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(54) **REFRIGERATOR**

KÜHLVORRICHTUNG

RÉFRIGÉRATEUR

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Description

Technical Field

[0001] The present invention relates to refrigerators, and relates particularly to a configuration for thermally insulating, from ambient air, an inside of a refrigerator in which a freezer compartment and a refrigerator compartment are arranged side by side.

Background Art

[0002] Conventionally, there is a refrigerator which is a vertically-long rectangular cuboid in shape and includes storage compartments of types different between right and left, with a wall partitioning a middle portion of the refrigerator in a width direction. Such a refrigerator is called, for example, a side-by-side (SBS) refrigerator. In the SBS refrigerator, for example, one of the storage compartments is a refrigerator compartment, and the other storage compartment is a freezer compartment.

[0003] In addition, conventionally, various types of refrigerators including the SBS refrigerator are equipped with a cooling cycle in which a refrigerant discharged from a compressor passes through a condenser, a throttle, and a cooler (also called an evaporator), and returns again to the compressor. The inside of the refrigerator is cooled by cool air generated in such a cooling cycle.

[0004] Since the refrigerator is generally installed at room temperature, it is necessary to insulate the inside of the refrigerator from the ambient air. Thus, generally, each of a body, a door, and so on included in a main body of the refrigerator includes an insulation material.

[0005] In recent years, some refrigerators have adopted a vacuum insulation material as part of the insulation material. The vacuum insulation material is an insulation material processed by: coating, with laminated film, a core material having a porous structure, reducing internal pressure, and sealing the laminated film.

[0006] When the vacuum insulation material is used in a part requiring thermal insulation, the contribution of gas thermal conductivity becomes almost zero, thus achieving excellent thermal insulation performance.

[0007] A technique related to the refrigerator including such a vacuum insulation material is disclosed (see Patent Reference 1, for example).

[0008] In the refrigerator disclosed in Patent Reference 1, a vacuum insulation material is included in a partition between the two storage compartments which are vertically arranged and have different temperature zones. This effectively suppresses thermal conduction that occurs from one storage compartment to the other storage compartment via the partition.

[0009] Patent Reference 1: Japanese Unexamined Patent Application Publication No. 2003-222466. JP 2008 298360 A discloses a refrigerator according to the preamble of claim 1.

Disclosure of Invention

Problems that Invention is to Solve

[0010] In recent years, while refrigerators are expected to have increased capacity, it is also expected to keep an installation area at almost the same level as before. Thus, in recent refrigerators, for example, there is a tendency that the wall of the body included in the refrigerator becomes thinner, and the dimension thereof in a height direction becomes longer. The same is applicable to the SBS refrigerator described above.

[0011] In this context, an increase in dimension in the height direction of the SBS refrigerator means an increase in dimension in the height direction of the refrigerator compartment and the freezer compartment. Thus, there is a tendency that a total area of the wall which insulates each of the refrigerator compartment and the freezer compartment from the ambient air increases, and that the wall becomes thinner.

[0012] Under such circumstances, the SBS refrigerator, as with the refrigerators of other types, needs to maintain the temperature of the freezer compartment at a freezing temperature (approximately - 20 C°), and the temperature of the refrigerator compartment at, for example, approximately 6 C°.

[0013] In other words, for the SBS refrigerator, a unique technique is necessary for efficiently maintaining, to a temperature zone appropriate for an intended use of each of the freezer and refrigerator compartments that are vertically long with increased capacity and adjacently arranged side by side.

[0014] However, the conventional technique is a technique related to thermal insulation between vertically-arranged storage compartments, and therefore cannot be regarded as appropriate for the SBS refrigerator.

[0015] An object of the present invention which is conceived in view of the problem above is to provide a refrigerator which includes a refrigerator compartment and a freezer compartment that are adjacently arranged side by side, and which efficiently cools these storage compartments with further increased storage capacities.

Means to Solve the Problems

[0016] According to the invention this object is achieved by a refrigerator as defined in claim 1.

[0017] With this configuration, it is possible to efficiently insulate, from ambient air, the freezer compartment whose temperature is the lowest in the refrigerator and which is vertically long. Furthermore, this allows reducing a distance between the second body and the outer case, in which the first vacuum insulation material is provided, that is, a thickness of a wall closer to the freezer compartment and opposite to the refrigerator compartment. This allows increasing a horizontal length of each of the freezing and the refrigerator compartment.

[0018] Thus, according to the present invention, it is

possible to realize increased capacity and efficient cooling of these storage compartments.

[0019] In addition, the refrigerator according to the aspect of the present invention may further include a second vacuum insulation material provided between a back face of the second body and the outer case.

[0020] With this configuration, it is possible to further improve thermal insulation performance of the freezer compartment, and to reduce the thickness of a wall in the back of the freezer compartment. In other words, it is possible to increase a length in a depth direction of the freezer compartment, thus allowing further increase in the capacity of the freezer compartment.

[0021] In addition, the refrigerator according the aspect of the present invention may further include a third vacuum insulation material provided between a bottom face of the second body and the outer case.

[0022] With this configuration, it is possible to further improve the thermal insulation performance of the freezer compartment, and to reduce the thickness of a wall in a lower part of the freezer compartment. In other words, it is possible to increase a length in a height direction of the freezer compartment, thus allowing further increase in the capacity of the freezer compartment.

[0023] In addition, the refrigerator according to the aspect of the present invention may further include a fourth vacuum insulation material provided between the first body and the second body.

[0024] With this configuration, it is possible to further improve the thermal insulation performance of the freezer compartment, and to effectively insulate the freezer compartment and the refrigerator compartment that have different temperature zones.

[0025] In addition, it is possible to decrease a thickness of a wall between the freezer compartment and the refrigerator compartment. In other words, this further increases a horizontal length of each of the freezer compartment and the refrigerator compartment, thus allowing further increase in the capacity of the freezer compartment and the refrigerator compartment.

[0026] In addition, the refrigerator according to the aspect of the present invention may further include a board box which is provided above the first body and houses a board that is for controlling an operation of the refrigerator, and at least part of a top face of the first body is an inclined face which downwardly inclines toward a back face of the first body, and the board box is provided above the inclined face such that a face of the board box inclines in a same direction as the inclined face, the face being on a side of the first body.

[0027] With this configuration, for example, it is possible to reduce the amount of insulation material to be filled in the part along with keeping the thermal insulation performance between the board box and the first body.

[0028] In addition, since the board box is provided such that the inclined face of the first body and a face of the board box which is closer to the first body, are inclined in the same direction, the board box, for example, does not become an obstacle in filling an insulator. In addition, for example, it is possible to provide the board box in the refrigerator without the board box protruding from the outer case.

[0029] Note that a board which controls an operation of the refrigerator is an essential component of the refrigerator. In addition, the first body of which the refrigerator compartment is formed is manufactured by, for example, vacuum molding, and the inclined face as described above is provided to facilitate pulling out the first body that is molded, from a mold used for the molding.

[0030] In other words, according to the invention as described above, it is possible to provide, utilizing a space above the inclined face, a refrigerator in which the board that is an essential component of the refrigerator is provided, without obstructing the thermal insulation performance of the refrigerator and increase in capacity of the storage compartments.

Effects of the Invention

[0031] According to the present invention, it is possible to provide a refrigerator which includes a refrigerator compartment and a freezer compartment that are adjacently arranged side by side, and whose rigidity is increased along with increased capacities of these storage compartments.

Brief Description of Drawings

[0032]

[FIG. 1] FIG. 1 is a perspective view showing an appearance of a refrigerator according to an embodiment of the present invention.

[FIG. 2] FIG. 2 is a perspective view showing an appearance of the refrigerator in which a first door and a second door are opened, according to the present embodiment.

[FIG. 3] FIG. 3 is a perspective view showing an appearance of the refrigerator according to the present embodiment, from which a first door and a second door are omitted.

[FIG. 4] FIG. 4 is a perspective view showing an appearance of an inner case according to the present embodiment.

[FIG. 5] FIG. 5 is a schematic diagram showing a layout position of the vacuum insulation material in the refrigerator according to the present embodiment.

[FIG. 6] FIG. 6 is a perspective view schematically showing constituent devices in a cooling cycle unit in a state attached to the refrigerator according to the present embodiment.

[FIG. 7] FIG. 7 is a diagram showing a cross-sectional shape of a fifth vacuum insulation material according to the present embodiment.

[FIG. 8] FIG. 8 is a perspective view showing an at-

tachment mode of the board box according to the present embodiment.

[FIG. 9] FIG. 9 is a partial cross-sectional view showing a positional relationship between the board box and the first body according to the present embodiment.

Numerical References

[0033]

100 Refrigerator
101 Compressor
102, 103, 104 Condenser
105, 106 Evaporator
111 First door
112 Third door
113 Through hole
121 Second door
122 Fourth door
123 Opening
141 First vacuum insulation material
142 Second vacuum insulation material
143 Third vacuum insulation material
144 Fourth vacuum insulation material
145 Fifth vacuum insulation material
145a Recessed portion
146 Sixth vacuum insulation material
147 Seventh vacuum insulation material
150 Main body
151 First body
151a Inclined face
152 Second body
153 Partition
156 Outer case
156a Main panel
156b Back panel
156c Bottom panel
157 Inner case
158 Board cover
162 Container
163 Shelf
170 Board box
171 Control board

Best Mode for Carrying Out the Invention

[0034] Hereinafter, an embodiment of the refrigerator according to the present invention will be described with reference to the drawings.

[0035] FIG. 1 is a perspective view showing an appearance of a refrigerator 100 according to the embodiment of the present invention.

[0036] The refrigerator 100 is an apparatus which chills or freezes to store a storage item that is stored inside. The refrigerator 100 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. In addition, the refrigerator 100 is a rectangular body having a height that is largest among the height, width, and depth of the refrigerator 100.

[0037] The first door 111 is a door that covers, to allow opening and closing, an opening on the right with respect to the main body 150. In the present embodiment, the first door 111 is attached to the main body 150 using a hinge (not shown) so as to rotate centering on an axis that vertically extends in front of the right wall of the main body 150. In addition, the first door 111 has a vertically-long rectangular shape, and is provided from top to bottom of the refrigerator 100 an axis passing through a right-end rim portion of the first door 111.

[0038] The second door 121 is a door that covers, to allow opening and closing, an opening portion on the left with respect to the main body 150. In the present embodiment, the first door 121 is attached to the main body 150 using a hinge (not shown) so as to rotate centering on an axis that vertically extends in front of the left wall of the main body 150. In addition, the second door 121 has a vertically long rectangular shape, and is provided from top to bottom of the refrigerator 100, with the axis passing through a left-end rim portion of the second door 121.

