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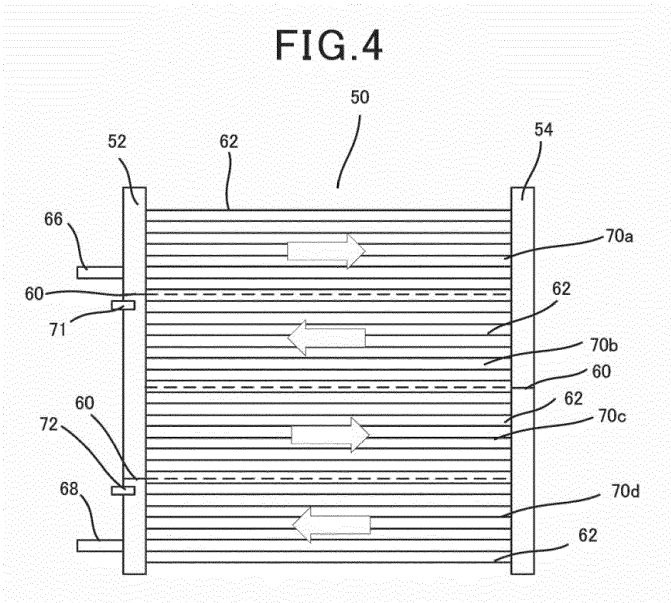
(54) **AIR CONDITIONING APPARATUS**

(57) The present disclosure provides an air conditioning apparatus that can make a determination on whether to finish defrosting with high accuracy. An air conditioning apparatus in the present disclosure includes: a compressor; an outdoor heat exchanger; an expansion valve; and an indoor heat exchanger, the outdoor heat exchanger includes a pair of header pipes, and a plurality of flat pipes connected to the header pipes, the flat pipes are divided into a plurality of blocks, each of the blocks including a plurality ones of the flat pipes, a refrigerant temperature detecting means is provided at a position corresponding to an upper part of the block, and a control unit that controls a defrosting operation based on a temperature detected by the refrigerant temperature detecting means is provided.

FIG.4



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present disclosure relates to an air conditioning apparatus.

Description of the Related Art

[0002] Japanese Patent Laid-Open No. 2019-184192 discloses an air conditioning apparatus in which a heat exchanger of an outdoor unit has a plurality of liquid-side openings formed on a front end part of a first portion extending in the front-back direction of a casing, the liquid-side openings being arranged in the up-down direction, a flow divider includes a flow divider main body having a plurality of flow dividing holes formed on the front side relative to the front end part and a plurality of liquid-side flow dividing pipes that connect the flow dividing holes and the liquid-side openings, one of the liquid-side flow dividing pipes has a front extending portion formed midway from the flow dividing hole to the liquid-side opening, the front extending portion being disposed on the front side relative to the flow dividing hole, and a temperature sensor is attached to the front extending portion.

[0003] The present disclosure provides an air conditioning apparatus that can make a determination on whether to finish defrosting with high accuracy.

SUMMARY OF THE INVENTION

[0004] An air conditioning apparatus in the present disclosure includes: a compressor; an outdoor heat exchanger; an expansion valve; and an indoor heat exchanger, the outdoor heat exchanger includes a pair of header pipes, and a plurality of flat pipes connected to the header pipes, the flat pipes are divided into a plurality of blocks, each of the blocks including a plurality ones of the flat pipes, a refrigerant temperature detecting means is provided at a position corresponding to an upper part of the block, and a control unit that controls a defrosting operation based on a temperature detected by the refrigerant temperature detecting means is provided.

Advantageous Effect of the Invention

[0005] Since the control unit controls the defrosting operation based on the frost formation state of the outdoor heat exchanger, the air conditioning apparatus of the present disclosure can prevent the defrosting operation from being finished with frost remaining unmelted and prevent the defrosting operation from being continued even though the frost has already melted completely, which improves the accuracy of determination on whether to finish the defrosting operation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

FIG. 1 is a perspective view of an outdoor unit of an air conditioning apparatus according to a first embodiment of the present disclosure;
FIG. 2 is a plan view schematically showing an internal structure of the outdoor unit;
FIG. 3 is a perspective view showing a heat exchanger;
FIG. 4 is an explanatory diagram showing a block configuration of an outdoor heat exchanger in the first embodiment;
FIG. 5 is a refrigeration cycle diagram of the air conditioning apparatus in the first embodiment;
FIG. 6 is a block diagram showing a control configuration of the first embodiment;
FIG. 7 is a flowchart showing a flow of a defrosting operation in the first embodiment; and
FIG. 8 is an explanatory diagram showing a block configuration of an outdoor heat exchanger in a second embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Knowledge and the like Underlying Present Disclosure)

[0007] At the time when the inventors conceived the present disclosure, there was a technique in which a temperature sensor is attached to a front extending portion of a liquid-side flow dividing pipe midway from a flow dividing hole to a liquid-side opening, the front extending portion being disposed on the front side relative to the flow dividing hole.

[0008] However, even if a flow of a refrigerant is divided by a flow divider and the temperature sensor is attached to the lowest part of the outdoor heat exchanger where frost is likely to form, in the outdoor heat exchanger including flat pipes and header pipes, the temperature of the flat pipe with frost formed thereon cannot be accurately measured because a temperature (average temperature) after a plurality of flows of the refrigerant merge is measured.

[0009] Thus, the inventors have found a problem that, since the frost formation state of each flat pipe cannot be accurately determined, it is determined to finish a defrosting operation when the defrosting operation does not start even if frost formation progresses too far or when the temperature of each flat pipe does not reach a target temperature at which frost melts, and frost on the outdoor heat exchanger thus remains unmelted, and has come to constitute the subject matter of the present disclosure to solve this problem.

[0010] Thus, the present disclosure provides an air conditioning apparatus that can make a determination on whether to finish defrosting with high accuracy.

[0011] Hereinbelow, embodiments will be described in detail with reference to the drawings. Note that more details than necessary may be omitted. For example, detailed description of already well-known matters or repetitive description for substantially identical configurations may be omitted. This is to avoid making the following description unnecessary redundant and facilitate the understanding of those skilled in the art.

[0012] Note that the accompanying drawings and the following description are provided to enable those skilled in the art to fully understand the present disclosure and are not intended to limit the subject matter described in the claims.

(First Embodiment)

[0013] Hereinbelow, a configuration of a first embodiment will be described with reference to FIGS. 1 to 4.

[1-1. Configuration]

[1-1-1. Configuration of Outdoor Unit]

[0014] FIG. 1 is a perspective view of an outdoor unit 6 of an air conditioning apparatus 1 according to the present embodiment. FIG. 2 is a plan view schematically showing an internal structure of the outdoor unit 6.

[0015] As shown in FIG. 1, the outdoor unit 6 of the present embodiment is a so-called side-flow type or side-blow type outdoor unit that draws air into the inside thereof through an outdoor heat exchanger 50 disposed on a side face, performs heat exchange between the air and a refrigerant, and blows the air out through another side face.

[0016] As shown in FIGS. 1 and 2, the outdoor unit 6 includes a housing 10 having a box shape. In the present embodiment, each part of the housing 10 is formed of a steel plate.

[0017] The housing 10 includes a bottom plate 12 constituting a bottom face of the housing 10, a top plate 14 constituting a top face, a front plate 16 constituting a front face, a back plate 18 constituting a back face, a left side plate 11 constituting a left side face, and a right side plate 13 constituting a right side face.

