

(19)



(11)

EP 1 761 733 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
11.03.2009 Bulletin 2009/11

(21) Application number: **04737099.4**

(22) Date of filing: **21.06.2004**

(51) Int Cl.:
F25D 17/06 ^(2006.01)

(86) International application number:
PCT/KR2004/001481

(87) International publication number:
WO 2005/124250 (29.12.2005 Gazette 2005/52)

(54) **REFRIGERATOR, AND METHOD FOR CONTROLLING OPERATION OF THE SAME**

KÜHLVORRICHTUNG UND VERFAHREN ZUR STEUERUNG DES BETRIEBS DERSELBEN

REFRIGERATEUR ET PROCEDE DE COMMANDE DE FONCTIONNEMENT DE CE
REFRIGERATEUR

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PL PT RO SE SI SK TR**

(43) Date of publication of application:
14.03.2007 Bulletin 2007/11

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US-A- 5 816 060 **US-A1- 2004 107 725**

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Description

TECHNICAL FIELD

[0001] The present invention relates to a refrigerator which can efficiently perform a cooling operation and reduce power consumption, by individually cooling a freezing chamber and a refrigerating chamber and effectively controlling the operations of each component, and a method for controlling an operation of the same.

BACKGROUND ART

[0002] In general, a refrigerator is one of the living necessities which preserves food fresh for a predetermined period, by lowering a temperature of a freezing chamber or a refrigerating chamber by repeating a refrigeration cycle of compressing, condensing, expanding and evaporating refrigerants.

[0003] The refrigerator has a refrigeration cycle including basic components such as a compressor for compressing refrigerants into high temperature high pressure gas refrigerants, a condenser for condensing the refrigerants from the compressor into high temperature high pressure liquid refrigerants, an expansion valve for decompressing the refrigerants from the condenser into low temperature low pressure liquid refrigerants, and an evaporator for maintaining a low temperature in a freezing chamber or a refrigerating chamber, by absorbing heat from the freezing chamber or the refrigerating chamber by evaporating the refrigerants from the expansion valve into low temperature low pressure gas refrigerants.

[0004] Fig. 1 is a schematic front perspective view illustrating a conventional side-by-side type refrigerator, and Fig. 2 is a structure view illustrating a refrigeration cycle applied to the refrigerator of Fig. 1.

[0005] The conventional side-by-side type refrigerator in which a freezing chamber and a refrigerating chamber are disposed side by side will now be described with reference to Figs. 1 and 2. A refrigeration cycle including a compressor 12, a condenser 14, an expansion valve 16 and an evaporator 18 is built in an inner wall, for generating cool air by the evaporator 18. The freezing chamber F maintaining about -18°C by sucking most of the cool air, and the refrigerating chamber R maintaining about 0 to 7°C by sucking part of the cool air are disposed side by side at both sides of a main body 2.

[0006] The refrigeration cycle includes basic components, and thus explanations thereof are omitted.

[0007] Here, the freezing chamber F and the refrigerating chamber R are divided by a cross wall 4. Part of the cross wall 4 is opened so that the cool air can flow between the freezing chamber F and the refrigerating chamber R.

[0008] The evaporator 18 is installed on the inner wall in the freezing chamber F, and a blast fan 22 is installed at the upper portion of the evaporator 18, for sending cool air generated in the evaporator 18 to the freezing

chamber F or the refrigerating chamber R. Generally, an axial flow fan for sucking and discharging cool air in an axial direction is used.

[0009] The freezing chamber F and the refrigerating chamber R compose a cool air circulation structure for circulating cool air near the evaporator 18 through the freezing chamber F and the refrigerating chamber R by the operation of the blast fan 22, and returning the cool air to the evaporator 18.

[0010] The operations of the components of the refrigerator are controlled by a microcomputer (not shown). The microcomputer controls the whole components so that a temperature T_f of the freezing chamber F and a temperature T_r of the refrigerating chamber R can reach a set freezing temperature T_{f0} and a set refrigerating temperature T_{r0} setting by the user or automatically set.

[0011] In the conventional refrigerator, when a load is applied, the compressor 12 is operated according to a control signal from the microcomputer, and refrigerants are circulated though the compressor 12, the condenser 14, the expansion valve 16 and the evaporator 18, for cooling air near the evaporator 18 and generating cool air.

[0012] In addition, the blast fan 22 is operated according to a control signal from the microcomputer, so that most of the cool air near the evaporator 18 can be supplied to the freezing chamber F and part of the cool air can be supplied to the refrigerating chamber R. The cool air circulated in the freezing chamber F and the refrigerating chamber R to have a high temperature is re-supplied to the evaporator 18.

[0013] In the conventional refrigerator, one evaporator 18 is installed in the freezing chamber F, and the cool air heat-exchanged through the evaporator 18 is partially distributed and supplied to the refrigerating chamber R on the passage of the freezing chamber F. Accordingly, when the inside temperature of any one of the freezing chamber F and the refrigerating chamber R does not satisfy the set freezing temperature T_{f0} or the set refrigerating temperature T_{r0} , the compressor 12 and the blast fan 22 are operated to lower the temperature, thereby increasing power consumption or supercooling food.

[0014] For example, when the temperature T_f of the freezing chamber F reaches the set freezing temperature T_{f0} , if the temperature T_r of the refrigerating chamber R does not satisfy the set refrigerating temperature T_{r0} , the temperature T_r of the refrigerating chamber R must be lowered to reach the set refrigerating temperature T_{r0} by operating the compressor 12 and the blast fan 22. Here, the cool air is also supplied to the freezing chamber F, to unnecessarily lower the temperature T_f of the freezing chamber F. In addition, power consumption increases.

[0015] On the other hand, when the temperature T_r of the refrigerating chamber R reaches the set refrigerating temperature T_{r0} , if the temperature T_f of the freezing chamber F does not satisfy the set freezing temperature T_{f0} , the temperature T_f of the freezing chamber F must be lowered to reach the set freezing temperature T_{f0} by operating the compressor 12 and the blast fan 22. The

cool air is also supplied to the refrigerating chamber R_1 to unnecessarily lower the temperature T_r of refrigerating chamber R. Moreover, food is supercooled.

[0016] In the conventional refrigerator, part of the cool air from the evaporator 18 is distributed to the refrigerating chamber R. A volume of the cool air distributed to the refrigerating chamber R is relatively smaller than a volume of the cool air distributed to the freezing chamber F. Therefore, a cooling speed of the refrigerating chamber R is reduced, to unnecessarily operate the compressor 12.

[0017] For example, when the temperature T_r of the refrigerating chamber R does not reach the set refrigerating temperature T_{r0} , the compressor 12 is operated until the temperature T_r of the refrigerating chamber R reaches the set refrigerating temperature T_{r0} . Accordingly, an excessive load is applied to the compressor 12 to reduce the temperature of the evaporator 18 lower than the temperature T_f of the freezing chamber F.

[0018] With respect to the prior art attention is drawn to international patent publication WO-A-00 79192 from which an improvement in the forced airflow system for refrigerators is known. The improvement comprises: at least two refrigeration environments; and a refrigeration air impelling means forcing the passage of an air flow from a refrigeration environment through a respective evaporator portion and comprising only one fan associated with at least two suction chamber, which are each opened to a respective refrigeration environment and to at least two discharge chambers, which are each opened to an inlet side of a respective evaporator portion.

[0019] From U.S. patent publication US-A-3 382 683 a refrigerator cabinet is known having a low and a high temperature compartment cooled by a single evaporator. The evaporator is arranged with a circular to comeingle the air from both compartments and pass it across different portions of the evaporator for return to the low temperature compartment. A counterflow between the compartments is through an open interconnecting passage-way.

[0020] The invention disclosed in published U.S. patent application US-A-2004 107 725 is to increase a floor area ratio of a freezing chamber and a utilization rate of heat transfer. A refrigerator is disclosed, which includes a cabinet having a storage space, a mullion provided in the cabinet to divide the storage space into a freezing chamber and a refrigerator chamber, the mullion having a cold airflow passage provided therein that is communicated with the freezing chamber and the refrigerator chamber, a double suction centrifugal blower provided in a middle space of the mullion and sucking air from the freezing chamber and the refrigerator chamber and exhausting to the cold airflow passage, an evaporator provided in the cold airflow passage for exchanging heat with the air exhausted from the double suction centrifugal blower, a top outlet and a bottom outlet exhausting air being passed through the evaporator to the freezing chamber and the refrigerator chamber.

[0021] Further, U.S. patent publication US-A-5 816 060 relates to an air flow control arrangement for a side-by-side refrigerator which results in temperature variations, both spatial and temporal, of approximately about ± 1 degree F. in the fresh food compartment, is described. Such air flow control also is believed to even further reduce the internal "sweat" in the fresh food compartment. In one embodiment, and with respect to a side-by-side refrigerator, the middle duct in the center mullion wall is closed off, and a duct is added in the center mullion wall, or could be installed as a separate duct outside the mullion, connecting a supply port in the top, back, left hand corner in fresh food compartment to a position in the evaporator chamber. The added duct also seals off direct airflow between the evaporator chamber and the fresh food compartment. An auxiliary air flow control fan located in a port in the center mullion wall controls air flow through the fresh food compartment, and ducts located in a middle portion of the center mullion wall arc provided to allow cool air in freezer compartment to flow into fresh food compartment. Manually set dampers may be located in these ducts to control the amount of air flow from the freezer compartment to the fresh food compartment. Cool freezer air also may flow through the center mullion wall lower duct into the fresh food compartment.

DISCLOSURE OF THE INVENTION

[0022] The present invention is achieved to solve the above problems. An object of the present invention is to provide a refrigerator which can improve cooling efficiency and reduce power consumption, by individually cooling a freezing chamber and a refrigerating chamber, and a method for controlling an operation of the same.

[0023] Another object of the present invention is to provide a refrigerator which can prevent a compressor from being unnecessarily operated, by increasing a cooling speed of a refrigerating chamber as well as a cooling speed of a freezing chamber so that a temperature of the refrigerating chamber can rapidly reach a set refrigerating temperature, and a method for controlling an operation of the same.

[0024] Yet another object of the present invention is to provide a refrigerator which can increase an inside capacity of a freezing chamber or a refrigerating chamber, and a method for controlling an operation of the same.

[0025] Yet another object of the present invention is to provide a refrigerator which can prevent an evaporator from being frosted and effectively perform a defrosting operation, and a method for controlling an operation of the same.

[0026] The present invention relates to a refrigerator as defined in independent claim 1. Further, the present invention relates to a method for controlling an operation of a refrigerator as defined in independent claim 31.

[0027] Preferred embodiments of the invention are disclosed in the dependent claims.

[0028] In order to achieve the above-described objects

of the present invention, there is provided a refrigerator including: a compressor for compressing refrigerants into high temperature high pressure gas refrigerants; a condenser for condensing the refrigerants compressed in the compressor into high temperature high pressure liquid refrigerants; a decompression means for expanding the refrigerants condensed in the condenser into low temperature low pressure liquid refrigerants; an evaporator for evaporating the refrigerants expanded in the decompression means into low temperature low pressure gas refrigerants, a heat exchange region of which being divided into a freezing chamber side region and a refrigerating chamber side region; and an air blast device linked respectively to the freezing chamber side region and the refrigerating chamber side region of the evaporator, for sending cool air from each region to a freezing chamber and a refrigerating chamber.

[0029] According to another aspect of the present invention, a method for controlling an operation of a refrigerator includes: a first step for compressing refrigerants into high temperature high pressure gas refrigerants according to a freezing load or a refrigerating load applied to a freezing chamber or a refrigerating chamber; a second step for condensing the refrigerants compressed in the first step into high temperature high pressure liquid refrigerants by performing a heat exchange operation with air; a third step for decompressing the refrigerants condensed in the second step into low temperature low pressure liquid refrigerants by controlling a decompression degree according to the load; and a fourth step for generating cool air by evaporating the refrigerants decompressed in the third step into low temperature low pressure gas refrigerants by performing a heat exchange operation with air, and selectively sending the cool air to the freezing chamber, the refrigerating chamber, or both the freezing chamber and the refrigerating chamber according to the load.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The present invention will become better understood with reference to the accompanying drawings which are given only by way of illustration and thus are not limitative of the present invention, wherein:

Fig. 1 is a schematic front perspective view illustrating a conventional side-by-side type refrigerator;
 Fig. 2 is a structure view illustrating a refrigeration cycle applied to the refrigerator of Fig. 1;
 Fig. 3 is a front perspective view illustrating a side-by-side type refrigerator in accordance with a first embodiment of the present invention;
 Fig. 4 is a cross-sectional view illustrating the refrigerator of Fig. 3;
 Fig. 5 is a front perspective view illustrating a side-by-side type refrigerator in accordance with a second embodiment of the present invention;
 Fig. 6 is a cross-sectional view illustrating the refrig-

erator of Fig. 5;

Fig. 7 is a structure view illustrating a first example of a refrigeration cycle applied to the refrigerators of Figs. 3 and 5;

Fig. 8 is a structure view illustrating a second example of the refrigeration cycle applied to the refrigerators of Figs. 3 and 5;

Fig. 9 is a structure view illustrating a third example of the refrigeration cycle applied to the refrigerators of Figs. 3 and 5;

Fig. 10 is a perspective view illustrating a first example of an evaporator applied to the refrigerators of Figs. 3 and 5;

Fig. 11 is a perspective view illustrating a second example of the evaporator applied to the refrigerators of Figs. 3 and 5; and

Fig. 12 is a flowchart showing sequential steps of a method for controlling an operation of a refrigerator in accordance with a preferred embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0031] A refrigerator and a method for controlling an operation of the same in accordance with the present invention will now be described in detail with reference to the accompanying drawings.

[0032] Fig. 3 is a front perspective view illustrating a side-by-side type refrigerator in accordance with a first embodiment of the present invention, and Fig. 4 is a cross-sectional view illustrating the refrigerator of Fig. 3.

[0033] The refrigerator in accordance with the first embodiment of the present invention will now be described with reference to Figs. 3 and 4. A freezing chamber F and a refrigerating chamber R are disposed side by side at both sides of a main body 52 from a cross wall 54. A compressor (not shown), a condenser (not shown) and an expansion means (not shown) are built in a machine room (not shown) formed at one side of the freezing chamber F and the refrigerating chamber R. An evaporator 68 is built in the freezing chamber F, for generating cool air by performing a heat exchange operation with refrigerants.

[0034] Especially, the evaporator 68 is divided into a freezing chamber side region 68a and a refrigerating chamber side region 68b. Individual circulation passages are formed to circulate the cool air heat-exchanged in each region in the freezing chamber F and the refrigerating chamber R, respectively. A freezing chamber fan 72 and a refrigerating chamber fan 74 for sending the cool air from the freezing chamber side region 68a and the refrigerating chamber side region 68b to the freezing chamber F and the refrigerating chamber R, respectively, and motors (not shown) for driving the fans 72 and 74 are installed on the circulation passages to be linked to the freezing chamber side region 68a and the refrigerating chamber side region 68b.

[0035] Preferably, the compressor is a capacity varia-

ble compressor such as an inverter compressor or a linear compressor to control a compression flow rate, and the expansion means is a capillary tube having a relatively small refrigerant tube diameter or an electronic expansion valve controlling opening.

[0036] In the evaporator 68, a heat exchange region is divided by a special blocking plate 70 so that the freezing chamber side region 68a and the refrigerating chamber side region 68b can be disposed side by side.

[0037] Here, the evaporator 68 is a straight type thin heat exchanger in which a plurality of cooling fins 68B are installed vertically to a refrigerant tube 68A. The blocking plate 70 is installed between the cooling fins 68B. A plurality of grooves (not shown) are formed on the surface of the blocking plate 70, for forming a turbulent bed to the cool air flowing along the surface of the evaporator 68, thereby improving heat exchange efficiency.

[0038] As shown in Fig. 10, in the evaporator 68, the freezing chamber side region 68a and the refrigerating chamber side region 68b can have the same area. Generally, in order to maintain the freezing chamber F at a lower temperature than the refrigerating chamber R, lower temperature cool air is necessary in the freezing chamber F. Accordingly, as depicted in Fig. 11, the freezing chamber side region 68a is preferably larger than the refrigerating chamber side region 68b.

