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Description

Technical Field

[0001] The present invention relates to a refrigerator, in particular, to a drawing structure in a drawing type storage compartment.

Background Art

[0002] In a conventional refrigerator, a drawing type storage compartment is often arranged at a lower level of the refrigerator in terms of effective storage of a back area, convenience, and the like. The drawing type storage compartment requires the smoothness in taking in and out of a container, the easiness of taking articles of food in and out of a storage compartment, easiness of putting and taking the container on/off, and the like.

[0003] As an example, a technique of improving the convenience of a drawing type storage compartment is disclosed (for example, see Patent Literature 1).

[0004] FIG. 26A is a section view showing an internal structure of conventional refrigerator 1100 when viewed from a side, and FIG. 26B is an enlarged view of a region D in FIG. 26A.

[0005] Conventional refrigerator 1100 includes, in heat insulation main body 1101, refrigerating compartment 1102, switching compartment 1106 in which a temperature can be changed, an ice making compartment (not shown) arranged next to switching compartment 1106, vegetable compartment 1103, and freezing compartment 1104, as storage compartments.

[0006] Heat insulation main body 1101 includes outer case 1112, inner case 1110, and thermally insulating material 1111 filled between outer case 1112 and inner case 1110.

[0007] Container 1306 stored in vegetable compartment 1103 is supported with a pair of rail apparatuses 1202 connected to drawing door 1201 of vegetable compartment 1103. Container 1306 stored in freezing compartment 1104 is also supported with one pair of rail apparatuses 1202 connected to drawing door 1201 of freezing compartment 1104.

[0008] Vegetable compartment 1103 and freezing compartment 1104 are drawing type storage compartments that can be put in or drawn out from heat insulation main body 1101 with the above configurations.

[0009] A configuration of drawing door 1201 to close a front-surface opening in conventional refrigerator 1100 is described here.

[0010] FIG. 27 is a perspective view of drawing door 1201 in conventional refrigerator 1100 when viewed from a rear side.

[0011] Door frame 1305 is fitted on drawing door 1201 to project in a direction vertical to drawing door 1201. Door frame 1305 is slidably engaged with rail apparatuses 1202 including a moving rail and a fixed rail. With the above configuration, drawing door 1201 can be horizon-

tally drawn or pushed back while drawing door 1201 is vertically raised.

[0012] As another example of conventional refrigerator 1100, a technique in which both left and right ends of a bottom part of container 1306 are supported with rail apparatuses 1202 to increase an actual volume of storing space of the drawing type storage compartment is proposed (for example, see Patent Literature 2).

[0013] However, in the configuration in which the both the left and right ends of the bottom part of container 1306 are supported with rail apparatuses 1202, container 1306 is placed on rail apparatuses 1202 through door frame 1305. Thus, when a volume in container 1306 increases to increase stored articles stored in container 1306, a load on rail apparatuses 1202 also increases. For this reason, when drawing door 1201 is opened, a load on rail apparatuses 1202 or drawing door 1201 increases.

[0014] In particular, stress acting on a fitting part between the door frame 1305 and drawing door 1201 increases. When opening/closing operations of drawing door 1201 are performed for a long period of time, drawing door 1201 may be deformed.

[0015] For this reason, even though the opening of vegetable compartment 1103 or freezing compartment 1104 is closed with drawing door 1201, a gap is formed in a seal part (not shown) formed between the opening and drawing door 1201 to make it impossible to seal the opening and drawing door 1201, cold air in the storage compartment leaks, and the storage compartment may not be able to be cooled to a predetermined temperature.

[Citation List]

[Patent Literature]

[0016]

PTL 1: Unexamined Japanese Patent Publication No. 2006-177653

PTL 2: Unexamined Japanese Patent Publication No. 2009-228948 discloses a refrigerator according to the preamble of claim 1.

[Summary of Invention]

[0017] The present invention has been made in consideration of the above problem and an object thereof is to provide a refrigerator as defined in the preamble of claim 1 wherein an injury of a person can be avoided when opening and closing the door and/or when putting something inside the container and wherein the design of the door/container combination can be improved all without a reduction of the stability and the strength of the door.

[0018] The refrigerator according to the present invention is defined in claim 1. In particular, the refrigerator comprises a heat insulation main body including an inner

case, an outer case, and a thermally insulating material filled between the inner case and the outer case, and a storage compartment formed inside the heat insulation main body and having an open front surface. The refrigerator also includes: a drawing door that openably/clos-

ably closes the open front surface of the storage compartment and a rail apparatus configured to move the drawing door back and forth; and a container having step parts that are formed at both ends of a bottom part and held by the rail apparatus. Furthermore, the drawing door has side ribs respectively protruding backward on both sides of the inner surface.

[0019] With the configuration, the drawing door is suppressed from being deformed, and distortion of the drawing door can be reduced to make it possible to improve the cooling capacity.

[0020] Thus, according to the present invention, in a drawing type storage compartment, a drawing door is suppressed from being deformed while ensuring a large actual storing space, and leakage of cold air is reduced to make it possible to improve the cooling capacity. Moreover, an injury of a person can be avoided and the design is improved.

[Brief Description of Drawings]

[0021]

[FIG. 1A] FIG. 1A is a front view of a refrigerator according to a first exemplary embodiment of the present invention.

[FIG. 1B] FIG. 1B is a diagram showing a sectional structure of a heat insulation main body in a region A in FIG. 1A.

[FIG. 2] FIG. 2 is a section view of the refrigerator according to the first exemplary embodiment of the present invention along a 2 - 2 line in FIG. 1A.

[FIG. 3] FIG. 3 is a perspective view showing a configuration of a rail apparatus of the refrigerator according to the first exemplary embodiment of the present invention.

[FIG. 4] FIG. 4 is a perspective view showing a state in which a drawing door and a door frame are connected to each other in the first exemplary embodiment of the present invention.

[FIG. 5] FIG. 5 is a perspective view of a door frame in the first exemplary embodiment of the present invention.

[FIG. 6] FIG. 6 is a section view showing a structure of a fitting part between an inner case and a rail apparatus in a freezing compartment of the refrigerator according to the first exemplary embodiment of the present invention when viewed from the front when viewed from the front.

[FIG. 7] FIG. 7 is a section view showing a structure of a fitting part between an inner case in a vegetable compartment and the rail apparatus in the refrigerator according to the first exemplary embodiment of

the present invention when viewed from the front.

[FIG. 8] FIG. 8 is a back view showing an outline state in which a container is arranged between the rail apparatuses in the refrigerator according to the first exemplary embodiment of the present invention.

[FIG. 9A] FIG. 9A is a diagram schematically showing arrangements of the rail apparatus and the container in the refrigerator according to the first exemplary embodiment of the present invention.

[fig.9B]FIG. 9B is a diagram schematically showing arrangements of the rail apparatus and the container in the refrigerator according to the first exemplary embodiment of the present invention.

[fig.9C]FIG. 9C is a diagram schematically showing arrangements of the rail apparatus and the container in the refrigerator according to the first exemplary embodiment of the present invention.

[fig. 10]FIG. 10 is a perspective view of a container in the refrigerator according to the first exemplary embodiment of the present invention.

[fig. 11]FIG. 11 is a main-part side view of a state in which the drawing door of the refrigerator is drawn to a front-most position in the first exemplary embodiment.

[fig. 12A]FIG. 12A is a main-part side view showing a state in which the drawing door is drawn in the refrigerator according to the second exemplary embodiment of the present invention.

[fig. 12B]FIG. 12B is a main-part side view showing a state in which the drawing door is closed in the refrigerator according to the second exemplary embodiment of the present invention.

[fig.13]FIG. 13 is a diagram showing a sectional structure of a vegetable compartment in the refrigerator according to the second embodiment of the present invention.

[fig. 14]FIG. 14 is a section view showing a structure of a fitting part between an inner case and a rail apparatus in a freezing compartment of a refrigerator according to a third exemplary embodiment of the present invention when viewed from the front.

[fig. 15]FIG. 15 is a section view showing another example of the structure of the fitting part between the inner case and the rail apparatus in the freezing compartment of the refrigerator according to the third exemplary embodiment of the present invention when viewed from the front.

[fig. 16]FIG. 16 is a section view showing an example of a structure of a fitting part between an inner case and a rail apparatus in a vegetable compartment of the refrigerator according to the third exemplary embodiment of the present invention when viewed from the front.

[fig. 17]FIG. 17 is a section view showing an example of a structure of a fitting part between an inner case and a rail apparatus in a vegetable compartment of the refrigerator according to the third exemplary em-

bodiment of the present invention when viewed from the front.

[fig. 18]FIG. 18 is a section view showing another example of the structure of the fitting part between the inner case and the rail apparatus in the vegetable compartment of the refrigerator according to the third exemplary embodiment of the present invention when viewed from the front.

[fig. 19]FIG. 19 is a section view showing another example of the structure of the fitting part between the inner case and the rail apparatus in the vegetable compartment of the refrigerator according to the third exemplary embodiment of the present invention when viewed from the front.

[fig. 20]FIG. 20 is a perspective view showing a configuration of a rail apparatus of a refrigerator according to a fourth exemplary embodiment of the present invention.

[fig. 21]FIG. 21 is a perspective view showing a state in which a drawing door and a door frame are connected to each other in the fourth exemplary embodiment of the present invention.

[fig. 22]FIG. 22 is a side view for explaining a method of fitting a rail apparatus in the fourth exemplary embodiment of the present invention.

[fig. 23]FIG. 23 is a side view for explaining a state in which a rail apparatus is fitted on a heat insulation main body in the fourth exemplary embodiment of the present invention.

[fig. 24]FIG. 24 is a section view showing a fitting part between a partition wall and a rail apparatus in a freezing compartment of the refrigerator according to the fourth exemplary embodiment of the present invention.

[fig. 25]FIG. 25 is a section view showing a fitting part between an inner case and a rail apparatus in a vegetable compartment of the refrigerator according to the fourth exemplary embodiment of the present invention.

[fig. 26A]FIG. 26A is a section view showing an internal structure of a conventional refrigerator when viewed from a side.

[fig. 26B]FIG. 26B is an enlarged view of a region D in FIG. 26A.

[fig. 27]FIG. 27 is a perspective view of drawing door in a conventional refrigerator when viewed from a rear side.

Description of Embodiments

[0022] Embodiments of the present invention will be described below with reference to the accompanying drawings. The present invention is not limited to the embodiments.

(First Exemplary Embodiment)

[0023] Refrigerator 100 in a first exemplary embodi-

ment of the present invention will be described.

[0024] FIG. 1A is a front view of refrigerator 100 in the first exemplary embodiment of the present invention, and FIG. 1B is a diagram showing a sectional structure of heat insulation main body 101 in a region A in FIG. 1A.

[0025] As shown in FIG. 1A, refrigerator 100 according to the present embodiment includes one pair of thermally insulating double doors 107 arranged on an upper part thereof. Refrigerator 100 includes a plurality of partitioned storage compartments in heat insulation main body 101 having an interior thermally insulated from the outside.

[0026] The plurality of partitioned storage compartments are named, depending on functions (cooling temperatures) thereof, as refrigerating compartment 102, ice making compartment 105, switching compartment 106 the temperature of which can be changed, vegetable compartment 103, and freezing compartment 104, the names being used to discriminate the storage compartments from each other.

[0027] On a front opening of refrigerating compartment 102 located on an uppermost part of refrigerator 100, pivoted thermally insulating door 107 that is filled with a foaming and heat insulating material such as urethane by foaming is arranged. In refrigerating compartment 102, a shelf-like storing space is formed.

[0028] Under refrigerating compartment 102, ice making compartment 105, switching compartment 106, vegetable compartment 103, and freezing compartment 104 are arranged. Each of the storage compartments is a drawing type storing space.

[0029] As shown in FIGS. 1A and 1B, heat insulation main body 101 is formed by filling thermally insulating material 111 such as rigid urethane foam between metal outer case 112 and resin inner case 110. Heat insulation main body 101 is a rectangular box body having an opening in at least one surface thereof. Heat insulation main body 101 has a function of shielding heat flowing from the external atmosphere (atmospheric air) into heat insulation main body 101.

[0030] Refrigerating compartment 102 is a storage compartment a temperature of which is maintained at a low temperature at which stored articles are not frozen to refrigerate the stored articles. A lower limit of a concrete temperature is generally set to 1 to 5 degrees Celsius.

[0031] Vegetable compartment 103 is a storage compartment that is arranged in a lowermost part of heat insulation main body 101 to mainly refrigerate vegetables. Vegetable compartment 103 is set at a temperature equal to or slightly higher than that of refrigerating compartment 102. A lower limit of a concrete temperature is generally set to 2 degrees Celsius to 7 degrees Celsius. As the set temperature of vegetable compartment 103 is decreased, the freshness of leaf vegetables can be maintained for a long period of time.

[0032] Freezing compartment 104 is a storage compartment that is set in a freezing temperature range. Set

temperature of freezing compartment 104 is generally set to -22 to -18 degrees Celsius to freeze and preserve articles. However, in order to improve a freezing and preserving state, for example, the set temperature may be set to a low temperature of -30 degrees Celsius, -25 degrees Celsius, or the like.

[0033] Ice making compartment 105 is a storage compartment that has an ice making machine (not shown) arranged therein, makes ice with the ice making machine, and preserves the ice. The set temperature is almost equal to that of freezing compartment 104.

[0034] Switching compartment 106 can switch set temperatures from a refrigerating temperature range to a freezing temperature range depending on applications with a console panel fitted on refrigerator 100.

[0035] FIG. 2 is a section view of refrigerator 100 according to the first exemplary embodiment of the present invention along a 2-2 line in FIG. 1A.

[0036] As shown in FIG. 2, in order to partition storage compartments having different temperature ranges, partition walls 108 are installed between the storage compartments. Of the storage compartments arranged in refrigerator 100, on a drawing type storage compartment (in the example in FIG. 2, freezing compartment 104 and vegetable compartment 103), drawing door 201 that closes the front opening and rail apparatus 202 are arranged. Rail apparatus 202 has a function of elastically connecting drawing door 201 to heat insulation main body 101 and a function of enabling container 206 arranged in the storage compartment to move back and forth.

[0037] Drawing door 201 is a plate-like member that can openably/closably close the opening of the storage compartment and has heat resistance. Packing 207 is fitted on a rim on a rear side (inner surface) of drawing door 201. Packing 207 tightly adheres to a surface of an opening of heat insulation main body 101 or the like while drawing door 201 closes the opening of the storage compartment to prevent cold air from leaking out of the storage compartment. As shown in FIG. 1A, handhold 201a on which a user puts her/his hand when the storage compartment is drawn out is arranged on an upper part on the front surface of drawing door 201.

[0038] As shown in FIG. 2, door frame 205 serving as a door support member is fitted on drawing door 201 to protrude in a direction substantially perpendicular to drawing door 201. Door frame 205 is fitted on rail apparatus 202. Although will be described later, door frame 205 holds both ends of the bottom part of container 206. More specifically, container 206 is fitted on rail apparatus 202 through door frame 205 fitted on rail apparatus 202.

[0039] FIG. 3 is a perspective view showing a configuration of rail apparatus 202 of refrigerator 100 according to the first exemplary embodiment of the present invention.

[0040] As shown in FIG. 3, rail apparatus 202 has three rails stacked in three levels. A second rail (middle rail 221) can be moved in a longitudinal direction of a first rail (cabinet rail 222). A third rail (top rail 203) is designed

to be able to be moved in a longitudinal direction of the second rail (middle rail 221). In this manner, rail apparatus 202 is configured to be able to expand and contract in a fore and aft direction as a whole.

[0041] Cabinet rail 222 is a "fixed rail" fixed on a side surface or a bottom surface of inner case 110, and top rail 203 and middle rail 221 are "moving rails" that are arranged to be able to move with respect to cabinet rail 222 serving as the fixed rail.

[0042] Planar rail fitting part 223 protruding in a direction substantially perpendicular to the longitudinal direction of cabinet rail 222 is integrally formed on cabinet rail 222.

[0043] On an upper surface of top rail 203, hook-shaped part 231 and fixing hole 232 that are used in fixation to door frame 205 are formed. Hook-shaped part 231 is a protrusion part and is formed at the rear of the center of top rail 203 in the longitudinal direction.

[0044] Hook-shaped part 231 is formed by notching a part of the upper surface of top rail 203 in a substantially laterally-U-shaped form and raising the notch. Hook-shaped part 231 has vertical part 231a and horizontal part 231b. Vertical part 231a is formed to rise up in a direction substantially vertical to the upper surface of top rail 203. Horizontal part 231b is arranged at a distal end of vertical part 231a, and is formed to be substantially horizontally bent forward with respect to the upper surface of top rail 203. A length of horizontal part 231b is configured to be larger than the height of vertical part 231a.

[0045] Fixing hole 232 is a screw hole formed at a position corresponding to a round hole formed in door frame 205. Fixing hole 232 is desirably formed at a position where a distance required to ensure the strength of fixing hole 232 from a front end of top rail 203 is ensured.

[0046] Configuration of drawing door 201 and door frame 205 will be described below.

[0047] FIG. 4 is a perspective view showing a state in which drawing door 201 and door frame 205 are connected to each other in the first exemplary embodiment of the present invention.

[0048] Door frame 205 is fixed on inside plate 211 that almost entirely covers a rear-side surface (inner surface) of drawing door 201. Inside plate 211 is one of members configuring drawing door 201, and is a plate-like member formed by vacuum molding.

[0049] Inside plate 211 is mainly molded with a resin. For this reason, even though door frame 205 is directly fixed to inside plate 211, door frame 205 cannot ensure strength that can withstand a load applied to door frame 205. Thus, as a means for reliably fixing door frame 205 to inside plate 211, door frame 205 is fixed to a reinforcing plate (not shown) buried in a thermal insulating material in drawing door 201 with a screw or the like through inside plate 211.

[0050] The reinforcing plate extends in a vertical direction of inside plate 211, and is mainly made of a metal material such as iron. Two reinforcing plates are inde-

pendently formed in correspondence with left and right door frames 205, respectively.

[0051] Inside plate 211 has, outside the fitting part to door frame 205, side rib 302 protruding from the inner surface to the back side.

[0052] In this manner, drawing door 201 is suppressed from being deformed, and a gap can be suppressed from being formed in the seal part between the opening and drawing door 201. For this reason, the cooling capacity of refrigerator 100 can be improved.

[0053] Side rib 302 is formed such that a height of a part under a center of side rib 302 in the longitudinal direction (vertical direction) is constant.

[0054] In this manner, rigidity of drawing door 201 can be improved without interfering with the fitting part between drawing door 201 and door frame 205. When drawing door 201 is drawn, an amount of cold air flowing from a lower side surface of drawing door 201 to the outside of the storage compartment can be reduced, and the cooling capacity of refrigerator 100 can also be improved.

[0055] Furthermore, a height of a part under the center of side rib 302 in the longitudinal direction is desirably equal to or larger than a width (length in a front-back direction) of enlarged part 281 of door frame 205 fixed to drawing door 201.

[0056] Furthermore, a width (horizontal direction) of a part under the center of side rib 302 in the longitudinal direction is desirably formed to be constant. A lower end of side ribs 302 arranged on both the sides are connected with lower ribs 303. Lower rib 303 is arranged to protrude to the lower side of the fitting part between inside plate 211 and door frame 205 and to the rear side of the inner surface. The height of lower rib 303 is set to be substantially equal to the height of the lower end of side rib 302.

[0057] Internal plate 211 includes container fixing part 301. Container fixing part 301 is a metal member and is fixed to the reinforcing plate with a screw or the like through inside plate 211. Container fixing part 301 has a gap formed between the upper part thereof and inside plate 211. Container 206 is partially inserted into the gap to make it possible to fix container 206.

[0058] Side rib 302 has a height equal to or higher than a height of a gap formed between the inner surface of drawing door 201 and an upper end of container 206.

[0059] When drawing door 201 is drawn, an amount of cold air flowing from a gap formed between the inner surface of drawing door 201 and a front surface of container 206 to the outside of the storage compartment can be reduced, and the cooling capacity of refrigerator 100 can also be improved.

[0060] In this case, a configuration of door frame 205 will be described in more detail.

[0061] FIG. 5 is a perspective view of door frame 205 in the first exemplary embodiment of the present invention.

[0062] Door frame 205 includes upper surface part 282 that covers an upper surface of top rail 203 and side surface part 283 that covers a side surface of top rail 203

on the outside of the refrigerator. Entire lengths (lengths in longitudinal directions) of upper surface part 282 and side surface part 283 are desirably larger than the entire length of top rail 203.

[0063] An end part of upper surface part 282 on the inside of the refrigerator is cut and raised at substantially right angles to form main body part 284 that is substantially parallel to side surface part 283. At the front end part of main body part 284, enlarged part 281 protruding upward from main body part 284 is arranged. At a front end of enlarged part 281, bent part 241 having an end part that is bent along inside plate 211 of drawing door 201 is formed. Bent part 241 is fitted on drawing door 201 such that an upper end of bent part 241 is located under a center of drawing door 201 in the vertical direction. Bent part 241 is fitted to a position of drawing door 201 above the proximal end part of top rail 203.

[0064] In this manner, enlarged part 281 is formed between bent part 241 and door frame 205 to make it possible to increase a size of a fixing part between door frame 205 and drawing door 201 in the vertical direction. In this manner, the lack of strength of the fitting part between rail apparatus 202 fitted on the lower part of drawing door 201 and drawing door 201 can be compensated for. More specifically, in particular, stress generated when a user pushes in or draws out drawing door 201 while holding drawing door 201, especially the upper end part of drawing door 201 with her/his hand can be suppressed from being concentrated on the front end part of door frame 205.

[0065] On an upper end of main body part 284 of door frame 205, flange part 285 formed to be bent in a direction substantially horizontal to upper surface part 282 is formed. At at least one of the front and rear of flange part 285, flange part 285 is partially notched to form flange notch part 285a. Container 206 is partially inserted into flange notch part 285a to make it possible to fix container 206.

