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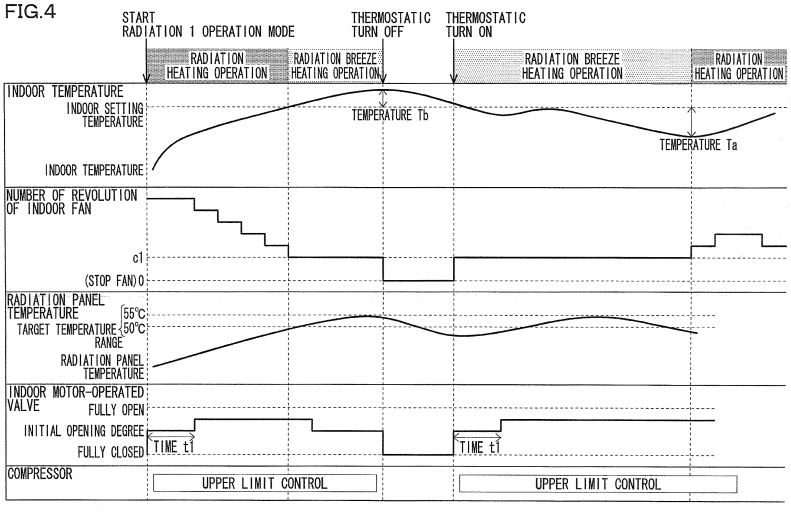
(54) AIR CONDITIONER

(57) To improve heating performance almost without the feeling of draft. An air conditioner (1) comprises an indoor unit (2) and an outdoor unit (3) coupled to the indoor unit via a refrigerant circuit. The indoor unit (2) includes: a heat exchanger (20) and a radiation panel (22) each having a part of pipes constituting the refrigerant circuit; and a fan (21) disposed in the vicinity of the heat exchanger (20). The air conditioner (1) is capable of: a hot-air heating operation for performing hot-air heating by introducing a refrigerant into the heat exchanger (20), not into the radiation panel (22); a radiation heating operation for performing the hot-air heating by introducing the refrigerant into the heat exchanger (20) and performing radiation heating by introducing the refrigerant into the radiation panel (22); and a radiation breeze heating operation for performing the hot-air heating by introducing the refrigerant into the heat exchanger (20) and performing the radiation heating by introducing the refrigerant into the radiation panel (22), while reducing the amount of air blown by the fan (21) less than in the radiation heating operation and the hot-air heating operation.

FIG.4



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Description

[Technical Field]

[0001] The present invention relates to an air conditioner including a heat exchanger, a fan, and a radiation panel.

[Background Art]

[0002] An indoor unit of a known air conditioner includes a heat exchanger and a radiation panel each having a part of a conduit constituting a refrigerant circuit and an indoor fan provided in the vicinity of the heat exchanger (see, e.g., Patent Document 1). This air conditioner is set at, as a heating operation mode, a fan-panel mode in which both warm-air heating and radiation heating are conducted, an automatic mode in which automatic switching is done between the warm-air heating and the radiation heating, or a panel mode in which only the radiation heating is conducted without the warm-air heating. When only the radiation heating is conducted and the warm-air heating is not conducted, the indoor fan is not driven. On the other hand, when only the radiation heating is conducted, the operation frequency of the compressor is arranged to be lower than in the case where both the warm-air heating and the radiation heating are conducted.

[Citation List]

[Patent Documents]

[0003]

[Patent Document 1] Japanese Unexamined Patent Publication No. 63-113239

[Summary of Invention]

[Technical Problem]

[0004] In regard to the above, in case of the radiation heating without the warm-air heating, heating may be insufficient on account of low radiation heating capability, when the operation frequency of the compressor is lowered. When the operation frequency of the compressor is increased to improve the radiation heating capability, the heat exchange amount of the refrigerant is small in the heat exchanger because the indoor fan has been stopped, with the result that the pressure in the refrigerant circuit is increased. This may stop the operation of the air conditioner for the reason of abnormally high pressure.
When both the warm-air heating and the radiation heating are conducted, the operation frequency of the compressor is improved and the problems above are resolved. However, because the warm-air heating typically gives the user the feeling of a draft, the user's demand for heating without the feeling of a draft is not satisfied.

[0005] Based on the above, an object of the present invention is to provide an air conditioner that has improved heating capability while hardly giving the user the feeling of a draft.

[Solution to Problem]

[0006] According to the first aspect of the invention, an air conditioner includes an indoor unit and an outdoor unit connected to the indoor unit via a refrigerant circuit, the indoor unit including a heat exchanger and a radiation panel each having a conduit constituting a part of the refrigerant circuit and a fan provided in the vicinity of the heat exchanger, the air conditioner being capable of executing: a radiation heating operation in which warm-air heating is conducted by supplying refrigerant to the heat exchanger and radiation heating is conducted by supplying the refrigerant to the radiation panel; and a radiation breeze heating operation in which warm-air heating is conducted by supplying the refrigerant to the heat exchanger, radiation heating is conducted by supplying the refrigerant to the radiation panel, and radiation breeze heating in which an air quantity generated by the fan is smaller than an air quantity in the radiation heating operation is conducted.

[0007] Because in this air conditioner the air quantity generated by the fan is reduced in the radiation breeze heating operation, it is possible to conduct the warm-air heating while hardly giving the user the feeling of a draft. Furthermore, because the fan is not stopped and hence the heat exchange amount by the heat exchanger is large, it is possible to prevent the pressure in the refrigerant circuit from becoming excessively high. The number of revolution of the compressor of the outdoor unit is increased as compared to the case where the fan is stopped and only the radiation heating is

conducted, with the result that the heating capability is improved.

[0008] According to the second aspect of the invention, the air conditioner of the first aspect further includes: an indoor temperature sensor configured to detect a temperature in a room in which the indoor unit is provided; and a switching unit configured to conduct switching between the radiation heating operation and the radiation breeze heating operation based on the indoor temperature detected by the indoor temperature sensor.

[0009] In this air conditioner, the switching between the radiation heating operation and the radiation breeze heating is conducted in accordance with the indoor temperature so that the radiation heating operation is conducted when the indoor temperature is low whereas the radiation breeze heating operation is conducted when the indoor temperature is high. This makes it possible to rapidly increase the indoor temperature when the indoor temperature is low, and the switching to the heating that hardly gives the user the feeling of a draft is automatically conducted when the indoor temperature becomes high.

[0010] According to the third aspect of the invention, the air conditioner of the first or second aspect further includes: a compressor provided in the outdoor unit; a control unit configured to control the compressor; and a storage unit configured to store an upper limit regarding a pressure in the heat exchanger, when at least one of the radiation heating operation and the radiation breeze heating operation is being conducted, the control unit controlling the compressor so that the pressure in the heat exchanger is substantially identical with a pressure corresponding to the upper limit.

[0011] In this air conditioner, the compressor is controlled so that the pressure in the refrigerant circuit is substantially equal to the maximum pressure in the radiation heating operation or the radiation breeze heating operation, with the result that the heating capability is improved.

[0012] According to the fourth aspect of the invention, the air conditioner of the third aspect further includes a heat exchanger temperature sensor provided in the heat exchanger, the storage unit storing the maximum temperature of the heat exchanger temperature in the heat exchanger as the upper limit regarding the pressure in the heat exchanger, and when at least one of the radiation heating operation and the radiation breeze heating operation is being conducted, the control unit controls the compressor so that the heat exchanger temperature detected by the heat exchanger temperature sensor is substantially equal to the maximum temperature.

[0013] In this air conditioner, the compressor is controlled so that the heat exchange temperature detected by the heat exchange temperature sensor is substantially equal to the maximum temperature, with the result that the pressure in the refrigerant circuit is controlled to be substantially equal to the maximum pressure.

[0014] According to the fifth aspect of the invention, an air conditioner includes an indoor unit and an outdoor unit connected to the indoor unit via a refrigerant circuit, the indoor unit including a heat exchanger and a radiation panel each having a conduit constituting a part of the refrigerant circuit and a fan provided in the vicinity of the heat exchanger, the air conditioner being capable of executing: a warm-air heating operation in which warm-air heating is conducted by supplying refrigerant not to the radiation panel but to the heat exchanger; and a radiation breeze heating operation in which warm-air heating is conducted by supplying the refrigerant to the heat exchanger, radiation heating is conducted by supplying the refrigerant to the radiation panel, and radiation breeze heating in which an air quantity generated by the fan is smaller than an air quantity in the warm-air heating operation is conducted.

[0015] Because in this air conditioner the air quantity generated by the fan is reduced in the radiation breeze heating operation, it is possible to conduct the warm-air heating while hardly giving the user the feeling of a draft. Furthermore, because the fan is not stopped and hence the heat exchange amount by the heat exchanger is large, it is possible to prevent the pressure in the refrigerant circuit from becoming excessively high. The number of revolution of the compressor of the outdoor unit is increased as compared to the case where the fan is stopped and only the radiation heating is conducted, with the result that the heating capability is improved.

[0016] According to the sixth aspect of the invention, the air conditioner of the fifth aspect further includes: a compressor provided in the outdoor unit; a control unit configured to control the compressor; and a storage unit configured to store an upper limit regarding a pressure in the heat exchanger, when the radiation breeze heating operation is being conducted, the control unit controlling the compressor so that the pressure in the heat exchanger is substantially equal to a pressure corresponding to the upper limit.

