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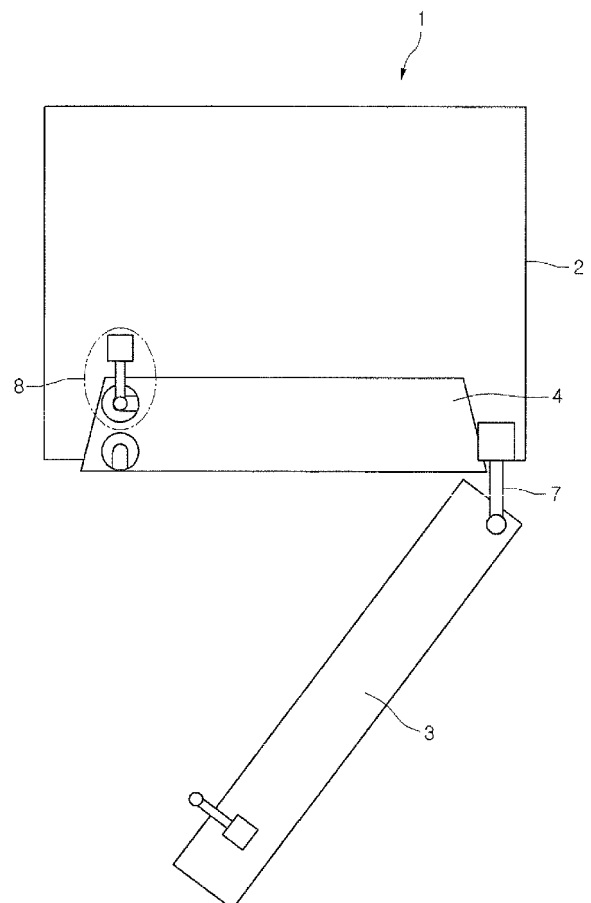
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(54) **Refrigerator**

(57) A refrigerator is provided. The refrigerator may include a sub hinge connecting a main door to a sub door, and a main hinge connecting the main door to a main body of the refrigerator. The sub hinge is not connected to the main hinge, to prevent interference during door movement and to minimize leakage of cool air. A single latch assembly may allow both the main door and the sub door to be smoothly opened and secured, to reduce manufacturing costs and enhance reliability with respect to a simultaneous operation of the latch.

FIG.3



Description

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application claims priority under 35 U.S.C. §119 to Korean Application Nos. 10-2011-0087500 filed on August 31, 2011 and 10-2011-0093657 filed on September 16, 2011, whose entire disclosures are hereby incorporated by reference.

BACKGROUND

1. Field

[0002] This relates to a refrigerator.

2. Background

[0003] Refrigerators may store items in refrigerated or frozen states to maintain the items in a fresh state. A refrigerator in which a receiving space is efficiently utilized, and in which a loss of cool air is minimized when a refrigerator door is opened or closed to reduce power consumption, may be desirable to consumers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements wherein:

[0005] Figs. 1 and 2 are perspective views of an exemplary refrigerator.

[0006] Figs. 3 and 4 are plan views of the exemplary refrigerator shown in Figs. 1 and 2.

[0007] Fig. 5 is a perspective view of a refrigerator as embodied and broadly described herein, with a main door opened.

[0008] Fig. 6 is a perspective view of the refrigerator shown in Fig. 5, with a sub door opened.

[0009] Fig. 7 is an exploded perspective view of a hinge structure which rotatably connects the main door and the sub door of the refrigerator shown in Figs. 5 and 6.

[0010] Figs. 8 to 10 successively illustrate an opening process of the main door of the refrigerator shown in Figs. 5 and 6.

[0011] Fig. 11 is a perspective view of a refrigerator according to another embodiment as broadly described herein.

[0012] Fig. 12 is a perspective view of an outer appearance of a latch assembly of the refrigerator shown in Fig. 11.

[0013] Fig. 13 is a perspective view of the latch assembly shown in Fig. 11 with a case thereof removed.

[0014] Fig. 14 is a side view of the latch assembly shown in Fig. 13.

[0015] Fig. 15 is a plan view of the latch assembly of the refrigerator shown in Fig. 11, with the door completely

closed.

[0016] Fig. 16 is a plan view of the latch assembly of the refrigerator shown in Fig. 11, with the door rotated.

5 [0017] Fig. 17 is a plan view of the latch assembly of the refrigerator shown in Fig. 11 with the main door and a sub door integrally rotated.

[0018] Figs. 18 and 19 are plan views of a latch assembly of a refrigerator, in accordance with another embodiment as broadly described herein.

10 [0019] Fig. 20 is a perspective view of a refrigerator including a sealing structure between a door and a main body thereof, in accordance with an embodiment as broadly described herein.

[0020] Fig. 21 is a horizontal cross-sectional view of the refrigerator shown in Fig. 20.

DETAILED DESCRIPTION

[0021] Hereinafter, a refrigerator according to embodiments will be described in detail with reference to the accompanying drawings.

20 [0022] A refrigerator in which a separate sub door is provided within a main door may provide access to an interior of the refrigerator without opening the main door, thus reducing loss of cool air. However, a separate auxiliary gasket provided along a circumference of the sub door so as to prevent cool air from leaking between the auxiliary door the main door may increase cost and complexity. In addition, dew may be generated on a front surface of the door due to weak insulation performance of the gasket. A separate heater may be provided to reduce/eliminate the dew, further increasing and complexity.

25 [0023] Alternatively, a refrigerator may include a single door divided into a main door and a sub door to store products having a relatively high frequency of withdrawal in a back surface of the main door, and to store products having a relatively low frequency of withdrawal in the sub door. In such an arrangement, a back surface of the sub door may contact a circumference of a front surface of a main body of the refrigerator, and a circumference of a back surface of the main door may contact a circumference of a front surface of the sub door. Thus, a sealing member may be provided between the main body and the sub door and between the main door and the sub door to prevent cool air from leaking between the main body and the door and between the main door and the sub door, again increasing cost and complexity.

30 [0024] Alternatively, a refrigerator may include a sub door completely received into the refrigerator, and a circumference of a back surface of a main door provided on a front surface of the sub door may contact a circumference of a front surface of a main body of the refrigerator.

35 [0025] In the exemplary refrigerator shown in Figs. 1 and 2, a refrigerator 1 may include a main body 2 having a cooling compartment 2a formed therein and a door for selectively opening or closing the cooling compartment

2a. The door may include a main door 3 defining a front surface of the refrigerator 1 and a sub door 4 coaxially rotated with the main door 3. In detail, the main door 3 may be independently rotated with respect to the sub door 4 so that a front surface of the sub door 4 is exposed to the outside. Also, the sub door 4 may be integrally rotated with the main door 3 to remove/replace products stored in the cooling compartment 2a. The sub door 4 may be completely received into the cooling compartment 2a. Thus, there is no contact between the sub door 4 and a circumference of a front surface the main body 2. That is, a circumference of a back surface of the main door 3 is closely attached to the circumference of the front surface of the main body 2.

[0026] The main door 3 may be rotatably connected to a main hinge 5, and the sub door 4 may be rotatably connected to a sub hinge 6. The sub hinge 6 may be connected to a rotation shaft of the main hinge 5, and thus the sub hinge 6 may be coaxially rotated with respect to the main hinge 5. A plurality of door baskets 4a may be mounted on the sub door 4.

[0027] In the refrigerator 1 shown in Figs. 1 and 2, to coaxially rotate the sub hinge 6 and the main hinge 5, one end of the sub hinge 6 may be connected to the sub door 4, and the other end of the sub hinge 6 may be connected to the main hinge 5. In this case, when the main door 3 is closed, a portion contacting the sub hinge 6 may be recessed or cut out to receive the sub hinge 6. In addition, a recess part for receiving the sub hinge 6 may be provided in the circumference of the front surface of the main body 2 contacting the sub hinge 6. That is, the back surface of the main door 3 and/or the front surface of the main body 2 may include a recess having an appropriate size, shape and depth to receive the sub hinge 6. Thus, portions of the main body 2 and the main door 3 on which the sub hinge 6 is disposed may have reduced in insulation efficiency. In addition, sealing and insulation members for preventing cool air from leaking and maintaining insulation performance may be provided on the back surface of the main door 3 and/or the front surface of the main body 2 on which the sub hinge 6 is disposed, further increasing cost and complexity.

[0028] Fig. 3 is a plan view of the refrigerator 1 with only the main door 3 open, and Fig. 4 is a plan view of the refrigerator with both the main door 3 and the sub door 4 open.

[0029] As shown in Figs. 3 and 4, the door assembly (including the main door 3 and the sub door 4) may be rotatably coupled to the main body 2 by a hinge assembly 7 and selectively fixed to the main body 2 by a latch assembly including a first latch 8 for fixing the sub door 4 to the inside of the storage space 2a and a second latch 9 for maintaining a state in which the main door 3 is fixed to the sub door 4 and is closed.

[0030] However, since two latches are used to allow only the main door to be opened and both the main door and the sub door to be opened at the same time, manufacturing costs and complexity may be increased. Also,

since such operations may be independently performed, two separate latch driving parts may be utilized, further increasing manufacturing costs and complexity, and possibly impacting reliability.

[0031] Figs. 5-7 provide various views of a refrigerator in accordance with an embodiment as broadly described herein. In particular, Fig. 5 is a perspective view of such a refrigerator having a main door opened, Fig. 6 is a perspective view of such a refrigerator having a sub door opened, and Fig. 7 is an exploded perspective view of a hinge structure which rotatably connects the main door and the sub door to a main body of such a refrigerator.

[0032] Referring to Figs. 5 to 7, a refrigerator 10 as embodied and broadly described herein may include a main body 11 having a storage space or a cooling compartment 111 therein, a door 12 disposed on a front surface of the main body 11 to selectively open or close the cooling compartment 111, and a hinge assembly 20 rotatably connecting the door 12 to the main body 11.

[0033] The door 12 may include a main door 121 disposed on a front surface of the refrigerator 10 such that the main door 121 forms a corresponding front surface of the refrigerator 10 when the door 12 is closed against the main body 11, and a sub door 122 received in the cooling compartment 111 and integrally rotated together with the main door 121. The main door 121 may be independently or integrally rotated with respect to the sub door 122.

[0034] The hinge assembly 20 may include a main hinge 21 for rotatably connecting the main door 121 to the main body 11 and a sub hinge 22 connected to the sub door 122. For example, the sub hinge 22 may maintain a position of the sub door 122 received in the main body 11 when only the main door 121 is opened or closed. In addition, a weight of the sub door 122 may be transmitted into the main door 121 through the sub hinge 22, and thus, the sub door 122 may ultimately be supported by the main hinge 21.

[0035] A plurality of shelves 112 and drawers 113 may be installed in the cooling compartment 111 provided in the main body 11, and a plurality of door baskets 123 may be provided on the sub door 122. A portion of the cool air supplied into the cooling compartment 111 may be supplied into the sub door 122.

[0036] A space for receiving food items and other products to be cooled may be defined in the sub door 122. Also, a receiving space may be defined in a back (interior facing) surface of the main door 121, which may face a corresponding side of the sub door 122 and form a relatively enclosed space therebetween when the main door 121 and the sub door 122 are closed against each other. Products having a relatively high frequency of withdrawal may be received in the space formed in the back surface of the main door 121. Products having a relatively low frequency of withdrawal may be received in the space formed in the sub door 122. Thus, when the products having the relatively high frequency of withdrawal are taken out, only the main door 121 may be opened, while

the sub door 122 remains positioned against the opening into the cooling compartment 111 to reduce a loss of the cool air.

[0037] When the door 12 is closed, a circumferential portion of the back surface of the main door 121 may be closely attached to a corresponding circumferential portion of a front surface of the main body 11, with the sub door 122 completely received within the cooling compartment 111. Thus, a gasket for preventing the cool air from leaking may be disposed on only a portion at which the main door 121 contacts the main body 11.

[0038] The main door 121 and the sub door 122 may be coaxially rotated with respect to the main hinge 21. That is, the main door 121 may be directly connected to the main hinge 21 and rotated with respect to the main body 11 about the main hinge 21. Since the sub door 122 is mounted on the back surface of the main door 121, when the sub door 122 is opened, the sub door 122 may be integrally rotated with the main door 121. Thus, the sub door 122 may be rotated using the main hinge 21 as a rotation shaft.

[0039] As shown in Fig. 7, the hinge shaft 23 may pass through one end of the main hinge 21 and be inserted into a top surface of the main door 121. The main hinge 21 may be fixed and coupled to a top edge portion of the main body 11, with the hinge shaft 23 passing through an end of the main hinge 21 extending to a front side of the main body 11. Such a main hinge 21 may be provided at both upper and lower ends of the main door 121.

