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(71) Applicant: **LG Electronics Inc.**
Yeongdeungpo-gu
Seoul 07336 (KR)

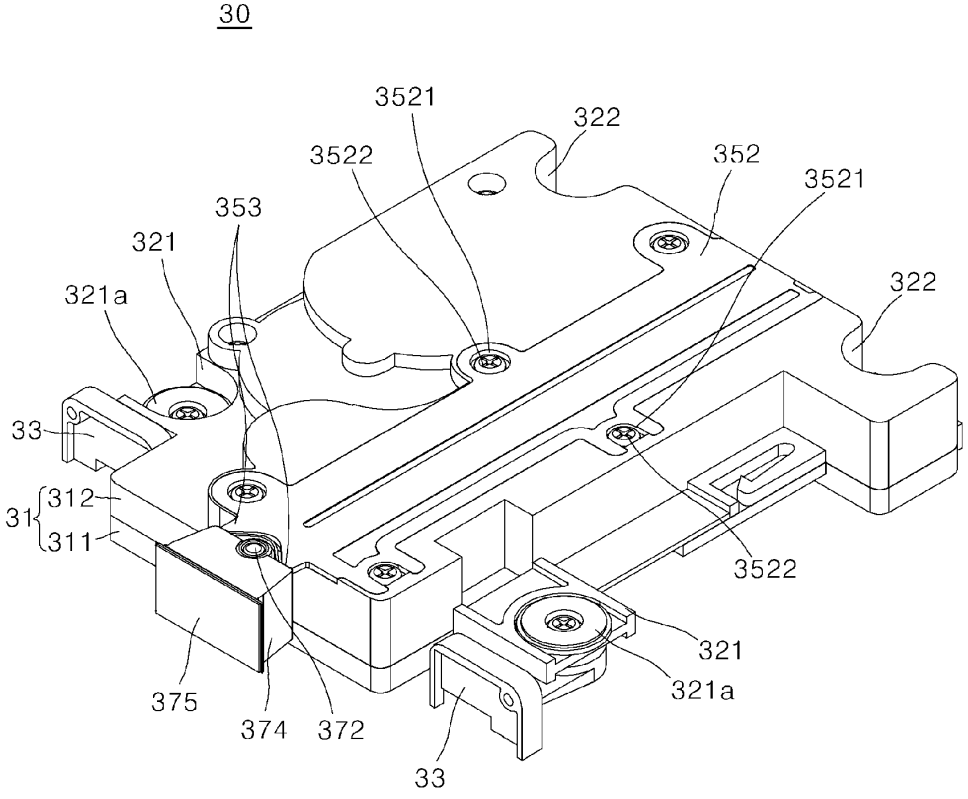
(72) Inventor: **Lee, Jong Hwa**
08592 Seoul (KR)

(74) Representative: **Ter Meer Steinmeister & Partner Patentanwälte mbB**
Nymphenburger Straße 4
80335 München (DE)

(54) DOOR OPENING DEVICE AND REFRIGERATOR INCLUDING THE SAME

(57) A door opening device (30) for opening a door assembly (20), comprising: a housing (31);a rack bar (37) accommodated in the housing (31) and configured to move to extract from the housing (31) or to retract into the housing (31);a head cover (374) connected to one end of the rack bar (37) and configured to push a surface of the door assembly (20); and a pair of protruding ribs (353) protruding from the housing (31) to correspond the head cover (374).

Fig. 7



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a door opening device that may automatically open a door or supplement door opening, and a refrigerator including the same.

BACKGROUND

[0002] A refrigerator is an electric home appliance that may keep various types of storage objects fresh for a long period of time by supplying cool air generated by circulation of a refrigerant to a storage chamber.

[0003] The refrigerator may include a cabinet defining the storage chamber and a door coupled to a front surface of the cabinet to open and close the storage chamber.

[0004] In general, a gasket may be additionally disposed on a surface between the door and the cabinet to prevent leakage of cool air inside the storage compartment.

[0005] To maintain the sealing of the storage compartment, the gasket may be made of a compressible material and seal the door to the cabinet.

[0006] Since the sealing of the gasket is inversely proportional to the amount of cold air leakage inside the storage compartment, the sealing of the gasket may be increased to reduce the amount of cold air leakage inside the compartment.

[0007] However, if the sealing of the gasket is increased, a strong power can be required when a user opens the door.

[0008] Accordingly, when a door opening device configured to automatically open the door is introduced to the refrigerator, the door opening device may assist the user to easily open the door with only a small force while maintaining high sealing capacity of the compartment.

[0009] The door opening device may include a head cover connected to a front end of a rack bar moving to protrude and return in a front-back direction to push a rear surface of the door, thereby opening the door.

[0010] The door is rotatable with respect to one side having a hinge part and a head cover for pushing a rear surface of the door is protruded in contact with the rear surface of the door, so that the head cover may protrude while rotating at one end of a rack bar.

[0011] When the rack bar returns after the door is open, the head cover protruded in a state of being rotated may return together with the rack bar.

[0012] In this instance, a front surface of the head cover in a state of being rotated needs to return so as to be horizontal.

[0013] For example, a case cover may be disposed on a front surface of the door opening device and the case cover may include a protruding hole serving as a passage of protrusion and returning of the rack bar.

[0014] A support protrusion protruding to the inside of the protruding hole may be formed on the case cover corresponding to the protruding hole. When the rack bar returns, an edge of the head cover is coupled to the support protrusion and then the front surface of the head cover can be horizontally aligned.

[0015] However, the case cover is a separate structure from the door opening device so that an assembling step might occur during the process of assembling the case cover and the door opening device to a refrigerator.

[0016] If such an assembling step occurs between the case cover and the door opening device, the edge of the head cover could not be properly coupled to the support protrusion of the case cover, which results in failing to horizontally align the front surface of the head cover.

SUMMARY

Technical Problems

[0017] Accordingly, one object of the present disclosure is to solve the above-noted disadvantages of the prior art, and to provide a door opening device that may solve horizontal alignment detect of a head cover due to an assembling step, and a refrigerator including the same.

[0018] Another object of the present disclosure is to provide a door opening device that may solve horizontal alignment detect of a head cover by compensating a sensing deviation of a hall sensor for detecting a restituting position of a rack bar, and a refrigerator including the same.

[0019] At least one of these objects are solved by the features of the independent claim. Objects of the present invention are not limited to the above-described objects, and other objects and advantages of the present invention will be understood by the following description and will be more definitely understood through the embodiments of the present invention. It is also to be easily understood that the objectives and advantages of the present invention may be realized and attained by means and a combination thereof described in the appended claims.

Technical Solutions

[0020] To solve the above-noted disadvantages of the prior art, a door opening device and a refrigerator according to an embodiment of the present disclosure are characterized in comprising a pair of protruding ribs protruding to a front of a housing to correspond to a rear surface of a head cover.

[0021] Specifically, the head cover connected to one end of the rack bar and configured to push a rear surface of a door assembly may be horizontally aligned by the pair of protruding ribs provided in the door opening device and protruding to the front of the housing to correspond to the rear surface of the head cover. Accordingly, the present disclosure may improve horizontal misalignment that might occur due to an assembling step between the

door opening device and a separate structure.

[0022] According to one aspect, the refrigerator may include a cabinet comprising a storage chamber; a door assembly configured to open and close the storage chamber, i.e. the cabinet, in particular a front surface of the cabinet; and a door opening device configured to automatically open the door assembly. The door opening device may be a door opening device according to any aspect or embodiment of this disclosure. The door opening device may include a housing; a rack bar accommodated in the housing and configured to move to protrude (or extract) from the housing or return (or retract) to the housing; a head cover connected to one end (e.g. a front end) of the rack bar and configured to push a rear surface of the door assembly; and a pair of protruding ribs protruding to a front of the housing to correspond a rear surface of the head cover.

[0023] In a further aspect of the present disclosure, a door opening device, e.g. a door opening device for a refrigerator, may include a housing; a rack bar accommodated in the housing and configured to move in a front-back direction of the housing to protrude (or extract) from the housing or return (or retract) into the housing; a head cover connected to one end (e.g. a front end) of the rack bar; and a pair of protruding ribs protruding to a front of the housing to correspond a rear surface of the head cover.

[0024] In a further aspect of the present disclosure, a door opening device, e.g. a door opening device for a refrigerator, for opening a door assembly (e.g. of the refrigerator) may include a housing; a rack bar accommodated in the housing and configured to move to protrude (or extract) from the housing or to return (or retract) into the housing; a head cover connected to one end (e.g. a front end) of the rack bar and configured to push a surface (e.g. a rear surface) of the door assembly; and a pair of protruding ribs protruding from the housing to correspond to the head cover and/or to support and/or contact the head cover in a retracted state of the rack bar.

[0025] The door opening device and/or the refrigerator according to any one of the herein described embodiments or aspects may include one or more of the following features:

[0026] The rack bar may be movably accommodated in the housing, e.g. movable in front-back direction of the housing and/or of the refrigerator. The head cover may be connected to the end of the rack bar which is exposed to an outside of the housing, e.g. the front end. The head cover may be configured to push a rear surface of a door, such as a door or door assembly of a refrigerator. The housing may have an opening, e.g. in a surface of the housing facing the head cover and/or the door assembly in a closed state, to allow the rack bar to move therethrough.

[0027] The door opening device may include a driving source, e.g. a motor, for driving or moving the rack bar. The door opening device or the refrigerator may include a control part for controlling movement of the rack bar, e.g. based on an external signal, e.g. an operation signal for opening the door.

[0028] The head cover may be connected to the rack bar, e.g. by a rotation pin, to be rotatable about a vertical axis and/or an axis perpendicular to a direction of movement (e.g. perpendicular to the front-back direction), e.g. an axis defined by the rotation pin. The axis may be denoted as rotation axis of the head cover. The pair of protruding ribs may be configured to align the head cover in a retracted state of the rack bar or to re-establish horizontal alignment of the head cover in a retracted state of the rack bar.

[0029] In a retracted state of the rack bar, the head cover, in particular a rear surface thereof, may come in contact with the pair of protruding ribs. That is, when the rack bar returns to the housing after protruding from the housing, the rear surface of the head cover may come in contact with the pair of protruding ribs.

[0030] The pair of protruding ribs may have shapes that are symmetrical to each other with respect to an up-down direction center line of the rear surface of the head cover and/or with respect to a plane defined by the rotation axis of the head cover and the movement direction of the rack bar.

[0031] The pair of protruding ribs may be disposed at positions that are symmetrical to each other with respect to an up-down direction center line of the rear surface of the head cover and/or with respect to a plane defined by the rotation axis of the head cover and the movement direction of the rack bar.

[0032] The pair of protruding ribs may come in contact with an edge portion of a rear surface of the head cover. The protruding ribs may come in contact with opposite edge portions, e.g. both lateral edge portions (i.e. left and right edge portions), of the head cover.

[0033] The pair of protruding ribs or at least one of the protruding ribs may be disposed to pass a left-right direction center line, i.e. a horizontal center line, of the head cover, in particular of the rear surface of the head cover.

[0034] The pair of protruding ribs may be disposed to correspond to four corners of the rear surface of the head cover, in particular to four corners of the edge portion of the rear surface of the head cover. The rear surface of the head cover may be a surface of the head cover connected to the rack bar and/or facing the housing.

