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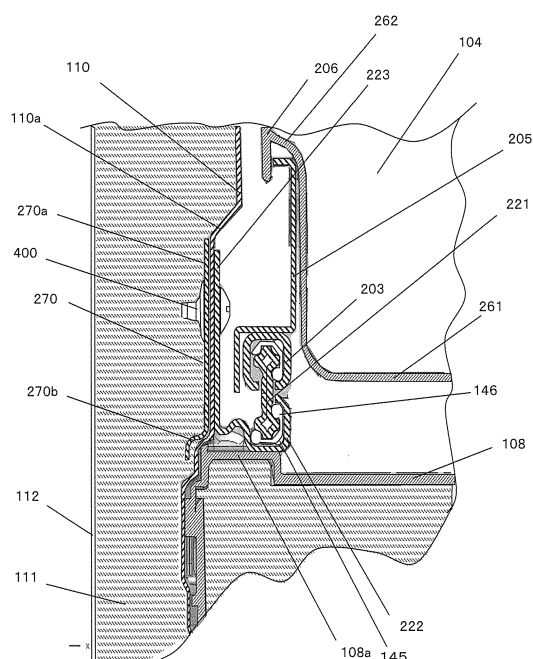
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(54) **REFRIGERATOR**

(57) In a refrigerator, rail devices (202) are connected below the center of a pull-out door (201) in a vertical direction, and connected to two ends thereof in a horizontal direction, and rail holding members (270) are arranged on an inner casing (110) in a heat-insulating material (111) so as to hold both the right and left ends of the bottom of a container (206).

FIG. 10



Description

[Technical Field]

[0001] The present invention relates to refrigerators, and particularly relates to a refrigerator having a pull-out structure for a storage compartment of a pull-out type.

[Background Art]

[0002] Conventionally, a storage compartment of a pull-out type is often provided at a lower part of a refrigerator in consideration of usability, so that items can be stored even in the back without wasting space. There is a demand for such a pull-out storage compartment to allow, for instance, the storage compartment to be smoothly pulled out and pushed back, food to be easily put in and out of the storage compartment, and a container provided inside the storage compartment to be easily attached and detached.

[0003] Now, techniques for improving usability of such a pull-out storage compartment have been disclosed (for example, see Patent Literature (PTL) 1 or 2).

[0004] FIG. 16 is a diagram illustrating a side cross section of a conventional refrigerator 100.

[0005] The conventional refrigerator 100 illustrated in FIG. 16 includes a refrigerator compartment 102, a switchable compartment 106 in which a temperature can be changed, an ice compartment provided next to the switchable compartment 106 (not shown), a vegetable compartment 103, and a freezer compartment 104, as storage compartments in a main body 101.

[0006] The main body 101 is formed using an outer casing 112, an inner casing 110, and a heat-insulating material 111 filled between the outer casing 112 and the inner casing 110.

[0007] A container 206 which is a component of the vegetable compartment 103 is supported by two rail devices 202 connected to a pull-out door 201 of the vegetable compartment 103.

[0008] Also, a container which is a component of the freezer compartment 104 is supported by two rail devices 202 connected to a pull-out door 201 of the freezer compartment 104.

[0009] The vegetable compartment 103 and the freezer compartment 104 both have such a configuration, which allows the compartments 103 and 104 to be pull-out storage compartments which can be pushed into and pulled out of the main body 101.

[0010] Here, a description is given of the pull-out doors 201 for closing open front faces of the conventional refrigerator.

[0011] FIG. 17 is a perspective view illustrating a pull-out door from the back.

[0012] As illustrated in FIG. 17, door frames 205 are attached to the pull-out door 201 in a manner such that the door frames 205 are projecting from and perpendicular to the pull-out door 201. The door frames 205 are

attached to the pull-out door 201, and the rail devices 202 (not shown) provided with a movable rail and a fixed rail are slidably engaged with the door frames 205, which enables the pull-out door 201 to be horizontally pulled out and pushed back while maintaining its vertically upright state.

[0013] FIG. 18 is a cross-sectional view illustrating a relationship between a pull-out door and a container from the back of a refrigerator.

[0014] As illustrated in FIG. 18, the container 206 is provided between the two rail devices 202, and supported by the two rail devices 202 at a substantially middle position in the height direction of the container 206.

[Citation List]

[Patent Literature]

[0015]

[PTL 1] Japanese Unexamined Patent Application Publication No. 2006-177653

[PTL 2] Japanese Unexamined Patent Application Publication No. 2006-214642

[Summary of Invention]

[Technical Problem]

[0016] A trend of a refrigerator in recent years shows an increase in its inner capacity for actually storing items by changing arrangement of the components of the refrigerator, for instance.

[0017] The container provided in a conventional pull-out storage compartment is merely placed on the rail devices. If the inner capacity of the container increases in such a state, the amount of items stored in the container increases, which also increases load exerted on the rail devices. If the pull-out door is open in this state, a still greater load is exerted on the rail devices, and in particular, a stress applied on the ends of the rail devices increases at which the rail devices are attached to the pull-out door.

[0018] An increase in the load exerted on the rail devices may deform the rail devices and cause the rail devices to incline inward. Such a state prevents the pull-out door from smoothly moving forward and backward.

[0019] This is because when the pull-out door is open to the maximum, only the rail devices 202 support the container 206 which moves in conjunction with the opening movement of the pull-out door. Furthermore, the pull-out door having a foam heat insulation inside is at the end of the rail devices 202, and thus in addition to the load of the container 206, the load of the pull-out door 201 is exerted at the end of the rail devices 202. Also, there is a case in which a vacuum heat-insulating material is provided inside the pull-out door 201 for the purpose of energy saving, which further increases the load on the

rail devices 202. Accordingly, the rail devices 202 are deformed by repetitions of the movement for opening and closing the pull-out door 201 for a long period of time. Due to this, even if the pull-out door 201 is brought into contact with the opening of the vegetable compartment 103 or the freezer compartment 104, the opening cannot be completely closed or sealed by a sealing part (not shown) of the pull-out door 201, since the pull-out door 201 is slant relative to the opening. As a result, there is a possibility that the cold air inside the compartment leaks, which prevents the compartment from being cooled to a predetermined temperature.

[0020] The present invention is conceived in order to solve the above conventional problems, and an object thereof is to provide a refrigerator which includes a pull-out storage compartment, and can distribute, in particular, a load exerted on the rail devices while securing a large actual storage capacity of the pull-out storage compartment, reduces slant of the pull-out door due to deformation of the rail devices, and reduces the tilt of the door, thereby securing cooling capability. Furthermore, an object thereof is to provide a refrigerator which avoids a gap being formed at a sealing part due to a tilt of the door, thereby securing cooling capability.

[Solution to Problem]

[0021] In order to solve the above conventional problems, a refrigerator according to the present invention includes: a main body including an inner casing, an outer casing, and a heat-insulating material filled between the inner casing and the outer casing; a storage compartment of a pull-out type formed inside the main body and having an open front face; a pull-out door which opens and closes the open front face of the storage compartment; a partition which makes a separation for the storage compartment of the main body; and rail devices each of which has a fixed rail and a movable rail, is fixed to a wall of the inner casing with the fixed rail and the movable rail previously put together, connects the pull-out door to the main body in an extendable and shortenable manner, and allows a container provided inside the storage compartment to move forward and backward, wherein the rail devices are connected below a center of the pull-out door in a vertical direction and connected to both ends thereof in a horizontal direction, and attached to rail holding members so as to hold both the right and left ends near the bottom of the container, and the rail holding members are arranged on the inner casing in the heat-insulating material.

[0022] With this, the rail devices are attached at both the right and left ends of the bottom of the container, and thus it is possible to avoid projections and recessions being formed in the face of the container in the space from the open top face to the lower bottom of the container, and form the face of the container as a flat face, which achieves an increase in the size and capacity of the container. Furthermore, using the rail holding mem-

bers, it is possible to prevent an inward inclination of the rail devices on which a force causing an inclination toward the inside of the compartment tends to be applied due to an increase in the load on the rail devices caused by an increase in the load from items stored in the container. In addition, the rail devices are attached at both the right and left ends of the bottom of the container, and thus it is possible to increase the size and capacity of the container supported by the rail devices. Furthermore, it is possible to reduce the slant of the pull-out door due to deformation of the rail devices, keep the movement for opening and closing forward and backward smooth, and secure cooling capability.

[0023] A refrigerator according to the present invention includes: a main body including an inner casing, an outer casing, and a heat-insulating material filled between the inner casing and the outer casing; a storage compartment of a pull-out type formed inside the main body and having an open front face; a pull-out door which opens and closes the open front face of the storage compartment; a partition which makes a separation for the storage compartment of the main body; a rail device which has a fixed rail and a movable rail, is fixed to a wall of the inner casing with the fixed rail and the movable rail previously put together, connects the pull-out door and the main body in an extendable and shortenable manner, and allows a container provided inside the storage compartment to move forward and backward; a door frame fixed to the pull-out door and connected to the rail device to hold the container; and a reinforcing plate which fixes the door frame to the pull-out door, wherein the reinforcing plate vertically extends along the pull-out door and is formed as a single member, the door frame is fixed at a lower part of the reinforcing plate, and the container is engaged at an upper part of the reinforcing plate.

[0024] This secures the strength of the pull-out door, and prevents the shift to the right and left. Consequently, it is possible to avoid a gap being formed at the sealing part due to a tilt of the door, and secure a cooling capability.

[Advantageous Effects of Invention]

[0025] A refrigerator of the present invention can reduce the tilt of the rail device, and secure cooling capability and a large actual storage capacity of a pull-out storage compartment.

[Brief Description of Drawings]

[0026]

[FIG. 1] FIG. 1 is a front view of a refrigerator according to Embodiment 1 of the present invention.

[FIG. 2] FIG. 2 is a diagram illustrating a cross section taken along line A-A in FIG. 1.

[FIG. 3] FIG. 3 is a perspective view illustrating a rail device of the refrigerator according to Embodiment

1 of the present invention.

[FIG. 4] FIG. 4 is a perspective view illustrating a pull-out door and rail devices which are connected, and a removable container of the refrigerator according to Embodiment 1 of the present invention.

[FIG. 5] FIG. 5 is a cross-sectional view illustrating an important part when the container illustrated in FIG. 4 is fit in.

[FIG. 6] FIG. 6 is a cross-sectional view illustrating, from the back side, a state where the container is provided between the rail devices of the refrigerator according to Embodiment 1 of the present invention.

[FIG. 7A] FIG. 7A is an enlarged view of an important part illustrating the arrangement of the rail device and the container of the refrigerator according to Embodiment 1 of the present invention.

[FIG. 7B] FIG. 7B is an enlarged view of an important part illustrating the arrangement of the rail device and the container of the refrigerator according to Embodiment 1 of the present invention.

[FIG. 7C] FIG. 7C is an enlarged view of an important part illustrating the arrangement of the rail device and the container of the refrigerator according to Embodiment 1 of the present invention.

[FIG. 8] FIG. 8 is a perspective view illustrating a state in which the container in FIG. 4 is fit in.

[FIG. 9] FIG. 9 is a perspective view of an inner casing and the rail devices according to Embodiment 1 of the present invention.

[FIG. 10] FIG. 10 is a cross-sectional view of portion A in FIG. 9.

[FIG. 11] FIG. 11 is a cross-sectional view of portion B in FIG. 9.

[FIG. 12] FIG. 12 is a perspective view of a rail holding member.

[FIG. 13] FIG. 13 is a perspective view of door frames of the refrigerator according to Embodiment 1 of the present invention.

[FIG. 14] FIG. 14 is a cross-sectional view of portion C in FIG. 13.

[FIG. 15] FIG. 15 is a cross-sectional view of portion D in FIG. 14.

[FIG. 16] FIG. 16 is a cross-sectional view illustrating a conventional refrigerator.

[FIG. 17] FIG. 17 is a perspective view illustrating a conventional relationship between a pull-out door and rails.

[FIG. 18] FIG. 18 is a cross-sectional view illustrating a conventional relationship between a container and the rails.

[Description of Embodiments]

[0027] According to a first aspect of the present invention, a refrigerator includes: a main body including an inner casing, an outer casing, and a heat-insulating material filled between the inner casing and the outer casing; a storage compartment of a pull-out type formed inside

the main body and having an open front face; a pull-out door which opens and closes the open front face of the storage compartment; a partition which makes a separation for the storage compartment of the main body; and rail devices each of which has a fixed rail and a movable rail, is fixed to a wall of the inner casing with the fixed rail and the movable rail previously put together, connects the pull-out door to the main body in an extendable and shortenable manner, and allows a container provided inside the storage compartment to move forward and backward, wherein the rail devices are connected below a center portion of the pull-out door in a vertical direction and connected to both ends in a horizontal direction, and attached to rail holding members so as to hold both the right and left ends of the bottom of the container, and the rail holding members are arranged on the inner casing in the heat-insulating material. Thus, it is possible to increase the size and capacity of the container, secure a large actual storage space in the pull-out storage compartment, and furthermore prevent the rail devices from inclining inward, and open and close the pull-out door smoothly.

[0028] According to a second aspect of the present invention, in the invention according to the first aspect of the present invention, the rail holding members each include an inward inclination prevention portion which prevents a corresponding one of the rail devices from inclining inward. The inward inclination prevention portion is formed integrally with the lower part of the rail holding portion which fixes the rail device, thereby forming a portion in the rail holding member buried in the heat-insulating material at which the rail holding member is tightly fit in the heat-insulating material. Thus, the rail holding members are in close contact with and firmly fixed to the heat-insulating material. Accordingly, even if a load on the rail devices increases, the strength of the rail holding members can be secured, and the rail devices can be prevented from inclining toward the inside of the compartment.

[0029] According to a third aspect of the present invention, in the first or second aspect of the present invention, the rail devices are each disposed at a gap portion provided in a side wall of the inner casing which forms an inner side wall face of the storage compartment, thereby reducing unusable space where the rail device is arranged, and increasing the effective inner capacity of the storage compartment.