[0039] The through hole 113 is a hole penetrating through the first door 111 in a thickness direction. The through hole 113 is a hole through which to take out a storage item that is stored behind the first door 111 and to insert to store an item behind the first door 111, without opening the first door 111.

[0040] The third door 112 is a door that covers the through hole 113 to allow 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 rotate centering on an axis that horizontally extends along a lower end rim of the through hole 113. In addition, the axis passes through a lower-end rim portion of the third door 112.

[0041] The fourth door 122 is a door that covers, to allow opening and closing, an opening 123 for receiving ice that is supplied from inside the refrigerator.

[0042] In addition, an upper part of the main body 150 houses a control board for controlling an operation of the refrigerator, and a board cover 158 for covering the housing space is attached.

[0043] FIG. 2 is a perspective view showing an external view of the refrigerator 100 with the first door 111 and the second door 121 open.

[0044] FIG. 3 is a perspective view showing an external view of the refrigerator 100, from which the first door 111 and the second door 121 are omitted.

[0045] As shown in these figures, the refrigerator 100 includes a first body 151, a second body 152, and an outer case 156.

[0046] The first body 151 is a vertically-long body which has an opening in a front face and forms the refrigerator compartment. In the present embodiment, the first body 151 is provided in a right side of the refrigerator 100 in

an entire vertical direction of the refrigerator 100. Note that the refrigerator compartment is a compartment which keeps a temperature within a range that is lower than a temperature outside the refrigerator 100 and higher than a water-freezing temperature, and is for storing a storage item such as vegetables.

[0047] The second body 152 is a vertically-long body which has an opening in a front face and forms the freezer compartment. In the present embodiment, the second body 152 is provided in a left side of the refrigerator 100 in the entire vertical direction of the refrigerator 100. Note that the freezer compartment keeps a temperature lower than the temperature in the refrigerator compartment and stores a storage item such as frozen food.

[0048] In addition, inside the first body 151 and the second body 152, a plurality of containers 162 for containing food and so on and shelves 163 on which the food and so on are placed are attached.

[0049] The outer case 156 is a metal plate covering an inner case 157 including the first body 151 and the second body 152 that are adjacently arranged side by side.

[0050] Thus, the refrigerator 100 according to the present embodiment is an SBS refrigerator in which the refrigerator compartment and the freezer compartment are adjacently arranged side by side.

[0051] FIG. 4 is a perspective view showing an appearance of the inner case 157 of the embodiment.

[0052] As shown in FIG. 4, at least part of the top face of the first body 151 is an inclined face 151a which downwardly inclines toward a back face of the first body 151. Specifically, approximately a third of the top face, in a depth direction, is the inclined face 151a.

[0053] The inclined face 151a is a portion derived from a manufacturing process of the inner case 157. Specifically, the inner case 157 is manufactured by, for example, vacuum molding. For this reason, the inclined face 151a is provided so as to facilitate pulling out the inner case 157 from the mold used for the molding.

[0054] In addition, above the inclined face 151a, a control board which controls an operation of the refrigerator 100 is provided using a space between the inclined face 151a and the outer case 156. The details of a layout position of the control board will be described later with reference to FIGS. 8 and 9.

[0055] Here, the main body 150 in the present embodiment is manufactured as below. Specifically, each of the refrigerator compartment and the freezer compartment that are partitioned by a partition 153 is independently manufactured by integral molding using resin.

[0056] In addition, outside the inner case 157 having a shape as shown in FIG. 4, the outer case 156 is placed to cover the inner case 157 at a predetermined space from the inner case 157. In addition, an inside of the partition 153 includes a space continuous to the space between the outer case and the inner case 157.

[0057] The space between the outer case 156 and the inner case 157 and the space inside the partition 153 are filled with an insulation material, for example, rigid urethane foam. As described above, the main body 150 is manufactured.

[0058] In addition, a vacuum insulation material is provided between: the outer case 156 and the inner case 157; and inside the partition 153. The layout position of the vacuum insulation material is to be described later with reference to FIG. 5.

[0059] Thus, in the present embodiment, the partition 153 that partitions the first body 151 and the second body 152 is inseparably formed with these bodies. In addition, the configuration is such that the first body 151 and the second body 152 share the partition 153 as a wall portion.

[0060] FIG. 5 is a schematic diagram showing the layout position of the vacuum insulation material in the refrigerator 100 according to the present embodiment. Note that to clearly show the layout position of the vacuum insulation material, illustration of the inner case 157, the first door 111, and the second door 121 is omitted from FIG. 5, and only the positional relationship between each vacuum insulation material and the outer case 156 is illustrated.

[0061] As shown in FIG. 5, the outer case 156 includes a main plate 156a formed by folding a metal plate into a U-shape, and a back plate 156b, and a bottom plate 156c.

[0062] In addition, the refrigerator 100 includes seven pieces of vacuum insulation material from a first vacuum insulation material 141 to a seventh vacuum insulation material 147.

[0063] Specifically, the first vacuum insulation material 141 is provided between the outer case 156 and a lateral face which is of the second body 152 and is opposite to the first body 151.

[0064] The second vacuum insulation material 142 is provided between a back face of the second body 152 and the outer case 156. In the present embodiment, the second vacuum insulation material 142 is extended up to the back of the first body 151.

[0065] The third vacuum insulation material 143 is provided between a bottom face of the second body 152 and the outer case 156.

[0066] The fourth vacuum insulation material 144 is provided between the fist body 151 and the second 152. In other words, the fourth vacuum insulation material 144 is provided inside the partition 153.

[0067] Specifically, the fifth vacuum insulation material 145 is provided between the outer case 156 and a lateral face which is of the first body 151 and is opposite to the second body 152.

[0068] The sixth vacuum insulation material 146 is provided between a top face of the second body 152 and the outer case 156.

[0069] The seventh vacuum insulation material 147 is provided inside the second door 121 which covers, to allow opening and closing, the opening in the front face of the second body 152.

[0070] Thus, the freezer compartment formed of the second body 152 is effectively insulated from the ambient air, by the first vacuum insulation material 141, the sec-

ond vacuum insulation material 142, the third vacuum insulation material 143, the sixth vacuum insulation material 146, and the seventh vacuum insulation material 147.

[0071] In addition, the fourth vacuum insulation material 144 effectively insulates the freezer compartment formed of the second body 152, and the refrigerator compartment formed of the first body 151.

[0072] Furthermore, the fifth vacuum insulation material 145 effectively insulates the refrigerator compartment formed of the first body 151 from the ambient air.

[0073] In addition, these vacuum insulation materials have higher thermal insulation capacities than an insulation material such as rigid urethane foam. Therefore, even a smaller thickness (for example, approximately 15 mm) can produce a sufficient thermal insulation effect.

[0074] In other words, assuming that the outer case 156 has a constant size, it is possible, when using the vacuum insulation material, to provide a shorter distance between the outer case 156 and the inner case 157 than the distance in the case of not using the vacuum insulation material. As a result, it is possible to increase the size of the inner case 157, that is, an inner capacity of the refrigerator compartment and the freezer compartment.

[0075] Specifically, by providing each of the first vacuum insulation material 141, the fourth vacuum insulation material 144, and the fifth vacuum insulation material 145, it is possible to increase a horizontal length of the refrigerator compartment and the freezer compartment.

[0076] In addition, by providing each of the third vacuum insulation material 143 and the sixth vacuum insulation material 146, it is possible to increase the length in the height direction of the freezer compartment.

[0077] In addition, by providing the second vacuum insulation material 142 and the seventh vacuum insulation material 147, it is possible to increase the length in the depth direction of the freezer compartment.

[0078] In other words, it is possible to increase the inner capacity of at least one of the refrigerator compartment and the freezer compartment by providing, in the refrigerator 100, at least one of the vacuum insulation materials from the first vacuum insulation material 141 to the seventh vacuum insulation material 147.

[0079] Note that the thermal insulation performance of the insulation materials from the first vacuum insulation material 141 to the seventh vacuum insulation material 147 according to the present embodiment will be described later.

[0080] In addition, a condenser for releasing heat is provided in a right side of the refrigerator compartment, that is, at the position where the fifth vacuum insulation material 145 is provided, and the fifth vacuum insulation material 145 also has a function to prevent the influence of the heat from the condenser onto the refrigerator compartment.

[0081] FIG. 6 is a perspective view schematically showing constituent devices in a cooling cycle unit in a state attached to the refrigerator 100, according to the present embodiment.

[0082] As shown in FIG. 6, the cooling cycle unit included in the refrigerator 100 is a device including: a compressor 101, condensers 102, 103, and 104, and evaporators 105 and 106.

[0083] The condensers 102, 103, and 104 are formed of a series of heat-releasing pipes that form a flow path of the refrigerant. Thus, it is possible to consider the condensers 102, 103, and 104 as one condenser.

[0084] The cooling cycle unit releases heat by the condensers 102, 103, and 104, and absorbs heat by the evaporators 105 and 106. This allows forcibly shifting the heat from one space to another.

[0085] The compressor 101 is an apparatus for increasing a pressure of the refrigerant by compressing a gaseous refrigerant flowing in the cooling cycle.

[0086] The condensers 102, 103, and 104 are apparatuses which cool the refrigerant by releasing the heat of the gaseous refrigerant whose pressure is increased, to change the refrigerant into a liquid refrigerant having a high pressure.

[0087] The evaporators 105 and 106 are apparatuses for cooling the ambient air by evaporating the refrigerant having passed through the condensers 102, 103, and 104.

[0088] In the present embodiment, the evaporator 105 is provided in the back of the first body 151, and has a function to cool the inside of the refrigerator compartment. In addition, the evaporator 106 is provided in the back of the second body 152, and has a function to cool the inside of the freezer compartment.

[0089] In addition, the condenser 103 is provided on an external lateral face of the first body 151, to be in contact with the outer case 156. In addition, the condenser 104 is provided along a rim of the opening in a front face of the second body 152, to be in contact with the outer case 156. In other words, the condensers 103 and 104 release the heat through the outer case 156.

[0090] Here, as described above, the condenser 103 is provided at the position where the fifth vacuum insulation material 145 is provided. Accordingly, the fifth vacuum insulation material 145 includes a recessed portion having a shape corresponding to a shape of the condenser 103.

[0091] FIG. 7 is a diagram showing a cross-sectional shape of the fifth vacuum insulation material 145 according to the present embodiment.

[0092] Note that FIG. 7 shows a cross-sectional shape of the fifth vacuum insulation material 145 when horizontally cut off.