[0035] The pair of protruding ribs or at least one of the protruding ribs may be disposed at a position corresponding to an upper portion (of the rear surface) of the head cover to come in contact with (the rear surface of) the head cover.

[0036] The pair of protruding ribs or at least one of the protruding ribs may extend downward from an upper portion (of the rear surface) of the head cover to pass a left-right direction center line, i.e. a horizontal center line, of the head cover, in particular of the rear surface of the head cover.

[0037] The door opening device may further include a rack cover coupled to the housing to cover the rack bar,

and the pair of protruding ribs may be disposed at or integrally formed with a front end of the rack cover, e.g. an end of the rack cover facing the head cover.

[0038] The pair of protruding ribs may protrude outward from the housing.

[0039] The pair of protruding ribs may be disposed on a (front) surface of the housing that faces the rear surface of the head cover.

[0040] The housing may include a lower base defining a lower surface and a predetermined lateral surface; and an upper cover coupled on the lower base and defining an upper surface and another predetermined lateral surface, and the pair of protruding ribs may be disposed on a front surface of the upper cover that faces the rear surface of the head cover.

[0041] The refrigerator may further include a case cover disposed in front of the door opening device and comprising a (protruding) hole through which the rack bar moves or protrudes. The case cover may cover the door opening device, except for the hole. In a retracted state of the rack bar, the head cover and/or a support rib in front of the head cover may be in contact with the case cover. The case cover may include a support protrusion at a circumference of the protruding hole, e.g. a support protrusion protruding from an inner circumference of the protruding hole. A support rib may be disposed on a front surface of the head cover and protruding an outer circumference of the head cover. The support rib may be configured to come into contact with the door assembly to push the same open. When the rack bar returns to the housing, the head cover, e.g. a peripheral portion or edge of the head cover, and/or the support rib may be disposed in front of the support protrusion to have a gap spaced a preset distance apart. Alternatively, when the rack bar returns to the housing, the head cover, e.g. a peripheral portion or edge of the head cover, and/or the support rib may be disposed on or rest on the support protrusion.

[0042] The refrigerator may further include a case cover disposed in front of the door opening device and including a protruding hole through which the rack bar protrudes. When the rear surface of the head cover comes in contact with the pair of protruding ribs and/or in a retracted state of the rack bar, a front surface of the head cover may be horizontally aligned with a front surface of the case cover.

[0043] In another aspect of the present disclosure, a door opening device according to an embodiment may include a housing; a rack bar accommodated in the housing and configured to move to protrude from the housing or return to the housing; a head cover connected to one side of the rack bar; a magnet disposed on the other side of the rack bar; a hall sensor disposed in a rear area of the housing and configured to sense the magnet; and a pair of protruding ribs protruding to a front of the housing to correspond a rear surface of the head cover.

[0044] In case that the hall sensor senses the magnet after the rack bar returns to the housing, the rack bar may stop movement after further returning as far as a preset returning distance, when the rear surface of the head cover and the protruding ribs are spaced a preset distance or more apart from each other.

[0045] In case that the hall sensor senses the magnet after the rack bar returns to the housing, the rack bar may be operated to further return when the rear surface of the head cover and the protruding ribs are spaced a preset distance or less apart from each other, and the rack bar may stop movement when the rear surface of the head cover and the protruding ribs become in contact with each other.

[0046] In case the hall that sensor senses the magnet after the rack bar returns to the housing, the rack bar may stop movement when the rear surface of the head cover and the protruding ribs become in contact with each other.

Advantageous Effect

[0047] The head cover connected to one end of the rack bar and configured to push a rear surface of a door assembly may be horizontally aligned by the pair of protruding ribs provided in the door opening device and protruding to the front of the housing to correspond to the rear surface of the head cover. Accordingly, the present disclosure may improve horizontal misalignment that might occur due to an assembling step between the door opening device and a separate structure.

[0048] The door opening device and the refrigerator according to the present disclosure may secure assembling reliability and improving a step generated in the assembling, thereby improving horizontal misalignment of the head cover provided in the door opening device.

[0049] The door opening device and the refrigerator according to the present disclosure may implement the operation logics for further returning the rack bar a preset distance even after the sensing of the hall sensor. Accordingly, the sensing deviation of the hall sensor sensing the returning position of the rack bar may be corrected, thereby improving horizontal misalignment of the head cover.

[0050] In addition to the above-described effects, specific effects of the present invention will be described together with the following detailed description for implementing the present invention.

Description of Drawings

[0051]

FIGS. 1 and 2 are front perspective views of a refrigerator in a state where a door assembly is closed and a state where the door assembly is open;

FIG. 3 is an exploded perspective view of a door assembly and a cabinet;

FIGS. 4 and 5 are enlarged views of a refrigerator in a state where a door assembly is closed and a state where the door assembly is open along movement

of a rack bar;

FIG. 6 is an exploded perspective view showing that a door opening device and a case cover are separated from a cabinet;

FIG. 7 is a view showing a door opening device and FIG. 8 is a view showing a predetermined inner area of the door opening device;

FIG. 9 shows a rack cover;

FIG. 10 shows that a head cover pushes a rear surface of the door assembly due to returning of the rack cover;

FIG. 11 shows that the head cover is horizontally aligned by a protruding rib due to protruding of the rack cover;

FIG. 12 is a side view showing horizontal alignment of a head cover is achieved by a protruding rib;

FIGS. 13 to 17 are schematic views showing various embodiments of the protruding rib formed in the door opening device;

FIG. 18 shows steps of returning logics of a rack bar additionally restituting when a rear surface of a head cover is spaced apart a preset distance or more apart from a protruding rib based on sensing results after a hall sensor senses a magnet of a rack cover;

FIG. 19 shows steps of returning logics of a rack bar additionally restituting more when a rear surface of a head cover is spaced apart a preset distance or less apart from a protruding rib based on sensing results after a hall sensor senses a magnet of a rack cover; and

FIG. 20 shows steps of stopping the movement of the rack bar without additionally restituting, when the rear surface of the head cover contacts the protruding rib based on sensing results after the hall sensor senses the magnet of the rack cover.

DESCRIPTION OF SPECIFIC EMBODIMENTS

[0052] The above-described aspects, features and advantages are specifically described hereunder with reference to the accompanying drawings such that one having ordinary skill in the art to which the present disclosure pertains can easily implement the technical spirit of the disclosure. In the disclosure, detailed descriptions of known technologies in relation to the disclosure are omitted if they are deemed to make the gist of the disclosure unnecessarily vague. Below, preferred embodiments according to the disclosure are specifically described with reference to the accompanying drawings. In the drawings, identical reference numerals can denote identical or similar components.

[0053] The terms "first", "second" and the like are used herein only to distinguish one component from another component. Thus, the components should not be limited by the terms. Certainly, a first component can be a second component unless stated to the contrary.

[0054] Throughout the disclosure, each component can be provided as a single one or a plurality of ones, unless explicitly stated to the contrary.

[0055] Hereinafter, expressions of 'a component is provided or disposed in an upper or lower portion' may mean that the component is provided or disposed in contact with an upper surface or a lower surface. The present disclosure is not intended to limit that other elements are provided between the components and on the component or beneath the component.

[0056] It will be understood that when an element is referred to as being "connected with" another element, the element can be directly connected with the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly connected with" another element, there are no intervening elements present.

[0057] A singular representation may include a plural representation unless it represents a definitely different meaning from the context. Terms such as "include" or "has" are used herein and should be understood that they are intended to indicate an existence of several components, functions or steps, disclosed in the specification, and it is also understood that greater or fewer components, functions, or steps may likewise be utilized.

[0058] A singular representation may include a plural representation unless it represents a definitely different meaning from the context. Terms such as "include" or "has" are used herein and should be understood that they are intended to indicate an existence of several components, functions or steps, disclosed in the specification, and it is also understood that greater or fewer components, functions, or steps may likewise be utilized.

[0059] Throughout the disclosure, the terms "A and/or B" as used herein can denote A, B or A and B, and the terms "C to D" can denote C or greater and D or less, unless stated to the contrary.

[0060] Hereinafter, a door assembly and a refrigerator according to several embodiments of the present disclosure will be described.

[0061] Referring to FIGS. 1 to 6, a refrigerator including a door opening device 30 configured to automatically open a door assembly 20 and a case cover 14 disposed on a front surface of the door opening device 30 will be described.

[0062] The refrigerator 1 may have an exterior design defined by a cabinet 10 having a storage chamber 13 provided therein as a storage space, and a door assembly 20 configured to open and close an open front of the cabinet 10. The storage chamber 13 may be provided with one or more shelves 131 and/or a drawer 132.

[0063] The cabinet 10 may include an outer case 11 defining an outer surface of the refrigerator 1 and an inner case 12 defining an inner surface thereof.

[0064] The outer case 11 and the outer case 12 may be spaced a preset distance apart from each other, and a heat insulating material may be foamed between the outer case 11 and the inner case 12 to fill in the empty space.

[0065] The storage chamber 13 may be formed in a

box shape with an open front and it may be divided into one or more storage spaces.

[0066] The door opening device 30 may be disposed in an upper portion of the cabinet 10 to automatically open the door assembly 20.

[0067] When a user touches a button unit 20b provided on a front surface of the door assembly 20, a rack bar 37 of the door opening device 30 may move forward to the front of the refrigerator to push the door assembly so that the user can open the refrigerator 1 without exerting much force.

[0068] The door assembly 20 may include a touch assembly (not shown), a body assembly 21 accommodating the touch assembly (not shown), and a panel assembly 22 detachably coupled to a front surface of the body assembly 21. A decorative cover 24 may be additionally coupled to an upper end of the panel assembly 22 and an upper end of the body assembly 21.

[0069] The touch assembly (not shown) may include a touch sensor configured to recognize a touch applied to the button unit 20b.

[0070] The door opening device 30 may be disposed in the cabinet 10.

[0071] The door opening device 30 may be accommodated inside an accommodating case 301 provided in an upper portion of the cabinet 10 to overlap the center of the cabinet 10.

[0072] The accommodating case 301 may have an open front and the door opening device 30 may be insertedly secured to the accommodating case 301 with the open front by sliding movement.

[0073] The door opening device 30 may include the rack bar 37 configured to open the door assembly 20 by pushing an upper rear surface of the door assembly 20.

[0074] A case cover 14 may be coupled to the cabinet 10 to finish the front surface of the door opening device 30.

[0075] A manipulation panel 142 may attached to the case cover 14 to facilitate the user's manipulation for displaying and setting various tips of information.

[0076] The case cover 14 may be formed by extending in a left-right direction of the refrigerator 1 but embodiments of the present disclosure are not limited thereto. The case cover 14 may be modified in various embodiments based on front surface finishing shape.

[0077] The case cover 14 may include a protruding hole 141 formed as a through-hole so that the rack bar 37 can pass through the protruding hole 141.

[0078] Accordingly, when the door assembly 20 is opened, the rack bar 37 may pass through the protruding hole 141 and be withdrawn to the outside to push the door assembly 20.

[0079] The protruding hole 141 and the rack bar 37 may be disposed at positions for pushing the center of the door assembly 20. Then, even if the opening direction of the door assembly 20 is changed, the door assembly 20 may be opened at a constant angle and force without additional setting changes.

[0080] Referring to FIGS. 7 and 8, the door opening device 30 may include the rack bar 37 configured to move inward and outward with respect to a housing 31 including a lower base 311 and an upper cover 312. The rack cover 37 may be protected by a rack cover 352.