[0030] According to a fourth aspect of the present invention, in the first or second aspect of the present invention, the rail devices are each disposed on a step portion provided on the bottom face of the inner casing which forms the bottom of the storage compartment, thereby improving working efficiency when attaching the rail devices, and preventing dew condensation water on the bottom of the storage compartment from being in contact with the rail device. Thus, the dew condensation water does not prevent smooth movement of the rail devices.

[0031] According to a fifth aspect of the present invention, in the first or second aspect of the present invention, the rail devices are each disposed on a step portion provided on a top face of the partition which forms the bottom of the storage compartment, thereby improving working efficiency when attaching the rail devices, and preventing dew condensation water on the bottom of the storage compartment from being in contact with the rail devices. Thus, the dew condensation water does not avoid smooth movement of the rail devices. Further, the wall thickness of the partition is large, and thus it is possible to avoid dew condensation occurring on the top face of the storage compartment at the lower part.

[0032] According to a sixth aspect of the present invention, in any of the first to third aspects of the present invention, a plurality of the pull-out doors are vertically arranged on the refrigerator, and an upper rail holding member and a lowermost rail holding member have different cross sectional shapes, the upper rail holding member holding the rail device which allows the pull-out door arranged at an upper position to be pulled forward and pushed backward, and the lowermost rail holding member holding the rail device which allows the lowermost pull-out door arranged at a lowermost position to be pulled forward and pushed backward. Consequently, when a user opens and closes the pull-out door, the lowermost pull-out door is at a position at which the user easily puts on his or her weight compared to the upper pull-out door, and thus there is a possibility that an external load is also applied thereto in addition to a load due to stored items. The lowermost rail holding member can firmly hold the rail device of the lowermost pull-out door, thereby preventing an inclination of the rail device.

[0033] According to a seventh aspect of the present invention, in the sixth aspect of the present invention, the lowermost rail holding member is a substantially L-shaped member formed along a side wall and a bottom face of the inner casing. Thus, the lowermost rail holding member can be reliably fixed to the rail device with a simple structure.

[0034] According to an eighth aspect of the present invention, in any of the first to seventh aspects of the present invention, a hole is formed in each of the rail holding members to allow the filled heat-insulating material to pass through. This avoids the rail holding members blocking the flow of the heat-insulating material to be filled, and prevents a hollow portion from being formed due to insufficient filling of the heat-insulating material. Thus, the heat-insulating capability as a refrigerator can be improved, and the heat-insulating material is sufficiently filled around the rail holding members. Consequently, it is possible to secure tight fitting of the rail holding member in the heat-insulating material, and maintain the strength of the rail devices.

[0035] A ninth aspect of the present invention is a refrigerator which includes: a main body including an inner casing, an outer casing, and a heat-insulating material filled between the inner casing and the outer casing; a

storage compartment of a pull-out type formed inside the main body and having an open front face; a pull-out door which opens and closes the open front face of the storage compartment; a partition which makes a separation for the storage compartment of the main body; a rail device which has a fixed rail and a movable rail, is fixed to a wall of the inner casing with the fixed rail and the movable rail previously put together, connects the pull-out door and the main body in an extendable and shortenable manner, and allows a container provided inside the storage compartment to move forward and backward; a door frame fixed to the pull-out door and connected to the rail device to hold the container; and a reinforcing plate which fixes the door frame to the pull-out door, wherein the reinforcing plate vertically extends along the pull-out door and is formed as a single member, the door frame is fixed at a lower part of the reinforcing plate, and the container is engaged at an upper part of the reinforcing plate. Thus, the reinforcing plate is vertically disposed along the pull-out door in the upright direction, the strength of the pull-out door is secured with respect to an increase in the moment depending on the distance between vertical positions of a handle part at which the pull-out door is pulled out by holding the upper part thereof and the door frame which holds the container, and the shift to the right and left can be prevented. Thus, it is possible to avoid a gap being formed at the sealing part due to the tilt of the pull-out door relative to the open front face, and to secure a cooling capability.

[0036] According to a tenth aspect of the present invention, in the ninth aspect of the present invention, the rail devices are connected below a center portion of the pull-out door in a vertical direction and connected to both ends in a horizontal direction, and hold both the right and left ends of the bottom of the container, it is possible to avoid projections and recessions being formed in the wall surface of the container in the vertical direction, and thus it is possible to prevent unusable space from being made between stored items and the wall face of the container. Accordingly, the size and capacity of the container can be increased, and a large actual storage space can be secured.

[0037] According to an eleventh aspect of the present invention, in the ninth or tenth aspect of the present invention, the pull-out door includes: an inner door board; an outer door board; and a heat-insulating material that fills, by foaming, a space between the inner door board and the outer door board, and the reinforcing plate is provided in contact with the inner door board in the space. Thus, a shift of the pull-out door and the deformation of the door frame can be prevented.

[0038] According to a twelfth aspect of the present invention, in the eleventh aspect of the present invention, the reinforcing plate includes a reinforcing plate flange portion extending toward the outer door board. Accordingly, an area in which the reinforcing plate is tightly fit in the heat-insulating material can be increased, and thus it is possible to prevent an inclination of the door frame,

and maintain the strength of the reinforcing plate.

[0039] According to a thirteenth aspect of the present invention, in the twelfth aspect of the present invention, a hole is formed in the reinforcing plate flange portion to allow the heat-insulating material to pass through. Thus, it is possible to prevent, around the reinforcing plate, formation of a hollow in which the heat-insulating material is not filled, and smoothly fill the heat-insulating material.

[0040] According to a fourteenth aspect of the present invention, in any of the ninth to thirteenth aspects of the present invention, a bead is formed at a position corresponding to a part of the reinforcing plate to which the door frame is attached. Accordingly, even if a moment on the door frame is large, the rigidity of the reinforcing plate itself can be secured, and the deformation thereof can be prevented.

[0041] The following is a description of embodiments of the present invention with reference to the drawings, and the same numeral is given to the same configuration as that in a conventional example or a previously described embodiment, and thus a detailed description thereof is omitted. The present invention is not limited by the embodiments below.

[Embodiment 1]

[0042] FIG. 1 is a front view of a refrigerator according to Embodiment 1 of the present invention.

[0043] As illustrated in FIG. 1, a refrigerator 100 according to the present embodiment includes side-by-side doors at the upper part, and storage compartments obtained by partitioning the inside of a main body 101 which separates the inside and outside of the refrigerator 100 in a heat-insulating state.

[0044] The storage compartments obtained by partitioning the inside of the refrigerator 100 may be referred to as a refrigerator compartment 102, an ice compartment 105, a switchable compartment 106 in which the temperature can be switched, a vegetable compartment 103, a freezer compartment 104, and others, depending on the function (cooling temperature).

[0045] A rotating heat-insulating door 107 in which, for example, a foam heat-insulating material such as urethane has foamed and fills is provided at an open front face of the refrigerator compartment 102 positioned at the uppermost part of the refrigerator 100. The refrigerator compartment 102 is a storage space having shelves.

[0046] Furthermore, the ice compartment 105, the switchable compartment 106, the vegetable compartment 103, and the freezer compartment 104 which are provided below the refrigerator compartment 102 are pull-out storage spaces.

[0047] The main body 101 is a body formed by filling a heat-insulating material 111 such as hard foam urethane between an outer casing 112 made of metal and an inner casing 110 made of resin, and is a cuboidal body having at least one open face. The main body 101 has a function of blocking heat entering from the outer atmos-

phere (outer air) to the inside of the main body 101.

[0048] The refrigerator compartment 102 is a storage compartment for storing items under refrigeration in which a temperature is maintained to a low temperature at which the stored items are not frozen. Specifically, the lowest temperature is usually set to 1 to 5°C.

[0049] The vegetable compartment 103 is a storage compartment provided at the lowermost part of the main body 101, and is a storage compartment mainly used for refrigerating vegetables. The vegetable compartment 103 is set to the same temperature as or a slightly higher temperature than that of the refrigerator compartment 102. Specifically, the lowest temperature is 2 to 7°C. It should be noted that the lower the temperature is, the longer the freshness of green leaves can be preserved.

[0050] The freezer compartment 104 is a storage compartment in which the temperature is set to a freezing temperature zone. Specifically, the temperature of the freezer compartment 104 is usually set to -22 to -18°C; however, the temperature may be set to a lower temperature, for example, -30 to -25°C, to improve the freezing storage state.

[0051] The ice compartment 105 is a storage compartment in which an ice maker (not illustrated) is provided to make ice, and is a compartment for storing the ice made by the ice maker. The temperature of the ice compartment 105 is set to a temperature substantially equal to that of the freezer compartment 104.

[0052] The temperature of the switchable compartment 106 may be switched from a refrigeration temperature zone to the freezing temperature zone depending on the usage, by using the operation board attached to the refrigerator 100.

[0053] Partitions 108 are each provided between temperature zones in the main body 101, for partition into a plurality of different temperature zones.

[0054] FIG. 2 is a vertical cross-sectional view of the refrigerator according to Embodiment 1 of the present invention, and illustrates a cross-section taken along line A-A in FIG. 1.

[0055] As illustrated in FIG. 2, each pull-out storage compartment among the storage compartments included in the refrigerator 100 is provided with a pull-out door 201 which closes an open front face, and rail devices 202 which connect the pull-out door 201 and the main body 101 in an extendable and shortenable manner, and allow a container 206 provided inside the storage compartment to move forward and backward. Furthermore, the refrigerator 100 includes door frames 205 and the containers 206.

[0056] Here, the door frame 205 corresponds to a reinforcing member.

[0057] The pull-out door 201 is a board-shaped member capable of opening and closing the opening of the storage compartment, and has insulation property. The pull-out door 201 includes a gasket 207 at the periphery on the back side. The gasket 207 is in close contact with the main body 101 in the state where the pull-out door

201 closes the opening of the storage compartment, and prevents the cold air from leaking.

[0058] FIG. 3 is a perspective view illustrating the rail device of the refrigerator according to Embodiment 1 of the present invention.

[0059] As illustrated in FIG. 3, the rail device 202 has three rails arranged in three layers, and can extend and shorten as a whole by having a second rail (middle rail 221) movable with respect to a first rail (cabinet rail 222), and a third rail (top rail 203) movable with respect to the second rail (middle rail 221).

[0060] The top rail 203 and the middle rail 221 each correspond to a "movable rail" in the claims, and the cabinet rail 222 corresponds to a "fixed rail" in the claims.

[0061] The fixed rail and the movable rails are each supported by a rotation supporting member (not illustrated), and the rail device 202 is fixed to the wall of the inner casing 110 with the fixed rail and the movable rails previously put together.

[0062] A rail attachment portion 223 included in the cabinet rail 222 of the rail device 202 is attached to the inner casing 110 of the main body 101, and the top rail 203, the middle rail 221, and the cabinet rail 222 of the rail device 202 are slidable with respect to one another. Consequently, the rail device 202 is extendable and shortenable as a whole. Accordingly, the pull-out doors 201 can be pulled out from or pushed back to the main body 101 along the extension and shortening track of the rail devices 202.

[0063] Specifically, between upper and lower flanges of the middle rail 221, the cabinet rail 222 holds a portion having the lower flange in its center, via a plurality of bearings 145 (see FIGS. 10 and 11).

[0064] The cabinet rail 222 supports the middle rail 221 in three directions via the plurality of bearings 145 in the cross sections, thereby holding and allowing the middle rail 221 to move in the lengthwise direction.

[0065] The top rail 203 holds a portion having the upper flange of the middle rail 221 in its center, via a plurality of bearings 145. The top rail 203 also supports the middle rail 221 in three directions via the plurality of bearings 145 in the cross sections, thereby holding and allowing the middle rail 221 to move in the lengthwise direction.

[0066] The cabinet rail 222, the middle rail 221, and the top rail 203 are put together in this way, thereby allowing the middle rail 221 to move on the cabinet rail 222 in its lengthwise direction.

[0067] Furthermore, the top rail 203 is movable on the middle rail 221 in its lengthwise direction. Specifically, the top rail 203 is movable on the cabinet rail 222 in its lengthwise direction via the middle rail 221.

[0068] The rotation of the plurality of bearings 145 allows the middle rail 221 and the top rail 203 to move smoothly when the rails are moving in the above described manner.

[0069] FIG. 4 is a perspective view illustrating the state where the pull-out door and the rail devices are connected via the door frames of the refrigerator according to

Embodiment 1 of the present invention.

[0070] As illustrated in FIG. 4, the pull-out door 201 includes an inner board 211 which covers the front of the main body 101 and the door frames 205. The inner board 211 is one of the members composing the pull-out door 201, and is a plate-shaped member formed by vacuum molding. The door frames 205 directly fixed to the inner board 211 are each connected to the top rail 203 using fastening members and the like. The pull-out door 201 can be pulled out and pushed back, using the function of the rail devices 202.

[0071] The inner board 211 of the pull-out door 201 includes first fixing parts 301 which fix the container 206 to the pull-out door 201, in order to reduce concentration of the stress on the base end portion of the top rails 223, the stress occurring when pushing and pulling the pull-out door 201, particularly by holding a top end portion of the pull-out door 201. The first fixing parts 301 are each provided at a position at which a front flange portion 206a is fixed which has a substantially L-shaped cross section and is formed at an open top face of the container 206, when the container 206 is placed on the rail devices 202. Then, the front flange portion 206a is inserted, from above, into the first fixing parts 301 formed so as to have a substantially L-shaped cross section and be in an insert state, and fixed.

[0072] The first fixing parts 301 are each a metal member fixed, via the inner board 211, to a planar metal plate (not illustrated) fixed in a foam heat-insulating material on the back side of the inner board 211 using fastening members and the like. Then, the front flange portion 206a is inserted into the first fixing parts 301 from above, and fixed. The door frames 205 each include a bend portion 241 obtained by bending the end thereof along the inner board 211 of the pull-out door 201. The bent parts 241 are each fixed, via the inner board 211, to a planar metal plate (not illustrated) fixed in the foam heat-insulating material on the back side of the inner board 211 using fastening members and the like.