[0066] In upper surface part 282, square hole 286 and round hole 287 are formed to fix top rail 203. Square hole 286 is a locking part and is formed behind the center of door frame 205 in the longitudinal direction. In particular, square hole 286 is desirably formed behind the center of main body part 284 in the longitudinal direction. Square hole 286 has a size that is enough to fit hook-shaped part 231 arranged on top rail 203 and serving as a protrusion part therein.

[0067] Round hole 287 is a hole formed at a position corresponding to fixing hole 232 formed in top rail 203. Round hole 287 is desirably formed at a position where a distance required to ensure the strength of round hole 287 from the front end of upper surface part 282 is ensured.

[0068] In main body part 284 located at a position corresponding to square hole 286, main body notch part 288 is formed. Main body notch part 288 is formed such that a part of main body part 284 is substantially notched in a laterally-U-shaped form and the notch is raised to be

bent to the outside of the refrigerator in a direction substantially vertical to main body part 284. For this reason, main body hole part 289 is formed at a position where main body notch part 288 of main body part 284 is formed.

[0069] Fixation between door frame 205 (see FIG. 5) and top rail 203 (see FIG. 3) is described here. Hook-shaped part 231 formed on top rail 203 is hooked on square hole 286 of door frame 205. More specifically, horizontal part 231b and vertical part 231a of hook-shaped part 231 are penetrated upward from square hole 286 to upper surface part 282 of door frame 205. Door frame 205 is relatively moved to the rear of top rail 203 to move horizontal part 231b of hook-shaped part 231 onto the upper surface of the front end part of square hole 286. A screw is screwed in fixing hole 232 formed in top rail 203 from above upper surface part 282 of door frame 205 through round hole 287 of door frame 205.

[0070] In this manner, door frame 205 and top rail 203 are reliably fixed to each other at two positions corresponding to a first fixing part fixed by hook-shaped part 231 and square hole 286 and a second fixing part fixed by fixing hole 232, round hole 287, and the screw. When at least one of the fixing parts uses a system in which hooking is performed by using a protrusion part and a locking part, door frame 205 can be easily fitted on or removed from top rail 203. In terms of resistance against upward force acting on the second fixing part, the second fixing part desirably also employs the hooking system.

[0071] As explained above, in the embodiment, rail apparatus 202 includes a protrusion part, and rail apparatus 202 is fixed to heat insulation main body 101 by the protrusion part and the locking part arranged at the bottom surface of the storage compartment.

[0072] In this manner, when rail apparatus 202 having a state in which a fixed rail and a moving rail are incorporated in advance, a clearance between the fixed rail and the moving rail can be reduced. As a result, a high-quality stable drawing configuration can be obtained.

[0073] As explained above, in the embodiment, in rail apparatus 202 having a state in which the moving rail and the fixed rail are incorporated in advance, rail apparatus 202 is fixed to heat insulation main body 101 with a protrusion part and a locking part. In this manner, since rail apparatus 202 as well as drawing door 201 can be easily fitted and removed, rail apparatus 202 can be improved in property of fitting and property of removing.

[0074] In the embodiment, main body notch part 288 is formed to cover square hole 286 and horizontal part 231b of hook-shaped part 231 protruding from the upper surface of upper surface part 282. In this manner, a hand or a finger can be prevented with a simple configuration from being injured by square hole 286 or hook-shaped part 231 to make it possible to improved safety. Since the first fixing part cannot be easily seen, visual design can be improved.

[0075] In refrigerator 100, fitting between inner case 110 and rail apparatus 202 will be described next with reference to freezing compartment 104 of drawing type

storage compartments.

[0076] FIG. 6 is a section view showing a structure of a fitting part between inner case 110 and rail apparatus 202 in freezing compartment 104 of refrigerator 100 according to the first exemplary embodiment when viewed from the front.

[0077] Rail apparatus 202 will be described in more detail first.

[0078] A sectional shape perpendicular to the longitudinal direction of cabinet rail 222 is not horizontally symmetrical and has a higher side surface that is fixed to an inner side surface of inner case 110 as rail fitting part 223.

[0079] Middle rail 221 has a shape having a substantially I-shaped section, more specifically, a shape in which horizontally protruding flanges are continuously formed on the upside and the downside in the longitudinal direction. Of the upper and lower flanges, the flange under middle rail 221 is held with cabinet rail 222 such that the flange can be moved in the longitudinal direction.

[0080] Top rail 203 has a substantially laterally-U-shaped section and holds the upper flange of middle rail 221 such that the flange can be moved in the longitudinal direction.

[0081] Cabinet rail 222 and top rail 203 hold a plurality of rotary support members 145 with rotary support member holding parts 146, respectively. Cabinet rail 222 and top rail 203 hold middle rail 221 with rotary support members 145 such that middle rail 221 can be moved. As rotary support members 145, for example, a bearing can be used.

[0082] More specifically, of the upper and lower flanges of middle rail 221, a part centered around the lower flange is held at three points with the plurality of rotary support members 145 of cabinet rail 222.

[0083] A part centered around the upper flange of middle rail 221 is held at three points with the plurality of rotary support members 145 of top rail 203.

[0084] With the above configuration, middle rail 221 can move on cabinet rail 222 in the longitudinal direction thereof. Furthermore, top rail 203 can move on middle rail 221 in the longitudinal direction thereof. That is, top rail 203 can move on cabinet rail 222 in the longitudinal direction thereof through middle rail 221.

[0085] Middle rail 221 and top rail 203 can smoothly move with rotation of the plurality of rotary support members 145.

[0086] Top rail 203, middle rail 221, cabinet rail 222, and rotary support members 145 are fitted on inner case 110 while being built in advance.

[0087] Fitting of rail apparatus 202 to inner case 110 will be described below.

[0088] As shown in FIG. 6, rail fitting part 223 integrally formed on cabinet rail 222 is arranged to have a surface that is brought into contact with a side-surface part of inner case 110, and fixed to a side part of inner case 110 with screw 400.

[0089] At this time, since inner case 110 serving as a fitting surface is mainly shaped with a resin, even though

screw 400 is directly fixed to inner case 110, inner case 110 is difficult to ensure strength that can withstand a load applied on rail apparatus 202.

[0090] Thus, in order to reliably fix rail apparatus 202, rail fitting part 223 is fitted on rail holding member 270 buried in thermally insulating material 111 through inner case 110.

[0091] Rail holding member 270 is made of a metal material such as iron. Rail holding member 270 is fixed to a predetermined position of an inner surface of inner case 110 in advance. Thereafter, a foaming and heat insulating material is filled between inner case 110 and outer case 112 to bury them. In this manner, holding power of rail holding member 270 to the load applied on rail apparatus 202 can be more improved.

[0092] Rail holding member 270 is integrally formed by rail holding part 270a fixed to rail fitting part 223 with screw 400 and reinforcing part 270b that prevents rail apparatus 202 from internally falling. Reinforcing part 270b is a lateral flange part that is formed on a lower part of rail holding part 270a. Rail holding part 270a is a vertical flange part that is formed to be in tight contact with inner case 110 from the thermally insulating material 111 side.

[0093] More specifically, reinforcing part 270b is formed such that reinforcing part 270b is separated from inner case 110 from the lower part of rail holding part 270a and bent toward outer case 112. Furthermore, a distal end part of reinforcing part 270b is formed to be bent downward. Thermally insulating material 111 is filled, the lateral flange part of reinforcing part 270b has a plane that receives thermally insulating material 111 and cuts into thermally insulating material 111. In this manner, the strength of rail holding member 270 can be further ensured. Thus, rail fitting part 223 can be prevented from falling on an inner side of the refrigerator in freezing compartment 104, i.e., rail apparatus 202 can be prevented from falling on the inner side of the refrigerator. Thus, drawing door 201 can be smoothly opened or closed.

[0094] Reinforcing part 270b serving as a lateral flange part may be bent from an upper part of rail holding part 270a and integrally formed, and reinforcing parts 270b may be formed on both the upper and lower parts, respectively. When reinforcing parts 270b are respectively formed on the upper and lower parts, the lateral flange parts formed on the upper and lower parts of rail holding part 270a have planes that receive thermally insulating material 111 and cut into thermally insulating material 111. In this manner, the strength of rail holding member 270 can be further ensured.

[0095] Bottom-surface step parts 108a are formed on both sides of partition wall 108 serving as a bottom-surface wall of freezing compartment 104. Bottom-surface step part 108a is formed in a direction of depth to have a level one-step higher than that of a central part serving as a reference surface of partition wall 108. Rail apparatus 202 is arranged on bottom-surface step part 108a.

[0096] Side-surface step part 110a is formed on a side wall-surface part of inner case 110 to which rail apparatus 202 is fixed. Side-surface step part 110a is formed to be recessed on outer case 112 side from an upper-side wall-surface part in freezing compartment 104 and has a small wall thickness.

[0097] Rail apparatus 202 is mounted on bottom-surface step part 108a and fixed to side-surface step part 110a with a screw. In this manner, rail apparatus 202 can be suppressed from protruding into a storing space, and an entire width of container 206 in freezing compartment 104 can be increased. For this reason, an invalid space can be reduced.

[0098] Since rail apparatus 202 is assembled with being mounted on bottom-surface step part 108a, workability can be improved. Furthermore, since the wall thickness of thermally insulating material 111 under partition wall 108 is large, even though metal rail apparatus 202 in freezing compartment 104 is cooled, a part of bottom-surface step part 108a can prevent dew concentration on partition wall 108 serving as a top surface of vegetable compartment 103 under bottom-surface step part 108a.

[0099] In refrigerator 100, fitting between inner case 110 and rail apparatus 202 will be described next with reference to vegetable compartment 103 of drawing type storage compartments.

[0100] FIG. 7 is a section view showing a structure of a fitting part between inner case 110 in vegetable compartment 103 and rail apparatus 202 in refrigerator 100 according to the first exemplary embodiment of the present invention when viewed from the front.

[0101] Even in vegetable compartment 103 formed in the lowermost part of refrigerator 100, rail holding member 280 is arranged in thermally insulating material 111. Rail holding member 280 includes rail holding part 280a and reinforcing part 280b.

[0102] Rail holding part 280a is substantially L-shaped, includes a vertical flange part and a lateral flange part, and is in tight contact with the side-surface part and a bottom-surface part of inner case 110. Reinforcing part 280b is integrated with the lateral flange part serving as the bottom-surface part of rail holding part 280a, and is formed as a lower flange part that faces downward in a direction away from inner case 110.

[0103] In this manner, reinforcing part 280b is buried in thermally insulating material 111 as the lower flange part that faces downward. Thus, even though a moment in a direction of falling on the inside of the refrigerator in vegetable compartment 103 acts on rail fitting part 223, the movement of reinforcing part 280b serving as the lower flange part is blocked with thermally insulating material 111 filled in the lower part of reinforcing part 280b. In this manner, rail holding member 280 can be prevented from falling down, and the strength of rail holding member 280 can be ensured. For this reason, rail apparatus 202 of vegetable compartment 103 can be prevented from falling on the inside of the refrigerator.

[0104] Bottom-surface step parts 401a are formed on

both side parts of bottom-surface wall 401 of vegetable compartment 103. Bottom-surface step part 401a is formed in a direction of depth to have a level one-step higher than that of a central part serving as a reference surface of bottom-surface wall 401. Rail apparatus 202 is arranged on bottom-surface step part 401a.

[0105] Side-surface step part 110a is formed on the side wall-surface part of inner case 110 to which rail apparatus 202 is fixed. Side-surface step part 110a is formed to be recessed on outer case 112 side from an upper-side wall-surface part in vegetable compartment 103 and has a small wall thickness.

[0106] A side surface of rail fitting part 223 is fixed to metal rail holding member 280 with screw 400 through side-surface step part 110a therebetween.

[0107] In this manner, since rail apparatus 202 is mounted on bottom-surface step part 401a and fixed to side-surface step part 110a with the screw, rail apparatus 202 can be suppressed from protruding into the storing space. Thus, the entire width of container 206 in vegetable compartment 103 can be increased, and an invalid space can be reduced.

[0108] Since rail apparatus 202 is assembled with being mounted on bottom-surface step part 401a, workability can be improved. Furthermore, apart of bottom-surface step part 401a can ensure heat resistance because the wall thickness of thermally insulating material 111 under bottom-surface wall 401 increases.

[0109] Drawing door 201 of bottom vegetable compartment 103 is on the lower side of drawing door 201 of upper freezing compartment 104. For this reason, when a user draws drawing door 201, drawing door 201 of vegetable compartment 103 located on the bottom of the refrigerator is located at a position on which her/his weight is easily put. Thus, in addition to a load of a content of stored articles, an external load may be applied to drawing door 201 of vegetable compartment 103. However, since rail holding member 280 may be integrally formed by substantially L-shaped rail holding part 280a and reinforcing part 280b serving as the lower flange part, rail apparatus 202 of bottom drawing door 201 can be prevented from falling down to make it possible to impart a rigid configuration to drawing door 201.

[0110] In each of freezing compartment 104 and vegetable compartment 103, side-surface step part 110a is arranged to decrease the wall thickness of the side surface. As a countermeasure against this, a vacuum thermally insulating material (not shown) can be arranged at a position corresponding to a part where rail apparatus 202 is installed. More specifically, in each of freezing compartment 104 and vegetable compartment 103, a vacuum thermally insulating material having a height larger than a distance between rail apparatuses 202 is stuck to outer case 112 to make it possible to ensure heat resistance.

[0111] A positional relationship between container 206 and rail apparatus 202 will be described below in more detail.

[0112] FIG. 8 is a back view showing an outline state in which container 206 is arranged between rail apparatuses 202 in refrigerator 100 according to the first exemplary embodiment of the present invention.

[0113] Container 206 is a container to store vegetables, beverage filled in plastic bottles, articles of frozen food, or the like, and is a resin box body having an opening on the upper side. Container 206 has narrow part 261 having a width narrower than the upper part such that step parts 262 are formed on both the end parts of the lower part to face inward. Container 206 has narrow part 261 arranged between one pair of rail apparatuses 202, and step parts 262 are arranged on an upper surface of door frame 205 so as to be supported with rail apparatuses 202 through door frame 205.

[0114] In this manner, since top rails 203 of rail apparatuses 202 are arranged on both the lower-end parts of drawing door 201, narrow part 261 can be widened as much as possible in container 206. Thus, container 206 can employ a shape in which a volume of storing space can be increased as much as possible.

[0115] FIGS. 9A to 9C are diagrams schematically showing arrangements of rail apparatus 202 and container 206 in refrigerator 100 according to the first exemplary embodiment of the present invention. FIGS. 9A to 9C show one end part of container 206 in close up. FIGS. 9A to 9C show a positional relationship between rail apparatus 202 and container 206, and door frame 205 is omitted and not shown.

[0116] In the example in FIG. 8 described above, as shown in FIG. 9A, container 206 has narrow part 261 having a small width to form step parts 262 on both the end parts of the lower part to face inward. However, the present invention is not limited to the example. For example, the side surface of container 206 may have an almost straight shape that does not have step parts 262, and rail apparatus 202 may be configured to support the sides of both the left and right ends of the bottom part of container 206 (see FIG. 9B). Rail apparatus 202 may also be configured to support the lower sides of both the left and right ends of the bottom part of container 206 (see FIG. 9C).

[0117] Container 206 will be described below in detail.

[0118] FIG. 10 is a perspective view of container 206 in refrigerator 100 according to the first exemplary embodiment of the present invention.

[0119] Container 206 includes a flange part that is formed around the opening to protrude externally. More specifically, front-surface flange part 206a is formed on the upper-end part of the front surface, side-surface flange part 206b is formed on the upper-end part of both the side surfaces, and back-side flange part 206c is formed on the upper-end part of the back surface. Front-surface flange part 206a, side-surface flange part 206b, and back-side flange part 206c are continuously formed. The flange parts are formed so as to fold the side walls on the front surface, the side surface, and the back surface, respectively, and desirably have hollow insides in

terms of weight saving. The flange parts are formed to make it possible to increase the strength of the opening of container 206.

[0120] On step parts 262 formed on lower parts of both the side surfaces of container 206, protrusion part 206d integrated with container 206 and protruding downward is formed on at least one of the front and rear sides. Each of protrusion parts 206d is inserted into notch-shaped flange notch part 285a formed in door frame 205.

[0121] Front-surface flange part 206a of container 206 is fixed to container fixing part 301 of drawing door 201, and protrusion part 206d is fixed to flange notch part 285a of door frame 205. In this manner, the lack of strength of the fitting part between rail apparatus 202 fitted on the lower part of drawing door 201 and drawing door 201 is compensated for to make it possible to smoothly open/close drawing door 201.

[0122] More specifically, a position that is a fulcrum of tensile strength is behind drawing door 201 to make it possible to decrease a moment acting on the fitting part. In this manner, the fitting part of top rail 203, rail fitting part 223, and the like can be prevented from being damaged.

[0123] On the bottom part of container 206, bottom-surface rib 206e that protrudes inward from the bottom part is formed. Bottom-surface rib 206e is formed on the front side of the center of container 206 in the direction of depth, i.e., on drawing door 201 side when container 206 is fitted in vegetable compartment 103, freezing compartment 104, or the like. Bottom-surface rib 206e is lengthwise formed in a direction of width (horizontal direction) over both the side surfaces of container 206.

[0124] Container 206 is partitioned with bottom-surface rib 206e into two regions, i.e., first storing part 263 arranged on the front side and second storing part 264 arranged on the rear side. The depth of first storing part 263 is configured to have a depth larger than that of second storing part 264.

[0125] As described above, in the embodiment, rail apparatus 202 is fixed to inner case 110, and door frame 205 fixed to drawing door 201 is connected to top rail 203 of rail apparatus 202. In this manner, drawing door 201 can be drawn from or pushed back to heat insulation main body 101 together with container 206.

[0126] A positional relationship between door frame 205, rail apparatus 202, container 206, and the opening of the storage compartment (at least one of vegetable compartment 103 and freezing compartment 104) will be described next.

[0127] FIG. 11 is a main-part side view of a state in which drawing door 201 of refrigerator 100 is drawn to a front-most position in the first exemplary embodiment.

[0128] In the state in which drawing door 201 is drawn to the front-most position, i.e., the state in which vegetable compartment 103 or freezing compartment 104 is fully opened, an end part of the back surface of container 206 is located ahead of the opening of vegetable compartment 103 or freezing compartment 104 that has been

drawn. More specifically, a maximum drawing length of drawing door 201 is a length at which container 206 is completely opened.

[0129] For this reason, storing of articles of food on the back side in container 206 and taking-out of article of food from the back side can be made easy. Since container 206 does not interfere with thermally insulating double doors 107 and drawing door 201 that are arranged thereabove, fitting and removing of container 206 can be easily performed.

[0130] In the state in which drawing door 201 is drawn on the front-most position, door frame 205 is configured such that rear end B is located at the rear of the opening of vegetable compartment 103 or freezing compartment 104. Hook-shaped part 231 and square hole 286 serving as the first fixing part are configured to be located at the front of the opening.

[0131] In this manner, refrigerator 100 includes door frame 205 serving as a door support member that fixes rail apparatus 202 to drawing door 201. When drawing door 201 is drawn to the front-most position, the rear end of the door support member is located at the rear of the opening.

[0132] In this manner, door frame 205 can ensure a sufficient length, and a load from container 206 can be dispersed to the entire area of moving rail. Stress acting on a fixing part between a shoulder support member and the moving rail is suppressed to suppress rail apparatus 202 from being deformed and to reduce distortion of drawing door 201, so as to make it possible to improve the cooling capacity. Furthermore, since door frame 205 covers rail apparatus 202 to make it possible to prevent a hand or a finger from injured by the rail member or to prevent a finger or the like from being caught between the moving rail and the opening, safety can be improved. Since rail apparatus 202 cannot be easily seen, visual design can be improved.

[0133] Square hole 286 and main body hole part 289 are located at the front of the rear end of container 206. Main body hole part 289 is formed by configuring main body notch part 288 that covers horizontal part 231b of hook-shaped part 231 protruding on the upper surface of upper surface part 282.

[0134] Square hole 286 and main body hole part 289 are desirably located at the rear of bottom-surface rib 206e of container 206. In this manner, on the back side of main body hole part 289, container 206 or the side surface of second storing part 264 are located. Thus, even though a finger or the like is inserted from a side into main body hole part 289, the finger is brought into contact with the side surface of container 206 and is not inserted into the main body hole part 289 any more. For this reason, even though drawing door 201 is closed in this state, a finger or the like is not caught. Since main body hole part 289 is not easily conspicuous, visual design can be improved.

[0135] As described above, in the embodiment, enlarged part 281 is arranged between drawing door 201

and main body part 284 of door frame 205. Bent part 241 is formed in door frame 205, and bent part 241 is fitted on drawing door 201 above the proximal end part of top rail 203. Furthermore, container 206 is fixed to container fixing part 301 of drawing door 201 and flange notch part 285a of door frame 205. With the configuration, container 206 regulates a positional relationship between drawing door 201 and door frame 205.

[0136] In this manner, even though back drawing door 201 is drawn out or pushed back while gripping drawing door 201, stress is dispersed to bent part 241 and a part connected through door frame 205 without being concentrated on the fitting part of top rail 203. For this reason, the fixing strength between drawing door 201 and top rail 203 can be improved.

[0137] The configuration described above is especially useful to a configuration such as refrigerator 100 according to the embodiment in which top rail 203 is fitted on the lower part of drawing door 201.

[0138] In this case, door frame 205 that ensures the minimum strength required for a case in which rail apparatus 202 is fitted at a position near the central part in a vertical direction of drawing door 201 is supposed. By using door frame 205, as in the example of the embodiment, drawing door 201 is opened or closed back and forth while rail apparatus 202 is arranged below the central part in the vertical direction of drawing door 201.

[0139] In this case, door frame 205 or internal plate 211 may be deformed due to the lack of strength of the fixing part side of door frame 205 to drawing door 201. As a result, packing 207 arranged on drawing door 201 is separated from heat insulation main body 101 to form a gap in a seal part, and a quality defect such as frost formation in refrigerator 100 may occur.

