(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 633 273 A1

(12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 153(4) EPC

(43) Date of publication:
08.04.2020 Bulletin 2020/15

(21) Application number: **17895499.6**

(22) Date of filing: **15.12.2017**

(51) Int Cl.:
F24F 1/00 *(2019.01)* ***F24F 11/62*** *(2018.01)*
F24F 11/84 *(2018.01)* ***F24F 11/86*** *(2018.01)*
F24F 120/00 *(2018.01)* ***F25B 29/00*** *(2006.01)*

(86) International application number:
PCT/JP2017/045205

(87) International publication number:
WO 2018/216252 (29.11.2018 Gazette 2018/48)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD TN

(30) Priority: **26.05.2017 JP 2017104103**

(71) Applicant: **Hitachi-Johnson Controls Air Conditioning, Inc.**
Tokyo 105-0022 (JP)

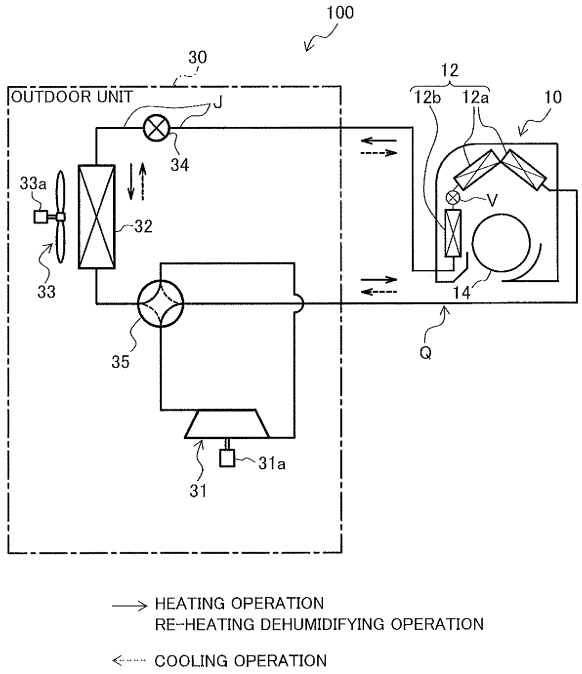
(72) Inventors:
- **TANAKA Yukinori**
  Tokyo 105-0022 (JP)
- **UEDA Yoshiro**
  Tokyo 105-0022 (JP)
- **YOSHIDA Kazumasa**
  Tokyo 105-0022 (JP)
- **AWANO Masakazu**
  Tokyo 105-0022 (JP)

(74) Representative: **MERH-IP Matias Erny Reichl Hoffmann**
Patentanwälte PartG mbB
Paul-Heyse-Strasse 29
80336 München (DE)

(54) AIR CONDITIONER

(57) An air conditioner capable of suitably washing an indoor heat exchanger is provided. An air conditioner (100) includes a refrigerant circuit (Q) in which refrigerant circulates in a refrigerating cycle through a compressor (31), a condenser, an outdoor expansion valve (34), and an evaporator sequentially, and a controller for controlling at least the compressor (31) and the outdoor expansion valve (34) . One of the condenser and the evaporator is an outdoor heat exchanger (32), and the other is at least a part of an indoor heat exchanger (12). The controller carries out freezing of the indoor heat exchanger (12), thawing of an upper part of the indoor heat exchanger (12), and thawing of a lower part of the indoor heat exchanger (12) sequentially.

FIG. 3



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Description

TECHNICAL FIELD

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

BACKGROUND ART

[0002] As a technique for maintaining an indoor heat exchanger of an air conditioner clean, for example, an air conditioner comprising a water adding means for adhering water to fin surfaces after a heating operation is disclosed in the patent document 1. The water adding means adheres water to fin surfaces of an indoor heat exchanger by carrying out a cooling operation after a heating operation.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0003] Patent document 1: JP4931566, B2

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] However, the technique disclosed in the patent document 1 has a possibility that dirt is left on a lower part of the indoor heat exchanger when water adhering to the fin surfaces of the indoor heat exchanger drips.

[0005] Therefore, an object of the present invention is to provide an air conditioner capable of suitably washing the indoor heat exchanger.

MEANS FOR SOLVING THE PROBLEM

[0006] To solve the problems, the present invention is characterized in that a controller carries out freezing of an indoor heat exchanger, thawing an upper part of the indoor heat exchanger, and thawing a lower part of the indoor heat exchanger sequentially.

[0007] In addition, the present invention is characterized in that a first indoor heat exchanger being an upper part of an indoor heat exchanger, and a second indoor heat exchanger being a lower part of the indoor heat exchanger are connected to each other through a second expansion valve, and that a controller works the first indoor heat exchanger on an upstream side of the second expansion valve as a condenser, and the second indoor heat exchanger on a downstream side of the second expansion valve as an evaporator to freeze the second indoor heat exchanger.

EFFECT OF THE INVENTION

[0008] The present invention can provide an air conditioner capable of suitably washing the indoor heat exchanger.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a front view of an indoor unit, an outdoor unit, and a remote controller included in an air conditioner according to a first embodiment of the present invention;

FIG. 2 is a cross sectional view of the indoor unit included in the air conditioner according to the first embodiment of the present invention;

FIG. 3 is an explanatory view showing a refrigerant circuit of the air conditioner according to the first embodiment of the present invention;

FIG. 4 is a functional block diagram of the air conditioner according to the first embodiment of the present invention;

FIG. 5 is a flow chart of a washing processing carried out by a controller of the air conditioner according to the first embodiment of the present invention;

FIG. 6 is a timing chart for explaining operations of a compressor and an indoor fun of the air conditioner according to the first embodiment of the present invention in a case where there exists a kitchen in a space being air-conditioned;

FIG. 7 is a flow chart of a process of freezing an indoor heat exchanger of the air conditioner according to the first embodiment of the present invention;

FIG. 8 is an explanatory view showing a refrigerant circuit of an air conditioner according to a second embodiment of the present invention;

FIG. 9 is a flow chart of a washing processing carried out by a controller of the air conditioner according to the second embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

<<First Embodiment>>

<Structure of Air Conditioner>

[0010] FIG. 1 is a front view of an indoor unit 10, an outdoor unit 30, and a remote controller 40 included in an air conditioner 100 according to a first embodiment.

[0011] The air conditioner 100 is a device for air-conditioning a space by circulating a refrigerant according to a refrigerating cycle (heat pump cycle) . The air conditioner 100 includes the indoor unit 10 provided indoors (in an air-conditioned space), the outdoor unit 30 provided outdoors, and the remote controller 40 to be operated by a user.

[0012] As shown in FIG. 1, the indoor unit 10 is provided with a remote control transmission/reception part 11. The remote control transmission/reception part 11 transmits and receives signals to or from the remote controller

40 by means of infrared communication or the like. For example, the remote control transmission/reception part 11 receives signals of an operation or stop instruction, a change of a temperature to be set, a change of an operation mode, setting of a timer, and the like from the remote controller 40. Furthermore, it transmits a detection value of an indoor temperature and the like to the remote controller 40.

[0013] The indoor unit 10 and the outdoor unit 30 are connected to each other through refrigerant ducts and communication wires, which are omitted in FIG. 1.

[0014] FIG. 2 is a cross sectional view of the indoor unit 10.

[0015] The indoor unit 10 is provided with an indoor heat exchanger 12, a drain pan 13, an indoor fan 14, a case body base 15, filters 16, 16, a front panel 17, left-right wind direction boards 18, and an upper-lower wind direction board 19 other than the foresaid remote control transmission/reception part 11 (refer to FIG. 1).

[0016] The indoor heat exchanger 12 is a heat exchanger for exchanging heat between a refrigerant flowing in heat transfer pipes 12g and an indoor air.

[0017] The drain pan 13 is a pan for receiving water dripping from the indoor heat exchanger 12, and is arranged under the indoor heat exchanger 12. Note that, water dripped to the drain pan 13 is discharged to the outside through a drain hose (not shown).

[0018] The indoor fan 14 is, for example, a cylindrical cross flow fan, and is driven by an indoor fan motor 14 (refer to FIG. 4).

[0019] The case body base 15 is a case body for attaching the indoor heat exchanger 12, the indoor fan 14 and the like thereto.

[0020] The filters 16, 16 are ones for removing dust out of an air taken through an air suction port h1 and the like, and are arranged at positions over and in front of the indoor heat exchanger 12.

[0021] The front panel 17 is a panel arranged so as to cover the front side filter 16, and is configured to be capable of rotating around an axis positioned at the lower end thereof toward the front side. Note that, the structure of the front panel 17 which is not to be rotated is also allowed.

[0022] The left-right wind direction boards 18 are plate-like members for adjusting a direction of wind to blow into a room in a left-right direction. The left-right wind direction boards 18 are arranged on the downstream side of the indoor fan 14, and are configured to be rotationally moved in the left-right direction by a left-right wind direction board motor 21 (refer to FIG. 4).

[0023] The upper-lower wind direction board 19 is a plate-like member for adjusting a direction of wind to blow into the room in an upper-lower direction. The upper-lower wind direction board 19 is arranged on the downstream side of the indoor fan 14, and is configured to be rotationally moved in the upper-lower direction by an upper-lower wind direction board motor 22 (refer to FIG. 4).

[0024] Heat exchanging is carried out between the air taken through the air suction port h1 and the refrigerant flowing in the heat transfer pipes 12g, and the air which has finished carrying out the heat exchanging is led to an air flow passage h2. The air flowing along the air flow passage h2 is led to a predetermined direction with the left-right wind direction boards 18 and the upper-lower wind direction board 19, and blows into the room through an air outlet port h3.

[0025] FIG. 3 is an explanatory view showing a refrigerant circuit Q of the air conditioner 100.

[0026] Note that, solid line arrows shown in FIG. 3 show the flow of the refrigerant at the times of a heating operation and a re-heating dehumidifying operation.

[0027] Dashed line arrows shown in FIG. 3 show the flow of the refrigerant at the time of a cooling operation.

[0028] The indoor unit 10 shown in FIG. 3 is provided with an indoor expansion valve (second expansion valve) V other than the foresaid structure. And the indoor heat exchanger 12 has a first indoor heat exchanger 12a and a second indoor heat exchanger 12b. The first and second indoor heat exchangers 12a, 12b are connected to each other through the indoor expansion valve V.

[0029] As shown in FIG. 3, the first indoor heat exchanger 12a is positioned above the second indoor heat exchanger 12b. In other words, the first indoor heat exchanger 12a is an upper part of the indoor heat exchanger 12. Furthermore, the second indoor heat exchanger 12b is a lower part of the indoor heat exchanger 12.

[0030] As shown in FIG. 3, the outdoor unit 30 is provided with a compressor 31, an outdoor heat exchanger 32, an outdoor fan 33, an outdoor expansion valve (first expansion valve) 34, and a four way switching valve 35.

[0031] The compressor 31 is a device which compresses a gas refrigerant having a low temperature and a low pressure by the drive of a compressor motor 31a to discharge it as a gas refrigerant having a high temperature and a high pressure.

