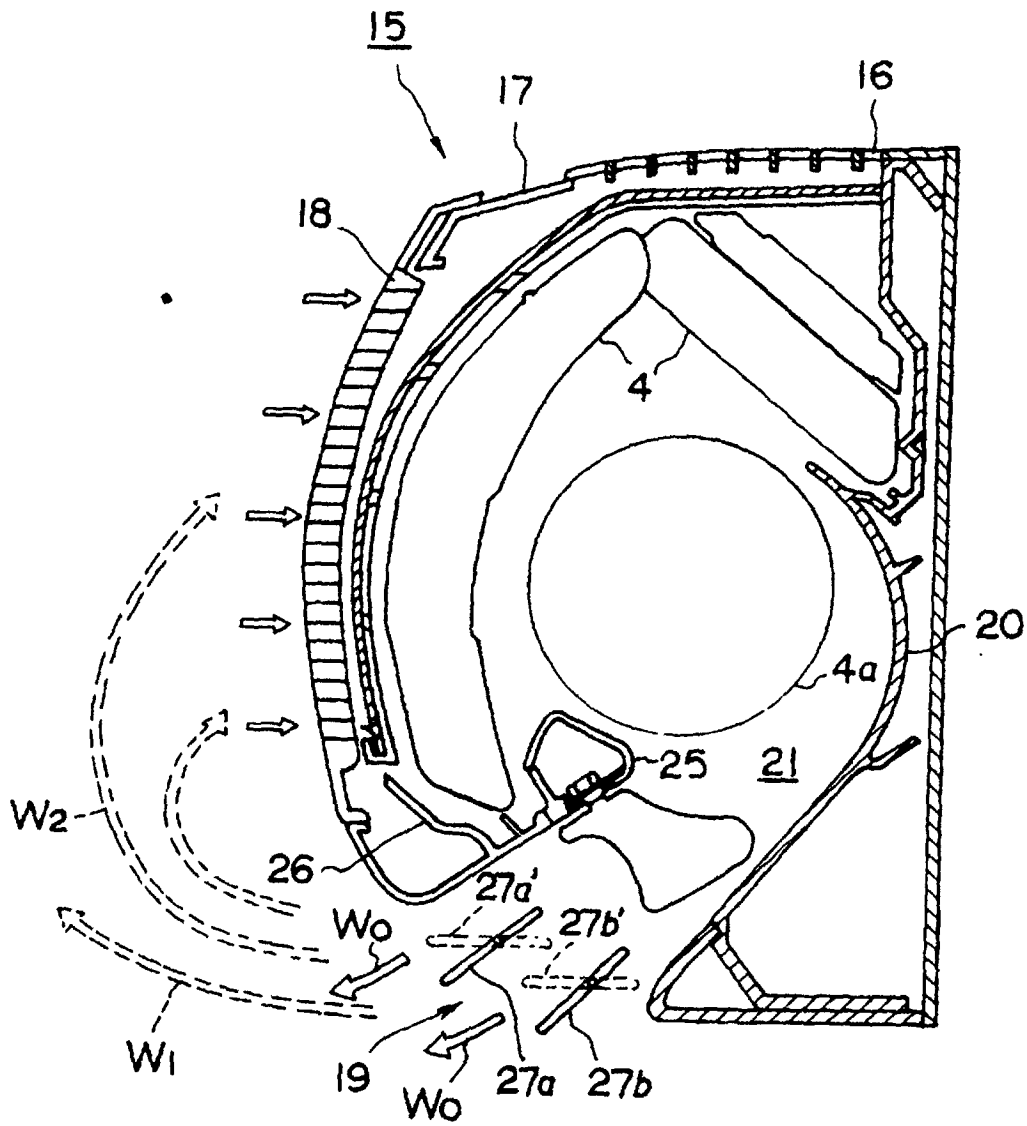


FIG. 2

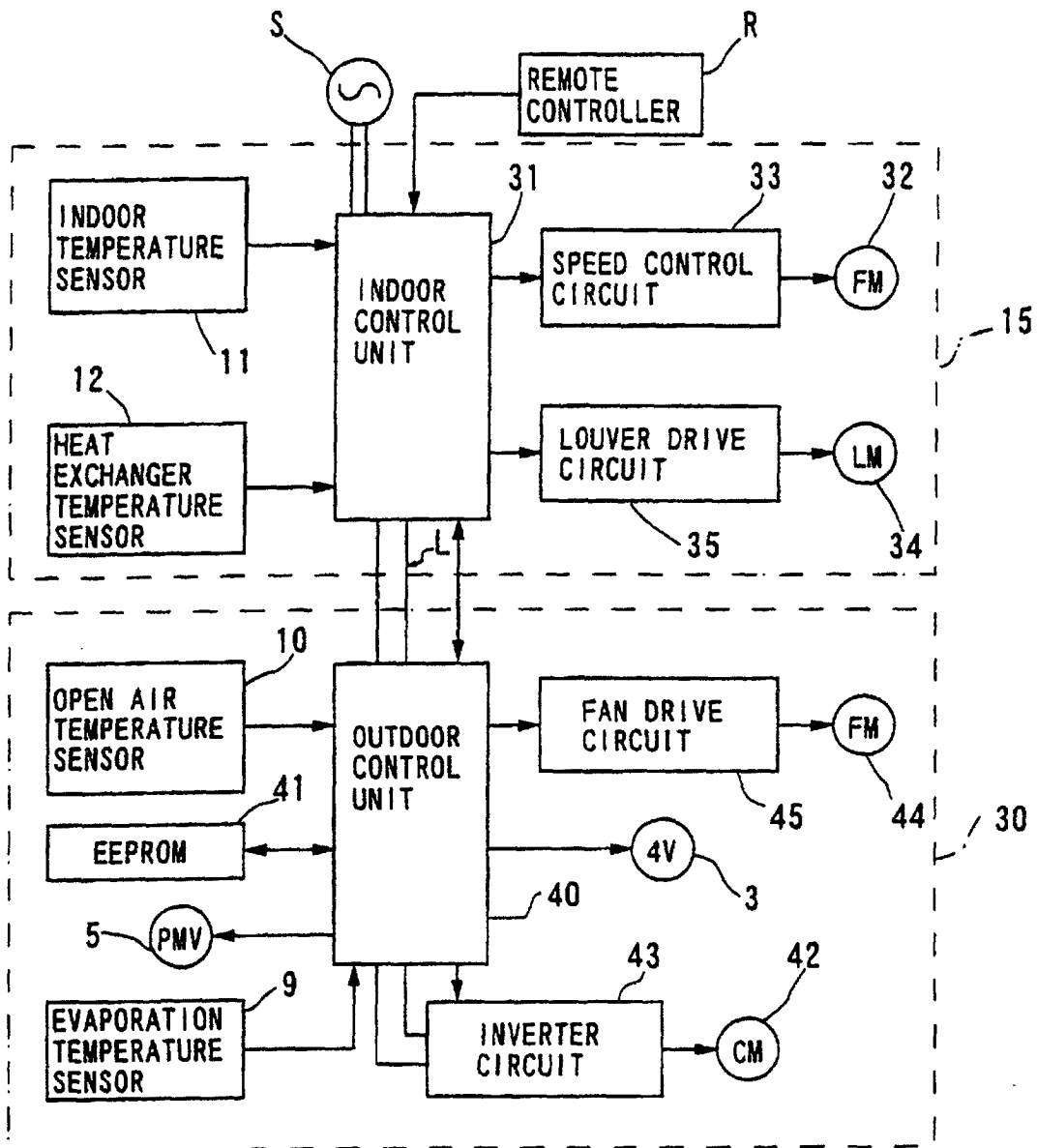


FIG. 3