[0073] As described above, the front flange portion 206a of the container 206 is fixed using the first fixing parts 301 provided at the upper part of the inner board 211 of the pull-out door 201, thereby adding strength to insufficient strength of attach portions of the pull-out door 201 and the rail devices 202 attached to a lower part of the pull-out door 201. This allows smoothly opening and closing the pull-out door.

[0074] A second fixing portion 303 formed integrally with the inner board 211 is a going-up prevention member which has a projecting form and abuts against a peripheral portion 304 forming the open top face of the container 206, thereby preventing the front flange portion 206a from going upward.

[0075] As illustrated in FIG. 4, the second fixing portion 303 is provided between the first fixing parts 301 provided on both the right and left sides.

[0076] As illustrated in FIG. 5, the removable container 206 is fit in from above the pull-out door 201, the front

flange portion 206a is inserted into the first fixing parts 301 as described above, and the peripheral portion 304 forming the open top face of the container 206 abuts the second fixing portion 303 at the upper part. In other words, the first fixing parts 301 support and fix the front part of the container 206 from below, and the second fixing portion 303 supports and fixes the front part of the container 206 from above, thereby fixing the front part of the container 206 to the inner board 211. Consequently, the inner board 211 supports and fixes the upper part of the container 206, and thus it is possible to add strength to insufficient strength at the attachment part of the pull-out door 201 and the rail devices 202 attached to the lower part of the pull-out door 201, which allows the pull-out door 201 to smoothly open and close.

[0077] Furthermore, even when the pull-out door 201 is pulled out or pushed back by holding the pull-out door 201, the stress is not concentrated on the attachment part of the top rails 223, but is dispersed to the parts connected via the bend portions 241 and the door frames 205. Thus, it is possible to increase the strength of attachment between the pull-out door 201 and the top rails 223 as a whole. This is particularly effective in the case of the present embodiment, in which the top rails 223 are attached to the lower part of the pull-out door 201.

[0078] If the pull-out door 201 is opened and closed forward and backward with the rail devices 202 provided below the center of the pull-out door 201 in the vertical direction as with the position in the present embodiment, using the door frames 205 having a minimum strength necessary when the rail devices 202 are attached near the center of the pull-out door 201 in the vertical direction, the door frames 205 or the inner board 211 may be deformed due to the insufficient strength on a side where the door frames 205 are fixed to the pull-out door 201. As a result, the gasket 207 provided on the pull-out door 201 may be detached from the main body 101, causing a gap, and this may lead to a defect of the quality of the refrigerator such as frost inside.

[0079] If the attachment part of the pull-out door 201 and the top rails 223 is at a lower part of the pull-out door 201, the moment on the attachment part is relatively large when the pull-out door 201 is pulled out or pushed back by holding the upper part of the pull-out door 201. However, in the present embodiment, the first fixing parts 301 or the second fixing portion 303, or all the first fixing parts 301 and the second fixing portion 303 are provided above the attachment part so as to fix the container 206. Accordingly, the moment on the attachment part is small, protecting the attachment part of the top rails 203 from being broken. More specifically, in the present embodiment, by providing the pull-out door 201 with the first fixing parts 301 and/or the second fixing portion 303, it is possible to set a supporting point of the tension in an upper part.

[0080] Furthermore, as described above, the first fixing parts 301 and the inner board 211 are formed separately, and the second fixing portion 303 is formed integrally with

the inner board 211. For this reason, by forming the first fixing parts 301 which form a structure for fixing the front flange portion 206a of the container 206 using a metal component separate from the inner board 211, it is possible to maintain the container 206 fixed along with the movement of the pull-out door 201, even if items are stored in the container 206. Furthermore, the number of components is reduced by forming the second fixing portion 303 integrally with the inner board 211.

[0081] FIG. 6 is a cross-sectional view illustrating, from the back side, the state where the container is provided between the rail devices of the refrigerator according to Embodiment 1 of the present invention.

[0082] As illustrated in FIG. 6, the container 206 is a container for housing, for instance, vegetables, drinks filled in plastic bottles, and frozen food, and is a casing made of resin having an open top face. The container 206 includes a narrow-width part 261 having a narrow width so that raised portions 262 facing inward are formed at both end portions at a lower part. The container 206 is supported by the top rails 223 when the narrow-width part 261 is provided between the two top rails 203, and the raised portions 262 are placed on the top faces of the door frames 205.

[0083] The narrow-width part 261 which is the bottom of the container 206 is provided above the rail devices 202, and is formed so as to be movable forward and backward.

[0084] As described above, the top rails 203 are provided at both corners at the lower part of the pull-out door 201, which can increase the size of the narrow-width part 261 which has a narrow width in the container 206 as much as possible. Accordingly, a shape which makes the storage capacity as large as possible can be used for the container 206.

[0085] FIGS. 7A, 7B, and 7C are important part enlarged views illustrating the arrangement of the rail device and the container of the refrigerator according to Embodiment 1 of the present invention.

[0086] In the present embodiment, as illustrated in FIG. 7A, the container 206 includes the narrow-width part 261 having a narrow width such that the raised portion 262 facing inward is formed at each of two end portions at the lower part toward the back of the container 206. However, as illustrated in FIGS. 7B and 7C, the side face of the container 206 may be substantially flat, and without providing the container 206 with the raised portions 262, the rail devices 202 may be supported by the side of the right and left edges of the bottom of the container 206 (see FIG. 7B), or the rail devices 202 may be supported under the right and left edges of the bottom of the container 206 (see FIG. 7C). It should be noted that FIGS. 7A, 7B, and 7C illustrate the positional relationship between the rail device 202 and the container 206, and the door frame 205 is omitted from the illustration.

[0087] In the case as shown in FIG. 7A, the raised portions 262 provided on both sides of the container 206 include projections 206b and 206c formed integrally with

the container 206 as shown in FIG. 4. The front projection 206b is formed at the front side portion of the container 206, and the back projection 206c is formed at the back side portion of the container 206. These projections are inserted into fixing holes 205a and 205b formed in the door frame.

[0088] The fixing holes 205a may each have a cut-out shape. The front projection 206b is inserted into the fixing hole 205a and positioned, and the back projection 206c is inserted into the fixing hole 205b formed at the back part of the door frame 205.

[0089] As illustrated in FIGS. 4 and 8, by shaping the back projection 206c so as to incline downward toward the back of the door frame 205, it is possible to prevent the back projection 206c inserted into the fixing hole 205b from easily coming out of the back fixed hole 205b.

[0090] As described above in particular, the back projection 206c and the door frame 205 are fixed on the backside while the front flange portion 206a of the container 206 is fixed to the pull-out door 201 on the front side, thereby adding strength to insufficient strength of the attachment part of the pull-out door 201 and the rail devices 202 attached to the lower part of the pull-out door 201. This allows the pull-out door to be smoothly opened and closed.

[0091] Specifically, a moment on the attachment part is small, and thus it is possible to protect the attachment part of the top rail 203 and the attachment part of the rail fixing part from being broken. Specifically, in the present embodiment, the front flange portion 206a of the container 206 is fixed to the pull-out door 201 provided with the first fixing parts 301 and/or the second fixing portion 303, and furthermore the back projection 206c of the container 206 is inserted into the fixing hole 205b provided in the door frame 205 and fixed, thereby causing the position of the supporting point of the tension to be behind the pull-out door 201.

[0092] Next, as illustrated in FIG. 9, the rail attachment portions 223 formed integrally with the cabinet rails 222 are provided such that the faces thereof are in contact with the side part of the inner casing 110, and fixed onto the side part of the inner casing 110 using fastening members 400.

[0093] At this time, the inner casing 110 which is the attachment face is mainly formed with resin, and thus even if the rail attachment portions 223 are directly fixed to the inner casing 110 using fastening members, the strength for bearing the load exerted on the rail devices 202 cannot be secured. In view of this, as means to reliably fix the rail devices 202, the rail attachment portions 223 of the rail devices 202 are each attached, via the inner casing 110, to a rail holding member 270 buried in the heat-insulating material 111.

[0094] The rail holding members 270 are formed mainly using metal material such as iron. The rail holding members 270 are each fixed at a predetermined position on the inner face of the inner casing 110 previously, and thereafter foam heat-insulating material is filled between

the inner casing 110 and the outer casing 112, thereby burying the rail holding members 270 in the heat-insulating material 111. This improves the holding force of the rail holding members 270.

[0095] Specifically, in the case of the freezer compartment 104 formed in the substantially center position in the layout of the refrigerator 100, the rail holding members 270 are provided above the partition 108 between the freezer compartment 104 and the vegetable compartment 103 provided below the freezer compartment 104.

[0096] Portion A shows a perspective view in which the rail device 202 which holds the container 206 of the freezer compartment 104 and the rail holding member 270 are provided on the inner casing 110, and will be described using FIG. 10 illustrating an important part cross-sectional view of portion A. Portion B shows a perspective view in which the rail device 202 which holds the container 206 of the vegetable compartment 103 and a rail holding member 280 are provided on the inner casing 110, and will be described using FIG. 11 illustrating an important part cross-sectional view of portion B.

[0097] As illustrated in FIG. 10, the rail holding member 270 has a rail holding portion 270a fixed to the rail attachment portion 223 of the rail device 202 using the fastening members 400 and an integrally formed inward inclination prevention portion 270b which prevents the rail device 202 from inclining inward. The inward inclination prevention portion 270b is a lateral flange portion formed integrally with a lower part of the rail holding portion 270a which is provided in close contact with the inner casing 110.

[0098] Specifically, the inward inclination prevention portion 270b is formed so as to be separate from the inner casing 110 and bent, toward the outer casing 112, at the lower part of the rail holding portion 270a which is a vertical flange portion formed in close contact with the inner casing 110 in the heat-insulating material 111, and the inward inclination prevention portion 270b is formed so as to be further bent downward. Then, the faces of the lateral flange portion of the inward inclination prevention portion 270b are in contact with the filled heat-insulating material 111, and furthermore, the lateral flange portion is tightly fit in the heat-insulating material. Thus, the rail holding portion 270a is fixed by the inward inclination prevention portion 270b, and the strength of the rail holding member 270 can be secured. Accordingly, it is possible to prevent the rail attachment portion 223 from inclining toward the inside of the freezer compartment, and furthermore, prevent the rail device 202 from inclining toward the inside of the compartment, thereby allowing the pull-out door 201 to be opened and closed smoothly.

[0099] The inward inclination prevention portion 270b which is the lateral flange portion may be integrally formed so as to be bent at the lower part of the rail holding portion 270a. Furthermore, the inward inclination prevention portion 270b may be formed at each of both the upper and lower parts. Consequently, the faces of the lateral

flange portions at the upper part and the lower part relative to the rail holding portion 270a are in contact with the heat-insulating material 111, and furthermore, the lateral flange portions at the upper and lower parts are tightly fit in the heat-insulating material. Thus, it is possible to further secure the strength of the rail holding member 270, and prevent the rail attachment portion 223 from inclining toward the inside of the freezer compartment, and the rail device 202 from inclining toward the inside of the compartment.

[0100] In FIG. 10, the partition 108 which is a bottom face of the freezer compartment 104 has a bottom step portion 108a formed on each of two sides, and the bottom step portions 108a are formed toward the back so as to be higher than the center portion serving as the reference face of the partition 108 by one step.

[0101] The rail device 202 is provided on the bottom step portion 108a. A side gap portion 110a is formed in the side wall portion of the inner casing 110 to which the rail device 202 is fixed. The side gap portion 110a is formed so as to be depressed toward the outer casing 112 and make the wall thickness thinner than that of the upper side wall portion of the freezer compartment 104.

[0102] The rail attachment portion 223 is fixed to the metal rail holding member 270 using the fastening members 400, with the side gap portion 110a therebetween.

[0103] Thus, the rail devices 202 are placed on the bottom step portions 108a, and fixed at the side gap portions 110a using fastening members. This can avoid the rail devices 202 protruding in the storage space, increase a total width size of the container 206 in the freezer compartment 104, and reduce unusable space.

[0104] The rail devices 202 are assembled, being placed on the bottom step portions 108a, which improves working efficiency. The thickness of the partition 108 is large at the bottom step portions 108a, which prevents dew condensation from occurring on the partition 108 which is a top face of the vegetable compartment 103 provided below the freezer compartment 104, due to the metal rail devices 202 in the freezer compartment 104 being cooled.

[0105] Furthermore, since the bottom step portions 108a are provided, the rail devices 202 will not be in contact with dew condensation water even if dew condensation water is in the center portion which is the reference face of the partition 108. Accordingly, the dew condensation water will not freeze, and the rails of the rail devices 202 do not stick to one another. This allows the pull-out door 201 to be opened and closed smoothly.

[0106] The door frames 205 are fixed onto the top face of the top rails 203 of the rail devices 202 using fastening members, and the raised portions 262 of the container 206 are placed on the top face portions of the door frames 205.

[0107] As illustrated in FIG. 11, the rail holding member 280 of the vegetable compartment 103 formed at the lowermost part is provided in the heat-insulating material 111. A rail holding portion 280a which is a part of the rail

holding member 280 and formed by substantially L-shaped vertical and lateral flange portions is in close contact with the side face portion and the bottom face portion of the inner casing 110. An inward inclination prevention portion 280b which is formed integrally with the lateral flange portion which is a bottom face portion of the rail holding portion 280a, and formed as a lower flange portion formed downward in a direction separating from the inner casing 110 is formed integrally with the rail holding portion 280a.

[0108] The lateral flange included in the rail holding member 280 of the vegetable compartment 103 formed at the lowermost part has a wider width than that of the lateral flange included in the rail holding member 270 of the freezer compartment 104 provided thereabove.