[0140] When the fitting part between drawing door 201 and top rail 203 is on the lower part of drawing door 201, a user draws or pushes back drawing door 201 while gapping the upper part of drawing door 201 to make a moment acting on the fitting part relatively large.

[0141] However, in the embodiment, door frame 205 having enlarged part 281 protruding upward from the fitting part is employed, and container fixing part 301 is arranged above the fitting part. For this reason, a position serving as a fulcrum of tensile strength can be arranged above the fitting part, and a moment acting on the fitting part decreases. Thus, the fitting part of top rail 203 can be prevented from being damaged.

[0142] Furthermore, rear end B of door frame 205 is located at the rears of the openings of vegetable compartment 103 and freezing compartment 104 even in a case in which drawing door 201 is drawn to the frontmost position to cover the whole length of top rail 203. For this reason, loads of container 206 and stored articles therein can be dispersed to the entire area of top rail 203.

[0143] Furthermore, when drawing door 201 is drawn, obliquely forward force acts on the upper end of drawing door 201. For this reason, downward force acts on the second fixing part located at the front. On the other hand,

as reaction force of the above force, upward force acting on the first fixing part located at the rear increases.

[0144] However, in the embodiment, since the first fixing part is configured to be located at the front of the opening, a distance between the upper end of drawing door 201 and the first fixing part becomes short. For this reason, an upward moment applied to the first fixing part can be reduced, door frame 205 and top rail 203 can be suppressed from being deformed. Since the first fixing part is located at the rear of the center of door frame 205 in the longitudinal direction, a moment applied to the first fixing part, and a distance to the second fixing part arranged at the front end can be sufficient. For this reason, door frame 205 and top rail 203 can be stably reliably fixed to each other.

[0145] Furthermore, door frame 205 covers the almost whole length of top rail 203 to make it possible to prevent a hand or a finger from being injured by top rail 203. Since rear end B of door frame 205 is located at the rear of the opening, a finger or the like can be prevented from being caught between the rear end of top rail 203 and the opening, and safety is improved. Since top rail 203 cannot be easily seen, visual design can be improved.

[0146] The first fixing part is configured to be located at the front of the rear end of container 206, stress acting on the first fixing part can be suppressed by the rigidity of container 206, and rail apparatus 202 can be suppressed from being deformed.

[0147] Furthermore, since drawing door 201 includes side ribs 302 on both the sides of the inner surface, drawing door 201 can be suppressed from being vertically deformed, and distortion of drawing door 201 can be reduced. In this manner, packing 207 is separated from heat insulation main body 101, a gap can be prevented from being formed in the seal part, and the cooling capacity can be improved.

[0148] A height of a part under the center of side rib 302 in the longitudinal direction is made constant, and the rigidity of drawing door 201 can be improved without interfering with door frame 205 fitted to drawing door 201 at a position under the center in a direction of height. A width of a part under the center of side rib 302 in the longitudinal direction is made constant, and the rigidity of drawing door 201 can be improved without interfering with door frame 205.

[0149] A height of a part under the center of side rib 302 in the longitudinal direction of at least side rib 302 is equal to or larger than a gap formed between the inner surface of drawing door 201 and the upper end of container 206. In this manner, when container 206 is drawn out together with drawing door 201, cold air accumulated between drawing door 201 and the front surface container 206 can be suppressed from flowing out of vegetable compartment 103 and freezing compartment 104, and the cooling capacity can be improved.

[0150] Furthermore, a height of a part under the center of side rib 302 in the longitudinal direction of at least side rib 302 is equal to or larger than a gap formed between

the inner surface of drawing door 201 and the front surface of container 206. In this case, an amount of outflowing cold air accumulated between drawing door 201 and the front surface of container 206 can be reduced by side rib 302 and enlarged part 281 of door frame 205, the cooling capacity can be improved. In addition, since a finger or the like can be prevented from being caught between enlarged part 281 and container 206, safety can be improved.

[0151] Furthermore, when a height of a part under the center of side rib 302 in the longitudinal direction is equal to or larger than a width of enlarged part 281 of door frame 205 fixed on drawing door 201, the side surface of enlarged part 281 of door frame 205 can be covered. In this manner, a hand or a finger can be prevented from being injured by enlarged part 281, and safety can be improved. In addition, since enlarged part 281 cannot be easily seen, design is more desirably improved.

[0152] As described above, in the embodiment, by the suppression of deformation of rail apparatus 202 and the reduction in distortion of drawing door 201, sealing property of packing 207 of drawing door 201 can be ensured, and the cooling capacity can be improved.

(Second Exemplary Embodiment)

[0153] A second exemplary embodiment of the present invention will be described below.

[0154] In the embodiment, points different from those in the first exemplary embodiment will be mainly described, the same configurations, the same operations, and the same functions may be omitted.

[0155] FIG. 12A is a main-part side view showing a state in which drawing door 201 is drawn in refrigerator 100 according to the second exemplary embodiment of the present invention. FIG. 12B is a main-part side view showing a state in which drawing door 201 is closed in refrigerator 100. FIG. 13 is a diagram showing a sectional structure of vegetable compartment 103 in refrigerator 100. FIG. 13 shows a state in which drawing door 201 is closed. In FIG. 12A, FIG. 12B, and FIG. 13, for descriptive convenience, container 206 is omitted and is not shown.

[0156] As shown in FIG. 12A and FIG. 12B, in the embodiment of the present invention, on a rear surface side of vegetable compartment 103 serving as a bottom storage compartment, machine compartment 501 is arranged. Machine compartment 501 is partitioned as a space separated from vegetable compartment 103 by inner case 110.

[0157] As a whole, a top surface part of refrigerator 100 is formed to have a shape that is gradually concaved toward the rear surface of the refrigerator. In the gradually concaved part, constituent components on a high-pressure side of a freezing cycle such as a compressor and a dryer (not shown) that removes moisture can be stored (see Fig. 2). In this case, in machine compartment 501, an evaporator and a drain pan (not shown) to receive defrosting water generated when frost and ice adhering

to the periphery of the evaporator are removed can be stored.

[0158] As another embodiment, without arranging a compressor in the top surface part of refrigerator 100, as in a conventional ordinary configuration, constituent components on a high-pressure side of a freezing cycle such as a compressor, a condenser, and a dryer may be stored in machine compartment 501.

[0159] As shown in FIG. 12A, a rear end of cabinet rail 222 serving as a fixed rail is fixed at the front of the front surface of machine compartment 501. However, as shown in FIG. 12B and FIG. 13, in a state in which drawing door 201 is closed, middle rail 221 serving as a moving rail, top rail 203, and the rear end of door frame 205 are configured to reach both the side surfaces of machine compartment 501.

[0160] Furthermore, as shown in FIG. 13, machine compartment 501 is configured to have a width that increases toward the rear surface (backward). More specifically, substantially V-shaped gap parts 502 are formed in both the side surfaces of machine compartment 501 to have widths that decrease toward the rear surface. Gap part 502 forms gaps having substantially equal areas (axisymmetric shapes) on the side surfaces of machine compartment 501 when viewed from above.

[0161] In the embodiment, when the rear end of door frame 205 comes close to both the side surfaces of machine compartment 501 when drawing door 201 is closed, door frame 205 has a sufficient length. For this reason, loads of container 206 and stored articles therein can be dispersed to the entire area of top rail 203, and rail apparatus 202 can be suppressed from being deformed.

[0162] Gap parts 502 are formed in both the side surfaces of machine compartment 501, and the rear end of cabinet rail 222 is located at the front of the front surfaces of machine compartment 501. In this manner, when cabinet rail 222 is fixed, an interval that is large enough to perform an operation can be ensured between the rear end of cabinet rail 222 and machine compartment 501, workability of installation can be improved.

[0163] Gap part 502 forms gaps having substantially equal areas (axisymmetric shapes) in a vertical direction (when viewed from above). In this manner, gap part 502 serves as an air trunk for cooling cold air flowing downward on the rear surface side of container 206, and vegetable compartment 103 can be efficiently cooled.

[0164] In the embodiment, although the bottom storage compartment is explained as vegetable compartment 103, even though freezing compartment 104 may be used, the same effect as described above can be obtained. The cooling cold air flows downward on the rear surface side of container 206 in the above description. However, even though the cold air flows upward, the same effect as described above can be obtained.

(Third Exemplary Embodiment)

[0165] A third exemplary embodiment of the present invention will be described below.

[0166] Also in the embodiment, points different from those in another embodiment will be mainly described. Descriptions of the same configuration, the same operation, and the same function may be omitted.

[0167] In the embodiment, variations of fitting of rail apparatus 202 to inner case 110 will be described below.

[0168] FIG. 14 is a section view showing a structure of a fitting part between inner case 110 and rail apparatus 202 in freezing compartment 104 of refrigerator 100 according to the third exemplary embodiment of the present invention when viewed from the front.

[0169] As shown in FIG. 14, rail fitting part 223 integrally formed on cabinet rail 222 is arranged to have a plane that is brought into contact with an upper part of bottom-surface step parts 108a arranged on both side parts of partition wall 108, and is fixed with screw 400.

[0170] Screw 400 is arranged to have a central axis that is perpendicular to the bottom surface of container 206. Screw 400 is a fastening part. As the fastening part, not only a screw but also a tapping screw, a rivet, or the like can be used.

[0171] In this manner, a rail fitting part serving as a rail holding member that regulates a fixing position of rail apparatus 202 is arranged, and rail apparatus 202 and the rail holding member are fixed to each other with a fastening part having an axis perpendicular to the bottom surface of container 206.

[0172] In this manner, at least a part of the rail holding member is consequently arranged under rail apparatus 202. Since the fastening part axially receive a load on rail apparatus 202, rail apparatus 202 can be prevented from internally falling.

[0173] Furthermore, since shearing force does not act on the fastening part, the fastening part is not loosened, and a gap is not formed between rail apparatus 202 and the rail holding member. For this reason, even though a heavy load acts on container 206, rail apparatus 202 can be reliably fixed.

[0174] Furthermore, since the rail holding member and the fitting part between rail apparatus 202 and the rail holding part can be reduced in size, a large actual volume of storing space can be ensured in the storage compartments. As a result, operability of an opening/closing operation can be improved while ensuring a large actual storing space.

[0175] Partition wall 108 serving as a fitting surface is mainly molded with a resin. Thus, even though rail fitting part 223 is directly fixed to partition wall 108 with a screw, strength that can withstand a load applied to rail apparatus 202 cannot be ensured. For this reason, as a means for reliably fixing rail apparatus 202, rail fitting part 223 is fitted on rail holding member 270 buried in thermally insulating material 111 through partition wall 108.

[0176] Rail holding member 270 is mainly made of a

metal material such as iron. Rail holding member 270 is fixed at a predetermined position on the inner surface (lower side) of an outer shell of partition wall 108 in advance. Thereafter, foaming and heat insulating material is filled in partition wall 108, and a resultant structure is buried in thermally insulating material 111. In this manner, holding power of rail holding member 270 can be more improved.

[0177] Rail holding member 270 is obtained by integrally forming rail holding part 270a having a shape along an inner side of the upper surface of bottom-surface step part 108a and reinforcing part 270b having a shape along an inner side of the side surface of partition wall 108. Rail holding part 270a is a lateral flange part formed to be in tight contact with bottom-surface step part 108a of partition wall 108 from a thermally insulating material 111 side, and reinforcing part 270b is a vertical flange part formed to extend downward from a side of rail holding part 270a.

[0178] Reinforcing part 270b is formed to be bent from a side part of rail holding part 270a along the inner side of the side surface of partition wall 108. A lower end part of reinforcing part 270b has bent part 270c formed to be bent outward. In this manner, bent part 270c is formed in rail holding member 270 to improve the strength of rail holding member 270 itself. Furthermore, reinforcing part 270b is brought into contact with the side surface of partition wall 108, and reinforcing part 270b is cut into thermally insulating material 111. In this case, a load applied to rail holding part 270a is dispersed to make it possible to prevent bottom-surface step part 108a from being deformed.

[0179] FIG. 15 is a section view showing another example of the structure of the fitting part between inner case 110 and rail apparatus 202 in freezing compartment 104 of refrigerator 100 according to the third exemplary embodiment of the present invention when viewed from the front.

[0180] As shown in FIG. 15, reinforcing part 270b may be formed to extend such that reinforcing part 270b is bent from a side part of rail holding part 270a to the inside of refrigerator 100. More specifically, reinforcing part 270b is bent from the side part of rail holding part 270a along an inside of a rising part of bottom-surface step part 108a and forms a lateral flange part along an inside (lower side) of a central part serving as a reference surface of partition wall 108. Furthermore, a distal end part of reinforcing part 270b is bent downward.

[0181] In the examples shown in FIG. 14 and FIG. 15, reinforcing part 270b is formed along the inside (lower side) of the outer shell of partition wall 108. In this manner, even though foaming and heat insulating material is filled in partition wall 108, the foaming and heat insulating material is not blocked from flowing.

[0182] Bottom-surface step parts 108a are formed on both side parts of partition wall 108 serving as a bottom surface wall of freezing compartment 104, and bottom-surface step part 108a is formed in a direction of depth

to have a level one-step higher than that of a central part serving as a reference surface of partition wall 108.

[0183] Side-surface step part 110a is formed on a side wall-surface part of inner case 110 located on a side of rail apparatus 202. Side-surface step part 110a is formed to be recessed on outer case 112 side from an upper-side wall-surface part in freezing compartment 104 and has a small wall thickness.

[0184] With the above configuration, rail apparatus 202 can be suppressed from protruding into a storing space, and an entire width of container 206 in freezing compartment 104 can be increased. For this reason, an invalid space can be reduced.

[0185] Since rail apparatus 202 is assembled with being mounted on bottom-surface step part 108a, workability can be improved. Furthermore, since a part of bottom-surface step part 108a has a large wall thickness vertical to partition wall 108, even though metal rail apparatus 202 in freezing compartment 104 is cooled, dew condensation on partition wall 108 serving as a top surface of vegetable compartment 103 under freezing compartment 104 can be prevented.

[0186] Rail apparatus 202 is arranged on bottom-surface step part 108a. In this manner, even though dew condensation water is accumulated on the central part serving as the reference surface of partition wall 108, rail apparatus 202 does not contact the dew condensation water. For this reason, rail apparatus 202 is not locked by freezing the dew condensation water. Thus, drawing door 201 can be smoothly opened or closed.

[0187] In refrigerator 100, fitting between inner case 110 and rail apparatus 202 will be described next with reference to vegetable compartment 103 of drawing type storage compartments.

[0188] FIG. 16 is a section view showing an example of the structure of the fitting part between inner case 110 and rail apparatus 202 in vegetable compartment 103 of refrigerator 100 according to the third exemplary embodiment of the present invention when viewed from the front.

[0189] As shown in FIG. 16, rail holding member 280 in vegetable compartment 103 formed in the lowermost part is arranged in thermally insulating material 111.

[0190] Rail fitting part 223 integrally formed on cabinet rail 222 is arranged to have a plane that is brought into contact with an upper part of bottom-surface step parts 401a arranged on both sides of a bottom part of inner case 110 and fixed to rail holding member 280 with screw 400. Screw 400 is arranged to have a central axis that is perpendicular to the bottom surface of container 206.

[0191] Rail holding member 280 is substantially L-shaped and includes rail holding part 280a serving as a lateral flange part and reinforcing part 280b serving as a vertical flange part. Rail holding part 280a is in tight contact with the bottom surface part of inner case 110, and reinforcing part 280b is in tight contact with the side surface part of inner case 110. A distal end part of reinforcing part 280b has bent part 280c that is bent sideward in such a direction that the distal end part comes away from

inner case 110.

[0192] In this manner, rail holding member 280 is substantially L-shaped to improve the strength of rail holding member 280 itself. Furthermore, reinforcing part 280b is brought into contact with a side surface of inner case 110, and the distal end part of reinforcing part 280b is cut into thermally insulating material 111. In this manner, a load applied to rail holding part 280a is dispersed to make it possible to prevent bottom-surface step part 401a from being deformed. When reinforcing part 280b is arranged along the side surface of inner case 110, foaming and heat insulating material is not blocked from flowing when the foaming and heat insulating material is filled between outer case 112 and inner case 110.

[0193] FIGS. 17 to 19 are section views showing other examples of the structure of the fitting part between inner case 110 and rail apparatus 202 in vegetable compartment 103 of refrigerator 100 according to the third exemplary embodiment of the present invention when viewed from the front.

[0194] As shown in FIGS. 17 to 19, reinforcing parts 280b having different configurations may be used.

[0195] In FIG. 17, reinforcing part 280b is bent downward from a side part of rail holding part 280a. Furthermore, a distal end part of reinforcing part 280b is bent in such a direction that the distal end part comes away from inner case 110 to form bent part 280c.

[0196] In this manner, rail holding member 280 is substantially L-shaped to improve the strength of rail holding member 280 itself. Furthermore, reinforcing part 280b is cut into thermally insulating material 111 to disperse a load applied to rail holding part 280a so as to make it possible to prevent bottom-surface step part 401a from being deformed.

[0197] In FIG. 18, reinforcing part 280b is bent once from the side part of rail holding part 280a and bent along the upper side to form a rib at an end part of bottom-surface step part 401a. Thereafter, reinforcing part 280b further extends in such a direction that reinforcing part 280b comes away from inner case 110.

[0198] In this manner, a rib is formed in rail holding member 280 to improve the strength of rail holding member 280 itself. Furthermore, reinforcing part 280b is cut into thermally insulating material 111 to disperse a load applied to rail holding part 280a so as to make it possible to prevent bottom-surface step part 401a from being deformed.

[0199] In FIG. 19, reinforcing part 280b is bent from the side part of rail holding part 280a along an inside (lower side) of a rising part of bottom-surface step part 401a, and, thereafter, forms a lateral flange part along an inside (lower side) of the bottom surface of inner case 110. Furthermore, the distal end part of reinforcing part 270b is bent downward to form bent part 280c.

[0200] In this manner, rail holding member 280 is substantially L-shaped to improve the strength of rail holding member 280 itself. Furthermore, reinforcing part 280b is brought into contact with a rising part of inner case 110,

and the distal end part of reinforcing part 280b is cut into thermally insulating material 111. In this manner, a load applied to rail holding part 280a is dispersed to make it possible to prevent bottom-surface step part 401a from being deformed. When reinforcing part 280b is arranged along inner case 110, foaming and heat insulating material is not blocked from flowing when the foaming and heat insulating material is filled between outer case 112 and inner case 110.

[0201] Bottom-surface step parts 401a are formed on both side parts of bottom-surface wall 401 of vegetable compartment 103, bottom-surface step part 401a is formed in a direction of depth to have a level one-step higher than that of a central part serving as a reference surface of bottom-surface wall 401.

[0202] Rail apparatus 202 is arranged on bottom-surface step part 401a. Side-surface step part 110a is formed on a side wall-surface part of inner case 110 to which rail apparatus 202 is fixed. Side-surface step part 110a is formed to be recessed on outer case 112 side from an upper-side wall-surface part in vegetable compartment 103 and has a small wall thickness.

[0203] With the above configuration, rail apparatus 202 can be suppressed from protruding into a storing space, and an entire width of container 206 in vegetable compartment 103 can be increased. For this reason, an invalid space can be reduced.

[0204] Since rail apparatus 202 is assembled with being mounted on bottom-surface step part 401a, workability can be improved. Furthermore, apart of bottom-surface step part 401a can ensure heat resistance because the wall thickness of thermally insulating material 111 under bottom-surface wall 401 increases.

[0205] Since rail apparatus 202 is arranged on bottom-surface step part 401a, even though dew condensation water is accumulated on the central part serving as the reference surface of partition wall 108, rail apparatus 202 does not contact the dew condensation water. For this reason, rail apparatus 202 is not locked by freezing the dew condensation water. In this manner, drawing door 201 can be smoothly opened or closed.

[0206] In each of freezing compartment 104 and vegetable compartment 103, side-surface step part 110a is arranged to decrease the wall thickness of the side surface. As a countermeasure against this, a vacuum thermally insulating material (not shown) can be arranged at a position corresponding to a part where rail apparatus 202 is installed. More specifically, in each of freezing compartment 104 and vegetable compartment 103, a vacuum thermally insulating material having a height larger than a distance between rail apparatuses 202 is stuck to outer case 112 to make it possible to ensure heat resistance.

[0207] As described above, in the embodiment, rail fitting part 223 of cabinet rail 222 and rail holding member 270 are fixed through an upper part of bottom-surface step part 108a of partition wall 108 by screw 400 having an axis vertical to the bottom surface of container 206.

Alternatively, rail fitting part 223 and rail holding member 280 are fixed through an upper part of bottom-surface step part 401a on the bottom part of inner case 110 by screw 400 having an axis vertical to the bottom surface of container 206.

[0208] With this configuration, rail holding parts 270a and 280a of rail holding members 270 and 280 are arranged under rail apparatus 202. Consequently, screw 400 axially receives a load applied to rail apparatus 202. Thus, rail apparatus 202 can be prevented from internally falling. Furthermore, since shearing force does not act on screw 400, screw 400 is not loosened, and a gap is not formed between rail fitting part 223 and rail holding members 270 and 280. For this reason, even though a heavy load acts on container 206, rail apparatus 202 can be reliably fixed to partition wall 108 and inner case 110.

[0209] Rail holding members 270 and 280 are arranged under rail apparatus 202. In this manner, rail holding members 270 and 280 can be reduced in size.

[0210] Furthermore, since the axis of screw 400 is vertical to the bottom surface of container 206, the bottom surface of container 206 can secure a wide width. In this manner, the storage compartment can include large container 206 therein.

[0211] The configuration described above is especially useful to a configuration of refrigerator 100 according to the embodiment in which top rail 203 is fitted on the lower part of drawing door 201.

[0212] If rail apparatus 202 is attached near a central part of drawing door 201 in the vertical direction, like the position of the embodiment, rail holding members 270 and 280 are arranged under rail apparatus 202. In this case, rail fitting part 223 of rail apparatus 202 must be vertically increased in size. As a result, container 206 cannot be increased in width, and the actual storing space of the storage compartment decreases.