[0040] The sub hinge 22 connecting the sub door 122 to the main door 121 may have a multi-joint link shape. The sub hinge 22 may include a sub door-side bracket 221 fixed to a front surface of the sub door 122, a multi-joint link 222 rotatably connected to one end of the sub door-side bracket 221, and a main door-side bracket 223 rotatably connected to one end of the multi-joint link 222 and fixed to the back surface of the main door 121.

[0041] The multi-joint link 222 may include a plurality of links 222a and 222b rotatably connected to each other. A support frame 124 may be disposed along an inner circumference of the front surface of the sub door 122. A support bracket 124a to which the sub door-side bracket 221 of the sub hinge 22 is coupled may be disposed on a front surface of the support frame 124. A plurality of coupling holes in which coupling members such, for example, as screws, are inserted may be defined in each of the sub door-side bracket 221 and the support bracket 124a. A plurality of coupling holes may also be defined in the back surface of the main door 121 and the main door-side bracket 223.

[0042] In the embodiment shown in Figs. 5-7, the sub hinge 22 may have a four-link structure. That is, first, second and third rotation shafts 224, 225 and 226 may be disposed on portions at which the links 222a and 222b and brackets 221 and 223 are connected to each other.

[0043] The sub hinge 22 may connect the front surface of the sub door 122 to the back surface of the main door 121, but is not connected to the hinge shaft 23 of the

main hinge 21. Thus, the main door 121 and sub door 122 may rotate as necessary without a recessed structure for avoiding interference with the sub hinge in the back surface of the main door or the front surface of the main body.

[0044] Figs. 8 to 10 successively illustrate an opening process of the main door of the refrigerator shown in Figs. 5-7.

[0045] In the position shown in Fig. 8, the main door 121 is closely attached to the front surface of the main body 11 to close the cooling compartment 111, with the sub hinge 22 maintained in a folded state.

[0046] When the main door 121 is opened at an angle of about 45 degrees, as shown in Fig. 9, the main door 121 is rotated about the hinge shaft 23 of the main hinge 21. Thus, the multi-joint links 222 of the sub hinge 22 are unfolded. An elastic member 227 such as, for example, a torsion spring may be mounted on the second rotation shaft 225 of the rotation shafts 224, 225, and 226 of the sub hinge 22. Thus, the elastic member 227 may apply an elastic restoring force in a direction in which an angle between the two links 222a and 222b connected to the second rotation shaft 225 is increased. As shown by the arrows in Fig. 9, when the elastic restoring forces of the elastic member 227 are applied, the elastic restoring forces may be transmitted into the sub door-side bracket 221 and the main door-side bracket 223. As a result, as shown in Fig. 10, since a force directed toward the inside of the cooling compartment 111 is applied to the sub door 122 until the main door 121 is completely opened, opening of the sub door 122, may be prevented when the main door 121 is opened. In certain embodiments, the elastic member may be mounted on each of the rotation shafts connecting the adjacent links to each other.

[0047] To open the sub door 122 when the door 12 is completely closed, a switch or button for opening the sub door 122 may be pushed, or a handle protruding forward may be pulled from the sub door 122. Thus, the sub door 122 may be opened while being integrally rotated with the main door 121, and the sub door 122 may be rotated with respect to the hinge shaft 23 which serves as a rotation center of the main door 121. Also, as the sub door 122 is opened, the inside of the cooling compartment 111 is exposed to the outside.

[0048] Fig. 11 is a perspective view of an inner structure of a refrigerator including a latching assembly, according to an embodiment as broadly described herein.

[0049] Referring to Fig. 11, the refrigerator 10 according to this embodiment is similar to the previously described embodiment(s) and may include a latch assembly 30 mounted on a side of the sub door 122, for example, at a top surface of the sub door 122, to control opening and closing of the main door 121 and the sub door 122 as, for example, the main door 121 and/or the sub door 122 are opened and closed using the previously described hinge structure or other rotation system as appropriate. In certain embodiments, the latch assembly 30 may be mounted on a side surface or a bottom surface

of the sub door 122. Other components may have the same or similar structure as those described with respect to the previous embodiment, and thus duplicated descriptions will be omitted.

[0050] Fig. 12 is a perspective view of an outer appearance of a latch assembly of the refrigerator shown in Fig. 11, Fig. 13 is a perspective view of the latch assembly shown in Fig. 12 with a case thereof removed, and Fig. 14 is a side view of the latch assembly shown in Fig. 13.

[0051] Referring to Figs. 12 to 14, the latch assembly 30 may include a latch case 31 surrounding and protecting various internal components, a plurality of hooks 32 for blocking the opening of the main door 121 or the sub door 122, a plurality of stoppers 33 selectively engaged with the plurality of hooks 32 to selectively restrict opening of the door 12, a rotation hook 34 for selectively restricting rotation of one of the plurality of stoppers 33, and a connection gear 35 that links the plurality of stoppers 33 for rotation.

[0052] The plurality of hooks 32 may include a first hook 321 fixed to the inside of the main body 11 of the refrigerator 10 and a second hook 322 protruding from a back surface of the main door 121. The plurality of stoppers 33 may include a first stopper 331 selectively restricting the first hook 321 and a second stopper 332 selectively restricting the second hook 322.

[0053] Hook grooves 331a and 332a in which the first and second hooks 321 and 322 are respectively inserted may be defined in side surfaces of the first and second stoppers 331 and 332, respectively. A first pinion 331b and a second pinion 332b engaged with gear teeth of the connection gear 35 may be disposed on side surfaces of the first and second stoppers 331 and 332, respectively. A hooking groove 332c on which a rotation end of the rotation hook 34 may be hooked may be defined in a side edge portion of the second stopper 332.

[0054] Thus, the second hook 322 and the second stopper 332 may be rotated according to opened states of the main door 121 and the sub door 122. Also, the first stopper 331 may be rotated together with the second stopper 332. Operation of the latch assembly 30 will be described below in detail with reference to the accompanying drawings.

[0055] The latch case 31 may include first and second hook grooves 311 and 312 in which the first and second hooks 321 and 322 are respectively inserted. The first and second hook grooves 311 and 312 may be defined in opposite sides of the latch case 31. The first and second hooks 321 and 322 may be inserted into the first and second hook grooves 311 and 312 or separated from the first and second hook grooves 311 and 312, respectively, according to the opened state of the door 12.

[0056] Fig. 15 is a plan view of the latch assembly in a state in which the door of the refrigerator shown in Fig. 11 is completely closed.

[0057] Referring to Fig. 15, when the door 12 is completely closed, the first and second hooks 321 and 322 are completely inserted into the first and second hook

grooves 311 and 312 of the latch case 31, respectively.

[0058] While the second hook 322 is inserted into the second hook groove 312 of the latch case 31, the second stopper 332 is rotated in a counterclockwise direction when viewed in Fig. 15. When the second hook 322 is completely inserted into the second hook groove 312 of the latch case 31, the second hook 322 is hooked in the hook groove 332a of the second stopper 332. When the second stopper 332 is then rotated in the counterclockwise direction, the connection gear 35 is rotated in a clockwise direction at the same time. When the connection gear 35 is rotated in the clockwise direction, the first stopper 321 is rotated in the counterclockwise direction, because the first and second stoppers 331 and 332 are gear-coupled to each other by the connection gear 35.

[0059] Since the first stopper 331 is rotated in the counterclockwise direction, an opening end of the hook groove 331a of the first stopper 331 faces the first hook 321. Then, the first hook 321 is completely inserted into the hook groove 331a. An end of the rotation hook 34 is hooked in the hooking groove 332c of the second stopper 332 to interrupt the rotation of the second stopper 332.

[0060] The door 12, particularly, the main door 121, may include a push button device 40 for controlling the rotation of the rotation hook 34. For example, a button 41 may be exposed at a front surface of the main door 121. Thus, a user may push the button 41 to rotate the rotation hook 34 in a front or rear direction. A push end 42 may extend backward from the button 41. When the main door 121 is closed, the push end 42 may maintain contact with a corresponding end of the rotation hook 34 (i.e., an end of the rotation hook 34 not engaged in the hooking groove 332c of the second stopper. In certain embodiments, it may be unnecessary that the push end 42 directly extends from a back surface of the button 41. That is, in a state in which the button 41 and the push end 42 are mounted at different positions, when the button 41 is pushed (by, for example, a mechanical or electrical connection device), the push end 42 may be retracted. For example, the latch assembly 30 may be mounted on a portion of an upper end of the door 12, and the push end 42 may be disposed at a position corresponding to a height of the latch assembly 30. The button 41 may be disposed on a front surface of the main door 121 corresponding to a position lower than that of the push end 42. That is, a force pushing the button 41 may be transmitted to the push end 42 through a separate power transmission device.

[0061] Fig. 16 is a plan view of the latch assembly shown in Figs. 12-14 when only the main door of the refrigerator is rotated.

[0062] Referring to Fig. 16, when the button 41 is pushed to open the main door 121, the rotation hook 34 is rotated in the counterclockwise direction when viewed in Fig. 16. As the rotation hook 34 is rotated, an end of the rotation hook 34 is separated from the second stopper 332 to release the connection therebetween. In this state, when the main door 121 is pulled, the second hook 322

is moved to rotate the second stopper 332 in the clockwise direction. Since the rotation hook 34 is formed of an elastic member such as, for example, a torsion spring, when the push end 42 of the push button device 40 is separated from the rotation hook 34, the rotation hook 34 may return to an original position thereof.

[0063] In more detail, since the second stopper 332 is rotated in the clockwise direction, the first stopper 331 may also be rotated in the clockwise direction at the same time by the connection gear 35. Thus, the first hook 321 inserted into the hook groove 331a of the first stopper 331 is hooked in the hook groove 331a. When the first hook 321 is hooked and restricted by the hook groove 331a, the rotation of the sub door 122 on which the latch assembly 30 is mounted may be interrupted. Thus, while the main door 121 is rotated, the sub door 122 is maintained in a state in which the sub door 122 is received in the cooling compartment 111 of the refrigerator 10.

[0064] Fig. 17 is a plan view of the latch assembly shown in Figs. 12-14 when the main door and sub door of the refrigerator are integrally rotated.

[0065] Referring to Fig. 17, in certain circumstances the door 12 may be completely closed with the door 12 positioned against the front of the main body 11 of the refrigerator 10, with the first hook 321 only inserted into the hook groove 331a of the first stopper 331, but not hooked therein. Thus, the first hook 321 is detachable from the hook groove 331a. In this state, when the main door 121 and the sub door 122 are pulled without pushing the button 41, the first hook 321 is separated from the first stopper 331.

[0066] As described above, according to the operation mechanism of the latch assembly 30, when only the main door 121 is opened, the rotation of the sub door 122 is restricted by the first hook 321. Also, when both the main door 121 and the sub door 122 are opened, the sub door 122 may be freely separated from the first hook 321. Thus, two types of opening mechanisms may be realized using a single latch assembly.

[0067] Figs. 18 and 19 are plan views of a latch assembly according to another embodiment as broadly described herein.

[0068] The embodiment shown in Figs. 18 and 19 is different from the embodiment shown in Figs. 12-14 in that a connecting rod instead of the connection gear is provided. In detail, the connecting rod 36 may have a first end connected to the first stopper 331 and a second end connected to the second stopper 332.

[0069] Fig. 18 is a view of a latch assembly 40 in a state in which the main door 121 is opened. Here, when the main door 121 is closed, the second stopper 332 is rotated in a counterclockwise direction. As the second stopper 332 is rotated, the second end of the connecting rod 36 is rotated in the counterclockwise direction and then retreated. At this time, the first end of the connecting rod 36 is also rotated in the counterclockwise direction and then retreated. That is, since the connecting rod 36 is retreated, the first stopper 331 releases the restriction

of the first hook 321 while the first stopper 331 is rotated.

[0070] In detail, when the main door 121 is completely closed, the first and second stoppers 331 and 332 are positioned as shown in Fig. 19. In this state, when the sub door 122 is pulled, the first hook 321 is separated from the first stopper 331 as shown in Fig. 19.

[0071] In alternatively embodiments, a device for allowing the two stoppers 331 and 332 to be rotated by being linked with each other through transmission of a rotation motion of the second stopper 332 into the first stopper 331 may be provided, in addition to the connection gear 35 or the connecting rod 36. It may be assumed that devices capable of providing the above-described function may be included in the scope of the present disclosure.

[0072] Fig. 20 is a perspective view of a sealing structure between the door and the main body of a refrigerator as embodied and broadly described herein, and Fig. 21 is a horizontal cross-sectional view of the refrigerator shown in Fig. 20.