[0018] As shown in FIG. 1, the front plate 16 is provided with a front intake opening 15. In the front plate 16, the front intake opening 15 is provided at a position closer to the left side plate 11 than to the right side plate 13.

[0019] In the front plate 16, a plurality of fastening holes 20, which are through holes, are provided at positions close to an edge of the front intake opening 15, the edge being adjacent to the right side plate 13. These fastening holes 20 are aligned on a line extending in the up-down direction of the housing 10. In the present embodiment, the front plate 16 is provided with three fastening holes 20.

[0020] The left side plate 11 is provided with a side intake opening 17. In the left side plate 11, the side intake opening 17 is provided at a position closer to the front plate 16 than to the back plate 18.

[0021] In the left side plate 11, as with the front plate 16, three fastening holes 20 are provided at positions close to an edge of the side intake opening 17, the edge being adjacent to the back plate 18, in such a manner that the fastening holes 20 are aligned on a line extending in the up-down direction of the housing 10.

[0022] As shown in FIG. 2, the back plate 18 is provided with an exhaust opening 19. The exhaust opening 19 is an opening through which air drawn into the inside of the housing 10 is blown out to the outside of the housing 10.

[0023] Note that the front intake opening 15 and the side intake opening 17 described above, and the exhaust opening 19 may be provided with a filter or a lattice-shaped protection member.

[0024] The inside of the housing 10 is partitioned by a partition plate 21 into two spaces. The partition plate 21 is a plate-like member that extends in the up-down direction of the housing 10 at a predetermined height dimension and extends in the front-back direction of the housing 10. The partition plate 21 is fixed to the housing 10 with a lower end coupled to the bottom plate 12. The partition plate 21 has an end that is located on the front side of the housing 10 and coupled to the front plate 16 and an end that is located on the back side of the housing 10 and coupled to the back plate 18.

[0025] Accordingly, inside the housing 10, two spaces are formed on the opposite sides of the partition plate 21, the two spaces including a machine chamber S1 located on the right side of the housing 10 and a fan chamber S2 located on the left side of the housing 10.

[0026] Members constituting a refrigeration circuit, such as a compressor 5, an outdoor expansion valve 76, and a refrigerant pipe 8, various electrical components, and the like are housed in the machine chamber S1.

[0027] An outdoor fan 30 and an outdoor heat exchanger 50 are housed in the fan chamber S2.

[0028] The outdoor fan 30 is an axial fan that is driven to rotate to introduce air into the fan chamber S2 from the outside of the housing 10, cause the air to exchange heat with a refrigerant flowing through the outdoor heat exchanger 50, and then release the air again to the outside of the housing 10. The outdoor fan 30 includes a fan motor 32, and an impeller 34 that is driven to rotate by the fan motor 32.

[0029] The outdoor fan 30 is fixed by a fan support member 40 provided in the fan chamber S2.

[1-1-2 Configuration of Outdoor Heat Exchanger]

[0030] Next, a configuration of the outdoor heat exchanger 50 will be described.

[0031] FIG. 3 is a perspective view showing the outdoor heat exchanger 50.

[0032] The outdoor heat exchanger 50 is a heat exchanger functioning as an evaporator that evaporates the refrigerant fed thereto from an indoor unit or a con-

denser that condenses the refrigerant.

[0033] As shown in FIG. 3, the outdoor heat exchanger 50 of the present embodiment is formed in a substantially L shape as a whole in plan view.

[0034] The outdoor heat exchanger 50 includes a pair of header pipes 52 and 54, a first refrigerant pipe 66, a second refrigerant pipe 68, a partition wall 60, a plurality of flat pipes 62, and a plurality of fins 64.

[0035] The header pipes 52 and 54 are both formed in a hollow cylindrical shape extending in the up-down direction of the housing 10.

[0036] The first refrigerant pipe 66 and the second refrigerant pipe 68 are connected to the header pipe 52. The first refrigerant pipe 66 and the second refrigerant pipe 68 function as an inflow port or an outflow port for the refrigerant in the outdoor heat exchanger 50.

[0037] The first refrigerant pipe 66 is connected to an upper part of the header pipe 52. The second refrigerant pipe 68 is connected to a lower part of the header pipe 52.

[0038] In the present embodiment, the first refrigerant pipe 66 and the second refrigerant pipe 68 are connected to points substantially corresponding to each other in the circumferential direction of the header pipe 52 in plan view.

[0039] Inside the header pipe 52, the partition wall 60 that partitions an internal space of the header pipe 52 is provided.

[0040] The flat pipes 62 are flat and long members inside each of which a channel through which the refrigerant flows is provided.

[0041] In a state in which the flat pipes 62 are aligned in the longitudinal direction of each of the header pipes 52 and 54 with the longitudinal directions of the flat pipes 62 parallel to each other, each of the opposite ends of each of the flat pipes 62 is connected to a corresponding one of side faces of the header pipes 52 and 54.

[0042] Thus, the opposite ends of each of the flat pipes 62 are connected to predetermined points on the side faces so that the ends of the flat pipes 62 are aligned on a line extending in the longitudinal direction of each of the header pipes 52 and 54.

[0043] The fins 64 are flat-plate members each provided with a plurality of insertion holes in which the respective flat pipes 62 can be inserted. Each of the flat pipes 62 is connected to each of the header pipes 52 and 54 in a state in which the flat pipe 62 is inserted in each of the fins 64. That is, each of the fins 64 is disposed perpendicular to each of the flat pipes 62.

[0044] In the fan chamber S2, the outdoor heat exchanger 50 is disposed, in its longitudinal direction, along the front plate 16 and the left side plate 11. Specifically, the header pipe 52 is disposed at a position close to the edge of the front intake opening 15, the edge being adjacent to the right side plate 13, and the header pipe 54 is disposed at a position close to the edge of the side intake opening 17, the edge being adjacent to the back plate 18. Also, the outdoor heat exchanger 50 is bent in a substantially L shape in plan view so as to be close to a corner 23 of the housing 10, the corner 23 being defined by the front plate 16 and the left side plate 11.

[0045] As shown in FIG. 1, in the outdoor heat exchanger 50 disposed in this manner, the flat pipes 62 and the fins 64 are largely exposed from the housing 10 through the front intake opening 15 and the side intake opening 17. On the other hand, the header pipe 52 is shielded by the front plate 16, and the header pipe 54 is shielded by the left side plate 11.

[0046] FIG. 4 is an explanatory diagram showing a block configuration of the outdoor heat exchanger 50. Note that the fins are omitted in FIG. 4.

[0047] As shown in FIG. 4, the outdoor heat exchanger 50 is divided into a plurality of blocks 70, each of the blocks 70 including a plurality ones of the flat pipes 62. In the present embodiment, four blocks 70 from a first block 70a to a fourth block 70d are formed in the up-down direction.

[0048] The header pipe 52 is provided with the partition wall 60 that separates the first block 70a and the second block 70b from each other, and the partition wall 60 that separates the third block 70c and the fourth block 70d from each other.

[0049] Also, the header pipe 54 is provided with the partition wall 60 that separates the second block 70b and the third block 70c from each other.

[0050] For example, during a cooling operation or a defrosting operation of the air conditioning apparatus 1, as indicated by arrows in the drawing, the refrigerant flows through the refrigerant pipe 66, the header pipe 52, the first block 70a, the header pipe 54, the second block 70b, the header pipe 52, the third block 70c, the header pipe 54, the fourth block 70d, the header pipe 52, and the refrigerant pipe 68 in this order.