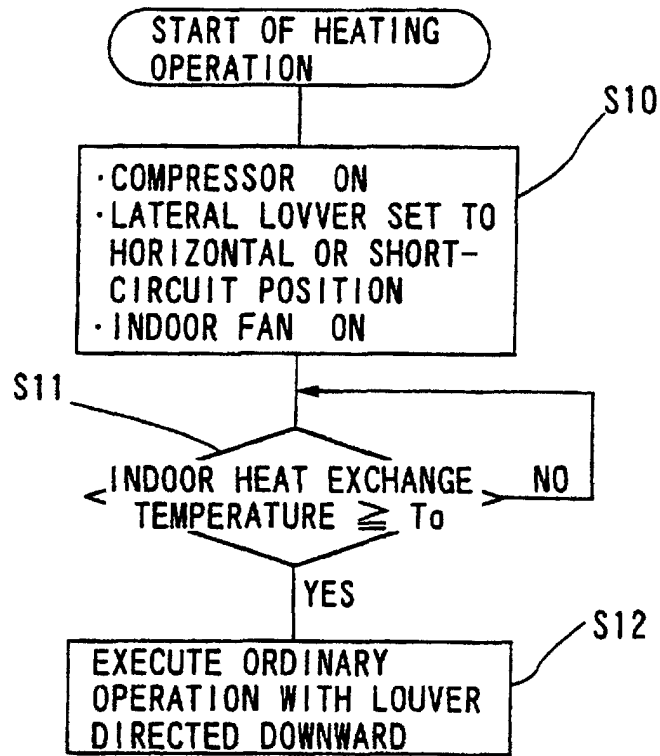


FIG. 4

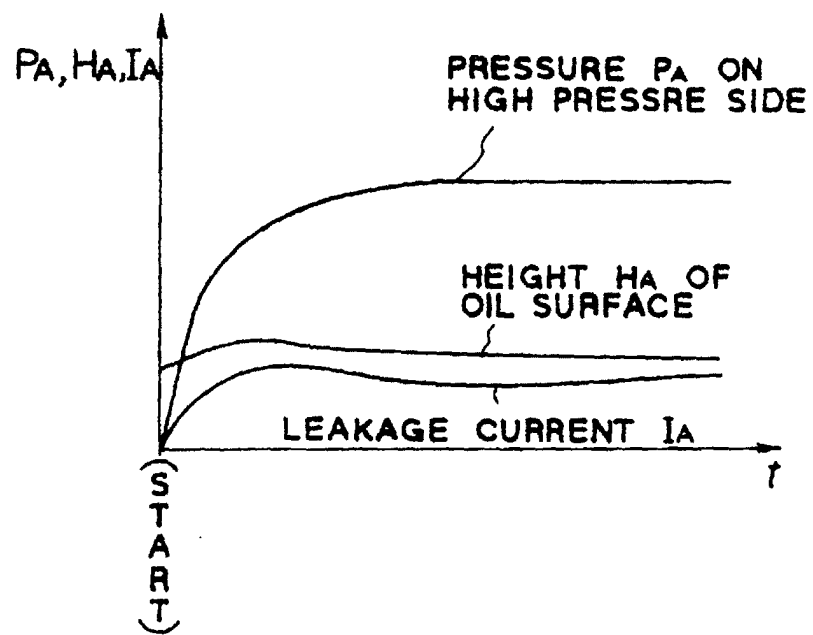


FIG. 5

