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(54) **REFRIGERATOR**

KÜHLVORRICHTUNG

RÉFRIGÉRATEUR

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Description

Technical Field

[0001] The present invention relates to refrigerators and particularly to a technique related to a cooling cycle unit of a refrigerator which has a refrigerator compartment and a freezer compartment arranged side by side in the horizontal direction.

Background Art

[0002] Conventionally, many refrigerators have a refrigerator compartment and a freezer compartment stacked in the vertical direction (see Patent Reference 1, for example). In the case of a refrigerator of this type, a compressor and a condenser included in a cooling cycle unit are arranged side by side in the horizontal direction in the lower and rear part of the refrigerator. This horizontal positional relation of these compressor and condenser is determined according to the conditions for easiness in piping and the like because the refrigerator having the refrigerator compartment and the freezer compartment arranged in the vertical direction has equal positional relations of the condenser and the compressor to the refrigerator compartment or the freezer compartment.

[0003] In the meantime, there have recently emerged refrigerators having a refrigerator compartment and a freezer compartment arranged side by side in the horizontal direction. Also in the case of a refrigerator of this type, a compressor and a condenser are located in the lower and rear part of the refrigerator, but, for this refrigerator, the horizontal positional relation of the compressor and the condenser is considered to be important. Specifically, since the temperature of the compressor rises to a relatively high level as compared to the temperature of the condenser, the condenser is disposed below the freezer compartment while the compressor is disposed below the refrigerator compartment so that the thickness-wise temperature gradient of a thermal insulant disposed below the freezer compartment stays low and also the thickness-wise temperature gradient of a thermal insulant disposed below the refrigerator compartment stays low.

[0004] Furthermore, in the refrigerator of either type, the compressor and the condenser are exposed to the atmosphere and thereby cooled by the air because the compressor and the condenser tend to have high temperatures.

Document US2003 0029189A discloses a refrigerator condenser system including an integral condenser coil and hot gas loop embedded in a floor and a vertical wall of a refrigeration compartment to increase heat transfer efficiency to ambient air. The condenser system is cast in place within the refrigerator cabinet to form a reliable, high efficiency, maintenance free refrigerator condenser system.

Patent Reference 1: Japanese Unexamined Patent Application Publication NO. 2003-42636

Patent Reference 2: US Patent Application 2003/0029189 A

Disclosure of Invention

Problems that Invention is to Solve

[0005] However, in the case of cooling the compressor and the condenser by the air as in the conventional refrigerators, dust gathers on their surfaces due to the long-term use of the refrigerator. Especially in the case where the condenser is covered with dust, the condenser is kept warm by the dust and therefore not able to cool a refrigerant as it should be, which tends to degrade the ability of the cooling cycle. Moreover, since a refrigerator of the type having the refrigerator compartment and the freezer compartment arranged side by side in the horizontal direction is relatively large in size, the refrigerator cannot easily be moved, which also makes it difficult to remove the dust gathered on the condenser and the compressor disposed in the lower and rear part of the refrigerator, and it therefore used to be also difficult to recover the degraded ability of the cooling cycle.

[0006] In such a circumstance, the inventors of the present invention found that the degraded ability of the cooling cycle can be complemented with the use of a metallic outer casing as a heat dissipation plate, and are in the process of filing another application in this regard.

[0007] Furthermore, the inventors of the present application finally invented a cooling cycle unit which is suitable in the case where the outer casing is used as a heat dissipation plate.

[0008] The present invention has been devised based on the above-mentioned finding, and has an object to provide a refrigerator of the type having the refrigerator compartment and the freezer compartment arranged side by side in the horizontal direction, which is capable of contributing to energy saving by improving energy efficiency of the cooling cycle while reducing degradation of the ability of the cooling cycle.

Means to Solve the Problems

[0009] In order to achieve the above object, the refrigerator according to an aspect of the present invention is a refrigerator including: a first body having an opening in a front face and defining a refrigerator compartment; a second body having an opening in a front face and defining a freezer compartment; an outer casing which is made of a metal and covers the first body and the second body that are arranged next to each other in a horizontal direction; a compressor disposed below the second body; a first condenser connected to the compressor and disposed below the first body, the first condenser providing direct heat exchange with air; a second condenser connected to the first condenser and disposed between

the first body and the outer casing, the second condenser providing heat exchange with air through the outer casing; and an evaporator which is connected to the second condenser and by which a refrigerant is evaporated.

[0010] This allows the second condenser to be disposed close to the first condenser, so that the pipe which connects the first condenser and the second condenser can be shorter. Thus, it becomes possible to improve energy efficiency of the cooling cycle by avoiding the unnecessary flow of the refrigerant.

[0011] Furthermore, a blower is provided which is disposed between the compressor and the first condenser and generates an air flow for cooling the compressor and the first condenser.

[0012] This allows circulation of the air in the space in which the first condenser and the compressor are disposed, with the result that the cooling effect can improve. Thus, even when the compressor is located below the freezer compartment, the influence of the heat of the compressor on the freezer compartment can be reduced, which allows for improvement in the energy efficiency of the whole refrigerator.

[0013] It is preferable that the evaporator include: a first evaporator which is connected to the second condenser and disposed in a rear part of the first body; and a second evaporator which is connected in series to the first evaporator and disposed in a rear part of the second body, and the refrigerator further include: a bypass pipe which connects the second condenser and the second evaporator without passing through the first evaporator; and a switch valve which selects between supplying the refrigerant from the second condenser to the first evaporator and supplying the refrigerant from the second condenser directly to the second evaporator.

[0014] This makes it possible to switch the first evaporator between operative and inoperative states while the second evaporator is in an operative state. Thus, there is no longer need to operate the first evaporator in conjunction with the second evaporator that operates for long hours in order to cool the cooling compartment required to be kept at relatively low temperatures, and the refrigerant can therefore be used efficiently to obtain high energy efficiency.

[0015] Furthermore, it is preferable that the switch valve be disposed, with respect to the blower, in a direction in which the first condenser is disposed.

[0016] With this, the switch valve is present in the region of the first condenser having a relatively low temperature and therefore is less likely to adversely affect the ability of the cooling cycle. Since the switch valve requires maintenance and the like, it is suitable that the switch valve be exposed to the air and be located in the region in which the first condenser is present.

[0017] Furthermore, it is preferable that a water cooling device be provided including a valve which is connected to a water pipe and selects between supplying tap water to the refrigerator and blocking the tap water, and the valve be disposed, with respect to the blower, in a direction in which the first condenser is disposed.

[0018] With this, the valve for controlling the water flow of the water cooling device that brings tap water into the refrigerator and cools and supplies the tap water is present in the region of the first condenser having a relatively low temperature, which makes it possible to reduce the degradation of the water cooling ability. Since the valve requires maintenance and the like, it is suitable that the valve be exposed to the air and be located in the region in which the first condenser is present.

[0019] Furthermore, it is preferable that the air flow generated by the blower be oriented in a direction from the second condenser toward the compressor.

[0020] With this, the flow of air from a low temperature area to a high temperature area can be generated, which makes it possible to improve the cooling efficiency of the first condenser and the compressor. Furthermore, the heat transfer from the compressor to the switch valve and the valve is suppressed, so that the degradations of the ability of the cooling cycle and of the water cooling ability can be avoided.

[0021] Furthermore, it is preferable that an evaporating dish be provided in which water resulting from defrosting by the cooling cycle is accumulated and evaporated and which is disposed between the second body and the compressor and includes a recessed portion that is in contact with a top surface and a side surface of the compressor.

[0022] With this, a member which is specifically an evaporating dish can be interposed between the second body and the compressor whose temperature rises to a relatively high level, with the result that the influence of the heat of the compressor on the inside of the second body can be reduced. Moreover, the evaporating dish is a dish for vaporizing water resulting from defrosting on a surface of the evaporator, and the heat of vaporization takes the heat of the compressor away, allowing a reduction in the influence on the inside of the second body.

[0023] Furthermore, it is preferable that the evaporating dish include a sloped part which guides the air flow above the compressor to the compressor.

[0024] With this, the efficiency of cooling the compressor by the blower can improve, with the result that not only the influence on the second body can be reduced, but also the energy efficiency of the cooling cycle can improve.

[0025] Furthermore, it is preferable that the evaporator include: a first evaporator which is connected to the second condenser and disposed in a rear part of the first body; and a second evaporator which is connected to the first evaporator and disposed in a rear part of the second body, and the refrigerator further include a guide channel which guides the water resulting from defrosting by the first evaporator to the evaporating dish.

[0026] This allows more water to be collected in the evaporating dish, with the result that the amount of water vaporized increases, allowing an increase in the heat which is taken away from the compressor by vaporization.

[0027] Furthermore, it is preferable that the compressor is lower in height than the first condenser.

[0028] This increases the distance between the compressor and the second body, allowing a reduction in the heat which is transferred from the compressor to the inside of the second body. In addition, the evaporating dish can be disposed easily in the space between the compressor and the second body, and it also becomes possible to easily dispose the guide channel and the like.

Effects of the Invention

[0029] According to the present invention, it becomes possible to provide a refrigerator which is capable of contributing to energy saving while maintaining and improving the ability as a refrigerator.

Brief Description of Drawings

[0030]

[FIG. 1] FIG. 1 is a perspective view showing an external appearance of a refrigerator.

[FIG. 2] FIG. 2 is a perspective view showing an external appearance of the refrigerator with the third door and the fourth door open.

[FIG. 3] FIG. 3 is a perspective view showing an external appearance of the refrigerator with the first door and the second door open.

[FIG. 4] FIG. 4 is a perspective view showing an external appearance of the refrigerator with the first door and the second door omitted.

[FIG. 5] FIG. 5 schematically shows a cooling cycle unit.

[FIG. 6] FIG. 6 is a perspective view schematically showing components of the cooling cycle unit when mounted in the refrigerator.

[FIG. 7] FIG. 7 is a perspective view showing the lower and rear part of the refrigerator from behind the refrigerator.