[0051] Also, during a heating operation, the refrigerant flows in the opposite direction from the refrigerant pipe 68 to the refrigerant pipe 66.

[0052] In the present embodiment, the header pipe 52 is provided with a first refrigerant temperature sensor 71 at a position corresponding to the second block 70b, more specifically, a position corresponding to an upper part of the second block 70b.

[0053] Also, the header pipe 52 is provided with a second refrigerant temperature sensor 72 at a position corresponding to the fourth block 70d, more specifically, a position corresponding to an upper part of the fourth block 70d.

[0054] The first refrigerant temperature sensor 71 detects the temperature of the refrigerant flowing through the second block 70b, and the second refrigerant temperature sensor 72 detects the temperature of the refrigerant flowing through the fourth block 70d.

[0055] Here, the first refrigerant temperature sensor 71 and the second refrigerant temperature sensor 72 are disposed at the positions corresponding to the upper part of the second block 70b and the upper part of the fourth block 70d, respectively, due to the following reason.

[0056] For example, while the refrigerant fed to the

header pipe 52 during a defrosting operation relatively uniformly flows through the flat pipes 62 in the first block 70a, the refrigerant tends to flow more through a lower part of the second block 70b when flowing from the header pipe 54 to the second block 70b.

[0057] Thus, in performing defrosting using the refrigerant during a defrosting operation, the defrosting is started from the lower side of the second block 70b.

[0058] If the first refrigerant temperature sensor 71 is provided corresponding to the lower part of the second block 70b and the defrosting operation is controlled based on a refrigerant temperature detected by the first refrigerant temperature sensor 71, the refrigerant temperature may reach a temperature at which the defrosting can be determined to be complete and there is a possibility that sufficient defrosting cannot be performed. The same applies to the second refrigerant temperature sensor 72.

[0059] Note that, although the present embodiment describes an example in which the outdoor heat exchanger is divided into the four blocks 70, this is not a limitation.

[0060] The outdoor heat exchanger may be divided into three blocks or divided into five or more blocks. In this case, the first refrigerant temperature sensor 71 may be provided at a position corresponding to the second highest block.

[1-1-3. Description for Refrigeration Cycle]

[0061] Next, a refrigeration cycle configuration of the air conditioning apparatus 1 in the present embodiment will be described.

[0062] FIG. 5 is a refrigeration cycle diagram of the air conditioning apparatus 1 in the present embodiment.

[0063] As shown in FIG. 5, the outdoor unit 6 includes the compressor 5, a selector valve 75, the outdoor heat exchanger 50, and the outdoor expansion valve 76.

[0064] An indoor unit 7 includes an indoor heat exchanger 77, an indoor fan 78, and an indoor expansion valve 79.

[0065] The indoor heat exchanger 77 and the indoor expansion valve 79 are connected to the outdoor unit 6 through the refrigerant pipe 8.

[0066] The refrigerant flows in the direction indicated by a solid-line arrow in the drawing during a cooling operation or a defrosting operation and flows in the direction indicated by a broken-line arrow in the drawing during a heating operation.

[1-1-4. Description for Control Configuration]

[0067] Next, a control configuration of the present embodiment will be described.

[0068] FIG. 6 is a block diagram showing the control configuration of the first embodiment.

[0069] As shown in FIG. 6, the air conditioning apparatus 1 includes a control unit 80. The control unit 80 includes, for example, a processor that executes a program, such as a CPU or an MPU, and a memory, such as a ROM or a RAM, and executes various processes through cooperation of hardware and software so that the processor reads a control program stored in the memory and executes processing.

[0070] Temperatures detected by the first refrigerant temperature sensor 71 and the second refrigerant temperature sensor 72 are input to the control unit 80.

[0071] The control unit 80 controls the compressor 5, the outdoor fan 30, the outdoor expansion valve 76, the selector valve 75, the indoor fan 78, and the indoor expansion valve 79 based on the temperatures detected by the first refrigerant temperature sensor 71 and the second refrigerant temperature sensor 72.

[0072] The control unit 80 inputs a first refrigerant temperature (S1) detected by the first refrigerant detection sensor and a second refrigerant temperature (S2) detected by the second refrigerant detection sensor and controls a defrosting operation based on the first refrigerant temperature and the second refrigerant temperature.

[0073] Details of the defrosting operation will be described further below.

[1-2. Operation]

[0074] Next, the operation of the first embodiment will be described.

[0075] First, the flow of the refrigerant in the air conditioning apparatus 1 will be described.

[0076] In the case of a heating operation of the air conditioning apparatus 1, when the outdoor unit 6 starts operating, the compressor 5 is driven. The compressor 5 compresses the refrigerant sealed in the refrigeration circuit and feeds gas refrigerant out through each refrigerant pipe 8.

[0077] The gas refrigerant is condensed in the indoor heat exchanger 77 by dissipating heat, then flows into the indoor expansion valve 79 through the pipe, is decompressed by the indoor expansion valve 79, and flows into the outdoor heat exchanger 50 through the refrigerant pipe 8. The refrigerant flows from the fourth block 70d to the first block 70a through the flat pipes 62 and is returned to the compressor 5 thereafter.

[0078] FIG. 7 is a flowchart showing a flow of a defrosting operation in the first embodiment.

[0079] As shown in FIG. 7, when the control unit 80 determines, during a heating operation (ST1), that frost has formed on the outdoor heat exchanger 50 (ST2: YES), the control unit 80 starts a defrosting operation (ST3).

[0080] In the defrosting operation, the selector valve 75 is switched to cause the refrigerant to flow in the same manner as in the cooling operation and feed, to the outdoor heat exchanger 50, high-temperature and high-pressure refrigerant discharged from the compressor 5. Accordingly, the outdoor heat exchanger 50 is heated and defrosting is performed.

[0081] During the defrosting operation, the high-temperature refrigerant from the compressor 5 is fed to the outdoor heat exchanger 50, and frost adhering to the outdoor heat exchanger 50 is removed by heat exchange with the high-temperature refrigerant.

[0082] In this case, as shown in FIG. 4, during the defrosting operation, the refrigerant flows in the direction indicated by the arrows. Thus, as the refrigerant flows from the first block 70a on the upper side of the outdoor heat exchanger 50 to the fourth block 70d on the lower side thereof while exchanging heat, the refrigerant temperature decreases gradually.

[0083] Thus, while the first refrigerant temperature at an upstream position in the flow of the refrigerant becomes high, the second refrigerant temperature at a downstream position after heat exchange becomes lower than the refrigerant temperature detected by the first refrigerant temperature sensor 71, which increases the difference between the temperature detected by the first refrigerant temperature sensor 71 and the temperature detected by the second refrigerant temperature sensor 72.

[0084] Then, as the defrosting progresses, the frost adhering to the outdoor heat exchanger 50 decreases, and when a heat exchange amount in the heat exchanger 50 decreases, the difference between the temperature detected by the first refrigerant temperature sensor 71 and the temperature detected by the second refrigerant temperature sensor 72 decreases.

[0085] When the frost formed on the outdoor heat exchanger 50 melts completely, there is no subject with which heat is exchanged. Thus, the difference between the temperature detected by the first refrigerant temperature sensor 71 and the temperature detected by the second refrigerant temperature sensor 72 is stabilized at a fixed threshold.