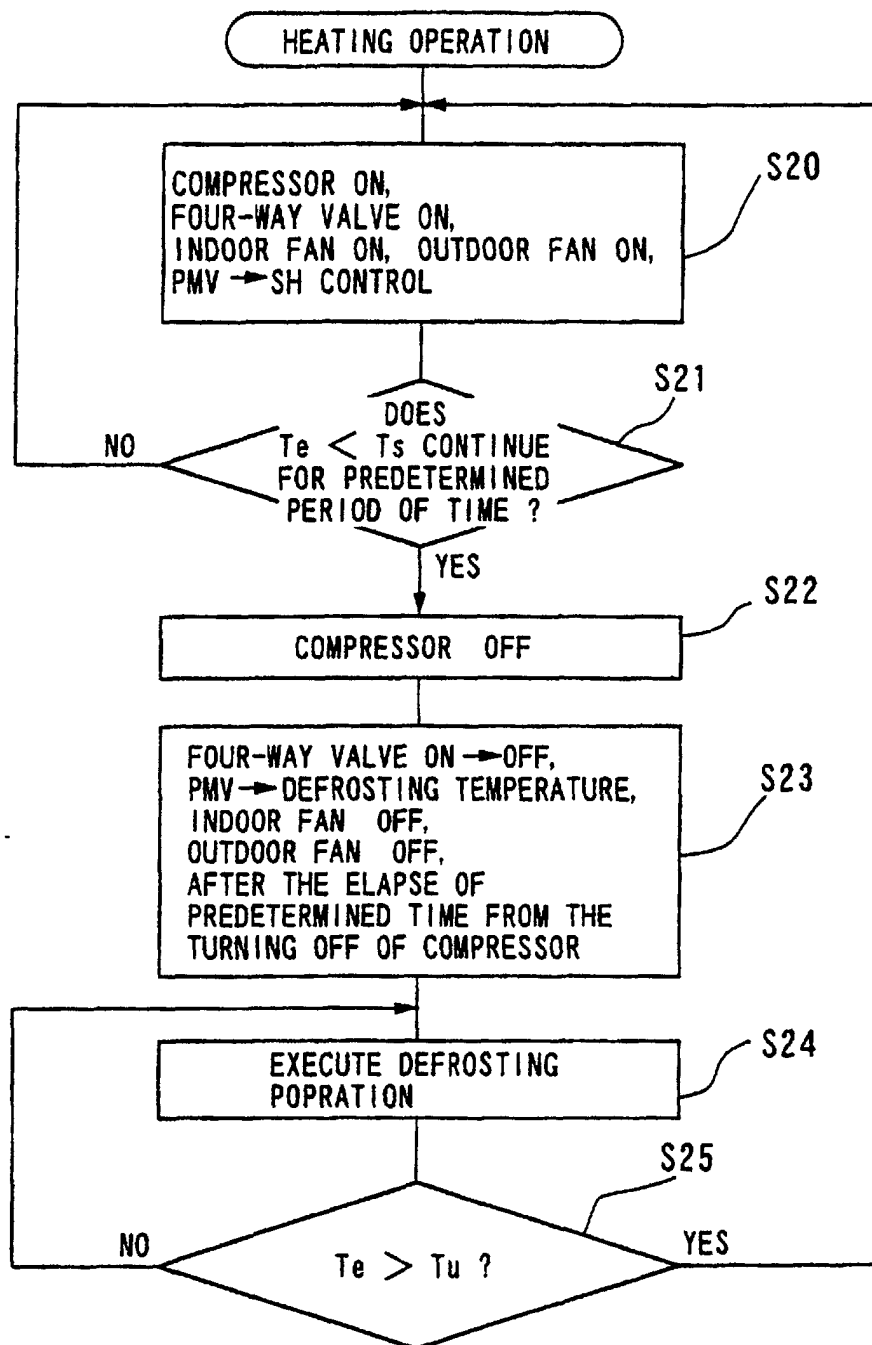


FIG. 6

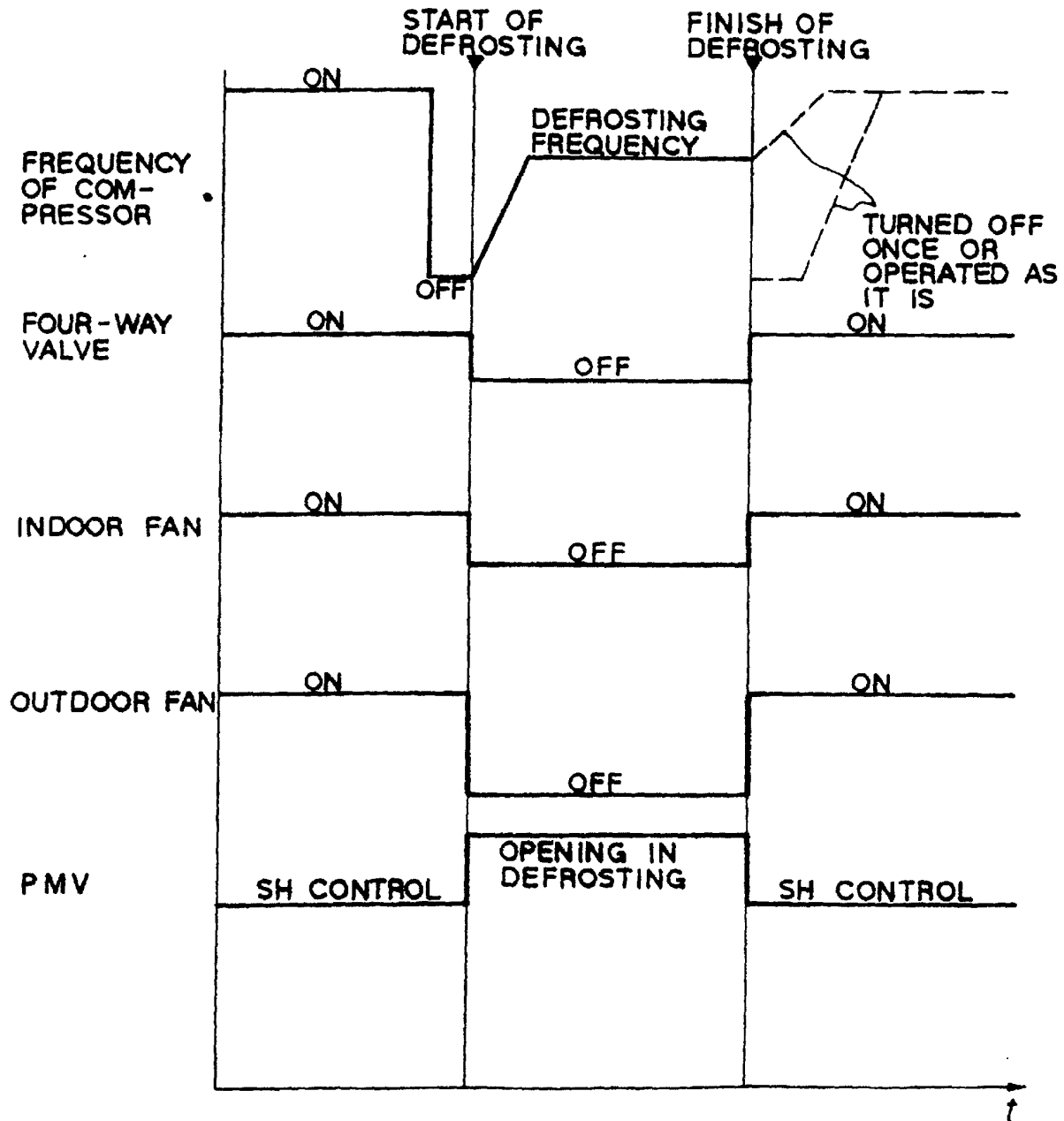


FIG. 7

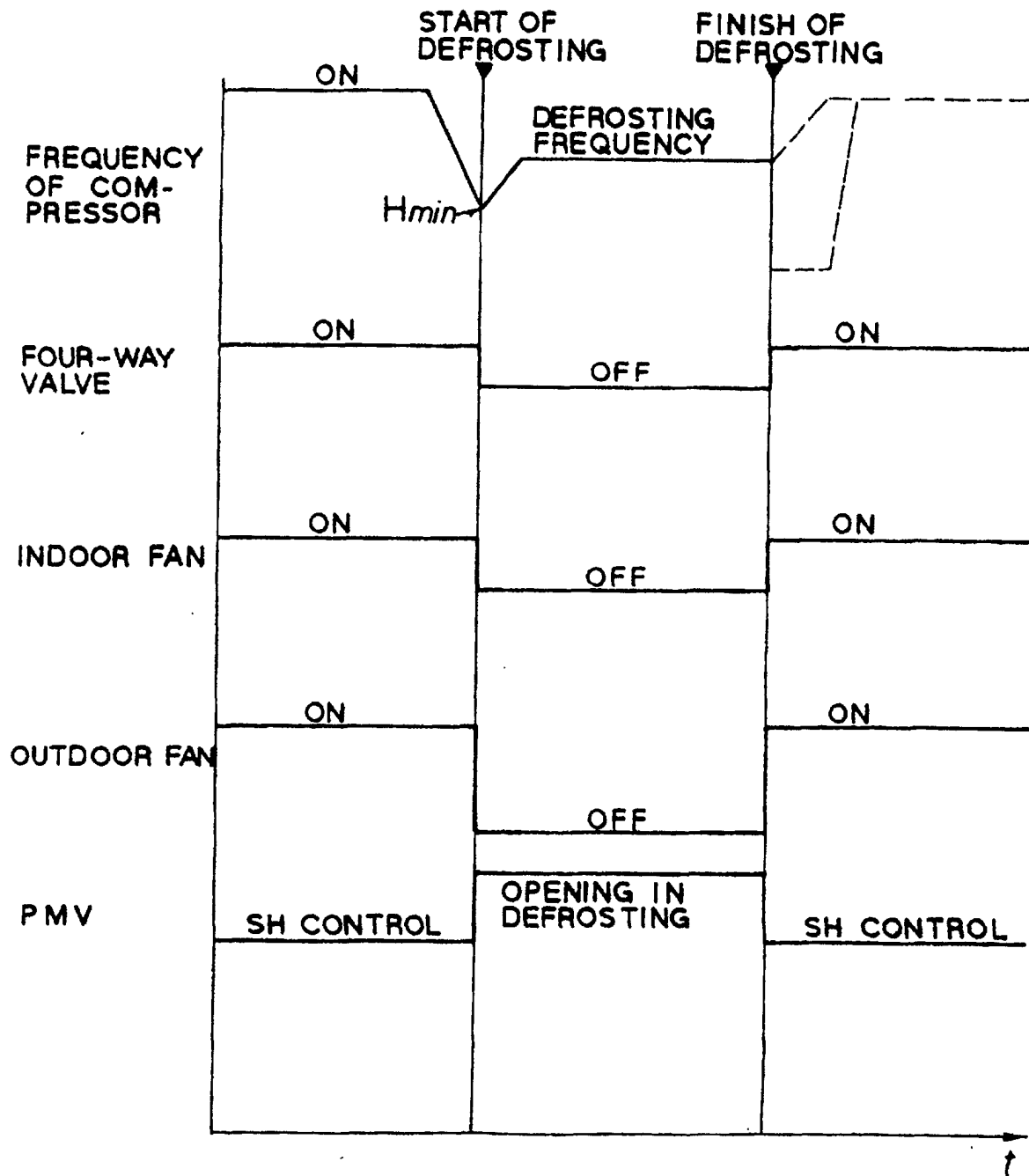