[0093] As shown in FIG. 7, the fifth vacuum insulation material 145 includes a recessed portion 145a having a shape corresponding to the shape of the condenser 103. In addition, the condenser 103 is placed to be embedded in the recessed portion 145a.

[0094] This allows the condenser 103 to efficiently release the heat by utilizing the lateral face of the outer

case 156, and allows reducing the influence of the heat from the condenser 103 onto the refrigerator compartment. In addition, even in the case of providing the condenser 103 at this position, it is not necessary to increase the distance between the first body 151 and the outer case 156, that is, a thickness of a lateral wall of the first body 151.

[0095] Note that as shown in FIG. 6, the condenser 104 on a freezer compartment side does not pass through the space in which the first vacuum insulation material 141 is provided. Therefore, as shown in FIG. 7, the first vacuum insulation material 141 has a flat shape without including the recessed portion or the like.

[0096] Thus, the refrigerator 100 according to the present embodiment includes vacuum insulation materials from the first vacuum insulation material 141 to the seventh vacuum insulation material 147. This allows increase in storage capacity of the refrigerator 100 and efficient cooling by effective thermal insulation.

[0097] Here, using a material with high nonflammability as the vacuum insulation materials from the first vacuum insulation material 141 to the seventh vacuum insulation material 147, it is possible to keep at a constant level or increase, the nonflammability of the refrigerator 100 as a whole even when a flammable refrigerant is used.

[0098] The following will describe a type of the refrigerant and the thermal insulation performance of the first vacuum insulation material 141 or the like that are used for the refrigerator 100 according to the present embodiment.

[0099] As the refrigerant for the cooling cycle unit included in the refrigerator 100 according to the present embodiment, a hydrocarbon refrigerant is adopted, for example.

[0100] In addition, as an insulation material to be filled between the outer case 156 and the inner case 157, for example, a foam resin including hydrocarbon cyclopentane as a foaming agent is adopted.

[0101] Here, although the hydrocarbon material used as the refrigerant and so on is flammable, such a hydrocarbon material has a small influence on global warming. Therefore, using the hydrocarbon material as the refrigerant or the like in the refrigerator 100, it is possible to minimize the influence on the global warming.

[0102] In addition, for the vacuum insulation materials from the first vacuum insulation material 141 to the seventh vacuum insulation material 147, a vacuum insulator is adopted which is processed by: using an inorganic material as a core material to increase nonflammability, coating, with a gas barrier film, a sheet-like inorganic fiber assembly which is a core material assembly formed by heating and pressurizing, and reducing internal pressure. The assembly of the cores may be formed using an inorganic binder.

[0103] By providing such vacuum insulators at respective points as shown in FIG. 5, it is possible to decrease the total amount of resin foam to be filled between the outer case 156 and the inner case 157. Furthermore, it is possible to increase safety by increasing nonflammability against catching fire from outside the main body 150 and suppressing generation of an organic gas.

[0104] Note that a heat-insulating wall may be formed by providing such vacuum insulators in a space formed by the outer case 156 and the inner case 157, and filling the space with foam resin. Alternatively, an insulator into which these vacuum insulators and foam resin are integrally foamed may be provided in the space formed by the outer case 156 and the inner case 157.

[0105] By providing the vacuum insulators using the sheet-like inorganic fiber assembly in the main body 150 that is a heat-insulating main body, it is possible to increase nonflammability of the main body 150, thus realizing the refrigerator 100 with high safety.

[0106] In addition, since the core material that is a sheet-like inorganic fiber assembly is used as the vacuum insulation material, it is possible to obtain a vacuum insulator which is thin and has a sufficient flatness. This allows a heat-insulating wall of the main body 150 to be thin and have satisfactory flatness.

[0107] In addition, since the vacuum insulation material has excellent workability in cutting, folding, forming a dent, a protrusion, a through hole or the like, it is possible to easily obtain the vacuum insulator having a shape that following the shape of the refrigerator 100.

[0108] For example, it is possible to use a sheet of vacuum insulator by folding the sheet to fit three lateral faces of the main body 150. Such shaping allows covering even an edge portion of the main body 150 with the vacuum insulator, thus allows manufacturing the main body 150 having excellent nonflammability and thermal insulation performance.

[0109] In addition, by providing one sheet of vacuum insulation material in a portion intended to be thinner than another portion in the main body 150 and providing, in the other portion, two layers of sheet, or the like, it is possible to manufacture, very easily, the vacuum insulator having a shape as required.

[0110] Additionally, since the core material of the vacuum insulator is in a sheet state, the vacuum insulation material is thin, and thus can meet a wide range of requirements when stacking the vacuum insulators to have a required thickness.

[0111] In addition, when providing, on the vacuum insulator, a pipe or line required for the refrigerator 100, it is possible, as shown in FIG. 7, to manufacture the vacuum insulator in which a dent following a shape of the pipe or the like is provided in the sheet-like inorganic fiber assembly. In addition, it is also possible to provide a dent after manufacturing the vacuum insulator and providing the pipe or the like in the dent.

[0112] It is also possible to form the dent by directly pressing the vacuum insulator against the pipe or the like that is provided along the outer case 156 and providing, as it is, the vacuum insulator between the outer case 156 and the inner case 157. As described above, such use of the fiber assembly as the vacuum insulator facilitates

molding and thus facilitates providing the dent.

[0113] In addition, such use of an inorganic fiber as the fiber assembly further suppresses, as compared to the vacuum insulator using an organic core material, degradation in performance of the vacuum insulator due to temperature increase that is caused when filling the resin foam into the space formed by the outer case 156 and the inner case 157 of the refrigerator 100.

[0114] In addition, in the vacuum insulator using an inorganic powder, it is necessary to fill the inorganic powder in an inner bag before inserting the powder into a covering material. This is because inorganic powder, unless filled in the inner bag in advance, disperses into air when evacuating an inside of the covering material.

[0115] In the case of manufacturing the vacuum insulator by filling the powder in the inner bag, for forming the shape of the vacuum insulator, it is necessary to shape the inner bag in advance. In the case of using the sheet-like core material, it is possible to obtain, in shape forming, a vacuum insulator having a required shape by simply cutting, folding, or the like of the sheet-like core material into the required shape. However, in the vacuum insulator using powder, forming the inner bag into a required shape restricts the shape forming so as to prevent the inner bag from breaking or the powder from leaning in the bag, thus significantly reducing operation efficiency.

[0116] In addition, since the vacuum insulator using the sheet-like inorganic fiber assembly is a sheet-like assembly, operation efficiency largely increases also when manufacturing the vacuum insulator, as compared to the case of using inorganic powder. This allows skipping a process of filling powder in the inner bag, which is an essential process in the case of using the powder, and has no problem of powder dispersion, thus significantly improving work environment.

[0117] Furthermore, since this does not cause dispersion of the core material even when the back of the vacuum insulator breaks, it is also possible, when disposing the refrigerator 100, to easily dispose the refrigerator 100 having this vacuum insulator, without causing degradation in the work environment.

[0118] In addition, since the assembly is formed not of powder but of a fibrous substance, the fibers therein, when formed into the assembly, have more contact points, thus allowing obtaining a core material which is easy to solidify using a binder or the like, and easy to manufacture.

[0119] In this case, the component material of the sheet-like inorganic fiber assembly is not particularly limited, but may be any inorganic fiber such as: alumina fiber, ceramic fiber, silica fiber, zirconia fiber, glass wool, rock wool, calcium sulfate fiber, silicon carbide fiber, potassium titanate fiber, and magnesium sulfate, and the component material is not limited to a single material.

[0120] In terms of thermal insulation performance, a fiber diameter of the inorganic fiber is preferably 10 μm or below, and more preferably, 5 μm or below, and particularly, 3 μm or below.

[0121] In addition, only the fiber material may be used, but an inorganic or organic binder may also be used to form the assembly.

[0122] For the inorganic binder, the material to be used is not particularly limited but may be a known material such as colloidal silica, liquid glass, alumina sol, and silicon resin.

[0123] In addition, for the organic binder, the material is not particularly limited, but a known material may be used such as: (a) a thermoset resin such as phenol resin, epoxy resin, or urea resin; (b) methyl acrylate, ethyl acrylate, butyl acrylate, cyanoacrylate, methyl methacrylate, ethyl methacrylate, or butyl methacrylate; (c) acrylic resin such as cyano methacrylate, polyether such as polyethylene terephthalate, polybutylene terephthalate, or polyethylene naphthalate; or (d) thermoplastic resin such as polypropylene, polyethylene, polystyrene, polyvinyl acetate, polyvinyl alcohol, polyacrylonitrile, or polyamide resin.

[0124] In terms of nonflammability, temporal gas generation from the inorganic fiber assembly, density, or the like, the content of the organic binder is preferably 10 % or below, and more preferably, 5% or below.

[0125] For such binders, it is also possible to use a mixture of two or more types of binders, and it is further possible to use a mixture of a plasticizer, a heat stabilizer, a light stabilizer, a filler, and so on that are generally used.

[0126] The density of the sheet-like inorganic fiber assembly manufactured using what is described above is not particularly limited, but the density is preferably 80 kg/m^3 or above in terms of maintainability of shape as an assembly, or is preferably 300 kg/m^3 or below in terms of thermal insulation performance, and particularly, the density is preferably 100 kg/m^3 or above but not exceeding 200 kg/m^3.

[0127] The gas barrier film covers the core material to provide an airtight portion inside, and is not limited to a particularly material component. Some gas barrier film is a laminated film which is formed into a bag state, to include: for example, plastic laminated film made of polyethylene terephthalate resin in an outermost layer, aluminum (hereinafter called AL) foil in a middle layer, and high-density polyethylene resin in an innermost layer; and for example, plastic laminated film made of polyethylene terephthalate in an outermost layer, ethylene vinylalcohol copolymer resin (called EVAL developed by KURARAY CO., LTD.) including AL evaporated layer in a middle layer, and high-density polyethylene resin in an innermost layer.

[0128] For a compositional feature of the covering material, the outermost layer is intended to provide protection from shock, the middle layer is to secure gas-barrier properties, and the innermost layer is for heat-sealing. Therefore, any known material may be used as long as the material meets these intended uses, and for further improvements, a nylon resin may be attached to the outermost layer so as to increase piercing resistance, or two

layers made of ethylene vinylalcohol copolymer resin including the AL evaporated layer may be provided for the middle layer.

[0129] In addition, as the innermost layer to be heat-sealed, it is preferable to use a high-density polyethylene resin in terms of sealing performance and resistance to chemical attacks, but another resin may be used such as a polypropylene resin or polyacrylonitrile resin.