[0017] Because in this air conditioner the compressor is controlled so that the pressure in the refrigerant circuit is substantially equal to the maximum pressure in the radiation breeze heating operation, the heating capability is improved.

[0018] According to the seventh aspect of the invention, the air conditioner of the sixth aspect further includes a heat exchanger temperature sensor provided in the heat exchanger, the storage unit storing the maximum temperature of the heat exchanger temperature in the heat exchanger as the upper limit regarding the pressure in the heat exchanger, and when the radiation breeze heating operation is being conducted, the control unit controlling the compressor so that the heat exchanger temperature detected by the heat exchanger temperature sensor is substantially equal to the maximum temperature.

[0019] In this air conditioner, the compressor is controlled so that the heat exchange temperature detected by the heat exchange temperature sensor is substantially equal to the maximum temperature, with the result that the pressure in the refrigerant circuit is substantially equal to the maximum pressure.

[0020] According to the eighth aspect of the invention, the air conditioner of any one of first to seventh aspects further includes a valve structure configured to adjust an amount of the refrigerant supplied to the radiation panel, and in the refrigerant circuit, the radiation panel and the valve structure being provided to be in parallel to the heat exchanger.

[0021] In this air conditioner, because the radiation panel and the valve structure are provided to be in parallel to the heat exchanger, it is possible to conduct the switching between (i) an operation in which only the warm-air heating is conducted without supplying the refrigerant to the radiation panel and (ii) the radiation heating operation or the radiation breeze heating operation in which the refrigerant is supplied to the radiation panel, only by opening or closing the valve structure.

[Advantageous Effects of Invention]

[0022] As described above, the following effects are obtained by the present invention.

[0023] According to the first and fifth aspects, because the air quantity generated by the fan is reduced in the radiation breeze heating operation, it is possible to conduct warm-air heating while hardly giving the user the feeling of a draft. Furthermore, because the fan is not stopped and hence the heat exchange amount by the heat exchanger is large, it is possible to prevent the pressure in the refrigerant circuit from becoming excessively high. The number of revolution of the compressor of the outdoor unit is increased as compared to the case where the fan is stopped and only the radiation heating is conducted, with the result that the heating capability is improved.

[0024] According to the second aspect of the invention, the switching between the radiation heating operation and the radiation breeze heating is conducted in accordance with the indoor temperature so that the radiation heating operation is conducted when the indoor temperature is low whereas the radiation breeze heating operation is conducted when the indoor temperature is high. This makes it possible to rapidly increase the indoor temperature when the indoor temperature is low, and the switching to the heating that hardly gives the user the feeling of a draft is automatically conducted when the indoor temperature becomes high.

[0025] According to the third and sixth aspects of the invention, the compressor is controlled so that the pressure in the refrigerant circuit is substantially equal to the maximum pressure in the radiation heating operation or the radiation breeze heating operation, with the result that the heating capability is improved.

[0026] According to the fourth and seventh aspects of the invention, the compressor is controlled so that the heat exchange temperature detected by the heat exchange temperature sensor is substantially equal to the maximum temperature, with the result that the pressure in the refrigerant circuit is substantially equal to the maximum pressure.

[0027] According to the eighth aspect of the invention, because the radiation panel and the valve structure are provided to be in parallel to the heat exchanger, it is possible to conduct the switching between (i) an operation in which only the warm-air heating is conducted without supplying the refrigerant to the radiation panel and (ii) the radiation heating operation or the radiation breeze heating operation in which the refrigerant is supplied to the radiation panel, only by opening or closing the valve structure.

[Brief Description of Drawings]

[0028]

FIG. 1 is a circuit diagram showing the schematic configuration of an air conditioner of an embodiment of the present invention, illustrating the flows of refrigerant in a cooling operation and in a warm-air heating operation.

FIG. 2 is a circuit diagram showing the schematic configuration of the air conditioner of the embodiment of the present invention, illustrating the flows of refrigerant in a radiation heating operation and in a radiation breeze heating operation.

FIG. 3 is a block diagram showing the schematic configuration of a controller controlling the air conditioner.

FIG. 4 is a graph showing the operations of components of the air conditioner when it is driven in a radiation 1 operation mode, an indoor temperature, and a radiation panel temperature.

FIG. 5 is a graph showing the operations of components of the air conditioner when it is driven in a radiation 2 operation mode, an indoor temperature, and a radiation panel temperature.

[Description of Embodiments]

[0029] The following will describe an embodiment of an air conditioner 1 of the present invention.

<Overall Structure of Air Conditioner 1>

[0030] As shown in FIG. 1 and FIG. 2, the air conditioner 1 of the present embodiment includes an indoor unit 2

provided inside a room, an outdoor unit 3 provided outside the room, and a remote controller 4 (see FIG. 3). The indoor unit 2 includes an indoor heat exchanger 20, an indoor fan 21 provided in the vicinity of the indoor heat exchanger 20, a radiation panel 22, an indoor motor-operated valve (valve structure) 23, and an indoor temperature sensor 24 configured to detect an indoor temperature. On the other hand, the outdoor unit 3 includes a compressor 30, a four-way valve 31, an outdoor heat exchanger 32, an outdoor fan 33 provided in the vicinity of the outdoor heat exchanger 32, and an outdoor motor-operated valve 34.

[0031] In this air conditioner 1, the indoor heat exchanger 20, the compressor 30, the four-way valve 31, the outdoor heat exchanger 32, and the outdoor motor-operated valve 34 are connected to one another and constitute an annular refrigerant circuit 10. Furthermore, in the refrigerant circuit 10, the conduits on the respective sides of the indoor heat exchanger 20 are connected with each other by a bypass conduit 11. This bypass conduit 11 is provided with the radiation panel 22 and the indoor motor-operated valve 23. On the respective sides of the radiation panel 22 on the bypass conduit 11, a panel incoming temperature sensor 25 and a panel outgoing temperature sensor 26 are provided. Furthermore, in the refrigerant circuit 10, an accumulator 35 is provided between the sucking side of the compressor 30 and the four-way valve 31 whereas a discharge temperature sensor 36 is provided between the discharging side of the compressor 30 and the four-way valve 31. Furthermore, the outdoor heat exchanger 32 is provided with an outdoor heat exchanger temperature sensor 28.

[0032] The indoor heat exchanger 20 includes a conduit constituting a part of the refrigerant circuit and is provided with an indoor heat exchanger temperature sensor 27. The indoor heat exchanger 20 is provided on the windward side of the indoor fan 21. The air heated or cooled by the heat exchange with the indoor heat exchanger 20 is blown by the indoor fan 21 into the room as warm air or cool air. As such, warm-air heating or cooling is carried out.

[0033] The radiation panel 22 is provided on the top surface side of the indoor unit 2 and includes a conduit constituting a part of the refrigerant circuit. As the heat of the refrigerant flowing in this conduit is radiated to the room, the radiation heating is conducted. The indoor motor-operated valve 23 is provided to adjust the flow rate of the refrigerant supplied to the radiation panel 22.

[0034] The air conditioner 1 of the present embodiment is able to perform a cooling operation, a warm-air heating operation, a radiation heating operation, and a radiation breeze heating operation. The cooling operation is an operation to perform cooling such that the refrigerant is supplied not to the radiation panel 22 but to the indoor heat exchanger 20, whereas the warm-air heating operation is an operation to perform warm-air heating by supplying the refrigerant not to the radiation panel 22 but to the indoor heat exchanger 20. The radiation heating operation is an operation to perform warm-air heating by supplying the refrigerant to the indoor heat exchanger 20 and perform radiation heating by supplying the refrigerant to the radiation panel 22. The radiation breeze heating operation is an operation to perform warm-air heating with a lower air quantity than the air quantities in the warm-air heating operation and the radiation heating operation, and perform radiation heating by supplying the refrigerant to the radiation panel 22.

[0035] The flow of the refrigerant in the refrigerant circuit in each operation will be described with reference to FIG. 1 and FIG. 2.

In the cooling operation, the indoor motor-operated valve 23 is closed and the four-way valve 31 is switched to the state indicated by the broken lines in FIG. 1. With this, as indicated by the broken-line arrows in FIG. 1, the high-temperature and high-pressure refrigerant discharged from the compressor 30 flows into the outdoor heat exchanger 32 via the four-way valve 31. The refrigerant is condensed in the outdoor heat exchanger 32, and after the pressure thereof is reduced by the outdoor motor-operated valve 34, the refrigerant flows into the indoor heat exchanger 20. The refrigerant evaporated in the indoor heat exchanger 20 flows into the compressor 30 via the four-way valve 31 and the accumulator 35.

[0036] In the warm-air heating operation, the indoor motor-operated valve 23 is closed and the four-way valve 31 is switched to the state indicated by the solid lines in FIG. 1. For this reason, as indicated by the solid-line arrows in FIG. 1, the high-temperature and high-pressure refrigerant discharged from the compressor 30 flows into the indoor heat exchanger 20 via the four-way valve 31. The refrigerant is condensed in the indoor heat exchanger 20, and after the pressure thereof is reduced by the outdoor motor-operated valve 34, the refrigerant flows into the outdoor heat exchanger 32. The refrigerant evaporated in the outdoor heat exchanger 32 flows into the compressor 30 via the four-way valve 31 and the accumulator 35.