[0032] The outdoor heat exchanger 32 is a heat exchanger which carries out heat exchanging between the refrigerant flowing in heat transfer pipes (not shown) thereof and the outdoor air sent through the outdoor fan 33.

[0033] The outdoor fan 33 is a fan which sends the outdoor air to the outdoor heat exchanger 32 by the drive of an outdoor fan motor 33a, and is arranged near the outdoor heat exchanger 32.

[0034] The outdoor expansion valve 34 has a function of decompressing the refrigerant, and is arranged at the refrigerant duct J connecting the outdoor heat exchanger 32 and the second indoor heat exchanger 12b.

[0035] The four way switching valve 35 is a valve switching a flow passage of the refrigerant according to an operation mode of the air conditioner 100. For example, at the time of the cooling operation (refer to the dashed line arrows), the refrigerant circulates in the refrigerant circuit Q through the compressor 31, the outdoor heat exchanger (condenser) 32, the outdoor expansion valve 34, the second indoor heat exchanger (evaporator)

12b, the indoor expansion valve V in the almost full open state, and the first indoor heat exchanger (evaporator) 12a sequentially, that is, the refrigerant circulates in a refrigerating cycle.

[0036] At the time of the heating operation (refer to the solid line arrows), the refrigerant circulates in the refrigerant circuit Q through the compressor 31, the first indoor heat exchanger (condenser) 12a, the indoor expansion valve V in the almost full open state, the second indoor heat exchanger (condenser) 12b, the outdoor expansion valve 34, and the outdoor heat exchanger (evaporator) 32 sequentially, that is, the refrigerant circulates in a refrigerating cycle.

[0037] Furthermore, at the time of the re-heating dehumidifying operation (refer to the solid line arrows), the refrigerant circulates in the refrigerant circuit Q through the compressor 31, the first indoor heat exchanger (condenser) 12a, the indoor expansion valve V, the second indoor heat exchanger (evaporator) 12b, the outdoor expansion valve 34 in the almost full open state, and the outdoor heat exchanger (evaporator) 32, sequentially, that is, the refrigerant circulates in a refrigerating cycle. Note that, at the time of the re-heating dehumidifying operation, the indoor expansion valve V is suitably throttled.

[0038] FIG. 4 is a functional block diagram of the air conditioner 100.

[0039] The indoor unit 10 shown in FIG. 4 is provided with an imaging part 23, an environmental detecting part 24, and an indoor control circuit 25 other than the foresaid structure.

[0040] The imaging part 23 is a part for imaging the room, and has an imaging element such as a CCD (Charge Coupled Device) sensor or a CMOS (Complementary Metal Oxide Semiconductor) sensor. A person in the room is detected by the indoor control circuit 25 based on the imaging result imaged by the imaging part 23. Note that, a "person detecting part" which detects a person in the room (air-conditioned space) is constructed by including the imaging part 23 and the indoor control circuit 25.

[0041] The environmental detecting part 24 has a function of detecting a room state and/or a state of each device in the indoor unit 10. As shown in FIG.ure 4, the environmental detecting part 24 is provided with an indoor temperature sensor 24a, a humidity sensor 24b, and an indoor heat exchanger temperature sensor 24c.

[0042] The indoor temperature sensor 24a is a sensor for detecting a room temperature (indoor temperature), and is arranged at a predetermined position (for example, on an air suction side of the filters 16, 16 shown in FIG. 2) of the indoor unit 10.

[0043] The humidity sensor 24b is a sensor for detecting an air humidity in the room, and is arranged at a predetermined position of the indoor unit 10.

[0044] The indoor heat exchanger temperature sensor 24c. is a sensor for detecting a temperature of the indoor heat exchanger 12 (refer to FIG. 2), and is arranged at the indoor heat exchanger 12.

[0045] Detection values of the indoor temperature sensor 24a, the humidity sensor 24b, and the indoor heat exchanger temperature sensor 24c are outputted to the indoor control circuit 25.

[0046] The indoor control circuit 25 is constructed by including electronic circuits such as a CPU (Central Processing Unit), a ROM (Read Only Memory), a RAM (Random Access Memory), and a various interfaces. A program stored in the ROM is read out of the ROM, is inputted to the RAM, and various processes are carried out by the CPU.

[0047] As shown in FIG. 4, the indoor control circuit 25 includes a memory part 25a and an indoor control part 25b.

[0048] The memory part 25a stores a predetermined program, an imaging result imaged by the imaging part 23, a detection result detected by the environmental detecting part 24, a received datum received from the remote control transmission/reception part 11, and the like.

[0049] The indoor control part 25b carries out a predetermined process based on data stored in the memory part 25a. Note that, the process to be carried out by the indoor control part 25b will be described later.

[0050] The outdoor unit 30 is provided with an outdoor temperature sensor 36 and an outdoor control circuit 37 other than the foresaid structure.

[0051] The outdoor temperature sensor 36 is a sensor for detecting an outdoor temperature (outdoor air temperature), and is arranged at a predetermined position of the outdoor unit 30. The outdoor unit 30 is provided also with various sensors for detecting a suction temperature, a discharge temperature, a discharge pressure, and the like of the compressor 31 (refer to FIG. 3), which sensors are not shown in FIG. 4. Detection values of the outdoor temperature sensor 36 and the other sensors are outputted to the outdoor control circuit 37.

[0052] The outdoor control circuit 37 is constructed by including electronic circuits such as a CPU, a ROM, a RAM, and various interfaces which are not shown, and is connected to the indoor control circuit 25 through communication wires. As shown in FIG. 4, the outdoor control circuit 37 includes a memory part 37a and an outdoor control part 37b.

[0053] The memory part 37a stores a predetermined program and detection values of the outdoor temperature sensor 36 and the other sensors.

[0054] The outdoor control part 37b controls the compressor motor 31a, an outdoor fan motor 33a, the outdoor expansion valve 34, and the like based on data stored in the memory part 37a. "A control part K" is used in the following as a control part including the indoor control circuit 25 and the outdoor control circuit 37.

[0055] Next, a series of processes for washing the indoor heat exchanger 12 (refer to FIG. 2) will be described.

[0056] As described above, filters 16, 16 (refer to FIG. 2) are arranged at positions (air suction side) over and in front of the indoor heat exchanger 12. The filters 16, 16 catch dust. However, there is a possibility that fine

dust and oil generated during cooking adhere to the indoor heat exchanger 12 through the filters 16. Therefore, it is desired to wash the indoor heat exchanger 12 periodically. So, in this embodiment, water contained in the air in the indoor unit 10 is frozen on the indoor heat exchanger 12, then, ice and/or frost on the indoor heat exchanger 12 are melted, thereby, the indoor heat exchanger 12 is washed. Such a series of processes is called "a washing processing" of the indoor heat exchanger 12.

[0057] FIG. 5 is a flow chart of the washing process carried out by the controller K of the air conditioner 100 (suitably refer to FIGS. 3, 4).

[0058] Note that, it is supposed that a predetermined air-conditioning operation (cooling operation, heating operation, or the like) has been carried out up to "START" in FIG. 5. Furthermore, it is supposed that a start condition of the washing process for the indoor heat exchanger 12 is satisfied at the time of "START". "The start condition of the washing process" is, for example, that an accumulated value of operation periods of an air conditioning operation from an end time of the previous washing process has reached a predetermined value.

[0059] At step S101, the controller K stops the air-conditioning operation during a predetermined period (for example, for several minutes). The foresaid predetermined period is a period for stabilizing a refrigerating cycle, and is predetermined. For example, when the indoor heat exchanger 12 is frozen after stopping a heating process which is being carried out up to the time of "START" (step S103), the controller K controls the four way switching valve 35 so that the refrigerant flows inversely against that of the heating process.

[0060] Note that, the process of step S101 may be omitted in a case where the cooling operation is suspended and the indoor heat exchanger 12 is frozen. This is because the flow direction of the refrigerant during the cooling operation (just before the time of START) is the same as the flow direction of the refrigerant during freezing of the indoor heat exchanger 12 (step S103).

[0061] Next, at step S102, the controller K judges whether or not there exists a kitchen in the space being air-conditioned. That is, the controller K judges whether or not there exists a kitchen in the space being air-conditioned based on position changes of a person detected by the foresaid "person detecting part" (the imaging part 23 and the indoor control circuit 25b: refer to FIG. 4).

[0062] A specific description will be done about step S102. The controller K detects a person existing in the space being air-conditioned based on imaging results imaged by the imaging part 23. If the height of the head of the person imaged by the foresaid "person detecting part" is within a predetermined range, and the person has reciprocating moves within a predetermined length in the left-right direction or in the depth direction in a view of the person from the indoor unit 10, the controller K judges that the person is cooking in a kitchen, that is, a kitchen exists in the space being air-conditioned. This is because a person often has reciprocating moves in the left-right direction or in the depth direction in a standing posture when the person is cooking in a kitchen.

[0063] If there exists a kitchen in a space being air-conditioned at step S102 (step S102: Yes), the processing of the controller K advances to step S103. In this case, there is a high possibility that oil generated during cooking in the kitchen adheres to the indoor heat exchanger 12.

[0064] At step S103, the controller K freezes the indoor heat exchanger 12. That is, the controller K freezes the first indoor heat exchanger 12a and the second indoor heat exchanger 12b shown in FIG. 3. A specific description will be done about step S103. The controller K makes the first indoor heat exchanger 12a and the second indoor heat exchanger 12b serve as evaporators like a cooling operation period. In this case, the indoor expansion valve V is in an almost fully opened state and an opened degree of the outdoor expansion valve 34 is suitably adjusted. Thereby, water contained in the air in the indoor unit 10 adheres to the first indoor heat exchanger 12a and the second indoor heat exchanger 12b as frost and frozen. Note that, detail of the process of step S103 will be described later.

[0065] Next, at step S104, the controller K thaws an upper part of the indoor heat exchanger 12 by performing the foresaid re-heating dehumidifying operation. That is, the controller K makes the first indoor heat exchanger 12a serve as a condenser and the second indoor heat exchanger 12b serve as an evaporator. In this case, the outdoor expansion valve 34 is in an almost fully opened state and an opened degree of the indoor expansion valve V is suitably adjusted. Thereby, the first indoor heat exchanger 12a (upper part of the indoor heat exchanger 12) is thawed. Note that, the second indoor heat exchanger 12b (lower part of the indoor heat exchanger 12) is further frozen.

[0066] When frost adhering to the first indoor heat exchanger 12a is defrosted, water containing dirt such as dust and oil flows downward, so that the first indoor heat exchanger 12a is washed. Furthermore, the water which flew down is frozen again on the second indoor heat exchanger 12b which is in a frozen state. That is, an ice layer containing the dirt such as dust and oil is formed on frost on the second indoor heat exchanger 12b which has been already frozen. Thereby, when the second indoor heat exchanger 12b is thawed thereafter (step S105), the ice layer containing the dirt which was on the first indoor heat exchanger 12a is thawed, so that the water containing the dirt flows out without dirtying the second indoor heat exchanger 12b.