[0130] In addition, the bag state of the covering material is not particularly limited, but may be a four-side seal bag, gazette bag, pillow bag, L-shaped bag, or the like.

[0131] In addition, it is possible to perform, before inserting the covering material, heating processing for the purpose of dehydration and degassing of the core material. Preferably, the heating temperature in the processing is 100 C° or above for reason of allowing minimum dehydration.

[0132] In addition, to further increase reliability of the vacuum insulator, it is possible to use a getter substance such as a gaseous absorbent or moisture absorbent.

[0133] In addition, an absorption mechanism may be any one of physical absorption, chemical absorption, storage, sorption, and so on, but a substance that reacts as a non-evaporation getter is satisfactory.

[0134] Specifically, the substance is a physical absorbent such as a synthetic zeolite, activate alumina, silica gel, dawsonite, and hydrotalcite.

[0135] As chemical absorbent, an oxide of an alkali metal or alkaline-earth metal, or a hydroxide of an alkali metal or alkaline-earth metal may be used, and particularly, lithium oxide, lithium hydroxide, calcium oxide, calcium hydroxide, magnesium oxide, magnesium hydroxide, barium oxide, and barium hydroxide work effectively.

[0136] In addition, calcium sulfate, magnesium sulfate, sodium sulfate, sodium carbonate, potassium carbonate, calcium chloride, lithium carbonate, unsaturated fatty acid, iron compounds, and so on also work effectively.

[0137] In addition, it is more effective to apply a getter substance that is a substance such as barium, magnesium, calcium, strontium, titanium, zirconium, vanadium or the like, which are separately used or used as an alloy.

[0138] Furthermore, it is more effective to apply a mixture of different types of such getter substances so as to absorb and remove at least nitrogen, oxygen, moisture, and carbon dioxide.

[0139] For the refrigerator 100 having a vacuum insulator and resin foam as described above, it is possible to use, for the resin foam, for example, rigid urethane foam, phenol foam, or styrene foam, but these materials are not particularly specified.

[0140] In addition, for example, a foaming agent used for foaming rigid urethane foam is not particularly specified, but in terms of protection of the ozone layer and prevention of global warming, it is preferable to use cyclopentane, isopentane, n-pentane, isobutane, n-butane, water (carbon dioxide gas foaming), azo compound, argon, and so on, and particularly cyclopentane is preferable in terms of thermal insulation performance.

[0141] In addition, the refrigerant used for the refrigerator 100 is not particularly specified, and isobutane, n-butane, propane, ammonium, or the like that is a flammable refrigerant is used as the refrigerant. Note that in terms of cooling capacity, isobutane is particularly preferable.

[0142] Here, the outer case 156 of the refrigerator 100 is formed of a metal plate and is formed in a plane state. This facilitates attaching, to an inside of the outer case 156, the first to the seventh vacuum insulation materials 141 to 147 each of which is the vacuum insulator.

[0143] In the case of previously providing the vacuum insulator in the outer case 156, for an attachment method for the vacuum insulator, there are some methods such as a method of attaching using adhesion bond, adhesive tape, a hot-melt adhesive, resin foam, or the like, or a method of fixing or holding the vacuum insulator using a fixture or the like and subsequently filling resin foam in a space other than the vacuum insulator, but the method is not particularly specified.

[0144] In addition, for the method of providing the vacuum insulator in a door such as the first door 111 and the second door 121, there are some methods such as: a method of attaching the vacuum insulator using the inorganic fiber assembly in an inner lateral face or outer lateral face of the door and filling resin form in the space other than the vacuum insulator.

[0145] With use of a nonflammable vacuum insulator for the door such as the first door 111 and the second door 121, it is possible to increase frame resistance to spread of fire to the door in case ignition and burning occurs around the refrigerator 100.

[0146] In addition, the partition 153 may be manufactured by providing only the vacuum insulator (the fourth vacuum insulation material 144) inside the partition 153 and covering a perimeter with an outer frame made of ABS resin, PP resin, or the like.

[0147] In addition, it is also possible to integrally form the vacuum insulation material, the resin foam, and an outer frame of a partition plate into the partition 153, and it is also possible, as shown in the present embodiment, to integrally form the outer frame of the partition 153 with the inner case 157. Alternatively, it is possible to previously manufacture a heat-insulating board using vacuum insulation material and resin foam, and to provide the heat-insulating board within the outer frame of the partition 153. In other words, as long as the partition 153 is formed of the vacuum insulation material using the sheet-like inorganic fiber assembly, other elements to be included in the partition 153 are not particularly specified.

[0148] By forming the partition 153 into the structure as described above and, for example, providing the vacuum insulator using a sheet-like inorganic fiber assembly on an inner case 157 side of the main body 150, it is also possible to prevent, in case ignition and burning occurs outside the refrigerator 100, the fire spreading to the freezer compartment partitioned by the partition 153 and also prevent the fire spreading to the main body 150,

even when, for example, the front door 111 in the front face of the refrigerator compartment is open and the inside the refrigerator compartment starts burning. In other words, it is possible to realize the refrigerator 100 with improved safety.

[0149] In addition, only the sheet-like inorganic assembly may be used as an insulation material for a sealed space which is formed by the inner case 157 and the outer case 156, and the pressure in the space may be reduced, and a flammable refrigerant may be used as the refrigerant to be used for the freezing cycle.

[0150] In addition, for the first door 111 and the second door 121, each door may have thermal insulation performance by reducing the pressure of the space inside these doors using only the sheet-like inorganic fiber assembly as the insulation material.

[0151] Furthermore, to keep a vacuum of the sealed space in which the sheet-like inorganic fiber assembly is provided, it is also possible to provide a gas absorbent in the sealed space.

[0152] By thus configuring the refrigerator 100, the insulation wall does not include resin foam, thus tremendously increasing safety of the refrigerator 100.

[0153] This is because, even in case of a fire spreading from outside of the refrigerator 100, the refrigerator 100, since it does not include any organic insulation material, allows suppressing the spread of the fire to the insulation material and also suppressing generation of organic gas from the resin foam.

[0154] In this case, the outer case 156 and the inner case 157 are preferably formed of a material having excellent gas-barrier properties and low thermal conductivity. In practice, a metal plate such as a very thin metal plate or a stainless plate is effective.

[0155] In addition, the use of the sheet-like inorganic fiber assembly between the outer case 156 and the inner case 157 provides an excellent flatness, thus allowing a surface flatness of the refrigerator to be maintained even when evacuating the inside of the outer case 156 and the inner case 157. In addition, even for producing the main body 150, it is only necessary to insert the sheet-like inorganic fiber assembly between the outer case 156 and the inner case 157 and evacuating the inside, thus achieving excellent productivity and workability.

[0156] In addition, the use of the inorganic fiber results in less temporal gas generation within the vacuum insulator.

[0157] In addition, the sheet-like inorganic fiber assembly used as the vacuum insulator may include at least silica.

[0158] Use of an inorganic fiber including silica allows obtaining a sheet-like inorganic fiber assembly which is inexpensive and has excellent heat resistance properties.

[0159] In addition, the sheet-like inorganic fiber assembly used as the vacuum insulator may include at least alumina.

[0160] Since the larger the content of alumina is, the further the heat resistance properties improve, it is possible to improve nonflammability of the sheet-state inorganic fiber assembly.

[0161] In addition, the sheet-like inorganic fiber assembly may include another component which may be an inorganic substance such as: calcium oxide, magnesium oxide, ferric oxide, titanic oxide, boron oxide, sodium oxide, zirconia, calcium sulfate, magnesium sulfate, silicon carbide, potassium titanate, chrome, zinc, and so on, but the component is not particularly specified.

[0162] Note that the insulator adopted as the first to the seventh vacuum insulation materials 141 to 147 according to the present embodiment is formed by: drying a sheet-like ceramic fiber assembly having a thickness of 5 mm at 140 °C for one hour, inserting the dried sheet-like ceramic fiber assembly into the covering material, and sealing an opening by evacuating the inside.

[0163] A chemical composition of the inorganic fiber that is used as the sheet-like ceramic fiber assembly is: silica at approximately 60 %, alumina at approximately 18 %, calcium oxide at approximately 17 %, and the other inorganic substance at approximately 5 %, and the fiber diameter is approximately 1 to 3 μm. In addition, an acrylic binder of approximately 5 % is used as the binder, and the density of the assembly under atmospheric pressure is 120 kg/m^3.

[0164] In addition, for the covering material, laminated film A as described below is used for one face, and laminated film B as described below is used for the other face.

[0165] The laminated film A is laminated film including: a surface protection layer formed of polyethylene terephthalate (12 μm); a middle portion formed of aluminum foil (6 μm); and a heat-sealing layer formed of high density polyethylene (50 μm).

[0166] The laminated film B is laminated film including: a surface protection layer formed of polyethylene terephthalate (12 μm); a middle portion formed of a film layer formed by evaporating aluminum onto an inside of the ethylene vinylalcohol copolymer resin composition (15 μ), and a heat-sealing layer formed of high-density polyethylene (50 μm).

[0167] In addition, in the covering material thus composed, a nylon resin layer is formed on the surface protection layer to increase resistance to scarring. In addition, a four-side seal bag is used for forming the covering material into a bag shape.

[0168] The thermal insulation performance of the vacuum insulation material is 0.043 W/mK at 30 Pa.

[0169] As an example for comparison, the property of the vacuum insulator using continuous urethane foam and silica powder as the core material is 0.0065 to 0.0075 W/mK at 30 Pa.

[0170] Thus, since the first to the seventh vacuum insulation materials 141 to 147 have a very high thermal insulation performance, such materials, even when the thickness thereof is reduced, sufficiently secure thermal insulation performance and increase the capacity inside the storage compartments.

[0171] In addition, such vacuum insulators are provided in a plurality of points such as a back or lateral face of the refrigerator 100, thus improving nonflammability of the entire refrigerator 100. As a result, the safety of the refrigerator 100 is increased.

[0172] In addition, the vacuum insulator may be provided only in a portion corresponding to a freezer compartment, in at least one of a lateral face, a back face, and a bottom face of the main body 150. For example, only the first vacuum insulation material 141 may be provided in the refrigerator 100. This allows suppressing manufacturing costs of the refrigerator 100 while maintaining thermal insulation performance of the freezer compartment.

[0173] In addition, for example, when providing the first vacuum insulation material 141, it is also possible to form the first vacuum insulation material 141 into a shape having, for example, a notch in a lower rear to follow the shape of the bottom plate 156c.