[0037] In the radiation heating operation and the radiation breeze heating operation, the indoor motor-operated valve 23 is opened and the four-way valve 31 is switched to the state indicated by the solid lines in FIG. 2. For this reason, as indicated by the solid-line arrows in FIG. 2, the high-temperature and high-pressure refrigerant discharged from the compressor 30 flows into the indoor heat exchanger 20 and the radiation panel 22 via the four-way valve 31. The refrigerant is condensed in the indoor heat exchanger 20 and the radiation panel 22, and after the pressure thereof is reduced by the outdoor motor-operated valve 34, the refrigerant flows into the outdoor heat exchanger 32. The refrigerant evaporated in the outdoor heat exchanger 32 flows into the compressor 30 via the four-way valve 31 and the accumulator 35.

<Remote Controller 4>

[0038] By using the remote controller 4, the user starts or stops the operation, selects the operation mode, sets the target temperature (indoor setting temperature) of the indoor temperature, sets the blowing air quantity, and so on. As shown in Table 1, in the air conditioner 1 of the present embodiment, the cooling operation mode or the heating operation mode is selectable as the main operation mode by making an instruction through the remote controller 4.

[0039] When the heating operation mode is selected as the main operation mode, as shown in Table 1, one of a warm-air heating operation mode, a radiation 1 operation mode, and a radiation 2 operation mode is selectable. The radiation 1 operation mode and the radiation 2 operation mode are included in the radiation heating operation mode.

[0040]

[Table 1]

<table>
<tr><td colspan="3">COOLING OPERATION MODE</td><td>COOLING OPERATION</td></tr>
<tr><td rowspan="3">HEATING OPERATION MODE</td><td colspan="2">WARM-AIR HEATING OPERATION MODE</td><td>WARM-AIR HEATING OPERATION</td></tr>
<tr><td rowspan="2">RADIATION HEATING OPERATION MODE</td><td>RADIATION 1 OPERATION MODE</td><td>SWITCHING BETWEEN RADIATION HEATING OPERATION AND RADIATION BREEZE HEATING OPERATION</td></tr>
<tr><td>RADIATION 2 OPERATION MODE</td><td>RADIATION BREEZE HEATING OPERATION</td></tr>
</table>

[0041] AS shown in Table 1, the cooling operation mode is a mode for conducting the cooling operation. The warm-air heating operation mode is a mode for conducting the warm-air heating operation. The radiation 1 operation mode is a mode for conducting switching between the radiation heating operation and the radiation breeze heating operation in accordance with the indoor temperature. The radiation 2 operation mode is a mode for conducting the radiation breeze heating operation. When the warm-air heating operation mode or the cooling operation mode is selected, one of "automatic air quantity", "strong", and "weak" is selectable as the air quantity setting. In the present embodiment, the air quantity is automatically controlled when the radiation 1 operation mode or the radiation 2 operation mode is selected.

<Controller 5>

[0042] Now, the controller 5 for controlling the air conditioner 1 will be described with reference to FIG. 3. As shown in FIG. 3, the controller 5 includes a storage (storage unit) 50, an operation mode controller (switching unit) 51, an indoor motor-operated valve controller 52, an indoor fan controller 53, a compressor controller (control unit) 54 , and an outdoor motor-operated valve controller 55.

(Storage 50)

[0043] The storage 50 stores various operation settings concerning the air conditioner 1, a control program, a data table required to execute the control program, and the like. The operation settings are classified into two types. Namely, settings set through a user's operation of the remote controller 4 such as a target temperature (indoor setting temperature) of the indoor temperature and settings that are set in advance for the air conditioner 1. In the air conditioner 1 of the present embodiment, the target temperature range of the radiation panel 22 is set at a predetermined temperature range (e.g., 50 to 55 degrees Celsius) in advance. It is noted that the target temperature range of the radiation panel 22 may be set through the remote controller 4. In addition to the above, the storage 50 stores the upper limit of the heat exchanger temperature of the indoor heat exchanger 20, which corresponds to the maximum pressure in the indoor heat exchanger 20.

(Operation Mode Controller 51)

[0044] When an instruction to start the operation in the cooling operation mode, in the warm-air heating operation mode, or in the radiation 2 operation mode is made through the remote controller 4, the operation mode controller 51 starts the cooling operation, the heating operation, or the radiation breeze heating operation.

In the meanwhile, when an instruction to start the operation in the radiation 1 operation mode is made through the remote controller 4, the operation mode controller 51 starts the radiation heating operation when the indoor temperature detected by the indoor temperature sensor 24 is lower than the indoor setting temperature, or starts the radiation breeze heating operation when the indoor temperature is equal to or higher than the indoor setting temperature.

In the air conditioner 1 of the present embodiment, when the operation starts in response to an instruction made through the remote controller 4, the heating operation does not start if the indoor temperature is higher than the indoor setting temperature by at least a predetermined temperature Tb.

[0045] In addition to the above, during the operation in the radiation 1 operation mode, when the indoor temperature detected by the indoor temperature sensor 24 becomes equal to or higher than the indoor setting temperature while the radiation heating operation is being conducted, the operation mode controller 51 switches the radiation heating operation to the radiation breeze heating operation, and when the indoor temperature becomes lower than the indoor setting temperature by at least a predetermined temperature Ta while the radiation breeze heating operation is being conducted, the operation mode controller 51 switches the radiation breeze heating operation to the radiation heating operation. Furthermore, when the indoor temperature becomes higher than the indoor setting temperature by at least a predetermined temperature Tb while the heating operation is being conducted, the operation mode controller 51 automatically stops the operation (thermostatic turn off), and then re-starts the operation when the indoor temperature is lowered to the indoor setting temperature (thermostatic turn on).

(Indoor Motor-Operated Valve Controller 52)

[0046] The indoor motor-operated valve controller 52 controls the opening degree of the indoor motor-operated valve 23. As shown in Table 2, in the cooling operation or the warm-air heating operation, the indoor motor-operated valve controller 52 closes the indoor motor-operated valve 23. Table 2 shows the control states of the indoor motor-operated valve 23, the indoor fan 21, and the compressor 30 in each operation mode.

[0047]

[Table 2]

	OPENING DEGREE OF INDOOR MOTOR-OPERATED VALVE	NUMBER OF REVOLUTION OF INDOOR FAN	FREQUENCY OF COMPRESSOR
COOLING OPERATION	FULLY CLOSED	AUTOMATIC (LOW-HIGH) /FIXED (HIGH/LOW)	CONTROL IN ACCORDANCE WITH INDOOR TEMPERATURE (LOW-HIGH)
WARM-AIR HEATING OPERATION	FULLY CLOSED	AUTOMATIC (LOW-HIGH) /FIXED (HIGH/LOW)	CONTROL IN ACCORDANCE WITH INDOOR TEMPERATURE (LOW-HIGH)
RADIATION HEATING OPERATION	CONTROL BASED ON RADIATION PANEL TEMPERATURE	AUTOMATIC (LOW-HIGH)	UPPER LIMIT CONTROL (MAXIMUM)
RADIATION BREEZE HEATING OPERATION	CONTROL BASED ON RADIATION PANEL TEMPERATURE	FIXED (MINIMUM)	UPPER LIMIT CONTROL (MAXIMUM)

[0048] As shown in Table 2, in the radiation heating operation or the radiation breeze heating operation, the indoor motor-operated valve controller 52 controls the opening degree of the indoor motor-operated valve 23 based on the temperature of the radiation panel 22. More specifically, based on an average of the temperatures detected by the panel incoming temperature sensor 25 and the panel outgoing temperature sensor 26, the surface temperature (predicted value) of the radiation panel 22 is figured out, and the opening degree of the indoor motor-operated valve 23 is controlled so that the predicted value of the surface temperature of the radiation panel 22 (hereinafter, this will be simply referred to as radiation panel temperature) falls within a panel target temperature range (e.g., 50 to 55 degrees Celsius). The indoor motor-operated valve controller 52 controls the opening degree of the indoor motor-operated valve 23 such that the flow rate of the refrigerant supplied to the radiation panel 22 is increased in proportion to the degree of to what extent the radiation panel temperature is lower than the panel target temperature range. However, until a predetermined time t1 elapses from the start of the operation (which is either the start of the operation in response to an instruction made through the remote controller 4 or the start of the operation due to the thermostatic turn on), the indoor motor-operated valve controller 52 keeps the opening degree of the indoor motor-operated valve 23 at an initial opening degree. While

in the present embodiment both of the temperatures detected by the panel incoming temperature sensor 25 and the panel outgoing temperature sensor 26 are used to figure out the radiation panel temperature, only the temperature detected by the panel incoming temperature sensor 25 may be used or only the temperature detected by the panel outgoing temperature sensor 26 may be used.

(Indoor Fan Controller 53)

[0049] The indoor fan controller 53 controls the number of revolution of the indoor fan 21. Fan taps selected in the air-quantity automatic operation, in the radiation heating operation, and in the radiation breeze heating operation in the warm-air heating operation and the numbers of revolution corresponding to the respective fan taps are shown in Table 3.