[0081] Coupling ends 33 may be formed at both front ends of the door opening device 30, respectively, to be fixedly screw-coupled to the accommodating case 301.

[0082] A pair of first coupling portions 321 may be formed in both sides of the door opening device 30, respectively, and a pair of second coupling portions 322 may be formed rearward at rear ends of the door opening device, respectively.

[0083] A first cushion member 321a may be formed in the first coupling portion 321 and a second cushion member 322a may be formed in the second coupling portion 322 to alleviate shock applied to the door opening device 30 and decrease vibration generated in the door opening device 30.

[0084] The second cushion member 322a may have a U-shape and coupled to surround a seating column provided on each of both sides of the accommodating case 301. When the door opening device 30 is coupled in a sliding method, the second cushion member 322a may be configured to guide the position of the door opening device 30.

[0085] A rack gear 376 may be formed in one lateral surface of the rack bar 37.

[0086] The rack gear 376 may be configured to engage with an pinion gear 391 exposed through an exposure hole 351 formed inside the rack gear 376 so that the rack bar may be drawn in or drawn out along a front-back direction.

[0087] In other words, the rack bar 37 may be movable to protrude from the housing 31 or return to the housing 31.

[0088] A rack head 371 may be rotatably coupled to a front end of the rack bar 37.

[0089] The rack head 371 may be disposed to have a first rotation range in which it may rotate in a direction to one side and a second rotation range in which it may rotate in a direction to the other side, about a rotation pin 372 at the front end of the rack bar 37.

[0090] The first rotation range may be set to a range in which the door with a left-opening structure rotates. The second rotation range may be set to a range in which the door with a right-opening structure rotates.

[0091] For example, the rack head 371 may be configured to rotate in a direction to one side as much as the first rotation range and in a direction to the other side as much as the second rotation range. At this time, the first rotation range and the second rotation range may be set identically or differently.

[0092] A head cover 374 may be attached to a front end of the rack bar 37 to alleviate shock when the rack bar 37 pushes the rear surface of the door assembly 20.

[0093] The head cover 374 may be made of a urethane material. Due to such a structure, only the head cover

374 may be replaced when the head cover 374 is damaged and damage such as tearing or breaking may be prevented even if the rack head 371 frequently rotates.

[0094] A support rib 375 may be formed at a front end of the head cover 374 along an outer circumferential surface. The support rib 375 may protrude outward from the circumference of the head cover 374.

[0095] A rack cover 352 may be disposed on the open top surface of the rack bar 37 to close the open top surface in order to prevent the rack bar 37 accommodated in the housing 31 from being unintentionally separated upward.

[0096] The rack cover 352 may have a long bar shape covering the rack bar 37 by longitudinally extending in a front-back direction of the door opening device 30.

[0097] In the present disclosure, the front-back direction of the rack cover 352 means a direction in which the rack bar 37 moves to protrude and return, and the left-right direction of the door opening device 30 means a direction crossing the front-back direction.

[0098] Accordingly, the rack cover 352 may have a long width in the front-back direction and a short width in the left-right direction, but embodiments of the present disclosure are not limited thereto.

[0099] One or more coupling holes 3521 may be formed in the rack cover 352.

[0100] Coupling holes 354 may be formed in the housing 31 at positions corresponding to the coupling holes of the rack cover 352, respectively. After the coupling holes 3521 and the coupling holes 354 are aligned, the rack cover 352 may be fixedly coupled to the housing 31 by a coupling member such as a screw.

[0101] A pair of protruding ribs 353 may be formed at a front end of the rack cover 352 facing the rear surface of the head cover 374.

[0102] In a state where the rack cover 352 is coupled to the housing 31, the pair of protruding ribs 353 may protrude outward to the front surface of the housing 31.

[0103] Accordingly, the pair of protruding ribs 353 may protrude forward to the front of the housing 31 to correspond to the rear surface of the head cover 374, and a front cross section 3531 of the protruding rib 353 may become in contact with the rear surface of the head cover 374.

[0104] An accommodation portion 3532 may be formed between the pair of protruding ribs 353 and serve as a space for accommodating the rack head 371 when the rack bar 37 returns.

[0105] Referring to FIGS. 10 and 11, the protruding movement of the rack bar 37 performed to push the rear surface of the door assembly 20 through the protruding hole 141 of the case cover 14 and the returning movement of the rack bar 37 performed to be horizontally aligned when the rack bar 37 returns will be described in detail.

[0106] For example, when an operation signal for opening the door is applied to the door opening device 30, the door opening device 30 may receive the operation signal and the head cover 374 of the rack bar 37 may push the door assembly 20 to make the door assembly 20 open to a preset angle.

[0107] In this instance, the head cover 374 may protrude forward in contact with the rear surface of the door assembly, in a state where it is rotated in the first rotation range or second rotation range.

[0108] Meanwhile, when a returning signal is applied to the door opening device 30, the door opening device 30 may return the rack 37.

[0109] When the rack bar 37 returns to the housing 31 after protruding from the housing 31 as described above, the head cover rear surface 3741 may become in contact with the pair of protruding ribs 353.

[0110] Specifically, when the rack bar 37 returns, the rear surface 3741 of the head cover may contact one of the pair of protruding ribs 353 first.

[0111] When the rack bar 37 further returns while in contact with one protruding rib 353, the head cover 374 may horizontally rotate about the rotation pin 372, and then the other protruding rib 353 may also become in contact with the rear surface 3741 of the head cover.

[0112] When the pair of protruding ribs 353 become in contact with the rear surface 3741 of the head cover, the rack bar 37 may stop returning.

[0113] Since the pair of protruding ribs 353 each support the circumference of the rear surface 3741 of the head cover to pressurize it from the rear surface, the front surface of the head cover 374 may be aligned horizontally.

[0114] When it is aligned horizontally, the head cover 374 may be aligned horizontally with the front surface of the case cover 14 so that the exterior quality may be improved.

[0115] Meanwhile, the case cover 14 may include a support protrusion 141a protruding from an inner circumference of the protruding hole 141.

[0116] When the rack bar 37 returns to the housing 31, the rear surface 3741 of the head cover may be in contact the pair of protruding ribs 353 and then positioned at a position in front of the support protrusion 141a to have a gap g spaced a preset distance apart from the support protrusion 141a.

[0117] When the head cover 374 is aligned horizontally, the support protrusion 141a of the case cover 14 may protrude more inward to overlap the rear surface of the supporting rib 375, viewed from the front of the refrigerator 1.

[0118] Accordingly, the support protrusion 141a may serve to prevent the inside from being visible from the outside through the protruding hole 141.

[0119] Since the head cover 374 is aligned horizontally by the pair of protruding ribs 353 protruding forward to the front of the housing 31 to correspond to the rear surface of the head cover 3741 when the head cover returns, the door opening device 30 according to the present disclosure may improve horizontal misalignment that might occur due to an assembling step between the door open-

ing device 30 and a separate structure.

[0120] For example, the horizontal alignment is obtained by locking the support rib 375 of the head cover 374 to the support protrusion 141a. In this instance, when an assembling step occurs between the door opening device 30 and the case cover 14 assembled as a separate structure, horizontal misalignment of the head cover 374 might occur.

[0121] However, the structure for the horizontal alignment of the head cover 374 may be formed in the door opening device 30, not a separate structure in the present disclosure as described above. Accordingly, the present disclosure may greatly improve the horizontal misalignment by decreasing the assembly step that might occur due to a separate horizontal alignment structure such as the support protrusion 141a of the case cover 14.

[0122] The embodiment of the present disclosure describes and shows that the support rib 375 is positioned in front of the support protrusion 141a, but the embodiment is not limited thereto.

[0123] For example, when the horizontal alignment due to the protruding rib 353 is performed together with the horizontal alignment due to the support protrusion 141a, the rear surface of the support rib 375 may be caught by the support protrusion 141a to become in contact with each other without a gap.

[0124] However, even in this instance, it should be understood that the horizontal alignment due to the protruding rib 353 is the main one and the horizontal alignment due to the supporting protrusion 141a is an auxiliary one.

[0125] Hereinafter, referring to FIGS. 12 to 17, various embodiments of the pair of protruding ribs 353 will be described.

[0126] Referring to FIGS. 12 and 13, the pair of protruding ribs 353 may be disposed at positions corresponding to an upper area of the rear surface of the head cover 374 to become in contact with the rear surface of the head cover 374.

[0127] The pair of protruding ribs 353 may have shapes symmetrical to each other with respect to a center line c2 of the rear surface of the head cover 374 in the vertical direction.

[0128] Alternatively, the pair of protruding ribs 353 may have shapes symmetrical to each other with respect to the center line c2 of the rear surface of the head cover 374 in the vertical direction.

[0129] Since the pair of protruding ribs 353 have to be horizontally aligned by supporting the rear surface of the head cover 374, it is preferred that the pressing force applied to the rear surface of the head cover 374 by the pair of protruding ribs 353 acts substantially the same.

[0130] Accordingly, the pair of protruding ribs 353 may be disposed at positions symmetrical to each other with respect to the vertical-direction center line c2 or have the shapes symmetrical to each other, so that the pressing force may be applied to them as uniformly as possible, thereby achieving more precise horizontal alignment.

[0131] The pair of protruding ribs 353 may become in contact with the edge portion of the rear surface of the head cover 374.

[0132] The edge portion of the rear surface of the head cover 374 is not limited to an outermost portion of the rear surface.

[0133] For example, the edge portion of the rear surface of the head cover 374 may mean including the outermost portion and the circumferential area located in an inner area from the outermost portion.

[0134] Referring to FIGS. 14 and 15, the pair of protruding ribs 353 may be disposed to pass through a left-right-direction (i.e., horizontal-direction) center line c1 of the rear surface of the head cover374.

[0135] For example, the pair of protruding ribs 353 disposed at the front end of the rack cover 352 may extend downward to pass through the left-right-direction center line c1 from an upper portion of the rear surface of the head cover 374.

[0136] As described above, the pair of protruding ribs 353 may be horizontally aligned by supporting the rear surface of the head cover 374. Accordingly, it is preferred that the pressing force applied to the rear surface of the head cover 374 by the pair of protruding ribs 353 acts identically.

[0137] Since the pair of protruding ribs 353 are disposed to pass through the left-right-direction center line c1 of the rear surface of the head cover 374, the protruding ribs may pressurize the center area of the rear surface of the head cover 374, thereby performing more precise horizontal alignment in comparison the pressurizing on only some area such as an upper area or a lower area thereof.

[0138] The pair of protruding ribs 353 may be formed in other structures of the door opening device 30 other than the rack cover 352.

[0139] For example, the pair of protruding ribs 353 may protrude from the front surface of the housing 31.

[0140] For example, referring to FIGS. 16 and 17, the pair of protruding ribs 353 may be formed on the upper cover 312 defining an upper portion and a predetermined area of a lateral surface by being coupled on the lower base 311.

[0141] Referring to FIG. 16, an additional pair of protruding ribs 353 may protrude from the front surface of the upper cover 312, in addition to the pair of protruding ribs protruding from the front surface of the rack cover 352 to correspond to the upper portion of the rear surface of the head cover 374.

[0142] Accordingly, the protruding ribs 353 may be disposed at four corners of the edge portion of the rear surface of the head cover 374, respectively.

[0143] Referring to FIG. 17, the pair of protruding ribs 353 formed on the upper cover 312 may be disposed to pass the left-right direction center line c1 of the rear surface of the head cover 374.