[FIG. 8] FIG. 8 is a perspective view showing an evaporating dish.

[FIG. 9] FIG. 9 is a perspective view showing a cross-section of the evaporating dish when mounted on a compressor.

[FIG. 10] FIG. 10 is a perspective view showing the lower and rear part in a partially transparent state from behind the refrigerator.

Numerical References

[0031]

100 Refrigerator
101 Compressor
102 Condenser
103 Evaporator
104 Refrigerant-return pipe
105 Bypass pipe
106 Switch valve
107 Valve
108 Connecting pipe
110 Cooling cycle unit
111 First door
112 Third door
113 Through hole
114 Water cooling device
115 Insulator
116 Water pipe
120 Mechanical compartment
121 Second door
122 Fourth door
123 Supply opening
124 First condenser
125 Second condenser
126 Third condenser
131 First evaporator
132 Second evaporator
133 Guide channel
134 Second guide channel
140 Evaporating dish
141 Blower
143 Recessed portion
145 Sloped part
147 Introduction hole
150 Main body
151 First body
152 Second body
153 Partition
156 Outer casing
157 Inner casing
160 First thin pipe
161 Second thin pipe

Best Mode for Carrying Out the Invention

[0032] Next, embodiments of a refrigerator according to the present invention are described with reference to the Drawings.

(First embodiment)

[0033] FIG. 1 is a perspective view showing an external appearance of a refrigerator.

[0034] FIG. 2 is a perspective view showing an external appearance of the refrigerator with the third door and the fourth door open.

[0035] A refrigerator 100 is an apparatus for chilling or freezing and preserving a storage item placed inside, and includes a main body 150, a first door 111, a second door 121, a third door 112, a through hole 113, and a fourth door 122. The refrigerator 100 is a rectangular box-shaped body whose height is largest of height, width, and depth.

[0036] The first door 111 is a door which covers the opening on the right when facing the main body 150, with

flexibility in opening and closing. In the present embodiment, the first door 111 is attached to the main body 150 using a hinge (not shown) so as to turn back and forth centering on a vertical axis that extends in an anterior portion of the right-side wall of the main body 150. In addition, the first door 111 is in the form of a rectangle which is long in the vertical direction, and disposed so as to extend from top to bottom of the refrigerator 100, with the above axis extending along the right-edge rim of the first door 111.

[0037] The second door 121 is a door which covers the opening on the left when facing the main body 150, with flexibility in opening and closing. In the present embodiment, the second door 121 is attached to the main body 150 using a hinge (not shown) so as to turn back and forth centering on a vertical axis that extends in an anterior portion of the left-side wall of the main body 150. In addition, the second door 121 is in the form of a rectangle which is long in the vertical direction, and disposed so as to extend from top to bottom of the refrigerator 100, with the above axis extending along the left-edge rim of the second door 121.

[0038] The through hole 113 is a hole penetrating through the first door 111 in the thickness direction. The through hole 113 is a hole through which a storage item stored behind the first door 111 is taken out or through which a storage item is put for storage behind the first door 111, without opening the first door 111.

[0039] The third door 112 is a door which covers the through hole 113 with flexibility in opening and closing. In the present embodiment, the third door 112 is attached to the first door 111 using a hinge (not shown) so as to turn back and forth centering on a horizontal axis that extends at the lower end of the through hole 113. In addition, the first door 112 is square in shape as viewed from the front (round-cornered), with an axis extending along the lower-end rim of the third door 112.

[0040] The fourth door 122 is a door which covers, with flexibility in opening and closing, a supply opening 123 of a water cooling device 114 that is connected to a water pipe and cools, using a cooling cycle unit 110 included in the refrigerator 100, tap water supplied into the refrigerator 100.

[0041] FIG. 3 is a perspective view showing an external appearance of the refrigerator with the first door and the second door open.

[0042] FIG. 4 is a perspective view showing an external appearance of the refrigerator with the first door and the second door omitted.

[0043] FIG. 3 shows also a storage item A stored in the refrigerator 100.

[0044] As shown in these figures, the refrigerator 100 includes a first body 151, a second body 152, and an outer casing 156.

[0045] The first body 151 is a vertically-long heat-insulating body having an opening in the front face and defining a refrigerator compartment. In the present embodiment, the first body 151 is disposed on the right in the refrigerator 100 so as to extend entirely from top to bottom of the refrigerator 100. The refrigerator compartment is a compartment having a temperature inside maintained in the temperature range of no lower than 0 degree C, and especially in the case of preserving vegetables and the like under moist conditions, this compartment is sectioned by providing a drawer case therein so as to provide a sub-compartment in which such vegetables stored therein are not directly exposed to the cool air circulating inside the refrigerator compartment.

[0046] The second body 152 is a vertically-long heat-insulating body having an opening in the front face and defining a freezer compartment. In the present embodiment, the second body 152 is disposed on the left in the refrigerator 100 so as to extend entirely from top to bottom of the refrigerator 100. The freezer compartment is a compartment having a lower temperature than a temperature of the refrigerator compartment, maintained at around minus 18 degrees C, and storing a storage item such as a frozen food.

[0047] The outer casing 156 is a metal plate covering the first body 151 and the second body 152 which are arranged next to each other in the horizontal direction.

[0048] The main body 150 in the present embodiment is manufactured as follows. That is, each of the refrigerator compartment and the freezer compartment separated by a partition 153 is manufactured, independently by the inner casing 157, with resin in solid casting. Outside the inner casing 157, the outer casing is disposed so as to cover the inner casing 157 with a predetermined gap between the outer casing and the inner casing 157. Inside the partition 153, there is also a gap which is communicated with the gap located between the outer casing 156 and the inner casing 157. Into the gap located between the outer casing 156 and the inner casing 157 and into the gap of the partition 153, rigid urethane foams or the like are injected and foamed to serve as a heat insulant, for example. Thus, the main body 150 is manufactured.

[0049] Consequently, in the present embodiment, the wall between the first body 151 and the second body 152 is inseparable, which means that the first body 151 and the second body 152 share the partition 153 as a wall part.

[0050] Next, the cooling cycle unit and the other constituents in the refrigerator 100 are described.

[0051] FIG. 5 schematically shows a cooling cycle unit.

[0052] FIG. 6 is a perspective view schematically showing components of the cooling cycle unit when mounted in the refrigerator.

[0053] FIG. 7 is a perspective view showing the lower and rear part of the refrigerator from behind the refrigerator.

[0054] The cooling cycle unit 110 functions to forcibly transfer heat from one space to another by dissipating heat using a condenser 102 and absorbing heat using an evaporator 103, and the evaporator 103 is disposed at such a position as to cool the inside of the refrigerator 100 while the condenser 102 is disposed in a mechanical compartment outside the refrigerator 100 so that the in-

side of the refrigerator can be cooled. As shown in these figures, the cooling cycle unit which the refrigerator 100 employs is an apparatus including the compressor 101, the condenser 102, and the evaporator 103, and implements a cooling cycle by connecting these devices annularly with a refrigerant-return pipe 104 that is a path of a refrigerant, and circulating the refrigerant. In the present embodiment, the refrigerator 100 further includes a bypass pipe 105, and the mechanical compartment 120 includes a switch valve 106, a valve 107, an evaporating dish 140, and a blower 141.

[0055] The compressor 101 is a device which compresses a gaseous refrigerant flowing in the refrigerant-return pipe 104 and thereby increases the pressure of the refrigerant. The compressor 101 is disposed inside the mechanical compartment 120 located in the lower and rear part of the refrigerator 100, and is disposed below the second body 152 that is the freezer compartment. The compressor 101 is attached to the mechanical compartment 120 via an insulator 115 in a manner that vibration of the compressor 101 is less likely to be transferred to the refrigerator 100. In the present embodiment, even with the insulator 115 taken into account, the top surface of the compressor 101 is located at a lower level than the top surface of a first condenser 124

[0056] The condenser 102 is a device which dissipates heat of the gaseous refrigerant at an increased pressure into the atmosphere to cool the refrigerant and thereby converts the refrigerant into a liquid refrigerant at a high pressure. In the present embodiment, the condenser 102 includes the first condenser 124, a second condenser 125, and a third condenser 126.

[0057] The first condenser 124 is a main condenser which provides direct heat exchange with the air. The first condenser 124 is disposed below the first body 151 that is the refrigerator compartment, and is disposed, in a state of exposure to the air, inside the mechanical compartment 120 located in the lower and rear part of the refrigerator 100. In the present embodiment, the main condenser is in the form of spiral fin coil obtained by spirally winding, onto a pipe, a thin heat dissipation fin made of a high thermally conductive material such as aluminum, and is formed by folding the pipe plural times in a meander state.

[0058] The second condenser 125 is an auxiliary condenser which is disposed in a meander state between the outer side wall of the first body 151 and the outer casing 156 so as to be in close contact with the rear surface of the outer casing 156, and provides heat exchange with the air via the metallic outer casing 156. Since there is a heat insulant between the second condenser 125 and the inside of the first body 151, the heat from the second condenser 125 is less likely to influence the inside of the first body 151. Furthermore, since the inside of the first body 151 is the refrigerator compartment having a relatively high temperature, the heat gradient between the second condenser 125 and the inside of the first body 151 is low, with the result that the heat is less likely to be transferred therebetween.

[0059] The third condenser 126 is an auxiliary condenser which is disposed along the rim of the opening of the second body 152, and functions not only to cool the refrigerant by dissipating the heat, but also to increase a temperature of the rim of the opening of the second body 152 to prevent dew condensation.

[0060] With the above structure of the condenser 102, even in the case where the ability of the first condenser 124 exposed to the atmosphere has been degraded due to dust accumulation or the like, the second condenser 125 complements the ability of the condenser 102, which makes it possible to maintain the ability of the cooling cycle unit 110 for a long period of time without the need for maintenance to secure the ability.

[0061] In addition, since the dew condensation at the opening of the freezer compartment can be prevented, a decrease in the sealing level of the second door 121 due to frost formation can be prevented, which makes it possible to improve or maintain the energy efficiency of the refrigerator 100.