[0039] In addition, in the evaporator 68, the freezing chamber side region 68a maintains a lower temperature than the refrigerating chamber side region 68b, and thus is more easily frosted than the refrigerating chamber side region 68b. Therefore, a cooling fin pitch a of the freezing chamber side region 68a is set wider than a cooling fin pitch b of the refrigerating chamber side region 68b, to efficiently prevent frost.

[0040] The refrigerating chamber side region 68b is narrower than the freezing chamber side region 68a, to reduce heat exchange efficiency. Here, the cooling fan pitch b of the refrigerating chamber side region 68b is narrower than the cooling fan pitch a of the freezing chamber side region 68a. Accordingly, more cooling fins are installed in a unit area of the refrigerating chamber side region 68b, thereby improving heat exchange efficiency in the refrigerating chamber side region 68b.

[0041] Preferably, at least one defrosting heater (not shown) is installed at the lower portion of the evaporator 68, for performing a defrosting operation. A defrosting heater (not shown) for the freezing chamber F is installed at the lower portion of the freezing chamber side region 68a, for defrosting the freezing chamber side region 68a, and a defrosting heater (not shown) for the refrigerating chamber R is installed at the lower portion of the refrigerating chamber side region 68b, for defrosting the refrigerating chamber side region 68b.

[0042] Preferably, the defrosting heater for the freezing chamber F and the defrosting heater for the refrigerating chamber R are radiant heaters for transmitting heat to the evaporator 68 by radiation. The defrosting heater

for the freezing chamber F has a larger capacity than the defrosting heater for the refrigerating chamber R, thereby rapidly defrosting the freezing chamber side region 68a.

[0043] The freezing chamber fan 72 and the refrigerating chamber fan 74 are disposed side by side at the upper portions of the freezing chamber side region 68a and the refrigerating chamber side region 68b, for sending the refrigerants from the evaporator 68 to the freezing chamber F and the refrigerating chamber R, respectively. Recently, as a large volume of cool air is required due to increase of a capacity of the refrigerator, sirocco fans which are centrifugal fans which have a relatively large air blast volume and which can be effectively installed in a restricted space of the upper portion of the evaporator 68 which is a thin heat exchanger are used as the freezing chamber fan 72 and the refrigerating chamber fan 74.

[0044] That is, the freezing chamber fan 72 and the refrigerating chamber fan 74 are sirocco fans for sucking air in an axial direction and discharging air in a radius direction. Therefore, the freezing chamber fan 72 and the refrigerating chamber fan 74 are disposed side by side at the upper portion of the evaporator 68 in an axial direction and installed on the individual circulation passages, respectively, so that the cool air from the evaporator 68 can be supplied to both sides of the freezing chamber fan 72 and the refrigerating chamber fan 74 and discharged to the front surface thereof.

[0045] Preferably, the motors for driving the freezing chamber fan 72 and the refrigerating chamber fan 74 are BLDC motors. Because the BLDC motor uses a driving circuit for converting an alternating current to a direct current instead of using a brush, the BLDC motor does not generate a spark by a carbon material brush, prevents gas explosion, is stably driven in most of rotation numbers, and maintains high efficiency of 70 to 80%.

[0046] In accordance with the first embodiment of the present invention, there are formed the circulation passage for the freezing chamber F for discharging the cool air from the freezing chamber side region 68a of the evaporator 68 to the freezing chamber F, circulating the cool air in the freezing chamber F, and re-supplying the circulated air to the freezing chamber side region 68a of the evaporator 68, and the circulation passage for the refrigerating chamber R for discharging the cool air from the refrigerating chamber side region 68b of the evaporator 68 to the refrigerating chamber R, circulating the cool air in the refrigerating chamber R, and re-supplying the circulated air to the refrigerating chamber side region 68b.

[0047] Here, the evaporator 68 is installed on the inner wall of the freezing chamber F. Accordingly, the circulation passage for the refrigerating chamber R including a suction passage for the refrigerating chamber R and a discharge passage for the refrigerating chamber R is formed between the refrigerating chamber side region 68b and the refrigerating chamber R, and the circulation passage for the freezing chamber F is automatically formed in the other regions.

[0048] The cool air is individually circulated in the freezing chamber F and the refrigerating chamber R to efficiently cool the freezing chamber F and the refrigerating chamber R. Even if a door of the freezing chamber F or the refrigerating chamber R is opened/closed, the other door is not moved.

[0049] On the other hand, a connection passage (not shown) is formed on the cross wall 54 between the freezing chamber F and the refrigerating chamber R, so that the cool air can flow therethrough. A damper (not shown) is installed to be opened/closed on the connection passage. The damper is opened/closed by the microcomputer for controlling the operation of the refrigerator, for supplying part of the cool air of the freezing chamber F to the refrigerating chamber R.

[0050] Fig. 5 is a front perspective view illustrating a side-by-side type refrigerator in accordance with a second embodiment of the present invention, and Fig. 6 is a cross-sectional view illustrating the refrigerator of Fig. 5.

[0051] The refrigerator in accordance with the second embodiment of the present invention will now be explained with reference to Figs. 5 and 6. Identically to the first embodiment, a freezing chamber F and a refrigerating chamber R are disposed side by side at both sides of a main body 52 from a cross wall 54. A compressor (not shown), a condenser (not shown) and an expansion means (not shown) are built in a machine room (not shown) formed at one side of the freezing chamber F and the refrigerating chamber R. An evaporator 68 is built in the freezing chamber F and the refrigerating chamber R for generating cool air by performing a heat exchange operation with refrigerants.

[0052] Especially, the evaporator 68 is divided into a freezing chamber side region 68a and a refrigerating chamber side region 68b by the cross wall 54. Individual circulation passages are formed to circulate the cool air heat-exchanged in each region in the freezing chamber F and the refrigerating chamber R, respectively. A freezing chamber fan 72 and a refrigerating chamber fan 74 for sending the cool air from the freezing chamber side region 68a and the refrigerating chamber side region 68b to the freezing chamber F and the refrigerating chamber R, respectively, and motors (not shown) for driving the fans 72 and 74 are installed on the circulation passages to be linked to the freezing chamber side region 68a and the refrigerating chamber side region 68b.

[0053] Preferably, the compressor and the expansion means are formed in the same manner as those of the first embodiment.

[0054] In the evaporator 68, a heat exchange region is divided by the cross wall 54 so that the freezing chamber side region 68a and the refrigerating chamber side region 68b can be disposed side by side. A plurality of grooves (not shown) are formed on the surface of the cross wall 54, for forming a turbulent bed to the cool air flowing along the surface of the evaporator 68, thereby improving heat exchange efficiency.

[0055] The evaporator 68 is a straight type thin heat exchanger in which a plurality of cooling fins 68B are installed vertically to a refrigerant tube 68A. As shown in Fig. 10, the freezing chamber side region 68a and the refrigerating chamber side region 68b can have the same area, or as depicted in Fig. 11, the freezing chamber side region 68a can be larger than the refrigerating chamber side region 68b. A cooling fin pitch a of the freezing chamber side region 68a is set wider than a cooling fin pitch b of the refrigerating chamber side region 68b, to efficiently prevent the freezing chamber side region 68a from being frosted and improve heat exchange efficiency in the refrigerating chamber side region 68b.

[0056] Preferably, at least one defrosting heater (not shown) is installed at the lower portion of the evaporator 68, for performing a defrosting operation. The defrosting heaters are also formed in the same manner as those of the first embodiment.

[0057] The freezing chamber fan 72, the refrigerating chamber fan 74, and the motors for driving the fans 72 and 74 are formed in the same manner as those of the first embodiment.

[0058] In accordance with the second embodiment of the present invention, there are formed the circulation passage for the freezing chamber F for discharging the cool air from the freezing chamber side region 68a of the evaporator 68 to the freezing chamber F, circulating the cool air in the freezing chamber F, and re-supplying the circulated air to the freezing chamber side region 68a of the evaporator 68, and the circulation passage for the refrigerating chamber R for discharging the cool air from the refrigerating chamber side region 68b of the evaporator 68 to the refrigerating chamber R, circulating the cool air in the refrigerating chamber R, and re-supplying the circulated air to the refrigerating chamber side region 68b.

[0059] In the evaporator 68, the freezing chamber side region 68a is disposed on the inner wall of the freezing chamber F, and the refrigerating chamber side region 68b is disposed on the inner wall of the refrigerating chamber R. Here, the freezing chamber side region 68a and the refrigerating chamber side region 68b are divided by the cross wall 54. Accordingly, the circulation passage for the freezing chamber F and the circulation passage for the refrigerating chamber R need not to be specially divided.

[0060] A connection passage (not shown) is formed on the cross wall 54 between the freezing chamber F and the refrigerating chamber R, so that the cool air can flow therethrough. A damper (not shown) is installed to be opened/closed on the connection passage. The damper is opened/closed by the microcomputer for controlling the operation of the refrigerator, for supplying part of the cool air of the freezing chamber F to the refrigerating chamber R.

[0061] Fig. 7 is a structure view illustrating a first example of a refrigeration cycle applied to the refrigerators of Figs. 3 and 5.

[0062] The first example of the refrigeration cycle which can be applied to the refrigerators in accordance with the first and second embodiments of the present invention will now be explained. The refrigeration cycle includes a compressor 62 for compressing refrigerants into high temperature high pressure gas refrigerants, a condenser 64 for condensing the refrigerants compressed in the compressor 62 into high temperature high pressure liquid refrigerants by performing a heat exchange operation with outdoor air, an expansion means 66 having a freezing expansion valve 66a or a refrigerating expansion valve 66b for decompressing the refrigerants condensed in the condenser 64 into low temperature low pressure liquid refrigerants by controlling a decompression degree according to a load, a three way valve 82 for controlling the refrigerants discharged from the condenser 64 to be selectively supplied to the freezing expansion valve 66a or the refrigerating expansion valve 66b, and an evaporator 68 for evaporating the refrigerants decompressed in the expansion means 66 into low temperature low pressure gas refrigerants by performing a heat exchange operation with air in a freezing chamber F or a refrigerating chamber R, and generating cool air at the same time.

[0063] The evaporator 68 is divided into a freezing chamber side region 68a and a refrigerating chamber side region 68b. A freezing chamber fan 72 and a motor are installed to be linked to the freezing chamber side region 68a, so that the cool air passing through the freezing chamber side region 68a can be supplied merely to the freezing chamber F. A refrigerating chamber fan 74 and a motor are installed to be linked to the refrigerating chamber side region 68b, so that the cool air passing through the refrigerating chamber side region 68b can be supplied merely to the refrigerating chamber R.

[0064] In detail, a constant speed compressor can be used as the compressor 62. However, the compressor 62 is preferably a capacity variable compressor for controlling a flow rate of the refrigerants circulated in the refrigeration cycle and controlling a compression degree of the refrigerants. For example, an inverter compressor or a linear compressor which can vary a rotation number is used as the compressor 62.

[0065] The condenser 64 is a heat exchanger. In order efficiently perform the heat exchange operation with outdoor air, a special fan (not shown) can be installed adjacently to the condenser 64.

[0066] The freezing expansion valve 66a and the refrigerating expansion valve 66b are disposed side by side. Refrigerant tubes formed at the front and rear ends of the freezing expansion valve 66a and the refrigerating expansion valve 66b are coupled to each other, respectively. Capillary tubes having a relatively small refrigerant tube diameter or electronic expansion valves controlling opening can be used.

[0067] Here, the freezing expansion valve 66a and the refrigerating expansion valve 66b are different in capacity. The freezing expansion valve 66a has a relatively

larger decompression capacity than the refrigerating expansion valve 66b. The freezing expansion valve 66a and the refrigerating expansion valve 66b can switch the passages of the refrigerants according to each load.

[0068] The three way valve 82 controls the refrigerants from the condenser 64 to be supplied in one direction of the freezing expansion valve 66a or the refrigerating expansion valve 66b. Preferably, the three way valve 82 is installed on the refrigerant tubes branched into the freezing expansion valve 66a and the refrigerating expansion valve 66b.

[0069] Here, the three way valve 82 controls the refrigerants to pass through the freezing expansion valve 66a so that a temperature T_f of the freezing chamber F can reach a set freezing temperature T_{f0} , and controls the refrigerants to pass through the refrigerating expansion valve 66b so that a temperature T_r of the refrigerating chamber R can reach a set refrigerating temperature T_{r0} .

[0070] The evaporator 68 is installed so that the freezing chamber side region 68a and the refrigerating chamber side region 68b can be linked to the freezing chamber F and the refrigerating chamber R, respectively. The freezing chamber fan 72, the refrigerating chamber fan 74, and the motors for driving the fans 72 and 74 are installed on each passage.

[0071] Preferably, the evaporator 68 is a straight type thin heat exchanger, the freezing chamber fan 72 and the refrigerating chamber fan 74 are sirocco fans, and the motors are BLCD motors.

[0072] While the compressor 62 is operated, the low temperature low pressure gas refrigerants are circulated in the freezing chamber side region 68a and the refrigerating chamber side region 68b of the evaporator 68. Accordingly, the cool air is supplied to the freezing chamber F or the refrigerating chamber R according to the operations of the freezing chamber fan 72 and the refrigerating chamber fan 74.

[0073] Here, the freezing chamber fan 72 sends the cool air from the freezing chamber side region 68a to the freezing chamber F so that the temperature T_f of the freezing chamber F can reach the set freezing temperature T_{f0} , and the refrigerating chamber fan 74 sends the cool air from the refrigerating chamber side region 68b to the refrigerating chamber R so that the temperature T_r of the refrigerating chamber R can reach the set refrigerating temperature T_{r0} .

[0074] The evaporator 68 is formed to individually link the freezing chamber side region 68a and the refrigerating chamber side region 68b to the freezing chamber F and the refrigerating chamber R, and to have circulation passages for circulating cool air in the freezing chamber F and the refrigerating chamber R, respectively.

[0075] The operations of the above-described components are controlled by a microcomputer (not shown).

[0076] The operation of the first example of the refrigeration cycle will now be described.

[0077] In a freezing mode for making the temperature T_f of the freezing chamber F reach the set freezing tem-

perature T_{f0} , the microcomputer controls the three way valve 82 so that the refrigerants can pass through the freezing expansion valve 66a, operates the freezing chamber fan 72, and stops the refrigerating chamber fan 74.

[0078] Therefore, the refrigerants are circulated through the compressor 62, the condenser 64, the freezing expansion valve 66a and the evaporator 68. As the freezing chamber fan 72 is operated, the cool air heat-exchanged in the freezing chamber side region 68a is supplied merely to the freezing chamber F, to cool the freezing chamber F.

[0079] In a refrigerating mode for making the temperature T_r of the refrigerating chamber R reach the set refrigerating temperature T_{r0} , the microcomputer controls the three way valve 82 so that the refrigerants can pass through the refrigerating expansion valve 66b, operates the refrigerating chamber fan 74, and stops the freezing chamber fan 74.

[0080] Accordingly, the refrigerants are circulated through the compressor 62, the condenser 64, the refrigerating expansion valve 66b and the evaporator 68. As the refrigerating chamber fan 74 is operated, the cool air heat-exchanged in the refrigerating chamber side region 68b is supplied merely to the refrigerating chamber R, to cool the refrigerating chamber R.

[0081] In a freezing and refrigerating mode for making the temperature T_f of the freezing chamber F and the temperature T_r of the refrigerating chamber R reach the set freezing temperature T_{f0} and the set refrigerating temperature T_{r0} , respectively, the three way valve 82 makes the refrigerants to pass through the freezing expansion valve 66a, the freezing chamber fan 72 is continuously operated, and the refrigerating chamber fan 74 is operated and stopped at intervals of a predetermined time.

[0082] As a result, the refrigerants are circulated through the compressor 62, the condenser 64, the freezing expansion valve 66a and the evaporator 68. As the freezing chamber fan 72 is operated, the cool air heat-exchanged in the freezing chamber side region 68a is supplied to the freezing chamber F, and as the refrigerating chamber fan 74 is intermittently operated, the cool air heat-exchanged in the refrigerating chamber side region 68b is supplied to the refrigerating chamber R during the operation, thereby cooling both the freezing chamber F and the refrigerating chamber R.