[0213] However, as in the embodiment, when the fitting part between drawing door 201 and top rail 203 is arranged under drawing door 201, and the fitting part between rail apparatus 202 and the rail holding members 270 and 280 can be reduced in size to make it possible to increase container 206 in width. A position that is a fulcrum of force applied in an internal falling direction can be set to a lower position, a moment applied to the fitting part can be reduced. For this reason, internal falling can be further prevented.

[0214] Furthermore, also in the embodiment, the first fixing part of door frame 205 is arranged at the rear of the center of door frame 205 in the longitudinal direction. In this manner, door frame 205 covers the almost whole length of top rail 203, and a load applied to container 206 can be dispersed to the entire area of top rail 203. For this reason, rail apparatus 202, bottom-surface step part 108a of partition wall 108, and bottom-surface step part 401a on the bottom part of inner case 110 can be suppressed from being deformed.

(Fourth Exemplary Embodiment)

[0215] A fourth exemplary embodiment of the present invention will be described below.

[0216] Also in the embodiment, points different from those in another embodiment will be mainly described. Descriptions of the same configuration, the same operation, and the same function may be omitted.

[0217] FIG. 20 is a perspective view showing a configuration of rail apparatus 702 of refrigerator 100 according to the fourth exemplary embodiment of the present invention.

[0218] As shown in FIG. 20, rail apparatus 702 has three rails stacked in three levels. A second rail (middle rail 221) can be moved with respect to a first rail (cabinet rail 222), and a third rail (top rail 203) can be moved with respect to the second rail (middle rail 221). In this manner, the rail apparatus can extend and contract as a whole.

[0219] Cabinet rail 222 is a "fixed rail" fixed on a side surface or a bottom surface of inner case 110, and top rail 203 and middle rail 221 are "moving rails" that are arranged to be able to move with respect to the fixed rail.

[0220] At a rear end part of cabinet rail 222, first hook-shaped part 331 serving as a first protrusion part is integrally formed. First hook-shaped part 331 is formed such that a part of a lower surface of cabinet rail 222 is extended and the extended part is bent.

[0221] First hook-shaped part 331 includes vertical part 331a and horizontal part 331b. Vertical part 331a is configured to rise up in a direction substantially vertical to a lower surface of cabinet rail 222. Horizontal part 331b is formed at a distal end of vertical part 331a and configured to be substantially horizontally bent forward with respect to the lower surface of cabinet rail 222. A length of horizontal part 331b is configured to be larger than the height of vertical part 331a.

[0222] At a central part of cabinet rail 222, central protrusion part 332 serving as a second protrusion part is integrally formed. Central protrusion part 332 is formed such that the lower surface of cabinet rail 222 is partially notched, and the notched part is bent, extends from the side surface of cabinet rail 222, and protrudes downward.

[0223] On the upper surface of top rail 203, second hook-shaped part 333 and fixing hole 234 to fix top rail 203 to door frame 305 are formed. Second hook-shaped part 333 is formed by notching a part of the upper surface of top rail 203 in a substantially laterally-U-shaped form and raising the notch. Second hook-shaped part 333 includes vertical part 333a and horizontal part 333b.

[0224] Vertical part 333a is formed to rise up in a direction substantially vertical to the upper surface of top rail 203. Horizontal part 333b is arranged at a distal end of vertical part 333a and configured to be substantially horizontally bent forward with respect to the upper surface of top rail 203. A length of horizontal part 333b is configured to be larger than the height of vertical part 333a.

[0225] Fixing hole 234 is a screw hole formed at a po-

sition corresponding to round hole 287 formed in door frame 305. Fixing hole 234 is desirably formed at a position where a distance required to ensure the strength of fixing hole 234 from a front end of top rail 203 is ensured.

[0226] Fixing between drawing door 201 and door frame 305 will be described below.

[0227] FIG. 21 is a perspective view showing a state in which drawing door 201 and door frame 305 are connected to each other in the fourth exemplary embodiment of the present invention.

[0228] As shown in FIG. 21, door frames 305 are respectively connected to both horizontal end parts lower than the central part of drawing door 201 in the vertical direction.

[0229] Door frame 305 is fixed on an inside plate 211 side that almost entirely covers a rear surface of drawing door 201. Inside plate 211 is one of members configuring drawing door 201, and is a plate-like member formed by vacuum molding.

[0230] Inside plate 211 is mainly molded with a resin. For this reason, even though door frame 305 is directly fixed to inside plate 211 with a screw, door frame 305 cannot ensure strength that can withstand a load applied to door frame 305. Thus, as a means for reliably fixing door frame 305 to inside plate 211, door frame 305 is fixed to a reinforcing plate (not shown) buried in a thermal insulating material in drawing door 201 with a screw or the like through inside plate 211.

[0231] The reinforcing plate extends in a vertical direction of inside plate 211, and is mainly made of a metal material such as iron. Two reinforcing plates are independently formed in correspondence with left and right door frames 305, respectively.

[0232] Door frame 305 includes upper surface part 282 that covers an upper surface of top rail 203 and side surface part 283 that covers a side surface of top rail 203 on the outside of the refrigerator. In the embodiment, entire lengths (lengths in longitudinal directions) of upper surface part 282 and side surface part 283 are desirably shorter than the entire length of top rail 203 to make it easy to fit rail apparatus 202 to heat insulation main body 101.

[0233] An end part of upper surface part 282 on the inside of the refrigerator is cut and raised at substantially right angles to form main body part 284 that is substantially parallel to side surface part 283. At the front end part of main body part 284, enlarged part 281 protruding upward from main body part 284 is arranged. At a front end of enlarged part 281, bent part 241 having an end part that is bent along inside plate 211 of drawing door 201 is formed. Bent part 241 is fitted on drawing door 201 such that an upper end of bent part 241 is located under a center of drawing door 201 in the height direction. Bent part 241 is fitted to a position of drawing door 201 above the proximal end part of top rail 203.

[0234] In this manner, enlarged part 281 is formed between bent part 241 and door frame 305 to make it pos-

sible to increase a size of a fixing part between door frame 305 and drawing door 201 in the vertical direction. In this manner, the lack of strength of the fitting part between rail apparatus 202 fitted on the lower part of drawing door 201 and drawing door 201 can be compensated for.

[0235] More specifically, in particular, stress generated when a user pushes in or draws out drawing door 201 while holding the upper end part of drawing door 201 with her/his hand can be suppressed from being concentrated on the front end part of door frame 305.

[0236] On an upper end of main body part 284 of door frame 305, flange part 285 formed to be bent in a direction substantially horizontal to upper surface part 282 is formed. At flange part 285, flange 285 is partially notched to form flange notch part 285a. Container 206 is partially inserted into flange notch part 285a to make it possible to fix container 206.

[0237] In upper surface part 282, square hole 286 and round hole 287 are formed to fix top rail 203. Square hole 286 is a locking part having a size that is enough to fit second hook-shaped part 333 arranged on top rail 203.

[0238] Round hole 287 is a hole formed at a position corresponding to fixing hole 234 formed in top rail 203. Round hole 287 is desirably formed at a position where a distance required to ensure the strength of round hole 287 from the front end of upper surface part 282 is ensured.

[0239] In main body part 284 located at a position corresponding to square hole 286, main body notch part 288 is formed. Main body notch part 288 is formed such that a part of main body part 284 is substantially notched in a laterally-U-shaped form and the notch is raised to be bent to the outside of the refrigerator in a direction substantially vertical to main body part 284.

[0240] Fixation between door frame 305 (see FIG. 21) and top rail 203 (see FIG. 20) is described here. Second hook-shaped part 333 formed on top rail 203 is hooked on square hole 286 of door frame 305. More specifically, horizontal part 333b and vertical part 333a of second hook-shaped part 333 are penetrated upward from square hole 286 to upper surface part 282 of door frame 305. Door frame 305 is relatively moved to the rear of top rail 203 to move horizontal part 333b of second hook-shaped part 333 onto the upper surface of the front end part of square hole 286. A screw is screwed in fixing hole 234 formed in top rail 203 from above upper surface part 282 of door frame 305 through round hole 287 of door frame 305.

[0241] In this manner, door frame 305 and top rail 203 are reliably fixed to each other at two positions corresponding to a position (first fixing part) fixed by second hook-shaped part 333 and square hole 286 and a position (second fixing part) fixed by fixing hole 234, round hole 287, and the screw. When a hooking system in which the fixing part at at least one of the positions is configured by second hook-shaped part 333 and square hole 286 is employed, door frame 305 can be easily fitted on and removed from top rail 203.

[0242] Main body notch part 288 covers square hole 286 and horizontal part 333b of second hook-shaped part 333 protruding on the upper surface of upper surface part 282. In this manner, a hand or a finger can be prevented from being injured by square hole 286 or second hook-shaped part 333, and safety can be improved. In addition, visual design can be improved.

[0243] Second hook-shaped part 333 and fixing hole 234 may be arranged on a side surface of top rail 203, and square hole 286 and round hole 287 may be formed in side surface part 283 or main body part 284.

[0244] A method of fitting rail apparatus 702 to heat insulation main body 101 will be described below.

[0245] FIG. 22 is a side view for explaining a method of fitting rail apparatus 702 in the fourth exemplary embodiment of the present invention, and FIG. 23 is a side view for explaining a state in which rail apparatus 702 is fitted on heat insulation main body 101.

[0246] A structure of a fitting part on heat insulation main body 101 side will be described first.

[0247] As shown in FIG. 22 and FIG. 23, on a bottom surface of a storage compartment in heat insulation main body 101, backward recessed part 251 and forward recessed part 252 that are recessed downward are formed at positions corresponding to first hook-shaped part 331 and central protrusion part 332 of cabinet rail 222, respectively. Backward recessed part 251 has a size that is large enough to insert first hook-shaped part 331 therein. At a front end of backward recessed part 251, backward protrusion part 253 is inserted between the lower surface of cabinet rail 222 and horizontal part 331b of first hook-shaped part 331 is arranged.

[0248] A method of fitting rail apparatus 702 will be described. Top rail 203 and middle rail 221 are drawn from cabinet rail 222. A rear end of cabinet rail 222 is inserted from an obliquely upper side into a rear side of the bottom surface. First hook-shaped part 331 is inserted into backward recessed part 251. Thereafter, a position of drawing door 201 is moved downward such that cabinet rail 222 is substantially parallel to the bottom surface.

[0249] At this time, backward protrusion part 253 is located at the front end of first hook-shaped part 331 and above horizontal part 331b, and the rear end of central protrusion part 332 is located above the rear end of forward recessed part 252. Finally, cabinet rail 222 is moved forward. As a result, backward protrusion part 253 inserted between the lower surface of cabinet rail 222 and horizontal part 331b of first hook-shaped part 331, and central protrusion part 332 is fitted in forward recessed part 252. In this manner, rail apparatus 702 can be reliably fixed to heat insulation main body 101. With respect to removal, the method described above may be adversely executed.

[0250] A structure of a fitting part between heat insulation main body 101 and rail apparatus 702 will be described in more detail with reference to freezing compartment 104 in the drawing type storage compartment.

[0251] FIG. 24 is a section view showing a fitting part between partition wall 108 and rail apparatus 702 in freezing compartment 104 of refrigerator 100 according to the fourth exemplary embodiment of the present invention.

[0252] Rail apparatus 702 will be described in more detail.

[0253] A sectional shape of cabinet rail 222 vertical to the longitudinal direction is not horizontally symmetrical. One end has rail fitting part 223 that rises upward once from the bottom surface and bends in a direction of width. Rail fitting part 223 is in contact with the upper surface of partition wall 108 that vertically partitions vegetable compartment 103 and freezing compartment 104.

[0254] Middle rail 221 has a shape having a substantially I-shaped section, and a shape in which horizontally protruding flanges are formed on the upside and the downside in the longitudinal direction. Of the upper and lower flanges, the lower flange is held with cabinet rail 222 such that the flange can be moved in the longitudinal direction.

[0255] Top rail 203 has a substantially laterally-U-shaped section and holds the upper flange of middle rail 221 such that the flange can be moved in the longitudinal direction.

[0256] Each of cabinet rail 222 and top rail 203 holds plurality of rotary support members 145 with rotary support member holding parts 146, and rotary support members 145 movably holds middle rail 221. As rotary support members 145, for example, a bearing can be used.

[0257] More specifically, of the upper and lower flanges of middle rail 221, a part centered around the lower flange is held at three points with the plurality of rotary support members 145.

[0258] A part centered around the upper flange of middle rail 221 is held at three points with top rail 203 through the plurality of rotary support members 145.

[0259] Cabinet rail 222, middle rail 221, and top rail 203 are combined to each other to make it possible to cause middle rail 221 to move on cabinet rail 222 in the longitudinal direction thereof.

[0260] Furthermore, top rail 203 can move on middle rail 221 in the longitudinal direction thereof. More specifically, top rail 203 is configured to move on cabinet rail 222 through middle rail 221 in the longitudinal direction thereof.

[0261] Middle rail 221 and top rail 203 can smoothly move by rotating plurality of rotary support members 145.

[0262] Top rail 203, middle rail 221, cabinet rail 222, and rotary support members 145 are fitted on drawing door 201 while being built in advance.

[0263] An internal structure of partition wall 108 will be described below.

[0264] As shown in FIG. 24, rail fitting part 223 integrally formed on cabinet rail 222 is arranged to have a plane that is brought into contact with an upper part of bottom-surface step parts 108a arranged on both side parts of partition wall 108, and, as described above, is fixed with first hook-shaped part 331 (see FIG. 23).

[0265] Partition wall 108 serving as a fitting surface is mainly molded with a resin. For this reason, even though rail fitting part 223 is directly fixed to partition wall 108, rail apparatus 702 is difficult to ensure strength that can withstand a load applied to rail apparatus 702. Thus, as a means for reliably fixing rail apparatus 702, rail holding member 270 buried in thermally insulating material 111 is arranged.

[0266] Rail holding member 270 is mainly made of a metal material such as iron. Rail holding member 270 is fixed to a predetermined position on the inner surface of an outer shell of partition wall 108 in advance. Thereafter, thermally insulating material 111 is filled between inner case 110 and outer case 112, and rail holding member 270 is buried in thermally insulating material 111. In this manner, holding power of rail holding member 270 can be more improved. The length of rail holding member 270 in the longitudinal direction desirably reaches the inside of backward protrusion part 253.

[0267] Rail holding member 270 is obtained by integrally forming rail holding part 270a having a shape along an inner side of the upper surface of bottom-surface step part 108a and reinforcing part 270b having a shape along an inner side of the side surface of partition wall 108. Rail holding part 270a is a lateral flange part formed to be in tight contact with bottom-surface step part 108a of partition wall 108 from a thermally insulating material 111 side, and reinforcing part 270b is a vertical flange part formed to extend downward from a side of rail holding part 270a.

[0268] Reinforcing part 270b is formed to be bent from a side part of rail holding part 270a along the inner side of the side surface of partition wall 108. A lower end part of reinforcing part 270b has bent part 270c formed to be bent outward. In this manner, bent part 270c is formed in rail holding member 270 to improve the strength of rail holding member 270 itself. Furthermore, reinforcing part 270b is brought into contact with the side surface of partition wall 108, and reinforcing part 270b is cut into thermally insulating material 111. In this case, a load applied to rail holding part 270a is dispersed to make it possible to prevent bottom-surface step part 108a from being deformed.

[0269] Bottom-surface step parts 108a are formed on both side parts of partition wall 108 serving as a bottom surface wall of freezing compartment 104, and bottom-surface step part 108a is formed in a direction of depth to have a level one-step higher than that of a central part serving as a reference surface of partition wall 108.

[0270] Rail apparatus 702 is arranged on bottom-surface step part 108a. Side-surface step part 110a is formed on a side wall-surface part of inner case 110 to which rail apparatus 702 is fixed. Side-surface step part 110a is formed to be recessed on outer case 112 side from an upper-side wall-surface part in freezing compartment 104 and has a small wall thickness.

[0271] In this manner, since rail apparatus 702 is mounted on bottom-surface step part 108a, rail appara-

tus 702 can be suppressed from protruding into the storing space. An entire width of container 206 in freezing compartment 104 can be increased, an invalid space can be reduced, and workability for fitting rail apparatus 702 to partition wall 108 can be improved.

[0272] Fitting between inner case 110 and rail apparatus 702 in the refrigerator will be described next with reference to vegetable compartment 103 of drawing type storage compartments.

[0273] FIG. 25 is a section view showing a fitting part between inner case 110 and rail apparatus 702 in vegetable compartment 103 of refrigerator 100 according to the fourth exemplary embodiment of the present invention.

[0274] As shown in FIG. 25, rail holding member 280 in vegetable compartment 103 formed in the lowermost part of refrigerator 100 is arranged in thermally insulating material 111. Rail fitting part 223 integrally formed on cabinet rail 222 is arranged to have a plane that is brought into contact with an upper part of bottom-surface step parts 401a arranged on both the sides of the bottom part of inner case 110, and is fixed with first hook-shaped part 331 (see FIG. 23).

[0275] Rail holding member 280 is substantially L-shaped and includes rail holding part 280a serving as a lateral flange part and reinforcing part 280b serving as a vertical flange part. Rail holding part 280a is in tight contact with the bottom surface part of inner case 110, and reinforcing part 280b is in tight contact with the side surface part of inner case 110. A distal end part of reinforcing part 280b has bent part 280c that is bent sideward in such a direction that the distal end part comes away from inner case 110.

[0276] In this manner, rail holding member 280 is substantially L-shaped to improve the strength of rail holding member 280 itself. Furthermore, reinforcing part 280b is brought into contact with a side surface of inner case 110, and the distal end part of reinforcing part 280b is cut into thermally insulating material 111. In this manner, a load applied to rail holding part 280a is dispersed to make it possible to prevent bottom-surface step part 401a from being deformed. When reinforcing part 280b is arranged along the side surface of inner case 110, foaming and heat insulating material is not blocked from flowing when the foaming and heat insulating material is filled between outer case 112 and inner case 110.

[0277] Drawing door 201 of bottom vegetable compartment 103 is on the lower side of drawing door 201 of upper freezing compartment 104. For this reason, when a user draws drawing door 201, drawing door 201 of vegetable compartment 103 located on the bottom of the refrigerator is located at a position on which her/his weight is easily put. Thus, in addition to a load of a content of stored articles, an external load may be applied to drawing door 201 of vegetable compartment 103. However, since rail holding member 280 may be integrally formed by substantially L-shaped rail holding part 280a and reinforcing part 280b serving as the lower flange part,

rail apparatus 202 of bottom drawing door 201 can be prevented from falling down to make it possible to impart a rigid configuration to drawing door 201.

[0278] In each of freezing compartment 104 and vegetable compartment 103, side-surface step part 110a is arranged to decrease the wall thickness of the side surface. As a countermeasure against this, a vacuum thermally insulating material (not shown) can be arranged at a position corresponding to a part where rail apparatus 702 is installed. More specifically, in each of freezing compartment 104 and vegetable compartment 103, a vacuum thermally insulating material having a height larger than a distance between rail apparatuses 702 is stuck to outer case 112 to make it possible to ensure heat resistance.

[0279] As described above, in the embodiment, after first hook-shaped part 331 arranged on cabinet rail 222 of rail apparatus 702 is inserted into backward recessed part 251 on the bottom surface of the storage compartment formed in heat insulation main body 101, backward protrusion part 253 is inserted between the lower surface of cabinet rail 222 and horizontal part 331b of first hook-shaped part 331. In this manner, rail apparatus 702 can be reliably fixed to heat insulation main body 101.

[0280] With the configuration, rail apparatus 702 fitted on drawing door 201 in advance can be easily fitted on or removed from heat insulation main body 101. Thus, rail apparatus 702 can be improved in property of fitting and property of removing. Rail apparatus 702 in which the fixed rail and the moving rail are built in advance can be applied. Thus, a clearance between the fixed rail and the moving rail can be reduced, and a high-quality stable drawing configuration can be obtained.

[0281] In particular, when first hook-shaped part 331 is arranged at the end part of cabinet rail 222, first hook-shaped part 331 can be easily integrally shaped with cabinet rail 222. In addition, since first hook-shaped part 331 is arranged at the end part of cabinet rail 222, first hook-shaped part 331 can be easily inserted from an obliquely upper side into a rear side of the bottom surface of the storage compartment, and thus rail apparatus 702 can be improved in property of fitting to heat insulation main body 101 and property of removing from heat insulation main body 101.

[0282] Furthermore, when a protrusion part is arranged on a cabinet rail 222 side, recessed parts need only be formed in bottom-surface step part 108a of partition wall 108 and bottom-surface step part 401a of inner case 110, and protrusion parts need not be formed. For this reason, in the storage compartment, a large actual volume of storing space can be ensured.

[0283] Furthermore, central protrusion part 332 is fitted in forward recessed part 252, and rail apparatus 702 can be prevented from horizontally swinging around first hook-shaped part 331. For this reason, since left and right rail apparatuses 702 are parallel to each other, the moving rail smoothly slides to make it possible to reduce operating physical force for drawing drawing door 201.

[0284] Furthermore, when rail apparatus 702 is arranged under the central part of drawing door 201 in the vertical direction, the rear end of cabinet rail 222 can be easily inserted from an obliquely upper side into a rear side of the bottom surface of the storage compartment. Thus, rail apparatus 702 can be improved in property of fitting to heat insulation main body 101 and property of removing from heat insulation main body 101.

[0285] Rail apparatus 702 is arranged under the central part of drawing door 201 in the vertical direction to cause a large part of the side surface of container 206 to have a flat shape in which an uneven surface is not formed. In this manner, air trunk resistance to cooling cold air flowing from the front side to the rear side along the side surface of container 206 can be reduced. As a result, an input to a cooling fan (not shown) can be reduced, and energy saving of refrigerator 100 can be achieved. Since the side surface becomes flat, the design can be improved. When container 206 is drawn together with drawing door 201, cold air in container 206 flowing out of container 206, i.e., out of vegetable compartment 103 can be reduced, and energy saving of refrigerator 100 can be achieved.