[0144] In this instance, the horizontal alignment of the head cover 374 may be adjusted by the protruding ribs 353 formed on the upper cover 312 without the additional

protruding ribs 353 formed in the rack cover 352.

[0145] Hereinafter, the logic of horizontally aligning the head cover 374 after the door is opened will be described in detail according to each situation.

[0146] The head cover 374 may be connected to one side of the rack bar 37 and a magnet 377 may be connected to the other side thereof.

[0147] A hall sensor for sensing the magnet 377 may be provided in a rear area of the housing 31.

[0148] The hall sensor 38 may detect the magnet 377 connected to the other side of the rack bar 37 so that the backward movement of the rack bar 37 may be restricted to prevent too much inward movement of the rack bar 37.

[0149] For example, a sensor line 381 may be formed in an area where the hall sensor 38 is disposed. When the magnet 377 is sensed at the sensor line 381, driving of a driving source, e.g. a motor, providing a driving force to forcibly move the rack bar 37 may stop to stop the backward movement of the rack bar 37.

[0150] However, a Gaussian value deviation of the magnet 377 itself might exist. If such a Gaussian value deviation exists, an error might occur in a position where the magnet 377 is recognized by the hall sensor 38.

[0151] If such an error occurs, the movement of the rack bar 37 may stop even without sensing the magnet 377 of the rack bar 37 passing the sensor line 381 or the movement of the rack bar 37 may not stop even with sensing the magnet 377 of the rack bar 37 passing the sensor line 381.

[0152] FIG. 18 shows steps of the returning logic implemented to additionally return the rack bar 37 further, when the head cover rear surface 3741 and the protruding ribs 353 are spaced a preset distance or more apart from each other after the hall sensor 38 senses the magnet 377 of the rack cover 352.

[0153] Specifically, as shown in (a), when the hall sensor 38 senses the magnet 377 of the rack cover 352, the head cover rear surface 3741 and the protruding ribs 353 may be spaced a preset distance d1 or more apart from each other. In this instance, the preset distance d1 may be set to 1mm or more but embodiments of the present disclosure are not limited thereto.

[0154] Next, as shown in (b), it is operated to further return the rack bar 37 as far as a preset returning distance. In this instance, the preset returning distance may be set to 1mm but embodiments of the present disclosure are not limited thereto.

[0155] Next, as shown in (c), the rack bar 37 further returned by the preset returning distance may stop movement and maintain a standby state.

[0156] In this instance, the rear surface 3741 of the head cover and the protruding ribs 353 may not become in contact with each other but become spaced a preset distance d2 apart from each other.

[0157] Such the operation logic may be in preparation for the case that might occur due to the large deviation of the Gaussian value of the magnet 377, and this operation logic is to prevent excessive returning operation of the rack bar 37 in consideration of the safety factor of the mechanical device.

[0158] FIG. 19 shows steps of the returning logic implemented to additionally return the rack bar 37 further, when the head cover rear surface 3741 and the protruding ribs 353 are spaced a preset distance or less apart from each other after the hall sensor 38 senses the magnet 377 of the rack cover 352.

[0159] Specifically, as shown in (a), when the hall sensor 38 senses the magnet 377 of the rack cover 352, the head cover rear surface 3741 and the protruding ribs 353 may be spaced a preset distance d3 or less apart from each other. In this instance, the preset distance d3 may be set to 1mm or less but embodiments of the present disclosure are not limited thereto.

[0160] Next, as shown in (b), it is operated to further return the rack bar 37 as far as a preset returning distance. Accordingly, the head cover rear surface 3741 and the protruding ribs 353 may be spaced a preset distance d4 less than the distance d3 apart from each other. In this instance, the preset returning distance may be set to 1mm but embodiments of the present disclosure are not limited thereto.

[0161] Next, as shown in (c), the head cover rear surface 3741 may become in contact with the protruding ribs 353. The additional returning of the rack bar 37 may stop as shown in (d).

[0162] For example, when the head cover rear surface 3741 becomes in contact with the protruding ribs 353, the force applied to the driving source controlling the movement of the rack bar 37 may increase. The increase of the force might be recognized as an obstacle so that the returning operation of the rack bar 37 could stop.

[0163] Next, as shown in (e), the head cover rear surface 3741 may be horizontally aligned by contact with the protruding ribs 353 and it may maintain a standby state while horizontally aligned.

[0164] FIG. 20 shows steps of stopping the movement of the rack bar 37 without further returning, when the head cover rear surface 3741 and the protruding ribs 353 become in contact with each other.

[0165] As shown in (a), when the hall sensor 38 senses the magnet 37 of the rack cover 352, the head cover rear surface 3741 and the protruding ribs 353 may be in contact with each other.

[0166] Hence, as shown in (b), the further returning of the rack bar 37 may stop. As shown in (c), the head cover rear surface 3741 may become in contact with the protruding ribs 353 and it may be horizontally aligned by contact with the protruding ribs 353, and it may then maintain a standby state.

[0167] As described above, the door opening device and the refrigerator according to the present disclosure may implement the operation logics for further returning the rack bar a preset distance even after the sensing of the hall sensor. Accordingly, the sensing deviation of the hall sensor sensing the returning position of the rack bar may be corrected, thereby improving horizontal misalign-

ment of the head cover.

[0168] The embodiments are described above with reference to a number of illustrative embodiments thereof. However, the present disclosure is not intended to limit the embodiments and drawings set forth herein, and numerous other modifications and embodiments can be devised by one skilled in the art. Further, the effects and predictable effects based on the configurations in the disclosure are to be included within the range of the disclosure though not explicitly described in the description of the embodiments.

Claims

1. A door opening device (30) for opening a door assembly (20), comprising:

a housing (31);
a rack bar (37) accommodated in the housing (31) and configured to move to extract from the housing (31) or to retract into the housing (31);
a head cover (374) connected to one end of the rack bar (37) and configured to push a surface of the door assembly (20); and
a pair of protruding ribs (353) protruding from the housing (31) to correspond the head cover (374).

2. The door opening device (30) of claim 1, wherein the head cover (374) is connected to the one end of the rack bar (37) to be rotatable about an axis perpendicular to a movement direction of the rack bar (37).

3. The door opening device (30) of claim 2, wherein the protruding ribs (353) have shapes that are symmetrical to each other with respect to a plane defined by the axis and the movement direction of the rack bar (37).

4. The door opening device (30) of claim 2 or 3, wherein the protruding ribs (353) are disposed at positions that are symmetrical to each other with respect to a plane defined by the axis and the movement direction of the rack bar (37).

5. The door opening device (30) according to any one of the preceding claims, wherein the protruding ribs (353) are arranged to come in contact with opposite edge portions of the head cover (374).

6. The door opening device (30) according to any one of the preceding claims, wherein at least one of the protruding ribs (353) extends in vertical direction to cross a horizontal center line (c1) of the head cover (374).

7. The door opening device (30) according to any one of the preceding claims, wherein the pair of protruding ribs (353) is disposed to correspond to four corners of a rear surface of the head cover (374).

8. The door opening device (30) according to any one of the preceding claims, wherein the door opening device (30) further comprises:

a rack cover (352) coupled to the housing (31) to cover the rack bar (37), and
the pair of protruding ribs (353) are disposed at an end of the rack cover (352) facing the head cover (374).

9. The door opening device (30) according to any one of the preceding claims, wherein the housing (31) comprises:

a lower base (311) defining a lower surface of the housing (31); and
an upper cover (312) coupled on the lower base (311) and defining an upper surface of the housing (31), and
wherein the pair of protruding ribs (353) is disposed on a front surface of the upper cover (312) that faces the head cover (374).

10. The door opening device (30) according to any one of the preceding claims, wherein the door opening device (30) further comprises:
a magnet (377) disposed on the other end of the rack bar (37), the other side being opposite to the one end; and
a hall sensor (38) disposed in the housing (31) and configured to sense the magnet.

11. The door opening device of claim 10, further including a motor and a control part configured to control the motor,
wherein when the rack bar is retracting and the hall sensor (38) senses the magnet (377) for the first time, the control part is configured to control the motor to further retract the rack bar (37) by a preset distance (d2) and then to stop movement of the rack bar (37) such that the head cover (374) and the protruding ribs (353) are spaced apart from each other.

12. The door opening device according to any one of the preceding claims, further including a motor and a control part configured to control the motor,
wherein the control part is configured to control the motor to retract the rack bar (37) until the head cover (374) and the protruding ribs (353) come in contact with each other.

13. A refrigerator comprising:

a cabinet (10) comprising a storage chamber

(13);
a door assembly (20) configured to open and close the storage chamber (13); and
a door opening device (30) according to any one of the preceding claims automatically open the door assembly (20).

14. The refrigerator of claim 13, further comprising:

a case cover (14) disposed in front of the door opening device (30) and comprising a hole (141) allowing the rack bar (37) to move through,
wherein in a retracted state of the rack bar (37): the head cover (374) closes the hole (141) and/or the head cover (374) is aligned to be flush with the case cover (14).

15. The refrigerator of claim 14, wherein the case cover (14) comprises a support protrusion (141a) at a circumference of the hole (141), and

a support rib (375) is disposed on the head cover (374) and protruding over an outer circumference of the front surface of the head cover (374),
wherein in a retracted state of the rack bar (37), the support rib (375) is disposed in front of the support protrusion (141a) to be spaced apart by a preset gap (g).