[0062] The evaporator 103 is a device which evaporates the refrigerant inside to absorb the heat of the surrounding air or the like. In the present embodiment, the evaporator 103 includes a first evaporator 131 and a second evaporator 132 which are connected in series to each other with a connecting pipe 108. The connecting pipe 108 penetrates the back of the first body 151 and the back of the second body 152, passing through the heat insulant, so that the evaporators are connected to the both ends of the connecting pipe 108.

[0063] The first evaporator 131 is an evaporator which is connected in series to the third condenser 126 and disposed in a rear part of the first body 151, and plays a role in cooling the inside of the first body 151. It is to be noted that, in a refrigerator of the side-by-side type in which the height of the refrigerator compartment is the same as the height of the freezer compartment, the second evaporator 132 is disposed in the height direction inside the freezer compartment in order to evenly cool the freezer compartment down to around minus 18 degrees C while the first evaporator 131 that cools the refrigerator compartment down to a temperature around 0 to 6 degrees C which is relatively high as compared to the temperature of the freezer compartment is disposed at not so high a level in the height direction inside the refrigerator compartment as the second evaporator 132, and in order to secure a large depth-wise inner volume of the refrigerator compartment, the first evaporator 131 is designed to be smaller in size than the second evaporator 132.

[0064] The second evaporator 132 is an evaporator which is connected in series to the first evaporator 131 and disposed in a rear part of the second body 152, and plays a role in cooling the inside of the second body 152. The second evaporator 132 is used to cool the freezer compartment, and therefore is larger in size than the first evaporator 131.

[0065] In the present embodiment, each of the first evaporator 131 and the second evaporator 132 employs a fin-and-tube type heat exchanger, to which the present invention is not limited, and a given heat exchanger is applicable such as a heat exchanger employing a corrugated fin and a flat tube.

[0066] Each of the first evaporator 131 and the second evaporator 132 has a pipe folded plural times in a meander state, and is configured so that an inlet and an outlet for the flowing refrigerant are located in an upper part of the evaporator.

[0067] As above, the first evaporator 131 for cooling the first body 151 (the refrigerator compartment) and the second evaporator 132 for cooling the second body 152 (the freezer compartment) are provided as separate devices, allowing for cooling suitable to respective set temperature ranges.

[0068] Particularly, in the case where a vertically long freezer compartment such as in the present embodiment is provided, there is a need to provide an evaporator having sufficient cooling ability in order to reduce the temperature difference in the vertical direction of the freezer compartment. However, when such an evaporator is located in a rear part of the refrigerator compartment, the freezer compartment may be excessively cooled, and it is therefore necessary to provide sufficient heat insulation between the refrigerator compartment and the evaporator. In this case, the heat insulant will cause a reduction in the inner volume of the refrigerator compartment. In view of this, as in the present invention, the first evaporator 131 suitable to cool the refrigerator compartment is provided in the rear part of the first body 151 (the refrigerator compartment) while the second evaporator 132 suitable to evenly cool the freezer compartment is provided in the rear part of the second body 152 (the freezer compartment), with the result that the inner volume of the refrigerator compartment can increase.

[0069] The blower 141 is a device which can generate a flow of air, and employs an axial fan in the present embodiment. Furthermore, the blower 141 is disposed in an upstanding state between the first condenser 124 and the compressor 101 inside the mechanical compartment 120. The blower 141 is disposed in such an orientation as to generate a flow of air which is directed from the first condenser 124 toward the compressor 101.

[0070] Accordingly, the air is directed from the first condenser 124 toward the compressor 101, that is, from a low temperature area to a high temperature area, so that the influence of the heat of the compressor 101 on the first condenser 124, the switch valve 106, and the valve 107 can be reduced as much as possible. Moreover, the axial fan can be thinner in thickness and therefore can be placed inside the small space of the mechanical compartment 120.

[0071] The switch valve 106 is a three-way valve which selects between supplying the refrigerant from the third condenser 126 to the first evaporator 131 and supplying the refrigerant from the third condenser 126 directly to the second evaporator 132, and is disposed in the same space as the compressor 101 and the condenser 102.

[0072] The switch valve 106 is disposed inside the mechanical compartment 120 in consideration of assembling, maintenance, and the like, of the refrigerator 100. In the present embodiment, the switch valve 106 is disposed upstream of the first condenser 124 in the flow of air generated by the blower 141. This means that no devices which dissipate heat are present upstream of the switch valve 106 and that the switch valve 106 is mounted at a position at which the temperature is presumably lowest in the mechanical compartment 120.

[0073] This is because the flow path of the refrigerant which is about to flow into the first evaporator 131 or the second evaporator 132 is switched by the switch valve 106, and with less influence of the heat of the first condenser 124 and the compressor 101, it is possible to secure the easiness in assembling and maintenance of the refrigerator 100 while reducing degradation of the ability of the cooling cycle unit 110.

[0074] To the switch valve 106 on the downstream side thereof, a first thin pipe 160 connected to the first evaporator 131 and a second thin pipe 161 connected to the second evaporator 132 are switchably connected.

[0075] The valve 107 is a valve which is connected to the water pipe and selects between supplying tap water to the refrigerator 100 and blocking the tap water . The valve 107 is disposed inside the mechanical compartment 120 in consideration of assembling, maintenance, and the like, of the refrigerator 100. In the present embodiment, the valve 107 is disposed upstream of the first condenser 124 in the flow of air generated by the blower 141. This mans that no devices which dissipate heat are present upstream of the valve 107 and that the valve 107 is mounted at a position at which the temperature is presumably lowest in the mechanical compartment 120.

[0076] The valve 107 is a device included in the water cooling device 114. The water cooling device 114 is a device which is connected to a water pipe 116 and supplies, through the supply opening 123, the tap water cooled by the first evaporator 131, and supplies water to an automatic icemaker (not shown).

[0077] The bypass pipe 105 is a pipe which is connected between the switch valve 106 and the second thin pipe 161 and directly connects the third condenser 126 and the second evaporator 132 via the switch valve 106. Here, directly connecting means not introducing the refrigerant into the second evaporator 132 via the first evaporator 131 but introducing the refrigerant from the switch valve 106 directly into the second evaporator 132 by bypassing the first evaporator 131.

[0078] While the bypass pipe 105 is provided between the switch valve 106 and the second thin pipe 161 to connect the pipes, it may be possible that the second thin pipe 161 is connected directly to the switch valve 106.

[0079] The refrigerant for use in the cooling cycle unit 110 of the refrigerator 100 is not particularly limited, but a carbon hydride-based refrigerant can be used, for ex-

ample.

[0080] The carbon hydride-based refrigerant includes propane and isobutene, for example. These are preferable because of their very small impacts on global warming as compared to hydrochlorofluorocarbon and hydrofluorocarbon.

[0081] As above, the first evaporator 131 that cools the refrigerator compartment is connected, on the downstream side thereof, in series to the second evaporator 132 that cools the freezer compartment, and furthermore, the cooling cycle is constructed which allows the refrigerant to flow only to the second evaporator 132 on the downstream side by changing the flow path of the refrigerant using the switch valve 106, with the result that, when the refrigerator compartment and the freezer compartment are not cooled to their set temperatures, the cooling cycle can be controlled by switching the switch valve 106 so as to allow the refrigerant to flow to both of the evaporators, and when the temperature of the refrigerator compartment reaches the set temperature, then the cooling cycle can be controlled by switching the switch valve 106 so as to allow the refrigerant to flow not to the first evaporator 131 that cools the refrigerator compartment but only to the second evaporator 132 that cools the freezer compartment only.

[0082] Subsequently, when the temperature of the freezer compartment reaches the set temperature, then the compressor 101 stops operation. This makes it possible to select the introduction of the refrigerant into the first evaporator 131 while maintaining the introduction of the refrigerant into the second evaporator 132. By so doing, eve when the second evaporator 132 operates continuously for long hours in order not to cause variations in temperature of the vertically-long second body 152 (the freezer compartment), the first evaporator 131 can be controlled in a manner suitable for the first body 151 (the refrigerator compartment).

[0083] Furthermore, since the first evaporator 131 and the second evaporator 132 can be arranged in the horizontal direction, the connecting pipe 108 that connects the first evaporator 131 and the second evaporator 132 can be shorter, with the result that, when the switch valve 106 allows the refrigerant to be introduced into both the first evaporator 131 and the second evaporator 132, the cooling loss in the connecting pipe 108 can be reduced, allowing an increase in the cooling efficiency of the second evaporator 132, and the amount of flammable refrigerant can be reduced, allowing for improvement in the resistance to explosion.

[0084] Furthermore, as the first evaporator 131 is disposed below the refrigerator compartment, the distance between the first evaporator 131 and the mechanical compartment in which the compressor is disposed is shorter, with the result that, even in the case where the flammable refrigerant leaks from around the first evaporator 131, the flammable refrigerant, which has a higher specific gravity than air, will descend and stay in a low level and moreover be able to be easily introduced into the mechanical compartment in which the compressor 131 is disposed, through a drain pipe for draining water resulting from defrosting by the first evaporator 131, and then be released from the mechanical compartment to outside the refrigerator, so that an increase in concentration of the flammable refrigerant inside the refrigerator due to stagnation of the leaked flammable refrigerant can be suppressed, which allows for improvement in the resistance to explosion.

[0085] Also in the case where the flammable refrigerant leaks from the second evaporator 132, the leaked refrigerant can be drained to outside the mechanical compartment through the drain pipe in the same manner as above, so that stagnation of the leaked refrigerant inside the refrigerator can be prevented, which allows for improvement in the resistance to explosion.

[0086] As described above, the first evaporator 131 and the second evaporator 132 are disposed below the refrigerator compartment and the freezer compartment, respectively, so that the heights of both the lower ends of the evaporator 103 become approximately the same, which enhances the draining property from inside to outside the refrigerator through the mechanical compartment, but the position of the first evaporator 131 that is shorter in height than the second evaporator 132 may be moved up so that the heights of both the upper ends of the evaporator 103 become approximately the same.