[0067] FIG. 6 is a timing chart for explaining operations of the compressor 31 and the indoor fun 14 in a case where there exists a kitchen in a space being air-conditioned (suitably refer to FIG. 3) .

[0068] Note that, the axis of abscissa in FIG. 6 represents the time, and the axis of ordinate in FIG. 6 represents the state of ON / OFF of the compressor 31 and the state of ON/OFF of the indoor fan 14.

[0069] In an example shown in FIG. 6, a predetermined air-conditioning operation has been carried out up to the time t1, the compressor 31 and the indoor fan 14 have been operated, that is, they are in the ON states. After that, the compressor 31 and the indoor fan 14 are not operating between the time t1 and the time t2 (step S101 in FIG. 5). Then, the indoor heat exchanger 12 is frozen between the time t2 and the time t3 (step S103). And then, a re-heating dehumidifying operation is carried out between the time t3 and the time t4 (step S104).

[0070] In spite of the stopping state of the indoor fan 14 between the time t2 and the time t3, a steam pressure in the indoor unit 10 becomes low because of freezing of steam on the indoor heat exchanger 12, thereby, steam continues to be supplied onto the surface of the indoor heat exchanger 12 because of diffusion phenomena of steam (natural convection) or the like and frost grows.

[0071] At the time of freezing of the indoor heat exchanger 12 (step S103 in FIG. 5), the refrigerant flows in the same direction as at the time of a cooling operation, and at the time of a re-heating dehumidifying operation (step S104), the refrigerant flows in the same direction as at the time of a heating operation. That is, at the times of freezing of the indoor heat exchanger 12 and a re-heating dehumidifying operation, the refrigerant flows in the opposite direction to each other. However, in this embodiment, the re-heating dehumidifying operation starts just after the freezing of the indoor heat exchanger 12 ends (without a predetermined downtime) (refer to the time t3 in FIG. 6). In other words, the controller K starts thawing the first indoor heat exchanger 12a just after the end of freezing of the first indoor heat exchanger 12a and the second indoor heat exchanger 12b.

[0072] Thereby, the re-heating dehumidifying operation (time t3 to time t4) can be carried out without defrosting the frost adhering to the second indoor heat exchanger 12b. Assumed that the re-heating dehumidifying operation starts after the frost on the second indoor heat exchanger 12b is defrosted fully, the dirt such as dust and oil has adhered onto the first indoor heat exchanger 12a drips in a state of water containing the dirt, so that the surface of the second indoor heat exchanger 12b is dirtied. Therefore, in this embodiment, downtime of the compressor 31 and the indoor fan 14 is not intendedly provided between the freezing operation (time t2 to time t3) and the re-heating dehumidifying operation (time t3 to time t4) .

[0073] Again, description about FIG. 5 will be re-started.

[0074] At step S105, the controller K thaws the lower part of the indoor heat exchanger 12. That is, the controller K thaws the second indoor heat exchanger 12b. A specific description will be done about step S105. The controller K continues the stopping state of respective devices including the compressor 31, the outdoor fan 33, and the indoor fan 14 during a predetermined period. Thereby, the ice and frost on the second indoor heat exchanger 12b is thawed or defrosted naturally at room temperature. In more detail, the ice layer (containing the dirt such as dust and oil having adhered onto the first indoor heat exchanger 12a) made on the second indoor heat exchanger 12b in the process of the preceding step S104 is thawed at room temperature, and drips in the drain pan 13 (refer to FIG. 2) .

[0075] There exists frost inside the ice layer, which frost has adhered to the second indoor heat exchanger 12b by carrying out the process of step S103 as described above. That is, the water containing the dirt such as dust and oil having adhered to the first indoor heat exchanger 12a falls down along the outside of the frost adhering to fins (not shown) of the second indoor heat exchanger 12b without direct contact to surfaces of the fins. Therefore, the second indoor heat exchanger 12b is prevented from becoming dirty because of dust and oil having adhered to the first indoor heat exchanger 12a.

[0076] After that, the frost adhering to the second indoor heat exchanger 12b which has been inside the ice layer is defrosted and drips in the drain pan 13 (refer to FIG. 2). Thereby, the second indoor heat exchanger 12b is also washed. And the water dripped in the drain pan 13 is discharged to the outside through a drain hose (not shown).

[0077] Thus, if a kitchen exists in the air-conditioned space (step S102: Yes), the controller K carries out freezing of the indoor heat exchanger 12 (step S 103), thawing the upper part of the indoor heat exchanger 12 (step S104), and thawing the lower part of the indoor heat exchanger 12 (step S105), sequentially.

[0078] Next, at step S106, the controller K dries the indoor heat exchanger 12. For example, the controller K carries out a heating operation and a blowing operation, sequentially. High temperature refrigerant flows in the indoor heat exchanger 12 by carrying out the heating operation, so that water on the surface of the indoor heat exchanger 12 is evaporated. Furthermore, since the inside of the indoor unit 10 is dried by the blowing operation after the heating operation, antibacterial and antifungal effect is exhibited. After carrying out step S107, the controller K ends a series of processes for washing (END).

[0079] In the example shown in FIG. 6, after freezing operation and re-heating dehumidifying operation are carried out sequentially during time t2 and time t4 (steps S103 and S104 in FIG. 5), the lower part of the indoor heat exchanger 12 is thawed during time t4 and time t5 (steps S105). And then, the heating operation and the blowing operation are carried out sequentially during time t5 and time t7, so that the indoor heat exchanger 12 can be dried (step S106).

[0080] Again, at step S102 in FIG. 5, if a kitchen does not exist in the air-conditioned space (step S102: No), a process of the controller K goes to step S107. In this case, the possibility of adhering to the indoor heat exchanger 12 is low. Therefore, the controller K carries out a process of step S108 without carrying out the foresaid re-heating dehumidifying operation after freezing the indoor heat exchanger 12 at step S107.

[0081] At step S108, the controller K thaws the indoor heat exchanger 12. That is, the controller K thaws both of the first indoor heat exchanger 12a and the second indoor heat exchanger 12b. A specific description will be done about step S108. The controller K continues the stopping state of respective devices including the compressor 31, the outdoor fan 33, and the indoor fan 14 shown in FIG. 3 during a predetermined period. Thereby frost of the indoor heat exchanger 12 is naturally defrosted at room temperature, so that dust adhering to the indoor heat exchanger 12 is washed away.

[0082] Note that, if a kitchen does not exist in the air-conditioned space (step S102: No), the indoor heat exchanger 12 is not severely gotten dirty. Therefore, almost no dirty remains on the lower part of the indoor heat exchanger 12 when the process of step S108 is finished.

[0083] After finishing the process of step S108, the controller dries the indoor heat exchanger 12 at step S106, thereby a series of washing process ends (END).

[0084] FIG. 7 is a flow chart showing a process of freezing the indoor heat exchanger 12 (step S103 in FIG. 5) (suitably refer to FIG. 3, FIG. 4).

[0085] At step S103a, the controller K controls the four way switching valve 35. That is, the controller K controls the four way switching valve 35 so that the outdoor heat exchanger 32 serves as a condenser, and the indoor heat exchanger 12 serves as an evaporator. Note that, in a case where a cooling operation has been carried out just before "a washing processing" (a series of processes shown in FIG. 5) is carried out, this embodiment assumes that the controller keeps the state of the four way switching valve 35 at step S103a.

[0086] At step S103b, the controller K sets a time for freezing. This "time" is a time in which a predetermined control (step S103c to step S103e) for freezing the indoor heat exchanger 12 is kept. For example, the controller K sets the time for freezing shorter as a detection value of the humidity sensor 24b is higher. Thereby, suitable amount of moisture necessary for washing the indoor heat exchanger 12 can be frosted onto the indoor heat exchanger 12. Note that, the time for freezing the indoor heat exchanger 12 may be a fixed value.

[0087] Next, at step S103c, the controller K sets rotational speed of the compressor 31. For example, the controller K sets rotational speed of the compressor motor 31a larger as a detection value of the outdoor temperature sensor 36 (refer to FIG. 4) is higher. It is because the outdoor heat exchanger 32 is required to release correspondingly more heat in order that the indoor heat exchanger 12 gets more heat from the indoor air. Heat exchange regarding the outdoor heat exchanger 32 is suitably carried out by setting the rotational speed of the compressor 31 in such a manner. Thereby, the indoor heat exchanger 12 is suitably frozen.

[0088] And next, at step S103d, the controller K adjusts the opening of the outdoor expansion valve 34. Note that, at step S103d, it is desired to reduce the opening of the outdoor expansion valve 34 than at a time of a usual cooling operation. Thereby, the refrigerant having a lower temperature and a lower pressure than at a time of a usual cooling operation flows in the indoor heat exchanger 12 through the outdoor expansion valve 34. Therefore, the indoor heat exchanger 12 is easily frozen and power consumption for freezing the indoor heat exchanger 12 is reduced.

[0089] Next, at step S103e, the controller K judges whether or not the temperature of the indoor heat exchanger 12 is within a predetermined range . The "predetermined range" is a range in which moisture existed in the air in the indoor unit 10 can be frozen, and is set beforehand. Note that, the temperature of the indoor heat exchanger 12 is detected by the indoor heat exchanger temperature sensor 24c (refer to FIG. 4).

[0090] If the temperature of the indoor heat exchanger 12 is out of a prescribed range at step S103e (step S103e: No), a process of the controller K returns to step S103d. For example, if the temperature of the indoor heat exchanger 12 is higher than the prescribed range, the controller K further reduces the opening of the outdoor expansion valve 34 (step S103d). In this way, the controller K adjusts the opening of the outdoor expansion valve 34 so that the temperature of the indoor heat exchanger 12 is within the prescribed range while freezing the indoor heat exchanger 12.

[0091] Note that, while freezing the indoor heat exchanger 12, the controller K may set the indoor fan 14 to the stopping state (refer to times t2 to t3). Furthermore, it may drive the indoor fan 14 at a prescribed rotational speed. Even if it is either case, freezing of the indoor fan 14 advances. It is the reason.

[0092] Furthermore, while freezing the indoor heat exchanger 12, the upper-lower wind direction board 19 (refer to FIG. 2) may be in either state of an open state and a closed state, but the closed state gives less discomfort to a user.

[0093] If the temperature of the indoor heat exchanger 12 is within the prescribed range at step S103e in FIG. 7 (S103e: Yes), a process of the controller K goes to step S103f.

[0094] At step S103f, the controller K judges whether or not the time for freezing having set at step S103b has passed. If the prescribed time for freezing has not passed from the time of START (step S103f: No), a process of the controller K returns to step S103c. On the other hand, if the prescribed duration for freezing has passed from the time of START (step S103f: Yes), the controller K ends a series of processes for freezing the indoor heat exchanger 12 (END).

[0095] Note that, detailed description is omitted regarding a process of step S107 shown in FIG. 5 because the process is similar to that of the foresaid step S103 (a series of processes shown in FIG. 7) .