Fig. 1

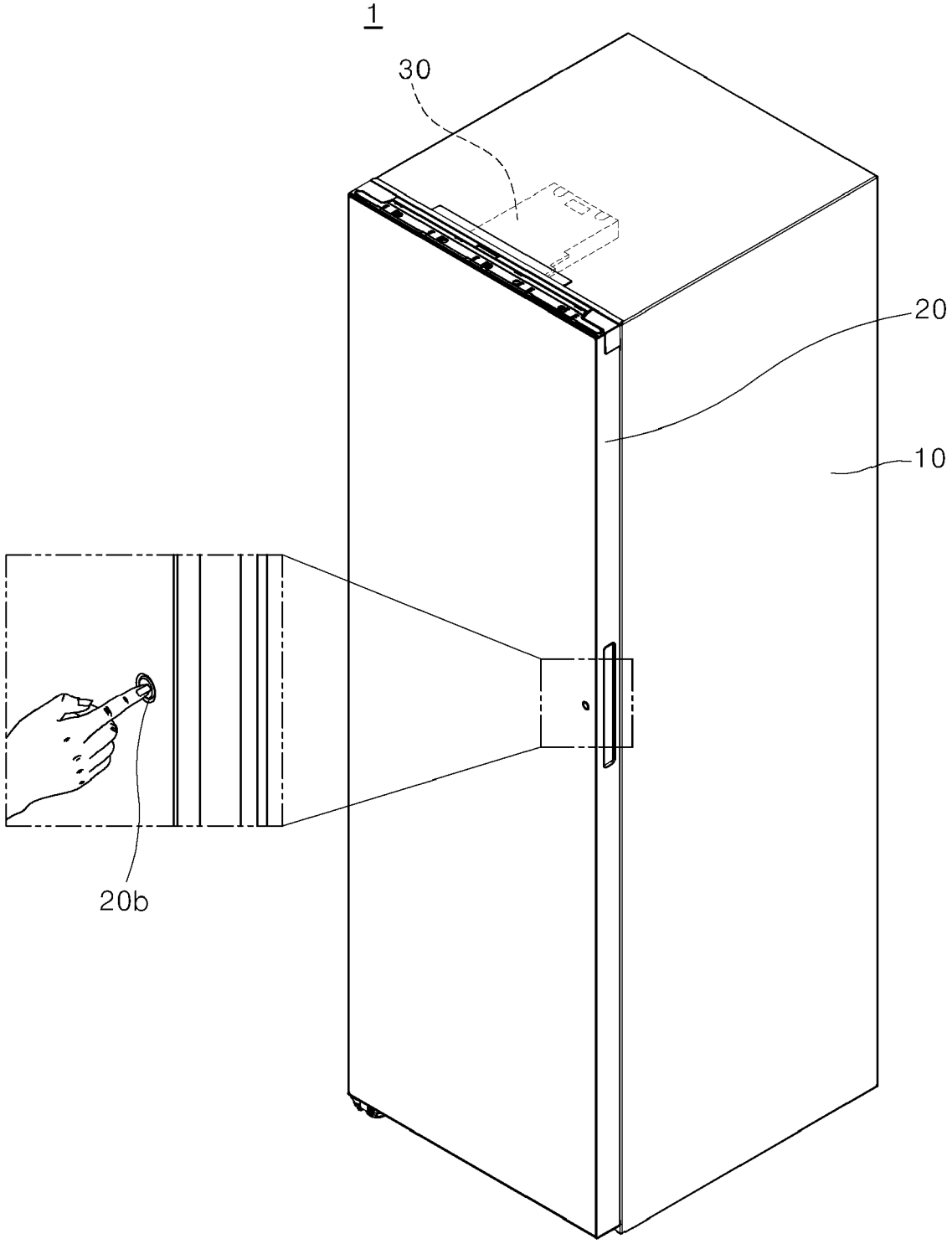

Fig. 2

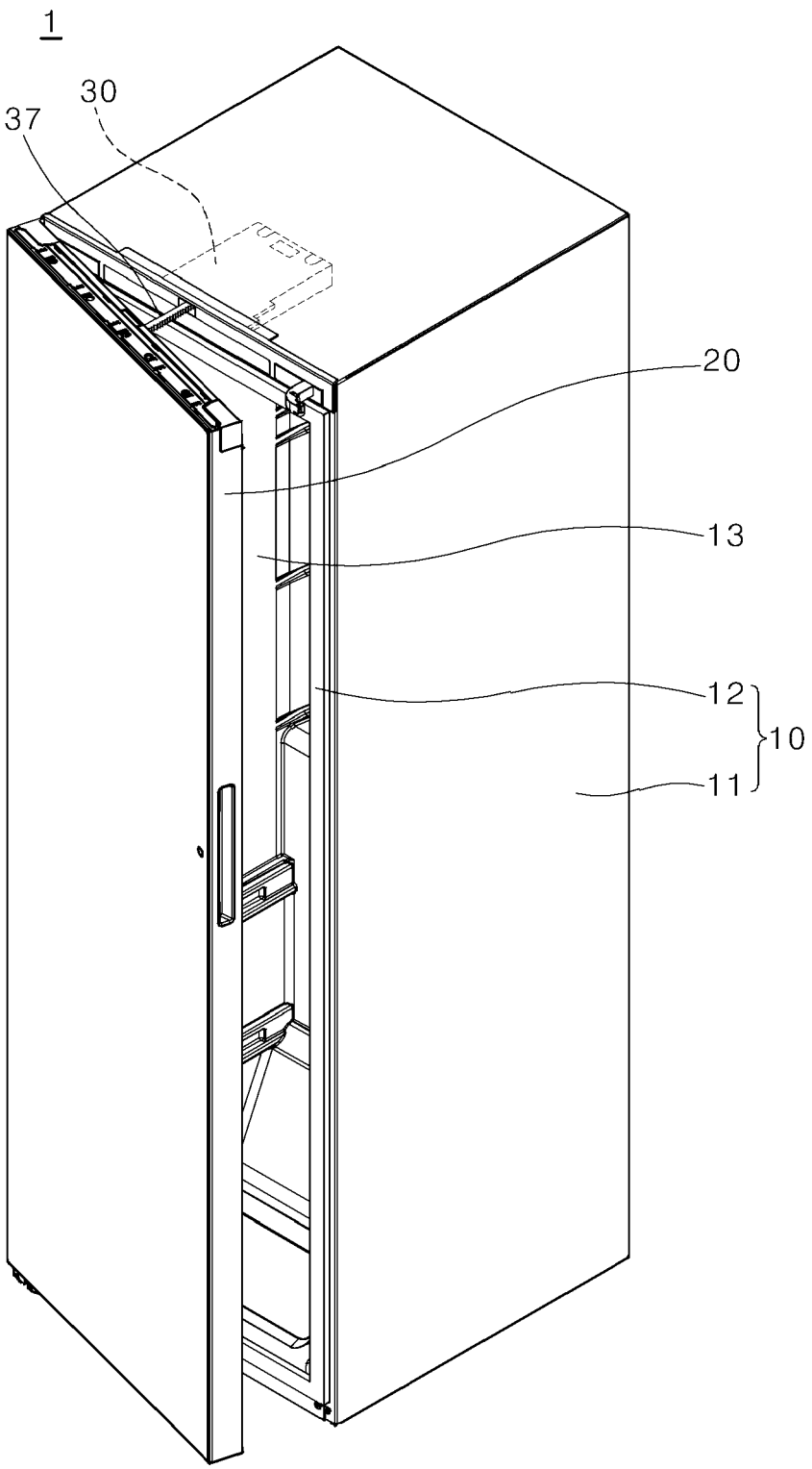

Fig. 3

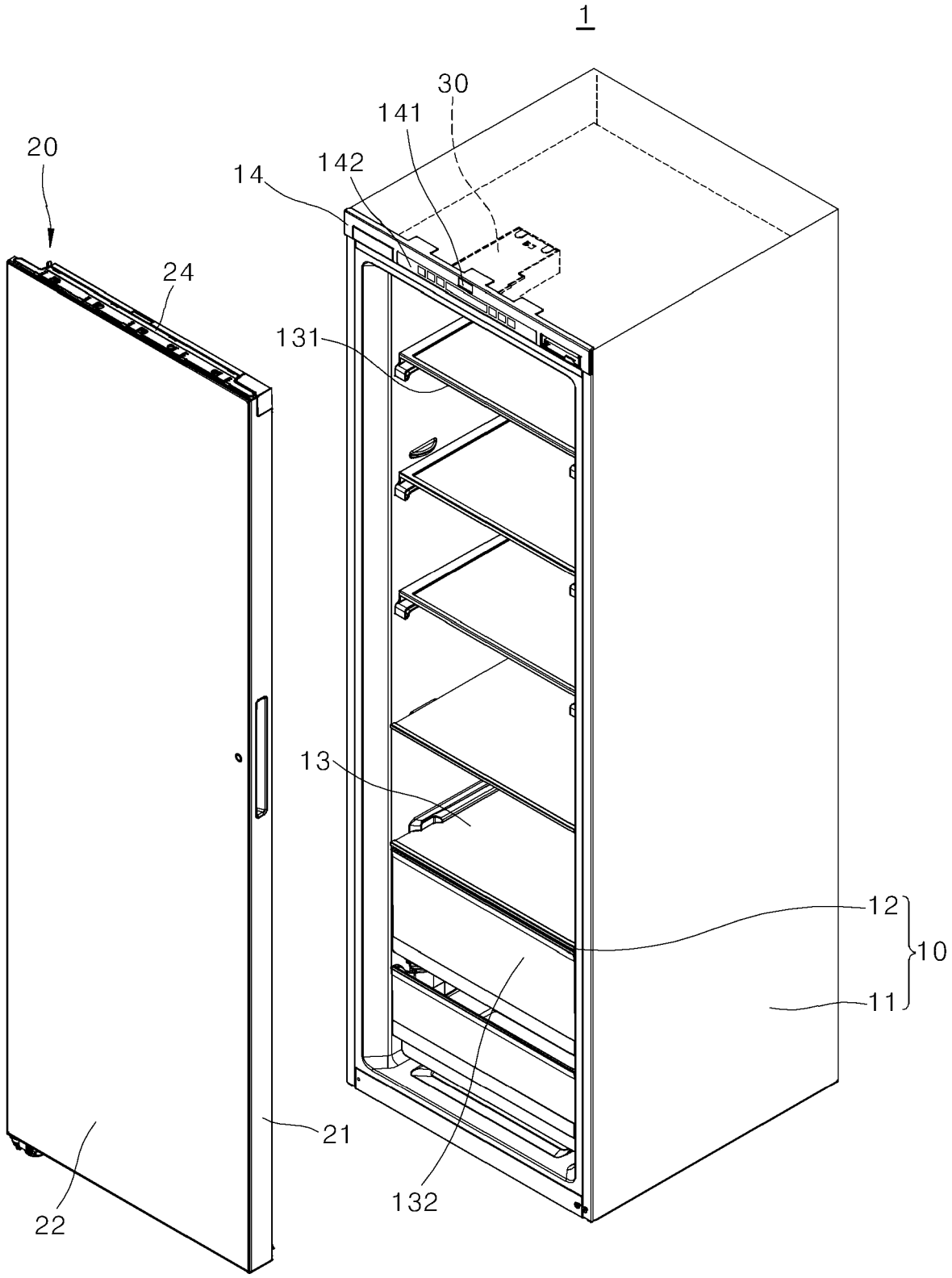

Fig. 4

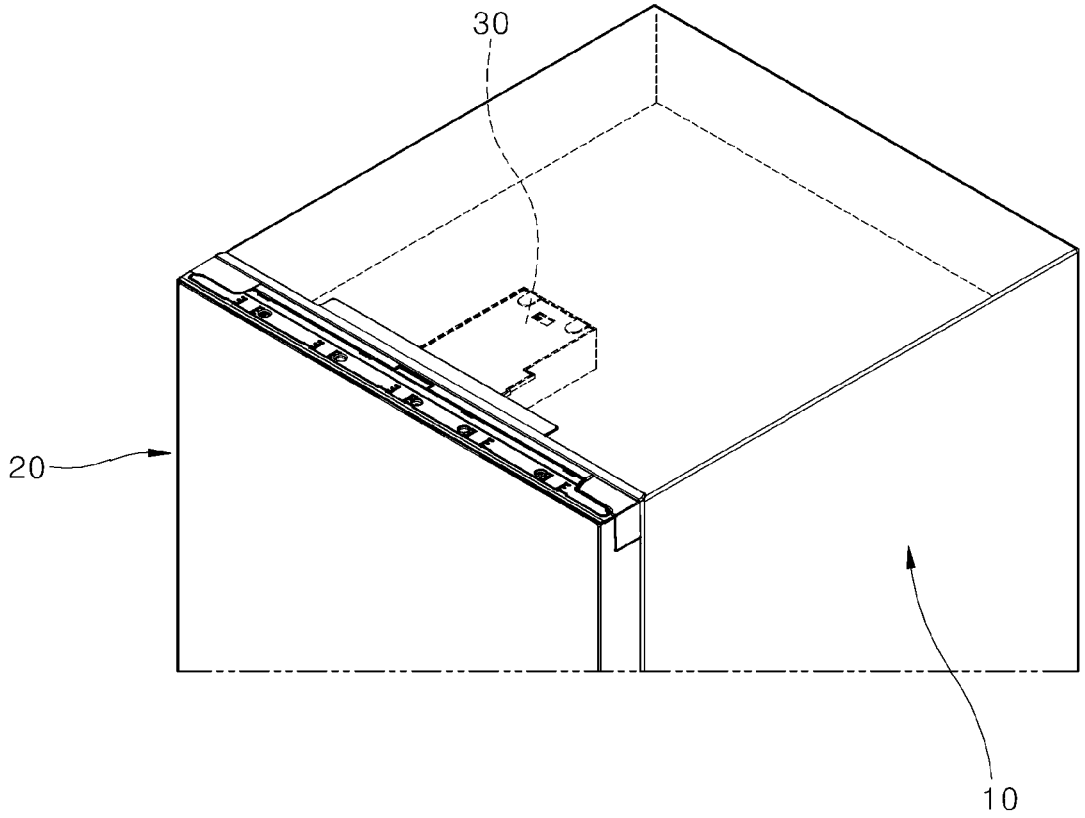

Fig. 5