[0083] In a defrosting mode for making the temperature T_f of the freezing chamber F and the temperature T_r of the refrigerating chamber R reach a defrosting temperature T_i for removing ice from the surface of the evaporator 68, the compressor 62 is stopped, the freezing chamber fan 72 is stopped, and the refrigerating chamber fan 74 is operated.

[0084] In a state where the refrigerants are not circulated, the refrigerating chamber side region 68b of the evaporator 68 is defrosted by the air sent by the operation of the refrigerating chamber fan 74, and the freezing

chamber side region 68a of the evaporator 68 is defrosted by the heat transmitted from the refrigerating chamber side region 68b.

[0085] In the defrosting mode, if the temperature T_f of the freezing chamber F and the temperature T_r of the refrigerating chamber R do not reach the defrosting temperature T_i , defrosting heaters installed at the lower portion of the evaporator 68 are heated to defrost the evaporator 68.

[0086] The first example of the refrigeration cycle improves the cooling speed of the refrigerating chamber R more than the general refrigeration cycle by cooling the freezing chamber F and the refrigerating chamber R, respectively, efficiently cools a large capacity of refrigerator, and individually effectively defrosts the freezing chamber F and the refrigerating chamber R.

[0087] Fig. 8 is a structure view illustrating a second example of the refrigeration cycle applied to the refrigerators of Figs. 3 and 5.

[0088] The second example of the refrigeration cycle which can be applied to the refrigerators in accordance with the first and second embodiments of the present invention will now be explained. The second example of the refrigeration cycle is basically identical to the first example of the refrigeration cycle. However, a connection passage (not shown) is formed between the freezing chamber F and the refrigerating chamber R, so that the cool air can flow therethrough, and a damper 76 is installed to be opened/closed on the connection passage.

[0089] Accordingly, the second example of the refrigeration cycle is operated in the same manner as the first example of the refrigeration cycle. However, in the freezing mode, if the temperature T_r of the refrigerating chamber R is higher than the set refrigerating temperature T_{r0} , the damper 76 is opened to supply part of the cool air of the freezing chamber F to the refrigerating chamber R, thereby controlling the temperature T_r of the refrigerating chamber R.

[0090] That is, when the temperature T_r of the refrigerating chamber R increases in the freezing mode, the temperature T_r of the refrigerating chamber R can be easily controlled by supplying the cool air of the freezing chamber F having a relatively low temperature to the refrigerating chamber R. Therefore, the refrigerating chamber fan 74 needs not to be driven, which results in low power consumption.

[0091] Fig. 9 is a structure view illustrating a third example of the refrigeration cycle applied to the refrigerators of Figs. 3 and 5.

[0092] The third example of the refrigeration cycle which can be applied to the refrigerators in accordance with the first and second embodiments of the present invention will now be explained. The refrigeration cycle includes a compressor 62 for compressing refrigerants into high temperature high pressure gas refrigerants, a condenser 64 for condensing the refrigerants compressed in the compressor 62 into high temperature high pressure liquid refrigerants by performing a heat ex-

change operation with outdoor air, an expansion means 66 having a freezing expansion valve 66a or a refrigerating expansion valve 66b for decompressing the refrigerants condensed in the condenser 64 into low temperature low pressure liquid refrigerants by controlling a decompression degree according to a load, first and second solenoid valves 84a and 84b installed on refrigerant tubes formed at the front ends of the freezing expansion valve 66a and the refrigerating expansion valve 66b, respectively, for controlling the refrigerant tubes to be opened/closed, and an evaporator 68 for evaporating the refrigerants decompressed in the expansion means 66 into low temperature low pressure gas refrigerants by performing a heat exchange operation with air in a freezing chamber F or a refrigerating chamber R, and generating cool air at the same time.

[0093] The evaporator 68 is divided into a freezing chamber side region 68a and a refrigerating chamber side region 68b. A freezing chamber fan 72 and a motor are installed to be linked to the freezing chamber side region 68a, so that the cool air passing through the freezing chamber side region 68a can be supplied merely to the freezing chamber F. A refrigerating chamber fan 74 and a motor are installed to be linked to the refrigerating chamber side region 68b, so that the cool air passing through the refrigerating chamber side region 68b can be supplied merely to the refrigerating chamber R.

[0094] In detail, the compressor 62, the condenser 64, the freezing expansion valve 66a, the refrigerating expansion valve 66b, the evaporator 68, the freezing chamber fan 72 and the refrigerating chamber fan 74 are formed in the same manner as those of the first embodiment.

[0095] The expansion means 66 further includes an auxiliary expansion valve 66c for intermediately cooling the refrigerants from the evaporator 68 by decompression, and re-supplying the refrigerants to the compressor 62. That is, the refrigerants are intermediately cooled between the evaporator 68 and the compressor 62, thereby improving efficiency of the whole refrigeration cycle.

[0096] The first and second solenoid valves 84a and 84b are installed on the refrigerant tubes at the front ends of the freezing expansion valve 66a and the refrigerating expansion valve 66b, for controlling the refrigerant tubes to be opened/closed. Therefore, the first and second solenoid valves 84a and 84b supply the refrigerants from the condenser 64 to the freezing expansion valve 66a, the refrigerating expansion valve 66b, or both the freezing expansion valve 66a and the refrigerating expansion valve 66b.

[0097] The operations of the above-described components are controlled by a microcomputer (not shown).

[0098] The operation of the third example of the refrigeration cycle will now be described.

[0099] In a freezing mode for making a temperature T_f of the freezing chamber F reach a set freezing temperature T_{f0} , the microcomputer opens the first solenoid valve 84a and closes the second solenoid valve 84b, so

that the refrigerants can pass through the freezing expansion valve 66a, operates the freezing chamber fan 72, and stops the refrigerating chamber fan 74.

[0100] Therefore, the refrigerants are circulated through the compressor 62, the condenser 64, the freezing expansion valve 66a, the evaporator 68 and the auxiliary expansion valve 66c. As the freezing chamber fan 72 is operated, the cool air heat-exchanged in the freezing chamber side region 68a is supplied merely to the freezing chamber F, to cool the freezing chamber F.

[0101] In a refrigerating mode for making a temperature T_r of the refrigerating chamber R reach a set refrigerating temperature T_{r0} , the microcomputer closes the first solenoid valve 84a and opens the second solenoid valve 84b, so that the refrigerants can pass through the refrigerating expansion valve 66b, operates the refrigerating chamber fan 74, and stops the freezing chamber fan 72.

[0102] Accordingly, the refrigerants are circulated through the compressor 62, the condenser 64, the refrigerating expansion valve 66b, the evaporator 68 and the auxiliary expansion valve 66c. As the refrigerating chamber fan 74 is operated, the cool air heat-exchanged in the refrigerating chamber side region 68b is supplied merely to the refrigerating chamber R, to cool the refrigerating chamber R.

[0103] In a freezing and refrigerating mode for making the temperature T_f of the freezing chamber F and the temperature T_r of the refrigerating chamber R reach the set freezing temperature T_{f0} and the set refrigerating temperature T_{r0} , respectively, the first solenoid valve 84a is opened and the second solenoid valve 84b is closed, so that the refrigerants can pass through the freezing expansion valve 66a, the freezing chamber fan 72 is continuously operated, and the refrigerating chamber fan 74 is operated and stopped at intervals of a predetermined time.

[0104] As a result, the refrigerants are circulated through the compressor 62, the condenser 64, the freezing expansion valve 66a, the evaporator 68 and the auxiliary expansion valve 66c. As the freezing chamber fan 72 is operated, the cool air heat-exchanged in the freezing chamber side region 68a is supplied to the freezing chamber F, and as the refrigerating chamber fan 74 is intermittently operated, the cool air heat-exchanged in the refrigerating chamber side region 68b is supplied to the refrigerating chamber R during the operation, thereby cooling both the freezing chamber F and the refrigerating chamber R.

[0105] In a defrosting mode for making the temperature T_f of the freezing chamber F and the temperature T_r of the refrigerating chamber R reach a defrosting temperature T_i for removing ice from the surface of the evaporator 68, the compressor 62 is stopped, the first and second solenoid valves 84a and 84b are closed, the freezing chamber fan 72 is stopped, and the refrigerating chamber fan 74 is operated.

[0106] In a state where the refrigerants are not circu-

lated, the refrigerating chamber side region 68b of the evaporator 68 is defrosted by the air sent by the operation of the refrigerating chamber fan 74, and the freezing chamber side region 68a of the evaporator 68 is defrosted by the heat transmitted from the refrigerating chamber side region 68b.

[0107] In the defrosting mode, if the temperature T_f of the freezing chamber F and the temperature T_r of the refrigerating chamber R do not reach the defrosting temperature T_i , the first and second solenoid valves 84a and 84b are opened to circulate the refrigerants having a relatively high temperature along the evaporator 68, and defrosting heaters installed at the lower portion of the evaporator 68 are heated to defrost the evaporator 68.

[0108] Identically to the first example of the refrigeration cycle, the third example of the refrigeration cycle improves the cooling speed of the refrigerating chamber R more than the general refrigeration cycle by cooling the freezing chamber F and the refrigerating chamber R, respectively, efficiently cools a large capacity of refrigerator, and individually effectively defrosts the freezing chamber F and the refrigerating chamber R.

[0109] Fig. 12 is a flowchart showing sequential steps of a method for controlling an operation of a refrigerator in accordance with a preferred embodiment of the present invention.

[0110] The method for controlling the operation of the refrigerator will now be explained with reference to Fig. 12, and the components of the refrigerator will now be explained with reference to Figs. 7 to 9.

[0111] In the first step, a temperature T_f of a freezing chamber F and a temperature T_r of a refrigerating chamber R are compared with a set freezing temperature T_{f0} and a set refrigerating temperature T_{r0} , for sensing a freezing load and a refrigerating load, and an operation mode of the refrigerator is determined (refer to S1, S2, S3, S5, S7 and S8).

[0112] In detail, the set freezing temperature T_{f0} and the set refrigerating temperature T_{r0} are set by the user or automatically set, and the temperature T_f of the freezing chamber F and the temperature T_r of the refrigerating chamber R sensed in the freezing chamber F and the refrigerating chamber R are compared with the set freezing temperature T_{f0} and the set refrigerating temperature T_{r0} , thereby determining the operation mode of the refrigerator.

[0113] Here, when the temperature T_f of the freezing chamber F is higher than the set freezing temperature T_{f0} and the temperature T_r of the refrigerating chamber R is higher than the set refrigerating temperature T_{r0} , a freezing and refrigerating mode is selected, when the temperature T_f of the freezing chamber F is higher than the set freezing temperature T_{f0} but the temperature T_r of the refrigerating chamber R is lower than the set refrigerating temperature T_{r0} , a freezing mode is selected, when the temperature T_f of the freezing chamber F is lower than the set freezing temperature T_{f0} but the temperature T_r of the refrigerating chamber R is higher than

the set refrigerating temperature T_{r0} , a refrigerating mode is selected, and when the temperature T_f of the freezing chamber F is lower than the set freezing temperature T_{f0} and the temperature T_r of the refrigerating chamber R is lower than the set refrigerating temperature T_{r0} , a cooling mode is not selected.

[0114] In the second step, a cooling operation is performed by sending cool air to the freezing chamber F and the refrigerating chamber R, the freezing chamber F or the refrigerating chamber R according to the mode set in the first step (refer to S4, S6 and S9).

[0115] Here, when the freezing and refrigerating mode is selected, a compression flow rate and a decompression degree are maximized, and the cool air is sent to the freezing chamber F and the refrigerating chamber R.

[0116] Therefore, refrigerants are compressed, condensed, expanded and evaporated sequentially through the compressor 62, the condenser 64, the expansion means 66 and the evaporator 68, for cooling air near the evaporator 68. Here, the ambient air can be rapidly cooled by remarkably controlling the compression flow rate and the decompression degree. When a freezing chamber fan 72 and a refrigerating chamber fan 74 installed at the upper portions of a freezing chamber side region 68a and a refrigerating chamber side region 68b of the evaporator 68 are operated, the cool air passing through the freezing chamber side region 68a of the evaporator 68 is circulated in the freezing chamber F, and the cool air passing through the refrigerating chamber side region 68b of the evaporator 68 is circulated in the refrigerating chamber R.

[0117] When the freezing mode is selected, the compression flow rate and the decompression degree are relatively remarkably controlled, and the cool air is sent merely to the freezing chamber F.

[0118] Only the freezing chamber fan 72 is operated, and thus the cool air passing through the freezing chamber side region 68a of the evaporator 68 is circulated in the freezing chamber F.

[0119] In the freezing mode, if the temperature T_r of the refrigerating chamber R gets higher than the set refrigerating temperature T_{r0} , part of the cool air of the freezing chamber F can be supplied to the refrigerating chamber R.

[0120] When the refrigerating mode is selected, the compression flow rate and the decompression degree are relatively slightly controlled, and the cool air is sent merely to the refrigerating chamber R.

[0121] Only the refrigerating chamber fan 74 is operated, and thus the cool air passing through the refrigerating chamber side region 68b of the evaporator 68 is circulated in the refrigerating chamber R.

[0122] Especially, in the refrigerating mode, a temperature of the evaporator 68 is preferably higher than that of the freezing chamber F and lower than that of the refrigerating chamber R.

[0123] In the third step, while the cooling operation is performed in each mode in the second step, the temper-

ature T_f of the freezing chamber F and the temperature T_r of the refrigerating chamber R are compared with a previously-inputted defrosting temperature T_i , and a defrosting mode is determined according to the comparison result (refer to S10 and S11).

[0124] Here, the surface of the evaporator 68 may be frosted during the cooling operation in each mode. The frosted surface of the evaporator 68 reduces heat exchange efficiency of the evaporator 68. Accordingly, the surface of the evaporator 68 needs to be defrosted.

[0125] Because the evaporator 68 does not perform a heat exchange operation with ambient air due to frost, the temperature T_f of the freezing chamber F or the temperature T_r of the refrigerating chamber R relatively increases. If the temperature T_f of the freezing chamber F or the temperature T_r of the refrigerating chamber R gets higher than the defrosting temperature T_i , the defrosting mode is started.

[0126] In detail, in the defrosting mode, in a state where the refrigerants are stopped not to flow, the refrigerating chamber fan 74 is operated so that the air of the refrigerating chamber R having a relatively high temperature can be sent and circulated to defrost the refrigerating chamber side region 68b of the evaporator 68. Here, the freezing chamber side region 68a of the evaporator 68 is also defrosted by heat transfer effects.

[0127] In addition, in the defrosting mode, the high temperature high pressure liquid refrigerants are supplied to the evaporator 68, and the refrigerating chamber fan 74 is rotatably operated, thereby efficiently performing the defrosting operation.

[0128] Furthermore, in the defrosting mode, defrosting heaters installed at the lower portion of the evaporator 68 are heated to rapidly perform the defrosting operation.

[0129] As discussed earlier, the side-by-side type refrigerator where the freezing chamber F and the refrigerating chamber R are disposed side by side in accordance with the preferred embodiments of the present invention has been described with reference to the accompanying drawings. However, it is understood that the present invention should not be limited to these preferred embodiments but various changes and modifications can be made by one skilled in the art within the scope of the present invention as hereinafter claimed.

Claims

1. A refrigerator, comprising:

a compressor (62) for compressing refrigerants into high temperature high pressure gas refrigerants;
a condenser (64) for condensing the refrigerants compressed in the compressor into high temperature high pressure liquid refrigerants;
a decompression means (66) for expanding the refrigerants condensed in the condenser into

low temperature low pressure liquid refrigerants; and

an evaporator (68) for evaporating the refrigerants expanded in the decompression means into low temperature low pressure gas refrigerants, a heat exchange region of which being divided into a freezing chamber side region (68a) and a refrigerating chamber side region (68b) by a blocking plate (70); **characterized in that** the refrigerator further comprises:

an individual freezing chamber circulation passage formed in the refrigerator for supplying cool air from the freezing chamber side region (68a) into a freezing chamber: a different individual refrigerating chamber circulation passage formed in the refrigerator for supplying cool air from the refrigerating chamber side region (68b) into a refrigerating chamber:

a freezing chamber fan (72) is installed in the freezing chamber circulation passage for sending the cool air to the freezing chamber: and

a refrigerating chamber fan (74) is installed in the refrigerating chamber circulation passage for sending the cool air to the refrigerating chamber.