[0174] In this case, in a rectangle or square covering material, a sheet-like ceramic fiber having a shape corresponding to a shape of the bottom face plate 156c is included. Furthermore, the first vacuum insulation material 141 is manufactured by folding the covering material to follow the shape of the sheet-like ceramic fiber assembly.

[0175] Alternatively, there are various methods for manufacturing the first vacuum insulation material 141 such as a method of previously manufacturing the covering material into a shape of the sheet-like ceramic fiber assembly and including the covering material, but the method is not particularly specified.

[0176] Likewise, the fifth vacuum insulation material 145 on the side of the refrigerator compartment may be formed into a shape according to a shape of another constituent element.

[0177] In addition, the first vacuum insulation material 141 and the fifth vacuum insulation material 145 may cover an entire surface of an inner lateral face of the main body 150, on which each of the vacuum insulation materials is provided. In addition, these inner lateral faces may be covered with a plurality of vacuum insulators.

[0178] Since the sheet-like ceramic fiber assembly is used for the first to the seventh vacuum insulation materials 141 to 147, the folding processing is very easy, thus achieving excellent productivity.

[0179] Note that when a plurality of vacuum insulators are overlapped for insulation, a gap is caused between each of the vacuum insulators, thus obstructing improvement in nonflammability and deteriorating thermal insulation performance.

[0180] From this, as seen in the first to the seventh vacuum insulation materials 141 to 147, such availability as a sheet of vacuum insulator that is foldable for use, leads to improvement in safety or improvement in thermal insulation performance of the refrigerator 100, and further energy saving through operation control of the compressor 101.

[0181] Note that in the present embodiment, the ceramic fiber has an alumina content of approximately 18 % as described above. However, since heatproof temperature is further increased when crystallinity is increased by increasing the alumina content, the vacuum insulator using a ceramic fiber having a larger alumina content may be used for the refrigerator 100 as the first to the seventh vacuum insulation materials 141 to 147. Thus, it is possible to further increase the safety of the refrigerator 100.

[0182] In addition, in a top surface of the main body 150 according to the present embodiment, the control board is housed as described above. Specifically, the control board is housed in the board box 170 attached to an upper part of the first body 151.

[0183] FIG. 8 is a perspective view showing a shape and a layout position of the board box 170 according to the present embodiment.

[0184] FIG. 9 is a partial cross-sectional view showing a positional relationship between the board box 170 and the first body 151 according to the embodiment. Note that a shaded area in FIG. 9 is a portion filled with an insulator such as rigid foam urethane.

[0185] As shown in these figures, the board box 170 houses different types of electronic components including the control board 171. In addition, the bottom face that is a face of the first body 151 of the board box 170 is inclined not in parallel with an upper edge that extends in a front-rear direction of the board box 170 but in a direction away from the upper rim toward the rear end.

[0186] The board box 170 is attached to the main body 150 such that the upper edge and the upper face of the main body 150 are in parallel. In other words, the board box 170 is disposed above the inclined face 151a such that the bottom face of the board box 170 is included in the same direction as the inclined face 151a.

[0187] Specifically, the bottom face of the board box 170 and the inclined face 151a included in the top face of the first body 151 are approximately parallel.

[0188] This, for example, reduces an amount of the insulator required for the space between the board box 170 and the first body 151 as compared to the case where the bottom face of the board box 170 and the upper edge extending in a front-rear direction are parallel.

[0189] In addition, the board box 170 requires a certain level of depth to house the control board 171.

[0190] Thus, assuming that the bottom face of the board box 170 and the upper edge extending in the front-rear direction are formed in parallel with each other, it is necessary to provide a length in a height direction of a front portion of the board box 170 longer than the length shown in FIGS. 8 and 9.

[0191] In this case, the front portion of the bottom face of the board box 170 and the inclined face 151a of the first box 151 becomes shorter. This deteriorates the flow of the insulator when an insulator such as rigid urethane foam or the like is filled around the board box 170.

[0192] In addition, it is possible to consider that the

thickness of the insulator provided between the front portion of the bottom face of the board box 170 and the inclined face 151a of the first body 151 becomes extremely thin, and in this case, it is also possible to consider a state that does not produce a sufficient thermal insulation effect.

[0193] Note that even in the case of forming the bottom face of the board box 170 in parallel with the upper edge extending in the front-rear direction, it is possible to separate the bottom face of the board box 170 from the inclined face 151a by displacing the position of the board box 170.

[0194] However, in this case, this causes an upper part of the board box 170 to protrude from the main body 150, and is not preferable in design terms.

[0195] Thus, according to the present embodiment, as shown in FIGS. 8 and 9, the bottom face of the board box 170 is inclined with respect to the upper edge extending in the front-rear direction. With this, when the board box 170 is attached to the main body 150, the bottom face of the board box 170 and the inclined face 151a are approximately parallel to each other.

[0196] With this, the board box 170 does not become an obstacle in filling the insulator such as rigid foam urethane, or does not interfere with sufficient thermal insulation in the top face of the first body 151.

[0197] In addition, it is not necessary to form the upper part of the board box 170 to protrude from the main body, and the board cover 158 secures flatness of the top face of the main body 150.

[0198] In addition, the control board 171 housed in the board box 170 is provided to be inclined along the bottom face of the board box 170.

[0199] In addition, since the board box 170 includes air inside, the board box 170 functions as a heat-insulating member.

[0200] In addition, the board box 170 is provided above the refrigerator compartment having a high temperature than the freezer compartment. With this, even an increase in temperature in the board box 170 does not have a significant influence on the temperature of the storage compartments of the refrigerator 100.

[0201] Note that, when, for example, the sixth vacuum insulation material 146 allows sufficient thermal insulation in the upper part of the second body 152 forming the freezer compartment, the board box 170 may be provided above the second body 152. In this case, on the top face of the second body 152, the same inclined face as the inclined face 151a may be provided, and the sixth vacuum insulation material 146 may be provided between the board box 170 and the second body 152.

[0202] In other words, the inner case 157 including the first body 151 and the second body 152 is manufactured by a method using a mold such as vacuum molding. This results in the inclined face formed at a rear end of the inner case 157.

[0203] Thus, when it is possible to provide, using the inclined face and so as not to block sufficient thermal insulation, the board box 170 having a shape corresponding to the inclined face at a position corresponding to the inclined face, it is possible to keep a balance between efficient use of the space within the refrigerator and sufficient thermal insulation performance.

[0204] A refrigerator having such a feature can be expressed as, for example: a refrigerator including an inner case having an opening in a front face and forming a storage compartment and an outer case covering the inner case, and includes a board box which is provided above the inner case and houses a board for controlling an operation of the refrigerator, and at least part of the top face of the inner case is an inclined face that downwardly inclines toward a back face of the first body, and the pane box is provided in the refrigerator such that a face, on the inner case side, of the board box is inclined in the same direction as the inclined face.

Industrial Applicability

[0205] According to the present invention, it is possible to provide a refrigerator which includes a refrigerator compartment and a freezer compartment that are adjacently arranged side by side, and which has increased rigidity while capacity of these storage compartments is intended to increase. Accordingly, the present invention is applicable as refrigerators and the like of various types and sizes for home and professional uses, and so on.

Claims

1. A refrigerator (100) which includes (i) a first body (151) having an opening (123) in a front face, forming a refrigerator compartment, and being long in a vertical direction, (ii) a second body (152) having an opening (123) in a front face, forming a freezer compartment, and being long in a vertical direction, and (iii) an outer case (156) which covers said first body (151) and said second body (152) that are adjacently arranged side by side, said refrigerator (100) comprising

a first vacuum insulation material (141) provided between a lateral face of said second body (152) and said outer case (156), the lateral face being on a side opposite to said first body (151); **characterized in that** the refrigerator (100) further comprises a condenser (102, 103, 104) which is provided between a lateral face of said first body (151) and said outer case (156) and performs heat exchange with air via said outer case (156), the lateral face being on a side opposite to said second body (152); and

a fifth vacuum insulation material (145) provided between the lateral face of said first body (151) and said condenser (102, 103, 104),

wherein said fifth vacuum insulation material (145) includes a recessed portion (145a) having a shape that follows a shape of said condenser (102, 103,

104),
said condenser (102, 103, 104) is provided along the recessed portion (145a) and formed of a series of heat-releasing pipes that form a flow path of a refrigerant, and
part of said heat-releasing pipes is provided along a rim of said opening (123) in the front face of said second body (152) to be in contact with said outer case (156).

2. The refrigerator (100) according to claim 1, further comprising
a second vacuum insulation material (142) provided between a back face of said second body (152) and said outer case (156).

3. The refrigerator (100) according to claim 2, further comprising
a third vacuum insulation material (143) provided between a bottom face of said second body (152) and said outer case (156).

4. The refrigerator (100) according to claim 3, further comprising
a fourth vacuum insulation material (144) provided between said first body (151) and said second body (152).

5. A refrigerator (100) according to one of claims 1 to 4, further comprising
a board box (170) which is provided above said first body (151) and houses a board that is for controlling an operation of said refrigerator (100),
wherein at least part of a top face of said first body (151) is an inclined face (151a) which downwardly inclines toward a back face of said first body (151), and
said board box (170) is provided above the inclined face (151a) such that a face of said board box (170) inclines in a same direction as the inclined face (151a), the face being on a side of said first body (151).

Patentansprüche

1. Kühlschrank (100) umfassend (i) einen ersten Körper (151) mit einer Öffnung (123) in einer Vorderseite, die ein Kühlfach bildet, und in einer vertikalen Richtung lang ist, (ii) einen zweiten Körper (152) mit einer Öffnung (123) in einer Vorderseite, die ein Gefrierfach bildet, und in einer vertikalen Richtung lang ist, und (iii) ein Außengehäuse (156), das den ersten Körper (151) und den zweiten Körper (152), die nebeneinander angeordnet sind, abdeckt, wobei der Kühlschrank (100) enthält
ein erstes Vakuumisolationsmaterial (141), das zwischen einer Seitenfläche des zweiten Körpers (152) und dem Außengehäuse (156) vorgesehen ist, wobei sich die Seitenfläche auf einer dem ersten Körper (151) gegenüberliegenden Seite befindet;
dadurch gekennzeichnet, dass der Kühlschrank (100) weiterhin enthält einen Kondensator (102, 103, 104), der zwischen einer Seitenfläche des ersten Körpers (151) und dem Außengehäuse (156) vorgesehen ist und einen Wärmeaustausch mit Luft über das Außengehäuse (156) durchführt, wobei sich die Seitenfläche auf einer dem zweiten Körper (152) gegenüberliegenden Seite befindet; und
ein fünftes Vakuumisolationsmaterial (145), das zwischen der Seitenfläche des ersten Körpers (151) und dem Kondensator (102, 103, 104) vorgesehen ist,
wobei das fünfte Vakuumisolationsmaterial (145) einen vertieften Abschnitt (145a) mit einer Form aufweist, die einer Form des Kondensators (102, 103, 104) folgt,
wobei der Kondensator (102, 103, 104) entlang des vertieften Abschnitts (145a) vorgesehen ist und aus einer Reihe von wärmeabgebenden Rohren gebildet ist, die einen Strömungsweg eines Kältemittels bilden, und
ein Teil der wärmeabgebenden Rohre entlang eines Rands der Öffnung (123) in der Vorderseite des zweiten Körpers (152) vorgesehen ist, um in Kontakt mit dem Außengehäuse (156) zu sein.