<Advantage Effect>

[0096] According to the first embodiment, if there is a

kitchen in an air-conditioned space (step S102: Yes in FIG. 5), the controller K firstly thaws the upper part of the indoor heat exchanger 12 (step S104) after having frozen the indoor heat exchanger 12 (step S103) . Thereby, water containing the dirt such as dust and oil having adhered to the first indoor heat exchanger 12a falls down, so that the water is frozen on the lower part of the indoor heat exchanger 12 to become an ice layer. After that, the lower part of the indoor heat exchanger 12 is thawed (step S105), so that the foresaid ice layer is thawed. Then, the frost which has been inside the ice layer is thawed. In this manner, by stepwise washing out the upper part and the lower part of the indoor heat exchanger 12, the lower part of the indoor heat exchanger 12 is prevented from remaining of the dirt. In particular, because the lower part of the indoor heat exchanger 12 is prevented from remaining of oil generated during cooking, the indoor heat exchanger 12 is to be suitably washed.

[0097] If there is not a kitchen in an air-conditioned space (step S102 : No in FIG. 5), freezing and thawing of the whole of the indoor heat exchanger 12 are carried out sequentially (step S107, step S108) . Therefore, since the re-heating dehumidifying operation (step S104) is not carried out, the time required for a series of processes for washing can be shortened, accordingly. A series of processes for washing can be carried out in a shorter time by as much time of not carrying out the re-heating dehumidifying operation (step S104).

<<Second Embodiment>>

[0098] A second embodiment differs from the first embodiment on the point that an indoor unit 10A (refer to FIG. 8) is not provided with an indoor expansion valve. Furthermore, the second embodiment differs from the second embodiment on the point that an upper part of an indoor heat exchanger 12A (refer to FIG. 8) is thawed in a state that a rotational speed of the compressor 31 (refer to FIG. 8) is lowered relative to a normal air-conditioning operation. And about the other matters (structures shown in FIG. 1, FIG. 2, FIG. 4, a flow chart shown in FIG. 7, and the like), this embodiment is the same as the first embodiment. So, matters different from the first embodiment will be described, and descriptions about the same parts will be omitted.

[0099] FIG. 8 is an explanatory view showing a refrigerant circuit QA of an air conditioner 100A according to the second embodiment.

[0100] The refrigerant circuit QA shown in FIG. 8 is a refrigerant circuit in which the refrigerant circulates according to a refrigerating cycle through the compressor 31, a"condenser", the outdoor expansion valve (first expansion valve) 34, and an "evaporator", sequentially. Furthermore, one of the foresaid "condenser" and "evaporator" is the outdoor heat exchanger 32, and the other is at least a part of the indoor heat exchanger 12A.

[0101] In a case where the indoor heat exchanger 12A is served as an evaporator (refer to dotted arrows in FIG. 8), an upper part of the indoor heat exchanger 12A is positioned at the downstream side of the lower side of the indoor heat exchanger 12A.

[0102] FIG. 9 is a flow chart of a washing process carried out by the controller K of the air conditioner 100 (suitably refer to FIG. 8) . Note that, a process similar to the first embodiment (refer to FIG. 5) has the same step number.

[0103] After the indoor heat exchanger 12A is frozen at step S103, a process of the controller K goes to step S104a.

[0104] At step S104a, the controller K lowers the rotational speed of the compressor 31 (the rotational speed of the compressor motor 31a in FIG. 4) relative to a normal air-conditioning operation to thaw the upper part of the indoor heat exchanger 12A. The process of step S104a will be described in detail. The controller K controls the four way switching valve 35 so that the refrigerant flows in the same direction as the cooling operation, to drive the compressor 31. Thus, while thawing the upper part of the indoor heat exchanger 12A, (step S104a), the refrigerant circulates in the refrigerant circuit QA through the compressor 31a, the outdoor heat exchanger 32, the outdoor expansion valve 34, the upper part of the indoor heat exchanger 12A, and the lower part of the indoor heat exchanger 12A, sequentially.

[0105] As described above, since the rotational speed of the compressor 31 is lowered relative to a normal air-conditioning operation, the amount of the refrigerant flowing in the indoor heat exchanger 12A is less than a normal air-conditioning operation (for example, a cooling operation). Thereby, the refrigerant is completely vaporized on the way of the flow path of the indoor heat exchanger 12A, so that freezing advances on the upstream side of that point, and thawing advances on the downstream side. In other words, the lower part of the indoor heat exchanger 12A is frozen and the upper part of the indoor heat exchanger 12A is thawed.

[0106] When the frost adhering to the upper part of the indoor heat exchanger 12A is thawed, water containing the dirt such as dust and oil flows downward to wash the upper part of the indoor heat exchanger 12A. Next, the water having flown downward from the upper part of the indoor heat exchanger 12A is again frozen on the lower part of the indoor heat exchanger 12A which is in a frozen state. That is, an ice layer containing the dirt such as dust and oil is formed outside the frost already having attached to the lower part of the indoor heat exchanger 12A. Thereby, after that, when the lower part of the indoor heat exchanger 12A is thawed (step S105), since the ice layer containing the dirt such as dust and oil is thawed to flow downward, the lower part of the indoor heat exchanger 12A is prevented from being dirtied.

[0107] Note that, since processes of steps S105 to S108 are the same as the first embodiment (refer to FIG. 5), description about them is omitted.

<Advantage Effect>

[0108] According to the second embodiment, since the upper part and the lower part of the indoor heat exchanger 12A are stepwise washed, the lower part of the indoor heat exchanger 12A is prevented from remaining of the dirt. And since the rotational speed of the compressor 31 is set to a lower value than a normal air-conditioning operation while the upper part of the indoor heat exchanger 12A is being thawed (step S104a in FIG. 9). Therefore, power consumption of the air conditioner 100A can be reduced relative to the first embodiment.

[0109] Furthermore, the refrigerant flows in the refrigerant circuit QA in the same direction as a cooling operation in both cases of freezing the indoor heat exchanger 12A (step S103 in FIG. 9) and thawing the upper part of the indoor heat exchanger 12A (step S104a). Therefore, just after starting thawing the upper part of the indoor heat exchanger 12A, for example, since neither the temperature of nor the flow direction of the refrigerant suddenly changes at the indoor heat exchanger 12A, generation of sound accompanied by these phenomena is prevented.

<<Modified Examples>>

[0110] In the above, the air conditioners 100, 100A are described in each embodiment. However, this invention is not limited to these, and has a various modifications.

[0111] For example, in the first embodiment, the process, in which thawing of the first indoor heat exchanger 12a starts just after the first indoor heat exchanger 12a and the second indoor heat exchanger 12b are frozen, has been described (refer to the time t3 in FIG. 6) . However, the first embodiment does not limited to that. For example, the controller K may start thawing the first indoor heat exchanger 12a after a predetermined time has passed from the time of finishing freezing the first indoor heat exchanger 12a and the second indoor heat exchanger 12b.

[0112] Note that, the foresaid "predetermined time" is set beforehand as a time that the second indoor heat exchanger 12b is not perfectly thawed within the time. During the "predetermined time", each device such as the compressor 31 is stopped. Thereby, the first indoor heat exchanger 12a can be thawed while the second indoor heat exchanger 12b is in a frozen state. Note that, At the time of freezing, the refrigerant flows in the same direction as a cooling operation, and at the time of thawing the first indoor heat exchanger 12a, it flows in the same direction as a heating operation. So, generation of sound accompanied by changing of a flow direction of the refrigerant inversely because of setting the foresaid "predetermined time" is prevented.

[0113] Furthermore, in each embodiment, the process that the controller K thaws the lower part of the indoor heat exchanger 12 by keeping the stop states of the devices including the compressor 31 during the predetermined time (step S105 in FIG. 5) is described, but each embodiment is not limited to that. For example, the controller K may thaw the lower part of the indoor heat exchanger 12 by working the indoor heat exchanger 12 as a condenser in the same way as a heating operation. Furthermore, the controller K may thaw the lower part of the indoor heat exchanger 12 by carrying out a blowing operation.

[0114] And furthermore, in each embodiment, the process that the controller K dries the indoor heat exchanger 12 by carrying out the heating operation, and the blowing operation, sequentially (times t5 to t7) is described, but each embodiment is not limited to that. That is, the controller K may dry the indoor heat exchanger 12 by carrying out only a heating operation during a predetermined time.

[0115] Furthermore, in each embodiment, the process (step S102 in FIG. 5) that the controller K judges whether or not there exists a kitchen in an air-conditioned space based on imaging results imaged by the imaging part 23 (refer to FIG. 4) is described, but each embodiment is not limited to that. For example, an indoor heat image may be taken by using an indoor temperature sensor 24a (person detecting part: refer to FIG. 4) such as a thermopile, a pyroelectric infrared sensor. In this case, the controller K judges whether or not there exists a kitchen in the air-conditioned space by detecting position changes of a person based on the foresaid heat image.

[0116] Furthermore, in each embodiment, the process (step S104, step S105) that the controller K thaws the upper part and the lower part of the indoor heat exchanger 12, stepwise when the controller K judges there exists a kitchen in the air-conditioned space (step S102: Yes) is described, but each embodiment is not limited to that. For example, the upper part and the lower part of the indoor heat exchanger 12 may be thawed stepwise regardless of existence of a kitchen in the air-conditioned space. Thereby, the dirt such as dust and oil adhered to the indoor heat exchanger 12 can be suitably washed out.

[0117] Furthermore, in each embodiment, the process (step S103c, step S103d in FIG. 7) that the controller K sets a rotational speed of the compressor 31 and suitably controls opening of the outdoor expansion valve 34 when the indoor heat exchanger 12 is frozen, is described, but each embodiment is not limited to that. For example, when the indoor heat exchanger 12 is frozen, the controller K may keep the outdoor expansion valve 34 at a prescribed opening and control a rotational speed of the compressor 31 so that a temperature of the indoor heat exchanger 12 approaches to a prescribed target temperature.

[0118] Furthermore, in each embodiment, the process that freezing of the whole of the indoor heat exchanger 12, thawing of the first indoor heat exchanger 12a (upper part of the indoor heat exchanger 12), and the second indoor heat exchanger 12b (lower part of the indoor heat exchanger 12) are carried out sequentially, is described (refer to FIG. 5), but each embodiment is not limited to

that. For example, the second indoor heat exchanger 12b may be frozen by carrying out a re-heating dehumidifying operation. In more detail, in the refrigerant circuit Q (refer to FIG. 3) in which the refrigerant circulates in the refrigerating cycle through the compressor 31, the "condenser", the second expansion valve V, and the "evaporator", sequentially, the controller K carries out the re-heating dehumidifying operation in the following manner. That is, the controller K works the first indoor heat exchanger 12a on the upstream side of the second expansion valve V as a condenser, and the second indoor heat exchanger 12b on the downstream side of the second expansion valve V as an evaporator to freeze the second indoor heat exchanger 12b.