2. The refrigerator of claim 1, wherein a plurality of grooves are formed on the surface of the blocking plate (70), for forming a turbulent bed to the cool air flowing along the surface of the evaporator (68).

3. The refrigerator of claim 1 or 2, wherein the evaporator (68) is installed so that the freezing chamber side region and the refrigerating chamber side region of the evaporator are divided by a cross wall (54) that separates the freezing chamber from the refrigerating chamber and the cross wall (54) is functioning as the blocking plate (70).

4. The refrigerator of claim 3, wherein a plurality of grooves are formed on the surface of the cross wall (54), for forming a turbulent bed to the cool air flowing along the surface of the evaporator (68).

5. The refrigerator of any of claims 1 to 4, wherein the evaporator (68) is a straight type thin heat exchanger in which a plurality of cooling fins are installed vertically to a refrigerant tube.

6. The refrigerator of claim 5, wherein the evaporator (68) is installed so that an interval between the cooling fins in the freezing chamber side region of the evaporator is larger than an interval between the cooling fins in the refrigerating chamber side region of the evaporator.

7. The refrigerator of any of claims 1 to 6, wherein the freezing chamber side region (68a) of the evaporator has a larger heat exchange area than the refrigerating chamber side region (68b) of the evaporator.
8. The refrigerator of any of claims 1 to 7, wherein at least one defrosting heater is further installed at the lower portion of the evaporator (68), for defrosting the freezing chamber side region and the refrigerating chamber side region of the evaporator (68).
9. The refrigerator of claim 8, wherein the at least one defrosting heater comprises a defrosting heater for the freezing chamber having a large capacity is installed at the lower portion of the freezing chamber side region of the evaporator (68), and a defrosting heater for the refrigerating chamber having a small capacity is installed at the lower portion of the refrigerating chamber side region of the evaporator (68).
10. The refrigerator of claim 8 or 9, wherein the at least one defrosting heater comprises radiant heaters.
11. The refrigerator of any of claims 1 to 10, wherein the compressor (62) is a capacity variable compressor which can vary a flow rate of the refrigerants circulated along the evaporator (68).
12. The refrigerator of any of claims 1 to 11, wherein the freezing chamber fan is installed at an upper portion of the freezing chamber side region of the evaporator, for sending the cool air to the freezing chamber and the refrigerating chamber fan is installed at an upper portion of the refrigerating chamber side region of the evaporator side by side with the freezing chamber fan, for sending the cool air to the refrigerating chamber.
13. The refrigerator of claim 12, wherein the freezing chamber fan and the refrigerating chamber fan are sirocco fans for sucking the cool air in an axial direction and discharging the air in a circumferential direction.
14. The refrigerator of claim 12 or 13, wherein a motor for driving the freezing chamber fan is installed at an upper portion of the freezing chamber side region of the evaporator and a motor for driving the refrigerating chamber fan is installed at an upper portion of the refrigerating chamber side region of the evaporator side by side with the freezing chamber fan and the motor for driving the freezing chamber fan.
15. The refrigerator of claim 14, wherein the motors for respectively driving the freezing chamber fan and the refrigerating chamber fan are brushless DC motors.
16. The refrigerator of any of claims 1 to 15, wherein the decompression means (66) are a freezing expansion valve (66a) and a refrigerating expansion valve (66b) installed side by side between the condenser (64) and the evaporator (68) to combine refrigerant tubes formed at the front and rear ends, the freezing expansion valve (66a) and the refrigerating expansion valve (66b) being different in capacity.
17. The refrigerator of any of claims 1 to 16, wherein the decompression means (66) further comprises an auxiliary expansion valve (66c) installed between the evaporator (68) and the compressor (62), for decompressing the refrigerants from the evaporator (68) and supplying the refrigerants to the compressor (62).
18. The refrigerator of claim 16 or 17, wherein the freezing expansion valve (66a) has a relatively larger capacity than the refrigerating expansion valve (66b).
19. The refrigerator of any of claims 16 to 18, wherein the freezing expansion valve (66a) and the refrigerating expansion valve (66b) are capillary tubes.
20. The refrigerator of any of claims 16 to 19, wherein the freezing expansion valve (66a) and the refrigerating expansion valve (66b) are electronic expansion valves.
21. The refrigerator of any of claims 16 to 20, comprising a valve means installed between the condenser (64) and the freezing expansion valve (66a) and the refrigerating expansion valve (66b), for selectively supplying the refrigerants from the condenser (64) to the freezing expansion valve (66a) or the refrigerating expansion valve (66b).
22. The refrigerator of claim 21, wherein the valve means is a three way valve (82) installed on a refrigerant tube branched from the condenser (64) into the freezing expansion valve (66a) and the refrigerating expansion valve (66b), for varying a passage of the refrigerants.
23. The refrigerator of claim 21, wherein the valve means are first and second solenoid valves (84a, 84b) installed on refrigerant tubes formed at the front ends of the freezing expansion valve (66a) and the refrigerating expansion valve (66b), for varying a passage of the refrigerants.
24. The refrigerator of claim 21, wherein, in a freezing mode for making a temperature of the freezing chamber (T_f) reach a set freezing temperature (T_{f0}), the valve means makes the refrigerants pass through the freezing expansion valve (66a), the freezing chamber fan is operated, and the refrigerating cham-

ber fan is stopped.

25. The refrigerator of claim 21, wherein, in a refrigerating mode for making a temperature of the refrigerating chamber (T_r) reach a set refrigerating temperature (T_{r0}), the valve means makes the refrigerants pass through the refrigerating expansion valve (66b), the refrigerating chamber fan is operated, and the freezing chamber fan is stopped. 5
26. The refrigerator of claim 21, wherein, in a freezing and refrigerating mode for making a temperature of the freezing chamber (T_f) and a temperature of the refrigerating chamber (T_r) reach a set freezing temperature (T_{f0}) and a set refrigerating temperature (T_{r0}), respectively, the valve means makes the refrigerants pass through the freezing expansion valve (66a), the freezing chamber fan is continuously operated, and the refrigerating chamber fan is operated and stopped at intervals of a predetermined time. 10
27. The refrigerator of claim 21, wherein, in a defrosting mode for making a temperature of the freezing chamber (T_f) and a temperature of the refrigerating chamber (T_r) reach a defrosting temperature (T_i) for removing ice from the surface of the evaporator (68), the compressor (62) is stopped, the valve means prevents the refrigerants from passing through the freezing expansion valve (66a) or the refrigerating expansion valve (66b), the freezing chamber fan is stopped, and the refrigerating chamber fan is operated. 15
28. The refrigerator of claim 27, wherein, in the defrosting mode, when the temperature of the freezing chamber (T_f) and the temperature of the refrigerating chamber (T_r) do not reach the defrosting temperature (T_i), the valve means makes the refrigerants pass through the freezing expansion valve (66a) and the refrigerating expansion valve (66b), and defrosting heaters installed at the lower portion of the evaporator (68) are heated. 20
29. The refrigerator of any of claims 3 to 28, wherein a connection passage is formed on the cross wall (54) between the freezing chamber and the refrigerating chamber, so that the cool air of the freezing chamber can be supplied to the refrigerating chamber, and a damper (76) is installed on the connection passage to open/close the connection passage. 25
30. The refrigerator of claim 29, wherein, in the freezing mode for making a temperature of the freezing chamber (T_f) reach the set freezing temperature (T_{f0}), when a temperature of the refrigerating chamber (T_r) gets higher than a set refrigerating temperature (T_{r0}), the damper (76) is opened to supply the cool air of the freezing chamber to the refrigerating chamber. 30

31. A method for controlling an operation of a refrigerator, comprising:

a first step for compressing refrigerants into high temperature high pressure gas refrigerants according to a freezing load or a refrigerating load applied to a freezing chamber or a refrigerating chamber;
 a second step for condensing the refrigerants compressed in the first step into high temperature high pressure liquid refrigerants by performing a heat exchange operation with air;
 a third step for decompressing the refrigerants condensed in the second step into low temperature low pressure liquid refrigerants by controlling a decompression degree according to the load; and
 a fourth step for generating cool air by evaporating the refrigerants decompressed in the third step into low temperature low pressure gas refrigerants by performing a heat exchange operation with air, and sending the cool air to the freezing chamber, the refrigerating chamber, or both the freezing chamber and the refrigerating chamber; **characterized in that**
 the cool air is selectively sent to one or more of the freezing chamber and the refrigerating chamber according to the load, by operating one or more of a freezing chamber fan (72) for sending the cool air generated in a freezing chamber side region (68a) of an evaporator (68) to the freezing chamber and a refrigerating chamber fan (74) for sending the cool air generated in a refrigerating chamber side region (68b) of the evaporator (68) to the refrigerator chamber.

32. The method of claim 31, comprising, in the first step, a process for setting the freezing load applied so that a temperature of the freezing chamber can reach a set freezing temperature, or the refrigerating load applied so that a temperature of the refrigerating chamber can reach a set refrigerating temperature. 35
33. The method of claim 32, wherein, when the load increases in the first step, a compression flow rate of the refrigerants also increases. 40
34. The method of claim 32 or 33, wherein, in the first step, the compression flow rate of the refrigerants is higher in application of the freezing load than in application of the refrigerating load. 45
35. The method of any of claims 31 to 34, wherein, in the third step, a decompression degree of the refrigerants is higher in application of the freezing load than in application of the refrigerating load. 50
36. The method of any of claims 31 to 35, wherein, in

the fourth step, when the freezing load and the refrigerating load are applied at the same time, the cool air generated in the freezing chamber side region of the evaporator is sent to the freezing chamber by a freezing chamber fan, and the cool air generated in the refrigerating chamber side region of the evaporator is sent to the refrigerating chamber by a refrigerating chamber fan.

37. The method of any of claims 31 to 36, wherein, in the fourth step, when the freezing load is applied, the cool air generated in the freezing chamber side region of the evaporator is sent merely to the freezing chamber by the freezing chamber fan, and when the refrigerating load is applied, the cool air generated in the refrigerating chamber side region of the evaporator is sent merely to the refrigerating chamber by the refrigerating chamber fan.
38. The method of claim 37, wherein, in the fourth step, while the freezing load is applied to send the cool air to the freezing chamber, when the refrigerating load is additionally applied, a passage linked between the freezing chamber and the refrigerating chamber is opened to supply the cool air of the freezing chamber to the refrigerating chamber.
39. The method of claim 37, wherein, in the fourth step, while the refrigerating load is applied to send the cool air to the refrigerating chamber, a temperature of the evaporator is set higher than the temperature of the freezing chamber and lower than the temperature of the refrigerating chamber.
40. The method of claim 37, further comprising, in the fourth step, a process for performing a defrosting operation when the temperature of the freezing chamber and the temperature of the refrigerating chamber get higher than a defrosting temperature, although the freezing load or the refrigerating load is applied to send the cool air to the freezing chamber or the refrigerating chamber.
41. The method of claim 40, wherein the defrosting operation operates only the refrigerating chamber fan in a state where the refrigerants are stopped not to flow.
42. The method of claim 40 or 41, wherein the defrosting operation does not decompress but directly supply the high temperature high pressure condensed refrigerants to the evaporator, and rotatably operates the refrigerating chamber fan.
43. The method of claim 42, wherein the defrosting operation further operates defrosting heaters installed at the lower portion of the evaporator to heat the evaporator.

44. The method of any of claims 31 to 43, wherein a heat exchange region of the evaporator is divided into the freezing chamber side region (68a) and the refrigerating chamber side region (68b) by a blocking plate (70).

Patentansprüche

1. Kühlschrank mit:

einem Kompressor (62), um Kühlmittel zu gasförmigen Kühlmitteln von hoher Temperatur und hohem Druck zu komprimieren;
 einem Kondensator (64), um die in dem Kompressor komprimierten Kühlmitteln zu flüssigen Kühlmitteln von hoher Temperatur und hohem Druck zu kondensieren;
 einem Dekompressionsmittel (66), um die in dem Kondensator kondensierten Kühlmittel zu flüssigen Kühlmitteln von niedriger Temperatur und niedrigem Druck zu expandieren; und
 einem Verdampfer (68), um die in dem Dekompressionsmittel expandierten Kühlmittel zu gasförmigen Kühlmitteln von niedriger Temperatur und niedrigem Druck zu verdampfen, wobei ein Wärmeaustauschbereich davon in einen Gefrierkammer-Seitenbereich (68a) und einen Kühlkammer-Seitenbereich (68b) durch eine Absperrplatte (70) aufgeteilt ist; **dadurch gekennzeichnet, dass** der Kühlschrank folgendes aufweist:

einen individuellen Gefrierkammer-Zirkulationsdurchlass, der in dem Kühlschrank ausgebildet ist, um Kaltluft aus dem Gefrierkammer-Seitenbereich (68a) in eine Gefrierkammer zu liefern;
 einen unterschiedlich individuellen Kühlkammer-Zirkulationsdurchlass, der in dem Kühlschrank ausgebildet ist, um Kaltluft aus dem Kühlkammer-Seitenbereich (68b) in eine Kühlkammer zu liefern;

wobei ein Gefrierkammer-Ventilator (72) in dem Gefrierkammer-Zirkulationsdurchlass installiert ist, um die Kaltluft zu der Gefrierkammer zu schicken; und
 ein Kühlkammer-Ventilator (74) in dem Kühlkammer-Zirkulationsdurchlass installiert ist, um die Kaltluft zu der Kühlkammer zu schicken.

2. Kühlschrank nach Anspruch 1, wobei eine Vielzahl von Furchen auf der Oberfläche der Absperrplatte (70) ausgebildet ist, um ein turbulentes Bett zu der entlang der Oberfläche des Verdampfers (68) strömenden Kaltluft zu bilden.
3. Kühlschrank nach Anspruch 1 oder 2, wobei der Ver-