2. Kühlschrank (100) nach Anspruch 1, weiterhin enthaltend
ein zweites Vakuumisolationsmaterial (142), das zwischen einer Rückseite des zweiten Körpers (152) und dem Außengehäuse (156) vorgesehen ist.

3. Kühlschrank (100) nach Anspruch 2, weiterhin enthaltend
ein drittes Vakuumisolationsmaterial (143), das zwischen einer Unterseite des zweiten Körpers (152) und dem Außengehäuse (156) vorgesehen ist.

4. Kühlschrank (100) nach Anspruch 3, weiterhin enthaltend
ein viertes Vakuumisolationsmaterial (144), das zwischen dem ersten Körper (151) und dem zweiten Körper (152) vorgesehen ist.

5. Kühlschrank (100) nach einem der Ansprüche 1 bis 4, weiterhin enthaltend
ein Platinengehäuse (170), das über dem ersten Körper (151) vorgesehen ist und eine Platine enthält, die zum Steuern eines Betriebs des Kühlschranks (100) dient,
wobei mindestens ein Teil einer Oberseite des ersten Körpers (151) eine geneigte Fläche (151a) ist, die sich nach unten zu einer Rückseite des ersten Körpers (151) hinneigt, und
das Platinengehäuse (170) über der geneigten Fläche (151a) derart vorgesehen ist, dass sich eine Flä-

che des Platinengehäuses (170) in dieselbe Richtung wie die geneigte Fläche (151a) neigt, wobei die Fläche auf einer Seite des ersten Körpers (151) liegt.

Revendications

1. Réfrigérateur (100) qui comprend (i) un premier corps (151) ayant une ouverture (123) dans une face avant, formant un compartiment de réfrigérateur, et étant long dans une direction verticale, (ii) un second corps (152) ayant une ouverture (123) dans une face avant, formant un compartiment de congélateur, et étant long dans une direction verticale, et (iii) un boîtier externe (156) qui recouvre ledit premier corps (151) et ledit second corps (152) qui sont disposés de manière adjacente côte à côte, ledit réfrigérateur (100) comprenant
un premier matériau d'isolation sous vide (141) disposé entre une face latérale dudit second corps (152) et ledit boîtier externe (156), la face latérale étant sur un côté opposé audit premier corps (151);
caractérisé en ce que le réfrigérateur (100) comprend en outre
un condenseur (102, 103, 104) qui est disposé entre une face latérale dudit premier corps (151) et ledit boîtier externe (156) et réalise un échange de chaleur avec de l'air par l'intermédiaire dudit boîtier externe (156), la face latérale étant sur un côté opposé audit second corps (152); et
un cinquième matériau d'isolation sous vide (145) disposé entre la face latérale dudit premier corps (151) et ledit condenseur (102, 103, 104),
dans lequel ledit cinquième matériau d'isolation sous vide (145) comprend une partie évidée (145a) ayant une forme qui suit une forme dudit condenseur (102, 103, 104),
ledit condenseur (102, 103, 104) est disposé le long de la partie évidée (145a) et formé d'une série de tuyaux de libération de chaleur qui forment un trajet d'écoulement d'un réfrigérant, et
une partie desdits tuyaux de libération de chaleur est disposée le long d'un rebord de ladite ouverture (123) dans la face avant dudit second corps (152) pour être en contact avec ledit boîtier externe (156).

2. Réfrigérateur (100) selon la revendication 1, comprenant en outre
un deuxième matériau d'isolation sous vide (142) disposé entre une face arrière dudit second corps (152) et ledit boîtier externe (156).

3. Réfrigérateur (100) selon la revendication 2, comprenant en outre
un troisième matériau d'isolation sous vide (143) disposé entre une face inférieure dudit second corps (152) et ledit boîtier externe (156).

4. Réfrigérateur (100) selon la revendication 3, comprenant en outre
un quatrième matériau d'isolation sous vide (144) disposé entre ledit premier corps (151) et ledit second corps (152).

5. Réfrigérateur (100) selon l'une des revendications 1 à 4, comprenant en outre
une boîte à carte (170) qui est disposée au-dessus dudit premier corps (151) et loge une carte qui est destinée à commander un fonctionnement dudit réfrigérateur (100),
dans lequel au moins une partie d'une face supérieure dudit premier corps (151) est une face inclinée (151a) qui s'incline vers le bas vers une face arrière dudit premier corps (151), et
ladite boîte à carte (170) est disposée au-dessus de la face inclinée (151a) de telle sorte qu'une face de ladite boîte à carte (170) s'incline dans une même direction que la face inclinée (151a), la face étant sur un côté dudit premier corps (151).