[0286] Furthermore, container 206 is consequently held with door frame 305 in the bottom part. For this reason, rail apparatus 702 does not divide a side space of container 206 into upper and lower parts, and dew condensation or frost formation is not caused by occurrence of a temperature difference between the upper and lower parts or a convection air pocket.

[0287] Rail apparatus 702 may be fixed with first hook-shaped part 331 and backward recessed part 251 without arranging central protrusion part 332 and forward recessed part 252.

Industrial Applicability

[0288] As described above, according to the present invention, the following special effect can be exerted. That is, in a drawing type storage compartment, a drawing door is suppressed from being deformed while ensuring a large actual storing space, and leakage of cold air is reduced to make it possible to improve the cooling capacity. Thus, the present invention can be used in a refrigerator including drawing type storage compartments. Furthermore, the present invention can be applied to a field such as a unit kitchen having drawers requiring a high quality level and good design.

Reference Signs List

[0289]

100 Refrigerator
101 Heat insulation main body
102 Refrigerating compartment
103 Vegetable compartment
104 Freezing compartment

105 Ice making compartment
106 Switching compartment
107 Thermally insulating door
108 Partition wall
108a Bottom-surface step part
110 Inner case
110a Side surface step part
111 Thermally insulating material
112 Outer case
145 Rotary support member
146 Rotary support member holding part
201 Drawing door
201a Handhold
202, 702 Rail apparatus
203 Top rail
205, 305 Door frame
206 Container
206a Front surface flange part
206b Side surface flange part
206c Rear surface flange part
206d Protrusion part
206e Bottom-surface rib
207 Packing
211 Internal plate
221 Middle rail
222 Cabinet rail
223 Rail fitting part
231 Hook-shaped part
231a Vertical part
231b Horizontal part
232, 234 Fixing hole
241 Bent part
251 Backward recessed part
252 Forward recessed part
253 Backward protrusion part
261 Narrow part
262 Step part
263 First storing part
264 Second storing part
270, 280 Rail holding member
270a, 280a Rail holding part
270b, 280b Reinforcing part
270c, 280c Bent part
281 Enlarged part
282 Upper surface part
283 Side surface part
284 Main body part
285 Flange part
285a Flange notch part
286 Square hole
287 Round hole
288 Main body notch part
289 Main body hole part
301 Container fixing part
302 Side rib
303 Lower rib
331 First hook-shaped part
331a Vertical part

331b Horizontal part
 332 Central protrusion part
 333 Second hook-shaped part
 333a Vertical part
 333b Horizontal part
 400 Screw
 401 Bottom surface wall
 401a Bottom-surface step part
 501 Machine compartment
 502 Gap part

Claims

1. A refrigerator (100) comprising:

a heat insulation main body (101) including an inner case (110), an outer case (112), and a thermally insulating material filled between the inner case (110) and the outer case (112);

a storage compartment (103, 104) formed inside the heat insulation main body (101) and having an open front surface;

a drawing door (201) that openably/closably closes the open front surface of the storage compartment (103, 104) and that has side ribs (302) respectively protruding backward on both sides of the inner surface, wherein each of the side ribs (302) is formed such that a height of a part of the each of the side ribs (302) located under a center of the side ribs (302) in a longitudinal direction is constant, wherein the longitudinal direction is along a vertical direction of the drawing door (201);

a rail apparatus (202) configured to move the drawing door (201) back and forth; and

a container (206) having step parts that are respectively formed at both ends of a bottom part and held by the rail apparatus (202), and

a door support member (205) fixing the rail apparatus (202) to the drawing door (201), wherein when the drawing door (201) is drawn to a front-most position, a rear end of the door support member (205) is located at the rear of the open front surface, and

the door support member (205) comprises an upper surface part (282) and a side surface part (283), a main body part (284) formed at an end part of the upper surface part (282) and being substantially parallel to the side surface part (283), and an enlarged part (281) protruding upward from the main body part (284) and arranged at the front end part of main body part (284);

characterized in that a height of a part under the center of the side rib (302) in the longitudinal direction is equal to or larger than a length in a front-back direction of the enlarged part (281).

2. The refrigerator according to claim 1, wherein each of the side ribs (302) has a height equal to or higher than a distance of a gap formed between the inner surface of the drawing door (201) and a front surface of the container (206).

3. The refrigerator according to claim 1, further comprising:

a rail holding member (223) that regulates a fixed position of the rail apparatus; and a fastening part that fixes the rail apparatus (202) and the rail holding member (223) and has an axis in a direction vertical to a bottom surface of the container (206).

4. The refrigerator according to claim 1, wherein the rail apparatus (202) further includes a protrusion part (231), and

the rail apparatus (202) is fixed to the heat insulation main body (101) with the protrusion part (231) and a locking part (286) arranged on a bottom surface of the storage compartment (103, 104).

Patentansprüche

1. Kühlschrank (100), umfassend:

einen Wärmeisolationshauptkörper (101), der ein inneres Gehäuse (110), ein äußeres Gehäuse (112) und ein thermisch isolierendes Material, das zwischen das innere Gehäuse (110) und das äußere Gehäuse (112) gefüllt ist, umfasst; ein Lagerfach (103, 104), das in dem Wärmeisolationshauptkörper (101) ausgebildet ist und eine offene Vorderfläche aufweist;

eine Ziehtür (201), welche die offene Vorderfläche des Lagerfachs (103, 104) offenbar/schließbar verschließt und seitliche Rippen (302) aufweist, die jeweils auf beiden Seiten der Innenfläche nach hinten hervorstehen, wobei jede der seitlichen Rippen (302) derart ausgebildet ist, dass eine Höhe eines Teils jeder der seitlichen Rippen (302) unter einer Mitte der seitlichen Rippen (302) in einer Längsrichtung konstant ist, wobei die Längsrichtung längs einer senkrechten Richtung der Ziehtür (201) verläuft;

eine Schienenvorrichtung (202), die ausgestaltet ist, um die Ziehtür (201) rückwärts und vorwärts zu bewegen; und

einen Behälter (206) mit stufigen Teilen, die jeweils an beiden Enden eines Unterteils ausgebildet sind und von der Schienenvorrichtung (202) gehalten werden, und

ein Türtragelement (205), mit dem die Schienenvor-

richtung (202) an der Ziehtür (201) befestigt ist, wobei sich ein hinteres Ende des Türtragelements (205) hinter der offenen Vorderfläche befindet, wenn die Ziehtür (201) in eine vorderste Position gezogen ist, und

das Türtragelement (205) ein oberes Flächenteil (282) und ein seitliches Flächenteil (283) umfasst, ein Hauptkörper (284), das an einem Endteil des oberen Flächenteils (282) ausgebildet und im Wesentlichen parallel zu dem seitlichen Flächenteil (283) ist, und

ein vergrößertes Teil (281), das vom Hauptkörper (284) nach oben hervorsteht und am vorderen Endteil des Hauptkörpers (284) angeordnet ist;

dadurch gekennzeichnet, dass eine Höhe eines Teils unter der Mitte der seitlichen Rippe (302) in der Längsrichtung gleich oder größer als eine Länge in einer Vorn-Hinten-Richtung des vergrößerten Teils (281) ist.

2. Kühlschrank nach Anspruch 1, wobei jede der seitlichen Rippen (302) eine Höhe hat, die gleich oder größer als ein Abstand zwischen der Innenfläche der Ziehtür (201) und einer Vorderfläche des Behälters (206) ausgebildeten Spalts ist.

3. Kühlschrank nach Anspruch 1, ferner umfassend:

ein Schienenhalteelement (223), das eine festgelegte Position der Schienenvorrichtung reguliert; und

ein Befestigungsteil, mit dem die Schienenvorrichtung (202) und das Schienenhalteelement (223) befestigt sind und das eine Achse in einer zu einer Bodenfläche des Behälters (206) senkrechten Richtung aufweist.

4. Kühlschrank nach Anspruch 1, wobei die Schienenvorrichtung (202) ferner ein Vorsprungsteil (231) enthält, und die Schienenvorrichtung (202) an dem Wärmeisolationshauptkörper (101) mit dem Vorsprungsteil (231) und einem Arretierteil (286), das auf einer Bodenfläche des Lagerfachs (103, 104) angeordnet ist, befestigt ist.

Revendications

1. Réfrigérateur (100) comprenant:

un corps principal d'isolation thermique (101) comprenant un boîtier interne (110), un boîtier externe (112), et un matériau thermiquement isolant étant comblé entre le boîtier interne (110) et le boîtier externe (112);

un compartiment de stockage (103, 104) formé à l'intérieur du corps principal d'isolation thermi-

que (101) et ayant une surface avant ouverte; une porte à tirer (201) qui ferme de manière ouvrable/fermable la surface avant ouverte du compartiment de stockage (103, 104) et qui a des nervures latérales (302) faisant respectivement saillie vers l'arrière sur les deux côtés de la surface interne, chacune des nervures latérales (302) étant formée de sorte qu'une hauteur d'une partie de chacune des nervures latérales (302) située sous un centre des nervures latérales (302) dans une direction longitudinale soit constante, la direction longitudinale étant le long d'une direction verticale de la porte à tirer (201); un appareil à rail (202) configuré pour déplacer la porte à tirer (201) en va-et-vient; et un récipient (206) ayant des parties étagées qui sont respectivement formées aux deux extrémités d'une partie inférieure et maintenues par l'appareil à rail (202), et

un élément de support de porte (205) fixant l'appareil à rail (202) à la porte à tirer (201), dans lequel, lorsque la porte à tirer (201) est tirée vers une position la plus en avant, une extrémité arrière de l'élément de support de porte (205) est située à l'arrière de la surface avant ouverte, et l'élément de support de porte (205) comprend une partie de surface supérieure (282) et une partie de surface latérale (283),

une partie de corps principal (284) formée au niveau d'une partie d'extrémité de la partie de surface supérieure (282) et étant sensiblement parallèle à la partie de surface latérale (283), et

une partie élargie (281) faisant saillie vers le haut à partir de la partie de corps principal (284) et agencée au niveau de la partie d'extrémité avant de la partie de corps principal (284);

caractérisé en ce qu'une hauteur d'une partie sous le centre de la nervure latérale (302) dans la direction longitudinale est égale ou supérieure à une longueur dans une direction avant-arrière de la partie élargie (281).

2. Réfrigérateur selon la revendication 1, dans lequel chacune des nervures latérales (302) a une hauteur égale ou supérieure à une distance d'un espace formé entre la surface interne de la porte à tirer (201) et une surface avant du récipient (206).

3. Réfrigérateur selon la revendication 1, comprenant en outre :

un élément de maintien de rail (223) qui régule une position fixe de l'appareil à rail; et une partie de fixation qui fixe l'appareil à rail (202) et l'élément de maintien de rail (223) et a un axe dans une direction verticale par rapport à une surface inférieure du récipient (206).

4. Réfrigérateur selon la revendication 1, dans lequel l'appareil à rail (202) inclut en outre une partie en saillie (231), et l'appareil à rail (202) est fixé au corps principal d'isolation thermique (101) avec la partie en saillie (231) et une partie de verrouillage (286) disposée sur une surface inférieure du compartiment de stockage (103, 104).

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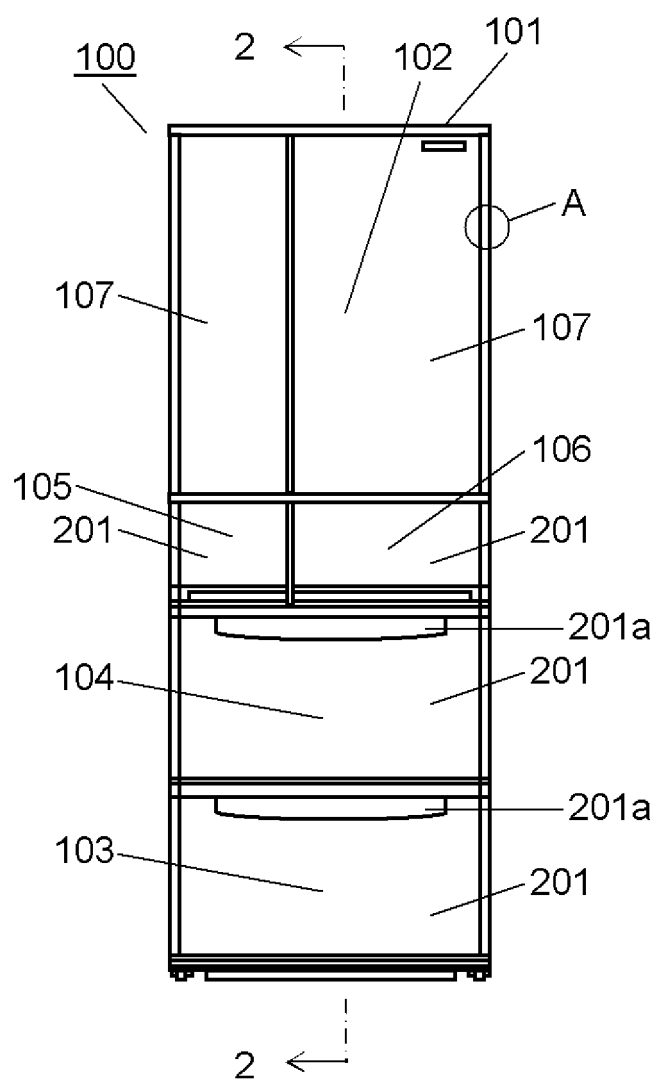
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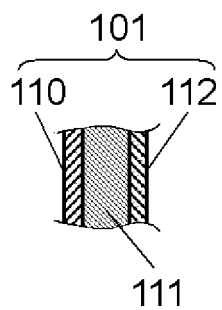
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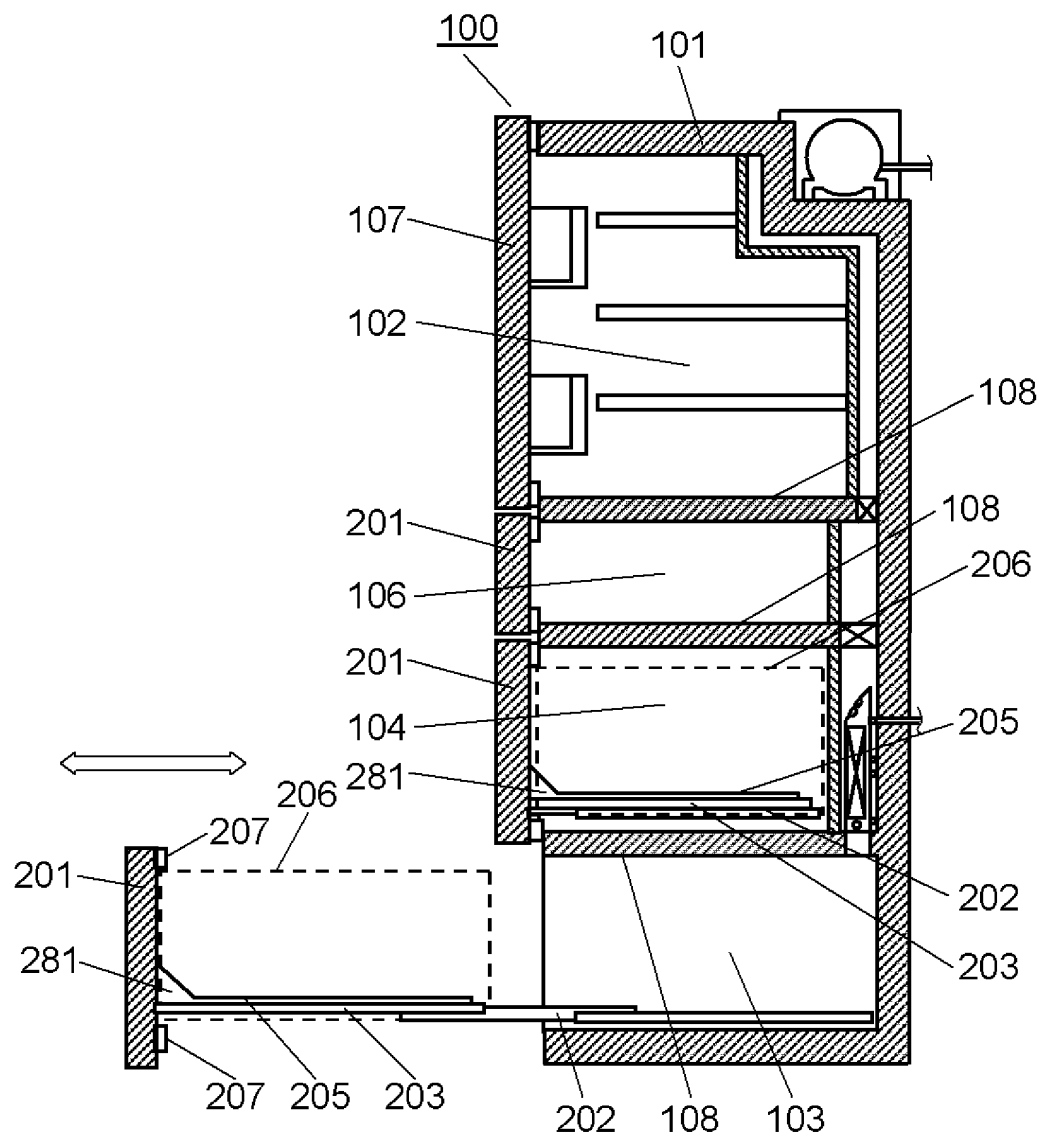
[Fig. 1A]



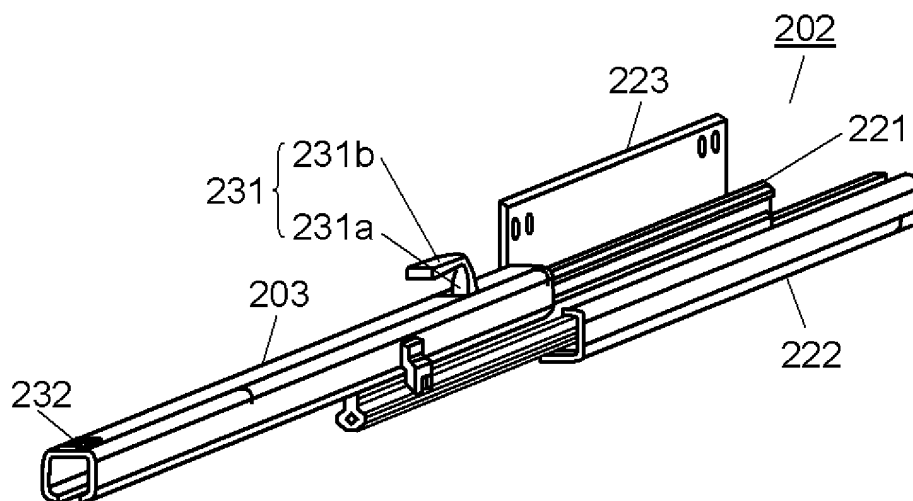
[Fig. 1B]



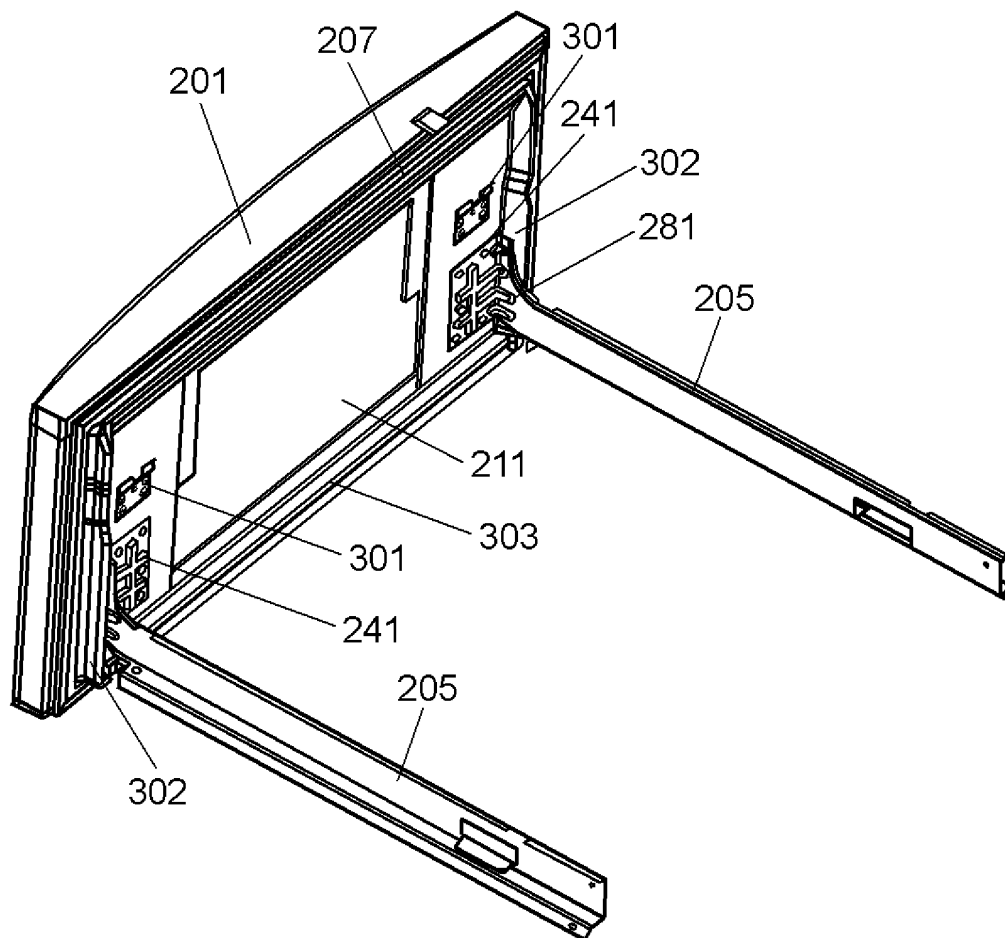
[Fig. 2]