- dampfer (68) derart installiert ist, dass der Gefrierkammer-Seitenbereich und der Kühlkammer-Seitenbereich des Verdampfers durch eine Querwand (54) aufgeteilt sind, welche die Gefrierkammer von der Kühlkammer trennt, und die Querwand (54) als die Absperrplatte (70) fungiert.
4. Kühlschrank nach Anspruch 3, wobei eine Vielzahl von Furchen auf der Oberfläche der Querwand (54) ausgebildet ist, um ein turbulentes Bett zu der entlang der Oberfläche des Verdampfers (68) strömenden Kaltluft zu bilden. 10
 5. Kühlschrank nach einem der Ansprüche 1 bis 4, wobei der Verdampfer (68) ein dünner Wärmeaustauscher vom geradlinigen Typ ist, in dem eine Vielzahl von Kühlrippen vertikal zu einer Kühlröhre installiert ist. 15
 6. Kühlschrank nach Anspruch 5, wobei der Verdampfer (68) derart installiert ist, dass ein Abstand zwischen den Kühlrippen in dem Gefrierkammer-Seitenbereich des Verdampfers größer als ein Abstand zwischen den Kühlrippen in dem Kühlkammer-Seitenbereich des Verdampfers ist. 20 25
 7. Kühlschrank nach einem der Ansprüche 1 bis 6, wobei der Gefrierkammer-Seitenbereich (68a) des Verdampfers eine größere Wärmeaustauschfläche als der Kühlkammer-Seitenbereich (68b) des Verdampfers aufweist. 30
 8. Kühlschrank nach einem der Ansprüche 1 bis 7, wobei zumindest ein Entfrosterhitzeheizer außerdem an dem unteren Abschnitt des Verdampfers (68) installiert ist, um den Gefrierkammer-Seitenbereich und den Kühlkammer-Seitenbereich des Verdampfers (68) zu entfrosten. 35
 9. Kühlschrank nach Anspruch 8, wobei der zumindest eine Entfrosterhitzeheizer einen Entfrosterhitzeheizer für die Gefrierkammer mit einer großen Kapazität, der an dem unteren Abschnitt des Gefrierkammer-Seitenbereichs des Verdampfers (68) installiert ist, und einen Entfrosterhitzeheizer für die Kühlkammer mit einer kleinen Kapazität aufweist, der an dem unteren Abschnitt des Kühlkammer-Seitenbereichs des Verdampfers (68) installiert ist. 40 45
 10. Kühlschrank nach Anspruch 8 oder 9, wobei der zumindest eine Entfrosterhitzeheizer Heizstrahler aufweist. 50
 11. Kühlschrank nach einem der Ansprüche 1 bis 10, wobei der Kompressor (62) ein Kompressor von variabler Kapazität ist, welcher eine Strömungsrate der entlang des Verdampfers (68) zirkulierten Kühlmittel verändern kann. 55
 12. Kühlschrank nach einem der Ansprüche 1 bis 11, wobei der Gefrierkammer-Ventilator an einem oberen Abschnitt des Gefrierkammer-Seitenbereichs des Verdampfers installiert ist, um die Kaltluft zu der Gefrierkammer zu schicken, und der Kühlkammer-Ventilator an einem oberen Abschnitt des Kühlkammer-Seitenbereichs des Verdampfers Seite an Seite mit dem Gefrierkammer-Ventilator installiert ist, um die Kaltluft zu der Kühlkammer zu schicken.
 13. Kühlschrank nach Anspruch 12, wobei der Gefrierkammer-Ventilator und der Kühlkammer-Ventilator Sirocco-Ventilatoren sind, um die Kaltluft in einer axialen Richtung zu saugen und die Luft in einer Umfangsrichtung abzugeben.
 14. Kühlschrank nach Anspruch 12 oder 13, wobei ein Motor zum Antreiben des Gefrierkammer-Ventilators an einem oberen Abschnitt des Gefrierkammer-Seitenbereichs des Verdampfers installiert ist und ein Motor zum Antreiben des Kühlkammer-Ventilators an einem oberen Abschnitt des Kühlkammer-Seitenbereichs des Verdampfers Seite an Seite mit dem Gefrierkammer-Ventilator und dem Motor zum Antreiben des Gefrierkammer-Ventilators installiert ist.
 15. Kühlschrank nach Anspruch 14, wobei die Motoren zum jeweiligen Antreiben des Gefrierkammer-Ventilators und des Kühlkammer-Ventilators bürstenlose DC-Motoren sind.
 16. Kühlschrank nach einem der Ansprüche 1 bis 15, wobei das Dekompressionsmittel (66) ein Gefrierexpansionsventil (66a) und ein Kühlexpansionsventil (66b) ist, welche nebeneinander zwischen dem Kondensator (64) und dem Verdampfer (68) installiert sind, um Kühlröhren zu kombinieren, die an den Vorder- und Rückenden ausgebildet sind, wobei das Gefrierexpansionsventil (66a) und das Kühlexpansionsventil (66b) unterschiedlich bezüglich der Kapazität ausgebildet sind.
 17. Kühlschrank nach einem der Ansprüche 1 bis 16, wobei das Dekompressionsmittel (66) ferner ein zwischen dem Verdampfer (68) und dem Kompressor (62) installiertes Hilfsexpansionsventil (66c) aufweist, um die Kühlmittel aus dem Verdampfer (68) zu dekomprimieren und die Kühlmittel dem Kompressor (62) zuzuführen.
 18. Kühlschrank nach Anspruch 16 oder 17, wobei das Gefrierexpansionsventil (66a) eine relativ größere Kapazität als das Kühlexpansionsventil (66b) aufweist.
 19. Kühlschrank nach einem der Ansprüche 16 bis 18, wobei das Gefrierexpansionsventil (66a) und das

Kühlexpansionsventil (66b) Kapillarröhren sind.

20. Kühltank nach einem der Ansprüche 16 bis 19, wobei das Gefrierexpansionsventil (66a) und das Kühlexpansionsventil (66b) elektronische Expansionsventile sind. 5
21. Kühltank nach einem der Ansprüche 16 bis 20, umfassend ein Ventilmittel, das zwischen dem Kondensator (64) und dem Gefrierexpansionsventil (66a) und dem Kühlexpansionsventil (66b) installiert ist, um selektiv die Kühlmittel aus dem Kondensator (64) dem Gefrierexpansionsventil (66a) oder dem Kühlexpansionsventil (66b) zuzuführen. 10
22. Kühltank nach Anspruch 21, wobei das Ventilmittel ein auf einer Kühlröhre installiertes Dreiwegeventil (82) ist, das von dem Kondensator (64) in das Gefrierexpansionsventil (66a) und das Kühlexpansionsventil (66b) abzweigt, um einen Durchlass der Kühlmittel zu verändern. 20
23. Kühltank nach Anspruch 21, wobei das Ventilmittel ein erstes und zweites Magnetventil (84a, 84b) ist, die auf Kühlröhren installiert sind, welche an den Vorderenden des Gefrierexpansionsventils (66a) und des Kühlexpansionsventils (66b) ausgebildet sind, um einen Durchlass der Kühlmittel zu verändern. 25
24. Kühltank nach Anspruch 21, wobei in einer Gefrierbetriebsart, um zu bewirken, dass eine Temperatur der Gefrierkammer (Tf) eine vorbestimmte Gefriertemperatur (Tf₀) erreicht, das Ventilmittel die Kühlmittel durch das Gefrierexpansionsventil (66a) durchgehen lässt, der Gefrierkammer-Ventilator betätigt wird und der Kühlkammer-Ventilator angehalten wird. 30
25. Kühltank nach Anspruch 21, wobei in einer Kühlbetriebsart, um zu bewirken, dass eine Temperatur der Kühlkammer (Tr) eine vorbestimmte Kühltemperatur (Tr₀) erreicht, das Ventilmittel die Kühlmittel durch das Kühlexpansionsventil (66b) durchgehen lässt, der Kühlkammer-Ventilator betätigt wird und der Gefrierkammer-Ventilator angehalten wird. 35
26. Kühltank nach Anspruch 21, wobei in einer Gefrier- und Kühl-Betriebsart, um zu bewirken, dass eine Temperatur der Gefrierkammer (Tf) und eine Temperatur der Kühlkammer (Tr) eine vorbestimmte Gefriertemperatur (Tf₀) und eine vorbestimmte Kühltemperatur (Tr₀) jeweils erreichen, das Ventilmittel die Kühlmittel durch das Gefrierexpansionsventil (66a) durchgehen lässt, der Gefrierkammer-Ventilator kontinuierlich betätigt wird und der Kühlkammer-Ventilator betätigt wird und in Abständen einer vorbestimmten Zeit angehalten wird. 40

27. Kühltank nach Anspruch 21, wobei in einer Entfrostonbetriebsart, um zu bewirken, dass eine Temperatur der Gefrierkammer (Tf) und eine Temperatur der Kühlkammer (Tr) eine Entfrostontemperatur (Ti) erreichen, um Eis von der Oberfläche des Verdampfers (68) zu entfernen, der Kompressor (62) angehalten wird, das Ventilmittel die Kühlmittel daran hindert, durch das Gefrierexpansionsventil (66a) oder das Kühlexpansionsventil (66b) zu gelangen, der Gefrierkammer-Ventilator angehalten wird und der Kühlkammer-Ventilator betätigt wird.

28. Kühltank nach Anspruch 27, wobei in einer Entfrostonbetriebsart, wenn die Temperatur der Gefrierkammer (Tf) und die Temperatur der Kühlkammer (Tr) nicht die Entfrostontemperatur (Ti) erreichen, das Ventilmittel die Kühlmittel durch das Gefrierexpansionsventil (66a) und das Kühlexpansionsventil (66b) gelangen lässt, und an dem unteren Abschnitt des Verdampfers (68) installierte Entfrostonsheizer erwärmt werden.

29. Kühltank nach einem der Ansprüche 3 bis 28, wobei ein Verbindungsdurchlass an der Querwand (54) zwischen der Gefrierkammer und der Kühlkammer ausgebildet ist, so dass die Kaltluft der Gefrierkammer an die Kühlkammer geliefert werden kann, und ein Schieber (76) an dem Verbindungsdurchlass installiert ist, um den Verbindungsdurchlass zu öffnen/schließen. 30

30. Kühltank nach Anspruch 29, wobei in der Gefrierbetriebsart, um zu bewirken, dass eine Temperatur der Gefrierkammer (Tf) die vorbestimmte Gefriertemperatur (Tf₀) erreicht, wenn eine Temperatur der Gefrierkammer (Tr) höher als eine vorbestimmte Kühltemperatur (Tr₀) wird, der Schieber (76) geöffnet wird, um die Kaltluft der Gefrierkammer an die Kühlkammer zu liefern.

31. Verfahren zum Steuern eines Betriebs eines Kühltanks, mit:

einem ersten Schritt, um Kühlmittel zu gasförmigen Kühlmitteln von hoher Temperatur und hohem Druck entsprechend einer Gefrier-Last oder einer Kühl-Last zu komprimieren, die auf eine Gefrierkammer oder eine Kühlkammer angewandt wird;

einem zweiten Schritt, um die in dem ersten Schritt komprimierten Kühlmittel zu flüssigen Kühlmitteln von hoher Temperatur und hohem Druck zu kondensieren, um einen Wärmeaustauschbetrieb mit Luft durchzuführen;

einem dritten Schritt, um die in dem zweiten Schritt kondensierten Kühlmittel zu flüssigen Kühlmitteln von niedriger Temperatur und niedrigem Druck zu dekomprimieren, indem ein De-

- kompressionsgrad entsprechend der Last gesteuert wird; und
 einem vierten Schritt zum Erzeugen von Kaltluft durch Verdampfen der in dem dritten Schritt dekomprimierten Kühlmittel zu gasförmigen Kühlmitteln von niedriger Temperatur und niedrigem Druck, indem ein Wärmeaustauschbetrieb mit Luft durchgeführt wird und die Kaltluft zu der Gefrierkammer, der Kühlkammer oder sowohl zu der Gefrierkammer als auch zu der Kühlkammer geschickt wird; **dadurch gekennzeichnet, dass** die Kaltluft selektiv zu einer oder mehr von der Gefrierkammer und der Kühlkammer entsprechend der Last geschickt wird, indem ein oder mehr von einem Gefrierkammer-Ventilator (72) zum Ausschicken der in einem Gefrierkammer-Seitenbereich (68a) eines Verdampfers (68) erzeugten Kaltluft zu der Gefrierkammer, und von einem Kühlkammer-Ventilator (74) zum Ausschicken der in einem Kühlkammer-Seitenbereich (68b) des Verdampfers (68) erzeugten Kaltluft zu der Kühlkammer betätigt wird.
32. Verfahren nach Anspruch 31, umfassend in dem ersten Schritt einen Prozess zum Einstellen der Gefrier-Last, die so angewandt wird, dass eine Temperatur der Gefrierkammer eine vorbestimmte Gefrier-temperatur erreichen kann, oder die Kühl-Last so angewandt wird, dass eine Temperatur der Kühlkammer eine vorbestimmte Kühltemperatur erreichen kann.
33. Verfahren nach Anspruch 32, wobei, wenn die Last in dem ersten Schritt zunimmt, eine Kompressionsströmungsrate der Kühlmittel ebenso zunimmt.
34. Verfahren nach Anspruch 32 oder 33, wobei in dem ersten Schritt die Kompressionsströmungsrate der Kühlmittel höher bei Anwendung der Gefrier-Last als bei Anwendung der Kühl-Last ist.
35. Verfahren nach einem der Ansprüche 31 bis 34, wobei in dem dritten Schritt ein Dekompressionsgrad der Kühlmittel höher bei Anwendung der Gefrier-Last als bei Anwendung der Kühl-Last ist.
36. Verfahren nach einem der Ansprüche 31 bis 35, wobei in dem vierten Schritt, wenn die Gefrier-Last und die Kühl-Last gleichzeitig angewandt werden, die in dem Gefrierkammer-Seitenbereich des Verdampfers erzeugte Kaltluft zu der Gefrierkammer mittels eines Gefrierkammer-Ventilators geschickt wird und die in dem Kühlkammer-Seitenbereich des Verdampfers erzeugte Kaltluft zu der Kühlkammer mittels eines Kühlkammer-Ventilators geschickt wird.
37. Verfahren nach einem der Ansprüche 31 bis 36, wobei in dem vierten Schritt, wenn die Gefrier-Last angewandt wird, die in dem Gefrierkammer-Seitenbereich des Verdampfers erzeugte Kaltluft bloß zu der Gefrierkammer mittels des Gefrierkammer-Ventilators geschickt wird und, wenn die Kühl-Last angewandt wird, die in dem Kühlkammer-Seitenbereich des Verdampfers erzeugte Kaltluft bloß zu der Kühlkammer mittels des Kühlkammer-Ventilators geschickt wird.
38. Verfahren nach Anspruch 37, wobei in dem vierten Schritt, während die Gefrier-Last angewandt wird, um die Kaltluft zu der Gefrierkammer zu schicken, wenn die Kühl-Last zusätzlich angewandt wird, ein zwischen der Gefrierkammer und der Kühlkammer verbundener Durchlass geöffnet wird, um die Kaltluft der Gefrierkammer an die Kühlkammer zu liefern.
39. Verfahren nach Anspruch 37, wobei in dem vierten Schritt, während die Kühl-Last angewandt wird, um die Kaltluft zu der Kühlkammer zu schicken, eine Temperatur des Verdampfers höher als die Temperatur der Gefrierkammer und niedriger als die Temperatur der Kühlkammer eingestellt wird.
40. Verfahren nach Anspruch 37, ferner umfassend in dem vierten Schritt einen Prozess zum Durchführen eines Entfrostonetriebs, wenn die Temperatur der Gefrierkammer und die Temperatur der Kühlkammer höher als eine Entfrostontemperatur werden, obgleich die Gefrier-Last oder die Kühl-Last angewandt werden, um die Kaltluft zu der Gefrierkammer oder der Kühlkammer zu schicken.
41. Verfahren nach Anspruch 40, wobei der Entfrostonbetrieb nur den Kühlkammer-Ventilator in einem Zustand betätigt, wo die Kühlmittel angehalten werden, um nicht zu strömen.
42. Verfahren nach Anspruch 40 oder 41, wobei der Entfrostonbetrieb nicht dekomprimiert, sondern unmittelbar die zu hoher Temperatur und hohem Druck kondensierten Kühlmittel dem Verdampfer zuführt und den Kühlkammer-Ventilator drehbar betätigt.
43. Verfahren nach Anspruch 42, wobei der Entfrostonbetrieb ferner an dem unteren Abschnitt des Verdampfers installierte Entfrostonheizer betätigt, um den Verdampfer zu erwärmen.
44. Verfahren nach einem der Ansprüche 31 bis 43, wobei ein Wärmeaustauschbereich des Verdampfers in den Gefrierkammer-Seitenbereich (68a) und den Kühlkammer-Seitenbereich (68b) durch eine Ab-sperrplatte (70) aufgeteilt ist.

Revendications

1. Réfrigérateur, comprenant :

un compresseur (62) pour comprimer des réfrigérants en réfrigérants gazeux à haute température et haute pression ;
 un condenseur (64) pour condenser les réfrigérants comprimés dans le compresseur en réfrigérants liquides à haute température et haute pression ;
 un moyen de détente (66) pour dilater les réfrigérants condensés dans le condenseur en réfrigérants liquides à basse température et basse pression ; et
 un évaporateur (68) pour évaporer les réfrigérants dilatés dans le moyen de décompression en réfrigérants gazeux à basse température et basse pression, une zone d'échange de chaleur de cet évaporateur étant divisée en une zone côté chambre de congélation (68a) et en une zone côté chambre de réfrigération (68b) par une plaque de blocage (70) ; **caractérisé en ce que** le réfrigérateur comprend en outre :

un passage individuel de circulation de chambre de congélation formé dans le réfrigérateur pour amener de l'air frais en provenance de la zone côté chambre de congélation (68a) dans une chambre de congélation ;
 un passage individuel différent de circulation de chambre de réfrigération formé dans le réfrigérateur pour amener de l'air frais en provenance de la zone côté chambre de réfrigération (68b) dans une chambre de réfrigération ;
 un ventilateur de chambre de congélation (72) installé dans le passage de circulation de chambre de congélation pour envoyer l'air frais à la chambre de congélation ; et
 un ventilateur de chambre de réfrigération (74) installé dans le passage de circulation de chambre de réfrigération pour envoyer l'air frais à la chambre de réfrigération.