[0073] In the refrigerator 10 shown in Figs. 20 and 21, the door 12 may include the main door 121 and the sub door 122. However, the sealing member 50 for preventing cool air from leaking through a contact portion between the main body 11 and the door 12 may be disposed on only the contact portion between the main door 121 and the main body 11.

[0074] For example, in a case in which a sub door is closely attached to a front surface of a main body and a main door is closely attached to a front surface of the sub door, a sealing member may be provided on a circumference of a contact portion between the main door and the sub door and a circumference of a contact portion between the main body and the sub door. However, in refrigerators according to embodiments as broadly described herein, since the sub door 122 is completely received into the main body 11, the circumference of the front surface of the sub door 122 does not contact the circumference of the front surface of the main body 11. Thus, the sealing member 50 may be provided on only the contact portion between the main door 121 and the main body 11. Therefore, manufacturing processes and costs of the refrigerator may be reduced.

[0075] In a refrigerator as embodied and broadly described herein, since the sub door is completely received into the refrigerator main body when the sub door is closed, and also only the main door and the refrigerator main body contact each other, leakage of the cool air occurring at a boundary between the main door and the sub door may be minimized. Further, since it may be unnecessary to provide a separate gasket on the contact portion between the main door and the sub door, productivity may be improved. Additionally, since it may be unnecessary to provide a separate heater for removing dew on the contact portion between the main door and the sub door, productivity may be improved and power consumption may be reduced. Still further, such an arrangement may prevent the cool air from leaking due to inter-

ference between the hinge supporting the sub door and the main door and/or the refrigerator main body or prevent the door from being shaken when the door is opened.

[0076] In a refrigerator as embodied and broadly described herein, since only the main door and all of the main door and the sub door may be smoothly opened using a single latch assembly, manufacturing costs may be reduced. Further, since the operations of the main door and the sub door may be controlled by the single latch assembly, a single latch driving part may be employed, and to latch mounting part may be reduced in volume and manufacturing costs may be reduced. Also, since a linkage member may control operation of each hook part in a case in which only the main door is opened and a case in which the main door and the sub door are opened together, reliability with respect to the simultaneous operation of the hook parts may be secured.

[0077] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

[0078] Embodiments provide a refrigerator in which a sub door is completely received into a cooling compartment, and a main door contacts a front surface of a refrigerator main body to prevent a hinge for sub door from interfering with the main door or the refrigerator main body and to minimize leakage of cool air.

[0079] Embodiments also provide a refrigerator which does not require a separate gasket for preventing insulation performance from being deteriorated due to the installation of a sub door and a separate heater for removing dew generated on an edge of the sub door.

[0080] Embodiments also provide a refrigerator in which a main door and a sub door are smoothly opened using a single latch assembly to reduce manufacturing costs and secure reliability with respect to a simultaneous operation of a latch.

[0081] In one embodiment, a refrigerator as broadly described herein may include a main body having a cooling compartment therein; a door rotatably provided on a front surface of the main body to selectively open or close the cooling compartment, the door including a main door defining the front surface of the main body and a sub door coaxially rotated with the main door at a rear side of the main door; and a hinge assembly including a main hinge rotatably connecting the main door to the main body and a sub hinge independently and rotatably connecting the main door to the sub door, wherein the sub

hinge connects a front surface of the sub door to a back surface of the main door.

[0082] In another embodiment, a refrigerator as broadly described herein may include a main body having a cooling compartment therein; a door rotatably provided on a front surface of the main body to selectively open or close the cooling compartment, the door including a main door defining the front surface of the main body and a sub door coaxially rotated with the main door at a rear side of the main door; and a latch assembly of which at least one portion is mounted on a side of the sub door to selectively restrict the rotation of the door, wherein the latch assembly includes: a first restriction unit for restricting rotation of the sub door; a second restriction unit for restricting rotation of the main door; and a connection unit allowing the first and second restriction units to be operated by being linked with each other.

[0083] Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

[0084] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

1. A refrigerator, comprising:

a main body having a cooling compartment therein;
a door rotatably coupled to the main body to selectively open and close the cooling compartment, the door comprising:

a main door having a front surface defining a front exterior surface of the main body;
and

- a sub door positioned at a rear surface of the main door opposite the front surface thereof, and being coaxially rotated with the main door; and
a hinge assembly, comprising: 5
- a main hinge rotatably coupling the main door to the main body; and
a sub hinge independently and rotatably coupling the sub door to the main door, wherein a front surface of the sub door faces and is coupled to the rear surface of the main door. 10
2. The refrigerator of claim 1, wherein the sub door and the sub hinge are completely received in the cooling compartment when the door is closed. 15
3. The refrigerator of claim 1 or 2, wherein the sub hinge comprises a multi-joint link which folds and unfolds based on a rotation direction of the main door. 20
4. The refrigerator of claim 3, wherein the sub hinge comprises: 25
- a first bracket attached to the front surface of the sub door;
a second bracket attached to the back surface of the main door; and
a multi-joint link connecting the first bracket to the second bracket. 30
5. The refrigerator of claim 4, wherein the multi-joint link comprises: 35
- a first link having a first end and a second end, the first end thereof being rotatably coupled to the first bracket by a first rotation shaft; and
a second link having a first end thereof rotatably coupled to the second end of the first link by a second rotation shaft and a second end thereof rotatably coupled to the second bracket by a third rotation shaft. 40
6. The refrigerator of claim 5, further comprising an elastic member provided on the second rotation shaft, wherein preferably the elastic member comprises a torsion spring generating a force in a direction increasing an angle between the first and second links when the main door is opened. 45
7. The refrigerator of any of claims 1 to 6, further comprising a latch assembly that selectively coupled the main body, the sub door and the main door, the latch assembly comprising: 50
- a first hook fixed to the main body and extending toward the sub door;
- a second hook fixed to the main door and extending toward the sub door;
a first stopper provided in the sub door, at a position corresponding to the first hook, the first stopper engaging the first hook so as to secure the sub door in the cooling compartment and disengaging the first hook so as to release the sub door for rotation with the main door; and
a second stopper provided in the sub door, at a position corresponding to the second hook, the second stopper engaging the second hook so as to secure the sub door to the main door and disengaging the second hook so as to release the sub door from the main door.
8. The refrigerator of claim 7, further comprising a connection device that operably couples the first and second stoppers, the connection device comprising at least one gear or at least one connecting rod.
9. A refrigerator, comprising:
- a main body having a cooling compartment therein;
a door rotatably coupled to the main body to selectively open and close the cooling compartment, the door comprising:
- a main door having a front surface defining a front exterior surface of the main body; and
a sub door provided at a rear surface of the main door and being coaxially rotated with the main door; and
a latch assembly that selectively couples the main body, the sub door and the main door to selectively restrict rotation of the door, wherein the latch assembly comprises:
- a first restriction device restricting rotation of the sub door;
a second restriction device restricting rotation of the main door; and
a connection device that operably links the first and second restriction devices.
10. The refrigerator of claim 9, wherein the first restriction device comprises:
- a first hook fixed to a side of the cooling compartment; and
a first stopper provided in the sub door, at a position corresponding to the first hook, the first stopper having a first groove formed therein for receiving the first hook to selectively engage the first hook, and/or, wherein the second restriction device comprises:

- a second hook fixed to a side of the main door; and
 a second stopper provided in the sub door, at a position corresponding to the second hook, the second stopper having a second groove formed therein for receiving the second hook to selectively engage the second hook. 5
11. The refrigerator of claim 10, wherein the connection device comprises a gear engaged with the first and second stoppers or wherein the connection device comprises a connecting rod connecting the first stopper to the second stopper. 10
12. The refrigerator of claim 10 or 11, further comprising: 15
- an actuator provided on the main door; and
 a rotation hook having a first end operably coupled to the actuator and a second end hooked on the second stopper to selectively restrict rotation of the second stopper based on an actuation state of the actuator, wherein preferably the actuator comprises: 20
- a push button provided on the main door; and
 a push rod having a first end corresponding to the push button and a second end corresponding to the rotation hook, wherein depression of the push button releases the hooked state between the rotation hook and the second stopper. 25
13. The refrigerator of any of claims 9 to 12, further comprising a seal provided on a contact area between the main body and the main door. 30
14. The refrigerator of any of claims 9 to 13, further comprising a hinge assembly that rotatably couples the door to the main body, comprising: 35
- a main hinge that rotatably couples the main door to the main body;
 a sub hinge that rotatably couples the sub door to the main door; and
 a multi-joint link coupled between the main door and the sub door that contracts and expands based on a rotation direction and position of the door. 40
15. A refrigerator, comprising: 45
- a main body having a cooling compartment formed therein; 50
- a door rotatably coupled to the main body, comprising: 55

- a main door having a first side defining an exterior surface of the main body and a second side opposite the first side; and
 a sub door rotatably coupled to the second side of the main door;
- a hinge assembly that rotatably couples the door to the main body, comprising:
- a first hinge that rotatably couples the main door to the main body; and
 a second hinge that rotatably couples the sub door to the main door, wherein the sub door and the main door rotate together about the first hinge; and
- a latch assembly that selectively couples the main body, the sub door and the main door, comprising:
- a first latch selectively engaged between the main body and the sub door, the first latch securing the sub door in the cooling compartment in a first mode thereof and releasing the sub door from the cooling compartment in a second mode thereof; and
 a second latch selectively engaged between the sub door and the main door, the second latch securing the sub door to the main door in a first mode thereof and releasing the sub door from the main door in a second mode thereof.