[0050]

[Table 3]

	FAN TAP	NUMBER OF REVOLUTION
WARM-AIR HEATING OPERATION (AUTOMATIC AIR QUANTITY)	A1	a1
	A2	a2
	A3	a3
	A4	a4
	A5	a5
RADIATION HEATING OPERATION	B1	b1
	B2	b2
	B3	b3
	B4	b4
	B5	b5
	B6	b6
	B7	b7
RADIATION BREEZE HEATING OPERATION	C1	c1

※c1＜a5＜a4＜a3＜a2＜a1

※c1＜b7＜b6＜b4＜b3＜b2＜b1

[0051] In the air-quantity automatic operation in the warm-air heating operation, the indoor fan controller 53 selects one of five stages of fan taps A1 to A5 shown in Table 3 based on the indoor temperature detected by the indoor temperature sensor 24, the indoor setting temperature, or the like, and controls the number of revolution of the indoor fan 21 to be equal to the number of revolution (a1 to a5) corresponding to the selected fan tap. Furthermore, when in the warm-air heating operation the air quantity setting is set at "strong" or "weak", the fan tap associated with each setting in advance is selected.

[0052] In addition to the above, in the air-quantity automatic operation in the cooling operation, the indoor fan controller 53 selects one of predetermined fan taps based on the indoor temperature detected by the indoor temperature sensor 24, the indoor setting temperature, or the like, and controls the number of revolution of the indoor fan 21 to be equal to the number of revolution corresponding to the selected fan tap. When in the cooling operation the air quantity setting is set at "strong" or "weak", the fan tap associated with each setting in advance is selected.

[0053] In the radiation heating operation, the indoor fan controller 53 selects one of seven stages of fan taps B1 to B7 shown in Table 3 based on the indoor temperature detected by the indoor temperature sensor 24, the indoor setting temperature, or the like, and controls the number of revolution of the indoor fan 21 to be equal to the number of revolution (b1 to b7) corresponding to the selected fan tap.

[0054] In addition to the above, in the radiation breeze heating operation, the indoor fan controller 53 controls the number of revolution of the indoor fan 21 to be identical with the number of revolution c1 corresponding to the fan tap

C1 shown in Table 3. The number of revolution c1 is smaller than the numbers of revolutions a1 to a5 in the warm-air heating operation and the numbers of revolution b1 to b7 in the radiation heating operation. The number of revolution c1 is a number with which the revolution of the indoor fan 21 is hardly accompanied with sound and the user is hardly given the feeling of a draft.

(Compressor Controller 54)

[0055] The compressor controller 54 controls the operation frequency of the compressor 30.
In the warm-air heating operation and the cooling operation, the frequency of the compressor 30 is controlled based on the indoor temperature, the indoor setting temperature, or the like. More specifically, the compressor controller 54 controls the compressor 30 so that the frequency of the compressor 30 is increased as the difference between the indoor temperature and the indoor setting temperature is widened.

[0056] In the radiation heating operation and the radiation breeze heating operation, the compressor controller 54 controls the compressor 30 so that the heat exchanger temperature detected by the indoor heat exchanger temperature sensor 27 is substantially equal to the maximum temperature corresponding to the maximum pressure in the refrigerant circuit. (This control will be referred to as upper limit control). More specifically, the frequency of the compressor 30 is controlled so that, even if the indoor temperature and the indoor setting temperature indicate that the heat exchanger temperature detected by the indoor heat exchanger temperature sensor 27 must be controlled to be higher than the maximum temperature, the heat exchanger temperature is controlled to be close to the maximum temperature without exceeding the maximum temperature.

(Outdoor Motor-Operated Valve Controller 55)

[0057] The outdoor motor-operated valve controller 55 controls the opening degree of the outdoor motor-operated valve 34 based on the indoor temperature, the indoor setting temperature, or the like.

<Operation of Air Conditioner 1>

[0058] Now, the operation of the air conditioner 1 in each heating operation mode will be described. The radiation 1 operation mode and the radiation 2 operation mode will be described with reference to the graphs in FIG. 4 and FIG. 5. In the graphs in FIG. 4 and FIG. 5, the horizontal axis indicates time whereas the vertical axes indicate the indoor temperature, the number of revolution of the indoor fan 21, the operation frequency of the compressor 30, the radiation panel temperature, and the opening degree of the indoor motor-operated valve 23, respectively.

(Operation in Warm-Air Heating Operation Mode)

[0059] When "automatic air quantity" is selected as the air quantity setting at the same time as an instruction to start the operation in the warm-air heating operation mode is made through the remote controller 4, the indoor fan controller 53 controls the number of revolution of the indoor fan 21 to be equal to the number of revolution corresponding to one of the fan taps A1 to A5, based on the indoor temperature. Furthermore, the compressor controller 54 controls the compressor 30 so that the operation frequency increases as the difference between the indoor temperature and the indoor setting temperature is widened. In the meanwhile, the indoor motor-operated valve 23 is closed.

[0060] In addition to the above, when "strong" or "weak" is selected as the air quantity setting at the same time as an instruction to start the operation in the warm-air heating operation mode is made through the remote controller 4, the indoor motor-operated valve 23 and the compressor 30 are controlled in the same manner as in the case of the selection of the "automatic air quantity", and the number of revolution of the indoor fan 21 is controlled by the indoor fan controller 53 to be equal to the number of revolution corresponding to a predetermined fan tap.

(Operation in Radiation 1 Operation Mode)

[0061] As shown in FIG. 4, when an instruction to start the operation in the radiation 1 operation mode is made through the remote controller 4, the radiation heating operation starts if the indoor temperature at the start of the operation is lower than the indoor setting temperature. In this case, the indoor fan controller 53 controls the number of revolution of the indoor fan 21 to be equal to the number of revolution corresponding to one of fan taps B1 to B7, based on the indoor temperature and the indoor setting temperature. Furthermore, the compressor controller 54 controls the compressor 30 so that the heat exchanger temperature detected by the indoor heat exchanger temperature sensor 27 is substantially equal to the maximum temperature (upper limit control). Furthermore, the indoor motor-operated valve controller 52 controls the indoor motor-operated valve 23 such that the opening degree of the valve is maintained at an initial opening

degree until a predetermined time t1 elapses from the start of the operation, and the opening degree is adjusted to keep the radiation panel temperature to fall within the panel target temperature range after the predetermined time t1 elapses from the start of the operation. While in FIG. 4 the initial opening degree of the indoor motor-operated valve 23 is smaller than the maximum opening degree, the initial opening degree may be equal to the maximum opening degree.

[0062] When the indoor temperature reaches the indoor setting temperature during the radiation heating operation, the radiation heating operation is switched to the radiation breeze heating operation. As such, the indoor fan controller 53 controls the number of revolution of the indoor fan 21 to be equal to the number of revolution c1 corresponding to the fan tap C1. Furthermore, the indoor motor-operated valve controller 52 and the compressor controller 54 control the indoor motor-operated valve 23 and the compressor 30 in the same manner as the state before the switching to the radiation breeze heating.

[0063] When the indoor temperature is further increased to be higher than the indoor setting temperature by at least a predetermined temperature Tb, the operation is automatically stopped (thermostatic turn off). With this, the indoor fan 21 and the compressor 30 are stopped and the indoor motor-operated valve 23 is switched to the fully closed state. Thereafter, when the indoor temperature is decreased to the indoor setting temperature, the operation starts again (thermostatic turn on). In FIG. 4, because the indoor temperature at the time of the thermostatic turn on is equal to or higher than the indoor setting temperature, the radiation breeze heating operation starts and the indoor motor-operated valve 23, the indoor fan 21, and the compressor 30 are controlled in the same manner as the state before the thermostatic turn off.

[0064] When the indoor temperature becomes lower than the indoor setting temperature by at least a predetermined temperature Ta during the radiation breeze heating operation, the radiation breeze heating operation is switched to the radiation heating operation, and the indoor motor-operated valve 23, the indoor fan 21, and the compressor 30 are controlled in the same manner as the above-described state in the radiation heating operation.

(Operation in Radiation 2 Operation Mode)

[0065] As shown in FIG. 5, the radiation breeze heating operation starts when an instruction to start the operation in the radiation 2 operation mode is made through the remote controller 4. The indoor fan controller 53 controls the number of revolution of the indoor fan 21 to be equal to the number of revolution c1 corresponding to the fan tap C1. Furthermore, the compressor controller 54 controls the compressor 30 so that the heat exchanger temperature detected by the indoor heat exchanger temperature sensor 27 is substantially equal to the maximum temperature (i.e., conducts upper limit control). Furthermore, the indoor motor-operated valve controller 52 controls the indoor motor-operated valve 23 so that the opening degree thereof is maintained at the initial opening degree until a predetermined time t1 elapses from the start of the operation, and the opening degree is controlled to keep the radiation panel temperature to fall within the panel target temperature range after the predetermined time t1 elapses from the start of the operation.

(Defrosting Operation)

[0066] In addition to the above, to remove the frost adhering to the outdoor heat exchanger 32 during the operation in the heating operation mode, the air conditioner 1 switches the four-way valve 31 to the state indicated by the broken lines in FIG. 1 and FIG. 2 in order to switch the heating operation to a defrosting operation. In the air conditioner 1 of the present embodiment, the indoor motor-operated valve 23 is closed when the defrosting operation is executed. As the low-temperature refrigerant does not flow into the radiation panel 22, the temperature decrease in the radiation panel 22 is restrained. For this reason, when the heating operation starts again, the temperature of the radiation panel 22 is swiftly changed to fall within the panel target temperature range.