[0119] In addition, prior to this, the whole of the indoor heat exchanger 12 may be frozen (similar to step S103 in FIG. 5), Furthermore, without the freezing operation, washing effect for the indoor heat exchanger 12 is provided. Since dewing water accompanied by a cooling operation or the like flows downward along the indoor heat exchanger 12b, the lower part of the indoor heat exchanger 12 (second indoor heat exchanger 12b) is easily dirtied. As described in the foregoing, since after the second indoor heat exchanger 12b is frozen, water accompanied by thawing flows downward together with dirt adhered to the second indoor heat exchanger 12b, the indoor heat exchanger 12 is effectively washed.

[0120] In addition, the first embodiment and the second embodiment can be combined. For example, in the structure of the indoor unit 10 (refer to FIG. 3) of the first embodiment, a series of processes for washing described in the second embodiment (refer to FIG. 9) may be carried out by almost fully opening the indoor expansion valve V (refer to FIG. 3) . Furthermore, separately from the foresaid series of processes for washing, the controller K may suitably carries out a re-heating dehumidifying operation according to an operation of the remote controller 40 (refer to FIG. 1) by a user.

[0121] Furthermore, in each embodiment, the structure in which one indoor unit 10 and one outdoor unit 30 are provided, is described, but each embodiment is not limited to that. That is, a plurality of indoor units connected in parallel to each other may be provided, and a plurality of outdoor units connected in parallel to each other may be provided.

[0122] Note that, each embodiment is described in detail in order to clearly explain the present invention, but the present invention is not limited to an air conditioner provided with all devices which have been described. A part of the structure of each embodiment may be replaced by another structure, or may be deleted. Furthermore, another structure may be added to the structure or to a part of the structure.

[0123] In addition, the foresaid mechanism or structure is one which is thought to be necessary for explaining, and all mechanism or structure for a product is not necessarily described.

DESCRIPTION OF THE SYMBOLS

[0124]

100, 100A Air conditioner
10, 10A Indoor unit
12, 12A Indoor heat exchanger (Evaporator/Condenser)
12a First indoor heat exchanger (Upper part of indoor heat exchanger)
12b Second indoor heat exchanger (Lower part of indoor heat exchanger)
14 Indoor fan
18 Left-right wind direction board
19 Upper-lower wind direction board
23 Imaging part (Person detecting part)
30 Outdoor unit
31 Compressor
31a Compressor motor (Motor of compressor)
32 Outdoor heat exchanger (Condenser /Evaporator)
33 Outdoor fan
34 Outdoor expansion valve (First expansion valve)
35 Four way switching valve
K Controller
Q, QA Refrigerant circuit
V Indoor expansion valve (Second expansion valve)

Claims

1. An air conditioner comprising:

a refrigerant circuit in which refrigerant circulates in a refrigerating cycle through a compressor, a condenser, a first expansion valve, and an evaporator sequentially; and
a controller for controlling at least the compressor and the first expansion valve,
wherein one of the condenser and the evaporator is an outdoor heat exchanger, and the other is at least a part of an indoor heat exchanger, and
wherein the controller executes a processing that freezing the indoor heat exchanger, thawing an upper part of the indoor heat exchanger, and thawing a lower part of the indoor heat exchanger are sequentially carried out.

2. The air conditioner according to claim 1, further comprising a person detecting part for detecting a person in an air-conditioned space,
wherein the controller executes the processing when a height of a head of the person detected by the person detecting part is within a predetermined range, and the person moves in a left-right direction or in a depth direction.

3. The air conditioner according to claim 1 or claim2,

wherein a first indoor heat exchanger being the upper part of the indoor heat exchanger, and a second indoor heat exchanger being the lower part of the indoor heat exchanger are connected to each other through a second expansion valve, and
wherein the controller, as the processing, sequentially carries out freezing of the first indoor heat exchanger and the second indoor heat exchanger, thawing of the first indoor heat exchanger, and thawing of the second indoor heat exchanger.

4. The air conditioner according to claim 3, wherein the controller starts the thawing of the first indoor heat exchanger just after the freezing of the first indoor heat exchanger and the second indoor heat exchanger is finished.

5. The air conditioner according to claim 3, wherein the controller starts the thawing of the first indoor heat exchanger after a predetermined time has passed since the freezing of the first indoor heat exchanger and the second indoor heat exchanger is finished.

6. The air conditioner according to claim 1, wherein the controller lowers a rotational speed of a motor the compressor relative to a normal air-conditioning operation during the thawing of the upper part of the indoor heat exchanger, and circulates the refrigerant in the refrigerant circuit through the compressor, the outdoor heat exchanger, the first expansion valve, the upper part of the indoor heat exchanger, and the lower part of the indoor heat exchanger sequentially.

7. An air conditioner comprising:

a refrigerant circuit in which refrigerant circulates in a refrigerating cycle through a compressor, a condenser, a second expansion valve, and an evaporator sequentially; and
a controller for controlling at least the compressor and the second expansion valve,
wherein a first indoor heat exchanger being an upper part of an indoor heat exchanger, and a second indoor heat exchanger being a lower part of the indoor heat exchanger are connected to each other through the second expansion valve, and
wherein the controller works the first indoor heat exchanger on an upstream side of the second expansion valve as the condenser, and the second indoor heat exchanger on a downstream side of the second expansion valve as the evaporator to freeze the second indoor heat exchanger.

Amended claims under Art. 19.1 PCT

1. (Amended) An air conditioner, comprising:

a refrigerant circuit in which a refrigerant circulates in a refrigerating cycle through a compressor, a condenser, a first expansion valve, and an evaporator sequentially; and
a controller for controlling at least the compressor and the first expansion valve,
wherein one of the condenser and the evaporator is an outdoor heat exchanger, and the other is at least a part of an indoor heat exchanger,
wherein the controller executes a processing in which freezing the indoor heat exchanger, thawing an upper part of the indoor heat exchanger, and thawing a lower part of the indoor heat exchanger are sequentially carried out, and
wherein the controller circulates the refrigerant in the refrigerant circuit through the compressor, the outdoor heat exchanger, the first expansion valve, the lower part of the indoor heat exchanger, and the upper part of the indoor heat exchanger sequentially while the upper part of the indoor heat exchanger is being thawed.

2. (Amended) The air conditioner according to claim 1, wherein the upper part of the indoor heat exchanger is positioned on a downstream side of the lower part of the indoor heat exchanger in a case where the indoor heat exchanger is worked as an evaporator.

3. (Amended) The air conditioner according to claim 1, wherein the refrigerant is completely vaporized on the way of a flow path of the indoor heat exchanger while the upper part of the indoor heat exchanger is being thawed.

4. (Amended) The air conditioner according to claim 1, wherein the controller keeps stop states of devices including the compressor during a predetermined time while the lower part of the indoor heat exchanger is being thawed.

5. (Deleted)

6. (Deleted)

7. (Deleted)

Statement under Art. 19.1 PCT

Claim 1 at the time of filing of this application is restricted by some matters to be new claim 1. The basis of the amendment is in paragraphs "0072" and

"0074" in Description and FIGS. 8 and 9.

Claim 2 at the time of filing of this application is changed to be new claim 2. The basis of the amendment is in paragraph "0072" in Description and FIG. 8.

Claim 3 at the time of filing of this application is changed to be new claim 3. The basis of the amendment is in paragraph "0075" in Description and FIG. 8.

Claim 4 at the time of filing of this application is changed to be new claim 4. The basis of the amendment is in paragraph "0081" in Description and FIGS. 5 and 6.

Claims 5 to 7 at the time of filing of this application are deleted.

We believe that each of inventions according to amended claims 1 to 4 has a novelty, an inventive step, and an industrial applicability.