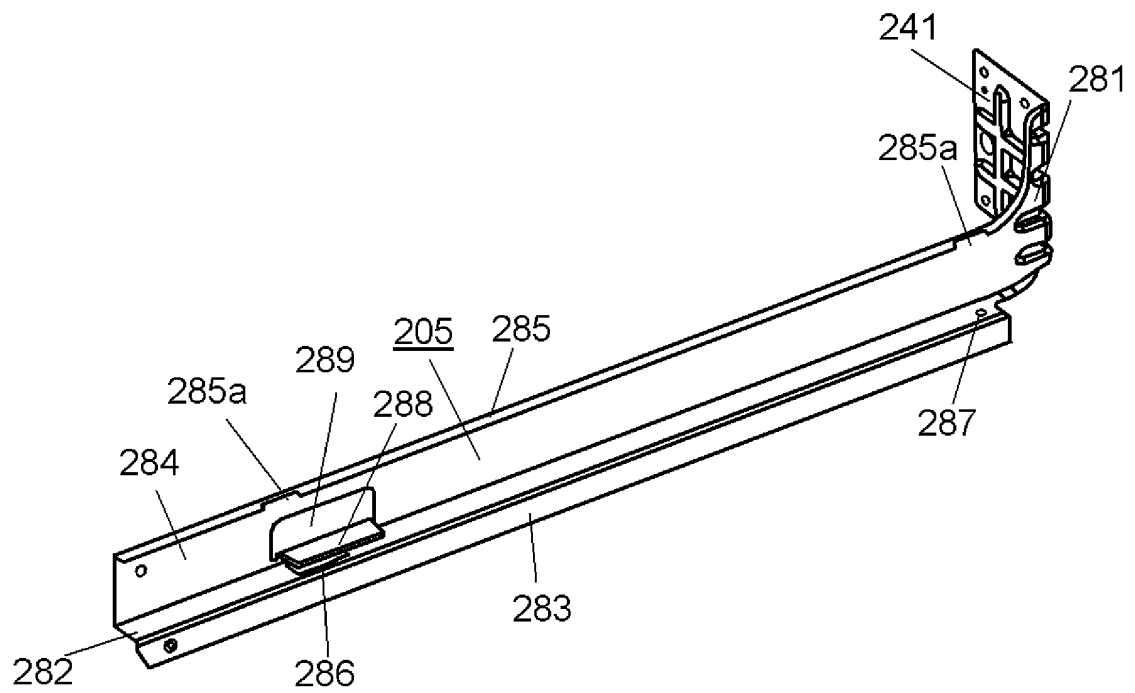
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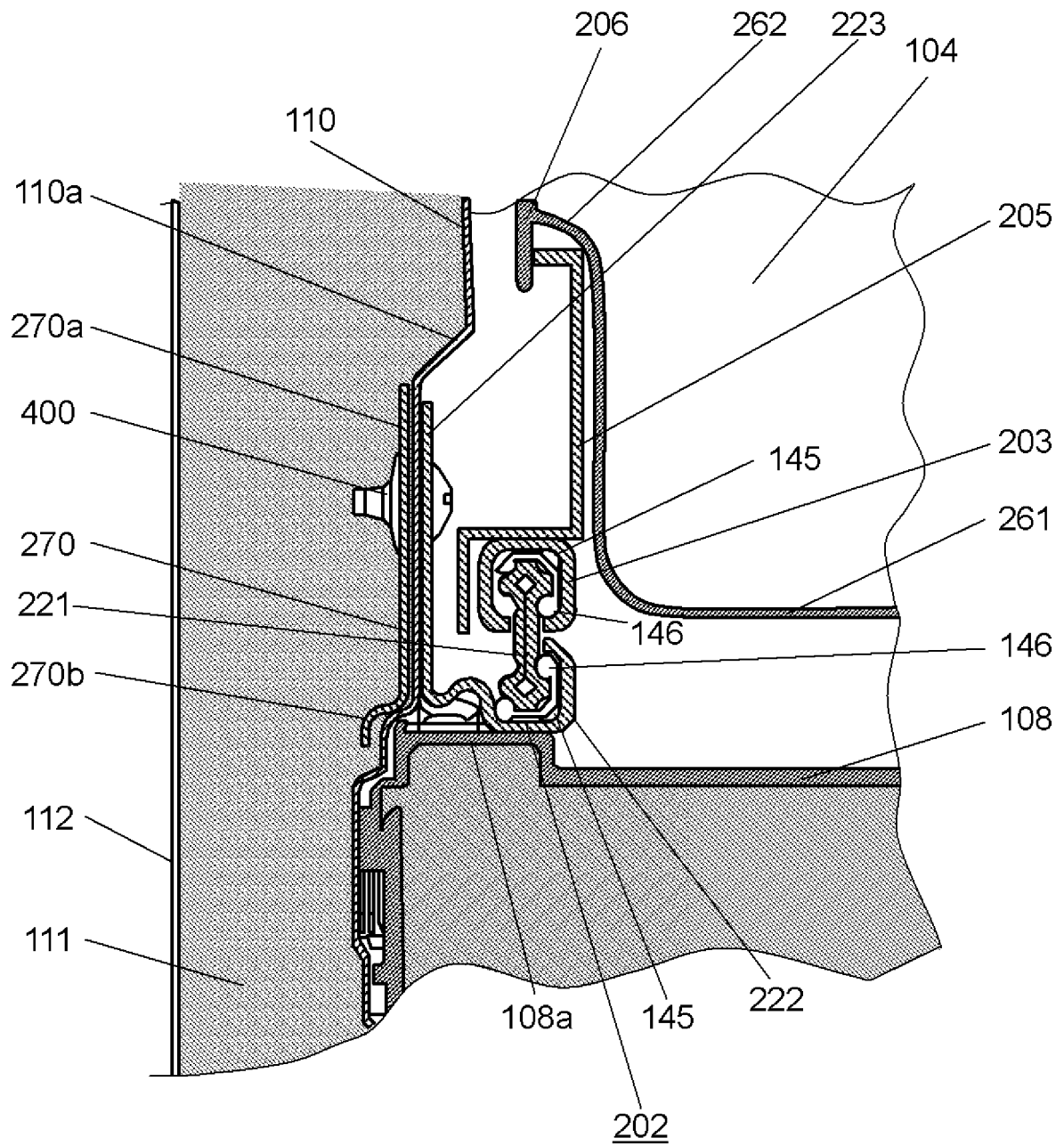
[Fig. 4]



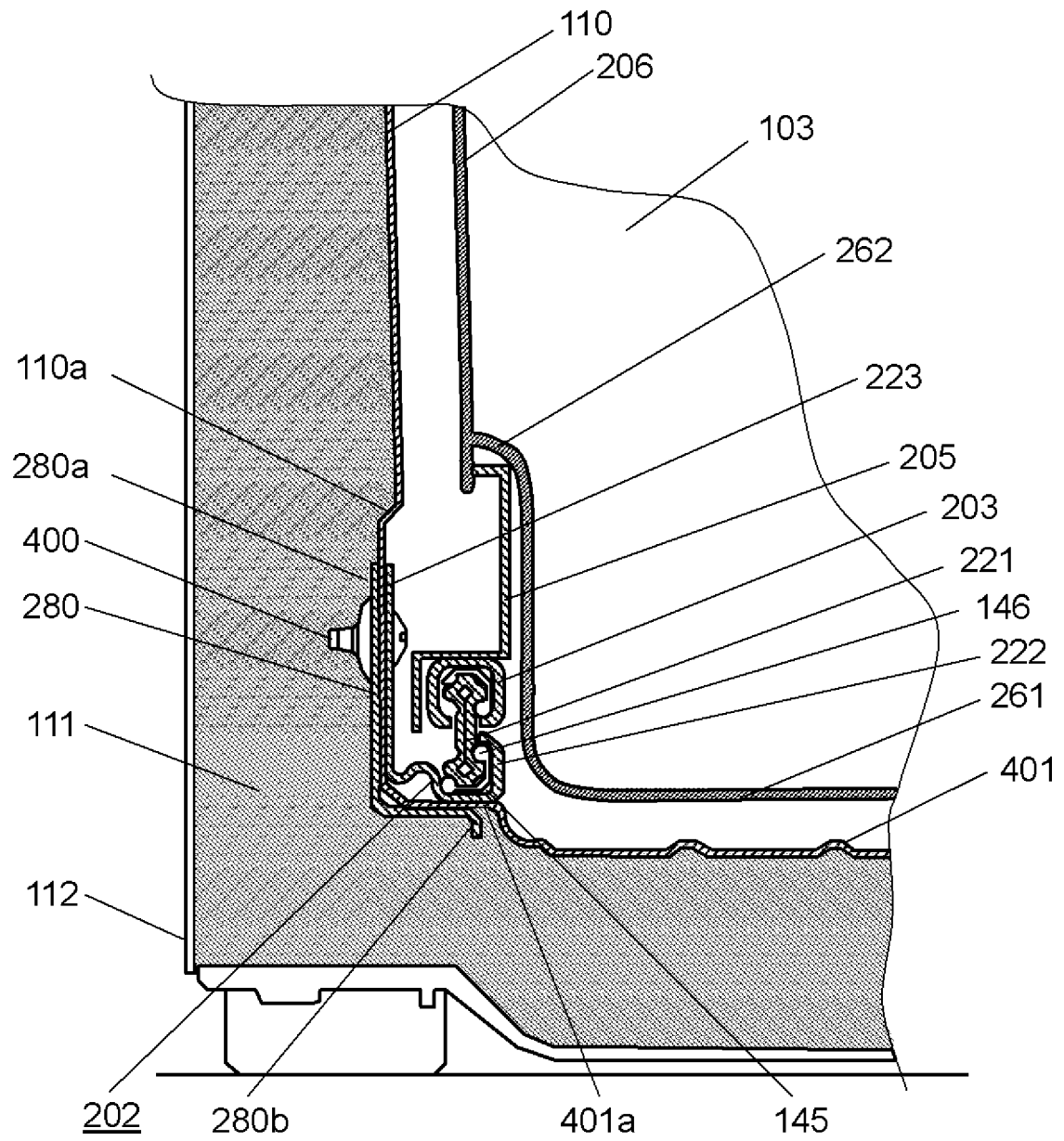
[Fig. 5]



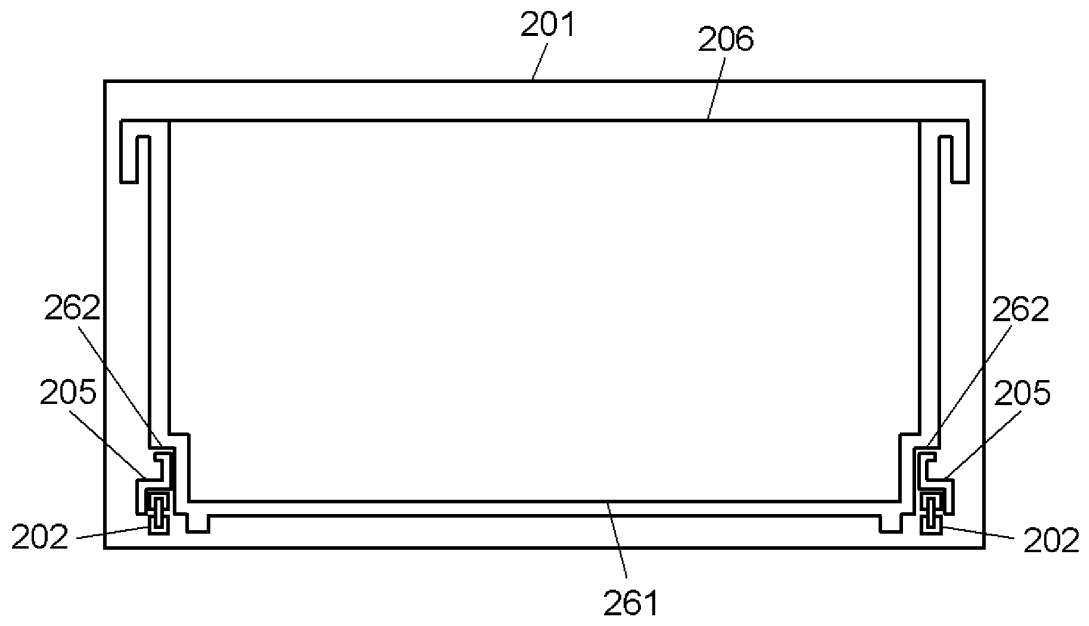
[Fig. 6]



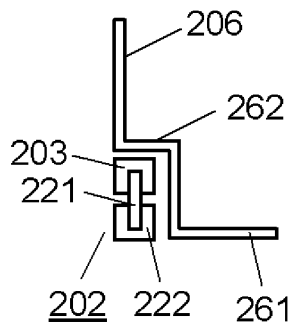
[Fig. 7]



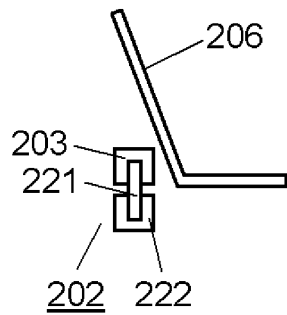
[Fig. 8]



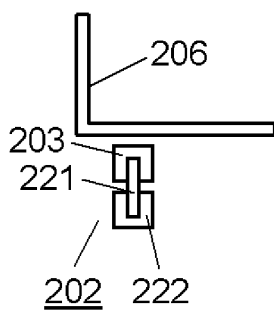
[Fig. 9A]



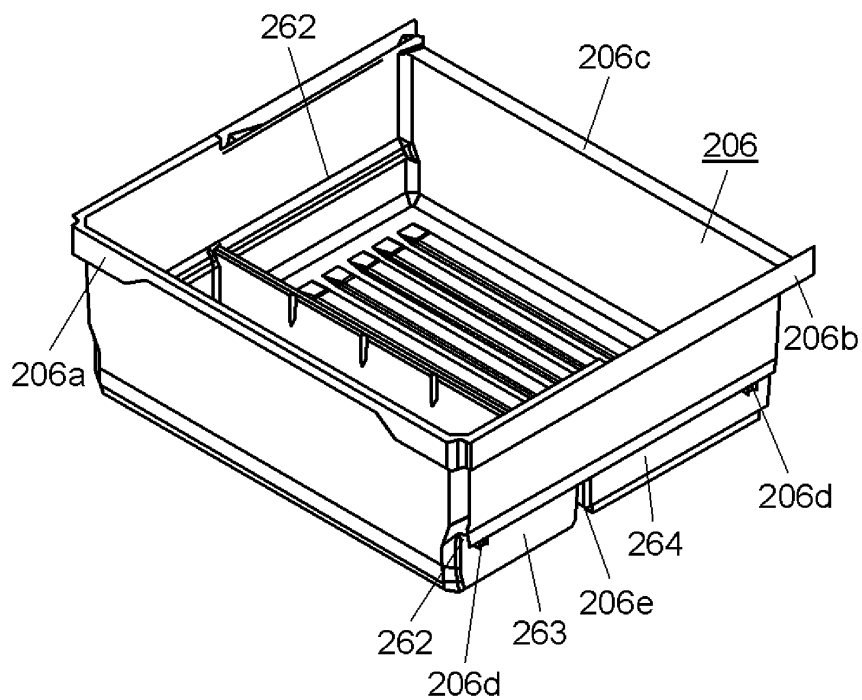
[Fig. 9B]



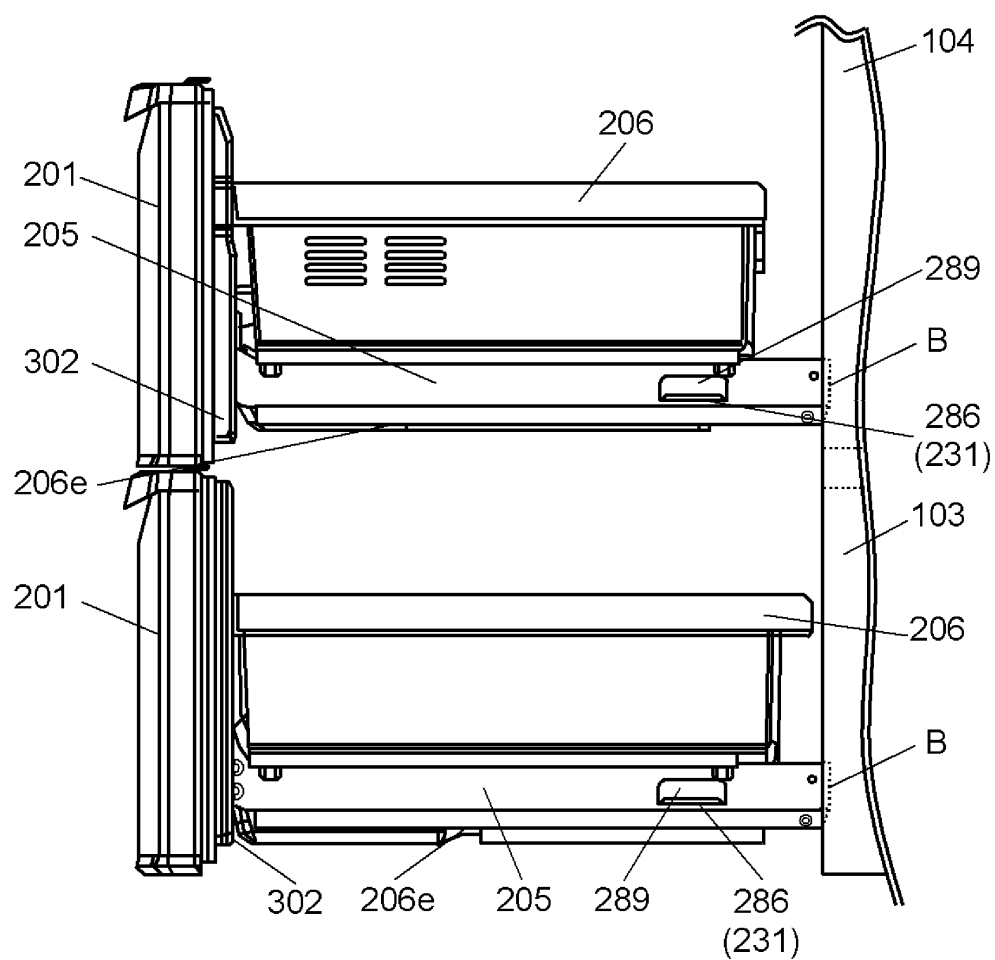
[Fig. 9C]



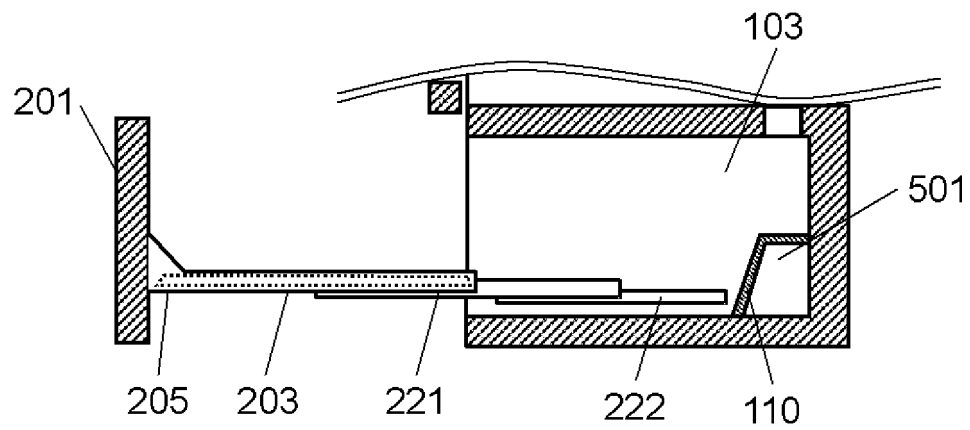
[Fig. 10]



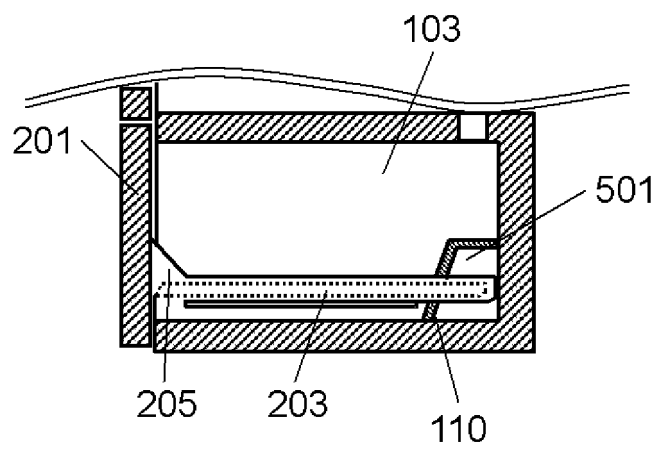
[Fig. 11]



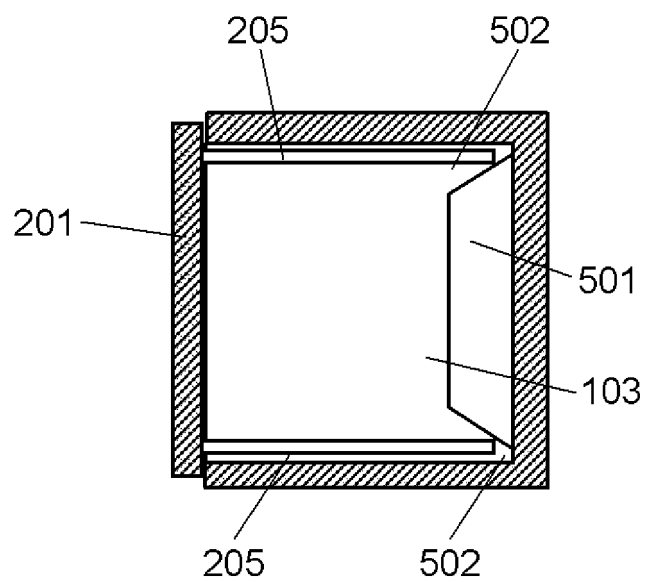
[Fig. 12A]