[0087] This allows the connecting pipe 108 that connects the refrigerant outlet of the first evaporator 131 and the refrigerant inlet of the second evaporator 132 to extend almost horizontally between the first evaporator 131 and the second evaporator 132, with the result that the length of the connecting pipe 108 can be shortest, and when the switch valve 106 allows the refrigerant to flow to both the first evaporator 131 and the second evaporator 132, the cooling loss in the connecting pipe 108 can be reduced further, and the amount of flammable refrigerant can also be reduced further.

[0088] By employing the refrigerator 100 with the above structure, it is possible to increase the whole energy efficiency and thereby contribute to energy saving.

[0089] FIG. 8 is a perspective view showing an evaporating dish.

[0090] FIG. 9 is a perspective view showing a cross-section of the evaporating dish when mounted on the compressor.

[0091] An evaporating dish 140 is a container in which the water (the dew condensation water) resulting from defrosting and collected from the cooling cycle unit 110 (in particular, the first evaporator 131 and the second evaporator 132) is accumulated and evaporated, and is a rectangular box-shaped body with the top opened. The evaporating dish 140 is disposed between the second body 152 and the compressor 101 and includes a recessed portion 143 which comes into contact with the top and side surfaces of the compressor 101. Furthermore, the evaporating dish 140 includes a sloped part 145 which guides the air flow above the compressor 101

to the compressor 101. In addition, in the middle part of the sloped part 145, an introduction hole 147 is provided to introduce the air flow into the evaporating dish 140 and promote evaporation of the water resulting from defrosting and accumulated in the evaporating dish 140.

[0092] With this, a large part of the air flow generated by the blower 141 comes into contact with the surface of the compressor 101 by the sloped part 145 of the evaporating dish 140, which allows the compressor 101 to be cooled efficiently.

[0093] FIG. 10 is a perspective view showing the lower and rear part in a partially transparent state from behind the refrigerator.

[0094] As shown in this figure, inside the refrigerator 100, there is a guide channel 133 which is a tube through which the water resulting from defrosting by the first evaporator 131 is guided to the evaporating dish 140. Furthermore, there is also a second guide channel 134 which is a tube through which the water resulting from defrosting by the second evaporator 132 is guided to the evaporating dish 140.

[0095] With this, the water resulting from a defrosting process of melting frost on the evaporator 103 using a heater mounted on the first evaporator 131 and the second evaporator 132 is allowed to pass through the guide channel 133 and the second guide channel 134 and then be collected in the evaporating dish 140.

[0096] According to the above refrigerator 100, in the cooling cycle unit 110, the compressor 101 is disposed below the second body 152 defining the freezer compartment, the first condenser 124 is disposed below the first body 151 defining the refrigerator compartment, and the second condenser 125 is disposed in the outer side wall of the first body 151. Thus, the pipes which connect these components can be shorter, allowing for improvement in the energy efficiency of the cooling cycle unit 110. Furthermore, also in assembling the refrigerator 100, the pipe arrangement is simple, which allows for easy assembly.

[0097] In addition, since the height of the compressor 101 is lower than the first condenser 124 disposed in the mechanical compartment 120, the distance between the second body 152 and the compressor 101 can be extended sufficiently without sacrificing the inner volume of the second body 152. Accordingly, the influence of the heat from the compressor 101 on the second body 152 can be reduced. Furthermore, since there is a space between the second body 152 and the compressor 101, the evaporating dish 140 can be disposed in such space. This allows for a further reduction in the influence of the heat of the compressor 101.

Industrial Applicability

[0098] The present invention is applicable to refrigerators for home and professional uses, and is applicable to refrigerators having a refrigerator compartment and a freezer compartment arranged next to each other in the horizontal direction.

Claims

1. A refrigerator (100) comprising:

a first body (151) having an opening in a front face and defining a refrigerator compartment;
a second body (152) having an opening in a front face and defining a freezer compartment;
an outer casing (156) which is made of a metal and covers said first body (151) and said second body (152) that are arranged next to each other in a horizontal direction;
a compressor (101) disposed below said second body (152);
a first condenser (124) connected to said compressor (101) and disposed below said first body (151), said first condenser (124) providing direct heat exchange with air;
a second condenser (125) connected to said first condenser (124) and disposed between said first body (151) and said outer casing (156), said second condenser (125) providing heat exchange with air through said outer casing (156)
an evaporator (103) which is connected to said second condenser (125) and by which a refrigerant is evaporated; and a blower (141) which is disposed between said compressor (101) and said first condenser (124) and generates an air flow for cooling said compressor (101) and said first condenser (124).

2. The refrigerator (100) according to claim 1, wherein said evaporator (103) includes:

a first evaporator (131) which is connected to said second condenser (125) and disposed in a rear part of said first body (151); and
a second evaporator (132) which is connected in series to said first evaporator (131) and disposed in a rear part of said second body (152), and
said refrigerator (100) further comprises:

a bypass pipe (105) which connects said second condenser (125) and said second evaporator (132) without passing through said first evaporator (131); and
a switch valve (106) which selects between supplying the refrigerant from said second condenser (125) to said first evaporator (131) and supplying the refrigerant from said second condenser (125) directly to said second evaporator (132).

3. The refrigerator (100) according to claim 2,

wherein said switch valve (106) is disposed, with respect to said blower (141), in a direction in which said first condenser (124) is disposed.

4. The refrigerator (100) according to Claim 2, further comprising
a water cooling device (114) including a valve (107) which is connected to a water pipe (116) and selects between supplying tap water to said refrigerator (100) and blocking the tap water,
wherein said valve (107) is disposed, with respect to said blower (141), in a direction in which said first condenser (124) is disposed.

5. The refrigerator (100) according to claim 1,
wherein the air flow generated by said blower (141) is oriented in a direction from said second condenser (125) toward said compressor (101).

6. The refrigerator (100) according to claim 1, further comprising
an evaporating dish (140) in which water resulting from defrosting by said evaporator (103) is accumulated and evaporated and which is disposed between said second body (152) and said compressor (101) and includes a recessed portion (143) that is in contact with a top surface and a side surface of said compressor (101).

7. The refrigerator according to claim 6,
wherein said evaporating dish (140) includes a sloped part (145) which guides the air flow above said compressor (101) to said compressor (101).

8. The refrigerator (100) according to claim 6 or claim 7, wherein said evaporator (103) includes:

a first evaporator (131) which is connected to said second condenser (125) and disposed in a rear part of said first body (151); and
a second evaporator (132) which is connected to said first evaporator (131) and disposed in a rear part of said second body (152), and
said refrigerator (100) further comprises
a guide channel (133) which guides the water resulting from defrosting by said first evaporator (131) to said evaporating dish (140).

9. The refrigerator (100) according to claim 6,
wherein said compressor (101) is lower in height than said first condenser (124).

Patentansprüche

1. Kühlvorrichtung (100) enthaltend:

einen ersten Körper (151), der eine Öffnung in einer Vorderseite aufweist und ein Kühlfach definiert;
einen zweiten Körper (152), der eine Öffnung in einer Vorderseite aufweist und ein Gefrierfach definiert;
ein Außengehäuse (156), das aus Metall hergestellt ist und den ersten Körper (151) und den zweiten Körper (152) umgibt, die nebeneinander in einer horizontalen Richtung angeordnet sind;
einen Kompressor (101), der unterhalb des zweiten Körpers (152) angeordnet ist;
einen ersten Kondensator (124), der mit dem Kompressor (101) verbunden und unterhalb des ersten Körpers (151) angeordnet ist, wobei der erste Kondensator (124) einen direkten Wärmeaustausch mit Luft bereitstellt;
einen zweiten Kondensator (125), der mit dem ersten Kondensator (124) verbunden und zwischen dem ersten Körper (151) und dem Außengehäuse (156) angeordnet ist, wobei der zweite Kondensator (125) einen Wärmeaustausch mit Luft durch das Außengehäuse (156) bereitstellt;
einen Verdampfer (103), der mit dem zweiten Kondensator (125) verbunden ist und durch den ein Kältemittel verdampft wird; und
ein Gebläse (141), das zwischen dem Kompressor (101) und dem ersten Kondensator (124) angeordnet ist und einen Luftstrom zum Kühlen des Kompressors (101) und des ersten Kondensators (124) erzeugt.

2. Kühlvorrichtung (100) nach Anspruch 1,
wobei der Verdampfer (103) umfasst:

einen ersten Verdampfer (131), der mit dem zweiten Kondensator (125) verbunden und in einem hinteren Teil des ersten Körpers (151) angeordnet ist; und
einen zweiten Verdampfer (132), der mit dem ersten Verdampfer (131) in Reihe geschaltet und in einem hinteren Teil des zweiten Körpers (152) angeordnet ist, und
die Kühlvorrichtung (100) ferner enthält:

eine Bypassleitung (105), die den zweiten Kondensator (125) und den zweiten Verdampfer (132) verbindet, ohne durch den ersten Verdampfer (131) zu verlaufen; und
ein Schaltventil (106), das zwischen dem Zuführen des Kältemittels von dem zweiten Kondensator (125) zu dem ersten Verdampfer (131) und dem Zuführen des Kältemittels von dem zweiten Kondensator (125) direkt zu dem zweiten Verdampfer (132) wählt.

3. Kühlvorrichtung (100) nach Anspruch 2, wobei das Schaltventil (106) bezüglich des Gebläses (141) in einer Richtung angeordnet ist, in der der erste Kondensator (124) angeordnet ist.

4. Kühlvorrichtung (100) nach Anspruch 2, weiterhin enthaltend
eine Wasserkühlvorrichtung (114) mit einem Ventil (107), das mit einer Wasserleitung (116) verbunden ist und zwischen dem Zuführen von Leitungswasser zu der Kühlvorrichtung (100) und dem Blockieren des Leitungswassers wählt,
wobei das Ventil (107) bezüglich des Gebläses (141) in einer Richtung angeordnet ist, in der der erste Kondensator (124) angeordnet ist.