FIG. 1

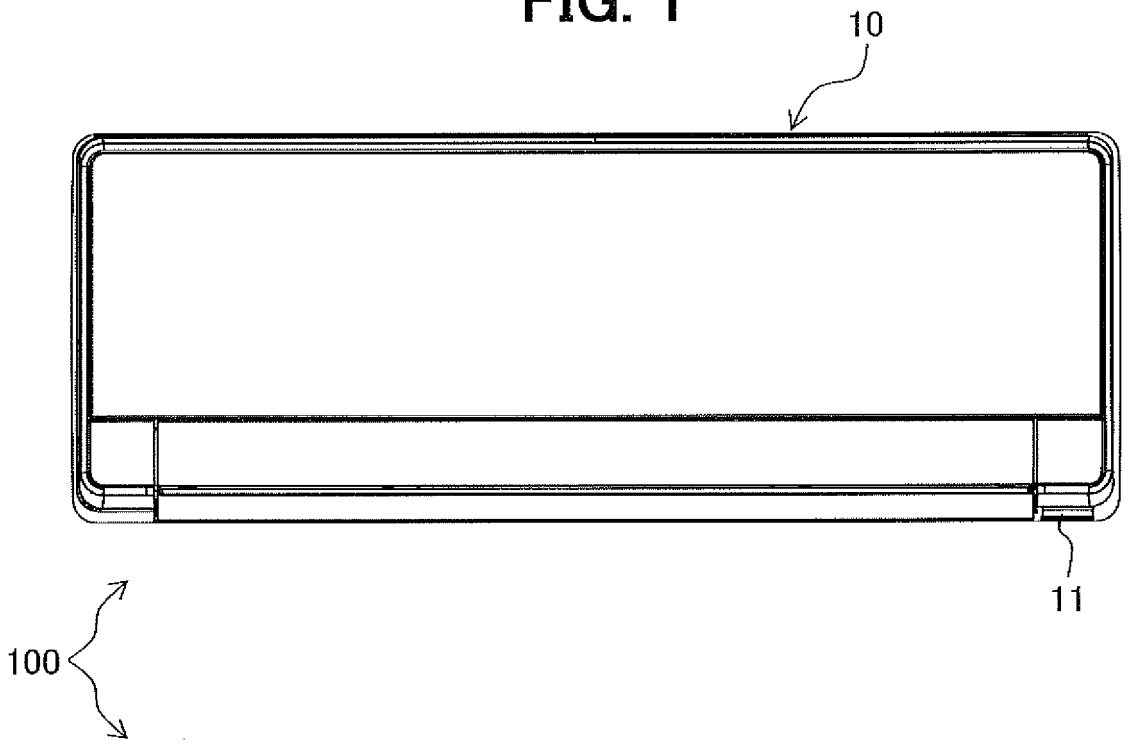


FIG. 2

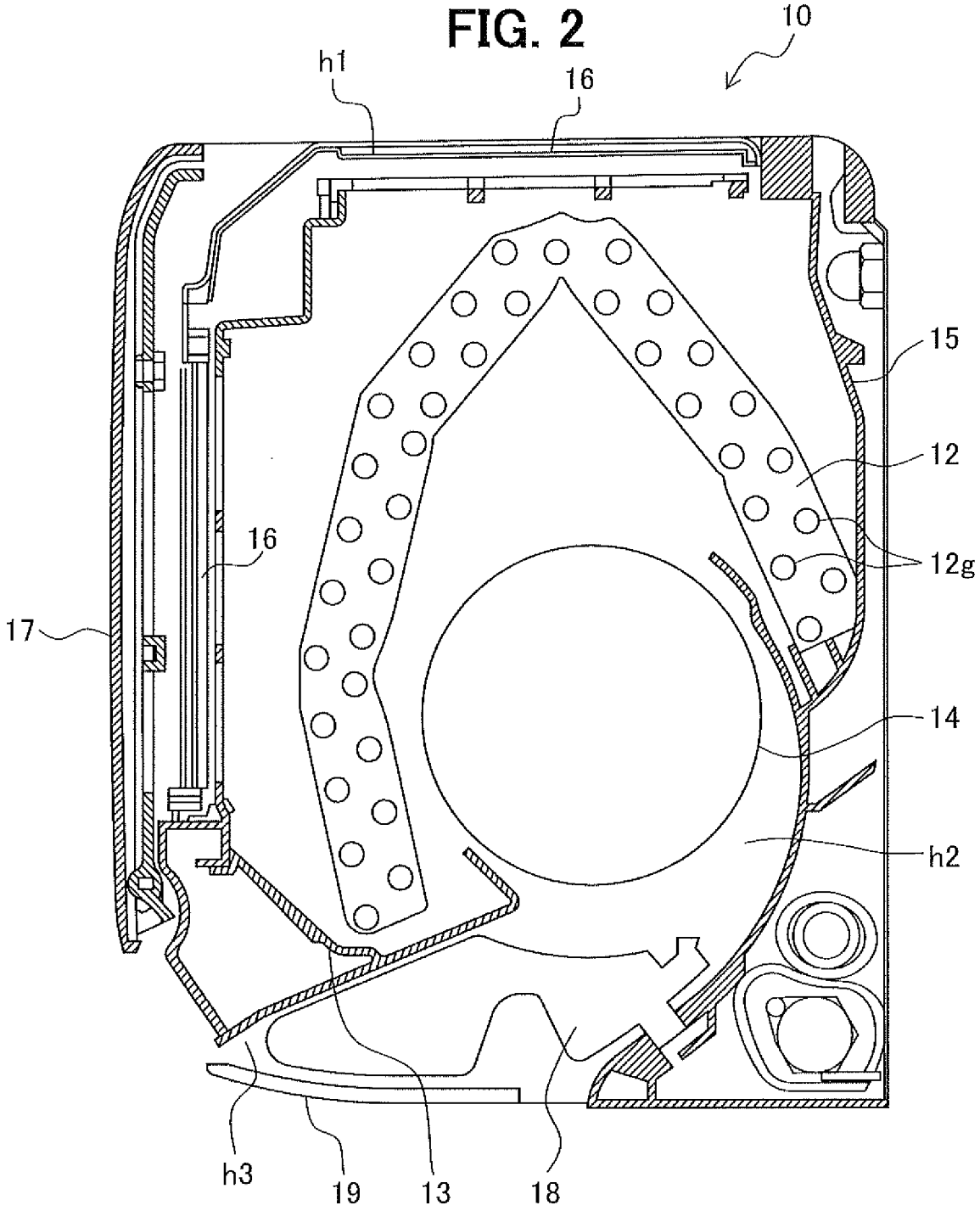


FIG. 3

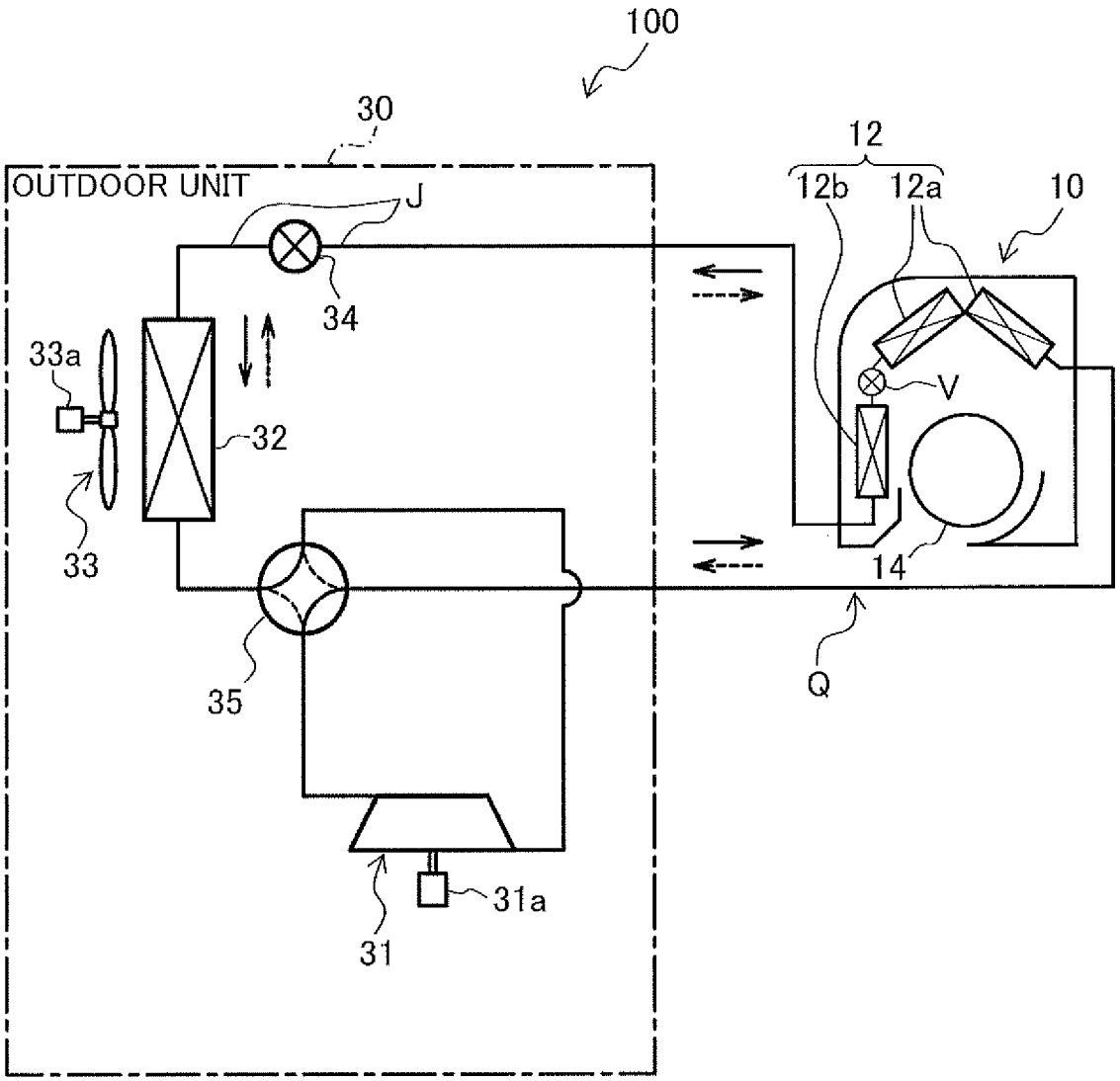

100
30
OUTDOOR UNIT
J
34
33a
32
33
35
31
31a
12
12b
12a
10
V
14
Q
HEATING OPERATION
RE-HEATING DEHUMIDIFYING OPERATION
COOLING OPERATION

FIG. 4

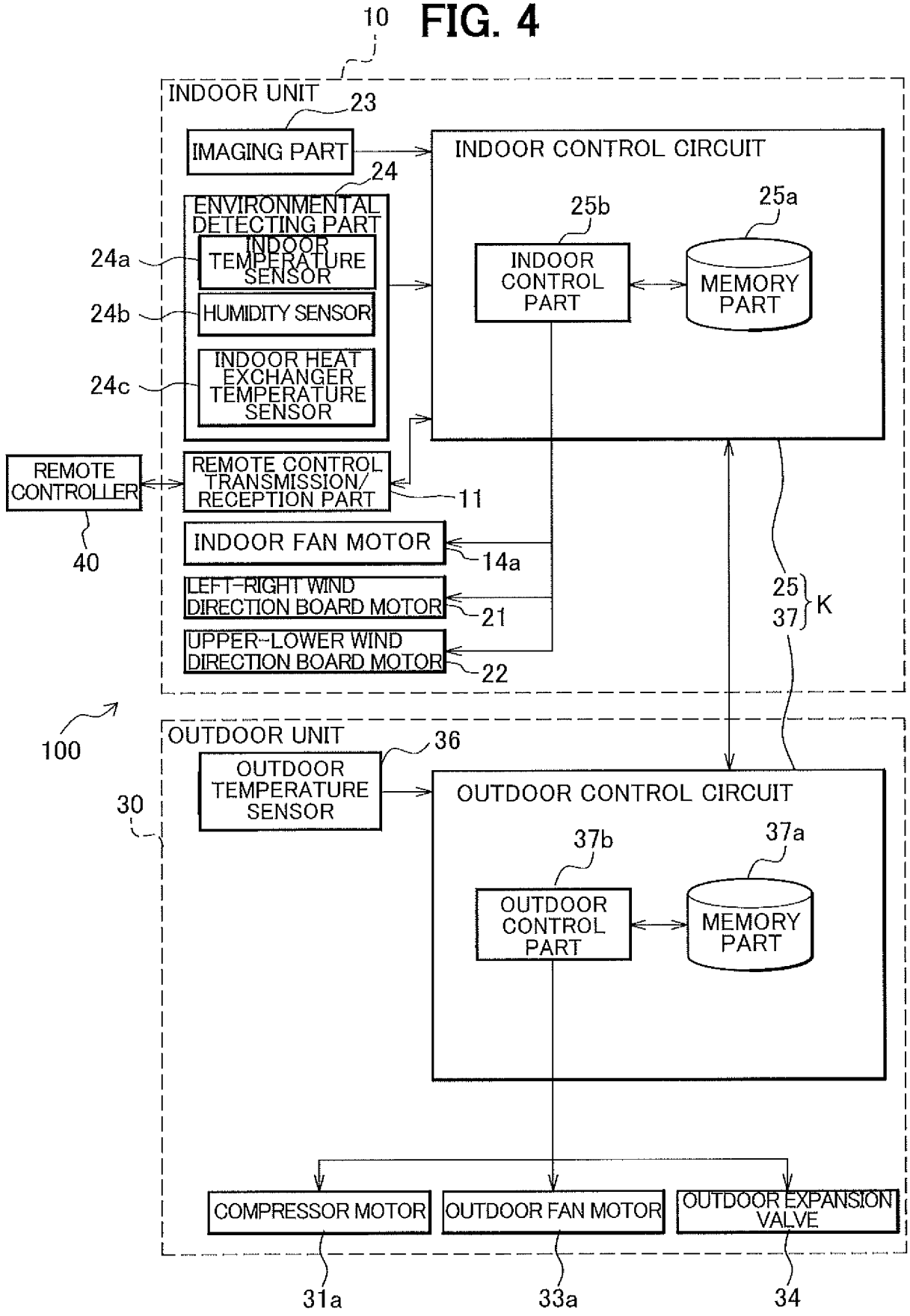

10
INDOOR UNIT
23
IMAGING PART
INDOOR CONTROL CIRCUIT
24
ENVIRONMENTAL DETECTING PART
INDOOR TEMPERATURE SENSOR
24a
HUMIDITY SENSOR
24b
INDOOR HEAT EXCHANGER TEMPERATURE SENSOR
24c
25b
INDOOR CONTROL PART
25a
MEMORY PART
REMOTE CONTROLLER
40
REMOTE CONTROL TRANSMISSION/ RECEPTION PART
11
INDOOR FAN MOTOR
14a
LEFT-RIGHT WIND DIRECTION BOARD MOTOR
21
UPPER-LOWER WIND DIRECTION BOARD MOTOR
22
25
37
K
100
OUTDOOR UNIT
36
OUTDOOR TEMPERATURE SENSOR
30
OUTDOOR CONTROL CIRCUIT
37b
OUTDOOR CONTROL PART
37a
MEMORY PART
COMPRESSOR MOTOR
OUTDOOR FAN MOTOR
OUTDOOR EXPANSION VALVE
31a
33a
34