FIG.1

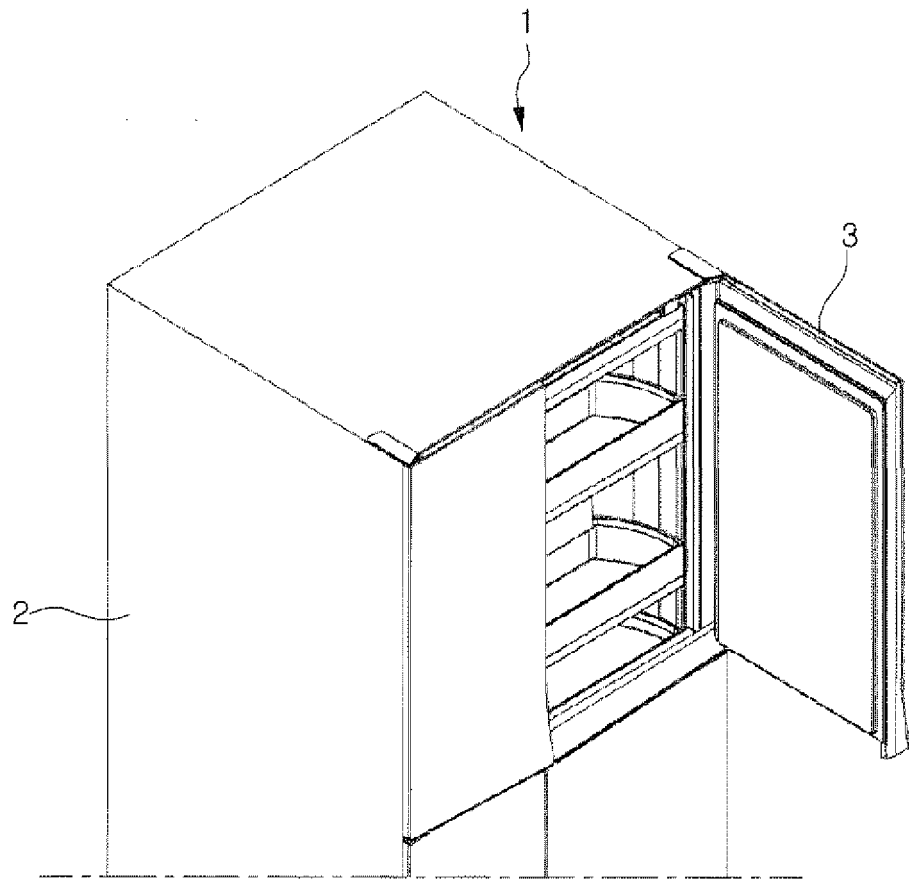


FIG.2

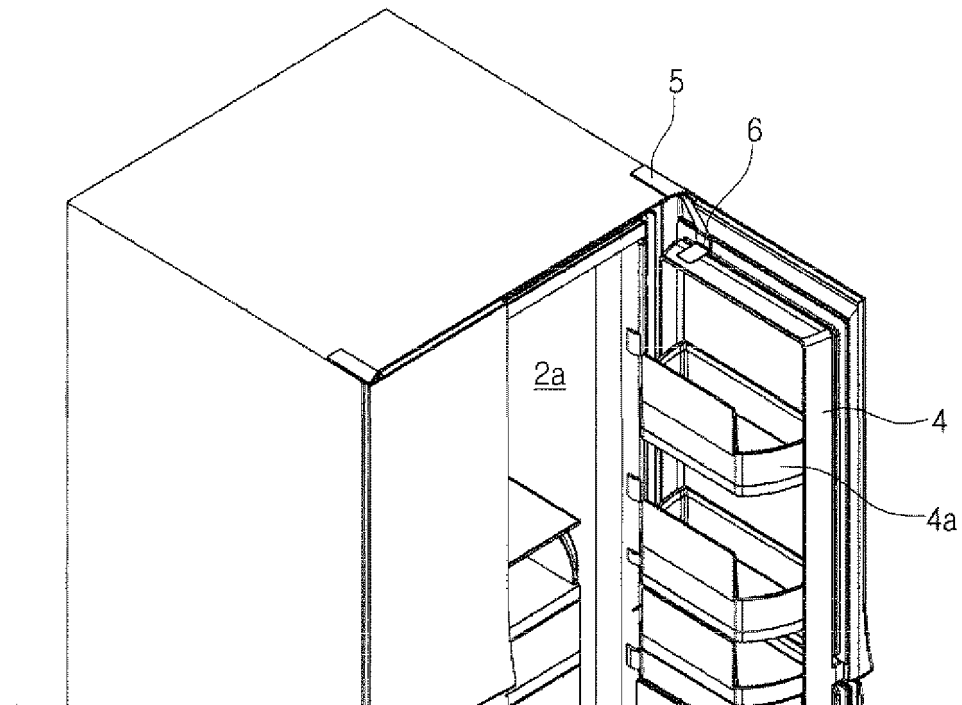


FIG.3

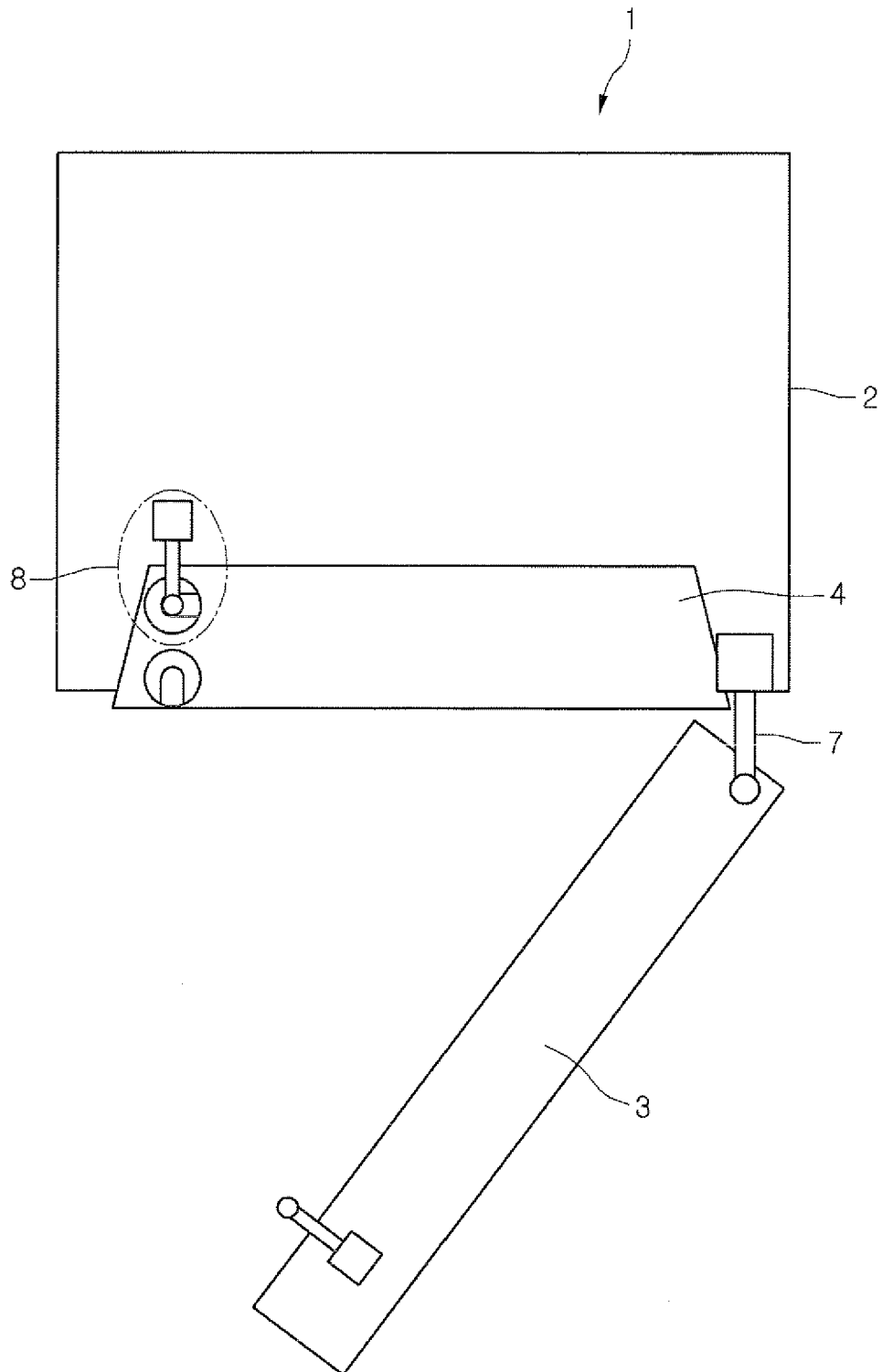


FIG.4

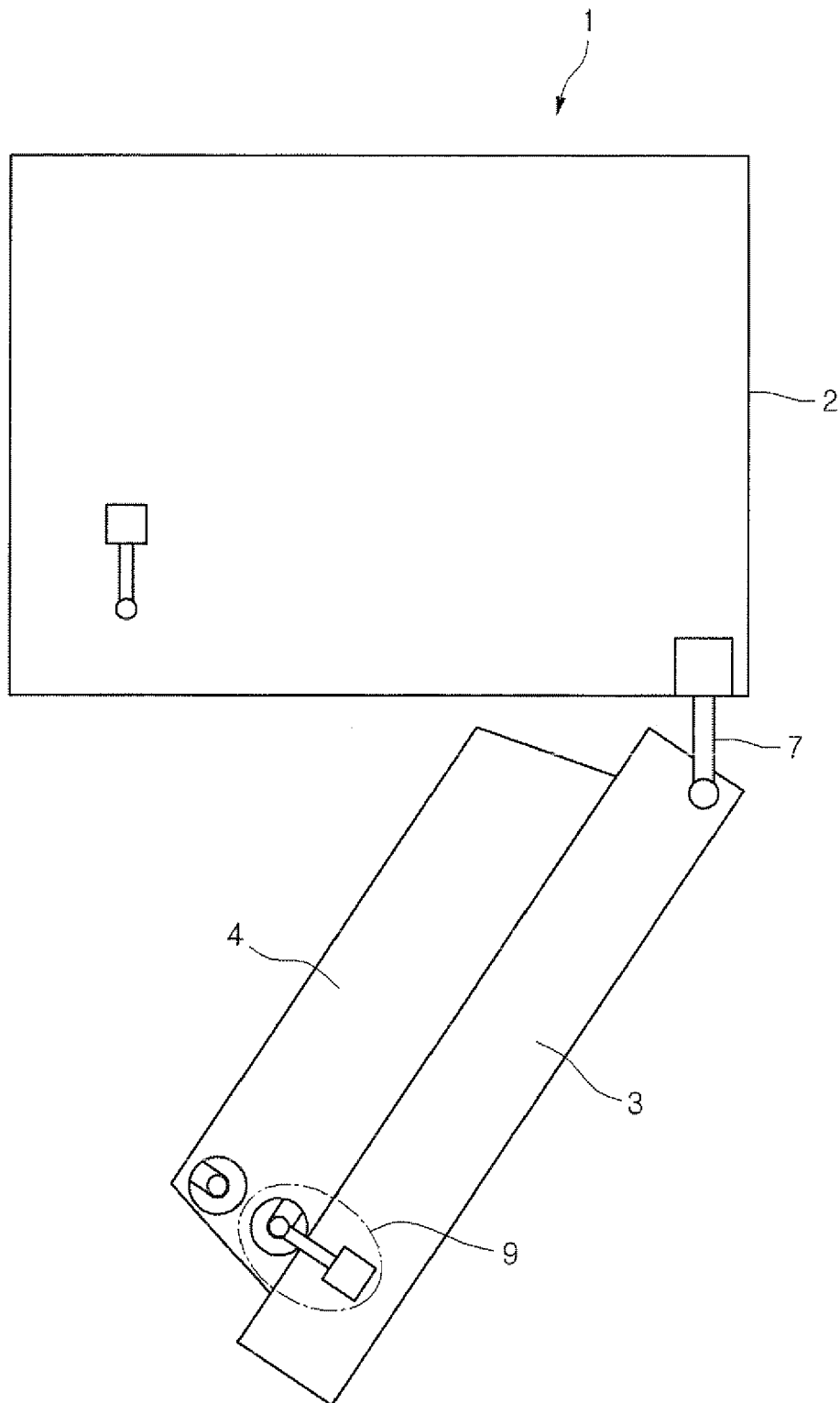


FIG.5

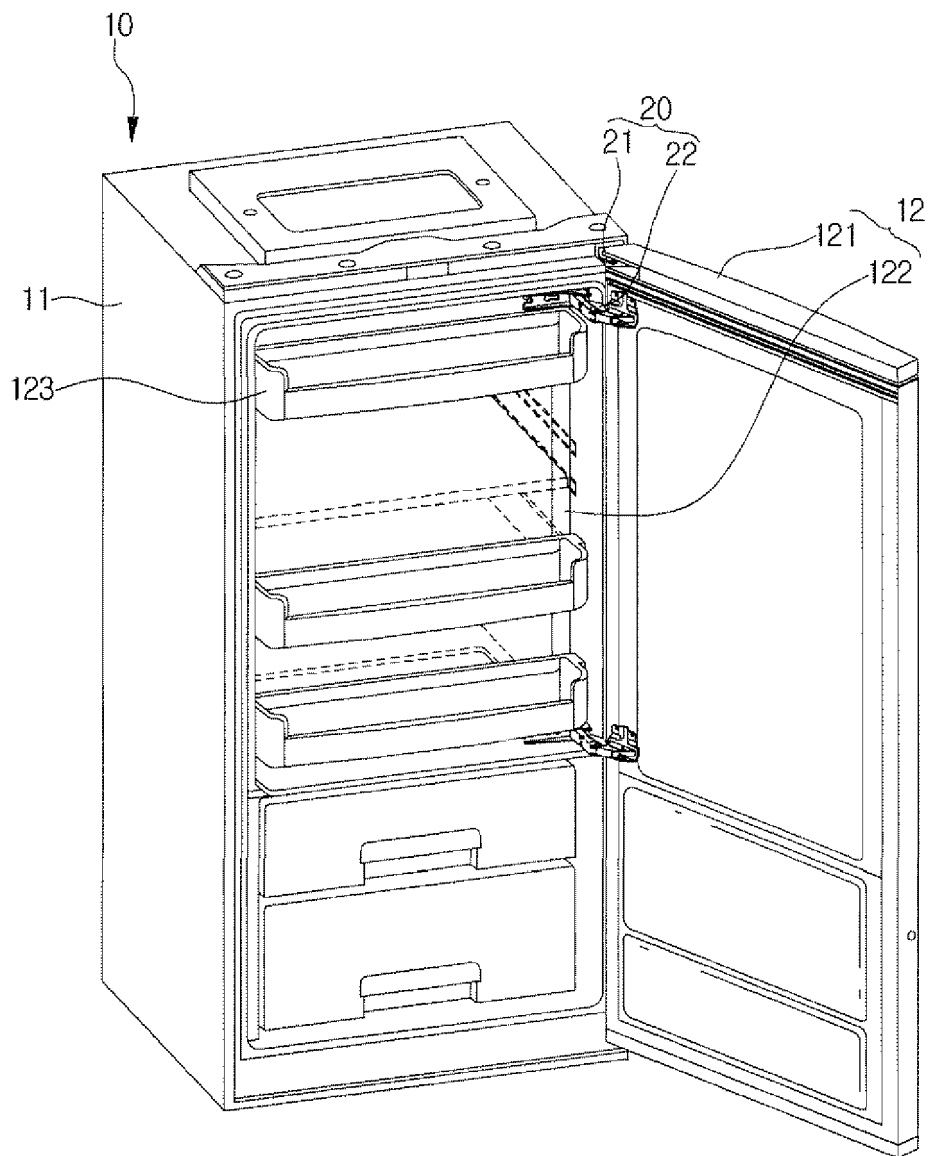