[0109] The inward inclination prevention portion 280b is buried in the heat-insulating material 111 as the lower flange portion formed downward, and thus even if a moment is applied to the rail attachment portion 223 in the direction in which the rail device 202 inclines toward the inside of the vegetable compartment, the inward inclination prevention portion 280b which is the lower flange portion is held by the heat-insulating material 111 filled at that lower portion. Consequently, it is possible to prevent inclination, further secure the strength of the rail holding member 280, and prevent the rail device 202 of the vegetable compartment 103 from inclining toward the inside of the compartment.

[0110] In FIG. 11, a bottom face 401 of the vegetable compartment 103 has a bottom step portion 401a formed on each of two sides, and the bottom step portions 401a are formed toward the back so as to be higher than the center portion serving as the reference face of the bottom face 401 by one step.

[0111] The rail device 202 is provided on the bottom step portion 401a. A side gap portion 110a is formed in the side wall portion of the inner casing 110 to which the rail device 202 is fixed. The side gap portion 110a is formed so as to be depressed toward the outer casing 112 and make the wall thickness thinner than that of the upper side wall portion of the vegetable compartment 103.

[0112] The rail attachment portion 223 is fixed to the metal rail holding member 280 on the side face using the fastening members 400, with the side gap portion 110a therebetween.

[0113] Thus, the rail devices 202 are placed on the bottom step portions 401a, and fixed at the side gap portions 110a using fastening members. This can prevent the rail devices 202 from protruding in the storage space, increase a total width size of the container 206 in the vegetable compartment 103, and reduce unusable space.

[0114] The rail devices 202 are assembled, being placed on the bottom step portions 401a, which improves working efficiency. The thickness of the bottom face 401 is large at the bottom step portions 401a, which secures insulation properties.

[0115] Furthermore, since the bottom step portions 401a are provided, the rail devices 202 will not be in contact with dew condensation water even if dew condensation water is in the center portion which is the reference face of the bottom face 401. Accordingly, the dew condensation water will not freeze, and the rails of the rail devices 202 do not stick to one another. This allows the pull-out door 201 to be opened and closed smoothly.

[0116] The pull-out door 201 of the lowermost vegetable compartment 103 is below the pull-out door 201 of the freezer compartment 104 at an upper position, and is at a position at which a user easily puts on his or her weight when the user pulls out the pull-out door 201 of the lowermost vegetable compartment 103. Thus, there is a possibility that an external load is also applied thereto in addition to the load due to stored items. The rail holding members 280 are each obtained by integrally forming the substantially L shaped rail holding portion 280a and the inward inclination prevention portion 280b which is the lower flange portion, and thus can firmly hold the rail devices 202 of the lowermost pull-out door 201, thereby preventing an inclination of the rail devices 202.

[0117] Furthermore, the lateral flanges included in the rail holding members 280 of the vegetable compartment 103 have a wider width than that of the lateral flanges included in the rail holding members 270 of the freezer compartment 104 at an upper position, and thus can firmly hold the rail devices 202 of the lowermost pull-out door 201, thereby preventing an inclination of the rail devices 202.

[0118] The thickness of the side faces of both the freezer compartment 104 and the vegetable compartment 103 is thin due to the side gap portions 110a, and thus a vacuum heat-insulating material (not shown) is attached to the outer casing 112 in correspondence with portions in which the rail devices 202 are provided, or specifically, a vacuum heat-insulating material having a larger size in the upright direction than the length between the rail devices 202 of the freezer compartment 104 and the vegetable compartment 103 is attached to the outer casing 112, thereby securing insulation properties.

[0119] As described above, the rail devices 202 are fixed to the rail holding members 270 at the side walls using the fastening members 400, and the rail devices 202 of the freezer compartment 104 are placed on the partition 108, and fixed to the rail holding members 270 via the rail attachment portions 223 using fastening members. In this case, the stress on the rail holding members 270 can be reduced, thereby preventing the rail devices 202 from inclining inward.

[0120] Similarly, the rail holding members 280 holding the rail devices 202 of the vegetable compartment 103 may be placed on corner portions of the bottom of the inner casing which forms a space in the vegetable compartment, and fixed using fastening members, and it is possible to prevent the rail devices 202 from inclining inward since the stress on the rail holding members 280 can be reduced.

[0121] FIG. 12 is a perspective view of the rail holding member 280. A plurality of holes 290 are formed in the rail holding member 280, and the filled heat-insulating material 111 comes into the holes 290, and adheres to the inner casing 110, thereby fixing the rail holding member 280 to the inner casing 110 in a close contact manner.

[0122] The holes 290 are formed in the rail holding portion 280a, and allow the rail holding member to be firmly fixed using the heat-insulating material 111, and furthermore, to be firmly held on the inner casing. It is possible to prevent the rail devices 202 from inclining inward, and to open and close the pull-out door smoothly. In addition, the rail holding members 270 also include the holes 290 as with the above description, and equivalent effects are achieved.

[0123] In the present embodiment, the refrigerator compartment 102 is provided at the upper part, the freezer compartment 104 is provided at a substantially middle part, and the vegetable compartment 103 is provided at the lowermost part. However, the arrangement may be adopted in which the pull-out freezer compartment 104 is provided at the lowermost part while the pull-out vegetable compartment 103 is provided above the freezer compartment 104, which allows equivalent effects to be achieved.

[Embodiment 2]

[0124] Next is a description of another embodiment.

[0125] FIG. 13 is a perspective view illustrating a state in which door frames and a pull-out door of a refrigerator in another embodiment are connected, and the pull-out door and fixing parts for fixing a removable container are connected.

[0126] As illustrated in FIG. 13, first fixing parts 301 that fix a container 206 to a pull-out door 201 are fixed to an inner board 211 of the pull-out door 201 on the inner compartment side using, for instance, fastening members. Bend portions 241 of door frames 205 are fixed to the inner board 211 using, for instance, fastening members.

[0127] Portion C in FIG. 13 shows a perspective view in which the first fixing parts 301 and the bend portions 241 are attached to the inner board 211, and a description is given of FIG. 14 illustrating an important part cross-sectional view of portion C.

[0128] As illustrated in FIG. 14, a reinforcing plate 500 provided in the outside of the compartment in which a heat-insulating material of the inner board 211 is provided is a planar metal plate which vertically extends along the inner board 211 and formed as a single member. The two reinforcing plates 500 which are independent in correspondence with the right and left door frames 205 connected to the inner board 211 of the pull-out door 201 are buried on the right and left sides of the pull-out door 201.

[0129] The first fixing part 301 that connects the container 206 to the pull-out door 201 is fixed to an upper

part 500a of the reinforcing plate 500, using, for instance, fastening members via the inner board 211. The bend portion 241 bent along the inner board 211 of the door frame 205 is attached to a lower part 500b of the reinforcing plate 500 via the inner board 211, using fastening members, for instance.

[0130] Since a bead 241a is formed on the bend portion 241, the rigidity of the bend portion 241 can be increased, thereby securing the rigidity of the reinforcing plate 500 itself and preventing deformation thereof even if a moment on the door frame 205 is large.

[0131] At the first fixing part 301 held at the upper part 500a of the reinforcing plate, a front flange portion 206a extending from the open top face at the upper part of the container 206 to the front and formed so as to be bent downward is provided, and the front flange portion 206a is inserted from above to the first fixing part 301 and locked therein. Thus, the container 206 is fixed to the pull-out door 201. The door frame 205 connected to the lower part 500b of the reinforcing plate is fixed to a top rail 203 of a rail device 202 using, for instance, fastening members, as illustrated in FIG. 2.

[0132] A reinforcing plate flange portion 500c inclined from the base of a horizontal plane part toward the front face of the pull-out door is formed at the upper part 500a, and a plurality of holes 500d are formed in the reinforcing plate flange portion 500c. The lower part 500b also has the same configuration as that of the upper part 500a.

[0133] As illustrated in FIG. 15, a tip portion 301a of the first fixing part 301 inclines toward the container 206 so as to form a large top opening, which allows the front flange portion 206a to be easily inserted from above to the tip portion 301a, and fixed and locked by the first fixing part 301.

[0134] Specifically, the first fixing part 301 fixes the door frame 205 to the lower part of the pull-out door 201, and also locks the front flange portion 206a of the container 206 placed on the door frame 205. The container 206 can be supported at the upper and lower positions by fixing using the first fixing part 301. When the container 206 is pulled frontward by holding handhold portions 103a and 104a of the pull-out door 201, the handhold portions 103a and 104a are at the upper part of the pull-out door 201, and thus a force exerted on the door frames 205 located at the lower part increases. However, the front flange portions 206a of the container 206 are locked by the first fixing parts 301, and thus a force exerted on the frames 205 can be distributed. Thus, it is possible to avoid a gap being formed between a gasket sealing part and the main body opening when the pull-out door 201 is closed, which avoids the leakage of cool air from the compartment.

[0135] Since the reinforcing plate 500 is obtained by integrally forming the upper part 500a and the lower part 500b, the curve of the pull-out door 201 due to pull-out operations and heat generated while the door is closed can be reduced, thereby avoiding a gap being formed.

[0136] The reinforcing plates 500 are buried in the

heat-insulating material which fills the inside of the pull-out door 201, and thus the inclining flange portions are formed on the right and left. Furthermore, the heat-insulating material passes through the holes, and also reaches and fills a space between the inner board 211 and the reinforcing plates 500. Accordingly, it is possible to firmly maintain fixation in the heat-insulating material, avoids voids being generated, and secure the insulation properties of the pull-out door 201.

[0137] Accordingly, functions of the rail devices 202 allow the pull-out door 201 to be pulled out from and pushed back to a main body 101, together with the reinforcing plates 500 and the container 206 to which the reinforcing plates 500 are connected.

[0138] In this way, the reinforcing plates 500 fixed in the foam heat insulation on the back side of the inner board 211 allow the first fixing parts 301 and the door frames 205 to be firmly attached to the pull-out door 201, and thus prevent the shift to the right and left. Consequently, it is possible to avoid a gap being formed at the sealing part due to a tilt of the door, and secure a cooling function.

[Industrial Applicability]

[0139] As described above, the refrigerator according to the present invention can secure a large actual storage space. Therefore, the refrigerator may be used as a refrigerator having a pull-out storage compartment, and furthermore, its use may even be expanded for a prefabricated kitchen having a drawer.

[Reference Signs List]

[0140]	
100	Refrigerator
101	Main body
102	Refrigerator compartment
103	Vegetable compartment (storage compartment)
104	Freezer compartment (storage compartment)
105	Ice compartment
106	Switchable compartment
107	Heat-insulating door
108	Partition
108a, 401a	Bottom step portion
110	Inner casing
110a	Side gap portion
111	Heat-insulating material
112	Outer casing
201	Pull-out door
202	Rail device
203	Top Rail (movable rail)
205	Door frame
205a, 205b	Fixing hole
206	Container

206a	Front flange portion
206b	Front projection
206c	Back projection
207	Gasket
211	Inner Board
221	Middle Rail (movable rail)
222	Cabinet Rail (fixed rail)
223	Rail attachment portion
262	Raised portion
270, 280	Rail holding member
270a, 280a	Rail holding portion
270b, 280b	Inward inclination prevention portion
290	Hole
301	First fixing part
303	Second fixing portion
304	Peripheral portion
400	Fastening member
401	Bottom face
500	Reinforcing plate
500c	Reinforcing plate flange portion

Claims

1. A refrigerator which includes: a main body including an inner casing, an outer casing, and a heat-insulating material filled between the inner casing and the outer casing; a storage compartment of a pull-out type formed inside the main body and having an open front face; a pull-out door which opens and closes the open front face of the storage compartment; a partition which makes a separation for the storage compartment of the main body; and a rail device which has a fixed rail and a movable rail, is fixed to an inner wall of the inner casing with the fixed rail and the movable rail previously put together, connects the pull-out door and the main body such that a distance between the pull-out door and the main body is extendable and shortenable, and allows a container provided inside the storage compartment to move forward and backward, the refrigerator comprising the rail device provided on a step portion formed on each of two sides of a bottom of the storage compartment.
2. The refrigerator according to Claim 1, wherein the rail device is fixed to a rail holding member having, at a lower part, an integrally formed inward inclination prevention portion which prevents the rail device from inclining inward.
3. The refrigerator according to Claim 1, wherein the rail device is disposed at a gap portion provided in a side wall of the inner casing.
4. The refrigerator according to Claim 1, wherein the bottom of the storage compartment is a bottom face of the inner casing.
5. The refrigerator according to Claim 1, wherein the bottom of the storage compartment is a top face of the partition.
6. The refrigerator according to Claim 2, wherein a plurality of the pull-out doors are vertically arranged on the refrigerator, and an upper rail holding member and a lowermost rail holding member have different cross sectional shapes, the upper rail holding member being the rail holding member which holds the rail device which allows the pull-out door arranged at an upper position to be pulled forward and pushed backward, and the lowermost rail holding member being the rail holding member which holds the rail device which allows the pull-out door arranged at a lowermost position to be pulled forward and pushed backward.
7. The refrigerator according to Claim 6, wherein the lowermost position rail holding member is a substantially L-shaped member formed along a side wall and a bottom face of the inner casing.
8. The refrigerator according to Claim 2, wherein the rail holding member has a hole formed therein through which the filled heat-insulating material passes.
9. The refrigerator according to Claim 1 which further includes: a door frame fixed to the pull-out door and connected to the rail device to hold the container; and a reinforcing plate which fixes the door frame to the pull-out door, the refrigerator comprising:
 - the reinforcing plate vertically extending along the pull-out door and formed as a single member;
 - the door frame fixed to a lower part of the reinforcing plate; and
 - the container engaged at an upper part of the reinforcing plate.
10. The refrigerator according to Claim 9, wherein the pull-out door includes: an inner door board; an outer door board; and a heat-insulating material that fills, by foaming, a space between the inner door board and the outer door board, and the reinforcing plate is provided in contact with the inner door board in the space.
11. The refrigerator according to Claim 10, wherein the reinforcing plate includes a reinforcing plate flange portion extending toward the outer door board.
12. The refrigerator according to Claim 11,

wherein the reinforcing plate flange portion includes a hole through which the heat-insulating material passes.