[0086] The control unit 80 determines whether the refrigerant temperature detected by the second refrigerant temperature sensor 72 is equal to or higher than a predetermined threshold (e.g., 8°C) (ST4). This is because the disappearance of frost formed on the outdoor heat exchanger 50 reduces the heat exchange amount in the first block 70a located on the upper side and also increases the temperature of the refrigerant flowing through the fourth block 70d located on the lower side.

[0087] Thereafter, the control unit 80 calculates the difference between the refrigerant temperature (S1) detected by the first refrigerant temperature sensor 71 and the refrigerant temperature (S2) detected by the second refrigerant detection sensor 72, and when the control unit 80 determines that the difference is smaller than a predetermined temperature difference (ST5: YES), the control unit 80 performs control to finish the defrosting operation (ST6).

[0088] As described above, since there is no subject with which heat is exchanged when frost formed on the outdoor heat exchanger 50 melts completely, the difference between the temperature detected by the first refrigerant temperature sensor 71 and the temperature detected by the second refrigerant temperature sensor 72 becomes nearly zero. Thus, when the difference between the refrigerant temperature (S1) detected by the first refrigerant temperature sensor 71 and the refrigerant temperature (S2) detected by the second refrigerant detection sensor 72 becomes small, it can be determined that the defrosting has been completed.

[1-3. Effects and the like]

[0089] As described above, in the present embodiment, the outdoor heat exchanger 50 includes the pair of header pipes 52 and 54, and the plurality of flat pipes 62 connected to the header pipes 52 and 54, and the flat pipes 62 are divided into the plurality of blocks from the first to block 70a to the fourth block 70d, each of the blocks including a plurality ones of the flat pipes 62, the first refrigerant temperature sensor 71 (the first refrigerant temperature detecting means) is provided at the position corresponding to the upper part of the second block 70b, which is the second highest block of the plurality of blocks 70, the second refrigerant temperature sensor 72 (the second refrigerant temperature detecting means) is provided at the position corresponding to the fourth block 70d, which is the lowest block of the plurality of blocks 70, and the control unit 80 that controls a defrosting operation based on temperatures detected by the first refrigerant temperature sensor 71 and the second refrigerant temperature sensor 72 is provided.

[0090] Accordingly, the frost formation state of the outdoor heat exchanger 50 with frost formed thereon can be determined by detecting the refrigerant temperature using the first refrigerant temperature sensor 71 after the refrigerant passes through the highest first block 70a and the second block 70b of the outdoor heat exchanger 50 and detecting the refrigerant temperature using the second refrigerant temperature sensor 72 after the refrigerant passes through the lowest fourth block 70d.

[0091] Thus, since the control unit 80 controls the defrosting operation based on the frost formation state of the outdoor heat exchanger 50, it is possible to prevent the defrosting operation from being finished with the frost remaining unmelted and prevent the defrosting operation from being continued even though the frost has already melted completely, which improves the accuracy of determination on whether to finish the defrosting operation.

[0092] Also, in the present embodiment, when the refrigerant temperature detected by the second refrigerant temperature sensor 72 (the second refrigerant temperature detecting means) becomes equal to or higher than a predetermined threshold and the difference between the temperature detected by the first refrigerant temperature sensor 71 (the first refrigerant temperature detecting means) and the temperature detected by the second refrigerant temperature sensor 72 becomes less than a predetermined threshold during a defrosting operation, the control unit 80 makes a switch from the defrosting

operation to a heating operation.

[0093] Accordingly, it is possible to determine the frost formation state of the outdoor heat exchanger 50 based on the temperatures detected by the first refrigerant temperature sensor 71 and the second refrigerant temperature sensor 72 and prevent the defrosting operation from being finished with frost remaining unmelted and prevent the defrosting operation from being continued even though the frost has already melted completely, which improves the accuracy of determination on whether to finish the defrosting operation.

(Second Embodiment)

[0094] Next, a second embodiment will be described. In the second embodiment, a part configured in the same manner as in the first embodiment is designated by the same reference sign as that in the first embodiment, and description thereof will be omitted.

[2-1. Configuration]

[0095] FIG. 8 is an explanatory diagram showing a block configuration of an outdoor heat exchanger 50 in the second embodiment of the present invention.

[0096] As shown in FIG. 8, in the present embodiment, a supercooling heat exchanger 90 is connected to the outdoor heat exchanger 50 through a refrigerant pipe 8.

[0097] A second refrigerant temperature sensor 72 is provided at a position corresponding to a fourth block 70d on an upstream side of the supercooling heat exchanger 90 during a defrosting operation.

[2-2. Operation/Effects and the like]

[0098] In the present embodiment, during a defrosting operation, the temperature of the refrigerant that has passed through the supercooling heat exchanger 90 decreases due to pressure loss. Thus, in addition to the influence of frost formation, another influence on the difference between the temperature detected by the first refrigerant temperature sensor 71 and the temperature detected by the second refrigerant temperature sensor 72 of the outdoor heat exchanger 50 occurs.

[0099] However, since the second refrigerant temperature sensor 72 is installed on the upstream side of the supercooling heat exchanger 90, the influence of the supercooling heat exchanger 90 can be prevented.

[0100] Accordingly, it is possible to prevent a defrosting operation from being finished with frost remaining unmelted and prevent the defrosting operation from being continued even though the frost has already melted completely, which improves the accuracy of determination on whether to finish the defrosting operation, by the control unit 80 controlling the defrosting operation based on the frost formation state of the outdoor heat exchanger 50.

[0101] As above, the first embodiment and the second embodiment have been described as examples of the technique disclosed in the present application. However, the technique in the present disclosure is not limited thereto and also applicable to embodiments with changes, replacements, additions, omissions, and the like. Also, the constituent elements described above in the first embodiment and the second embodiments may be combined to constitute a new embodiment.

Industrial Applicability

[0102] The present disclosure is applicable to an air conditioning apparatus that can prevent a defrosting operation from being finished with frost remaining unmelted and prevent the defrosting operation from being continued even though the frost has already melted completely, and improve the accuracy of determination on whether to finish the defrosting operation by a control unit controlling the defrosting operation based on the frost formation state of an outdoor heat exchanger.

Reference Signs List

[0103]

1	air conditioning apparatus
5	compressor
6	outdoor unit
7	indoor unit
8	refrigerant pipe
10	housing
15	front intake opening
17	side intake opening
19	exhaust opening
21	partition plate
30	outdoor fan
50	outdoor heat exchanger
52	header pipe
54	header pipe
60	partition wall
62	flat pipe
64	fin
66	first refrigerant pipe
68	second refrigerant pipe
70	block
70a	first block
70b	second block
70c	third block
70d	fourth block
71	first refrigerant temperature sensor
72	second refrigerant temperature sensor
75	selector valve
76	outdoor expansion valve
77	indoor heat exchanger
78	indoor fan
79	indoor expansion valve
80	control unit
90	supercooling heat exchanger

Claims

1. An air conditioning apparatus (1) comprising: a compressor (5); an outdoor heat exchanger (50); an expansion valve (76); and an indoor heat exchanger (77), **characterized in that**

   the outdoor heat exchanger includes a pair of header pipes (52, 54), and a plurality of flat pipes (62) connected to the header pipes, and the flat pipes are divided into a plurality of blocks (70), each of the blocks including a plurality ones of the flat pipes,
   a refrigerant temperature detecting means is provided at a position corresponding to an upper part of the block, and
   a control unit (80) configured to control a defrosting operation based on a temperature detected by the refrigerant temperature detecting means is provided.