FIG. 8

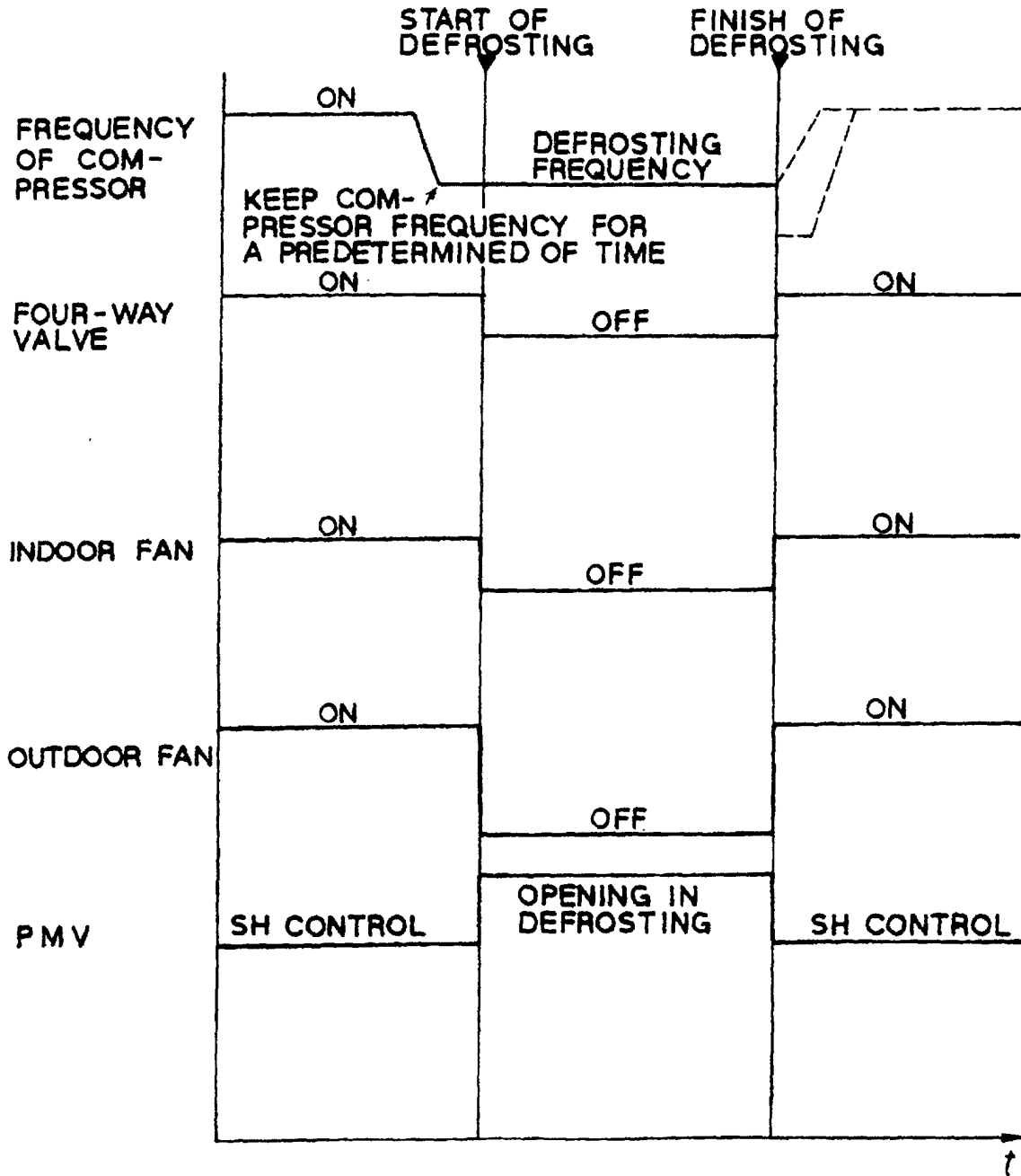


FIG. 9

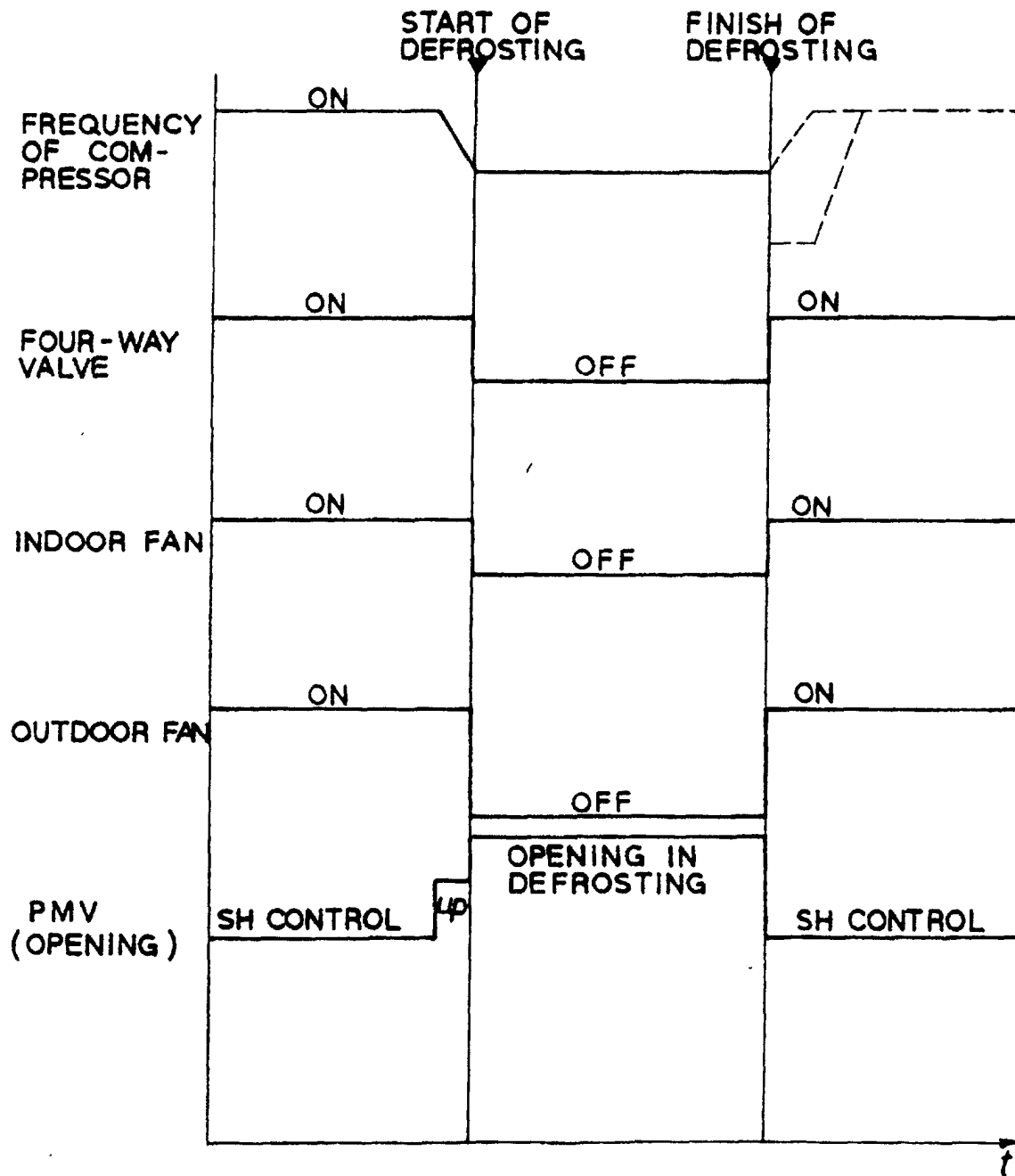