2. Réfrigérateur selon la revendication 1, dans lequel plusieurs rainures sont formées sur la surface de la plaque de blocage (70), pour former un lit turbulent pour l'air frais s'écoulant le long de la surface de l'évaporateur (68).

3. Réfrigérateur selon la revendication 1 ou 2, dans lequel l'évaporateur (68) est installé de sorte que la zone côté chambre de congélation et la zone côté chambre de réfrigération de l'évaporateur sont divisées par une paroi de séparation (54) qui sépare la chambre de congélation de la chambre de réfrigé-

ration et la paroi de séparation (54) fonctionne en tant que plaque de blocage (70).

4. Réfrigérateur selon la revendication 3, dans lequel plusieurs rainures sont formées sur la surface de la paroi de séparation (54), pour former un lit turbulent pour l'air frais s'écoulant le long de la surface de l'évaporateur (68).

5. Réfrigérateur selon l'une quelconque des revendications 1 à 4, dans lequel l'évaporateur (68) est un échangeur de chaleur peu épais de type linéaire dans lequel plusieurs ailettes de refroidissement sont installées verticalement par rapport à un tube de réfrigérant.

6. Réfrigérateur selon la revendication 5, dans lequel l'évaporateur (68) est installé de sorte qu'un intervalle entre les ailettes de refroidissement dans la zone côté chambre de congélation de l'évaporateur est plus grand qu'un intervalle entre les ailettes de refroidissement dans la zone côté chambre de réfrigération de l'évaporateur.

7. Réfrigérateur selon l'une quelconque des revendications 1 à 6, dans lequel la zone côté chambre de congélation de l'évaporateur possède une plus grande surface d'échange de chaleur que la zone côté chambre de réfrigération (68b) de l'évaporateur.

8. Réfrigérateur selon l'une quelconque des revendications 1 à 7, dans lequel au moins un dispositif de chauffage dégivrante est en outre installé au niveau de la partie inférieure de l'évaporateur (68), pour dégivrer la zone côté chambre de congélation et la zone côté chambre de réfrigération de l'évaporateur (68).

9. Réfrigérateur selon la revendication 8, dans lequel le dispositif de chauffage dégivrante comprend un dispositif de chauffage dégivrante pour la chambre de congélation ayant une grande capacité qui est installé au niveau de la partie inférieure de la zone côté chambre de congélation de l'évaporateur (68), et un dispositif de chauffage dégivrante pour la chambre de réfrigération ayant une petite capacité qui est installé au niveau de la partie inférieure de la zone côté chambre de réfrigération de l'évaporateur (68).

10. Réfrigérateur selon la revendication 8 ou 9, dans lequel le dispositif de chauffage dégivrante comprend des dispositifs de chauffage radiants.

11. Réfrigérateur selon l'une quelconque des revendications 1 à 10, dans lequel le compresseur (62) est un compresseur à capacité variable qui peut faire varier le débit des réfrigérants mis en circulation le long de l'évaporateur (68).

- 12.** Réfrigérateur selon l'une quelconque des revendications 1 à 11, dans lequel le ventilateur de chambre de congélation, est installé au niveau d'une partie supérieure de la zone côté chambre de congélation de l'évaporateur, pour envoyer l'air frais à la chambre de congélation, et le ventilateur de chambre de réfrigération est installé au niveau d'une partie supérieure de la zone côté chambre de réfrigération de l'évaporateur, côte-à-côte avec le ventilateur de chambre de congélation, pour envoyer l'air frais à la chambre de réfrigération. 5
- 13.** Réfrigérateur selon la revendication 12, dans lequel le ventilateur de chambre de congélation et le ventilateur de chambre de réfrigération sont des ventilateurs de type sirocco pour aspirer l'air frais dans une direction axiale et pour évacuer l'air dans une direction circonférentielle. 10
- 14.** Réfrigérateur selon la revendication 12 ou 13, dans lequel un moteur pour entraîner le ventilateur de chambre de congélation est installé au niveau d'une partie supérieure de la zone côté chambre de congélation de l'évaporateur et un moteur pour entraîner le ventilateur de chambre de réfrigération est installé au niveau d'une partie supérieure de la zone côté chambre de réfrigération de l'évaporateur côte à côte avec le ventilateur de chambre de congélation et le moteur pour entraîner le ventilateur de chambre de congélation. 20
- 15.** Réfrigérateur selon la revendication 14, dans lequel les moteurs pour entraîner respectivement le ventilateur de chambre de congélation et le ventilateur de chambre de réfrigération sont des moteurs à courant continu (DC) sans collecteur. 25
- 16.** Réfrigérateur selon l'une quelconque des revendications 1 à 15, dans lequel le moyen de détente (66) est constitué par une vanne de dilatation de congélation (66a) et par une vanne de dilatation de réfrigération (66b) installées côte à côte entre le condenseur (64) et l'évaporateur (68) pour combiner des tubes réfrigérants formés au niveau des extrémités avant et arrière, la vanne de dilatation de congélation (66a) et la vanne de dilatation de réfrigération (66b) étant de capacité différente. 30
- 17.** Réfrigérateur selon l'une quelconque des revendications 1 à 16, dans lequel le moyen de détente (66) comprend en outre une vanne de dilatation auxiliaire (66c) installée entre l'évaporateur (68) et le compresseur (62), pour détendre les réfrigérants en provenance de l'évaporateur (68) et pour amener les réfrigérants au compresseur (62). 35
- 18.** Réfrigérateur selon la revendication 16 ou 17, dans lequel la vanne de dilatation de congélation (66a) présente une capacité relativement plus grande que la vanne de dilatation de réfrigération (66b). 40
- 19.** Réfrigérateur selon l'une quelconque des revendications 16 à 18, dans lequel la vanne de dilatation de congélation (66a) et la vanne de dilatation de réfrigération (66b) sont des tubes capillaires. 45
- 20.** Réfrigérateur selon l'une quelconque des revendications 16 à 19, dans lequel la vanne de dilatation de congélation (66a) et la vanne de dilatation de réfrigération (66b) sont des vannes de dilatation électroniques. 50
- 21.** Réfrigérateur selon l'une quelconque des revendications 16 à 20, comprenant un moyen formant vanne installé entre le condenseur (64) et la vanne de dilatation de congélation (66a) et la vanne de dilatation de réfrigération (66b), pour amener de manière sélective les réfrigérants en provenance du condenseur (64) à la vanne de dilatation de congélation (66a) ou à la vanne de dilatation de réfrigération (66b). 55
- 22.** Réfrigérateur selon la revendication 21, dans lequel le moyen formant vanne est une vanne trois voies (82) installée sur un tube réfrigérant dérivé du condenseur (64) dans la vanne de dilatation de congélation (66a) et la vanne de dilatation de réfrigération (66b), pour faire varier un passage des réfrigérants.
- 23.** Réfrigérateur selon la revendication 21, dans lequel le moyen formant vanne est constitué par des première et seconde électrovannes (84a, 84b) installées sur des tubes réfrigérants formés au niveau des extrémités avant de la vanne de dilatation de congélation (66a) et de la vanne de dilatation de réfrigération (66b), pour faire varier un passage des réfrigérants.
- 24.** Réfrigérateur selon la revendication 21, dans lequel, dans un mode de congélation pour faire en sorte que la température de la chambre de congélation (T_f) atteigne une température de congélation fixée (T_{f0}), le moyen formant vanne fait en sorte que les réfrigérants passent à travers la vanne de dilatation de congélation (66a), le ventilateur de chambre de congélation est mis en action et le ventilateur de chambre de réfrigération est arrêté.
- 25.** Réfrigérateur selon la revendication 21, dans lequel, dans un mode de réfrigération pour faire en sorte que la température de la chambre de réfrigération (T_r) atteigne une température de réfrigération fixée (T_{r0}), le moyen formant vanne fait en sorte que les réfrigérants passent à travers la vanne de dilatation de réfrigération (66b), le ventilateur de chambre de réfrigération est mis en action et le ventilateur de

chambre de congélation est arrêté.

26. Réfrigérateur selon la revendication 21, dans lequel, dans un mode de congélation et de réfrigération pour faire en sorte que la température de la chambre de congélation (T_f) et la température de la chambre de réfrigération (T_r) atteignent respectivement une température de congélation fixée (T_{f0}) et une température de réfrigération fixée (T_{r0}), le moyen formant vanne fait en sorte que les réfrigérants passent à travers la vanne de dilatation de congélation (66a), le ventilateur de chambre de congélation est mis en action de façon continue et le ventilateur de chambre de réfrigération est mis en action et arrêté à des intervalles de temps prédéterminés.
27. Réfrigérateur selon la revendication 21, dans lequel, dans un mode de dégivrage pour faire en sorte que la température de la chambre de congélation (T_f) et la température de la chambre de réfrigération (T_r) atteignent une température de dégivrage (T_i) pour enlever la glace de la surface de l'évaporateur (68), le compresseur (62) est arrêté, le moyen formant vanne empêche les réfrigérants de passer à travers la vanne de dilatation de congélation (66a) ou la vanne de dilatation de réfrigération (66b), le ventilateur de chambre de congélation est arrêté et le ventilateur de chambre de réfrigération est mis en action.
28. Réfrigérateur selon la revendication 27, dans lequel, dans le mode de dégivrage, quand la température de la chambre de congélation (T_f) et la température de la chambre de réfrigération (T_r) n'atteignent pas la température de dégivrage (T_i), le moyen formant vanne fait en sorte que les réfrigérants passent à travers la vanne de dilatation de congélation (66a) et la vanne de dilatation de réfrigération (66b), et les dispositifs de chauffage dégivrant installés au niveau de la partie inférieure de l'évaporateur (68) sont mis en action.
29. Réfrigérateur selon l'une quelconque des revendications 3 à 28, dans lequel un passage de connexion est formé sur la paroi de séparation (54) entre la chambre de congélation et la chambre de réfrigération, de sorte que l'air frais de la chambre de congélation peut être amené à la chambre de réfrigération, et un volet (76) est installé sur le passage de connexion pour ouvrir / fermer le passage de connexion.
30. Réfrigérateur selon la revendication 29, dans lequel, dans le mode de congélation pour faire en sorte que la température de la chambre de congélation (T_f) atteigne la température de congélation fixée (T_{f0}), quand la température de la chambre de réfrigération (T_r) dépasse une température de réfrigération fixée (T_{r0}), le volet (76) est ouvert pour amener l'air frais de la chambre de congélation à la chambre de réfri-

gération.

31. Procédé pour commander la mise en oeuvre d'un réfrigérateur, comprenant :

une première étape consistant à comprimer des réfrigérants en réfrigérants gazeux à haute température et haute pression selon une charge de congélation ou une charge de réfrigération appliquées à une chambre de congélation ou à une chambre de réfrigération ;
une deuxième étape consistant à condenser les réfrigérants comprimés dans la première étape en réfrigérants liquides à haute température et haute pression en effectuant une opération d'échange de chaleur avec de l'air,
une troisième étape consistant à détendre les réfrigérants condensés dans la deuxième étape en réfrigérants liquides à basse température et basse pression en commandant un degré de détente selon la charge ; et
une quatrième étape consistant à produire de l'air frais en évaporant les réfrigérants décompressés dans la troisième étape en réfrigérants gazeux à basse température et basse pression en effectuant une opération d'échange de chaleur avec de l'air, et en envoyant l'air frais à la chambre de congélation, à la chambre de réfrigération, ou tant à la chambre de congélation qu'à la chambre de réfrigération ;

caractérisé en ce que

l'air frais est envoyé de manière sélective à l'une et/ou l'autre de la chambre de congélation et de la chambre de réfrigération selon la charge, en mettant en action l'un et/ou l'autre d'un ventilateur de chambre de congélation (72) pour envoyer l'air frais produit dans une zone côté chambre de congélation (68a) d'un évaporateur (68) à la chambre de congélation et d'un ventilateur de chambre de réfrigération (74) pour envoyer de l'air frais produit dans une zone côté chambre de réfrigération (68b) de l'évaporateur (68) à la chambre de réfrigération.

32. Procédé selon la revendication 31, comprenant, dans la première étape, un processus pour paramétrer la charge de congélation appliquée de sorte que la température de la chambre de congélation peut atteindre une température de congélation fixée, ou la charge de réfrigération appliquée de sorte que la température de la chambre de réfrigération peut atteindre une température de réfrigération fixée.

33. Procédé selon la revendication 32, dans lequel, lorsque la charge augmente dans la première étape, le débit de compression des réfrigérants augmente également.

34. Procédé selon la revendication 32 ou 33, dans lequel, dans la première étape, le débit de compression des réfrigérants est plus élevé dans l'application de la charge de congélation que dans l'application de la charge de réfrigération. 5
35. Procédé selon l'une quelconque des revendications 31 à 34, dans lequel, dans la troisième étape, un degré de décompression des réfrigérants est plus élevé dans l'application de la charge de congélation que dans l'application de la charge de réfrigération. 10
36. Procédé selon l'une quelconque des revendications 31 à 35, dans lequel, dans la quatrième étape, lorsque la charge de congélation et la charge de réfrigération sont appliquées en même temps, l'air frais produit dans la zone côté chambre de congélation de l'évaporateur est envoyé à la chambre de congélation par un ventilateur de chambre de congélation, et l'air frais produit dans la zone côté chambre de réfrigération de l'évaporateur est envoyé à la chambre de réfrigération par un ventilateur de chambre de réfrigération. 15
37. Procédé selon l'une quelconque des revendications 31 à 36, dans lequel, dans la quatrième étape, lorsque la charge de congélation est appliquée, l'air frais produit dans la zone côté chambre de congélation de l'évaporateur est envoyé uniquement à la chambre de congélation par le ventilateur de chambre de congélation, et lorsque la charge de réfrigération est appliquée, l'air frais produit dans la zone côté chambre de réfrigération de l'évaporateur est envoyé uniquement à la chambre de réfrigération par le ventilateur de chambre de réfrigération. 20
38. Procédé selon la revendication 37, dans lequel, dans la quatrième étape, tandis que la charge de congélation est appliquée pour envoyer l'air frais à la chambre de congélation, lorsque la charge de réfrigération est en outre appliquée, un passage lié entre la chambre de congélation et la chambre de réfrigération est ouvert pour amener l'air frais de la chambre de congélation à la chambre de réfrigération. 25
39. Procédé selon la revendication 37, dans lequel, dans la quatrième étape, tandis que la charge de réfrigération est appliquée pour envoyer l'air frais à la chambre de réfrigération, la température de l'évaporateur est fixée plus haute que la température de la chambre de congélation et plus basse que la température de la chambre de réfrigération. 30
40. Procédé selon la revendication 37, comprenant en outre, dans la quatrième étape, un processus pour effectuer une opération de dégivrage lorsque la température de la chambre de congélation et la température de la chambre de réfrigération dépassent une température de dégivrage, bien que la charge de congélation ou la charge de réfrigération soient appliquées pour envoyer l'air frais à la chambre de congélation ou à la chambre de réfrigération. 35
41. Procédé selon la revendication 40, dans lequel l'opération de dégivrage met uniquement en action le ventilateur de chambre de réfrigération dans un état où les réfrigérants sont empêchés de s'écouler. 40
42. Procédé selon la revendication 40 ou 41, dans lequel l'opération de dégivrage ne détend pas mais amène directement les réfrigérants condensés à haute température et haute pression à l'évaporateur, et met en rotation le ventilateur de chambre de réfrigération. 45
43. Procédé selon la revendication 42, dans lequel l'opération de dégivrage met de plus en action des dispositifs de chauffage dégivrants installés au niveau de la partie inférieure de l'évaporateur pour chauffer l'évaporateur. 50
44. Procédé selon l'une quelconque des revendications 31 à 43, dans lequel une zone d'échange de chaleur de l'évaporateur est divisée en une zone côté chambre de congélation (68a) et en une zone côté chambre de réfrigération (68b) par une plaque de blocage (70). 55