[0067] The indoor motor-operated valve 23 is not necessarily controlled as above in the defrosting operation. The opening degree of the indoor motor-operated valve 23 may be maintained at a predetermined opening degree until the radiation panel temperature becomes equal to a predetermined temperature, and the indoor motor-operated valve 23 may be switched to the closed state when the radiation panel temperature is decreased to the predetermined temperature. In such a case, even if the temperature of the radiation panel 22 is decreased to some degree as the low-temperature refrigerant flows into the radiation panel 22, the frost on the outdoor heat exchanger 32 is removed rapidly as compared to the case above because the high-temperature refrigerant in the radiation panel 22 is used for the defrosting of the outdoor heat exchanger 32. Furthermore, it is possible to prevent frost from attaching to the radiation panel 22 during the defrosting operation.

<Features of Air Conditioner 1>

[0068] The above-described air conditioner 1 of the present embodiment is able to conduct warm-air heating while hardly giving the user the feeling of a draft, because the air quantity generated by the indoor fan 21 is reduced in the

radiation breeze heating operation. Furthermore, since the amount of heat exchange by the indoor heat exchanger 20 is large as the indoor fan 21 is not stopped, it is possible to prevent the pressure in the refrigerant circuit from becoming excessively high. The number of revolution of the compressor 30 of the outdoor unit 3 is therefore increased and hence the heating capability is improved, as compared to the case where the indoor fan 21 is stopped and only the radiation heating is conducted.

[0069] In the air conditioner 1 of the present embodiment, the switching between the radiation heating operation and the radiation breeze heating operation is conducted in accordance with the indoor temperature, in such a way that the radiation heating operation is conducted when the indoor temperature is low whereas the radiation breeze heating operation is conducted when the indoor temperature is high. This makes it possible to swiftly increase the indoor temperature when the indoor temperature is low, and to automatically switch the operation to heating that hardly gives the user the feeling of a draft when the indoor temperature becomes high.

[0070] In addition to the above, in the present embodiment, at the start of the operation in the radiation 1 operation mode, the radiation heating operation is conducted if the indoor temperature is lower than the indoor setting temperature, and when the indoor temperature becomes equal to or higher than the indoor setting temperature, the operation is switched to the radiation breeze heating operation. This makes it possible to swiftly increase the indoor temperature to the indoor setting temperature.

[0071] In addition to the above, in the present embodiment, when the indoor temperature is lower than the indoor setting temperature by at least a predetermined temperature Ta during the radiation breeze heating operation in the radiation 1 operation mode, the radiation breeze heating operation is switched to the radiation heating operation. With this, the radiation breeze heating operation is continued with less switching of the operation when the indoor temperature is lower than the indoor setting temperature, as compared to the case of the switching from the radiation breeze heating operation to the radiation heating operation.

[0072] In the air conditioner 1 of the present embodiment, the compressor 30 is controlled so that the pressure in the refrigerant circuit is substantially equal to the maximum pressure in the radiation heating operation or the radiation breeze heating operation. The heating capability is therefore improved. Furthermore, in the present embodiment the compressor 30 is controlled so that the heat exchange temperature detected by the temperature sensor 27 is substantially equal to the maximum temperature. Therefore the pressure in the refrigerant circuit is controlled to be substantially equal to the maximum pressure.

[0073] The air conditioner 1 of the present embodiment is arranged so that the radiation panel 22 and the indoor motor-operated valve 23 are in parallel to the indoor heat exchanger 20. It is therefore possible to conduct switching between (i) the warm-air heating operation in which only the warm-air heating is conducted without supplying the refrigerant to the radiation panel 22 and (ii) the radiation heating operation or the radiation breeze heating operation in which the refrigerant is supplied to the radiation panel 22, only by opening or closing the indoor motor-operated valve 23.

[0074] In addition to the above, in the air conditioner 1 of the present embodiment, the number of fan taps (B1 to B7) in the radiation heating operation is larger than the number of fan taps (A1 to A5) in the warm-air heating operation. In other words, in the radiation heating operation, the number of revolution of the indoor fan 21 is changed with a larger number of stages than in the warm-air heating operation. As the number of revolution of the indoor fan 21 is changed with a larger number of stages in the radiation heating operation, the sound accompanied with the rotation of the indoor fan 21 when the radiation heating operation is switched to the radiation breeze heating operation is restrained.

[0075] While the embodiment of the present invention has been described based on the figures, the scope of the invention is not limited to the above-described embodiment. The scope of the present invention is defined by the appended claims rather than the foregoing description of the embodiment, and various changes and modifications can be made herein without departing from the scope of the invention.

[0076] While in the embodiment above the radiation breeze heating operation is switched to the radiation heating operation when the indoor temperature becomes lower than the indoor setting temperature by at least the predetermined temperature Tb during the radiation breeze heating operation in the radiation 1 operation mode, the switching from the radiation breeze heating operation to the radiation heating operation may be conducted when the indoor temperature becomes lower than the indoor setting temperature.

[0077] While in the embodiment above the number of revolution of the indoor fan 21 in the radiation breeze heating operation is maintained to be equal to the number of revolution c1 which is set in advance, the number of revolution of the indoor fan 21 may be varied on condition that the number of revolution remains to be smaller than the number during the radiation heating operation.

[0078] While in the embodiment above the heating operation is selected from the warm-air heating operation, the radiation heating operation, and the radiation breeze heating operation and the indoor air quantity in the radiation breeze heating operation is smaller than the indoor air quantity in the warm-air heating operation and than the indoor air quantity in the radiation heating operation, the disclosure is not limited to this arrangement.

The minimum requirement is that the heating operation is selected from the radiation heating operation and the radiation breeze heating operation and the indoor air quantity in the radiation breeze heating operation is smaller than the indoor

air quantity in the radiation heating operation. While in the embodiment above not only the radiation 1 operation mode and the radiation 2 heating operation mode but also other operation modes are selectable as the operation mode, the other operation modes may not be selectable. Therefore the cooling operation mode and the warm-air heating operation mode may not be selectable as the operation mode, for example.

[0079] In addition to the above, the minimum requirement is that the heating operation is selectable from the warm-air heating operation and the radiation breeze heating operation and the indoor air quantity in the radiation breeze heating operation is smaller than the indoor air quantity in the warm-air heating operation. While in the embodiment above not only the warm-air heating operation mode and the radiation 2 operation mode but also other operation modes are selectable as the operation mode, the other operation modes may not be selectable. Therefore the cooling operation mode and the radiation 1 operation mode may not be selectable as the operation mode, for example.

[Industrial Applicability]

[0080] The present invention makes it possible to improve the heating capability while hardly giving the user the feeling of a draft.

[Reference Signs List]

[0081]

1 AIR CONDITIONER
2 INDOOR UNIT
3 OUTDOOR UNIT
4 REMOTE CONTROLLER
20 INDOOR HEAT EXCHANGER (HEAT EXCHANGER)
21 INDOOR FAN (FAN)
22 RADIATION PANEL
23 INDOOR MOTOR-OPERATED VALVE (VALVE STRUCTURE)
24 INDOOR TEMPERATURE SENSOR
27 TEMPERATURE SENSOR (HEAT EXCHANGER TEMPERATURE SENSOR)
30 COMPRESSOR
50 STORAGE (STORAGE UNIT)
51 OPERATION MODE CONTROLLER (SWITCHING UNIT)
52 INDOOR MOTOR-OPERATED VALVE CONTROLLER
53 INDOOR FAN CONTROLLER
54 COMPRESSOR CONTROLLER (CONTROL UNIT)

Claims

1. An air conditioner comprising an indoor unit and an outdoor unit connected to the indoor unit via a refrigerant circuit, the indoor unit including a heat exchanger and a radiation panel each having a conduit constituting a part of the refrigerant circuit and a fan provided in the vicinity of the heat exchanger, the air conditioner being capable of executing: a radiation heating operation in which warm-air heating is conducted by supplying refrigerant to the heat exchanger and radiation heating is conducted by supplying the refrigerant to the radiation panel; and
a radiation breeze heating operation in which warm-air heating is conducted by supplying the refrigerant to the heat exchanger,
radiation heating is conducted by supplying the refrigerant to the radiation panel, and radiation breeze heating in which an air quantity generated by the fan is smaller than an air quantity in the radiation heating operation is conducted.

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

an indoor temperature sensor configured to detect a temperature in a room in which the indoor unit is provided; and
a switching unit configured to conduct switching between the radiation heating operation and the radiation breeze heating operation based on the indoor temperature detected by the indoor temperature sensor.

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

a compressor provided in the outdoor unit;
a control unit configured to control the compressor; and
a storage unit configured to store an upper limit regarding a pressure in the heat exchanger,
when at least one of the radiation heating operation and the radiation breeze heating operation is being conducted,
the control unit controlling the compressor so that the pressure in the heat exchanger is substantially identical with a pressure corresponding to the upper limit.