FIG. 10

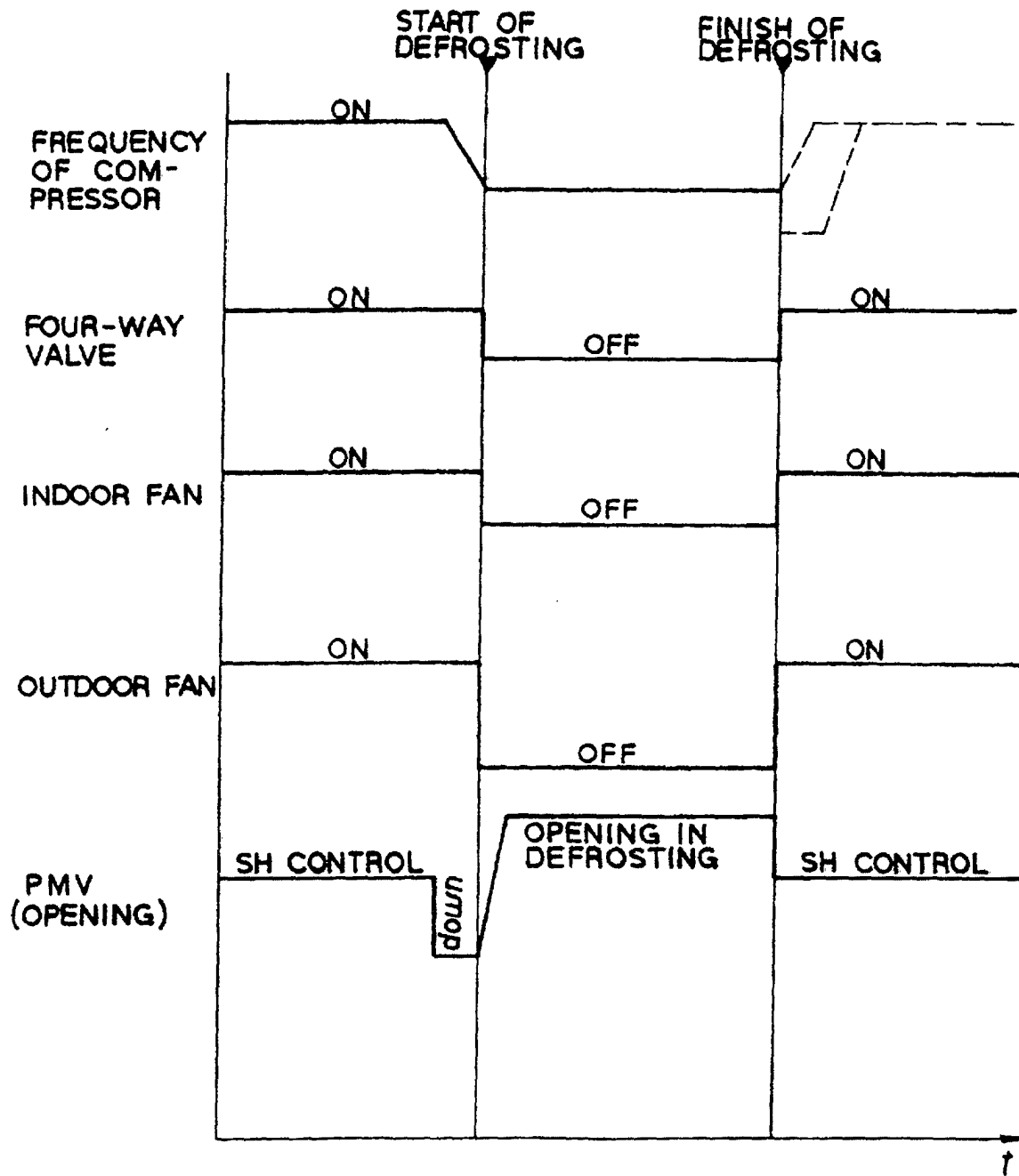


FIG. 11

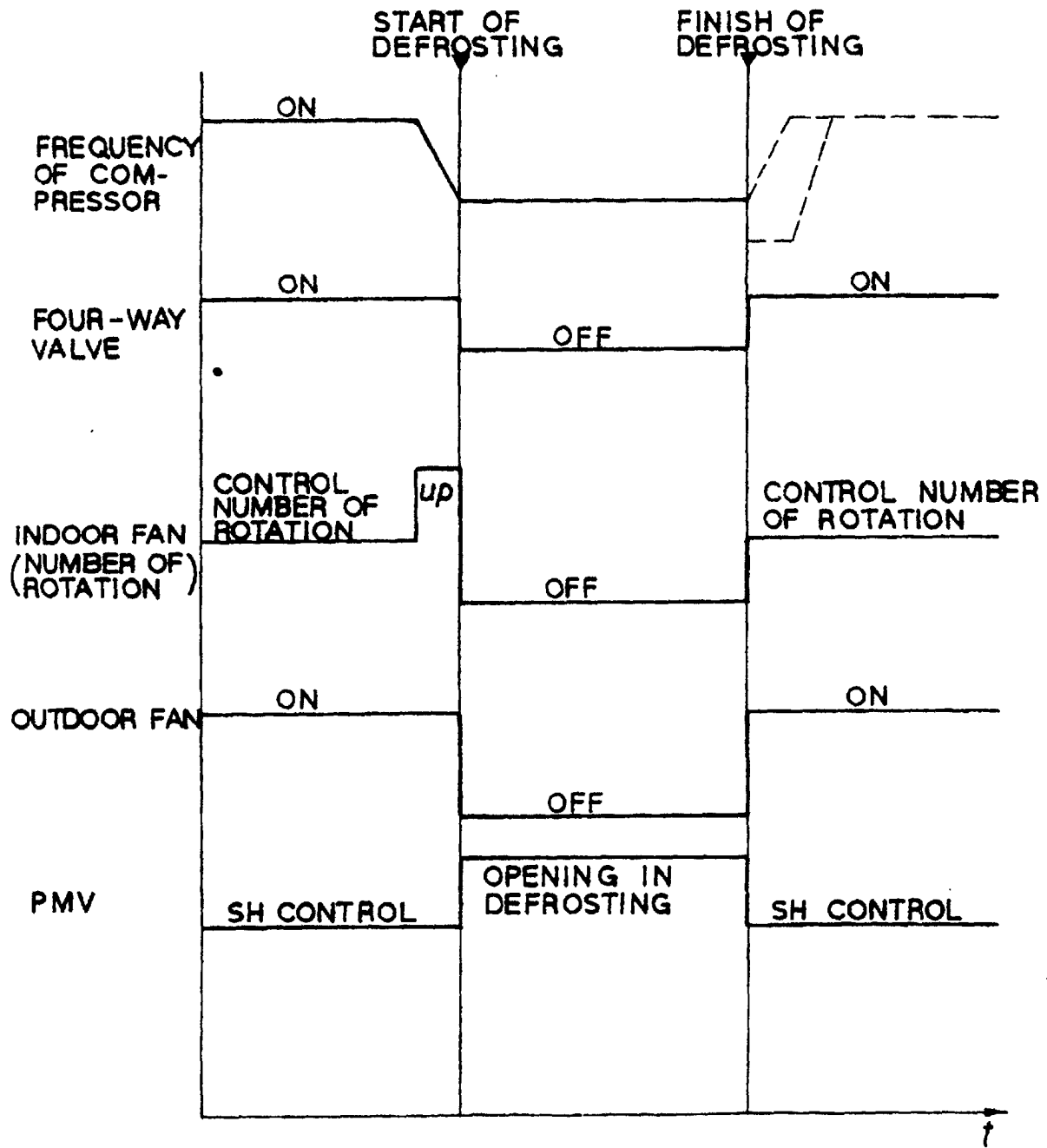