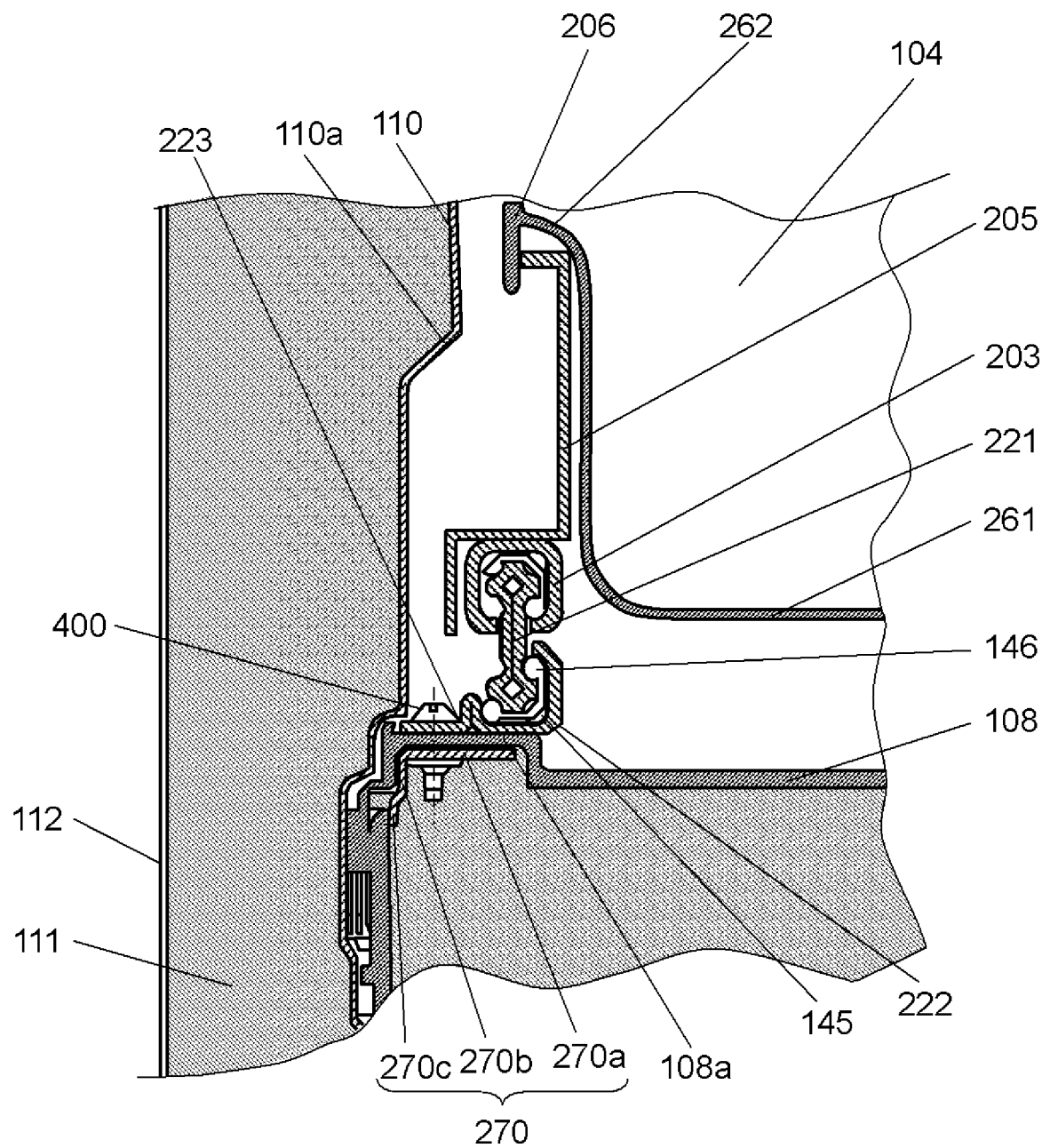
[Fig. 12B]



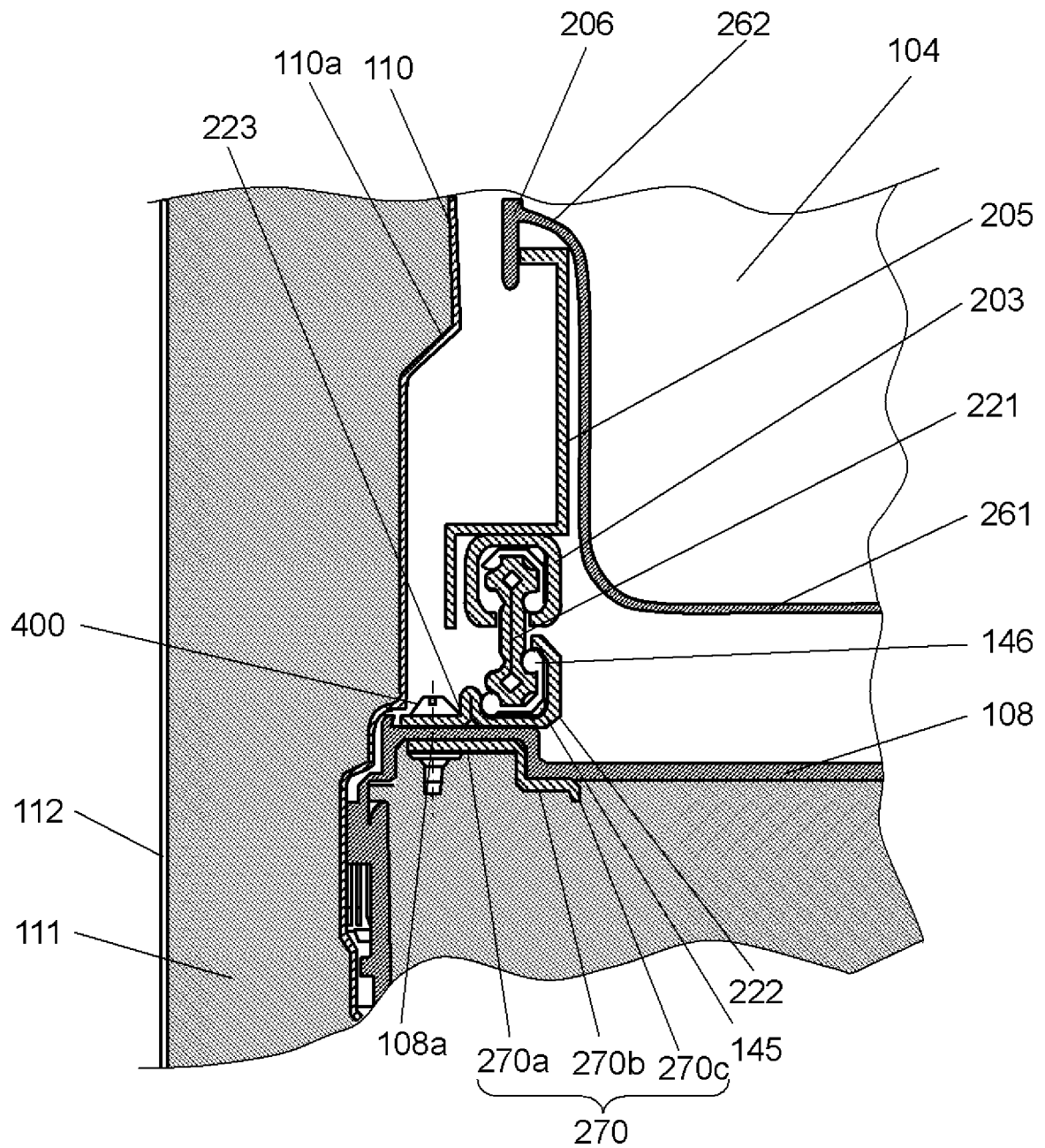
[Fig. 13]



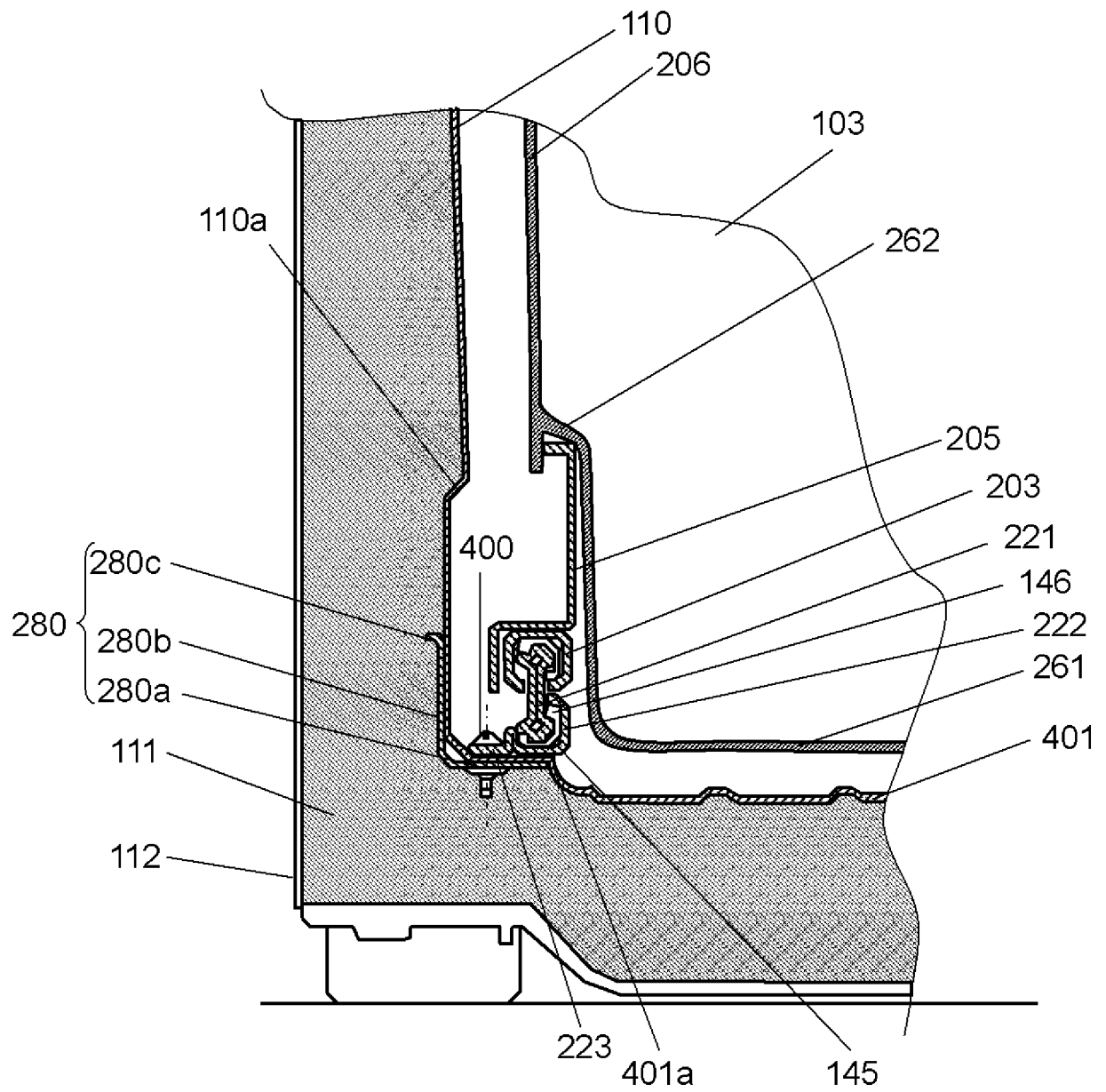
[Fig. 14]



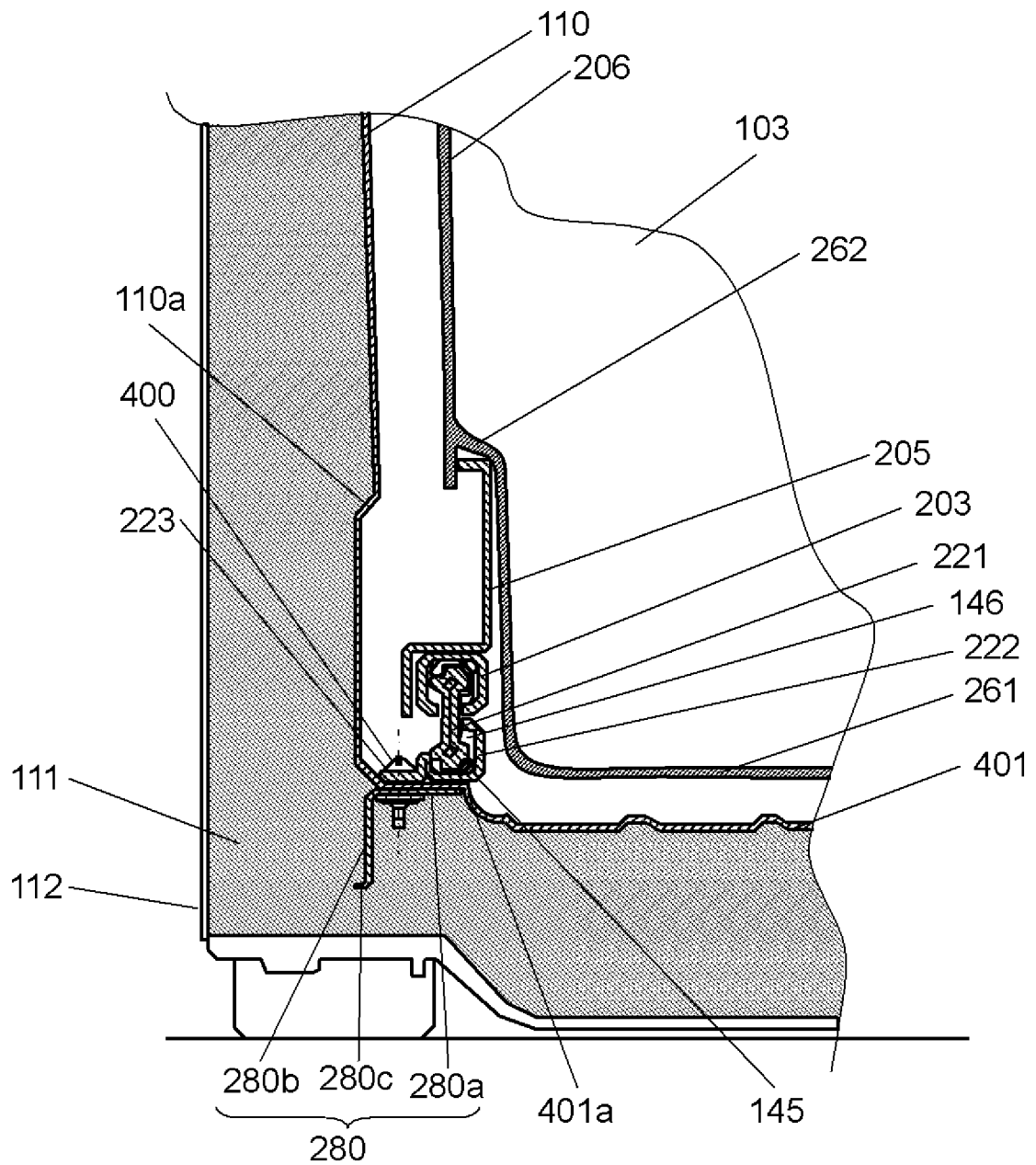
[Fig. 15]



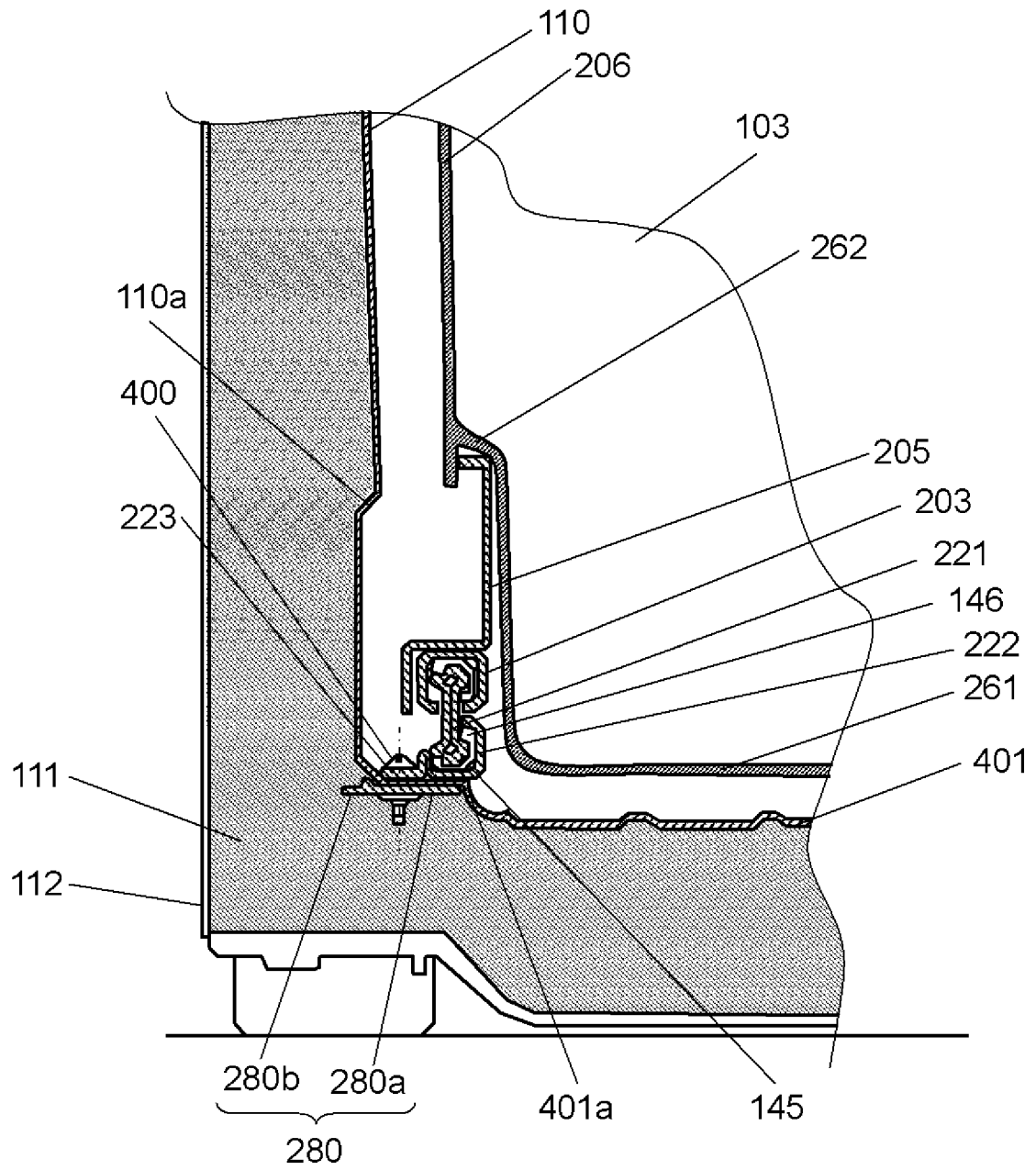
[Fig. 16]



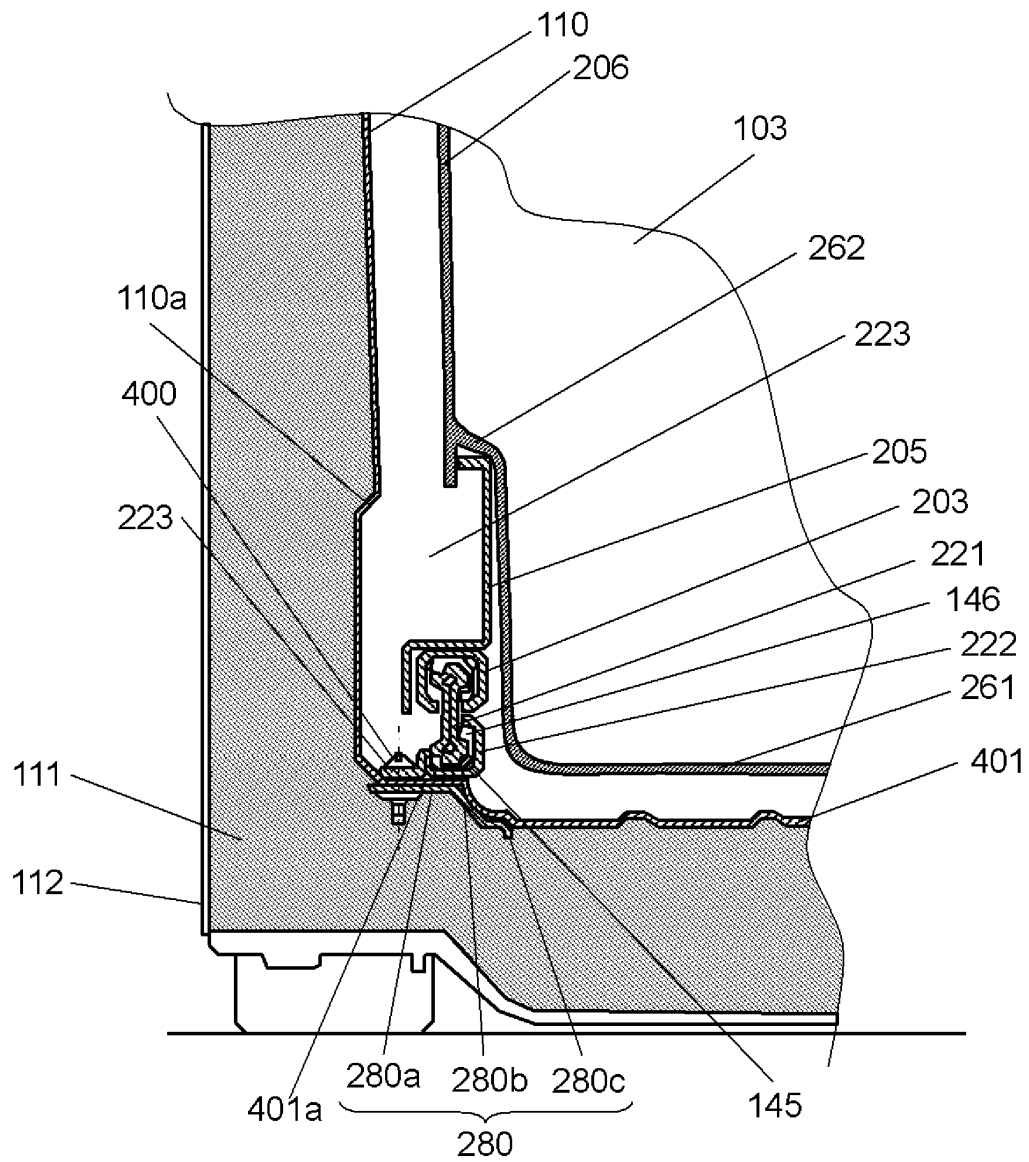
[Fig. 17]