FIG. 5

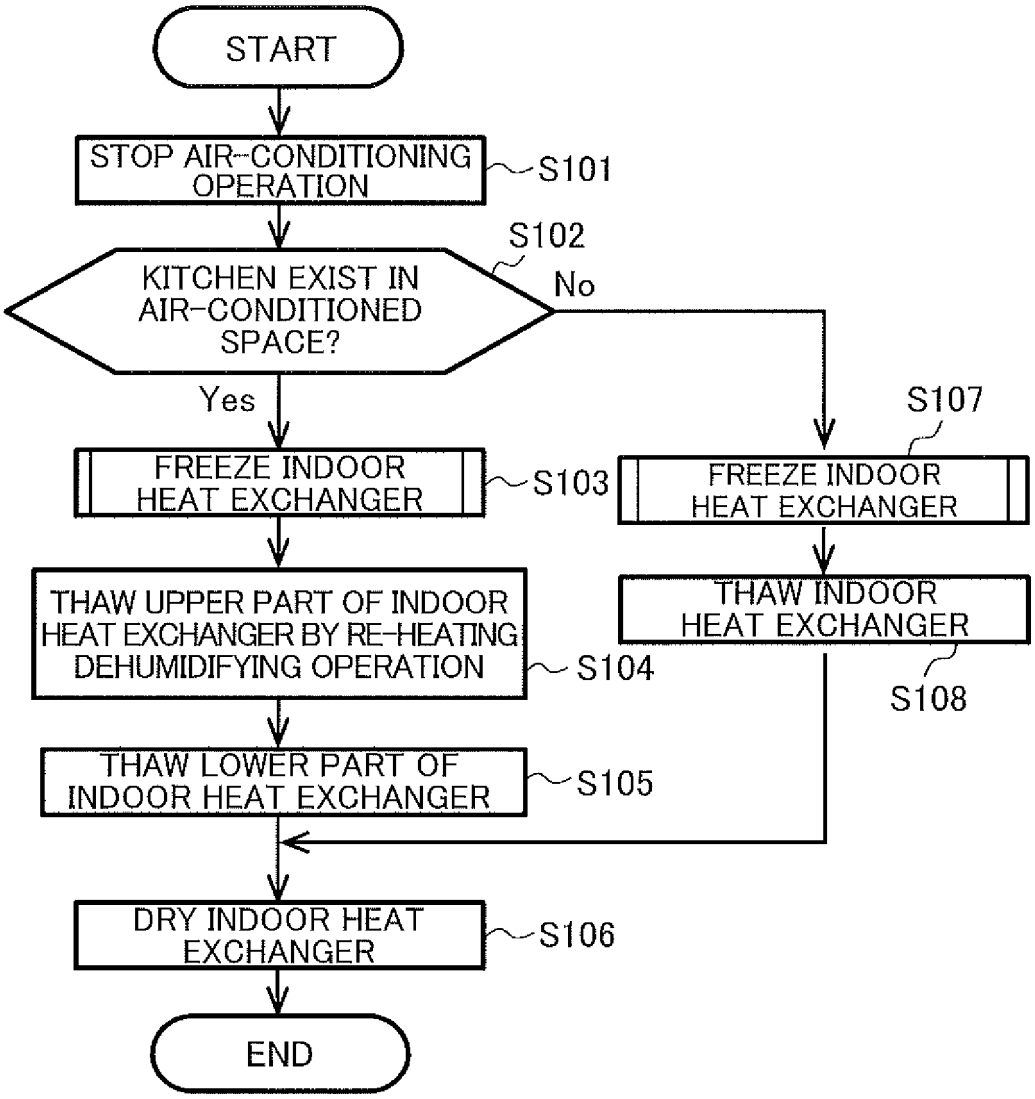

START
STOP AIR-CONDITIONING OPERATION
S101
S102
KITCHEN EXIST IN AIR-CONDITIONED SPACE?
No
Yes
S107
FREEZE INDOOR HEAT EXCHANGER
S103
FREEZE INDOOR HEAT EXCHANGER
THAW UPPER PART OF INDOOR HEAT EXCHANGER BY RE-HEATING DEHUMIDIFYING OPERATION
S104
THAW INDOOR HEAT EXCHANGER
S108
THAW LOWER PART OF INDOOR HEAT EXCHANGER
S105
DRY INDOOR HEAT EXCHANGER
S106
END

FIG. 6

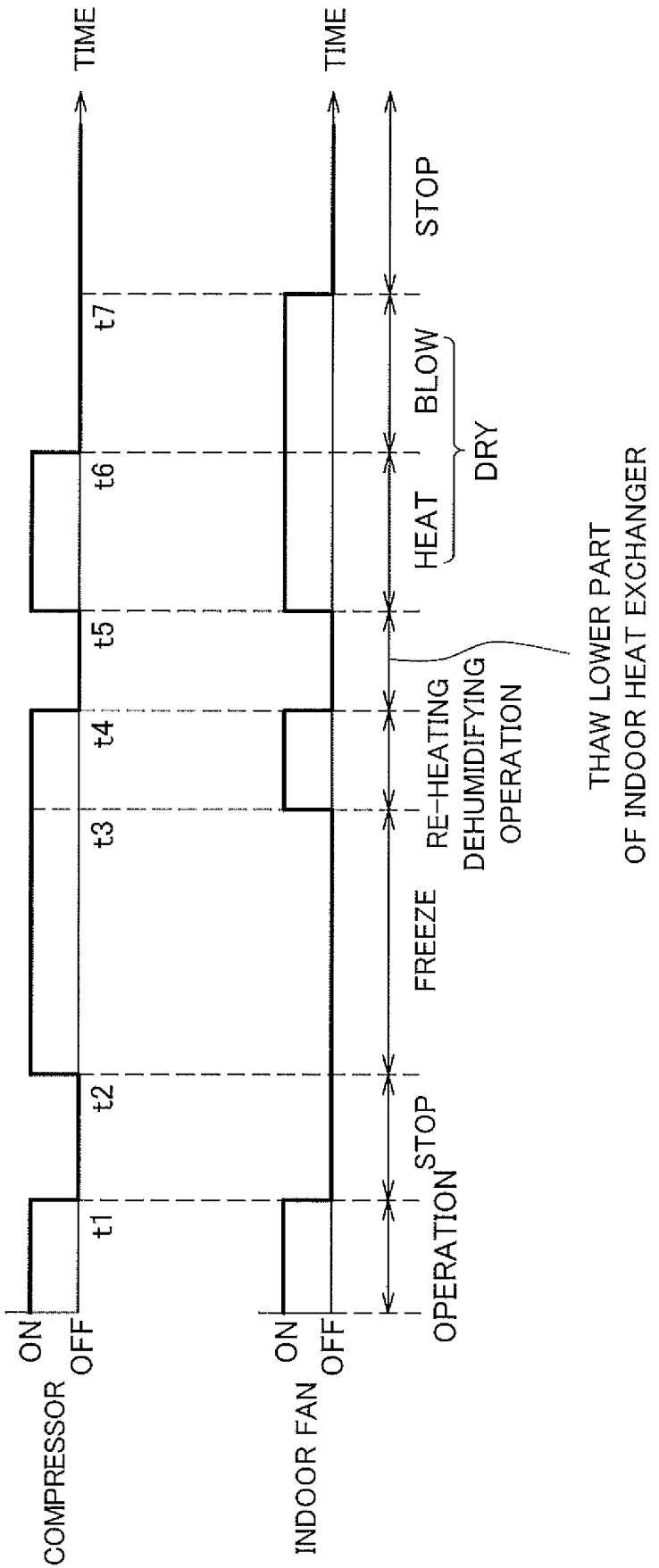

TIME
TIME
t1
t2
t3
t4
t5
t6
t7
COMPRESSOR
ON
OFF
INDOOR FAN
ON
OFF
OPERATION
STOP
FREEZE
RE-HEATING DEHUMIDIFYING OPERATION
HEAT
BLOW
DRY
STOP
THAW LOWER PART OF INDOOR HEAT EXCHANGER

FIG. 7

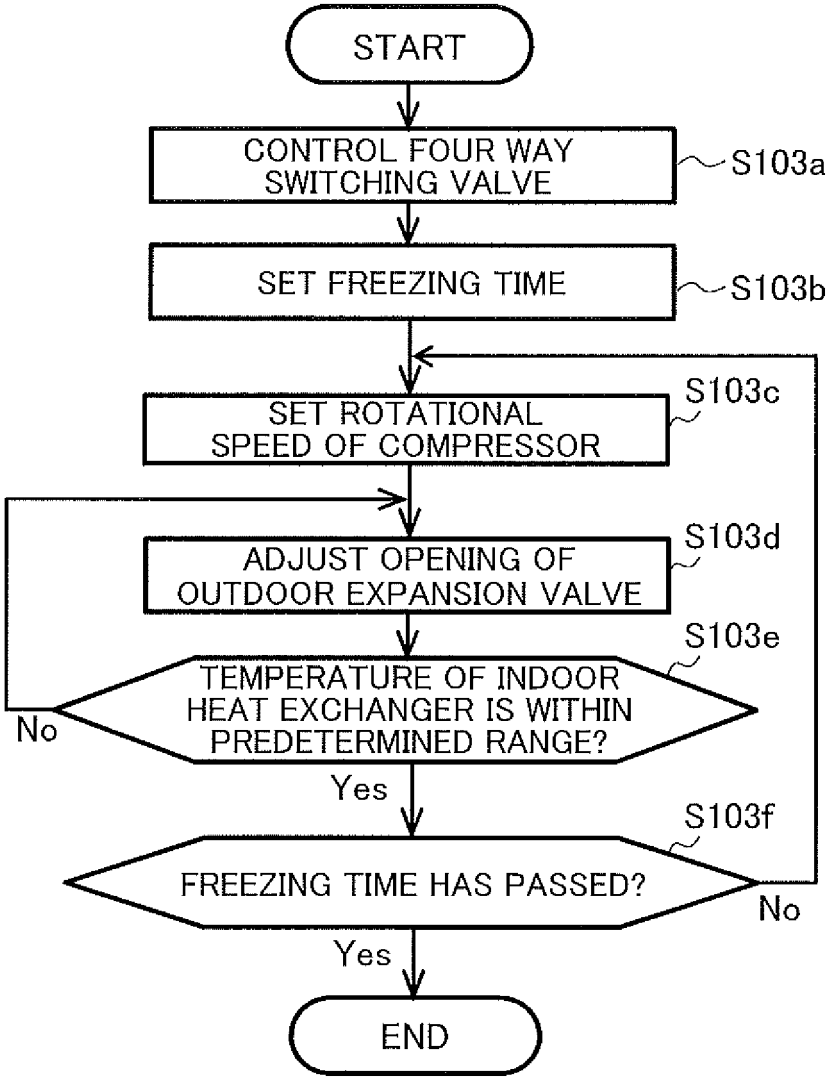

START
CONTROL FOUR WAY SWITCHING VALVE
S103a
SET FREEZING TIME
S103b
SET ROTATIONAL SPEED OF COMPRESSOR
S103c
ADJUST OPENING OF OUTDOOR EXPANSION VALVE
S103d
TEMPERATURE OF INDOOR HEAT EXCHANGER IS WITHIN PREDETERMINED RANGE?
S103e
No
Yes
FREEZING TIME HAS PASSED?
S103f
No
Yes
END