FIG. 12

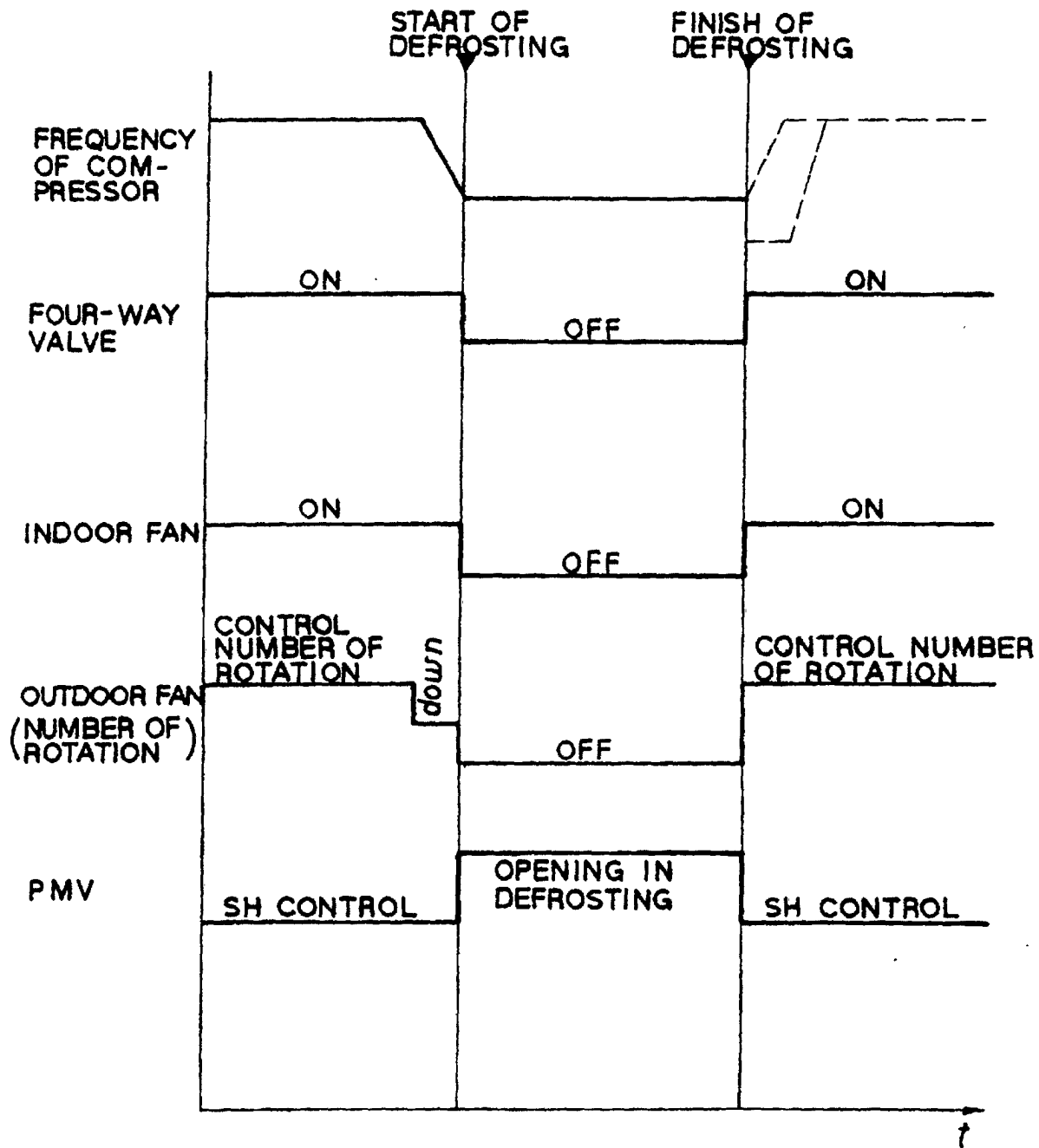


FIG. 13

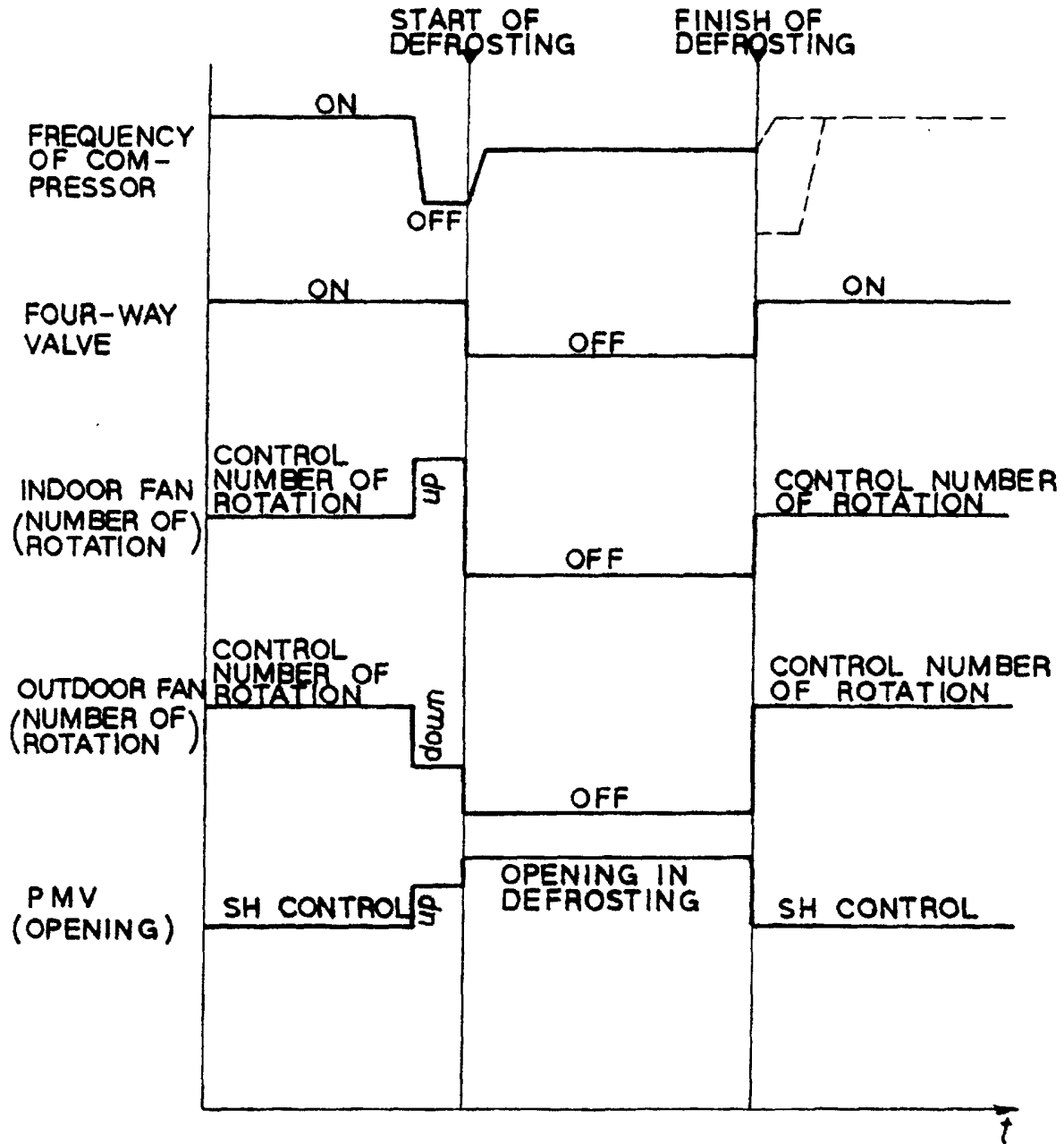