FIG. 1

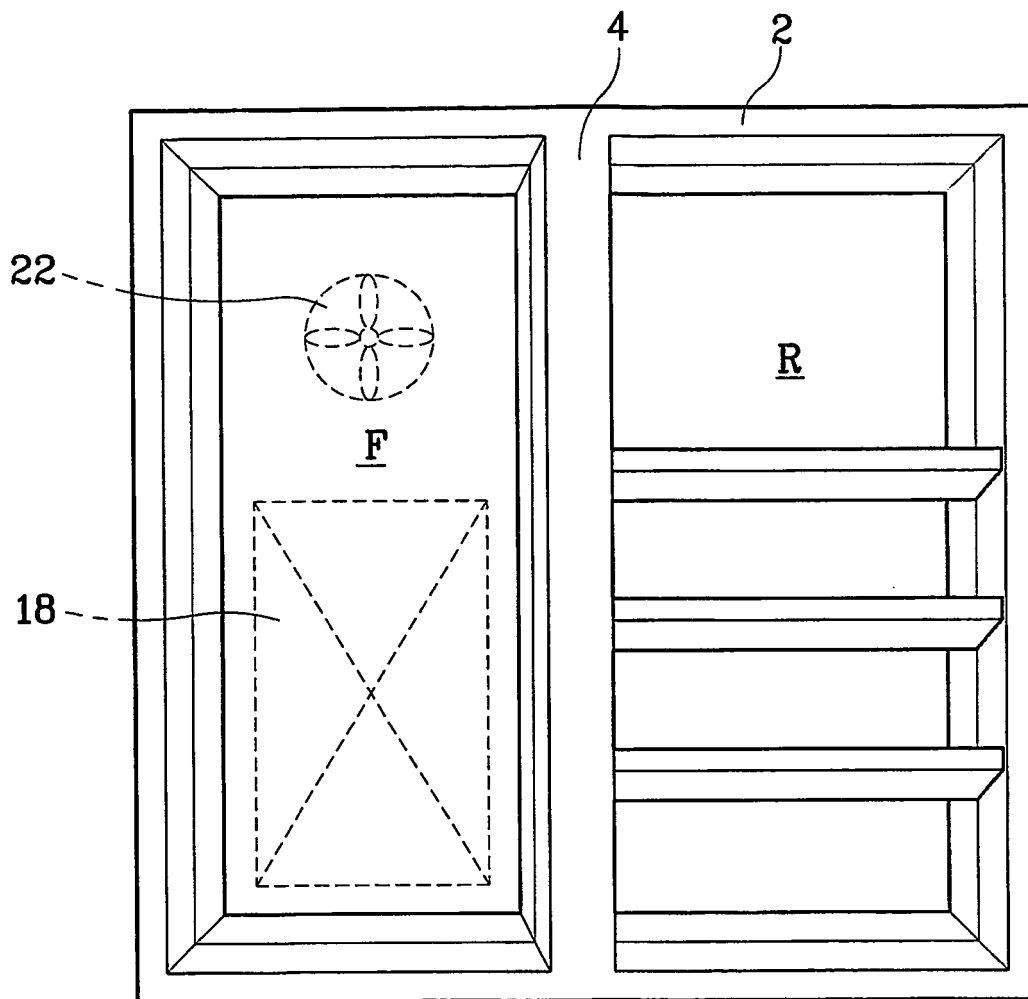


FIG. 2

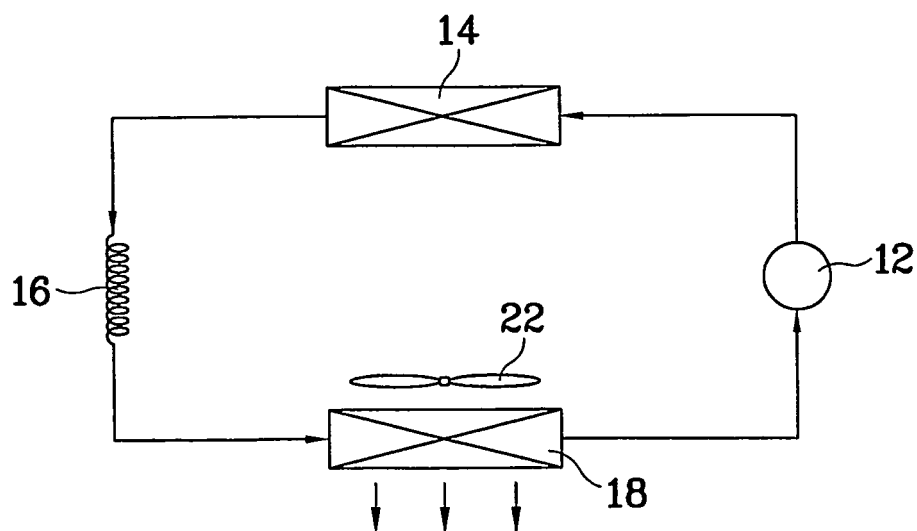


FIG. 3

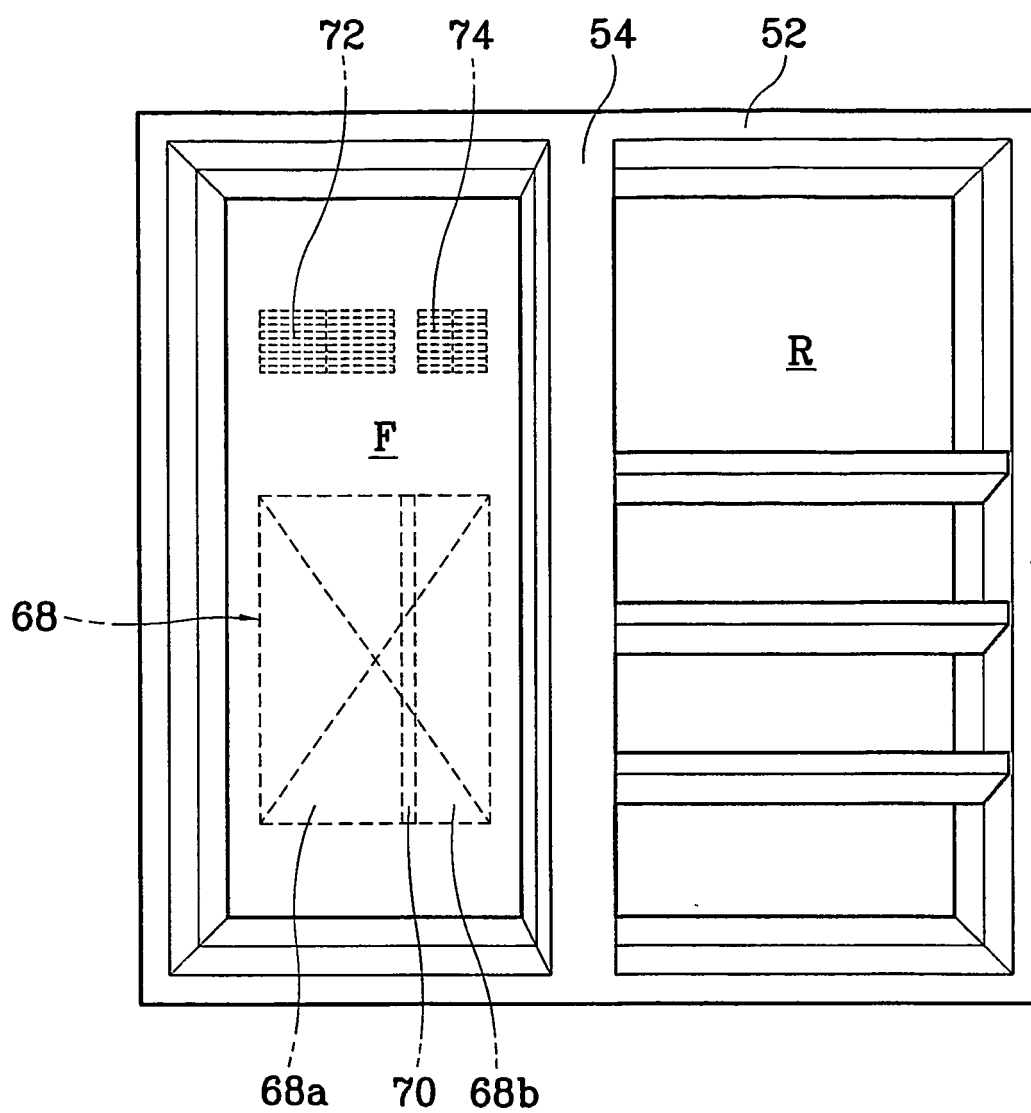


FIG. 4

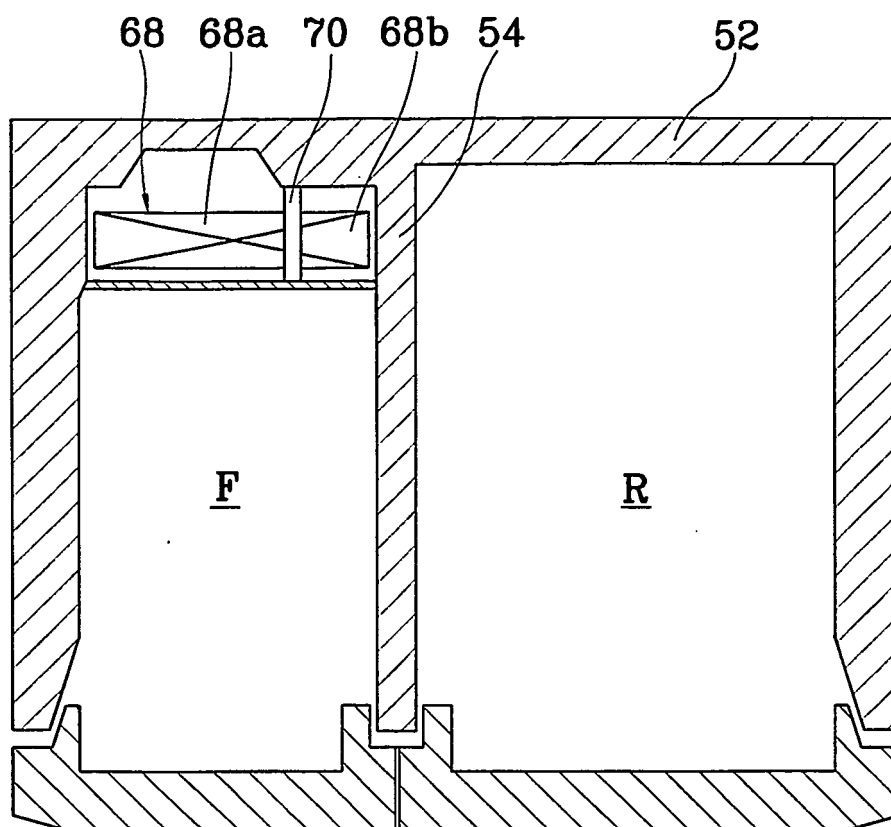


FIG. 5

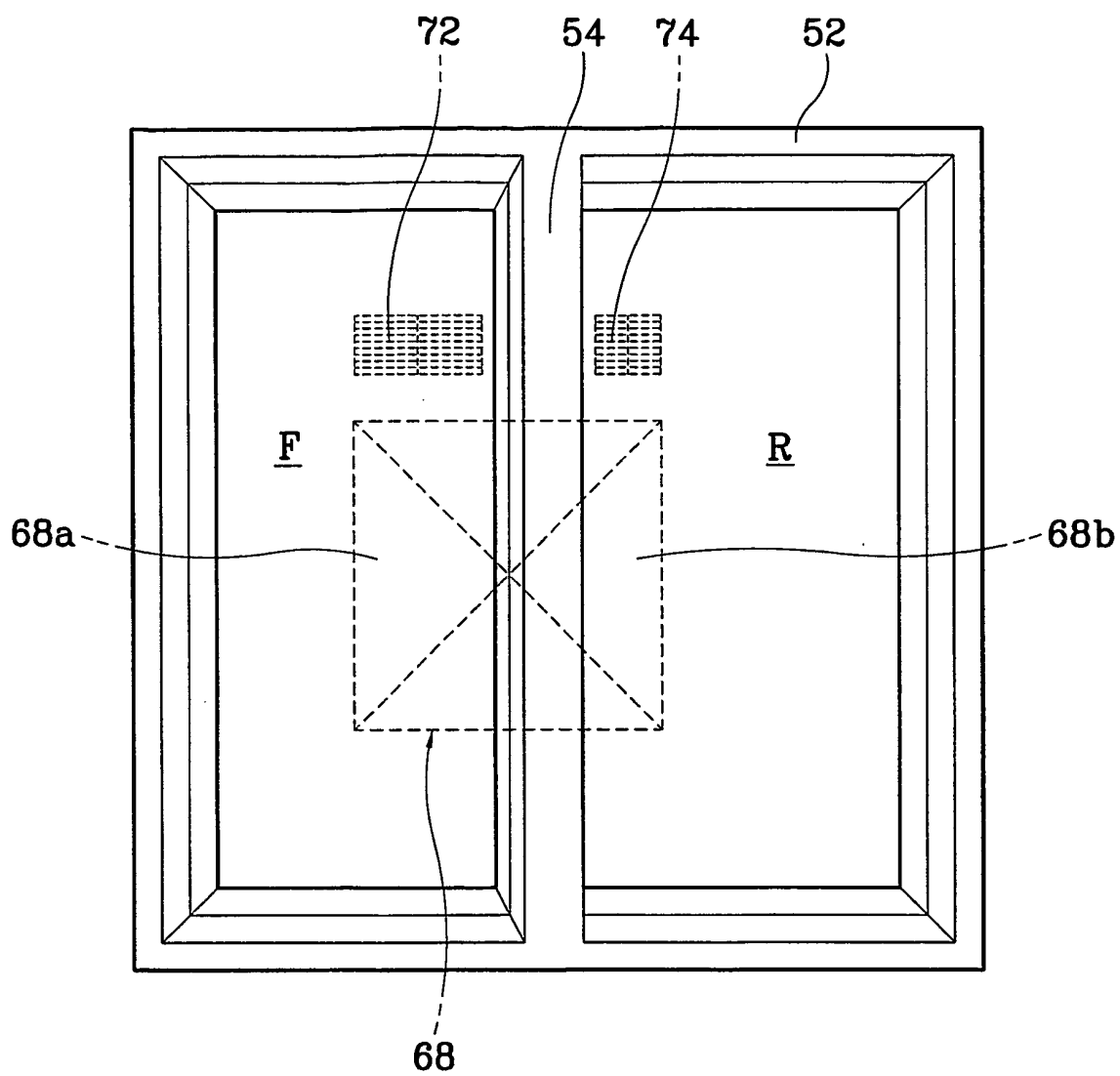


FIG. 6

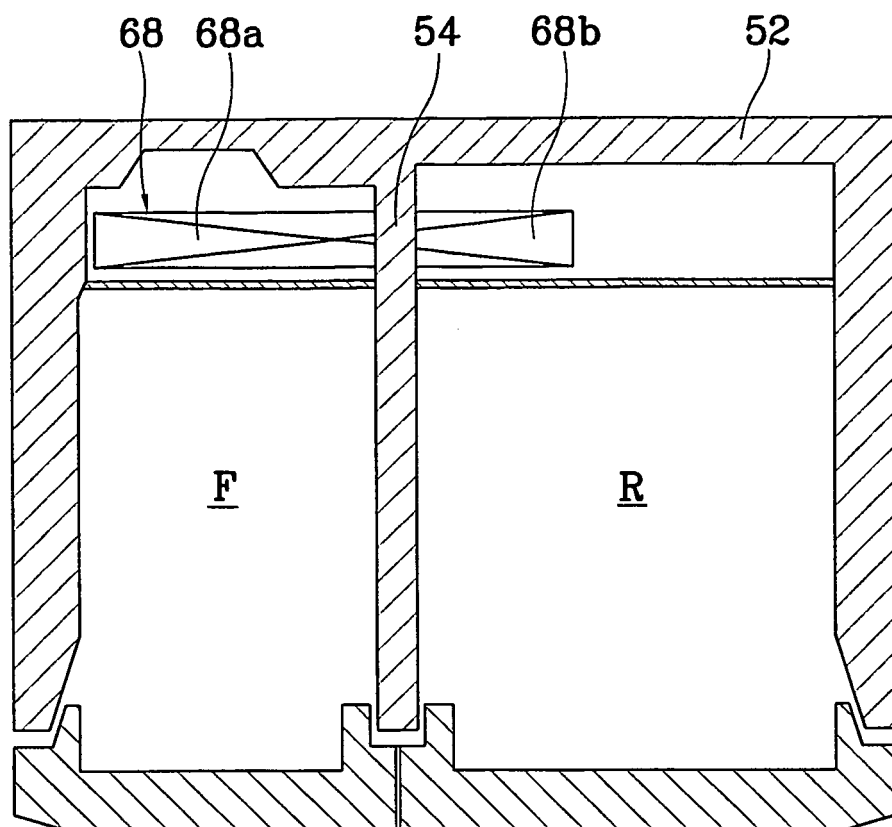


FIG. 7

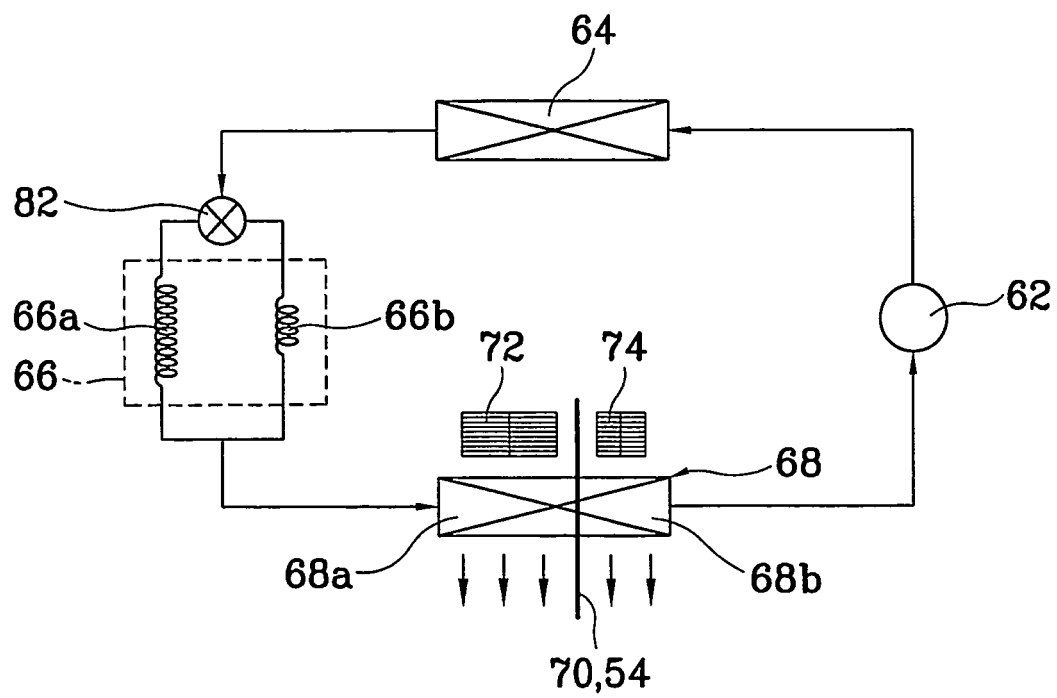