13. The refrigerator according to any one of Claims 9 to 12, comprising
a bead at a position corresponding to a part of the reinforcing plate to which the door frame is attached.

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FIG. 1

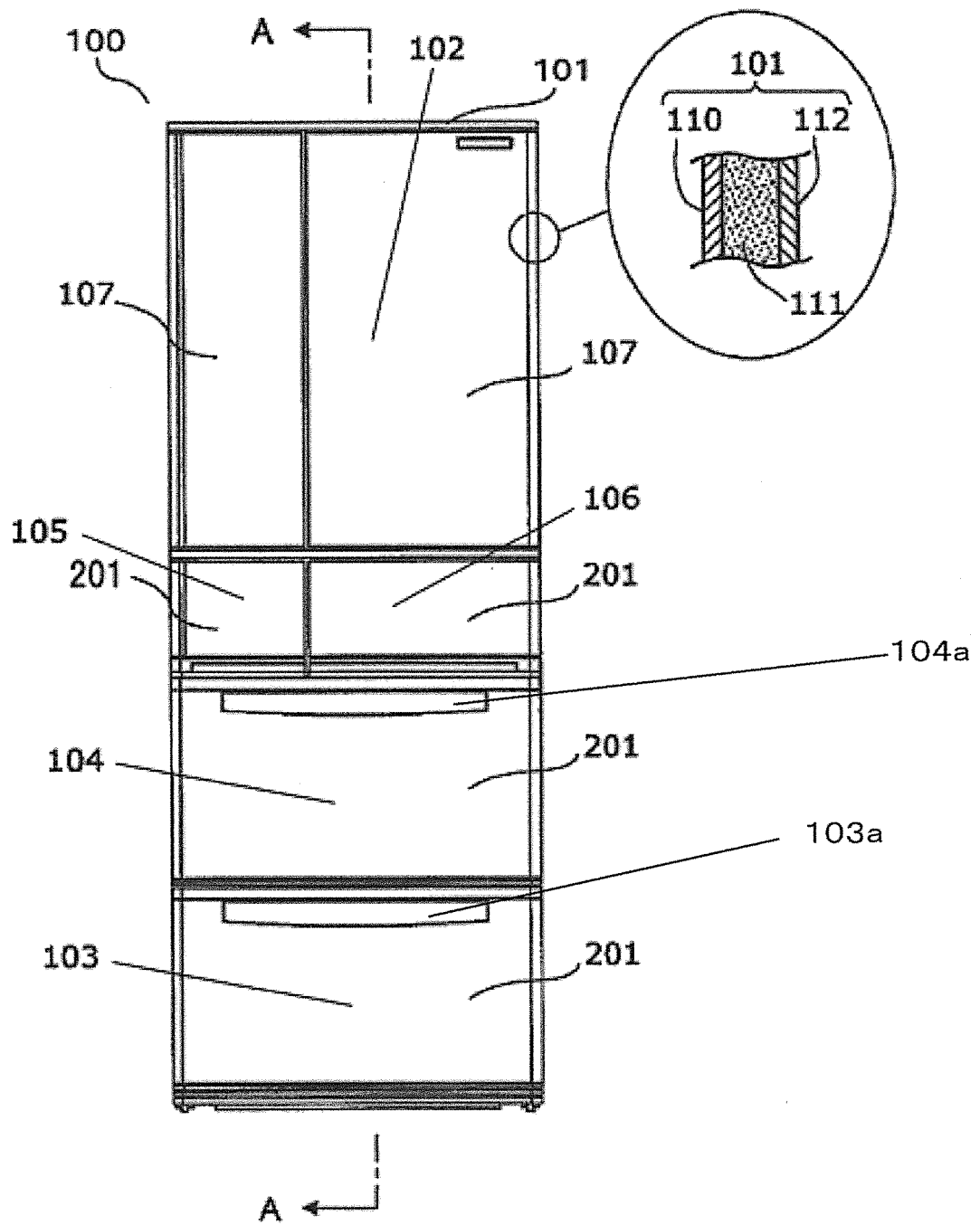


FIG. 2

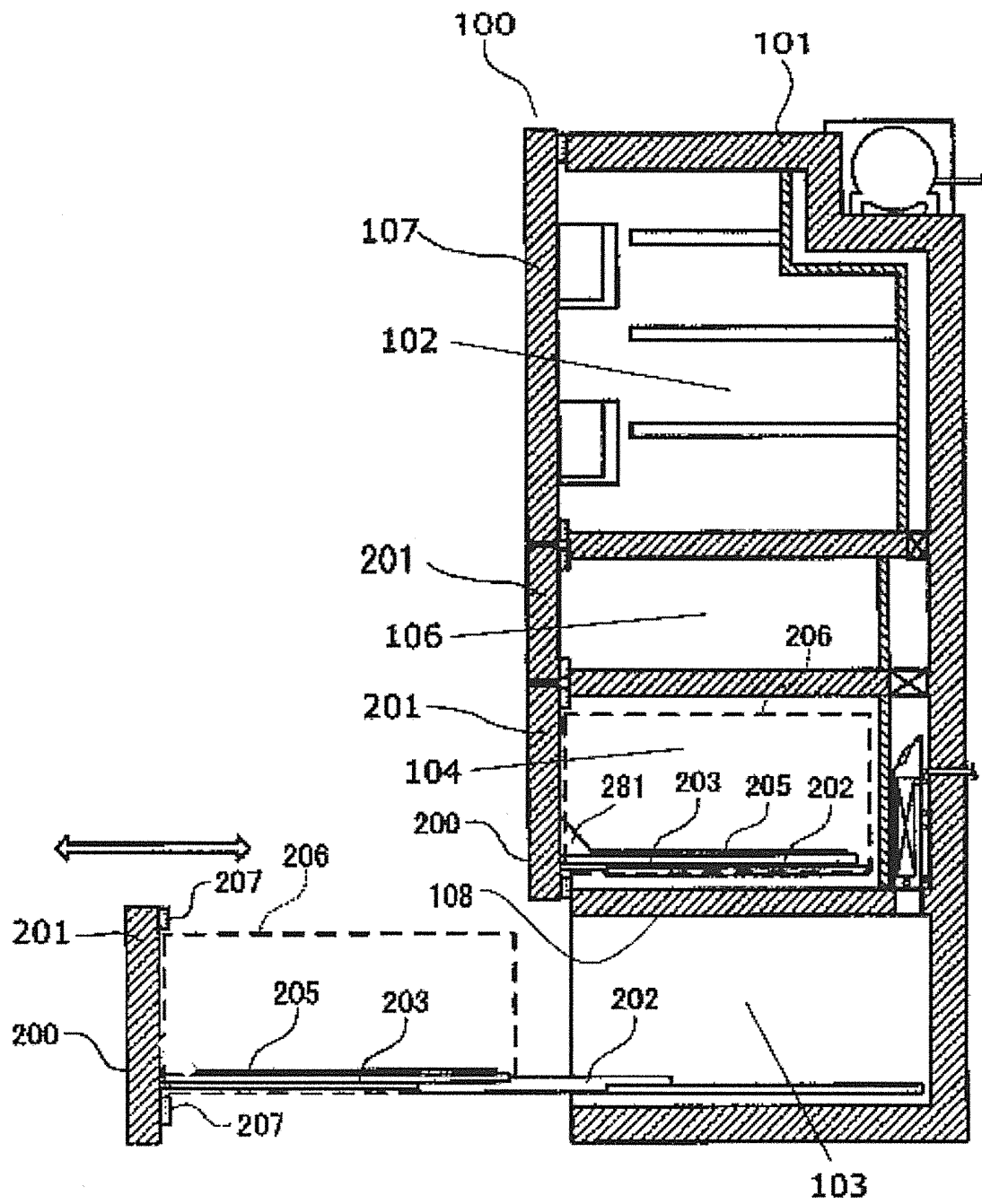


FIG. 3

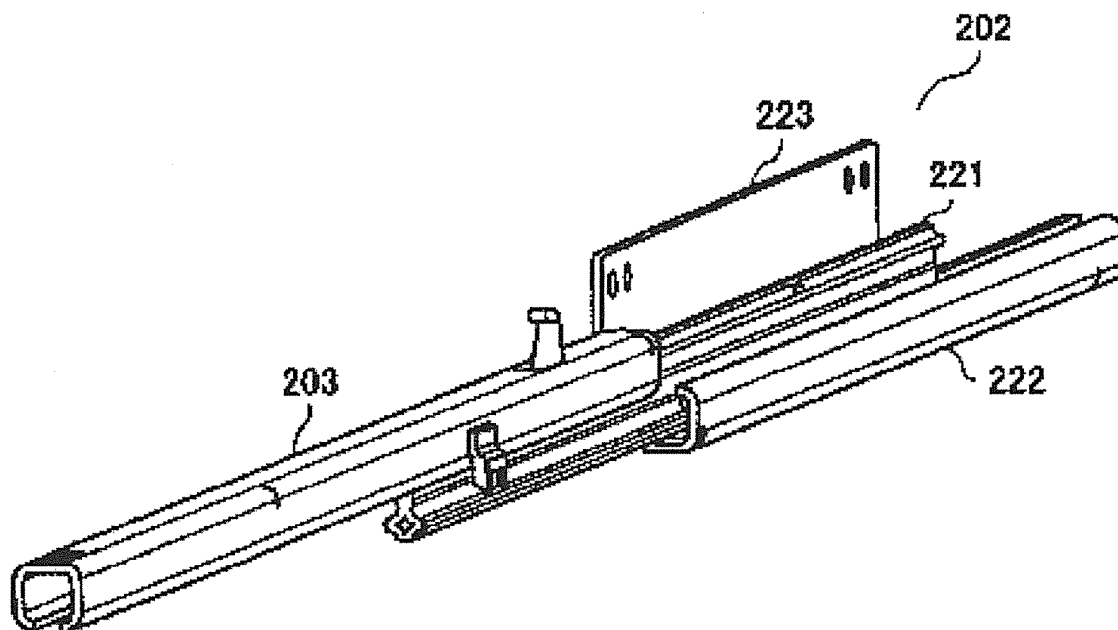


FIG. 4

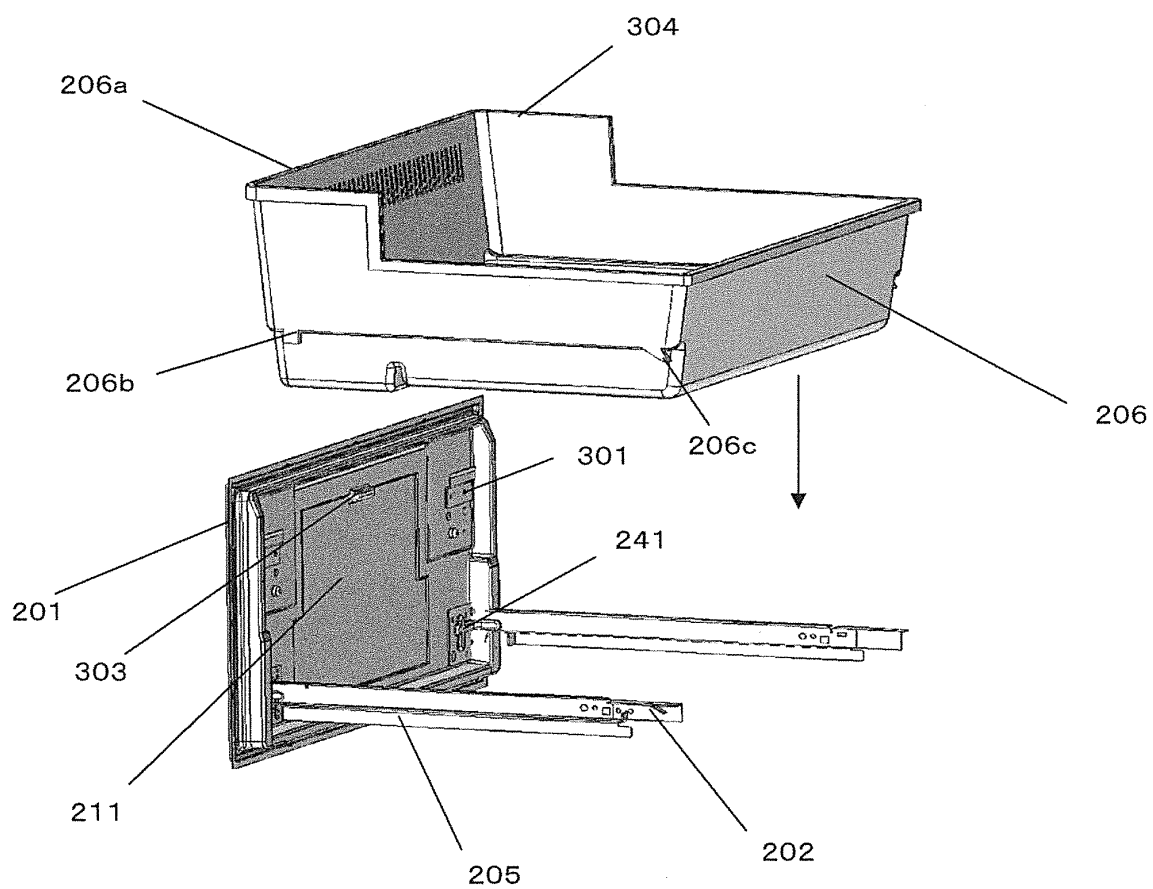


FIG. 7A

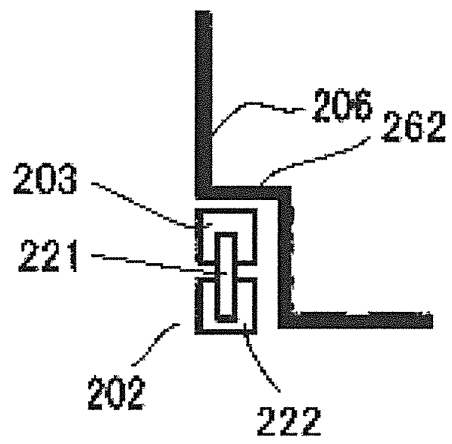


FIG. 7B

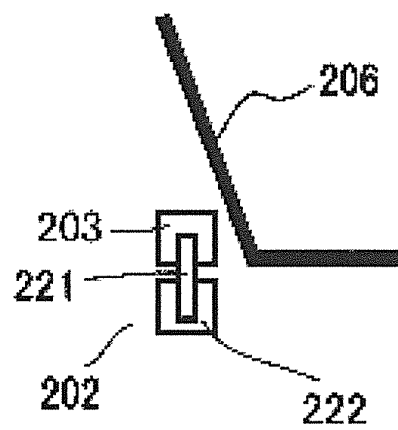


FIG. 7C

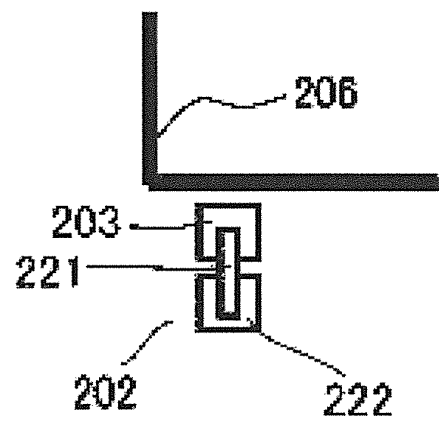


FIG. 8

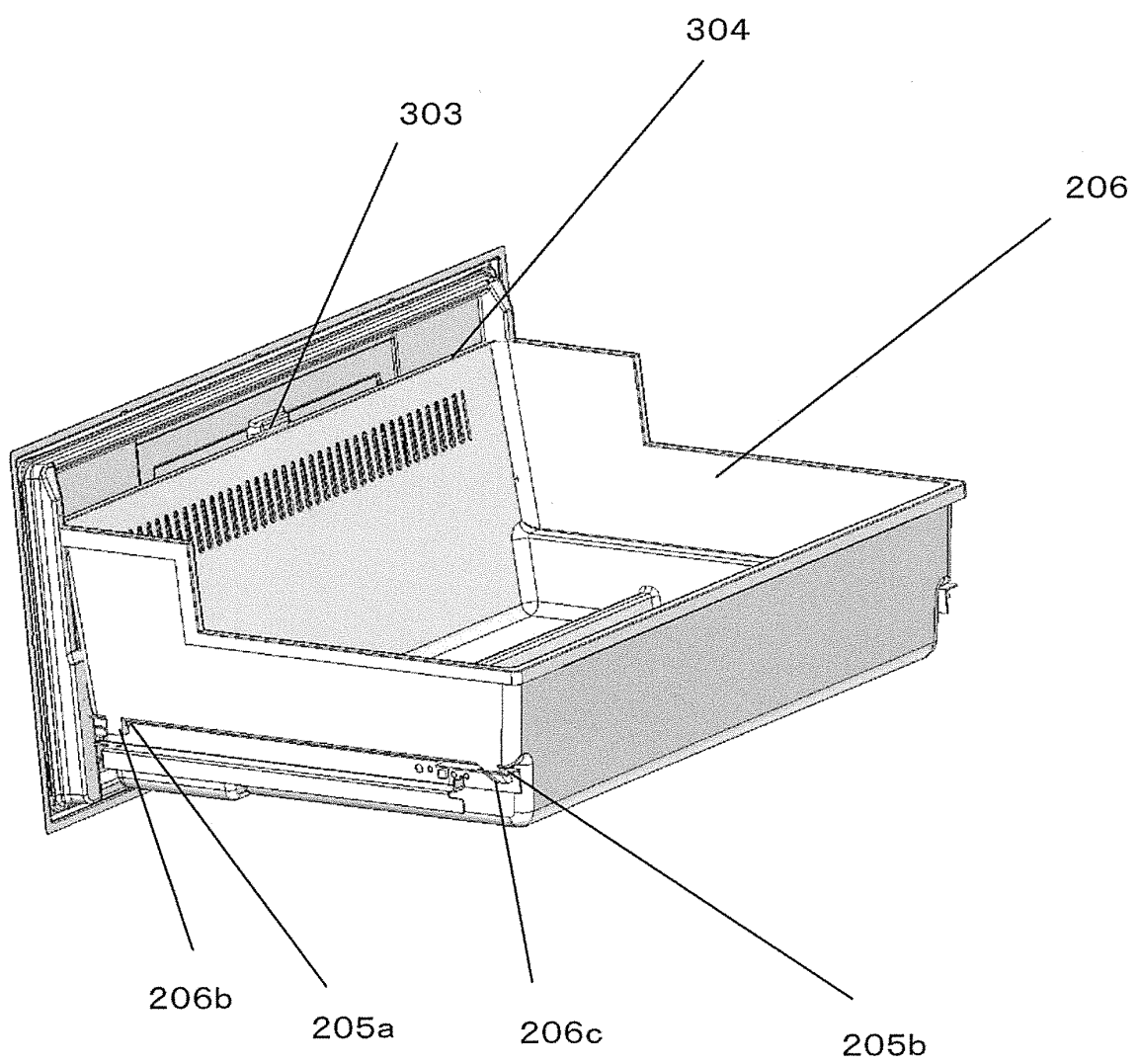


FIG. 9

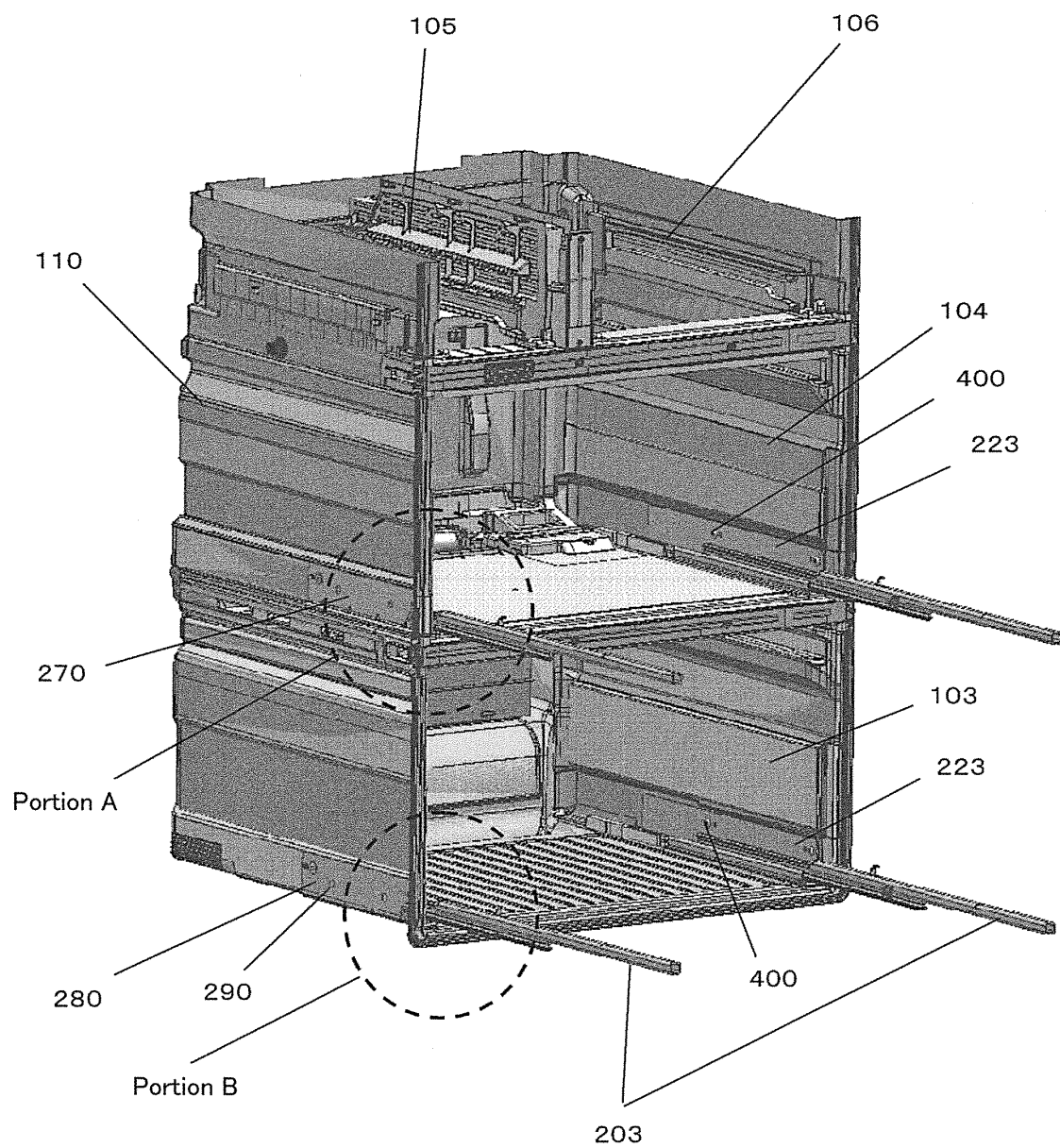


FIG. 10