FIG. 14

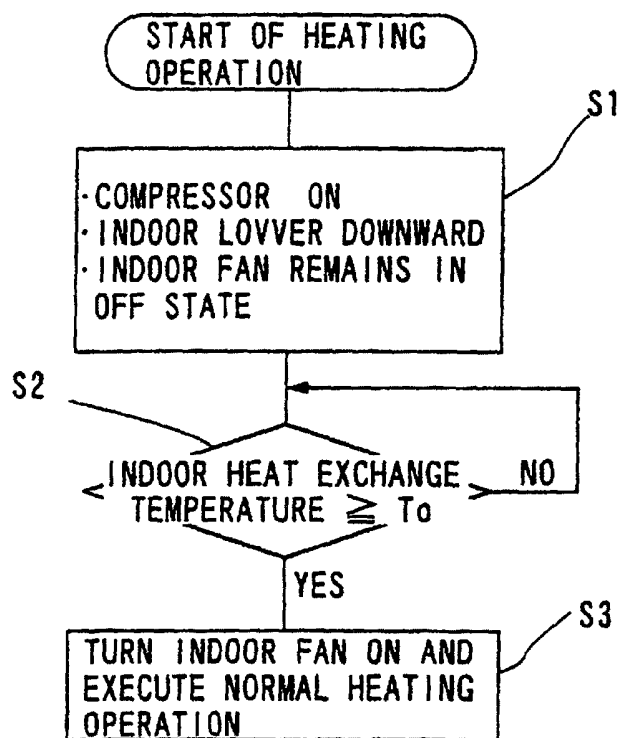


FIG. 15

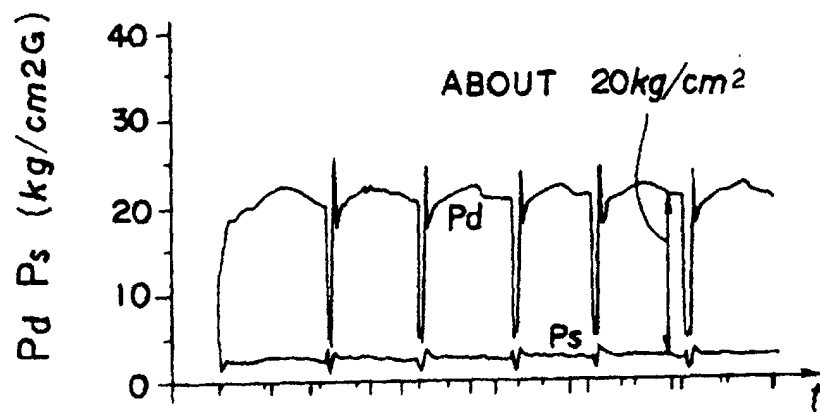