FIG.6

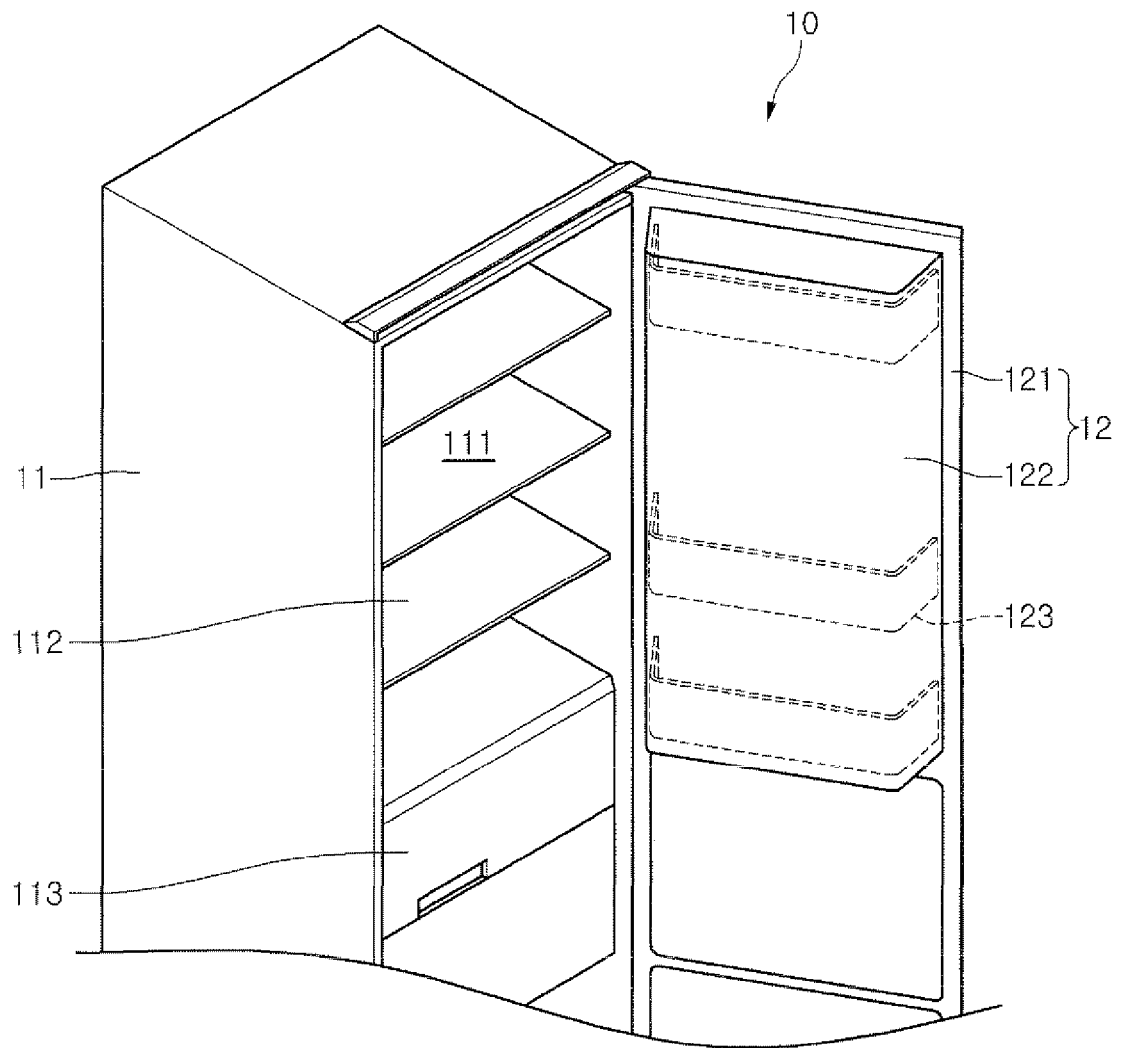


FIG.7

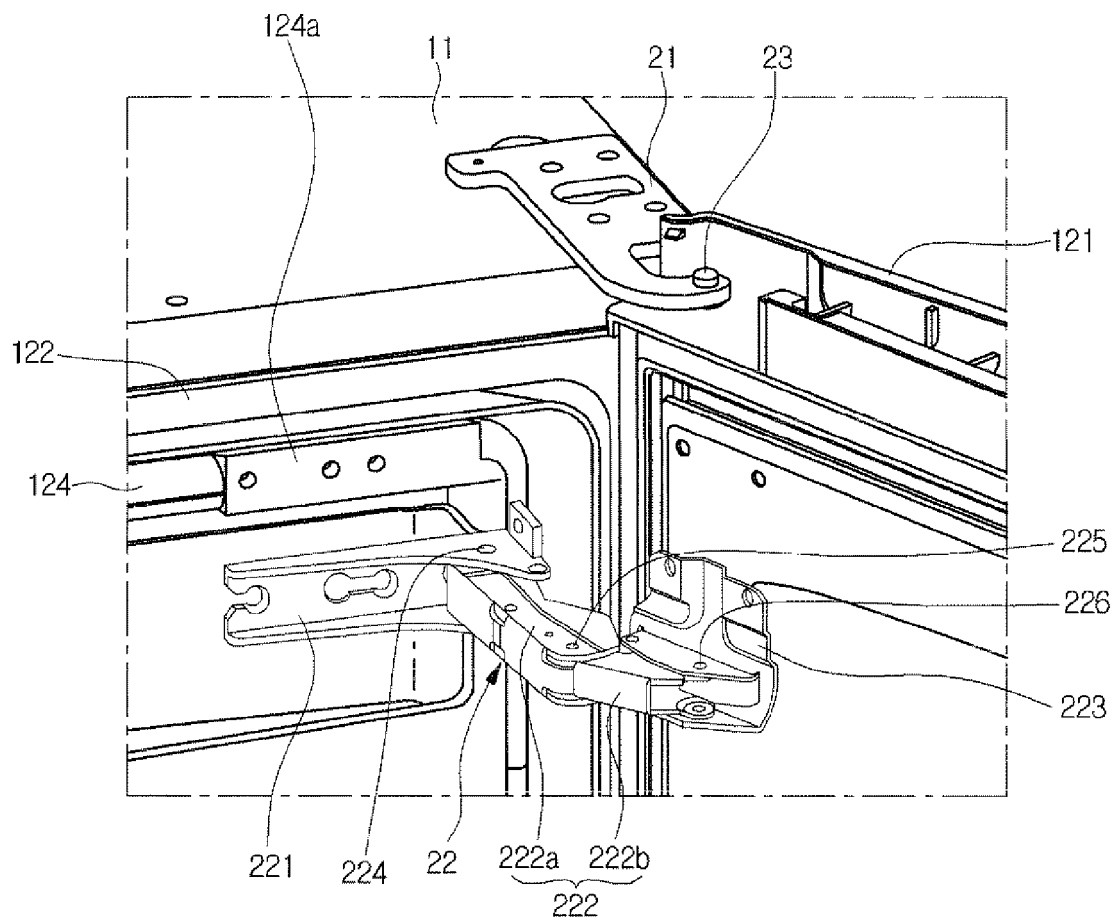


FIG.8

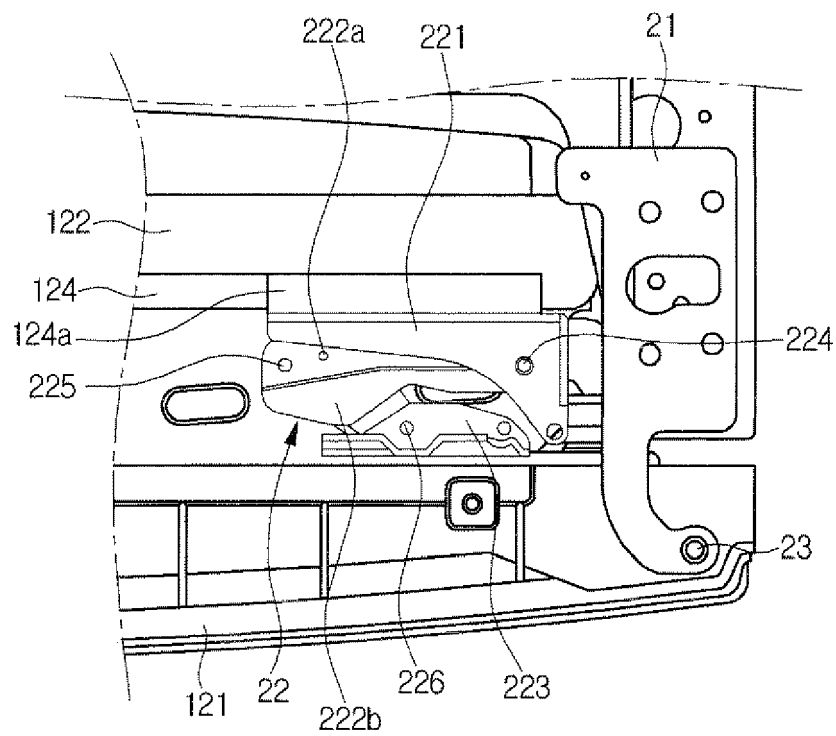


FIG.9

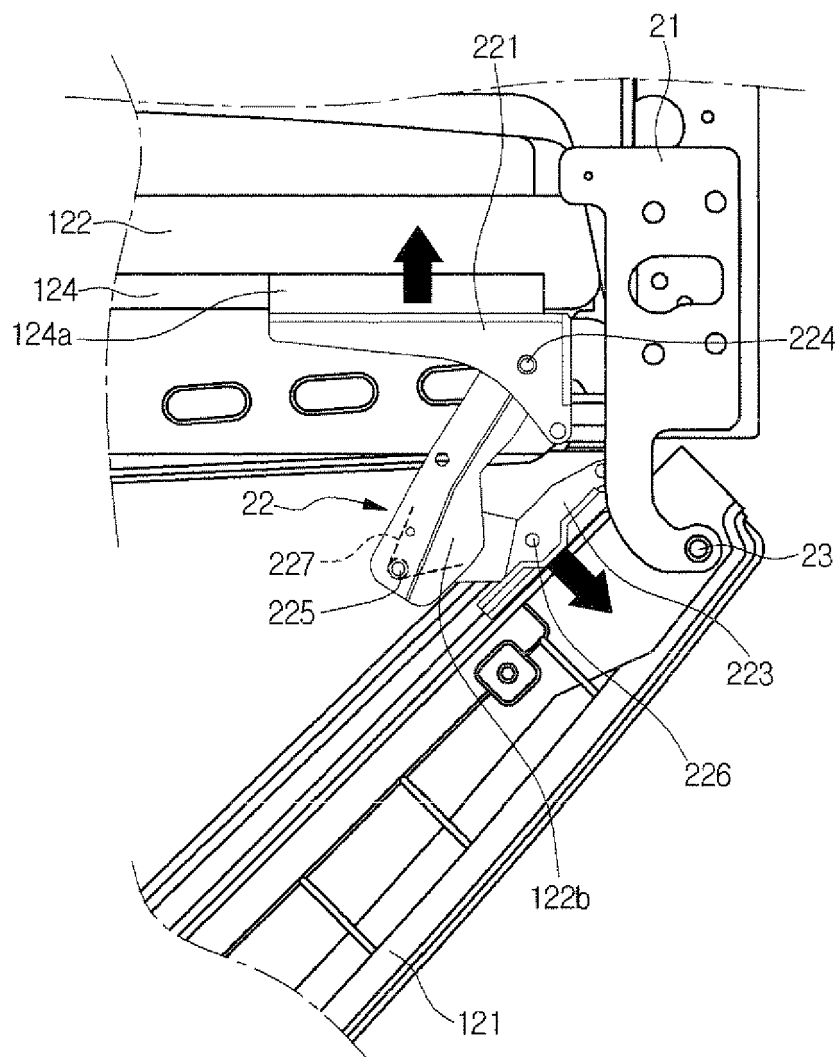


FIG.10

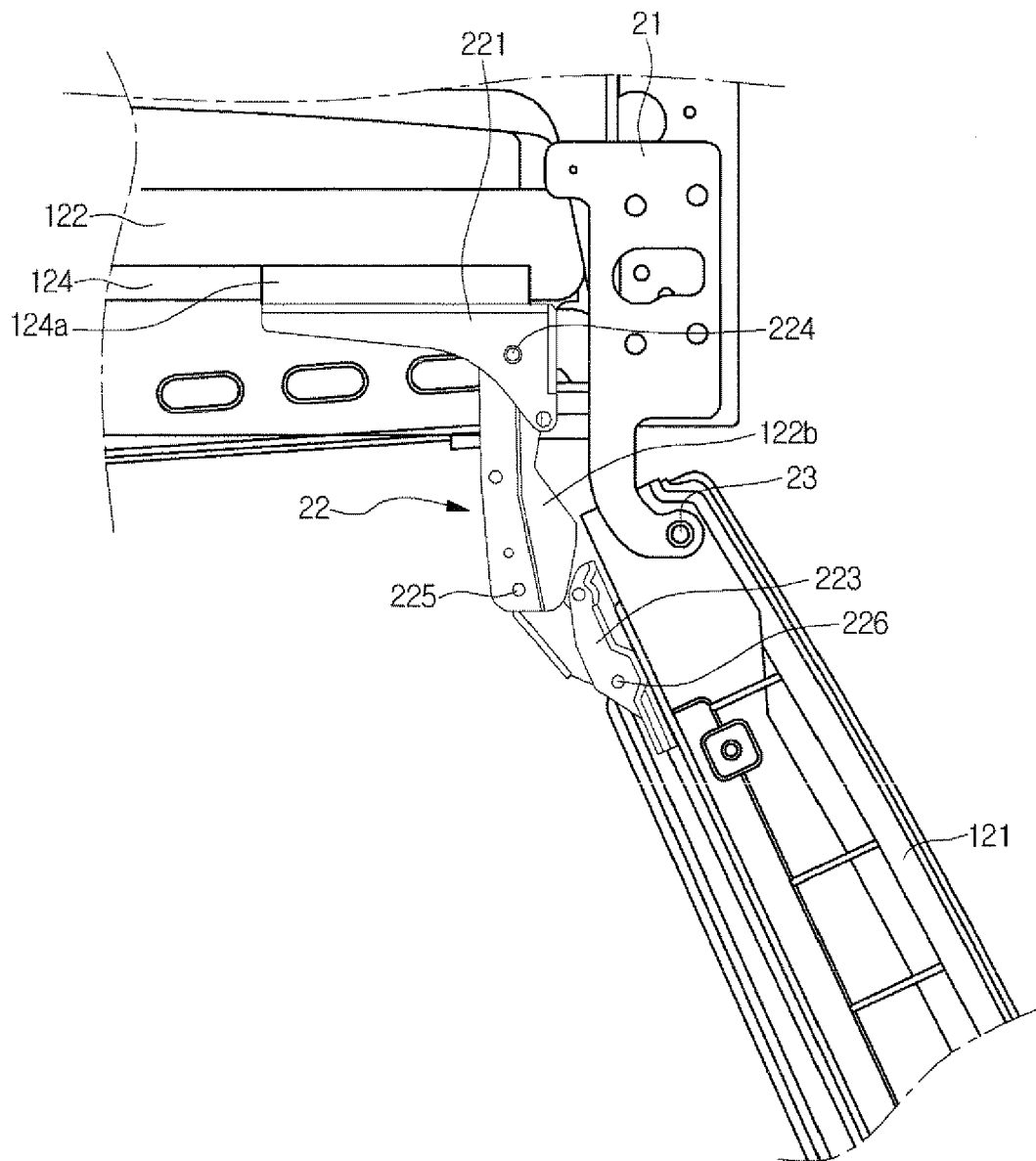