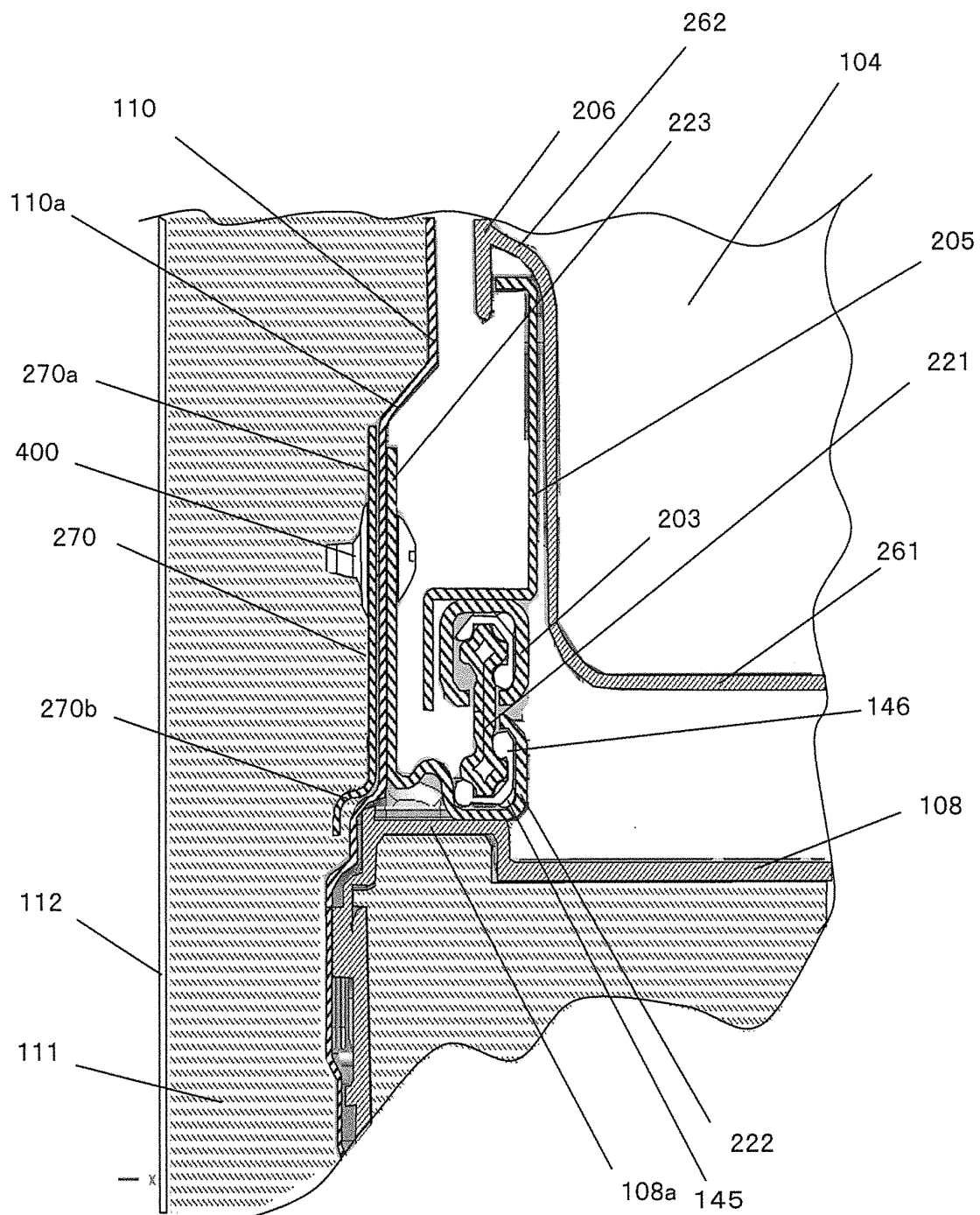


FIG. 11

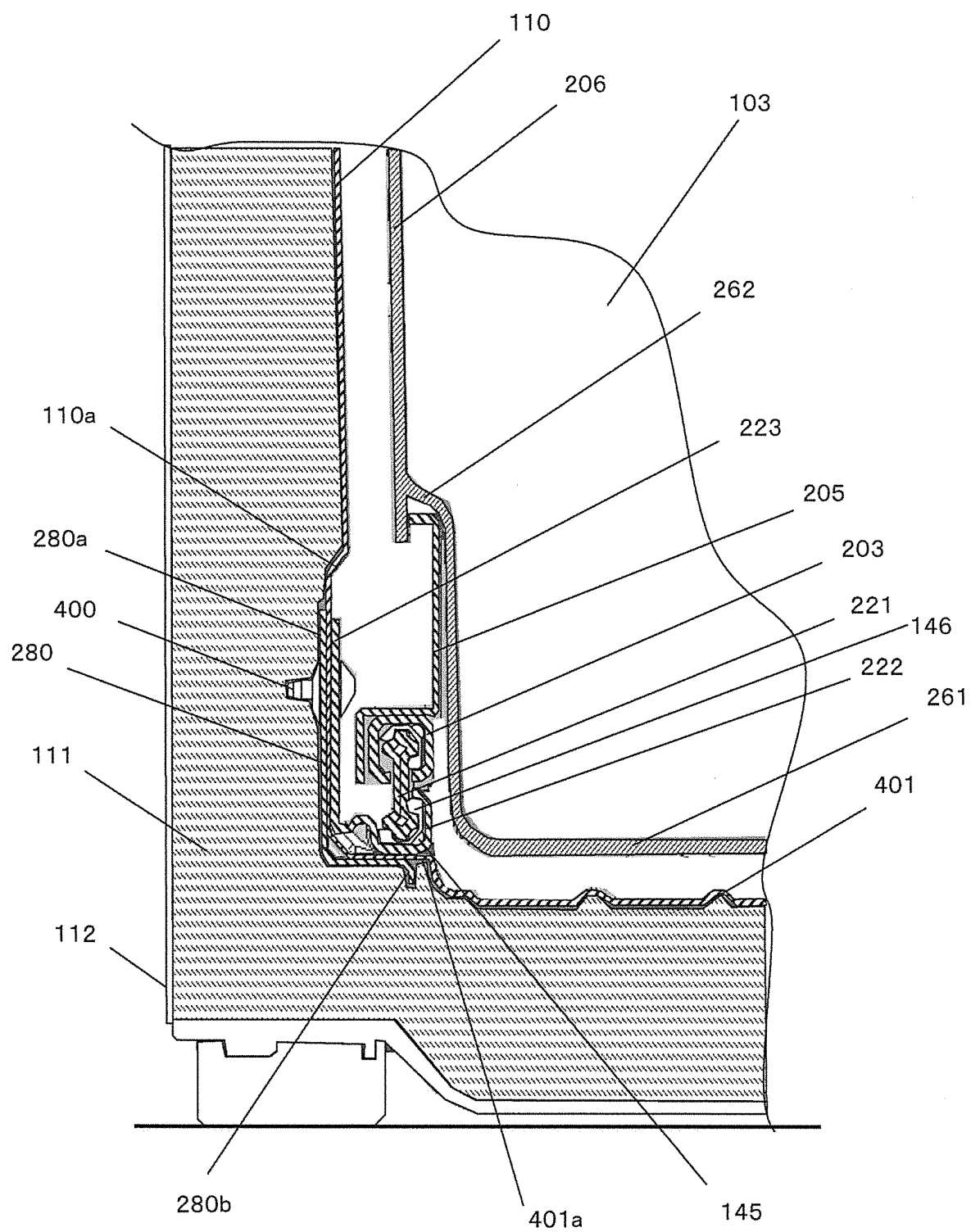


FIG. 12

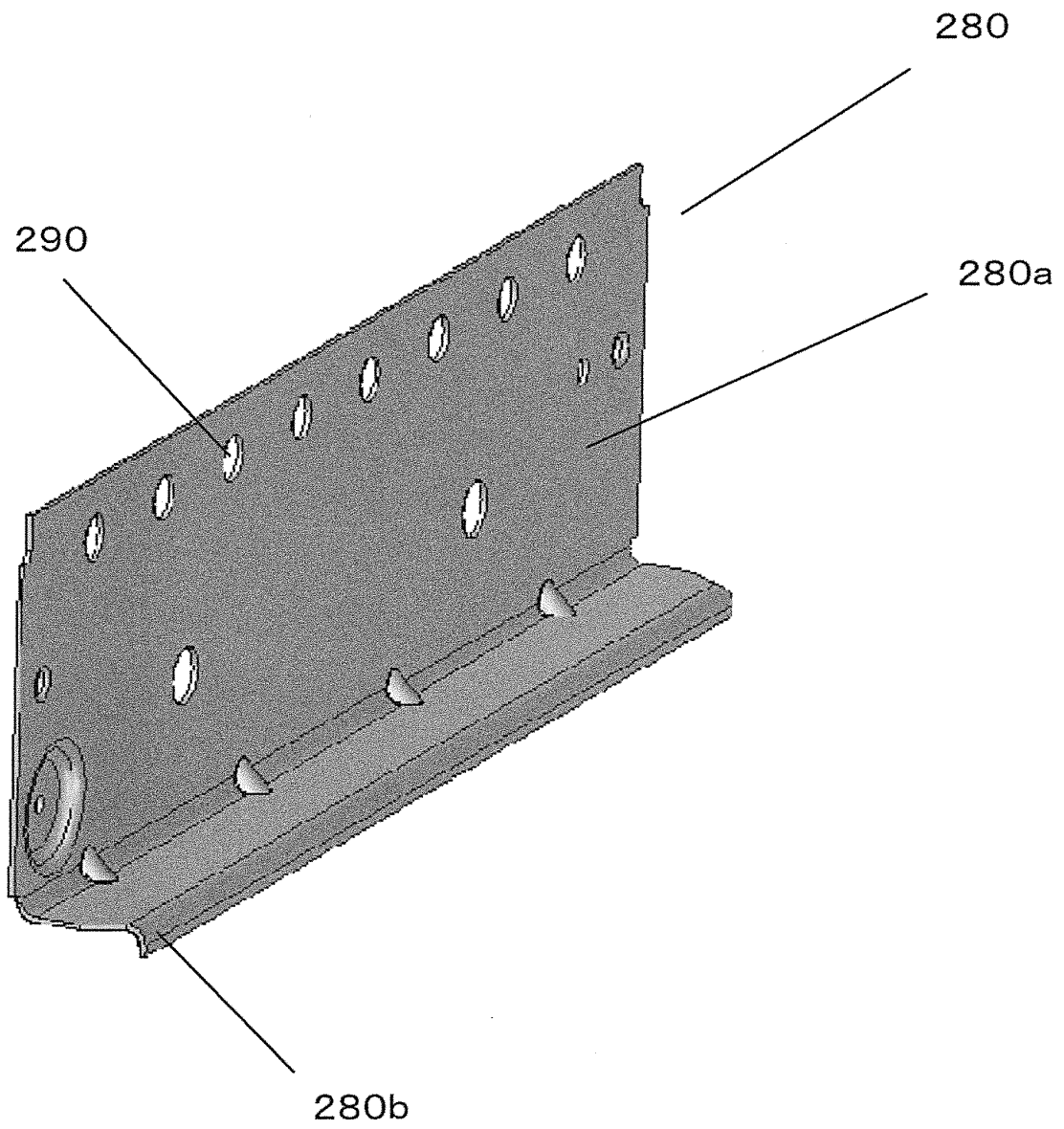


FIG. 13

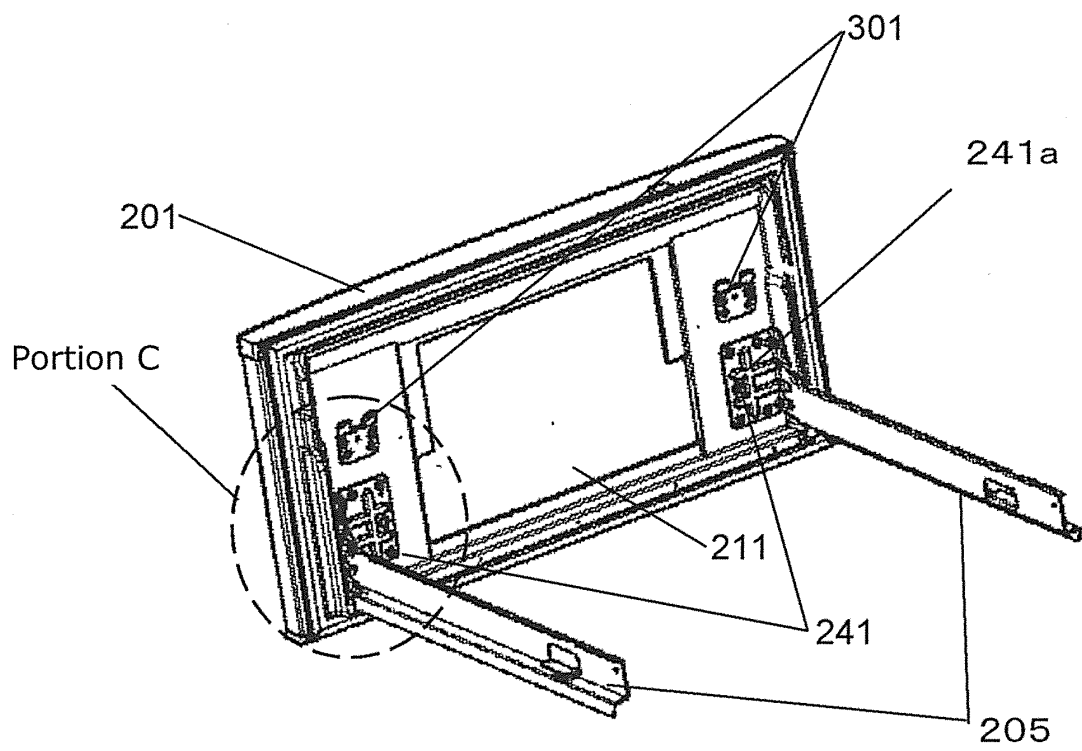


FIG. 14

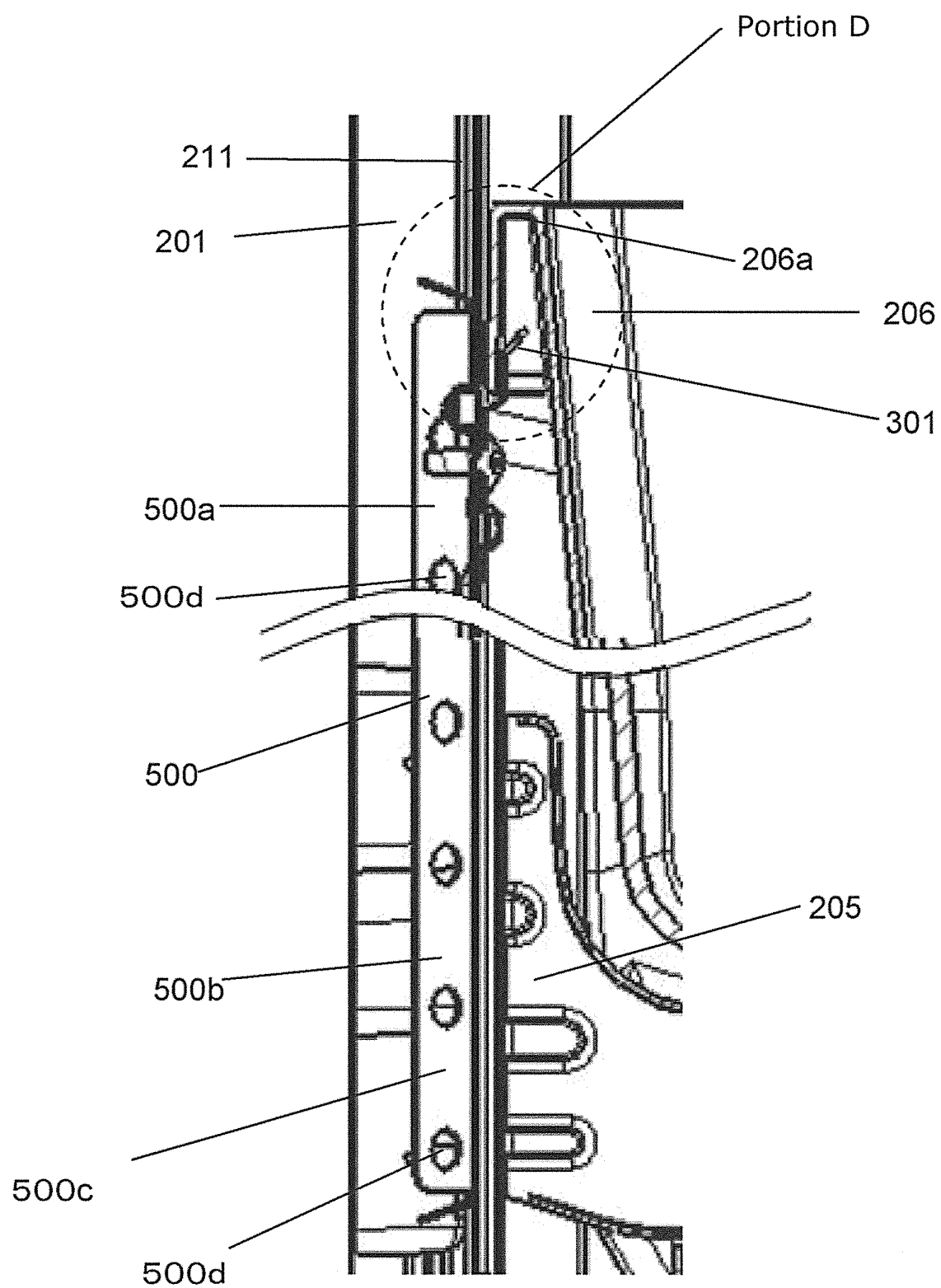


FIG. 15

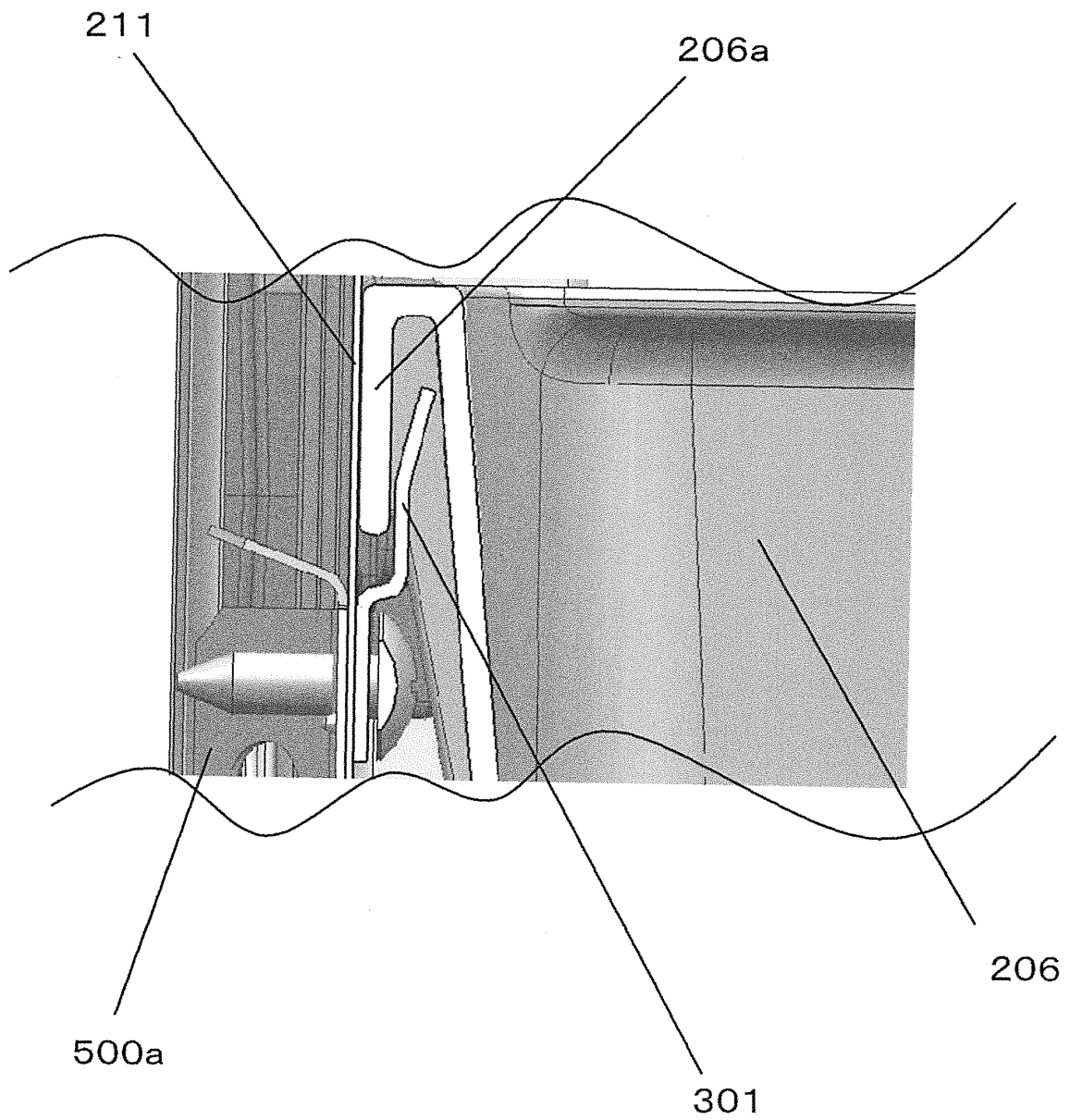


FIG. 16

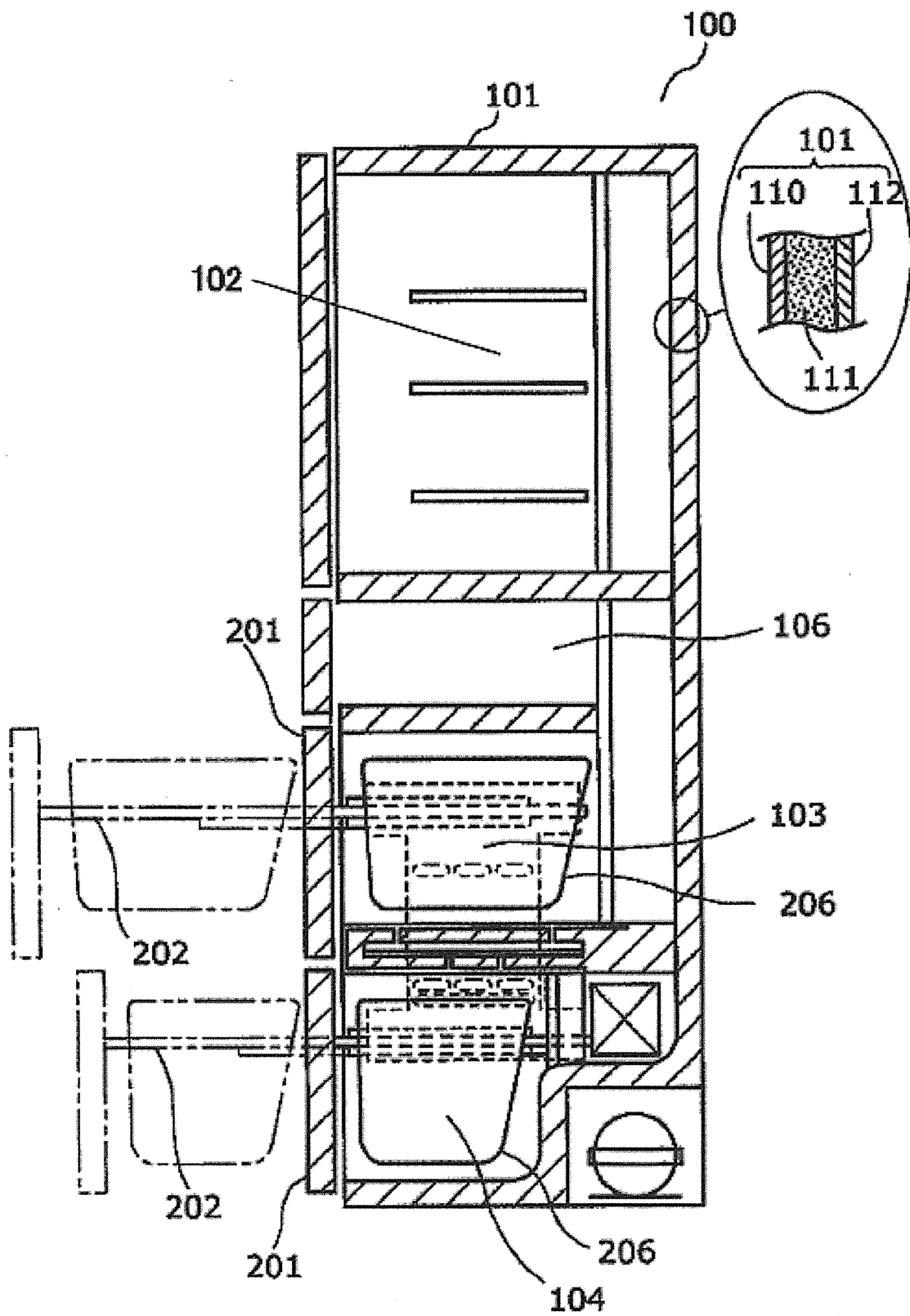


FIG. 17

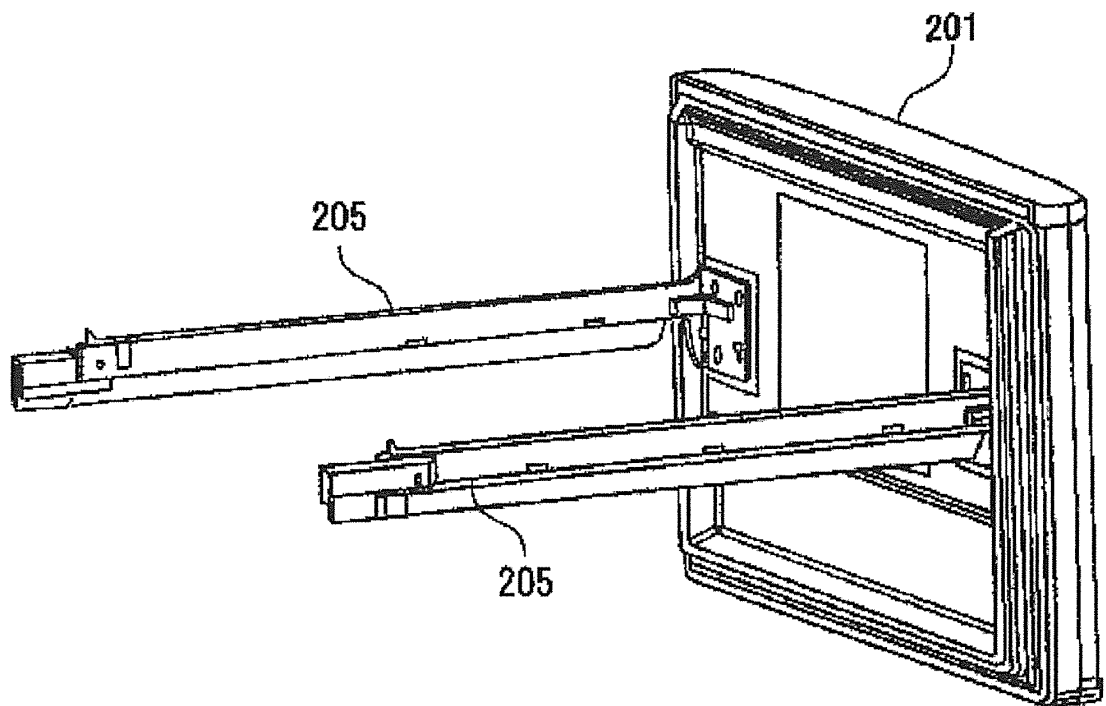
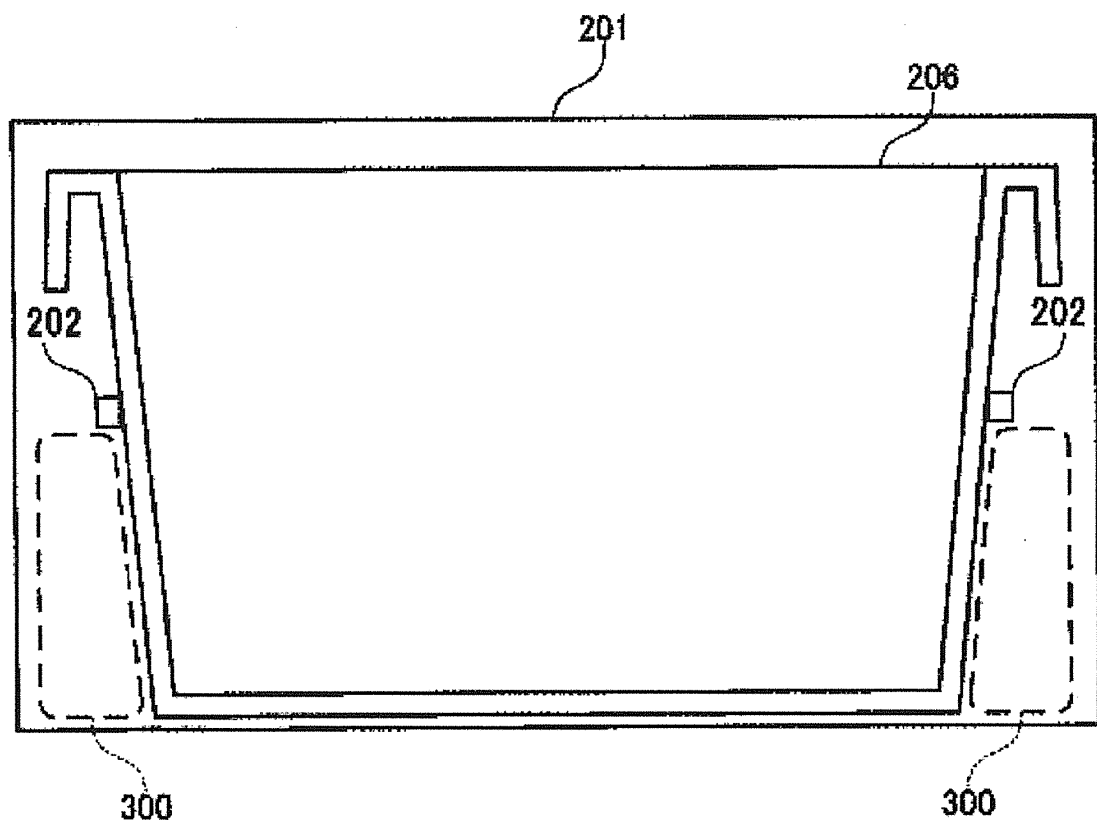


FIG. 18



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/001405

A. CLASSIFICATION OF SUBJECT MATTER

F25D25/00 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F25D25/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2012