FIG. 1

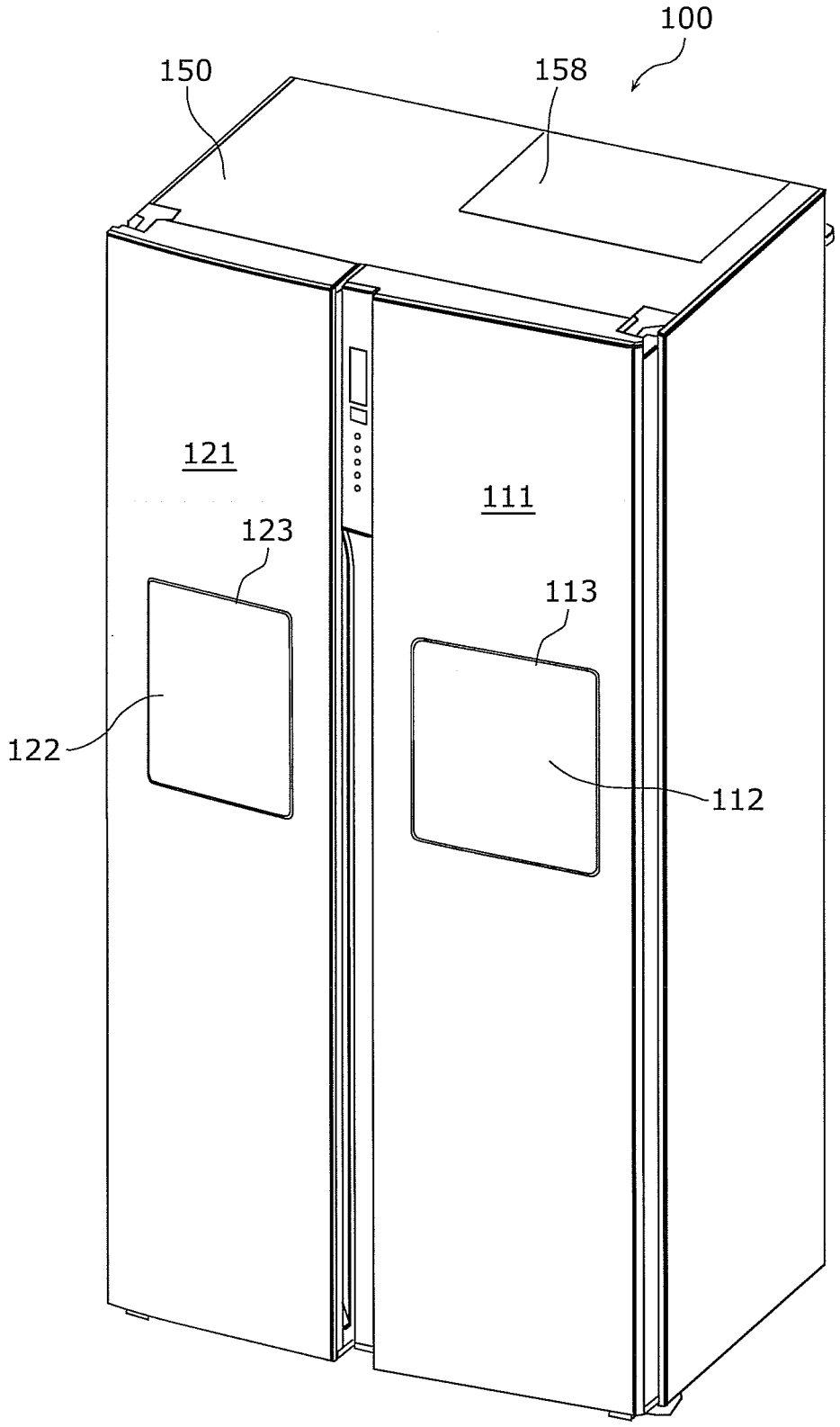


FIG. 2

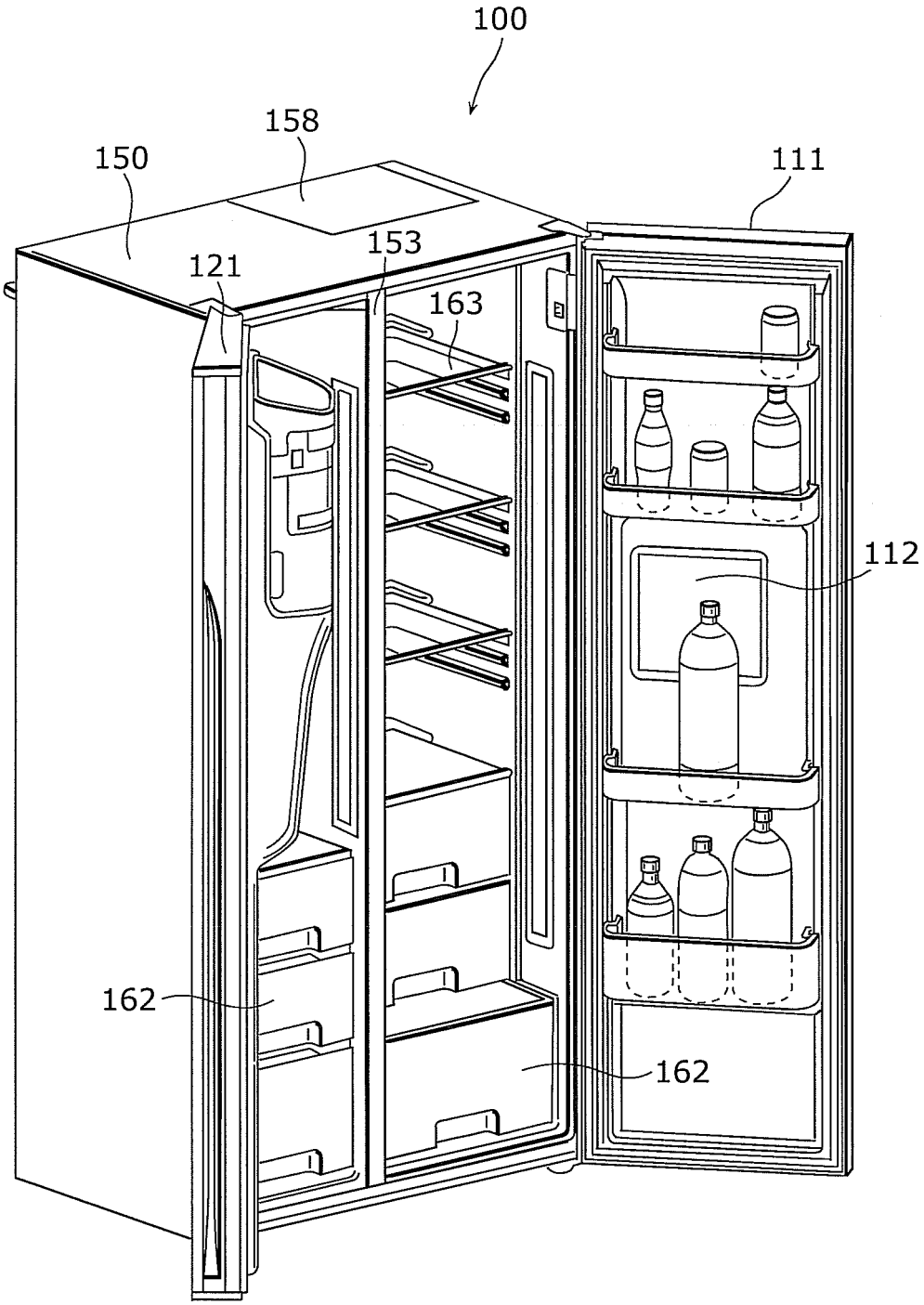


FIG. 3

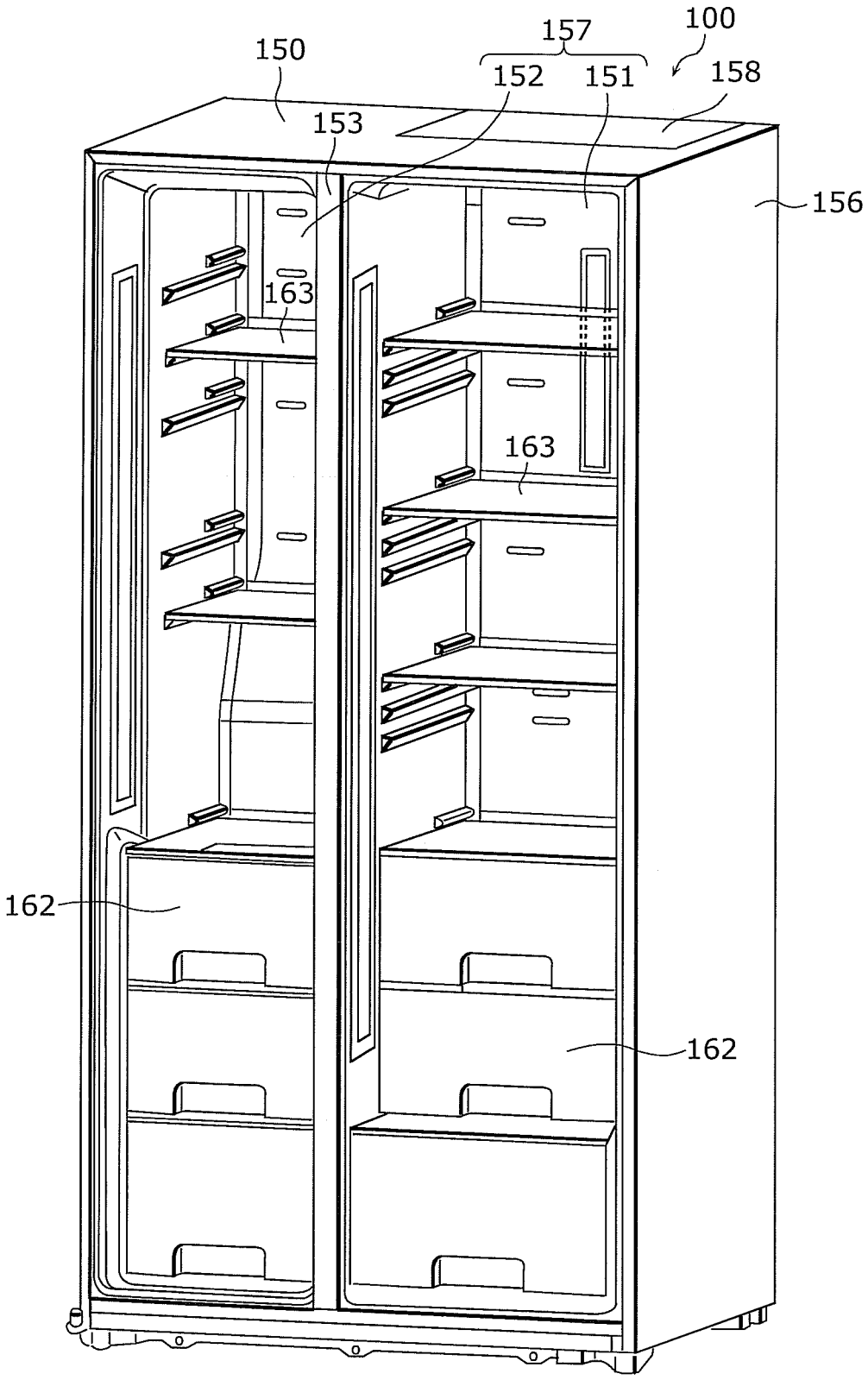


FIG. 4

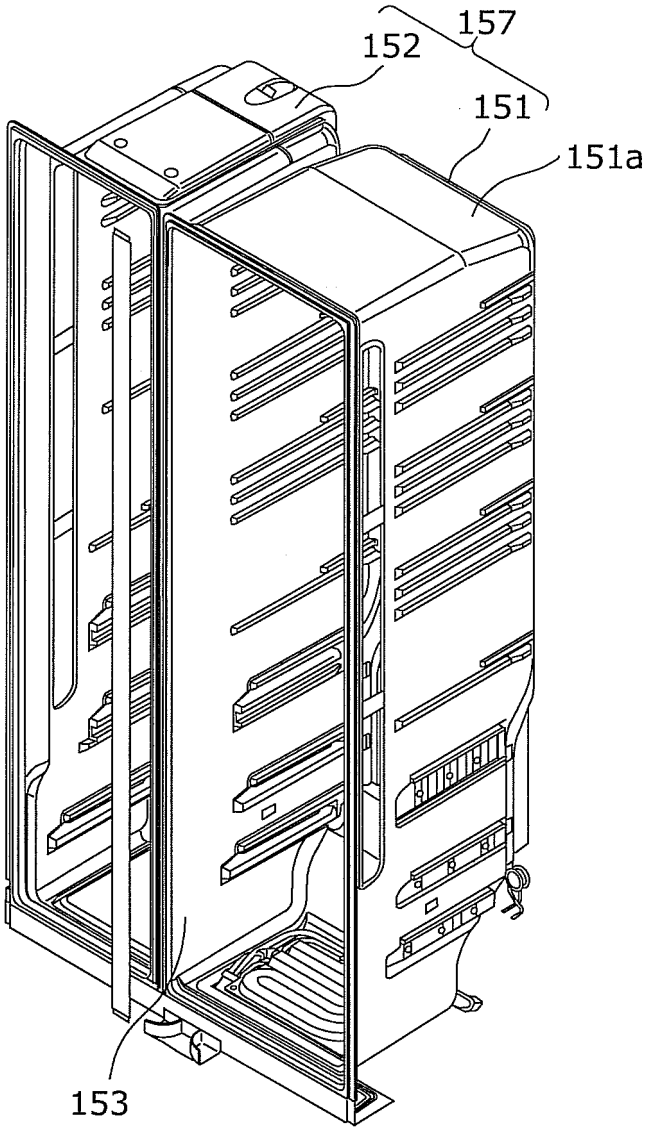


FIG. 5

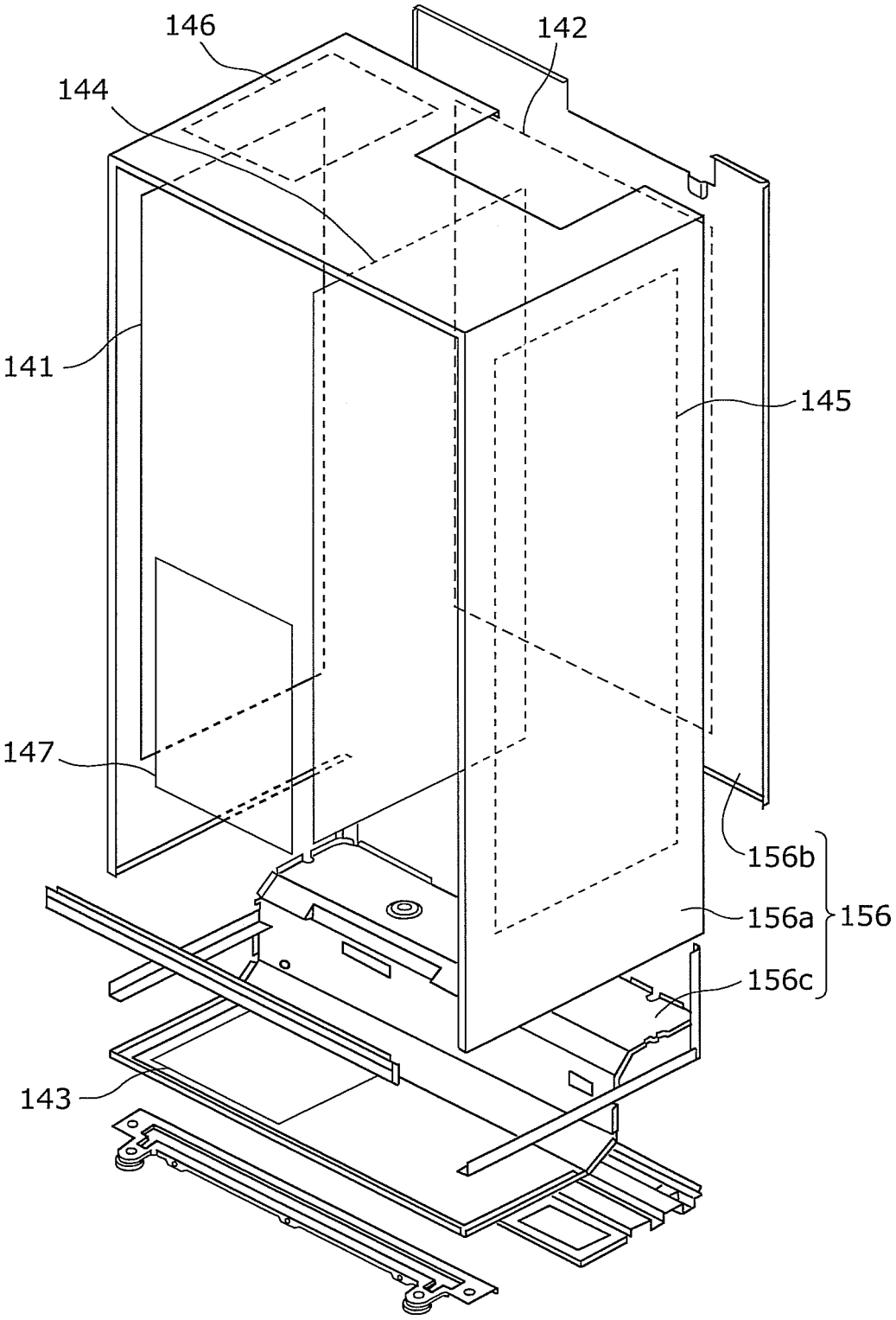


FIG. 6