4. The air conditioner according to claim 3, further comprising:

a heat exchanger temperature sensor provided in the heat exchanger,
the storage unit storing the maximum temperature of the heat exchanger temperature in the heat exchanger as the upper limit regarding the pressure in the heat exchanger, and
when at least one of the radiation heating operation and the radiation breeze heating operation is being conducted,
the control unit controls the compressor so that the heat exchanger temperature detected by the heat exchanger temperature sensor is substantially equal to the maximum temperature.

5. An air conditioner comprising an indoor unit and an outdoor unit connected to the indoor unit via a refrigerant circuit, the indoor unit including a heat exchanger and a radiation panel each having a conduit constituting a part of the refrigerant circuit and a fan provided in the vicinity of the heat exchanger,
the air conditioner being capable of executing: a warm-air heating operation in which warm-air heating is conducted by supplying refrigerant not to the radiation panel but to the heat exchanger; and
a radiation breeze heating operation in which warm-air heating is conducted by supplying the refrigerant to the heat exchanger, radiation heating is conducted by supplying the refrigerant to the radiation panel, and radiation breeze heating in which an air quantity generated by the fan is smaller than an air quantity in the warm-air heating operation is conducted.

6. The air conditioner according to claim 5, further comprising: a compressor provided in the outdoor unit;
a control unit configured to control the compressor; and
a storage unit configured to store an upper limit regarding a pressure in the heat exchanger,
when the radiation breeze heating operation is being conducted, the control unit controlling the compressor so that the pressure in the heat exchanger is substantially equal to a pressure corresponding to the upper limit.

7. The air conditioner according to claim 6, further comprising:

a heat exchanger temperature sensor provided in the heat exchanger,
the storage unit storing the maximum temperature of the heat exchanger temperature in the heat exchanger as the upper limit regarding the pressure in the heat exchanger, and
when the radiation breeze heating operation is being conducted, the control unit controlling the compressor so that the heat exchanger temperature detected by the heat exchanger temperature sensor is substantially equal to the maximum temperature.

8. The air conditioner according to any one of claims 1 to 7, further comprising:

a valve structure configured to adjust an amount of the refrigerant supplied to the radiation panel, and
in the refrigerant circuit, the radiation panel and the valve structure being provided to be in parallel to the heat exchanger.