2. The air conditioning apparatus according to claim 1, wherein the refrigerant temperature detecting means is a second refrigerant temperature (72) detecting means provided at a position corresponding to a lowest block of the plurality of blocks.

3. The air conditioning apparatus according to claim 2, wherein the refrigerant temperature detecting means is a first refrigerant temperature detecting means (71) provided at a position corresponding to a second highest block of the plurality of blocks.

4. The air conditioning apparatus according to claim 3, wherein when a refrigerant temperature detected by the second refrigerant temperature detecting means becomes equal to or higher than a predetermined threshold and a difference between a refrigerant temperature detected by the first refrigerant temperature detecting means and the refrigerant temperature detected by the second refrigerant temperature detecting means becomes less than a predetermined threshold during a defrosting operation, the control unit is configured to make a switch from the defrosting operation to a heating operation.

5. The air conditioning apparatus according to any one of claims 2 to 4, wherein

   a supercooling heat exchanger is connected to the outdoor heat exchanger, and
   the second refrigerant temperature detecting means is provided at a position corresponding to the block on an upstream side of the supercooling heat exchanger during a defrosting operation.

FIG.1

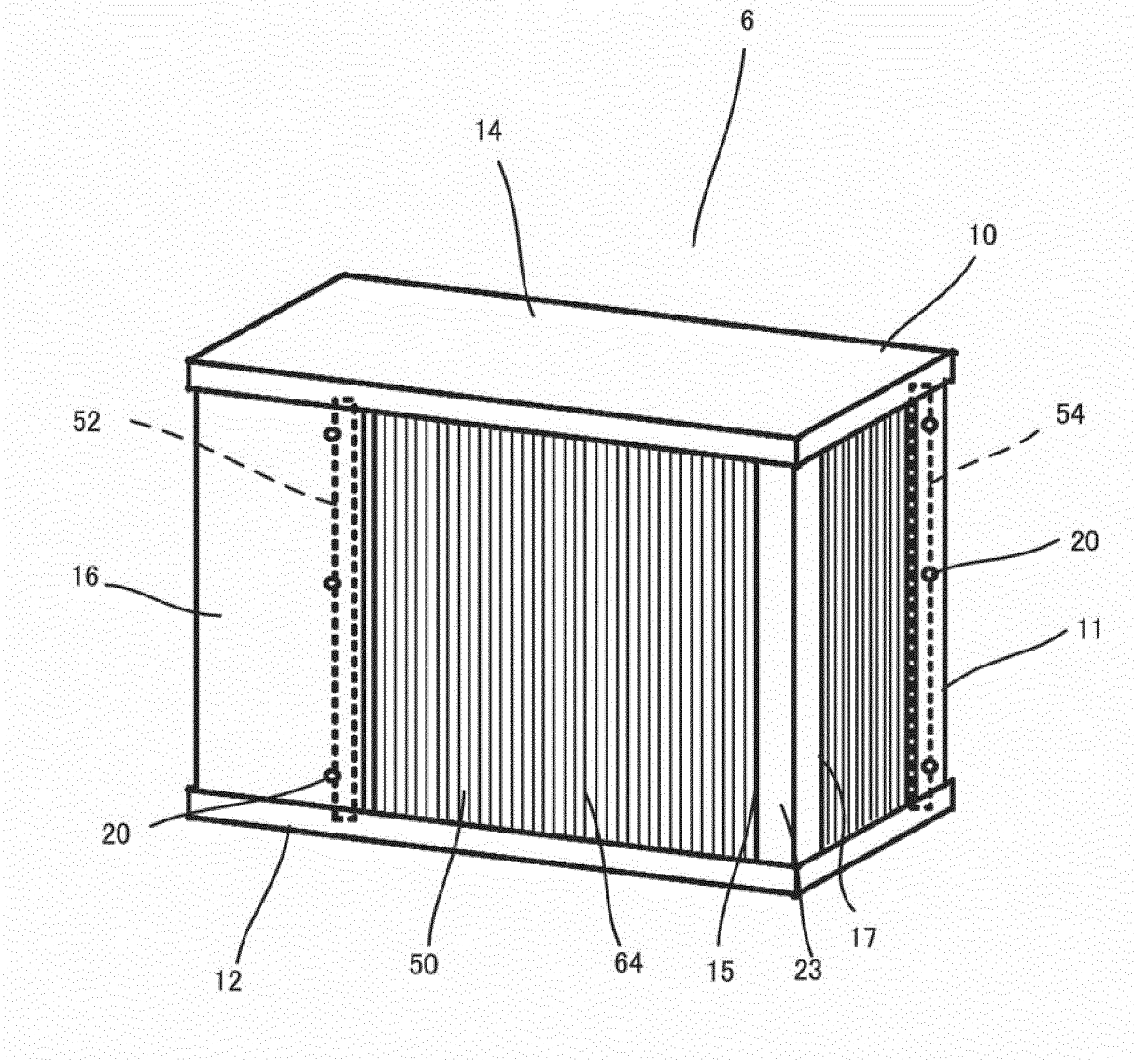


FIG.2

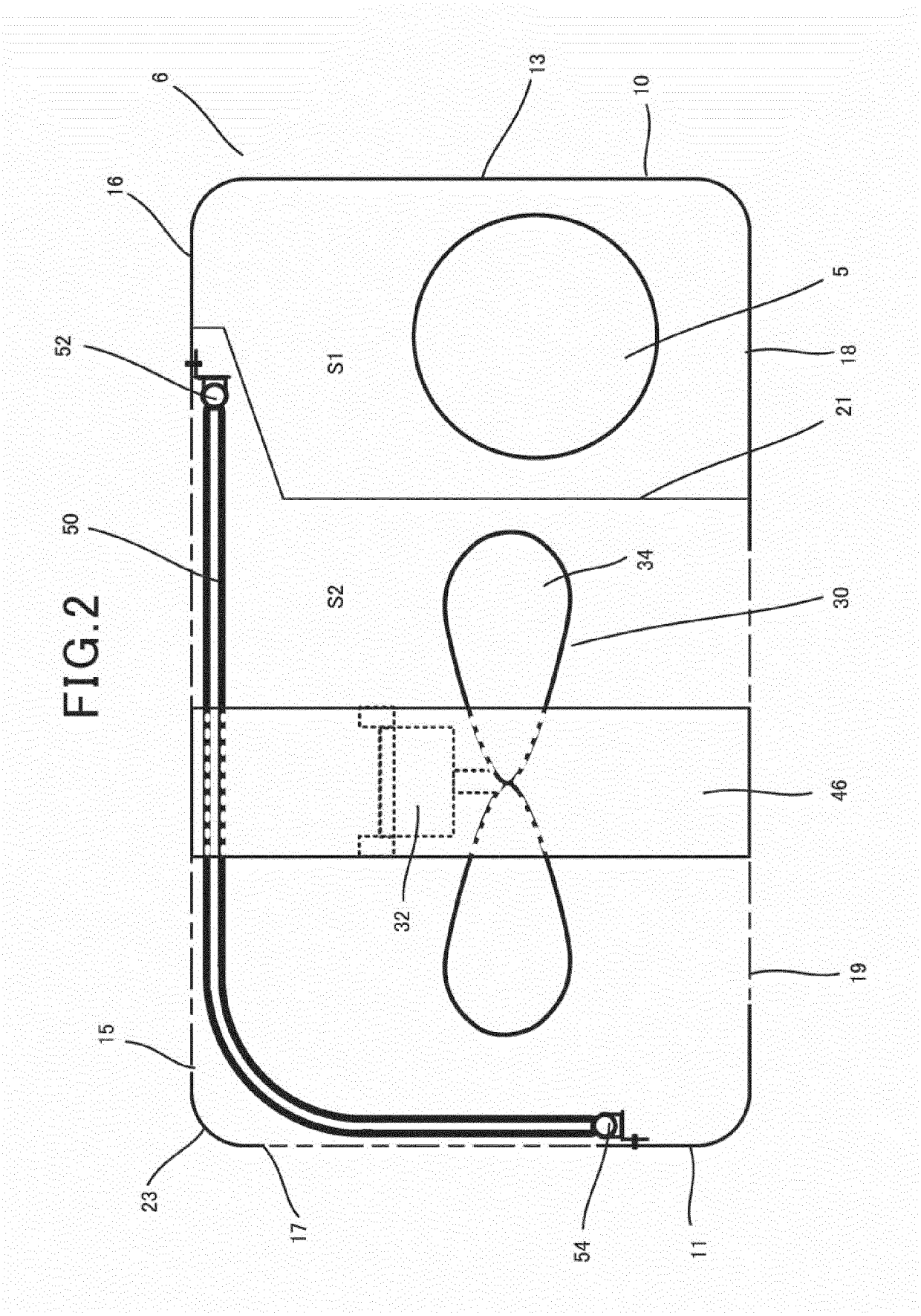


FIG.3

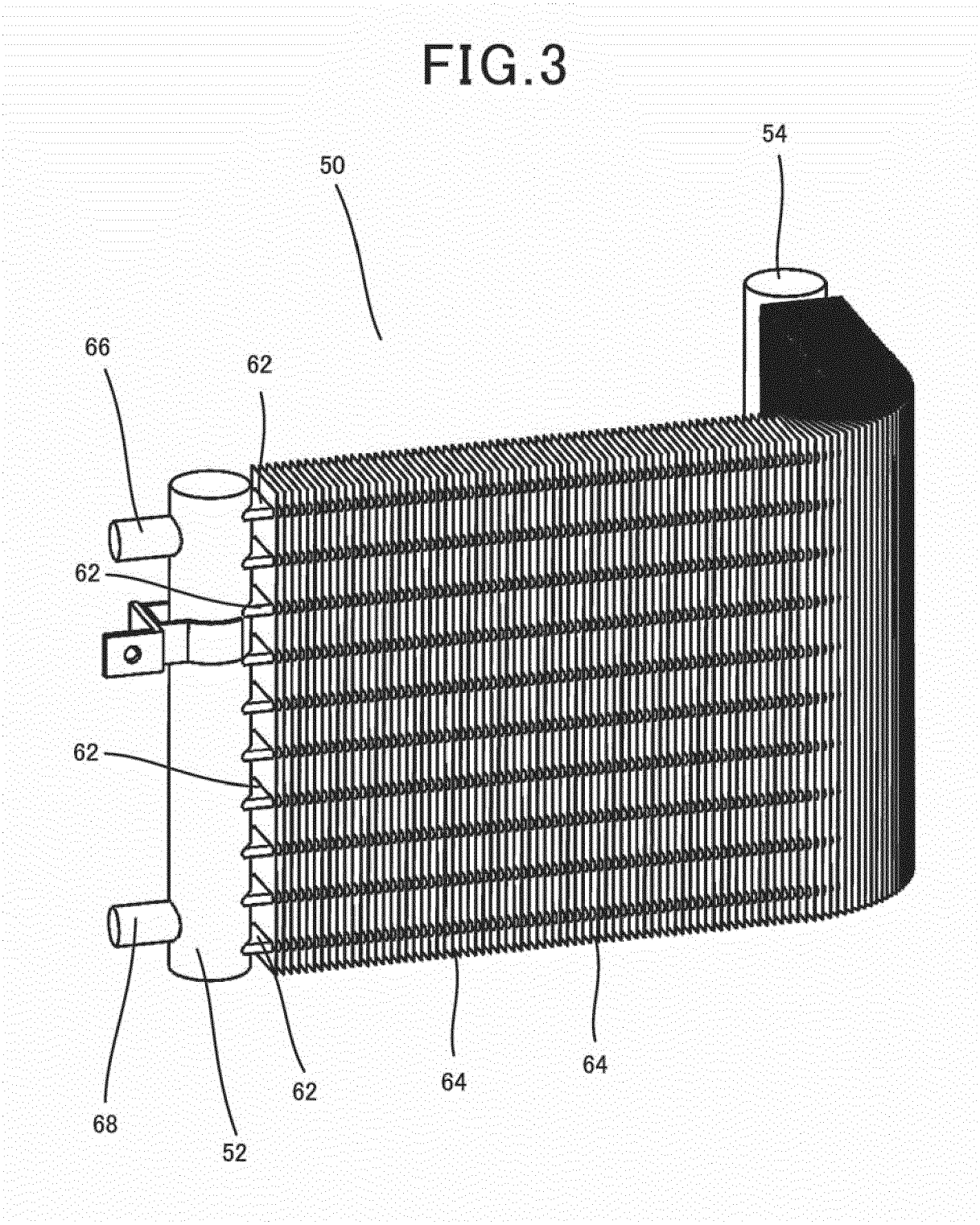


FIG.4

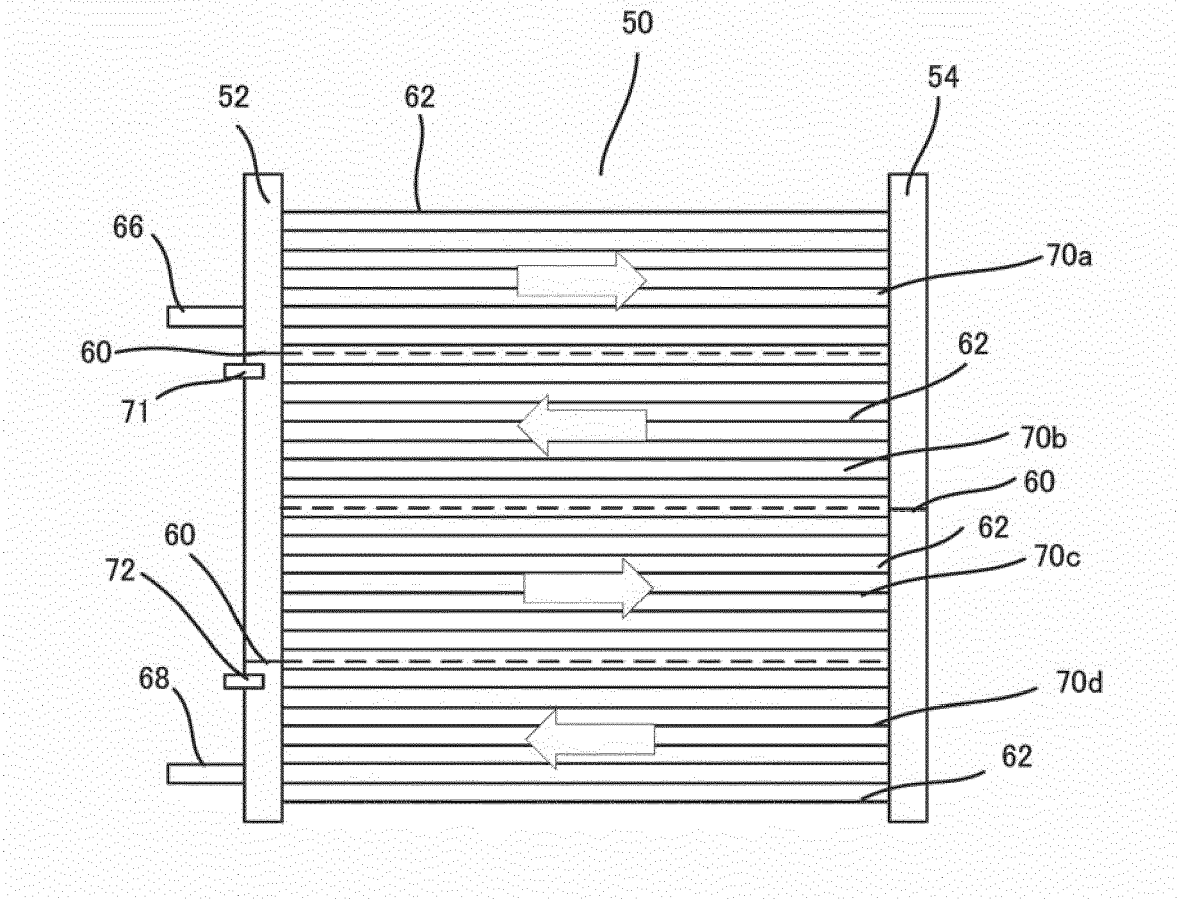


FIG.5

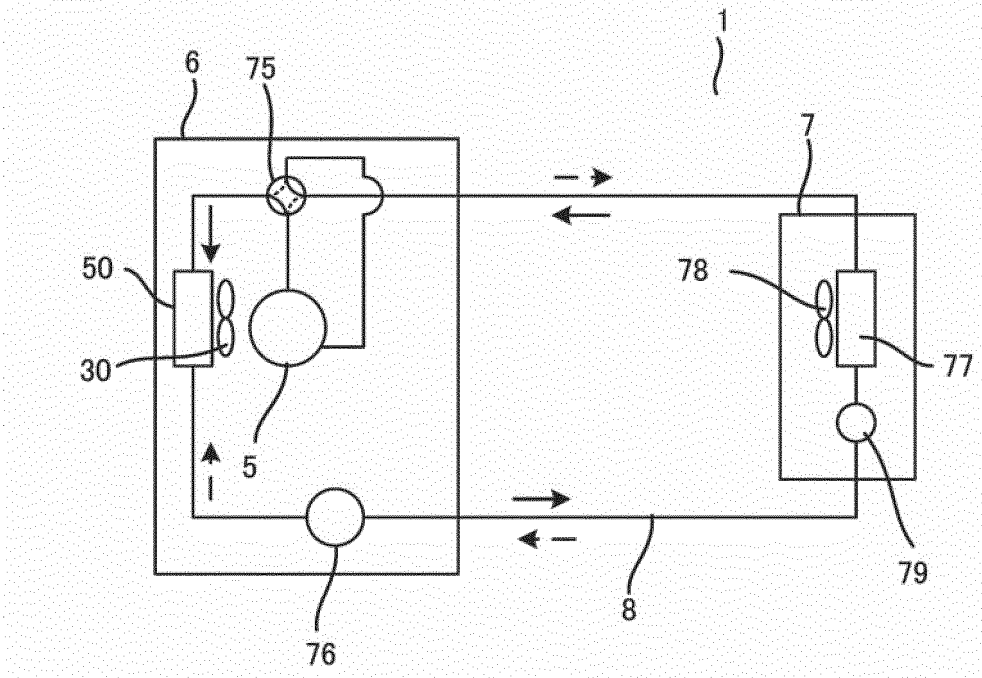


FIG.6

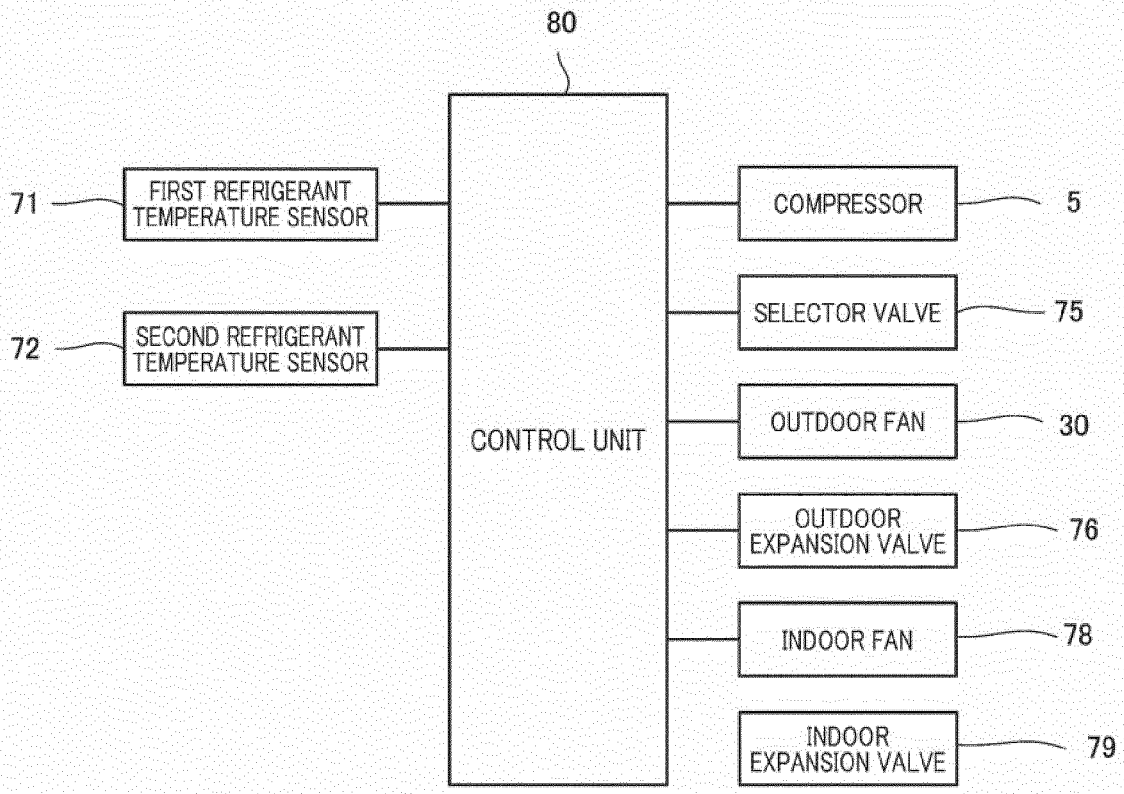

80
71
FIRST REFRIGERANT TEMPERATURE SENSOR
72
SECOND REFRIGERANT TEMPERATURE SENSOR
CONTROL UNIT
COMPRESSOR
5
SELECTOR VALVE
75
OUTDOOR FAN
30
OUTDOOR EXPANSION VALVE
76
INDOOR FAN
78
INDOOR EXPANSION VALVE
79