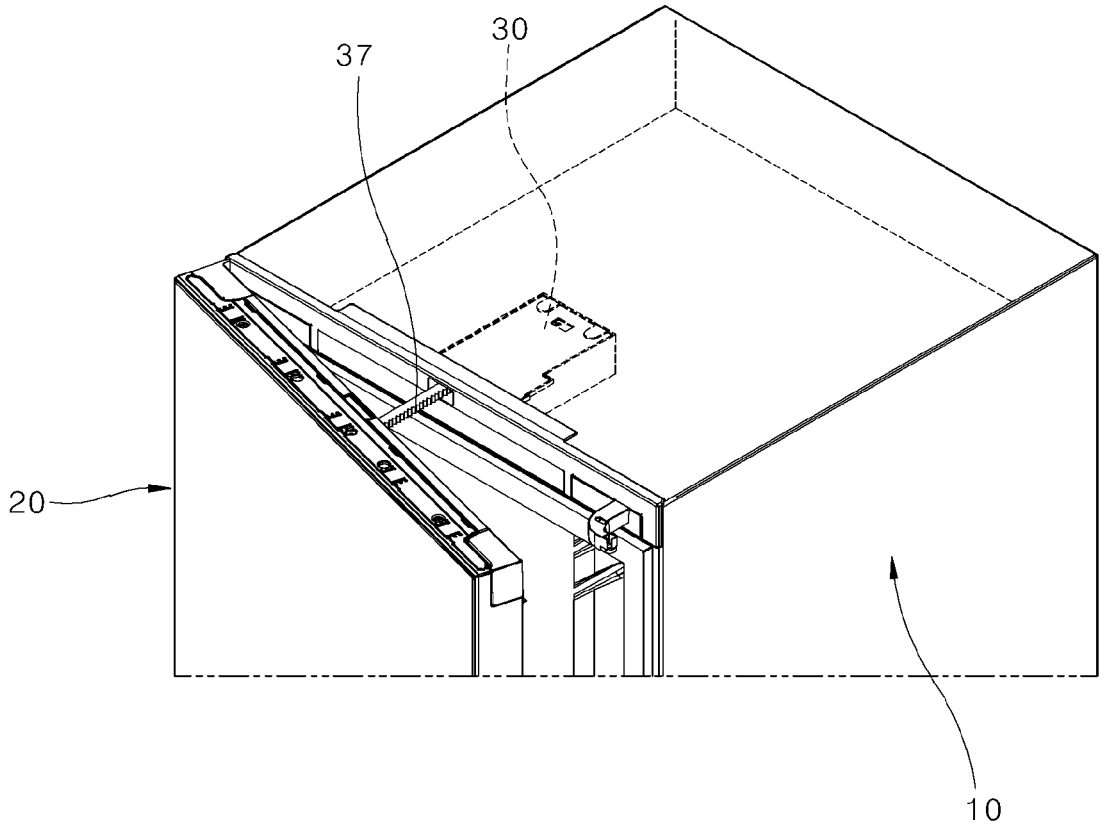

Fig. 6

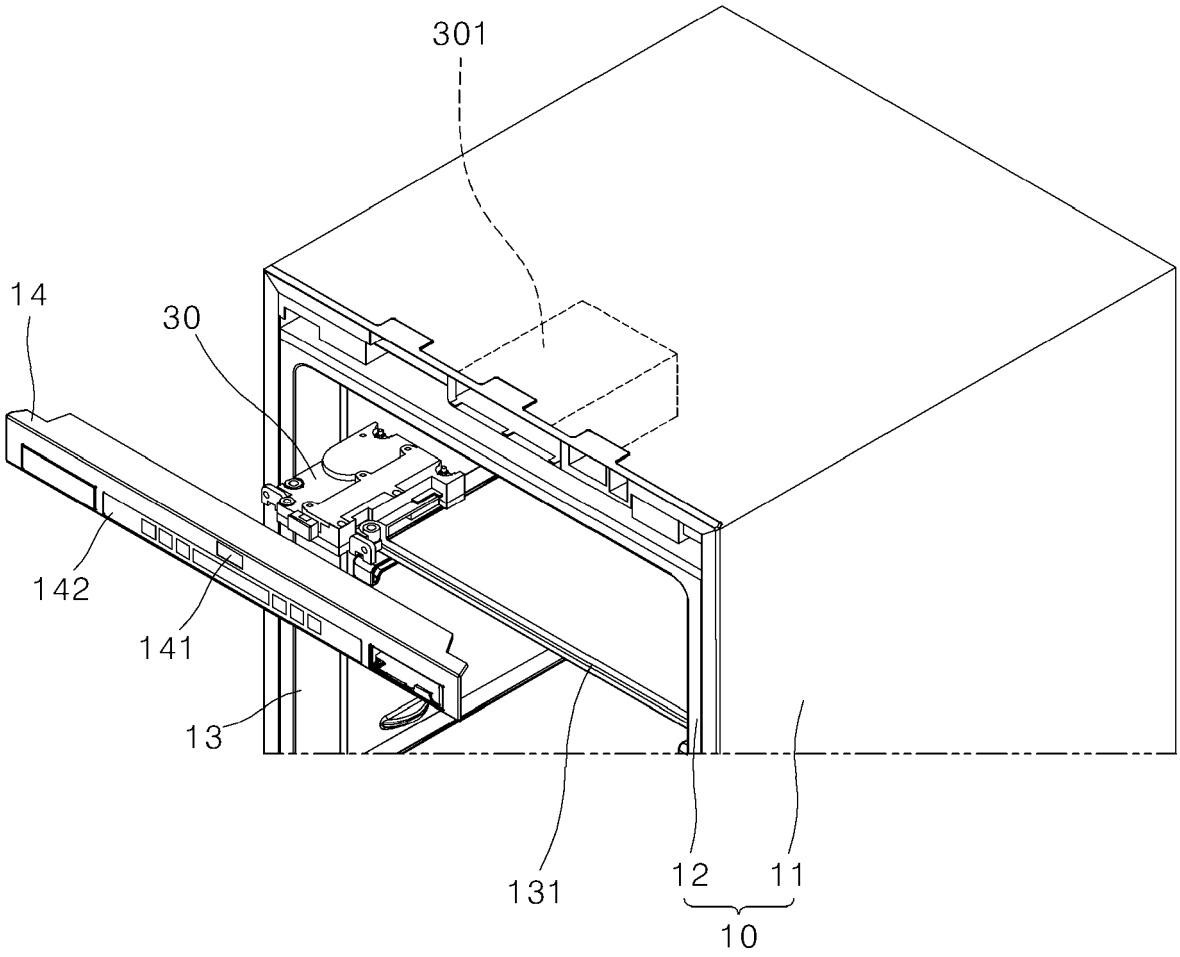

Fig. 7

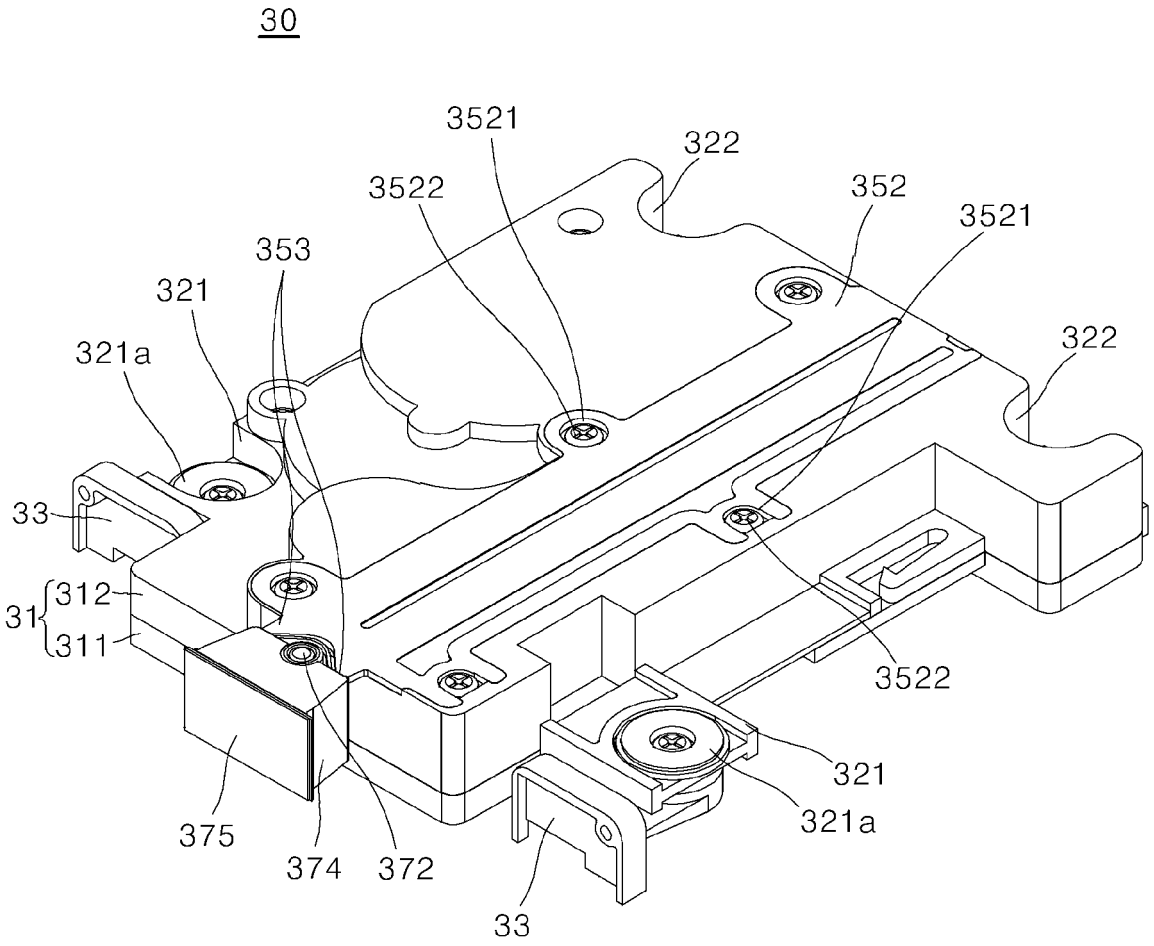
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Fig. 8