FIG.11

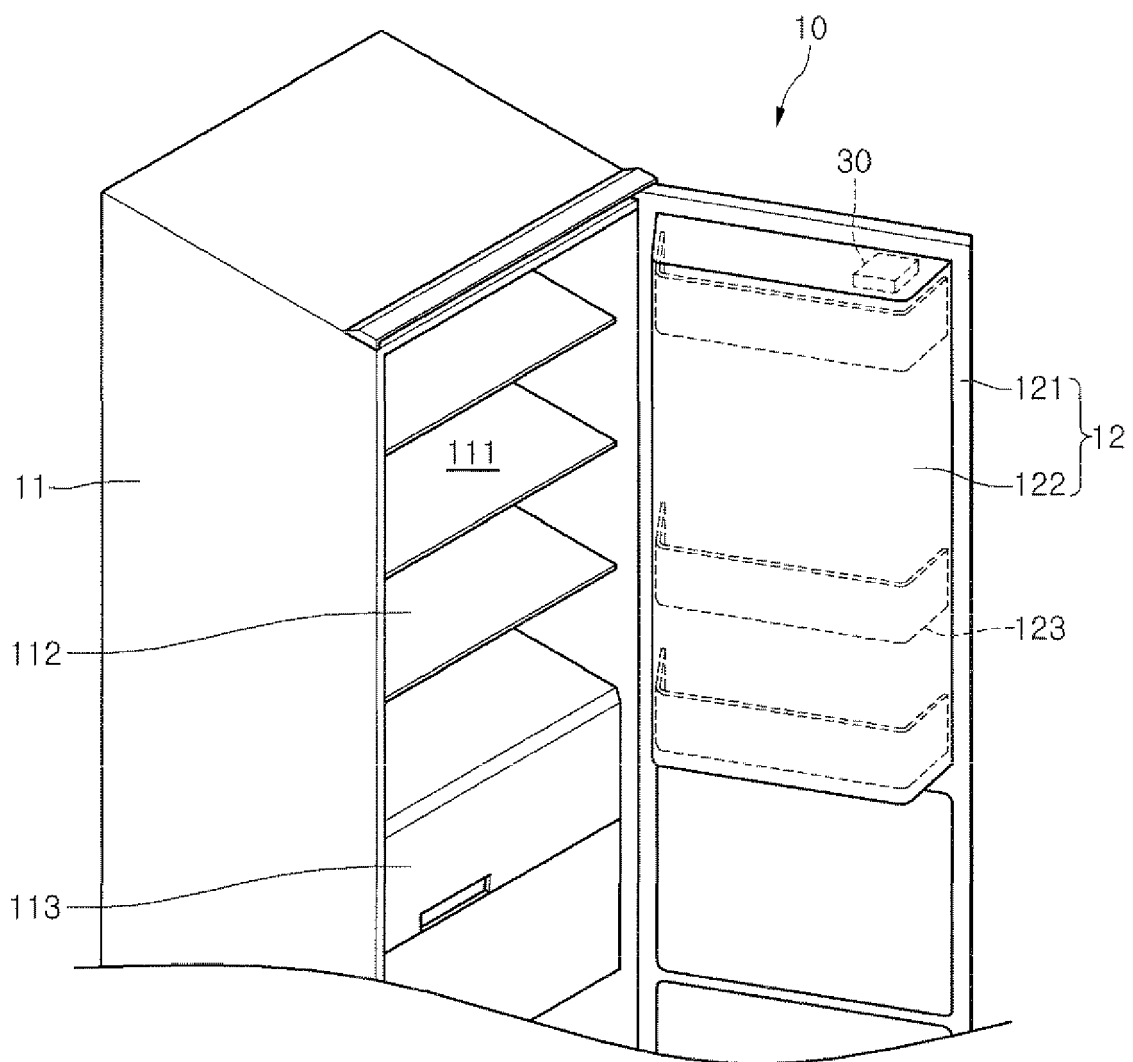


FIG.12

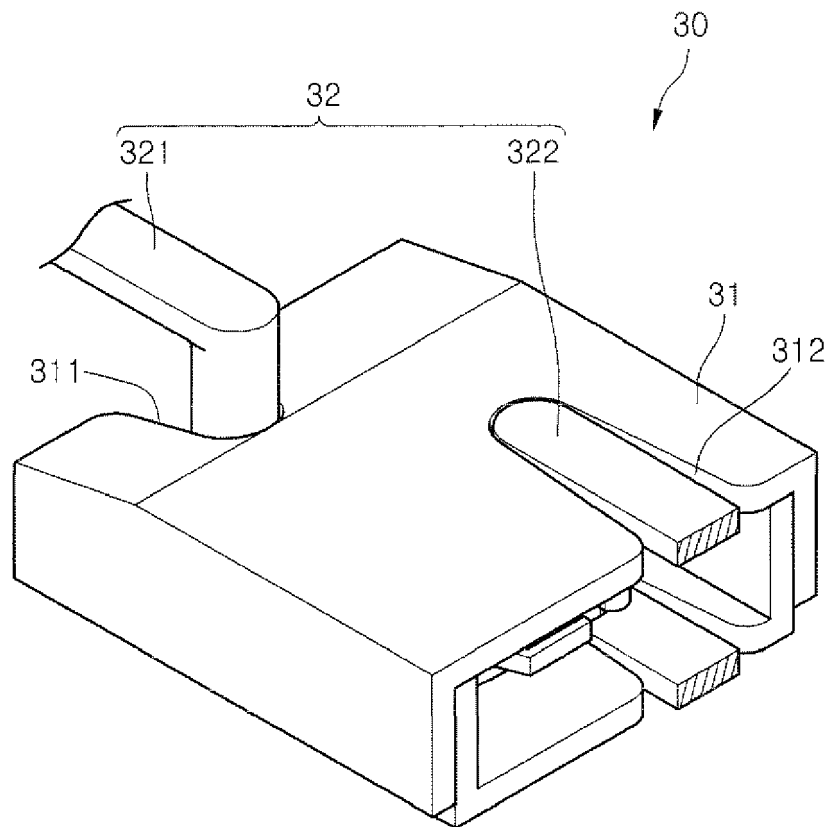


FIG.13

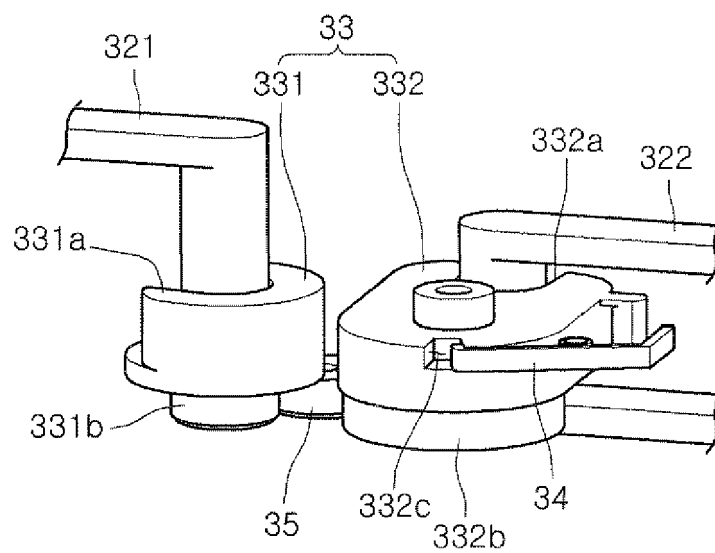


FIG.14

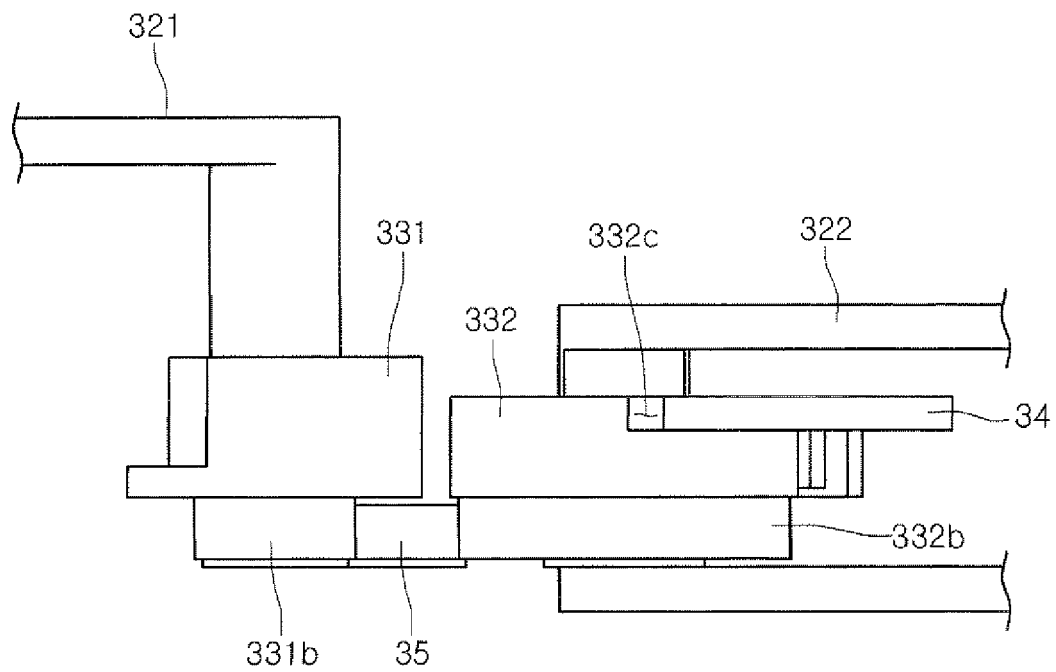


FIG.15