FIG.1

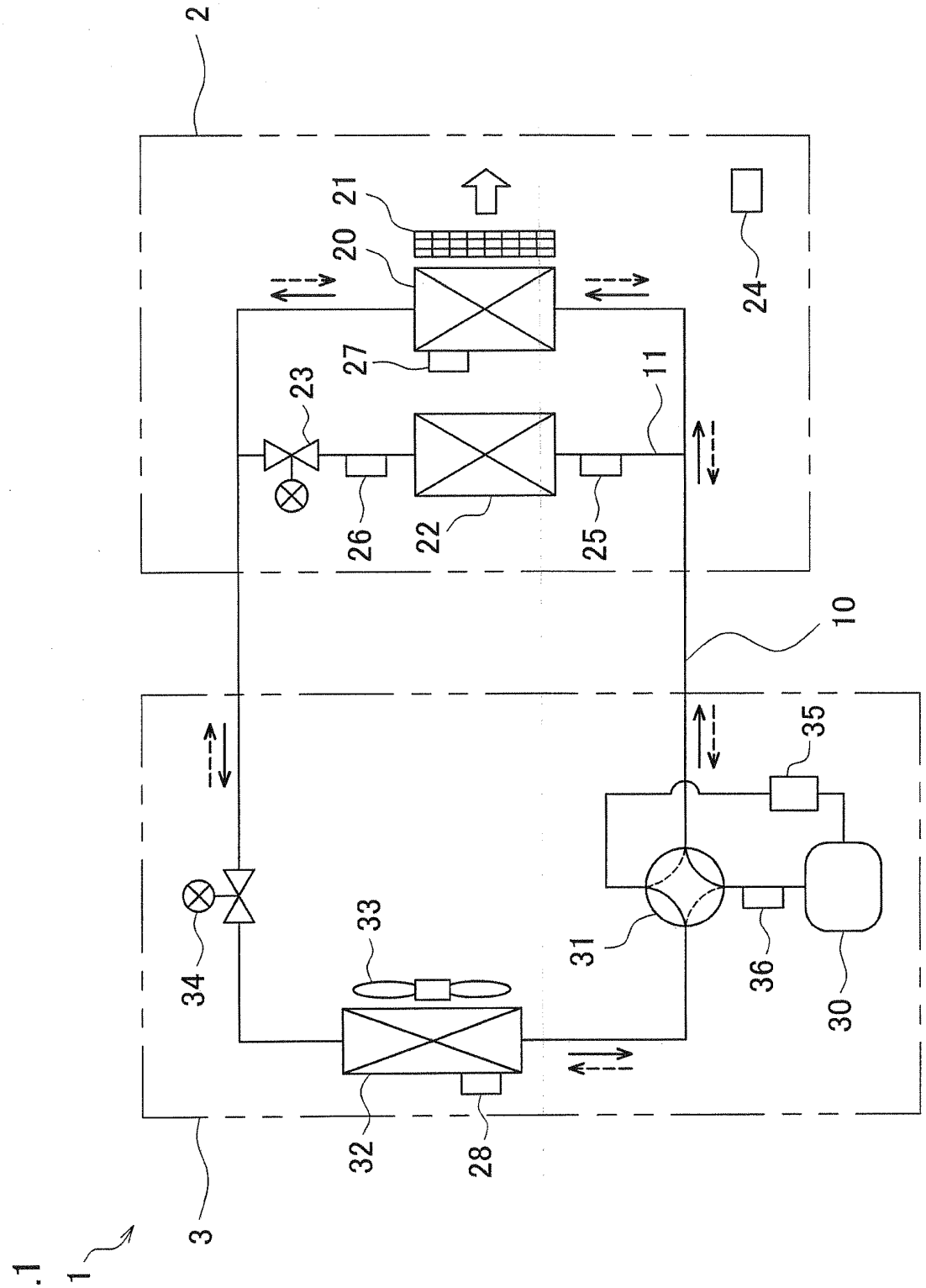


FIG.2

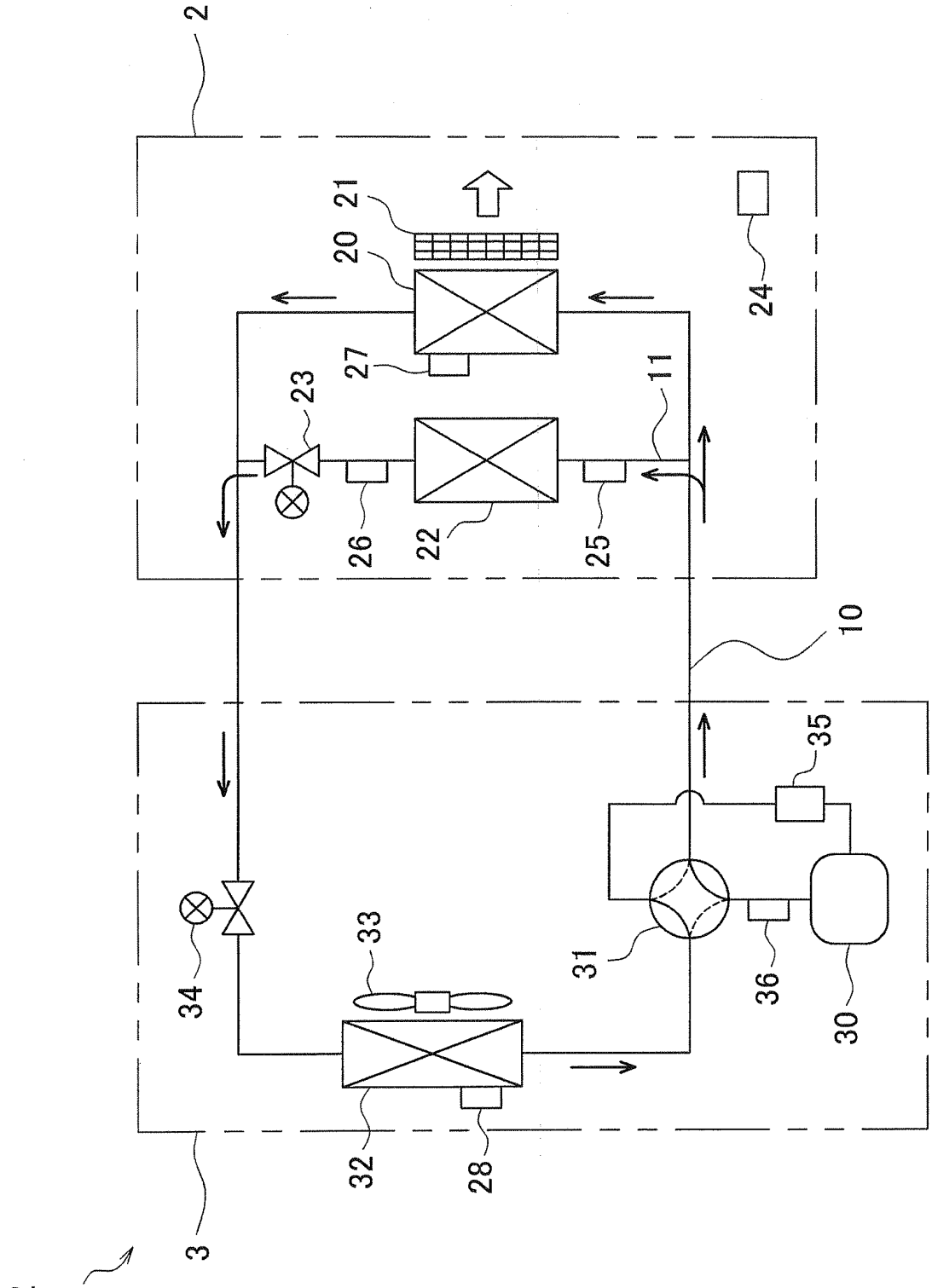


FIG.3

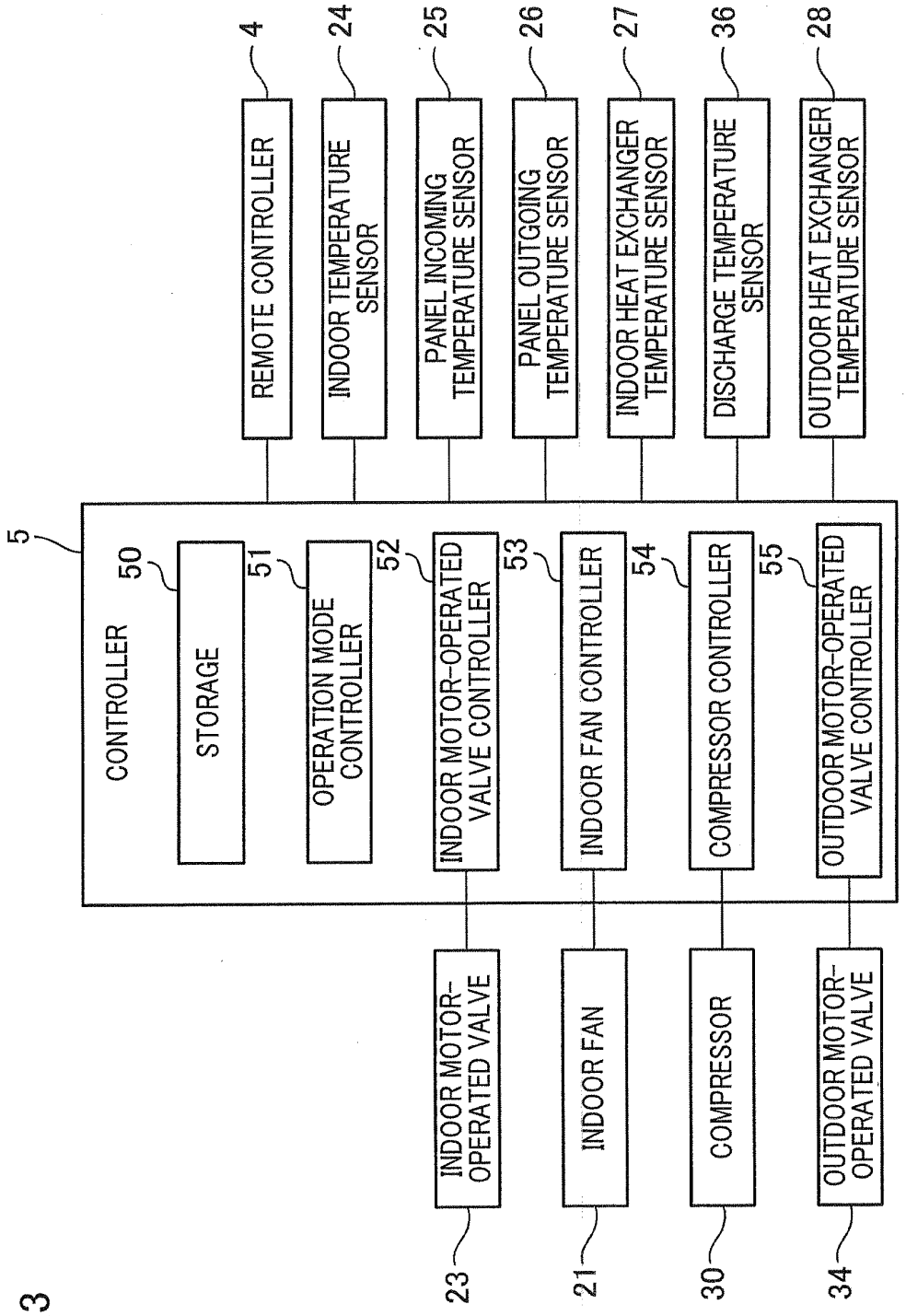

5
CONTROLLER
50
STORAGE
51
OPERATION MODE CONTROLLER
52
INDOOR MOTOR-OPERATED VALVE CONTROLLER
53
INDOOR FAN CONTROLLER
54
COMPRESSOR CONTROLLER
55
OUTDOOR MOTOR-OPERATED VALVE CONTROLLER
4
REMOTE CONTROLLER
24
INDOOR TEMPERATURE SENSOR
25
PANEL INCOMING TEMPERATURE SENSOR
26
PANEL OUTGOING TEMPERATURE SENSOR
27
INDOOR HEAT EXCHANGER TEMPERATURE SENSOR
36
DISCHARGE TEMPERATURE SENSOR
28
OUTDOOR HEAT EXCHANGER TEMPERATURE SENSOR
23
INDOOR MOTOR-OPERATED VALVE
21
INDOOR FAN
30
COMPRESSOR
34
OUTDOOR MOTOR-OPERATED VALVE