FIG.7

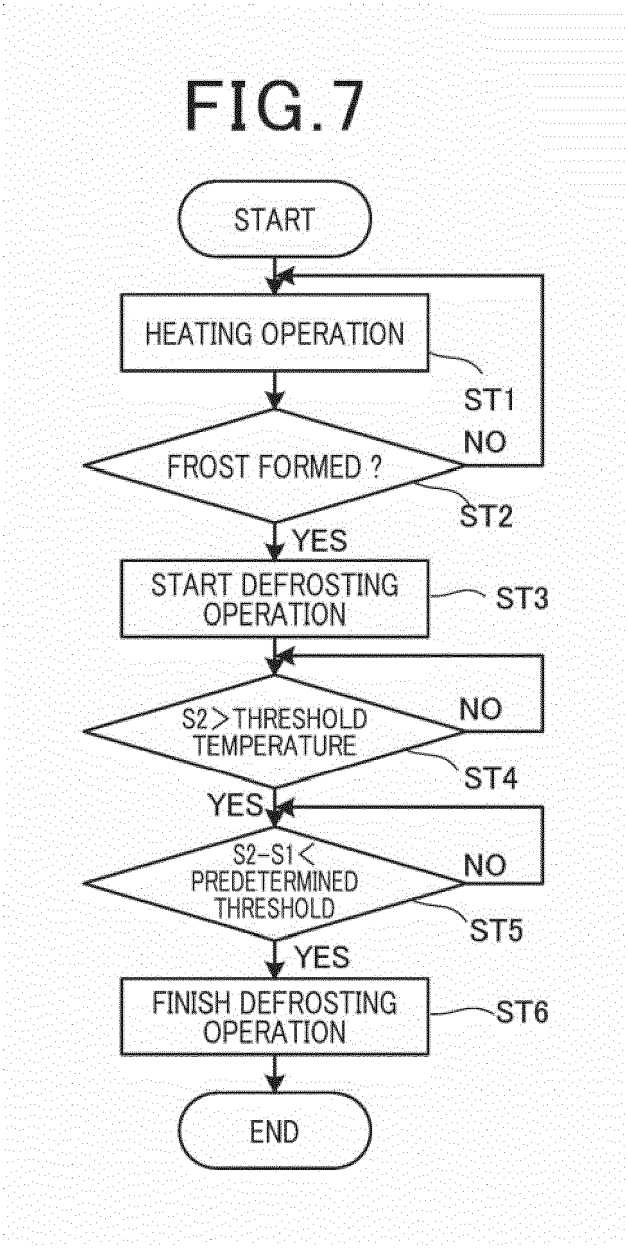
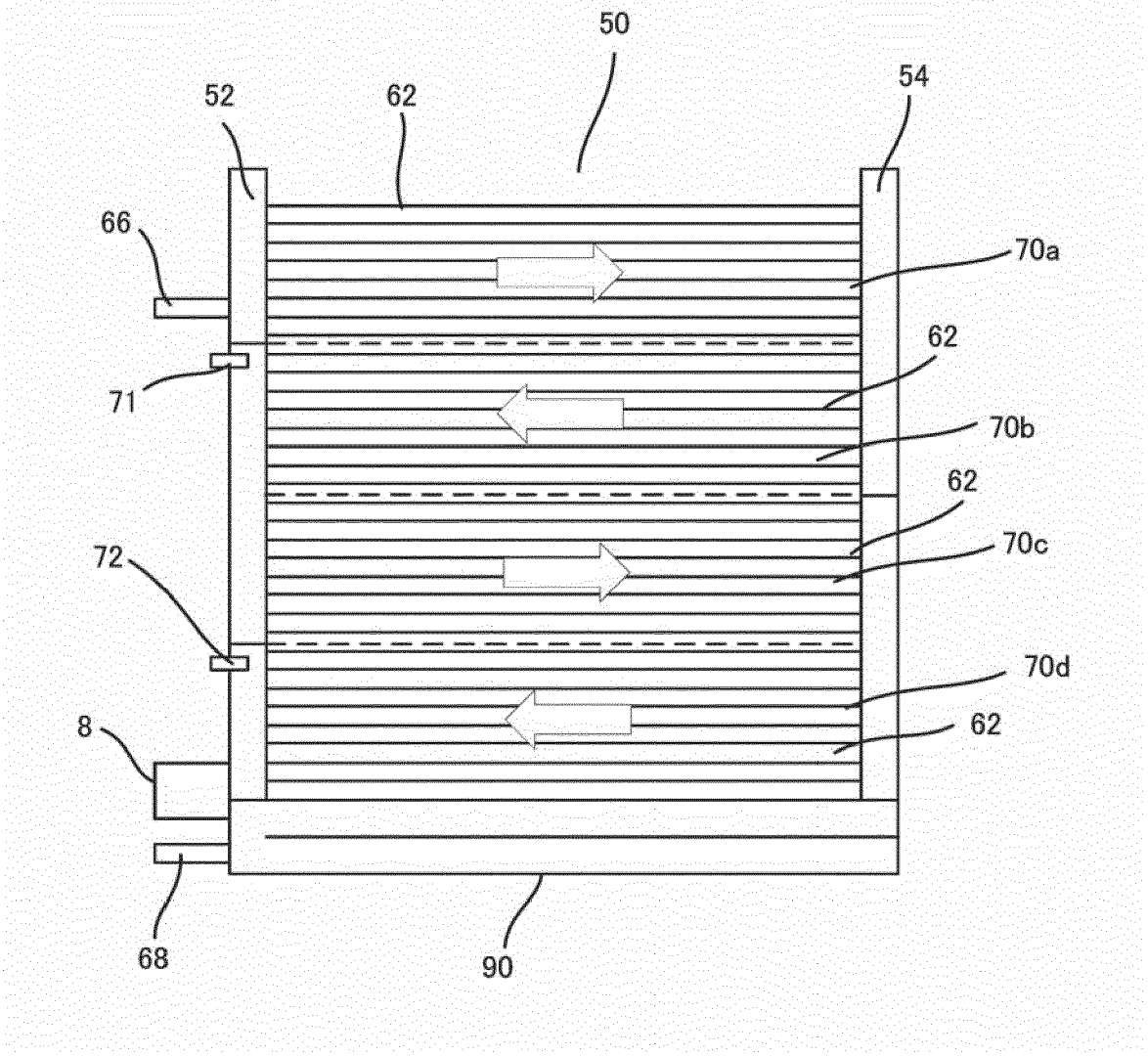

START
HEATING OPERATION
ST1
FROST FORMED ?
NO
ST2
YES
START DEFROSTING OPERATION
ST3
S2 > THRESHOLD TEMPERATURE
NO
ST4
YES
S2-S1 < PREDETERMINED THRESHOLD
NO
ST5
YES
FINISH DEFROSTING OPERATION
ST6
END

FIG.8



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EUROPEAN SEARCH REPORT

Application Number
EP 23 15 0081

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X	CN 106 556 078 A (GUANGDONG MIDEA REFRIGERATION EQUIPMENT CO LTD; MIDEA GROUP CO LTD) 5 April 2017 (2017-04-05)	1-3,5	INV. F25B49/02 F25B47/02 F25B13/00 F28F9/02
A	* the whole document *	4	
X	US 2017/108249 A1 (MORISHITA YUYA [JP]) 20 April 2017 (2017-04-20) * the whole document *	1	
A	EP 3 650 800 A1 (DAIKIN IND LTD [JP]) 13 May 2020 (2020-05-13) * the whole document *	1-5	

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F25B
F28F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 May 2023	Lucic, Anita

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18-05-2023

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