FIG. 16

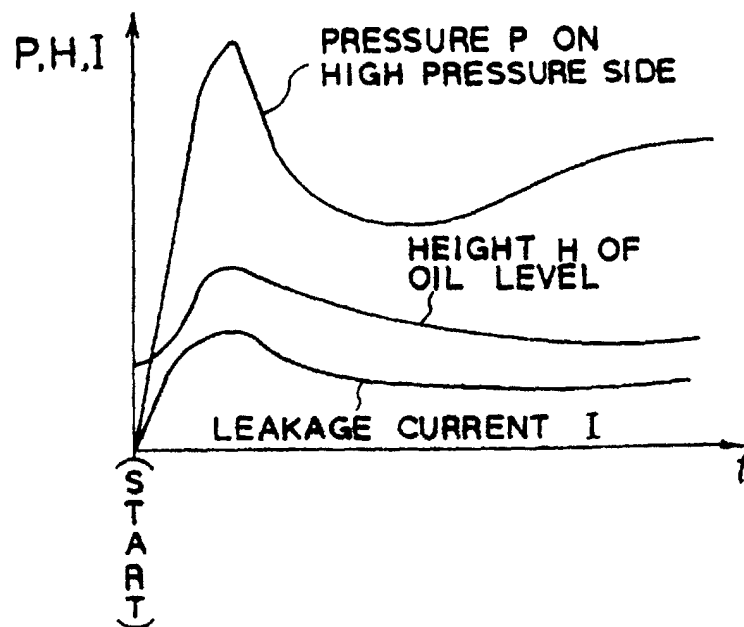


FIG. 17

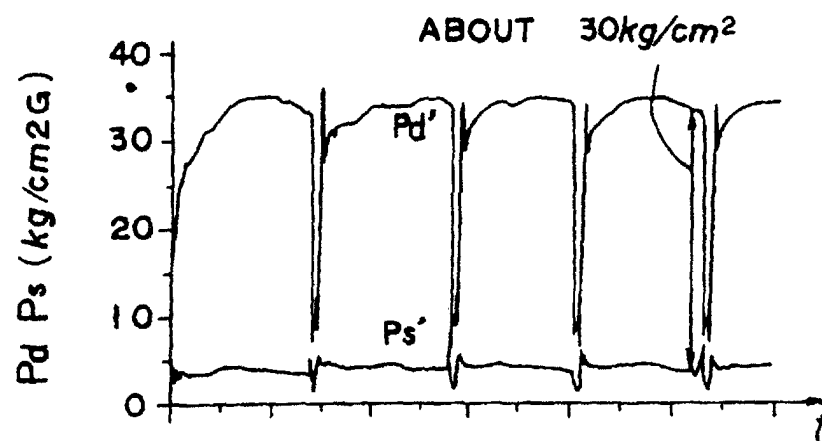


FIG. 18