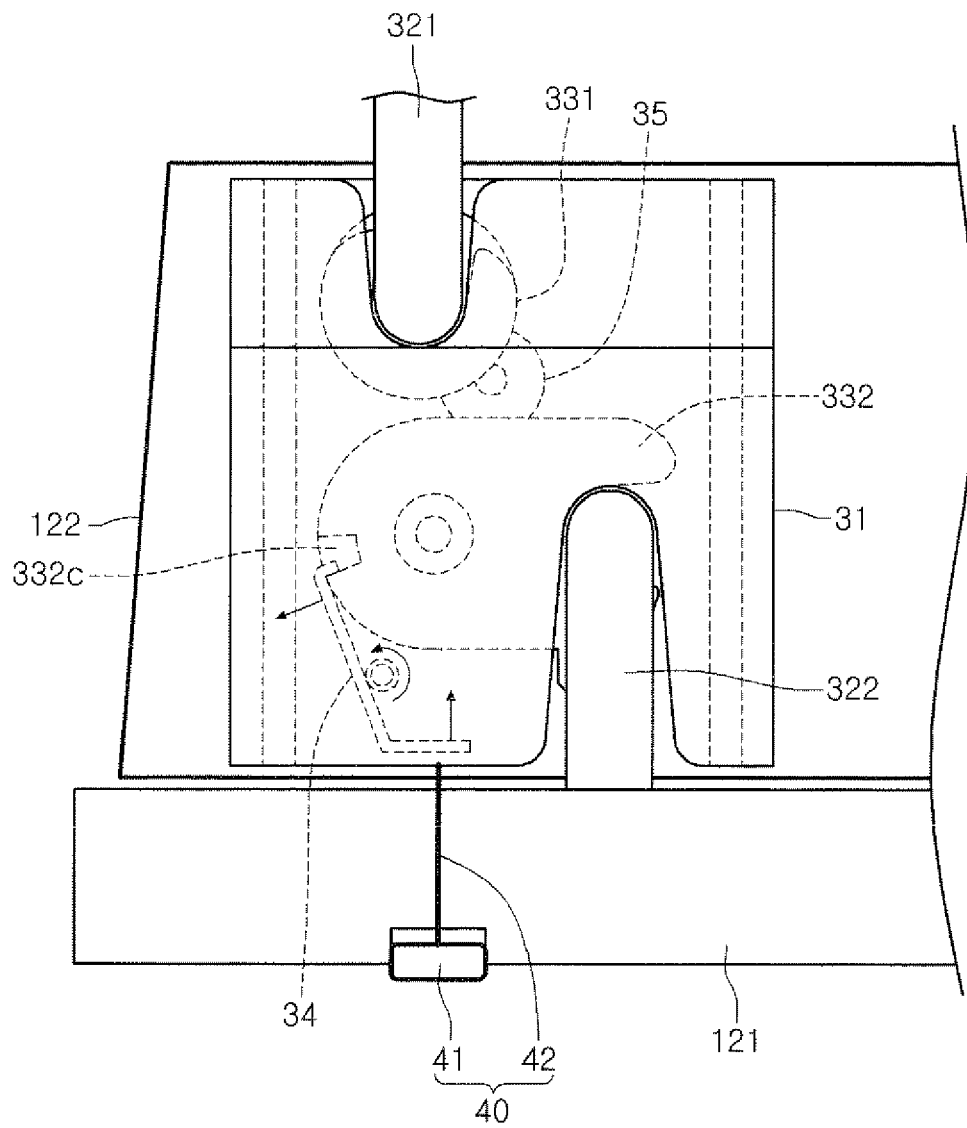


FIG.16

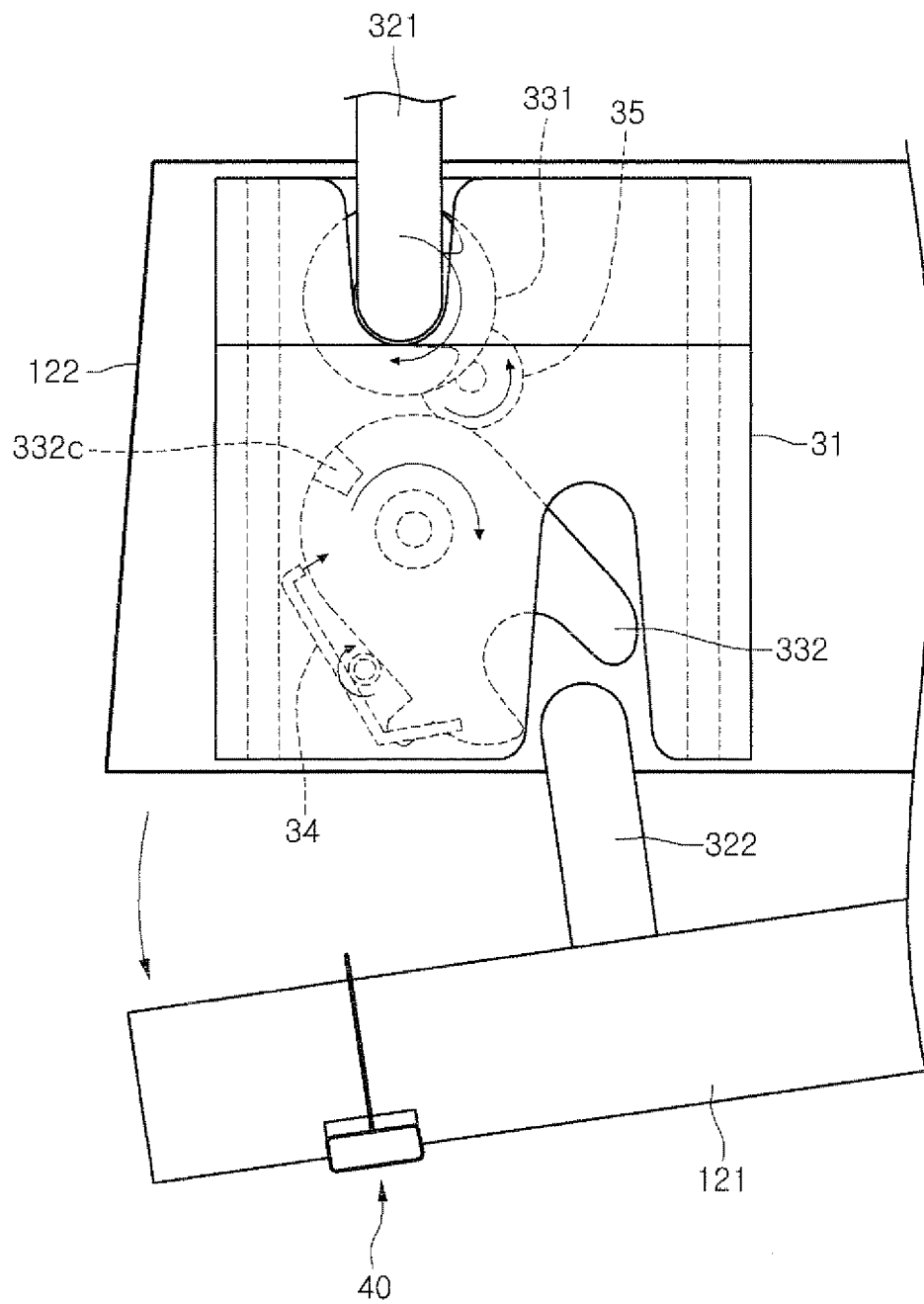


FIG.17

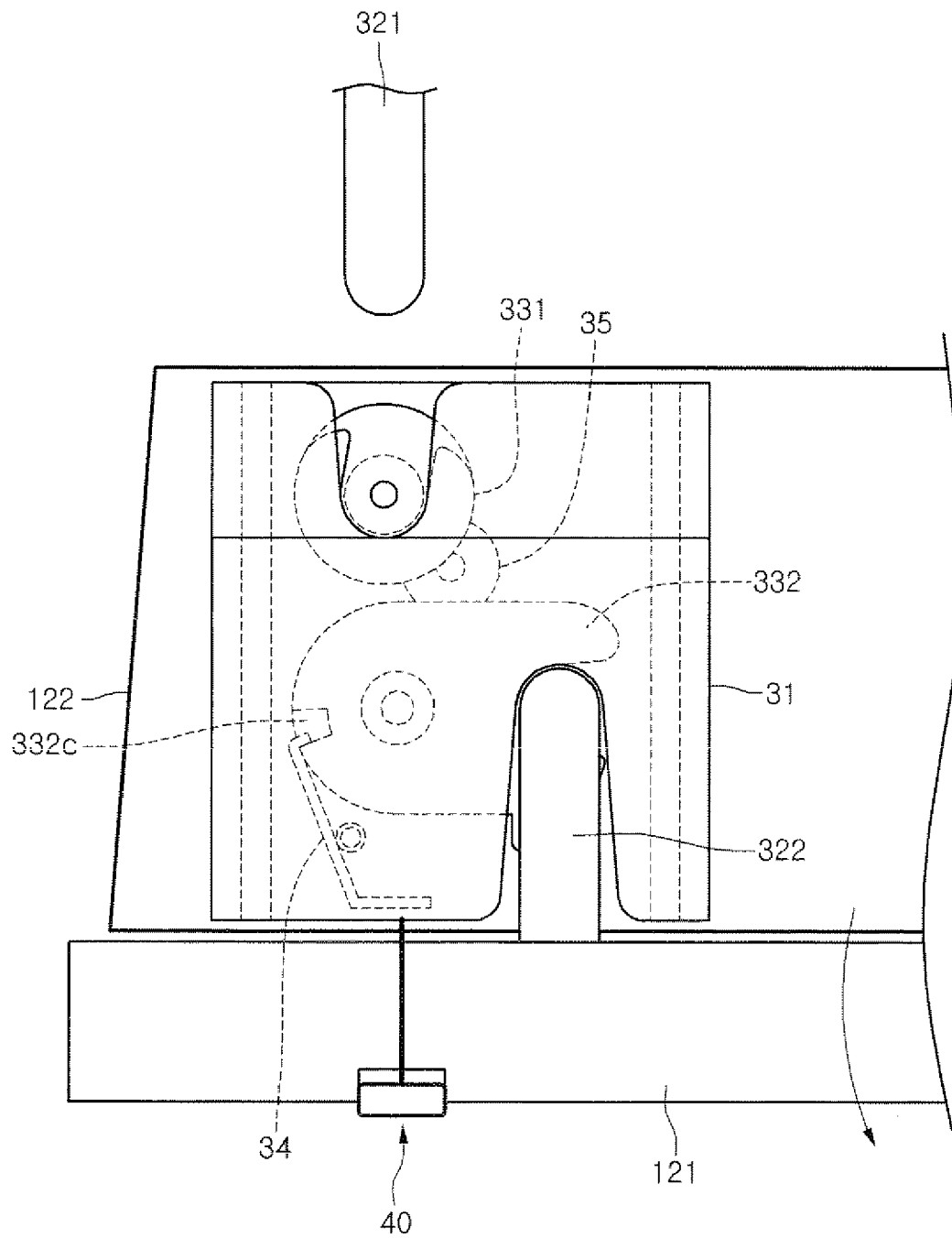


FIG.18

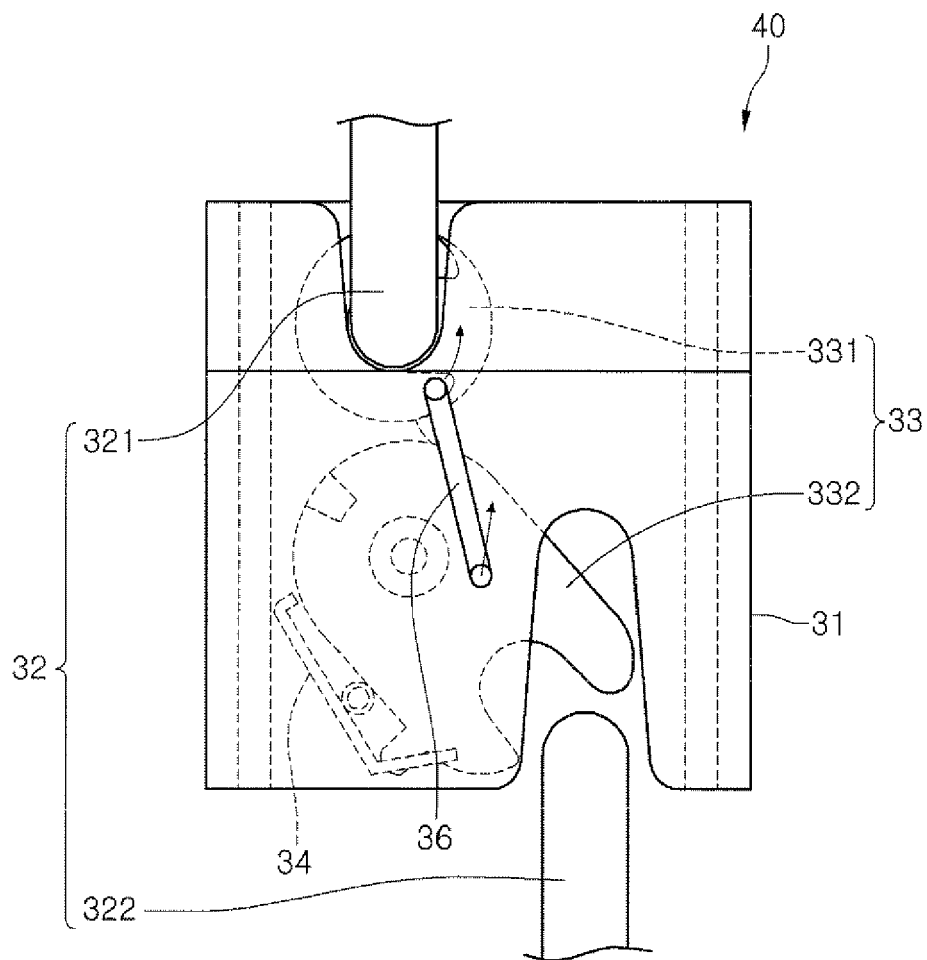


FIG.19

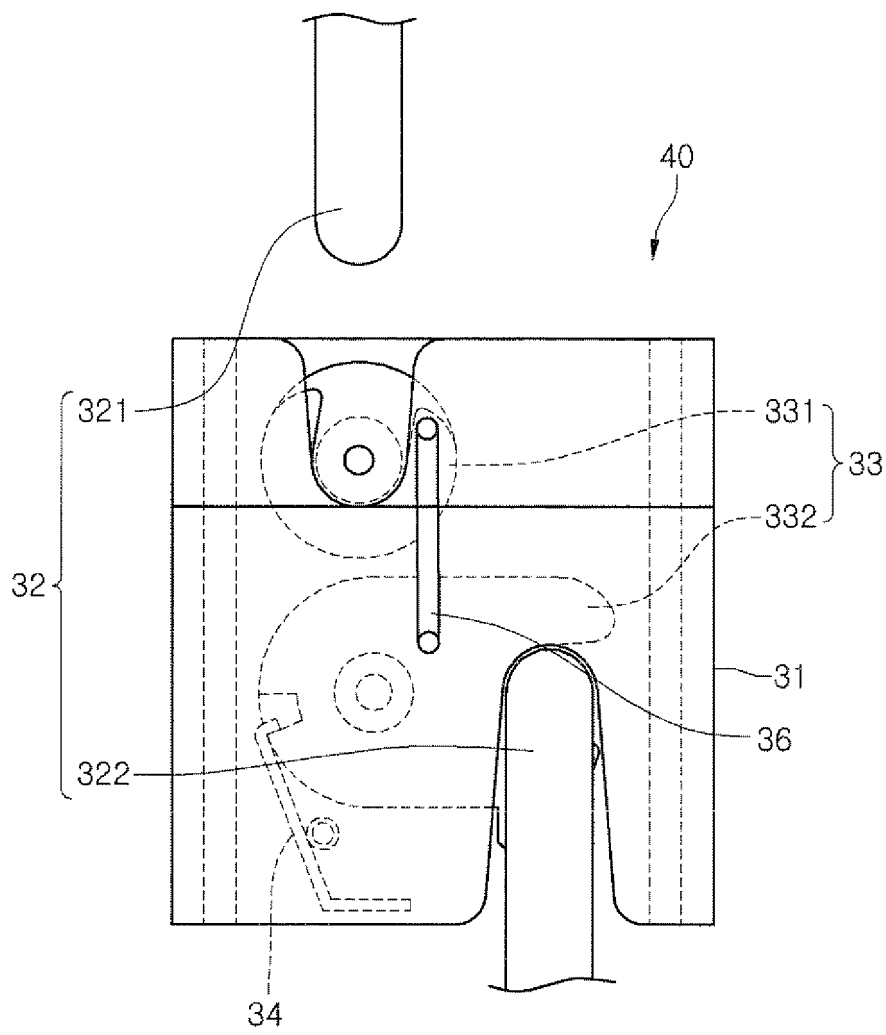