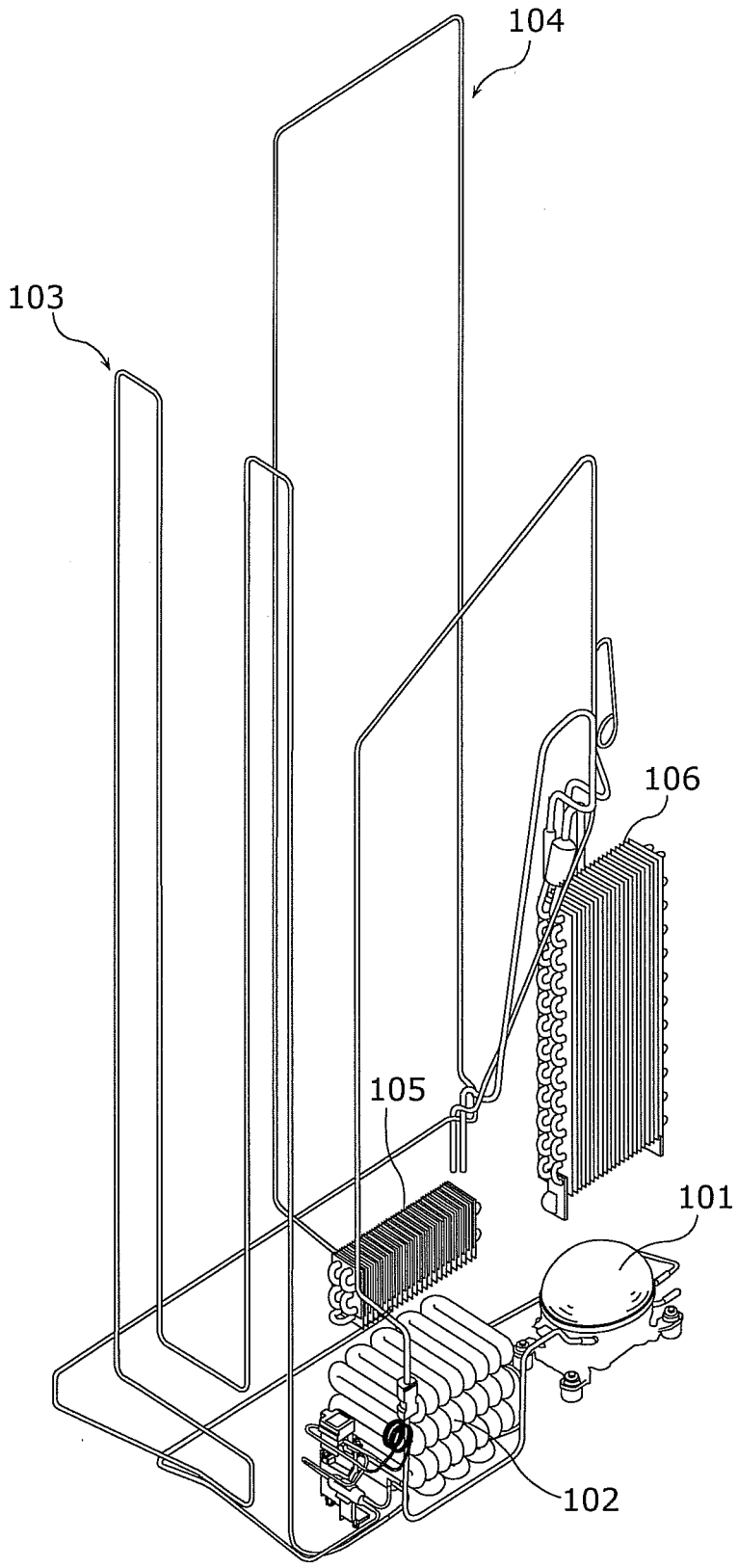


FIG. 7

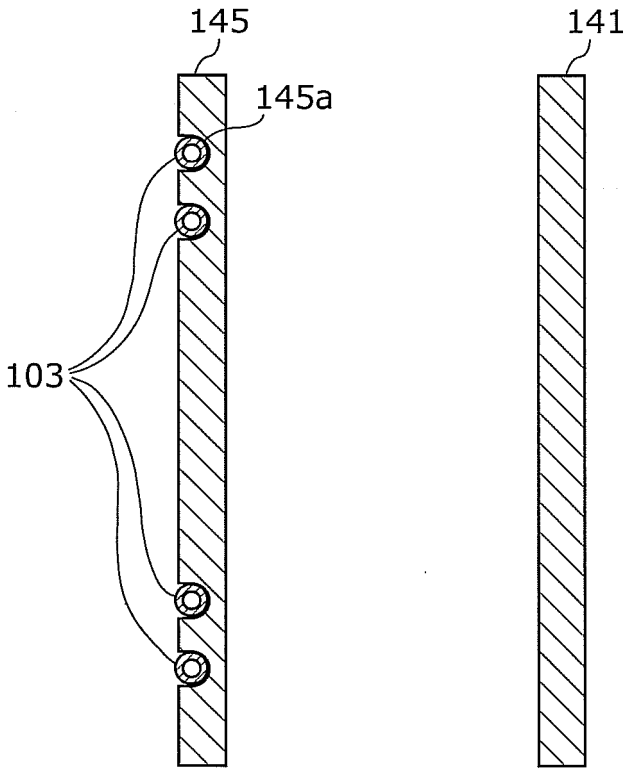


FIG. 8

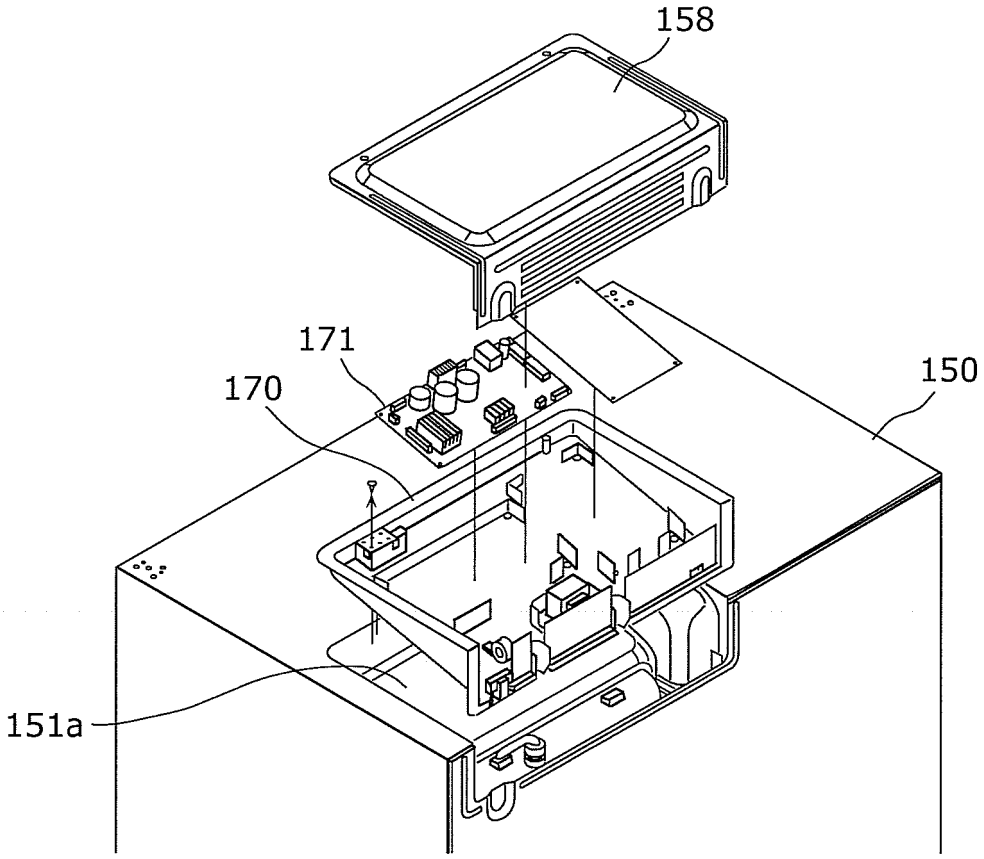
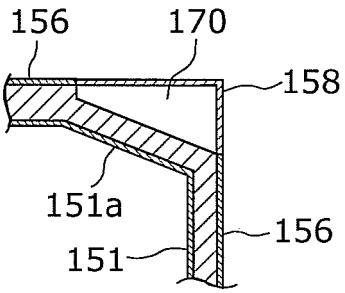


FIG. 9



REFERENCES CITED IN THE DESCRIPTION

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