5. Kühlvorrichtung (100) nach Anspruch 1, wobei der durch das Gebläse (141) erzeugte Luftstrom in eine Richtung von dem zweiten Kondensator (125) zu dem Kompressor (101) gerichtet ist.

6. Kühlvorrichtung (100) nach Anspruch 1, weiterhin enthaltend
eine Verdampfungsschale (140), in der Wasser, das beim Abtauen durch den Verdampfer (103) entsteht, angesammelt und verdampft wird, und die zwischen dem zweiten Körper (152) und dem Kompressor (101) angeordnet ist und einen vertieften Abschnitt (143) aufweist, der mit einer oberen Fläche und einer Seitenfläche des Kompressors (101) in Kontakt steht.

7. Kühlvorrichtung nach Anspruch 6, wobei die Verdampfungsschale (140) einen geneigten Teil (145) aufweist, der den Luftstrom über dem Kompressor (101) zu dem Kompressor (101) führt.

8. Kühlvorrichtung (100) nach Anspruch 6 oder 7, wobei der Verdampfer (103) umfasst:

einen ersten Verdampfer (131), der mit dem zweiten Kondensator (125) verbunden und in einem hinteren Teil des ersten Körpers (151) angeordnet ist; und
einen zweiten Verdampfer (132), der mit dem ersten Verdampfer (131) verbunden und in einem hinteren Teil des zweiten Körpers (152) angeordnet ist, und
die Kühlvorrichtung (100) ferner enthält
einen Führungskanal (133), der das beim Abtauen durch den ersten Verdampfer (131) entstehende Wasser zu der Verdampfungsschale (140) führt.

9. Kühlvorrichtung (100) nach Anspruch 6, wobei der Kompressor (101) in der Höhe niedriger ist als der erste Kondensator (124).

Revendications

1. Réfrigérateur (100) comprenant:

un premier corps (151) ayant une ouverture dans une face avant et définissant un compartiment réfrigérateur;
un second corps (152) ayant une ouverture dans une face avant et définissant un compartiment congélateur;
un boîtier externe (156) qui est constitué d'un métal et recouvre ledit premier corps (151) et ledit second corps (152) qui sont disposés l'un à côté de l'autre dans une direction horizontale;
un compresseur (101) disposé au-dessous dudit second corps (152);
un premier condenseur (124) relié audit compresseur (101) et disposé sous ledit premier corps (151), ledit premier condenseur (124) fournissant un échange thermique direct avec de l'air;
un second condenseur (125) relié audit premier condenseur (124) et disposé entre ledit premier corps (151) et ledit boîtier externe (156), ledit second condenseur (125) fournissant un échange thermique avec de l'air à travers ledit boîtier externe (156); et
un évaporateur (103) qui est relié audit second condenseur (125) et par lequel un réfrigérant est évaporé;
une soufflante (141) qui est disposée entre ledit compresseur (101) et ledit premier condenseur (124) et génère un flux d'air pour refroidir ledit compresseur (101) et ledit premier condenseur (124).

2. Réfrigérateur (100) selon la revendication 1, dans lequel ledit évaporateur (103) comprend:

un premier évaporateur (131) qui est relié audit second condenseur (125) et disposé dans une partie arrière dudit premier corps (151); et
un second évaporateur (132) qui est relié en série audit premier évaporateur (131) et disposé dans une partie arrière dudit second corps (152), et
ledit réfrigérateur (100) comprend en outre:

un tuyau de dérivation (105) qui relie ledit second condenseur (125) et ledit second évaporateur (132) sans passer par ledit premier évaporateur (131); et une vanne de commutation (106) qui sélectionne entre l'alimentation en réfrigérant depuis ledit second condenseur (125) vers ledit premier évaporateur (131) et l'alimentation en réfrigérant depuis ledit second condenseur (125) directement vers ledit second évaporateur (132).

3. Réfrigérateur (100) selon la revendication 2, dans lequel ladite vanne de commutation (106) est disposée, par rapport à ladite soufflante (141), dans une direction dans laquelle ledit premier condenseur (124) est disposé.

4. Réfrigérateur (100) selon la revendication 2, comprenant en outre
un dispositif de refroidissement d'eau (114) comprenant une vanne (107) qui est reliée à un tuyau d'eau (116) et sélectionne entre l'alimentation en eau du robinet vers ledit réfrigérateur (100) et le blocage de l'eau du robinet,
dans lequel ladite vanne (107) est disposée, par rapport à ladite soufflante (141), dans une direction dans laquelle ledit premier condenseur (124) est disposé.

5. Réfrigérateur (100) selon la revendication 1, dans lequel le flux d'air généré par ladite soufflante (141) est orienté dans une direction depuis ledit second condenseur (125) vers ledit compresseur (101).

6. Réfrigérateur (100) selon la revendication 1, comprenant en outre
une coupelle d'évaporation (140) dans laquelle de l'eau résultant du dégivrage par ledit évaporateur (103) est accumulée et évaporée et qui est disposée entre ledit second corps (152) et ledit compresseur (101) et inclut une partie évidée (143) qui est en contact avec une surface supérieure et une surface latérale dudit compresseur (101).

7. Réfrigérateur selon la revendication 6, dans lequel ladite coupelle d'évaporation (140) inclut une partie inclinée (145) qui guide le flux d'air au-dessus dudit compresseur (101) vers ledit compresseur (101).

8. Réfrigérateur (100) selon la revendication 6 ou la revendication 7, dans lequel ledit évaporateur (103) inclut:

un premier évaporateur (131) qui est relié audit second condenseur (125) et disposé dans une partie arrière dudit premier corps (151); et
un second évaporateur (132) qui est relié audit premier évaporateur (131) et disposé dans une partie arrière dudit second corps (152), et
ledit réfrigérateur (100) comprend en outre
un canal de guidage (133) qui guide l'eau résultant du dégivrage par ledit premier évaporateur (131) vers ladite coupelle d'évaporation (140).

9. Réfrigérateur (100) selon la revendication 6, dans lequel ledit compresseur (101) est plus bas en hauteur que ledit premier condenseur (124).