FIG.20

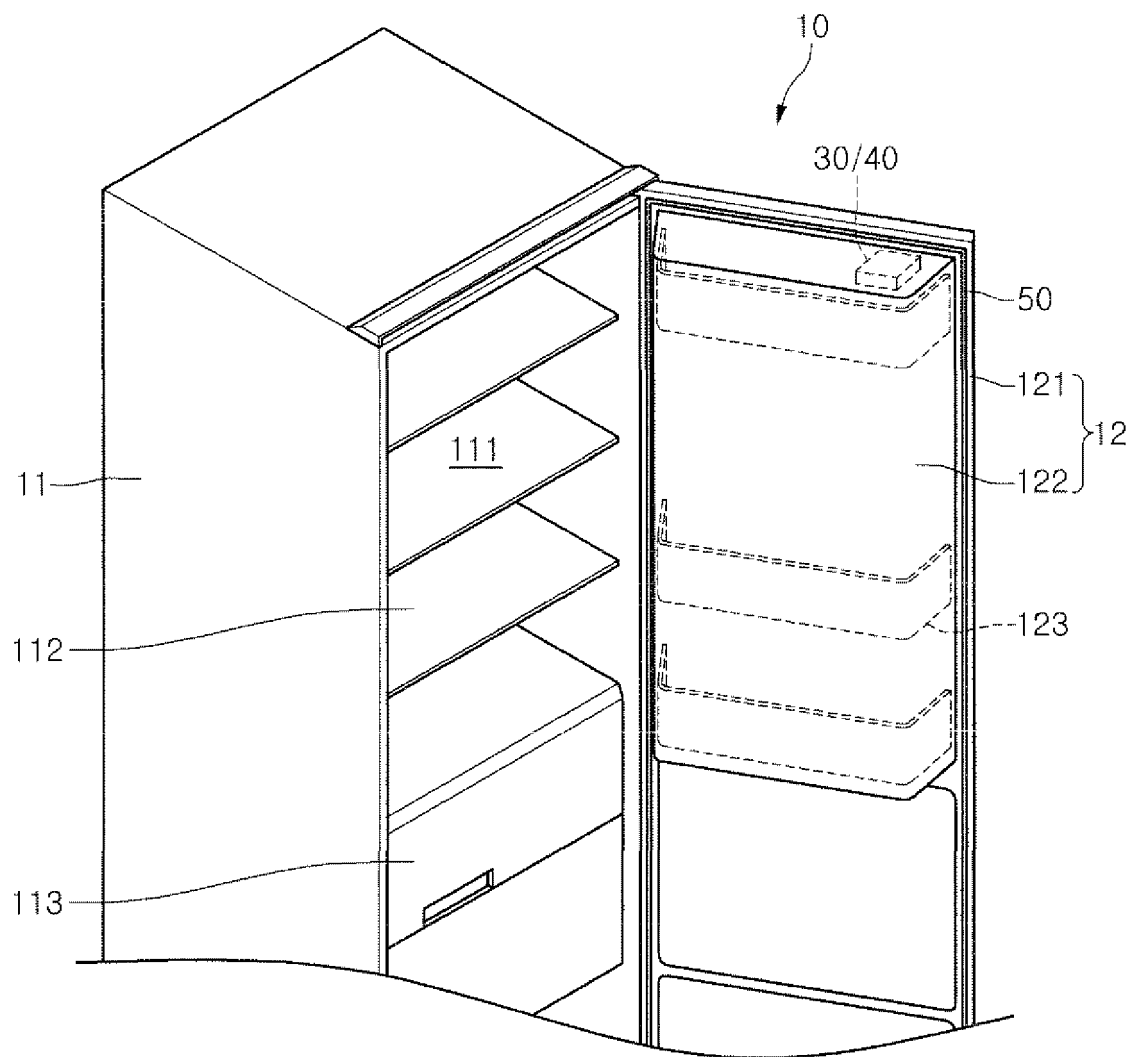
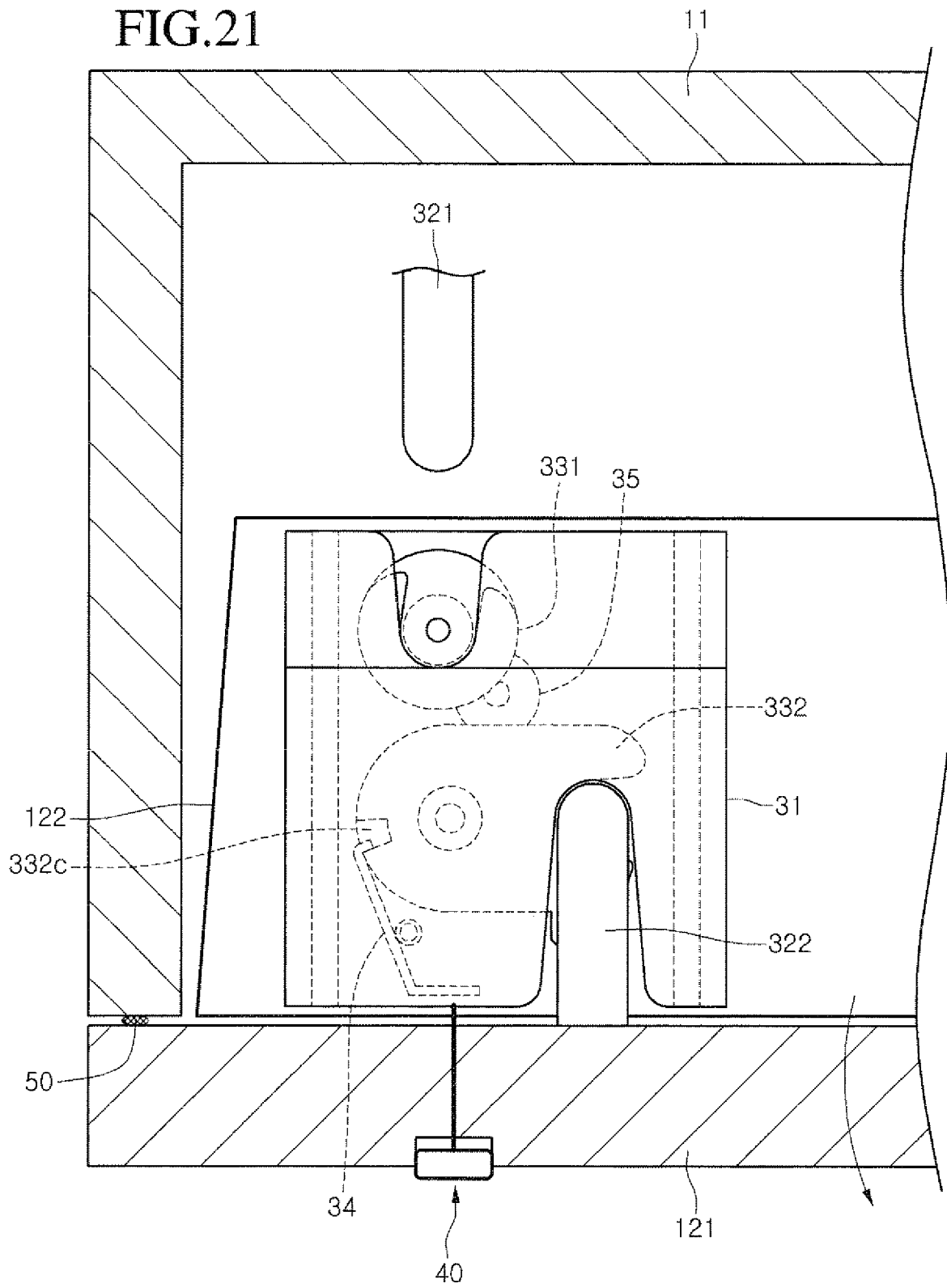


FIG.21



REFERENCES CITED IN THE DESCRIPTION

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- KR 1020110087500 [0001]
- KR 1020110093657 [0001]