FIG. 8

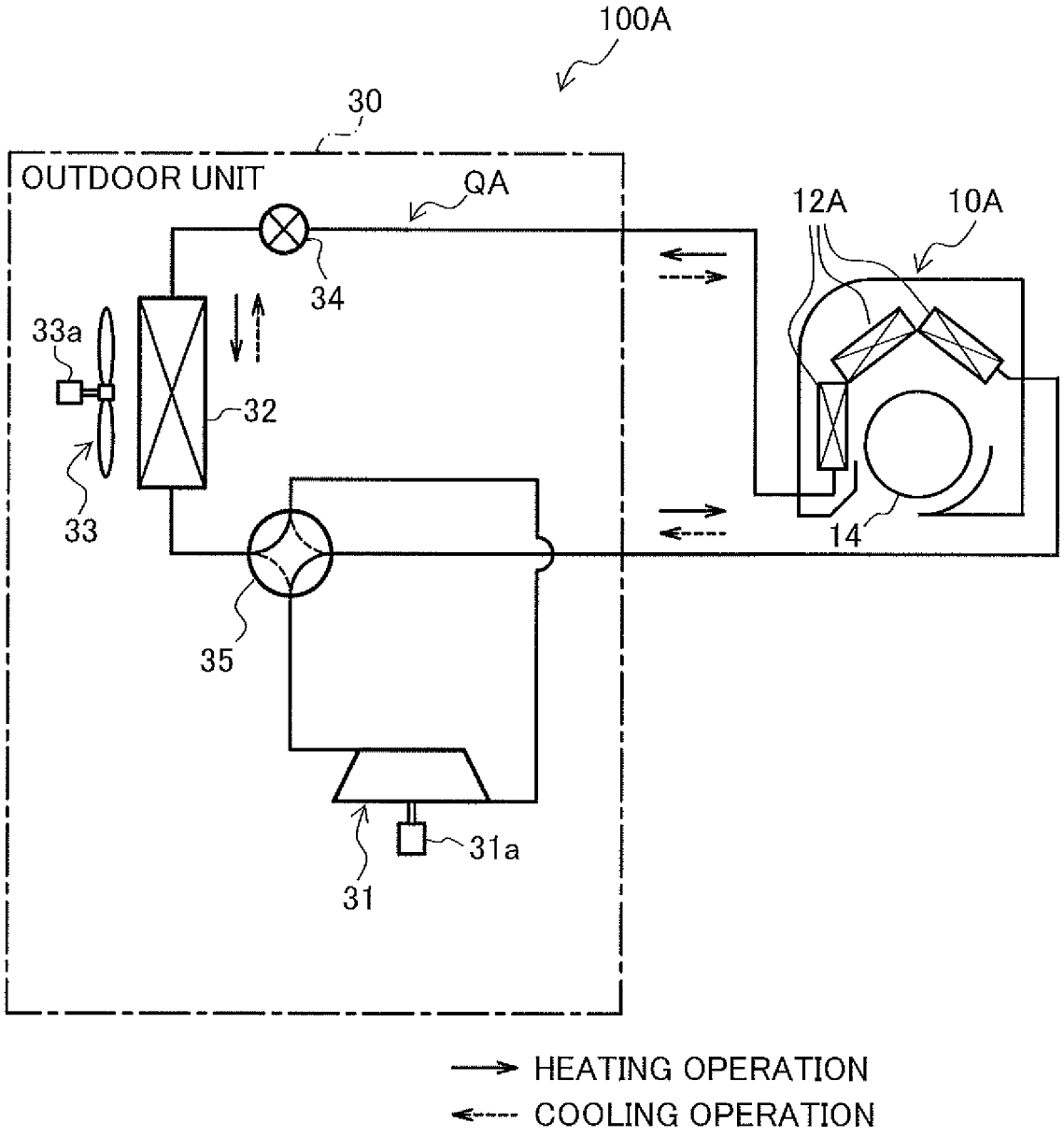
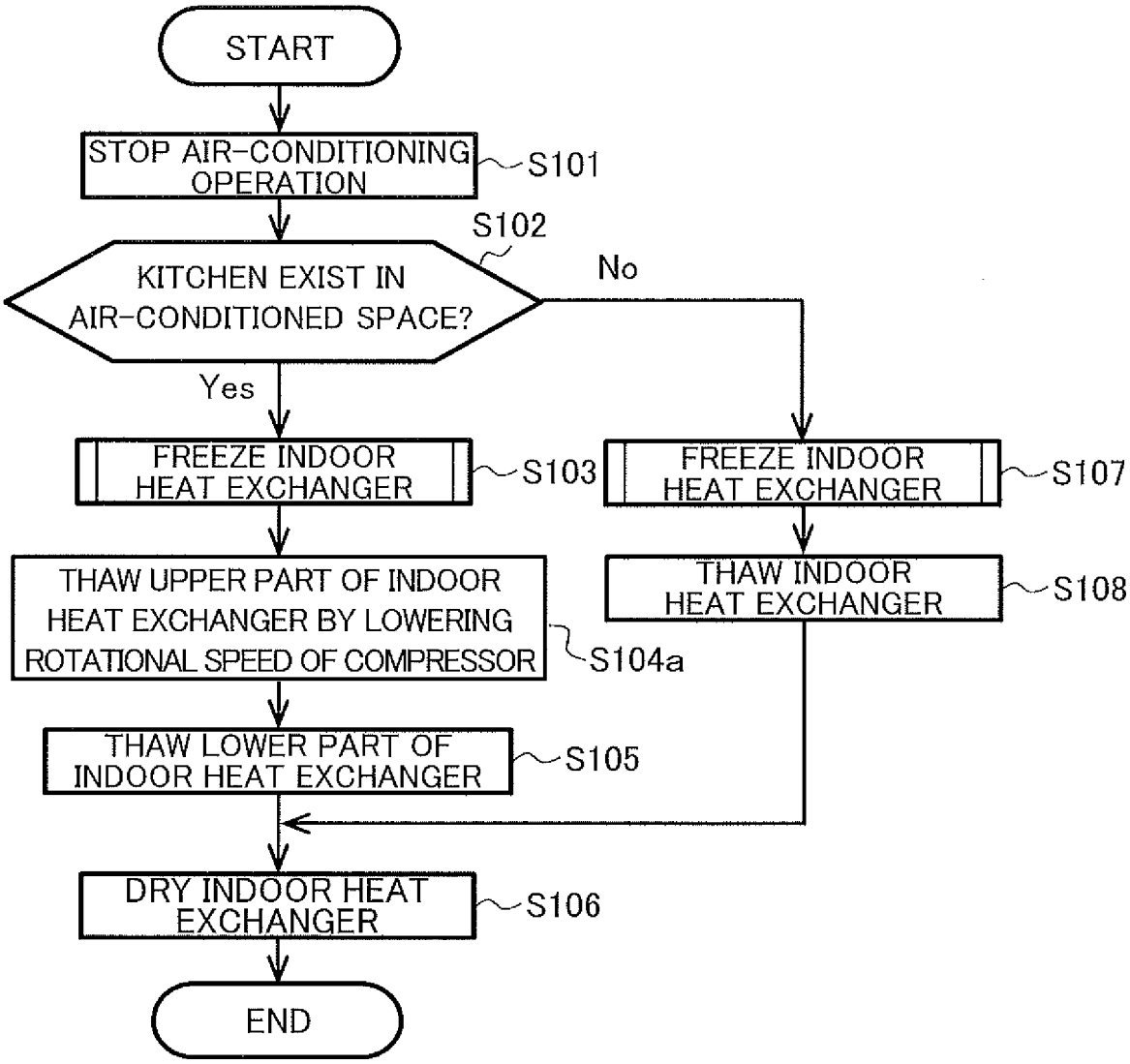

100A
30
OUTDOOR UNIT
QA
12A
10A
34
33a
32
33
14
35
31a
31
HEATING OPERATION
COOLING OPERATION

FIG. 9


START
STOP AIR-CONDITIONING OPERATION
S101
S102
KITCHEN EXIST IN AIR-CONDITIONED SPACE?
No
Yes
FREEZE INDOOR HEAT EXCHANGER
S103
FREEZE INDOOR HEAT EXCHANGER
S107
THAW UPPER PART OF INDOOR HEAT EXCHANGER BY LOWERING ROTATIONAL SPEED OF COMPRESSOR
S104a
THAW INDOOR HEAT EXCHANGER
S108
THAW LOWER PART OF INDOOR HEAT EXCHANGER
S105
DRY INDOOR HEAT EXCHANGER
S106
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/045205

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. F24F1/00(2011.01)i, F24F11/62(2018.01)i, F24F11/84(2018.01)i, F24F11/86(2018.01)i, F24F120/00(2018.01)i, F25B29/00(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)
Int. Cl. F24F1/00, F24F11/62, F24F11/84, F24F11/86, F24F120/00, F25B29/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2018
Registered utility model specifications of Japan 1996-2018
Published registered utility model applications of Japan 1994-2018

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2010-14288 A (TOSHIBA CARRIER CORP.) 21 January 2010, paragraphs [0011]-[0072], fig. 1-10 (Family: none)	1, 3-5, 7 2, 6
Y	JP 2009-281698 A (HITACHI APPLIANCES, INC.) 03 December 2009, paragraphs [0057]-[0063] & CN 10592414 A	1, 3-5, 7
A	CN 106679111 A (SHENZHEN SKYWORTH AIR CONDITIONING TECH CO. LTD.) 17 May 2017, entire text, all drawings (Family: none)	1-7

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

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Date of the actual completion of the international search	Date of mailing of the international search report
20.02.2018	27.02.2018
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4931566 B **[0003]**