Kokai Jitsuyo Shinan Koho	1971-2012	Toroku Jitsuyo Shinan Koho	1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2009/107388 A1 (Panasonic Corp.), 03 September 2009 (03.09.2009), paragraphs [0086] to [0093], [0102], [0166] to [0167], [0303] to [0306], [0321] to [0325], [0354]; fig. 1 to 7, 17, 20 to 22, 24 & EP 2249111 A1 & CN 101981395 A	1-13
Y	JP 8-296957 A (Toshiba Corp.), 12 November 1996 (12.11.1996), paragraph [0023]; fig. 7, 8 & CN 1162732 A	1-13
Y	JP 2009-52776 A (Toshiba Corp.), 12 March 2009 (12.03.2009), fig. 5 (Family: none)	3

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search

17 May, 2012 (17.05.12)

Date of mailing of the international search report

29 May, 2012 (29.05.12)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/001405

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-300034 A (Matsushita Electric Industrial Co., Ltd.), 27 October 2005 (27.10.2005), paragraph [0049]; fig. 2, 4 & WO 2005/083339 A1	8, 12, 13
Y	JP 2001-116446 A (Hitachi, Ltd.), 27 April 2001 (27.04.2001), paragraphs [0021] to [0026]; fig. 1, 4, 5 (Family: none)	9-13
Y	JP 9-21585 A (Sharp Corp.), 21 January 1997 (21.01.1997), paragraph [0018]; fig. 5, 8, 9, 11 (Family: none)	11-13
A	JP 2005-265244 A (Matsushita Electric Industrial Co., Ltd.), 29 September 2005 (29.09.2005), fig. 1, 2 (Family: none)	1-13

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006177653 A [0015]
- JP 2006214642 A [0015]