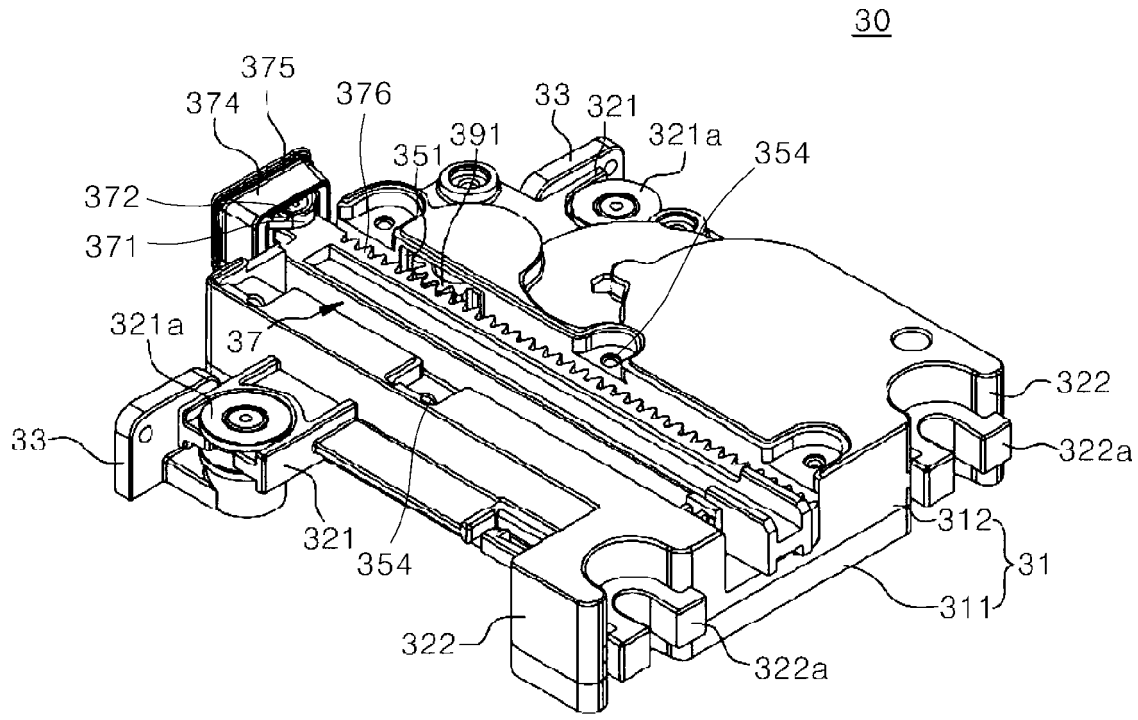
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Fig. 9

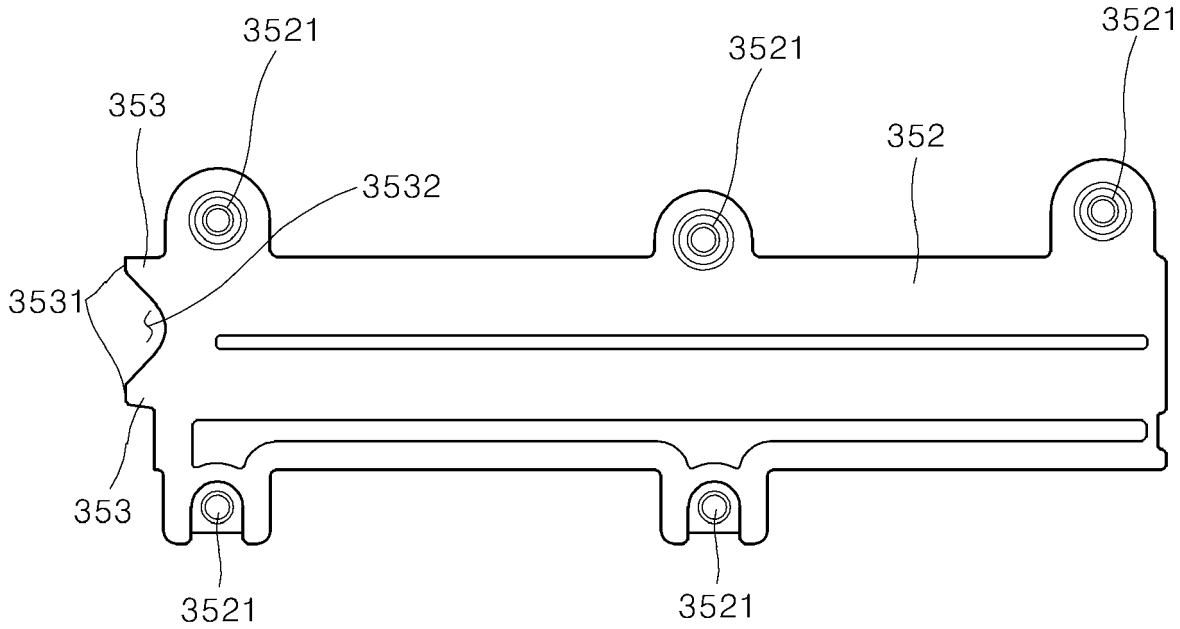
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Fig. 10

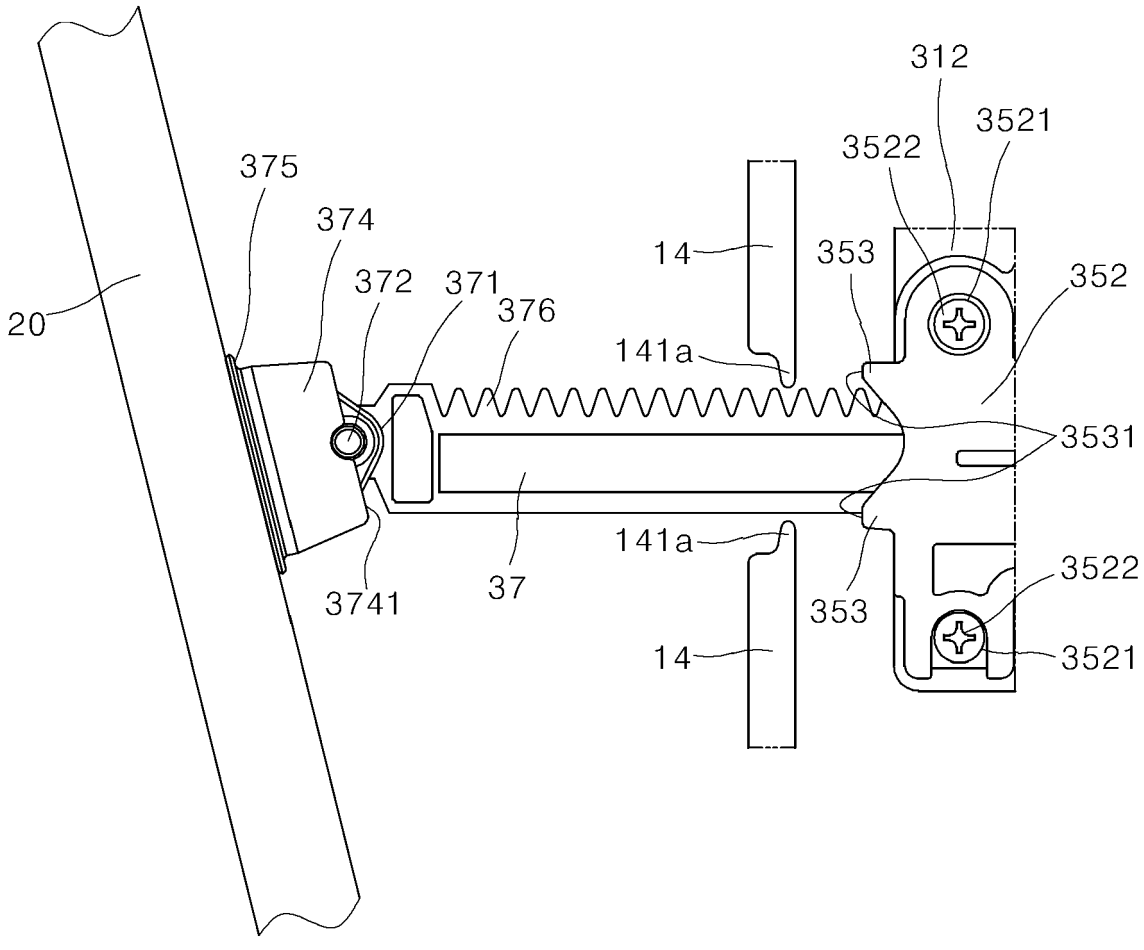
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Fig. 11

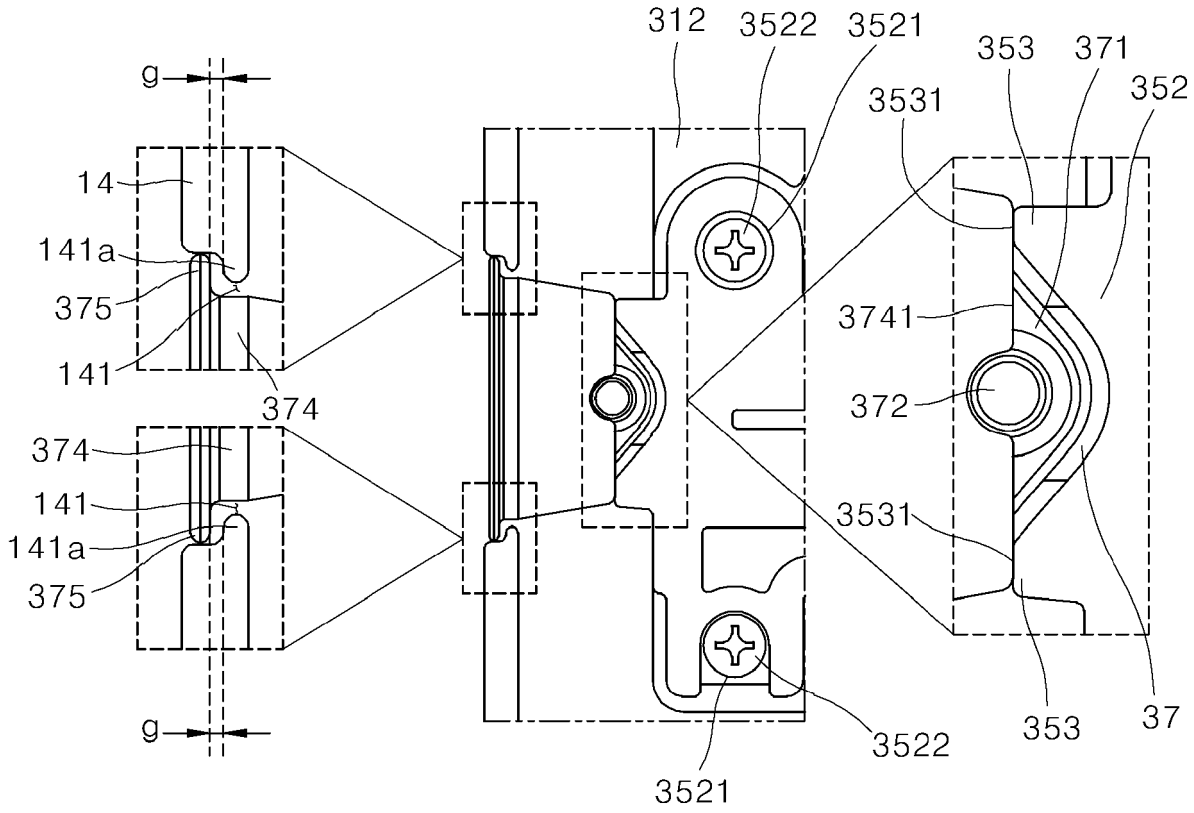
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Fig. 12