FIG. 1

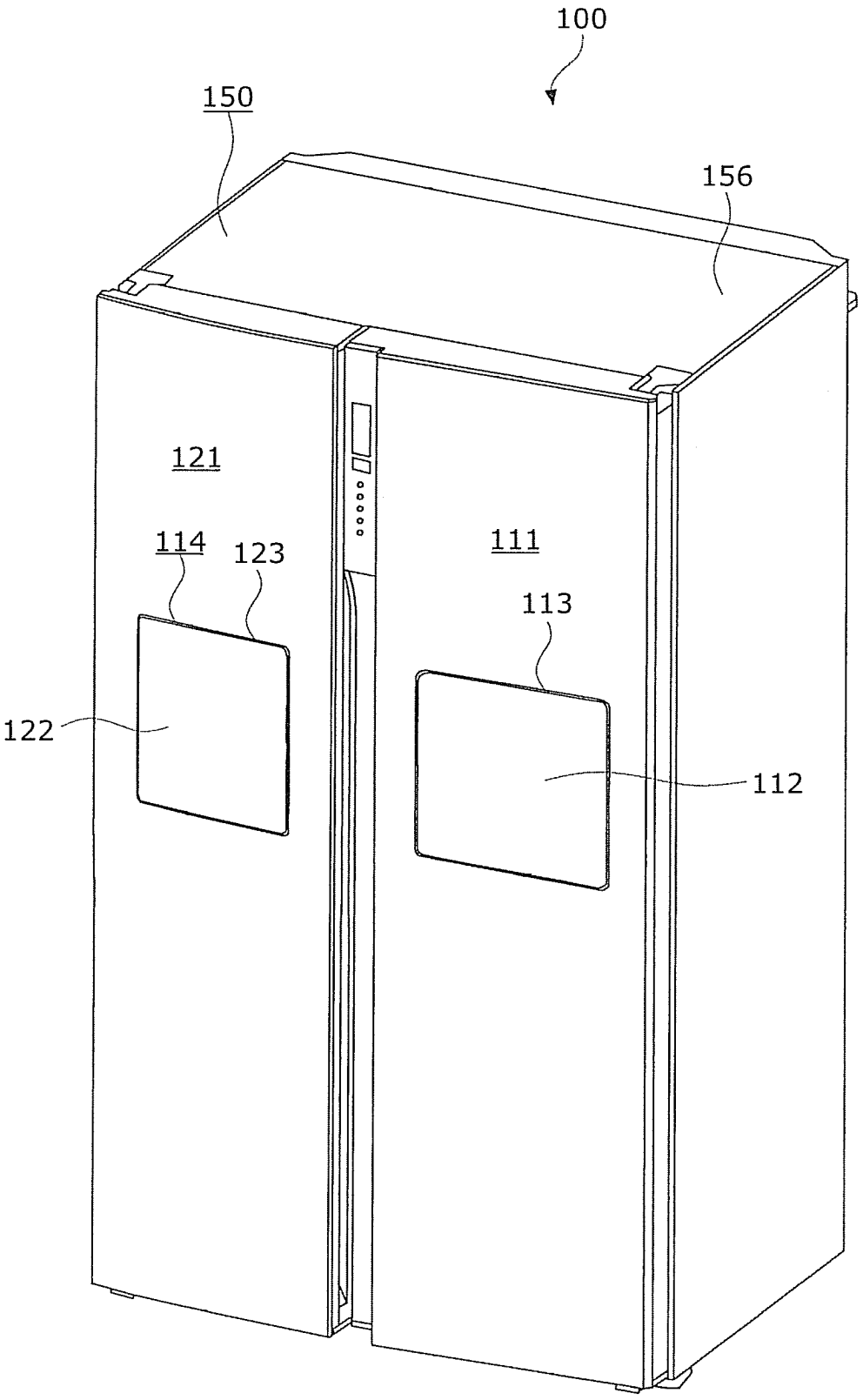


FIG. 2

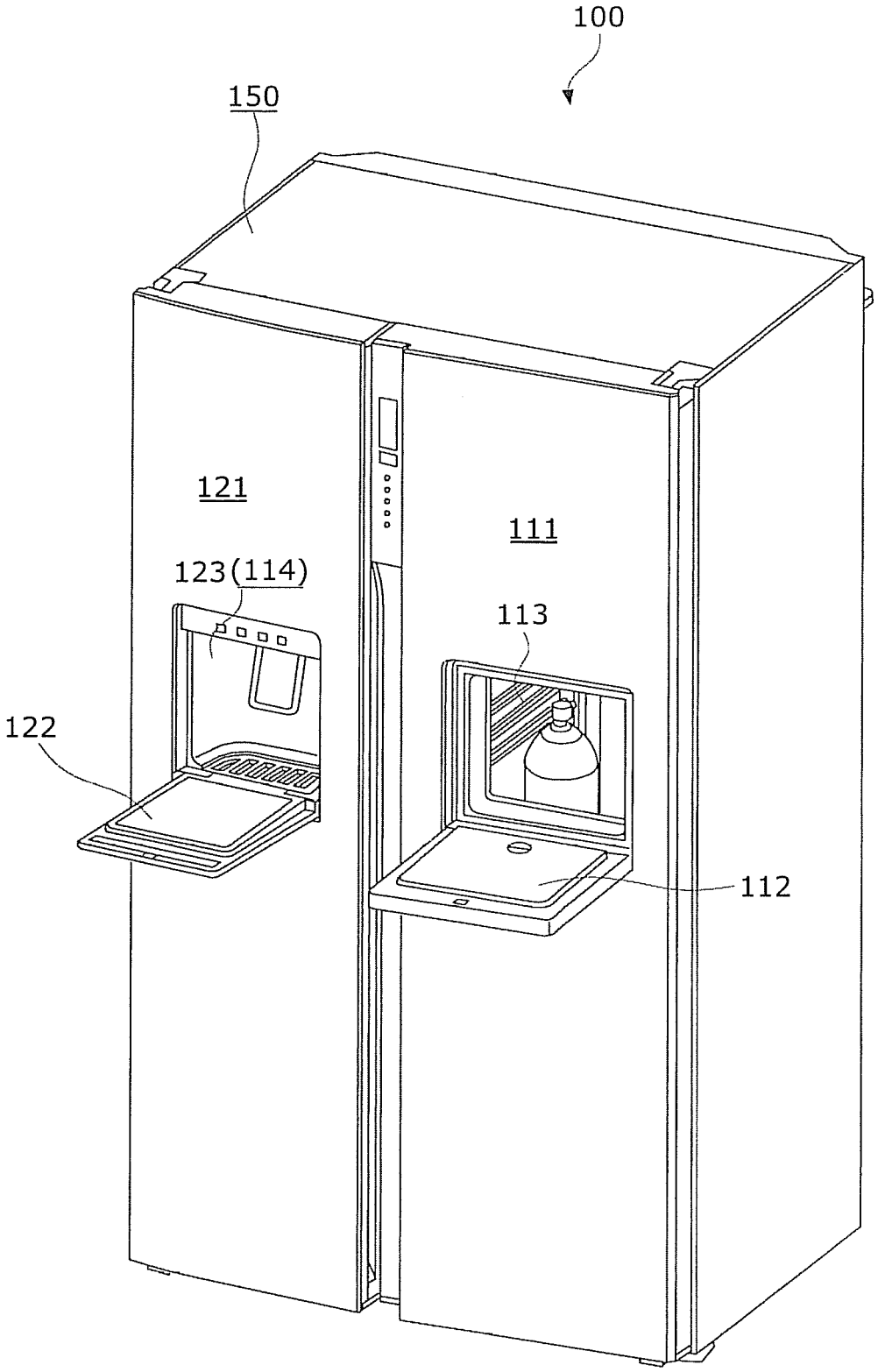


FIG. 3

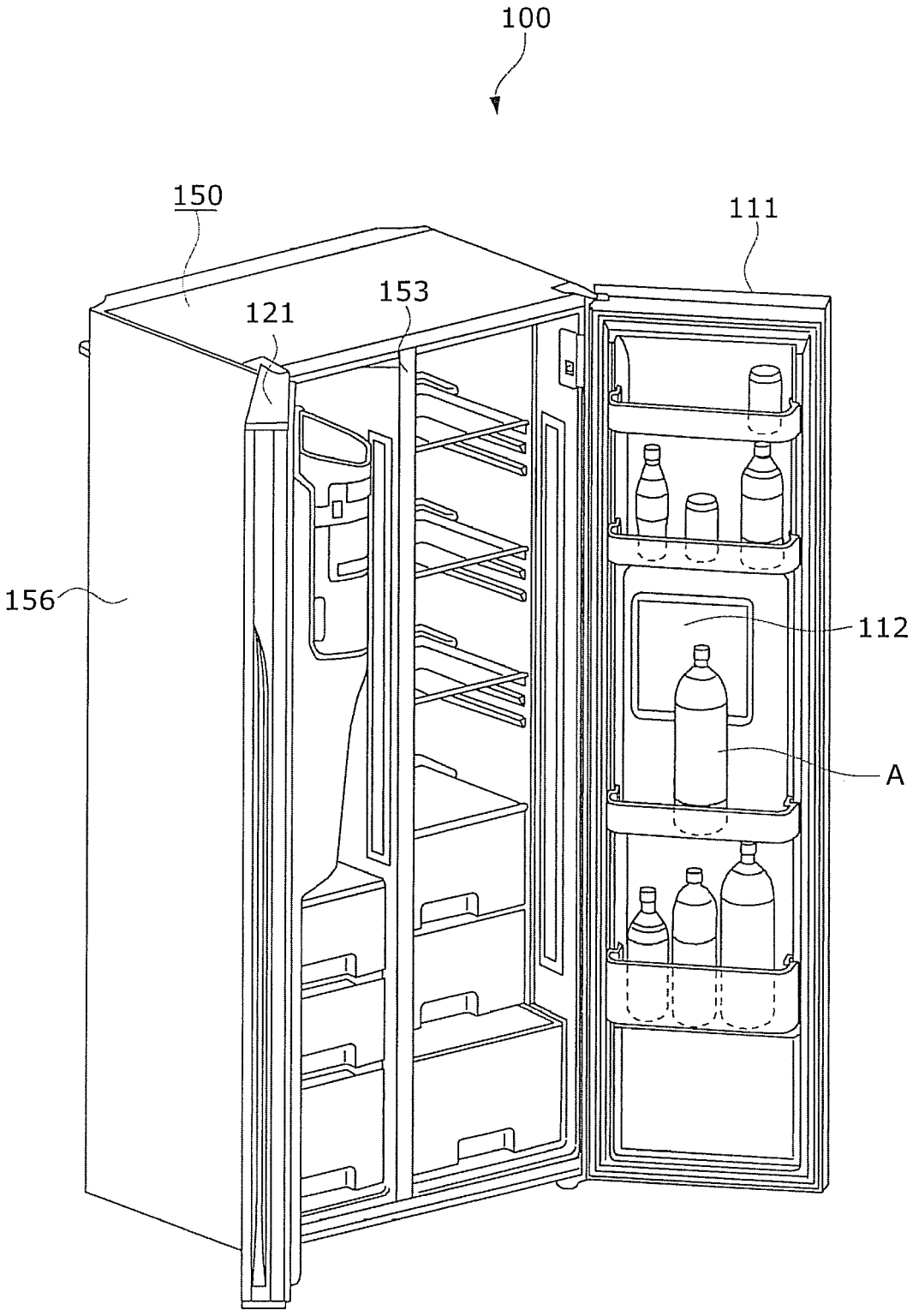


FIG. 4

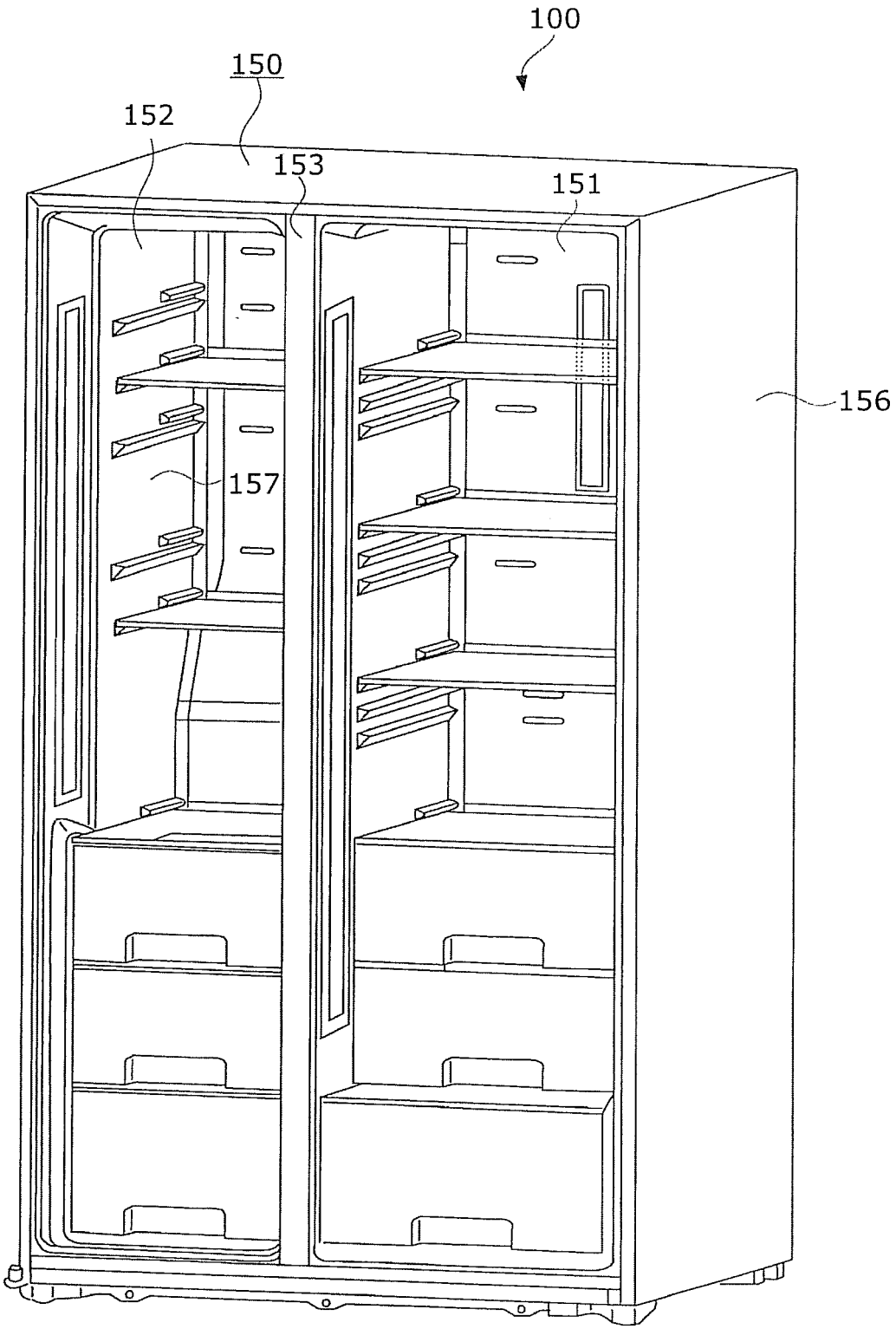


FIG. 5