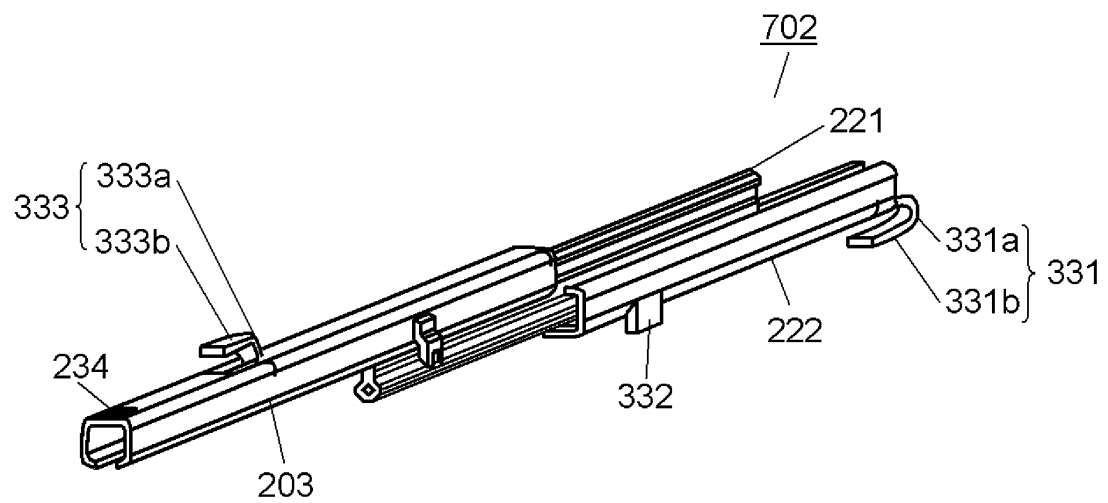
[Fig. 18]



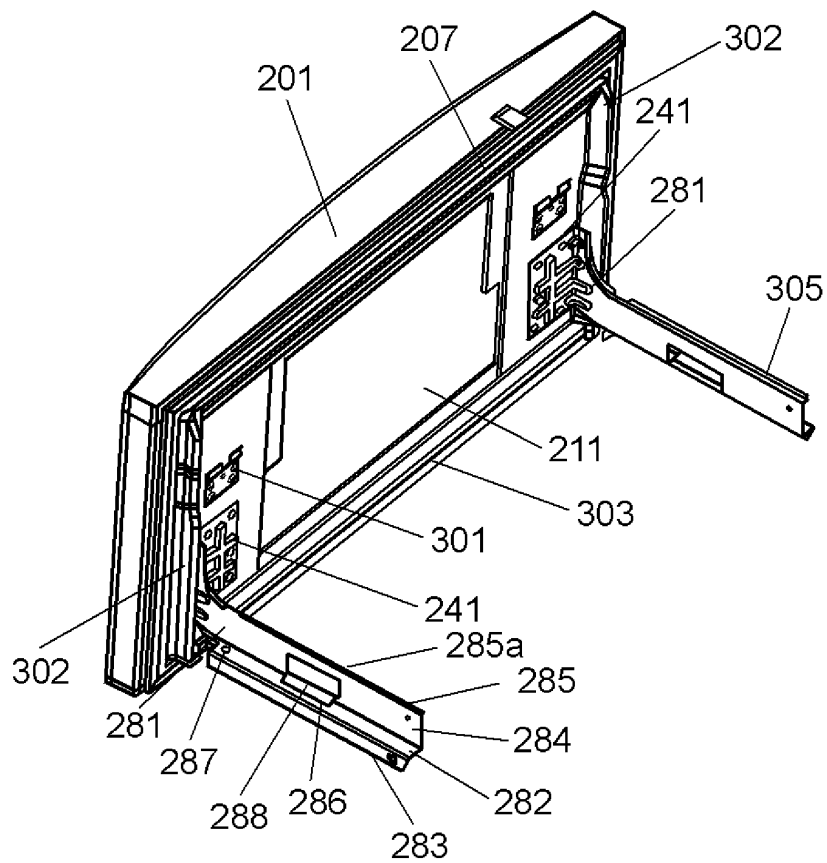
[Fig. 19]



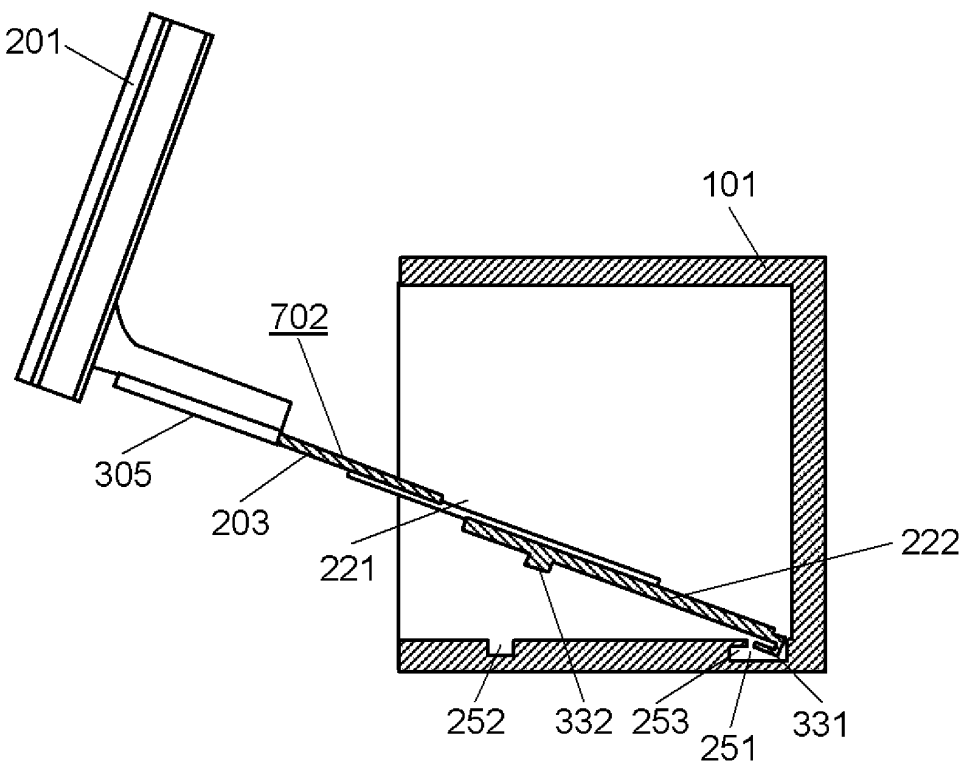
[Fig. 20]



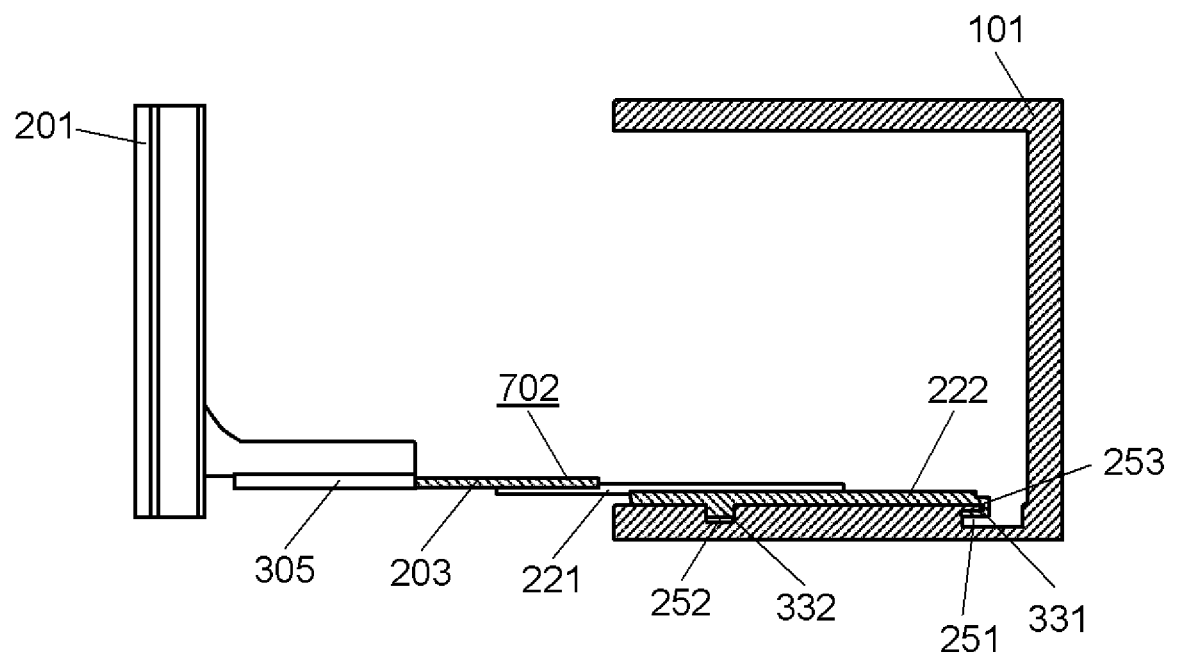
[Fig. 21]



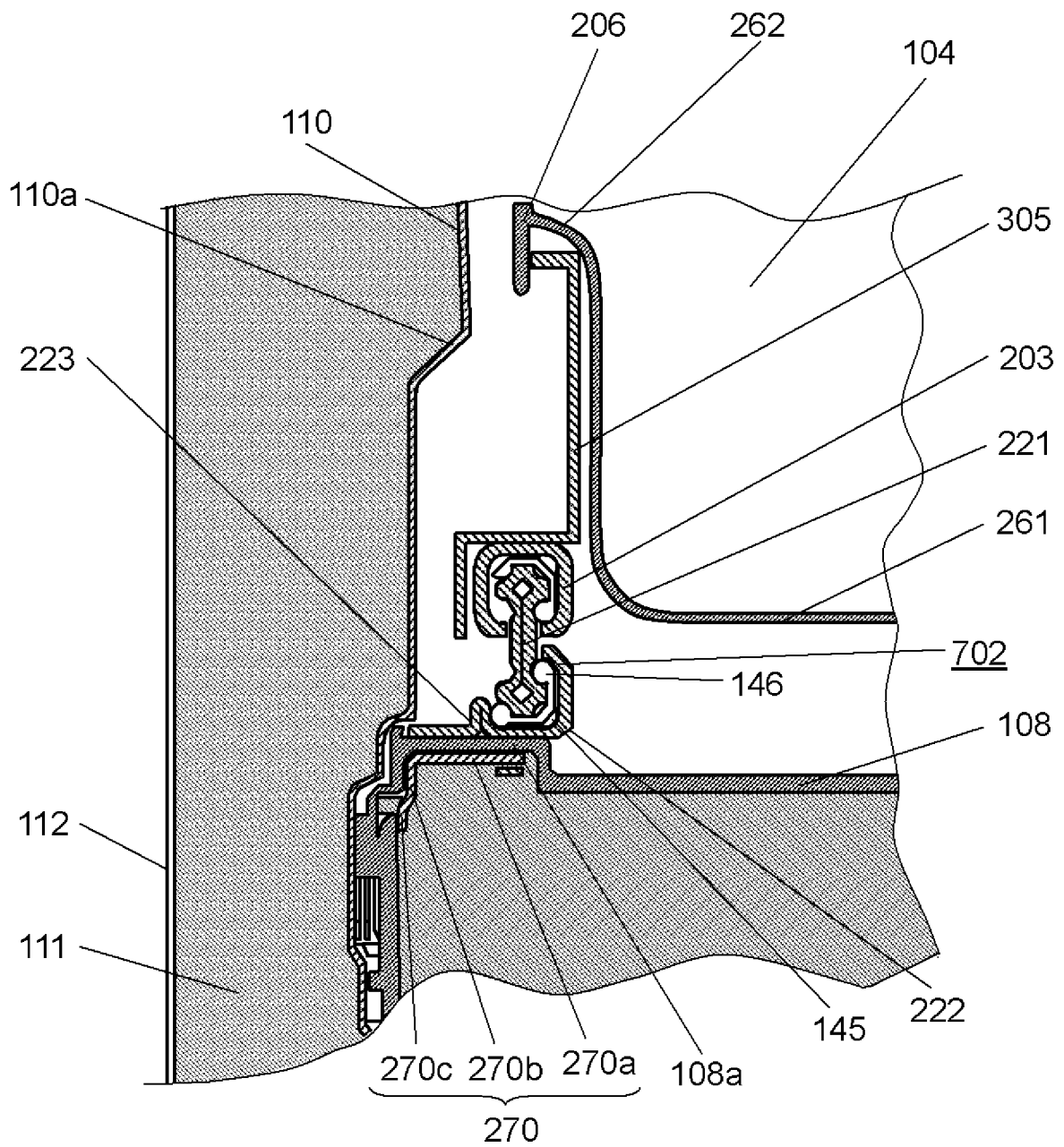
[Fig. 22]



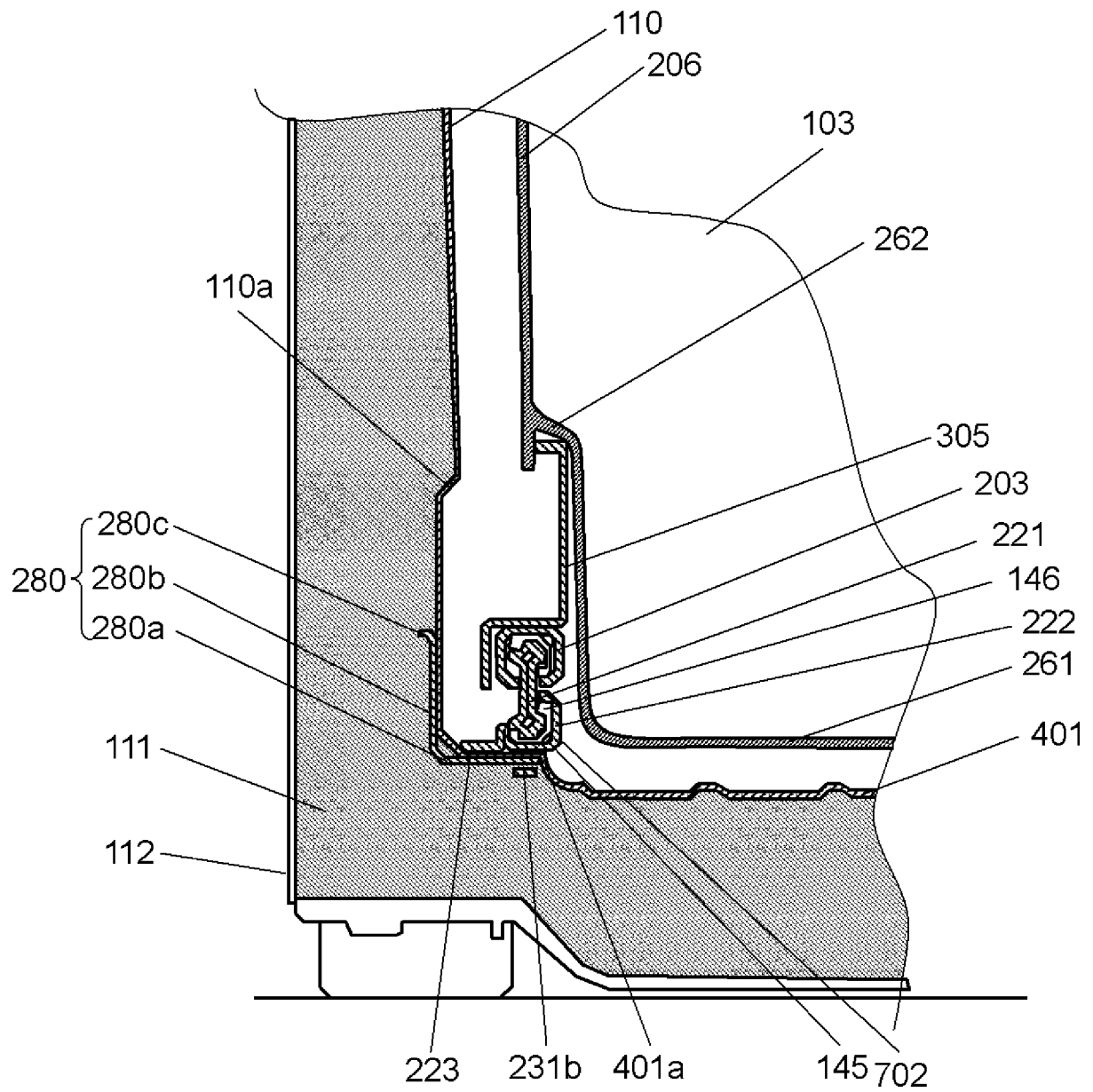
[Fig. 23]



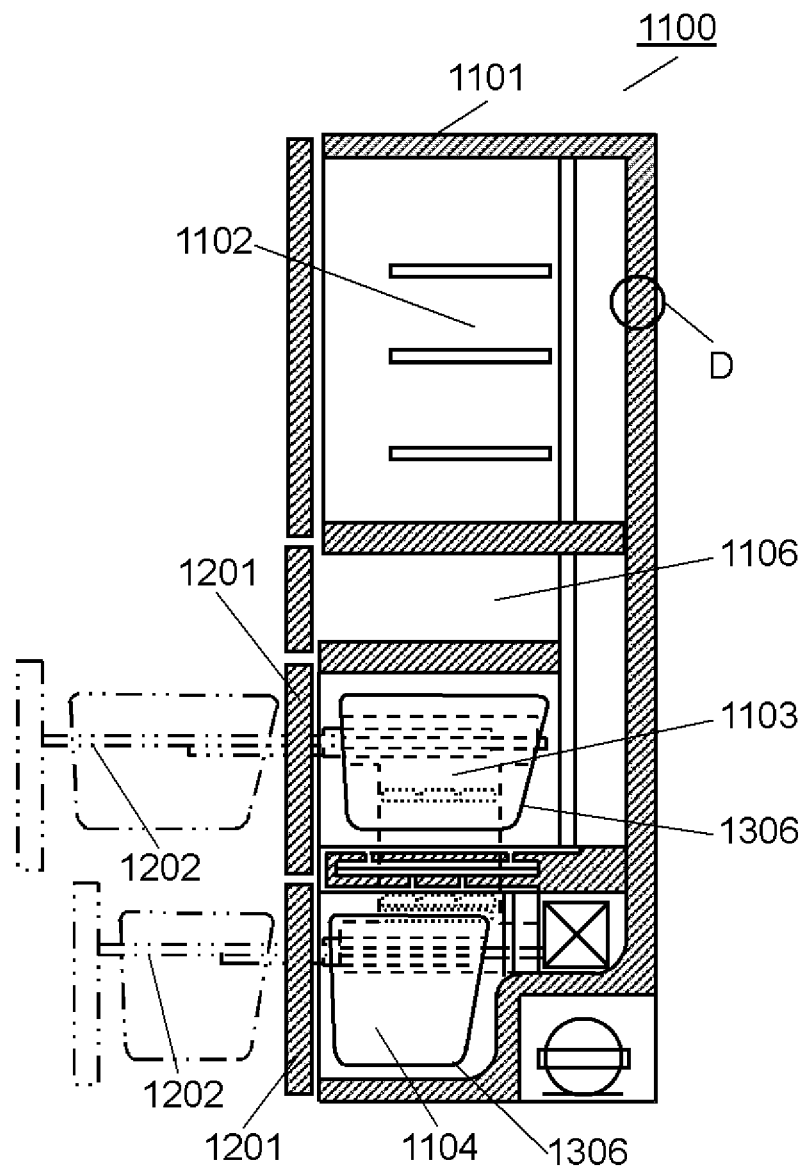
[Fig. 24]



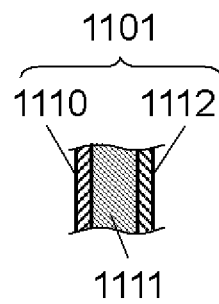
[Fig. 25]



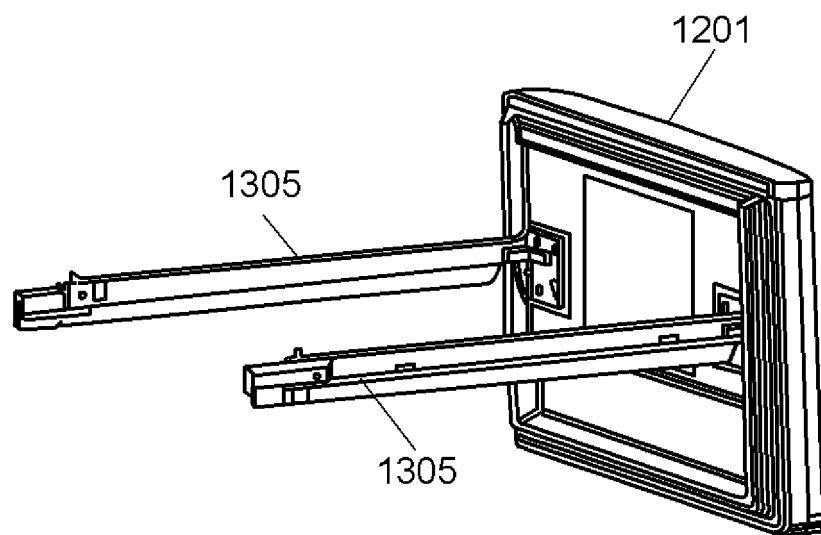
[Fig. 26A]



[Fig. 26B]



[Fig. 27]



REFERENCES CITED IN THE DESCRIPTION

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