FIG. 8

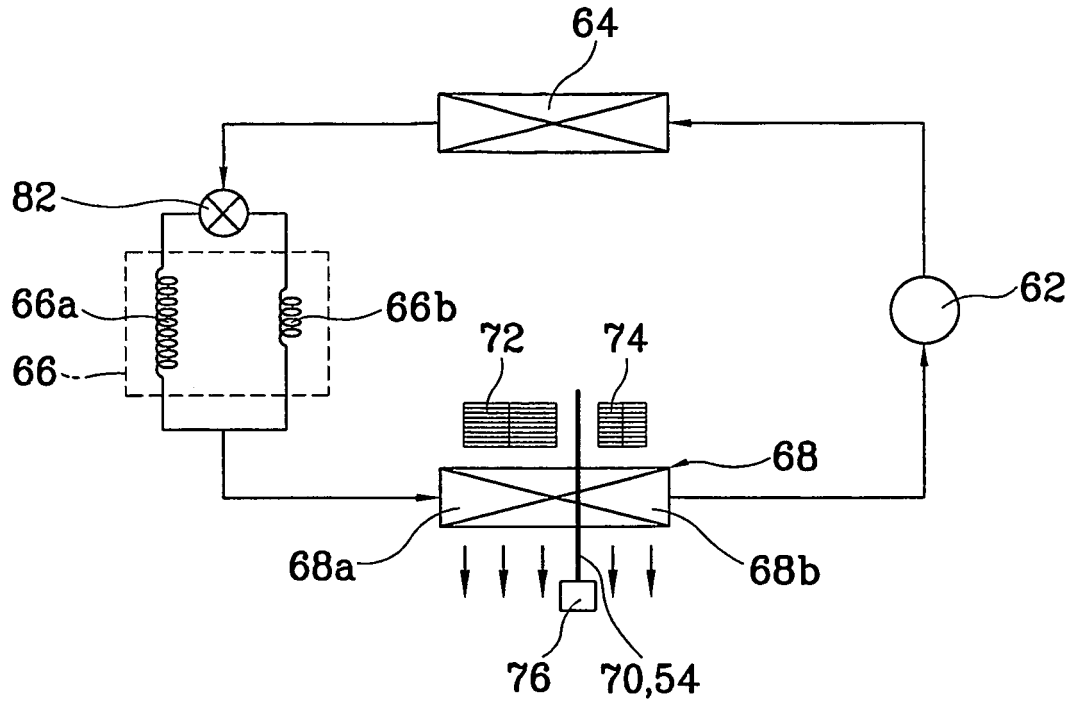


FIG. 9

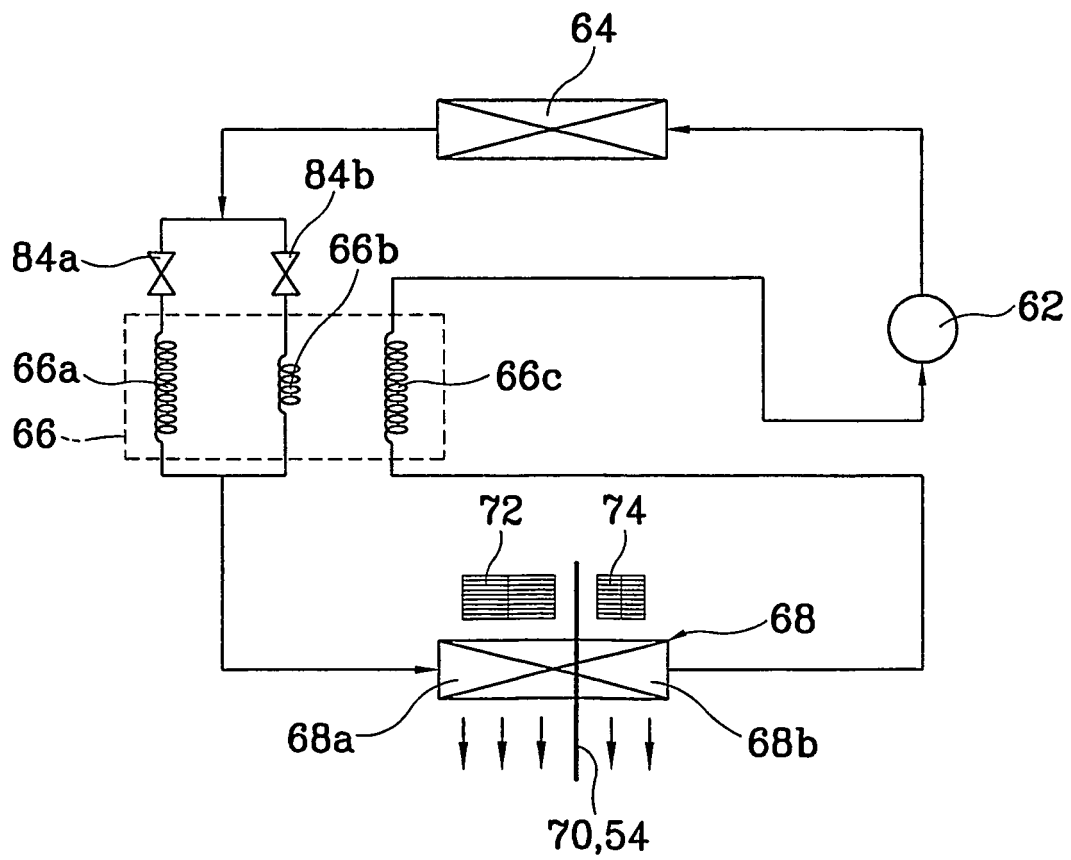


FIG. 10

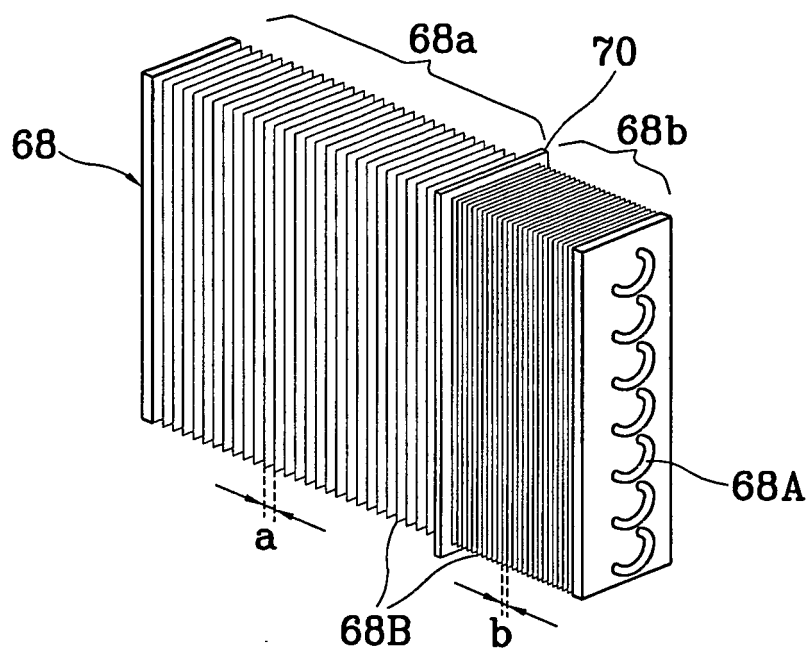


FIG. 11

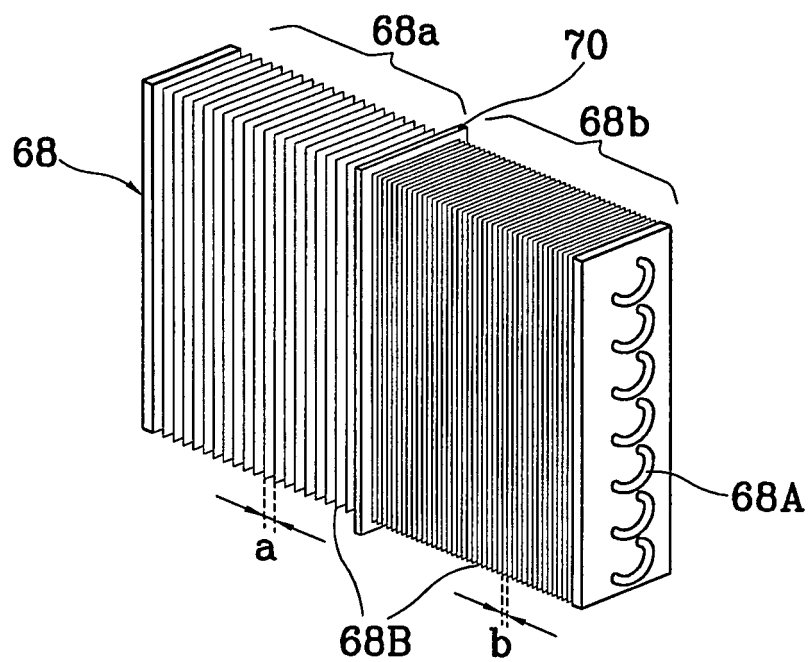
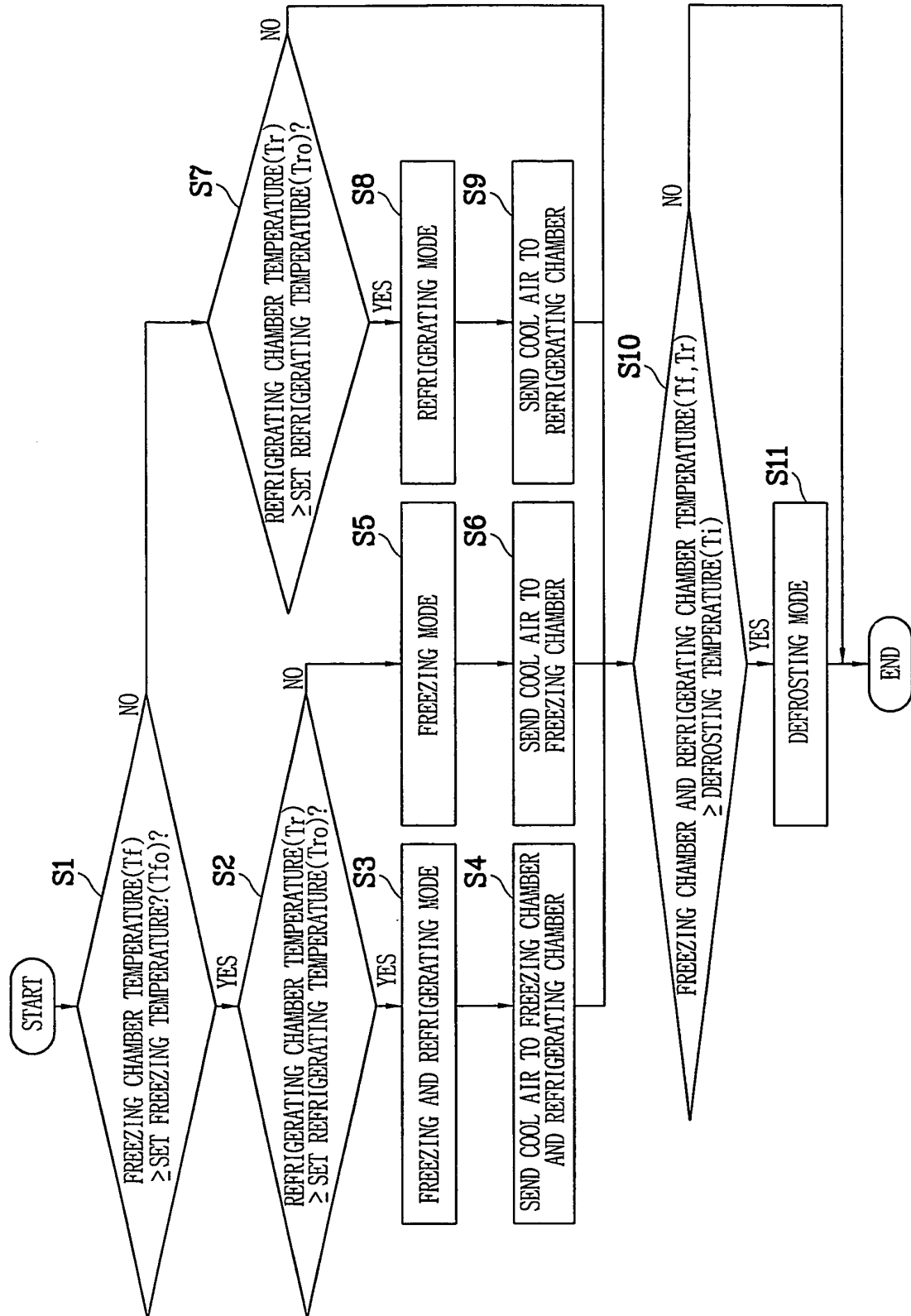


FIG. 12



REFERENCES CITED IN THE DESCRIPTION

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