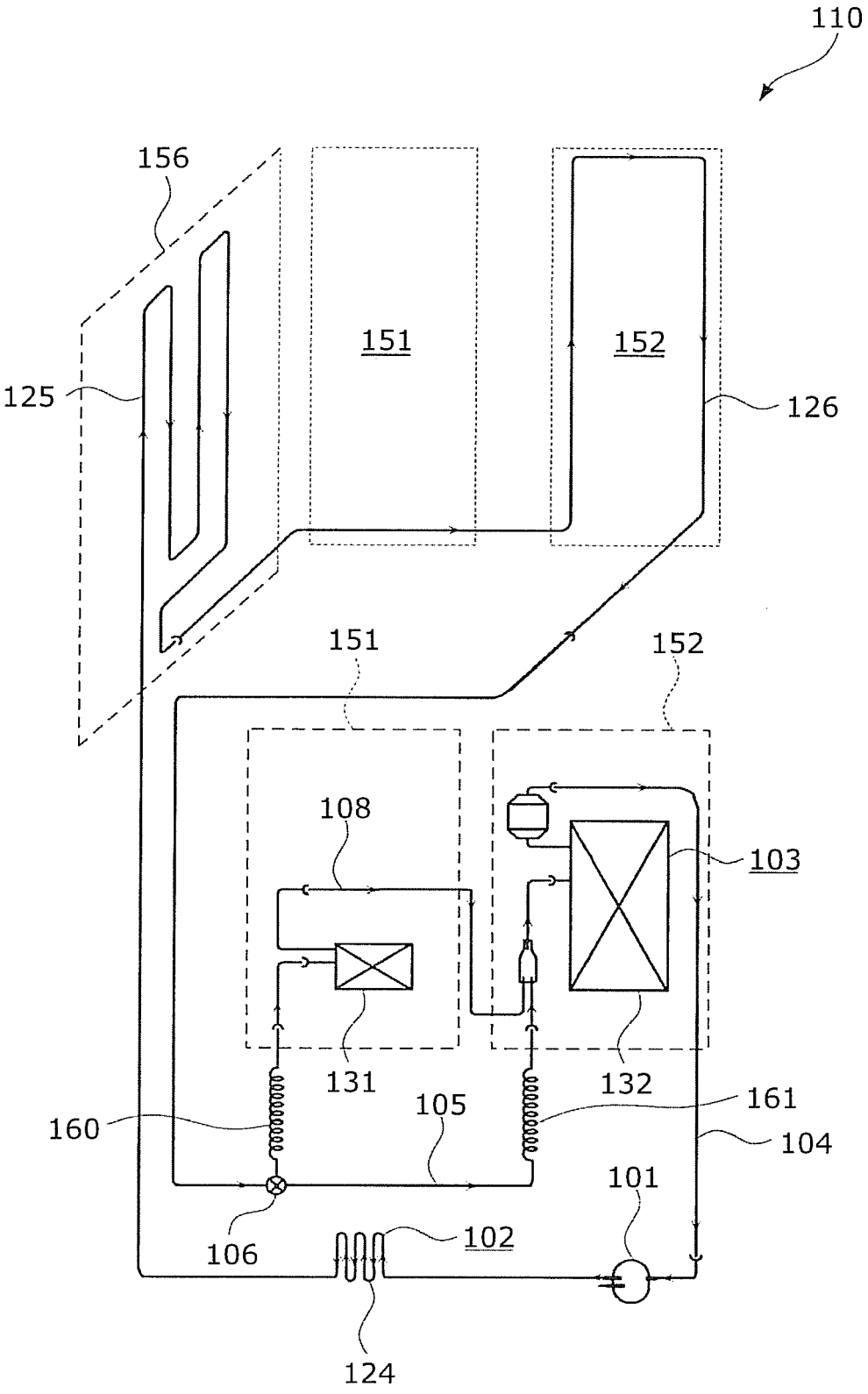

110
156
151
152
125
126
151
152
108
103
131
132
160
105
161
104
101
106
102
124

FIG. 6

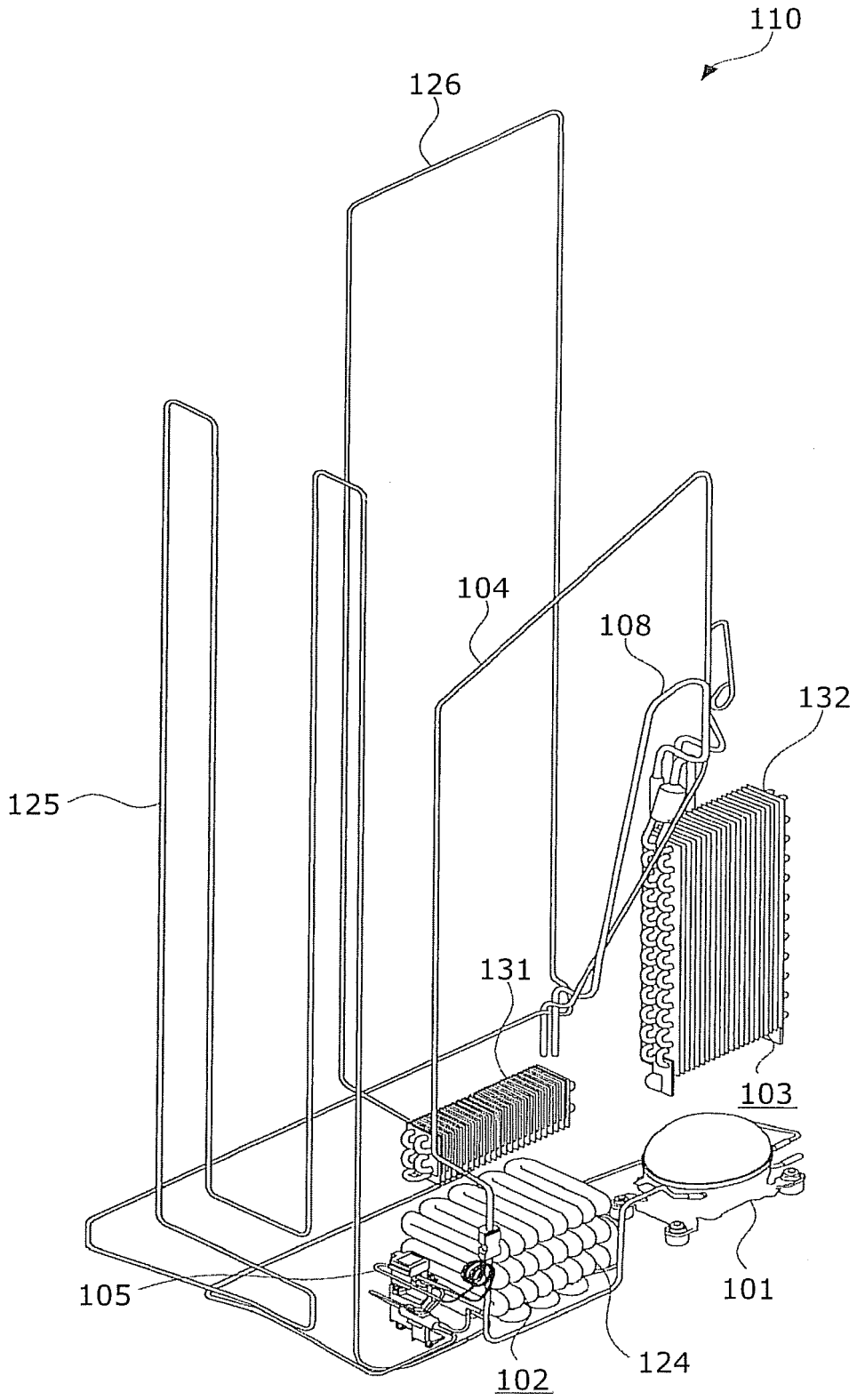


FIG. 7

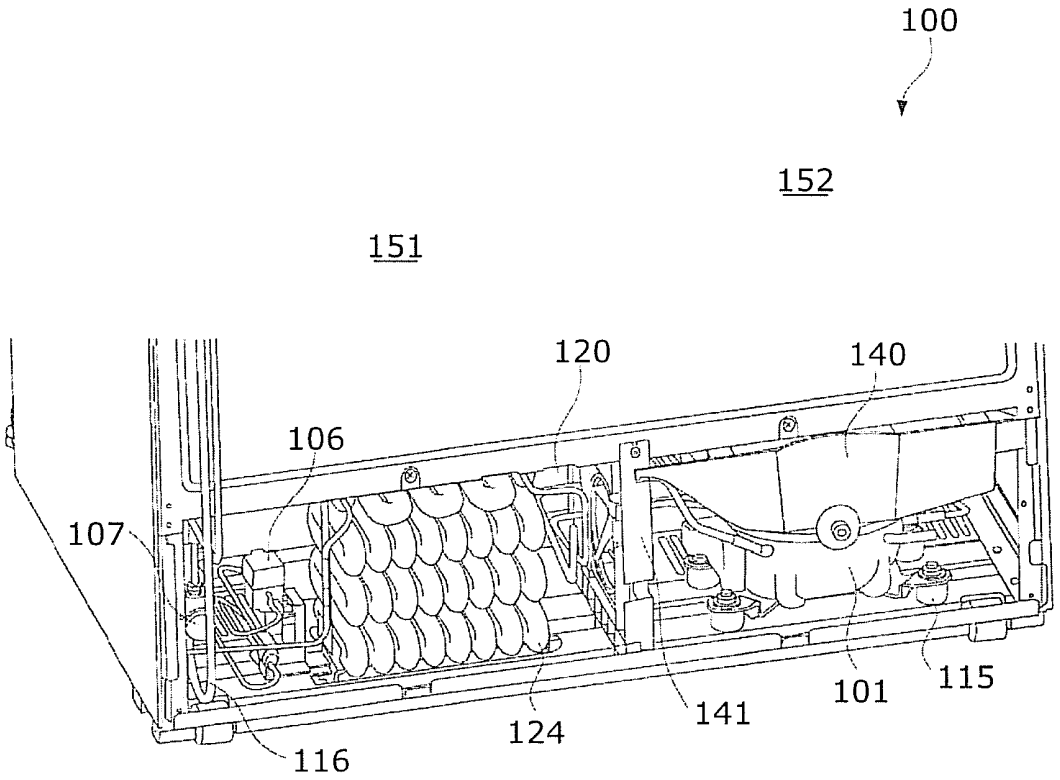


FIG. 8