FIG.4

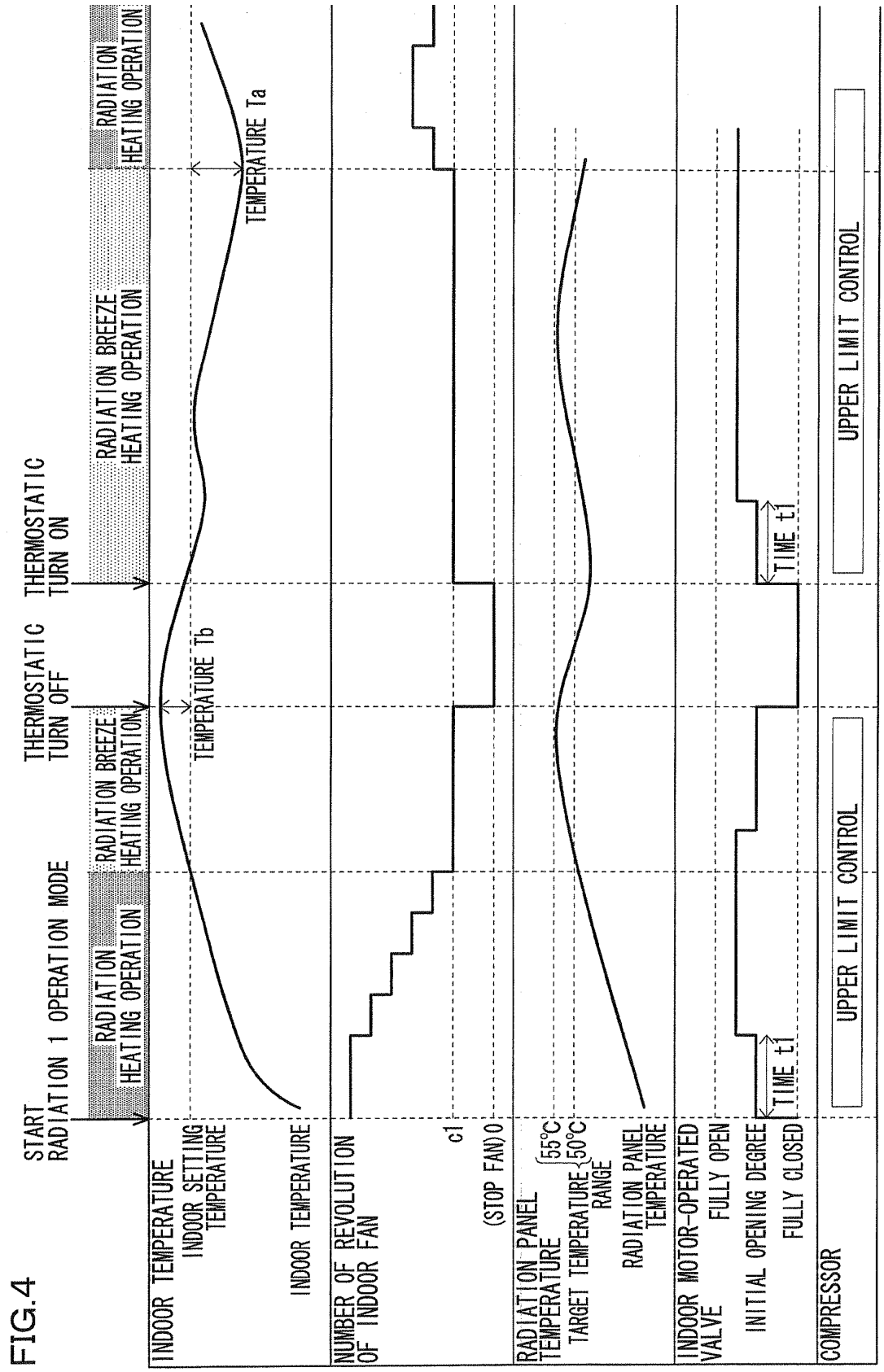
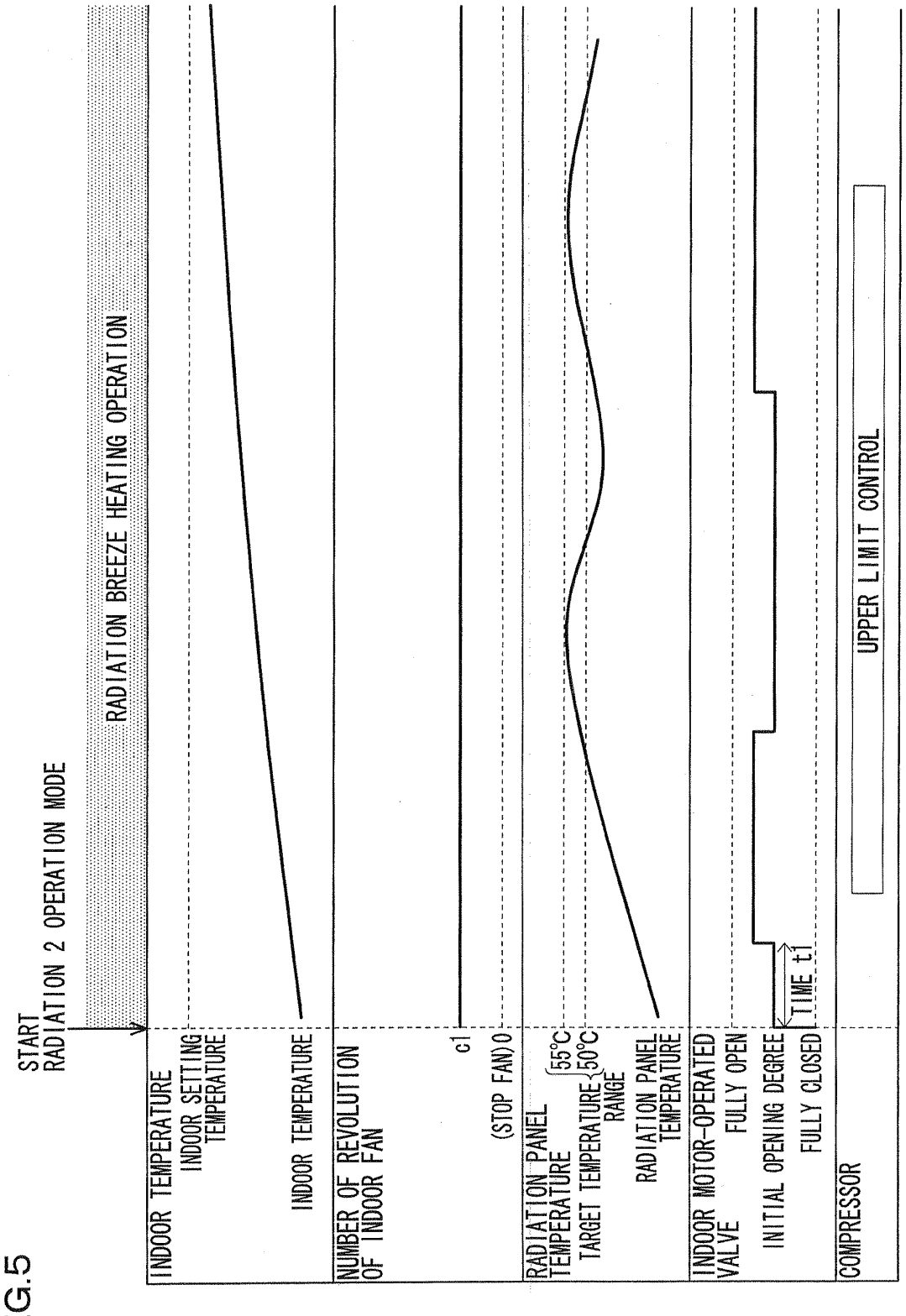

START
RADIATION 1 OPERATION MODE
RADIATION HEATING OPERATION
RADIATION BREEZE HEATING OPERATION
THERMOSTATIC TURN OFF
THERMOSTATIC TURN ON
RADIATION BREEZE HEATING OPERATION
RADIATION HEATING OPERATION
INDOOR TEMPERATURE
INDOOR SETTING TEMPERATURE
INDOOR TEMPERATURE
TEMPERATURE Tb
TEMPERATURE Ta
NUMBER OF REVOLUTION OF INDOOR FAN
c1
(STOP FAN) 0
RADIATION PANEL TEMPERATURE
55°C
50°C
TARGET TEMPERATURE RANGE
RADIATION PANEL TEMPERATURE
INDOOR MOTOR-OPERATED VALVE
FULLY OPEN
INITIAL OPENING DEGREE
FULLY CLOSED
TIME t1
TIME t1
COMPRESSOR
UPPER LIMIT CONTROL
UPPER LIMIT CONTROL

FIG.5


START
RADIATION 2 OPERATION MODE
RADIATION BREEZE HEATING OPERATION
INDOOR TEMPERATURE
INDOOR SETTING TEMPERATURE
INDOOR TEMPERATURE
NUMBER OF REVOLUTION OF INDOOR FAN
c1
(STOP FAN) 0
RADIATION PANEL TEMPERATURE
55°C
TARGET TEMPERATURE RANGE
50°C
RADIATION PANEL TEMPERATURE
INDOOR MOTOR-OPERATED VALVE
FULLY OPEN
INITIAL OPENING DEGREE
TIME t1
FULLY CLOSED
COMPRESSOR
UPPER LIMIT CONTROL

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/073242

A. CLASSIFICATION OF SUBJECT MATTER
F24F11/02(2006.01)i, *F24F1/00*(2011.01)i, *F24F11/053*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F11/02, F24F1/00, F24F11/053

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011
Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 179693/1987(Laid-open No. 88252/1989) (Toshiba Corp.), 12 June 1989 (12.06.1989), entire text; all drawings (Family: none)	1,2 3,4
Y	JP 6-11174 A (Daikin Industries, Ltd.), 21 January 1994 (21.01.1994), paragraphs [0015] to [0039] (Family: none)	3,4,6,7

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 November, 2011 (10.11.11)	22 November, 2011 (22.11.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/073242

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 7-294029 A (Toshiba Corp.), 10 November 1995 (10.11.1995), paragraphs [0018] to [0036] (Family: none)	3,4,6,7
X Y	JP 2-259348 A (Toshiba Corp.), 22 October 1990 (22.10.1990), entire text; all drawings (Family: none)	5 6,7
X	JP 7-55234 A (Toshiba Corp.), 03 March 1995 (03.03.1995), entire text; all drawings (Family: none)	1,2,8

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/073242

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Document 1 (Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 179693/1987(Laid-open No. 88252/1989), (Toshiba Corp.), 12 June 1989 (12.06.1989), entire text, all drawings) discloses the invention of a radiant panel air conditioner provided with an indoor unit 2, an outdoor unit 1, an indoor heat exchanger 9, a radiant panel 11, a cross flow fan 10, a room temperature sensor 29, a compressor 4, and an outdoor controller 18, and discloses switching between warm air and panel heating operation 38, and soft warm air heating and panel heating operation 42 on the basis of the indoor temperature. Therefore, the invention in claim 1 (Continued to the extra sheet.)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2011/073242

Continuation of Box No.III of continuation of first sheet(2)

does not have a special technical feature since it is not considered to be novel over the invention disclosed in document 1. Thus, the following two invention groups are contained in the claims.

Note that the invention in claim 1 which does not have a special technical feature is classified as invention 1.

(Invention 1) Claims 1-4, 8: An air conditioner provided with an indoor unit, and an outdoor unit connected to the indoor unit via a refrigerant circuit, the indoor unit comprising a heat exchanger and a radiant panel respectively having some of pipes constituting the refrigerant circuit, and a fan disposed near the heat exchanger, the air conditioner capable of radiant breeze heating operation in which warm air heating is performed by passing a refrigerant through the heat exchanger, radiant heating is performed by passing the refrigerant through the radiant panel, and radiant breeze heating having a smaller quantity of air generated by the fan than in radiant heating operation is performed, and capable of the radiant heating operation in which the warm air heating is performed by passing the refrigerant through the heat exchanger and the radiant heating is performed by passing the refrigerant through the radiant panel.

(Invention 2) Claims 5-7: An air conditioner provided with an indoor unit, and an outdoor unit connected to the indoor unit via a refrigerant circuit, the indoor unit comprising a heat exchanger and a radiant panel respectively having some of pipes constituting the refrigerant circuit, and a fan disposed near the heat exchanger, the air conditioner capable of radiant breeze heating operation in which warm air heating is performed by passing a refrigerant through the heat exchanger, radiant heating is performed by passing the refrigerant through the radiant panel, and radiant breeze heating having a smaller quantity of air generated by the fan than in radiant heating operation is performed, and capable of warm air heating operation in which the warm air heating is performed by passing the refrigerant through the heat exchanger without passing the refrigerant through the radiant panel.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 63113239 A **[0003]**