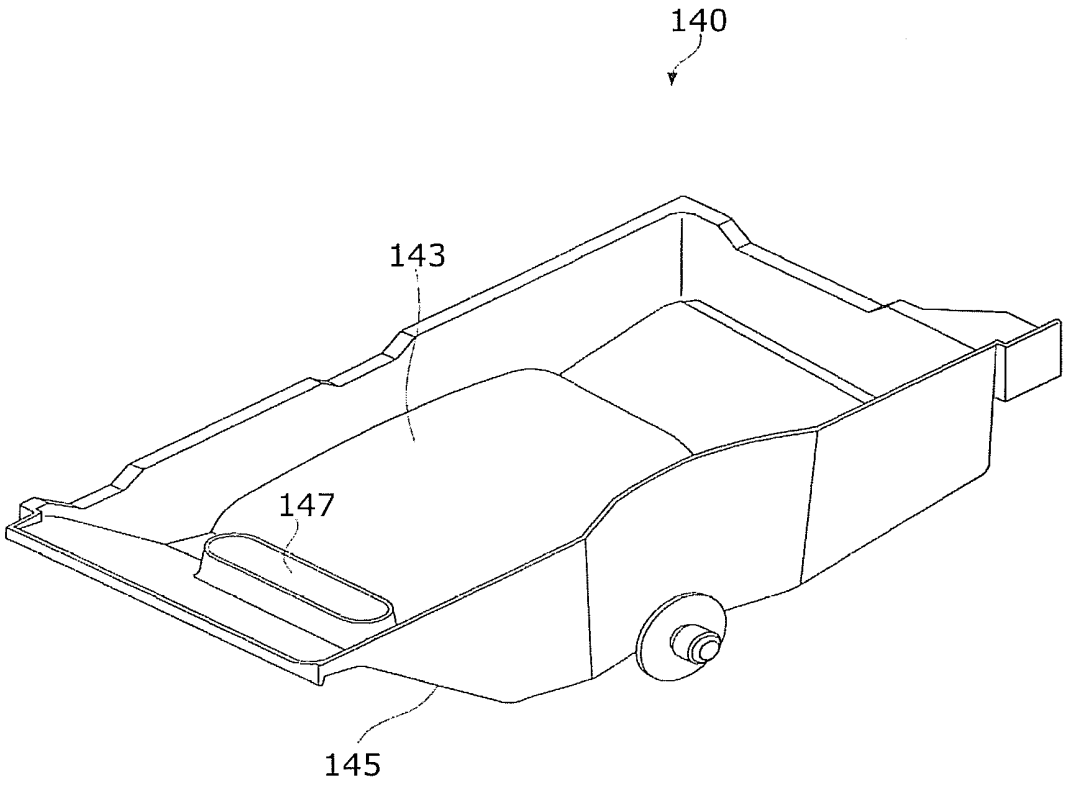


FIG. 9

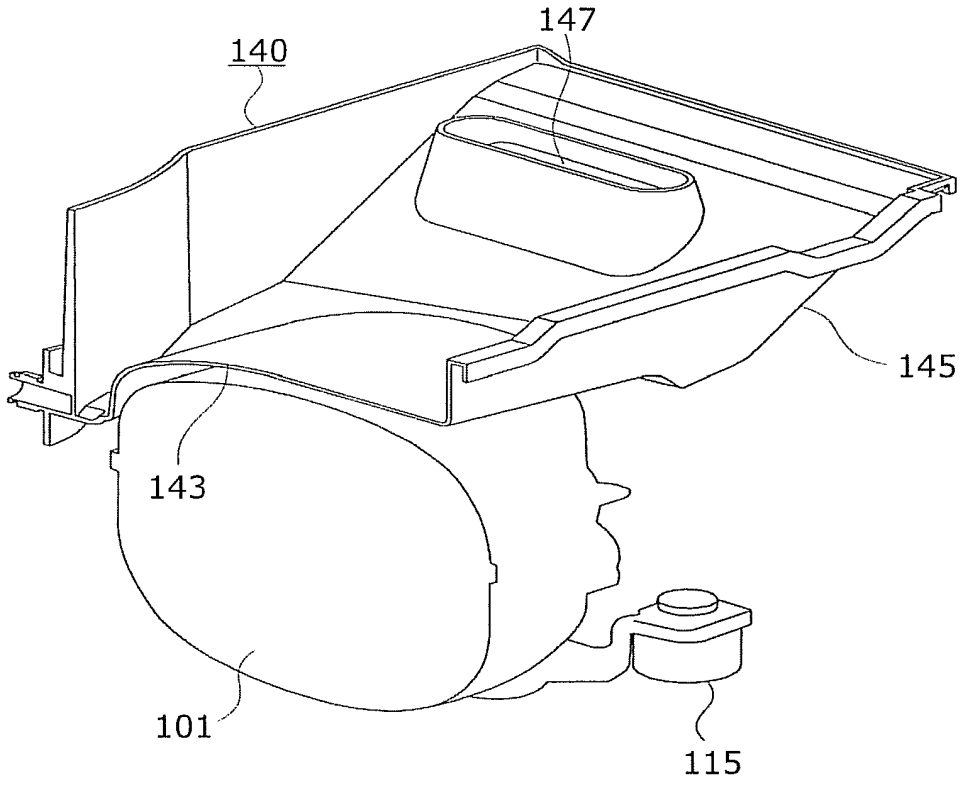
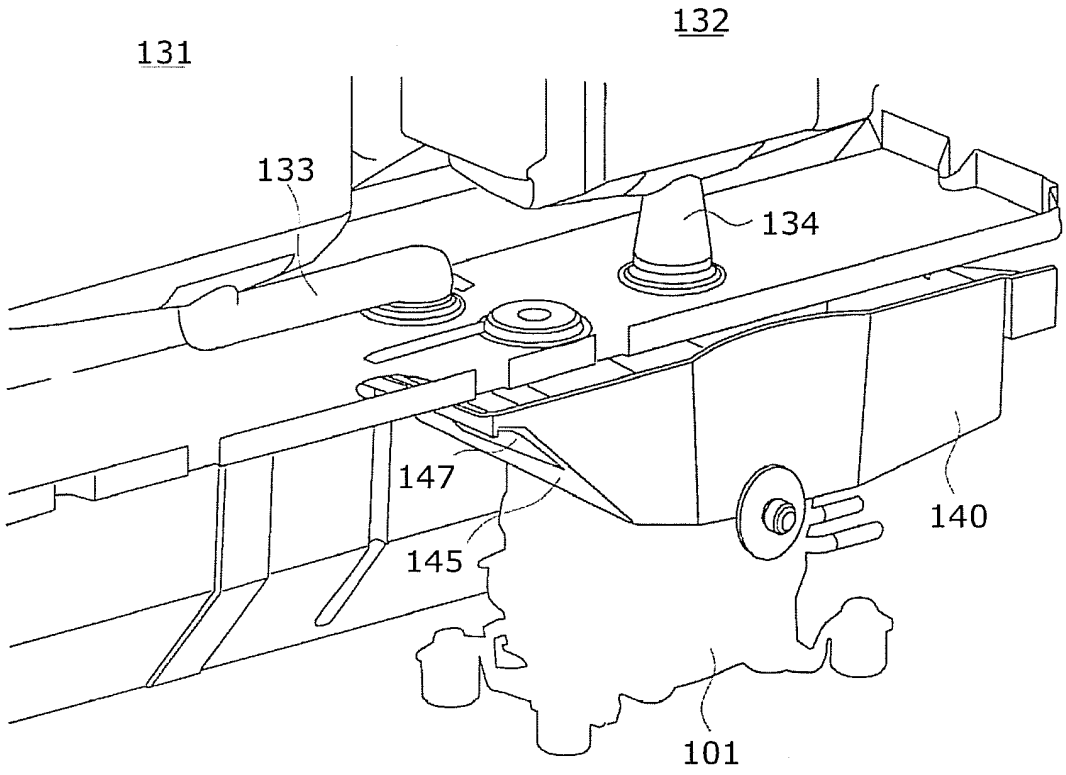


FIG. 10



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- JP 2003042636 A **[0004]**