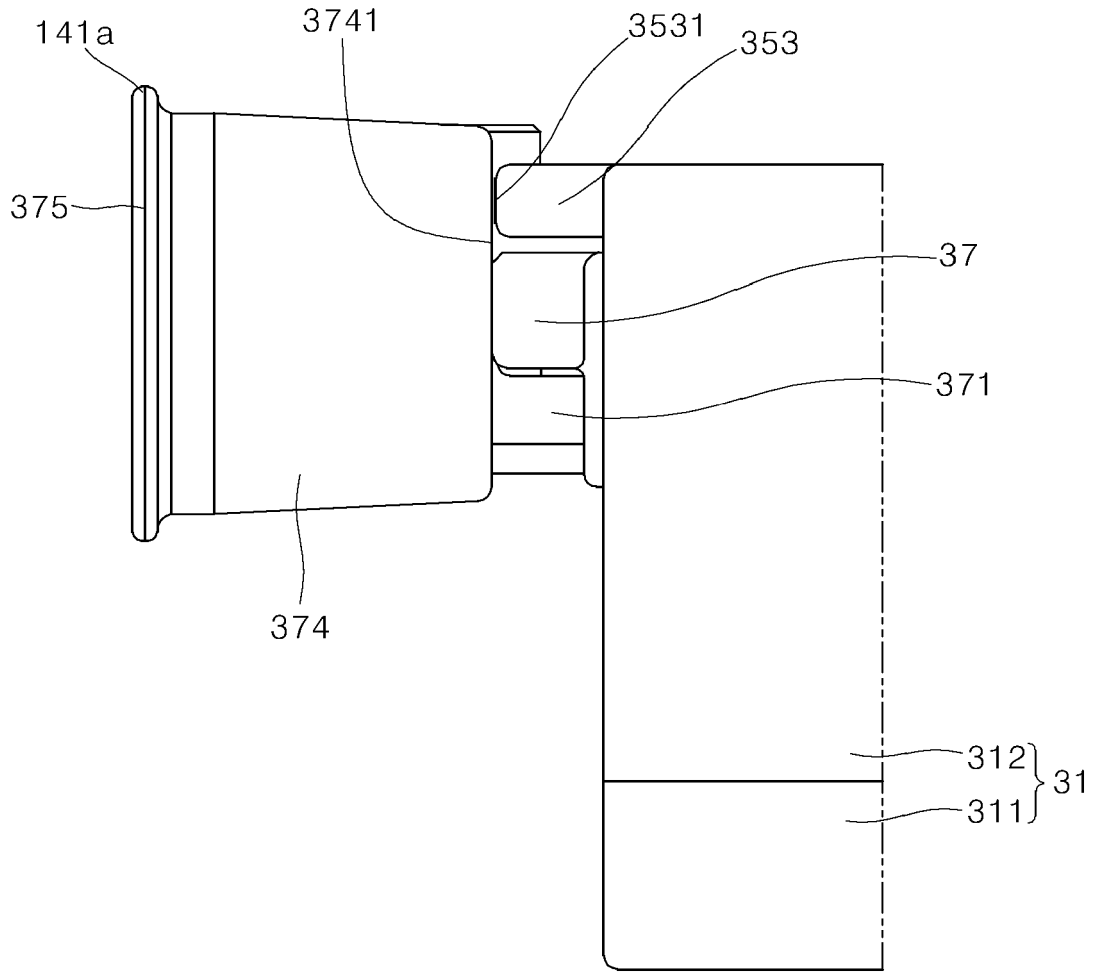

Fig. 13

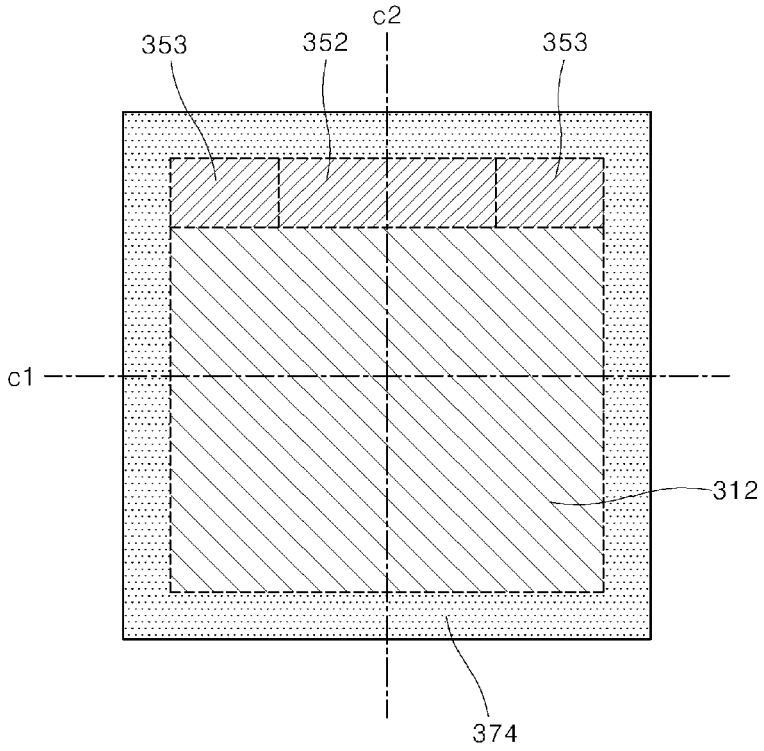

Fig. 14

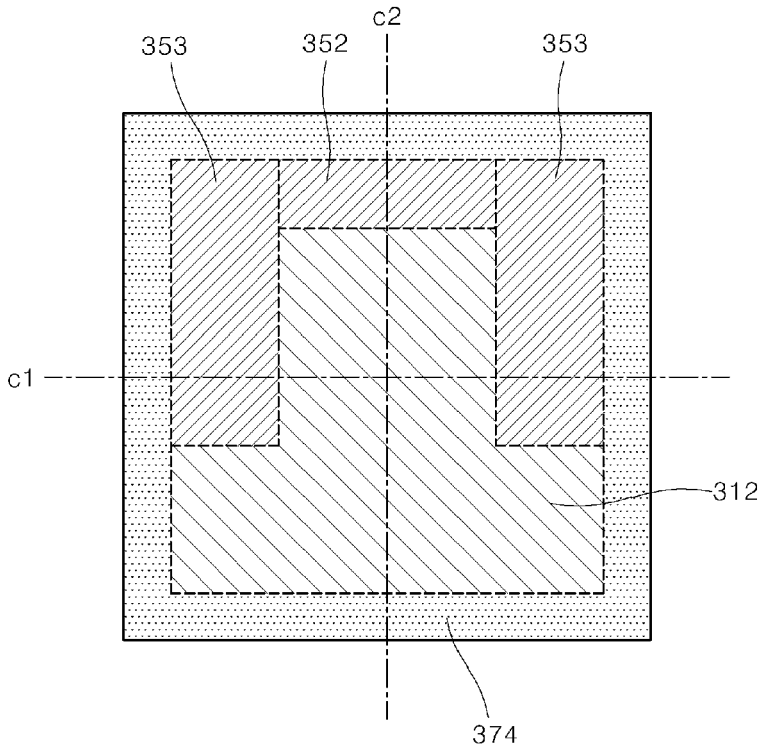

Fig. 15

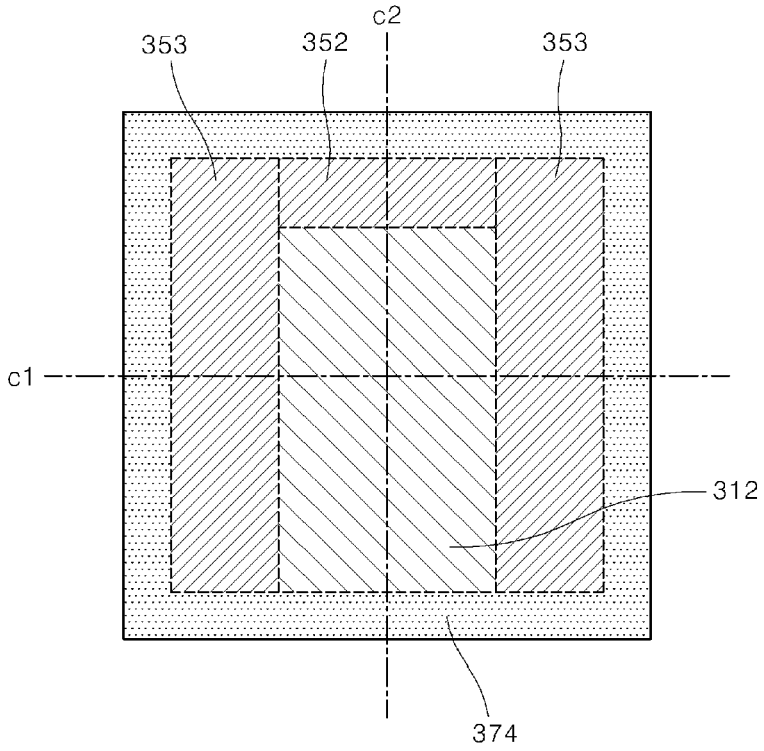

Fig. 16

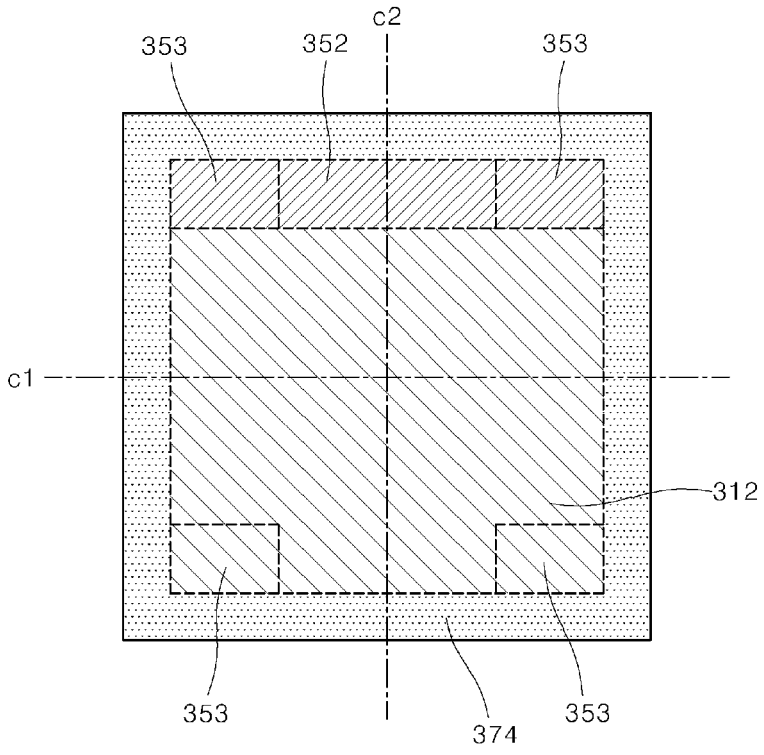

Fig. 17

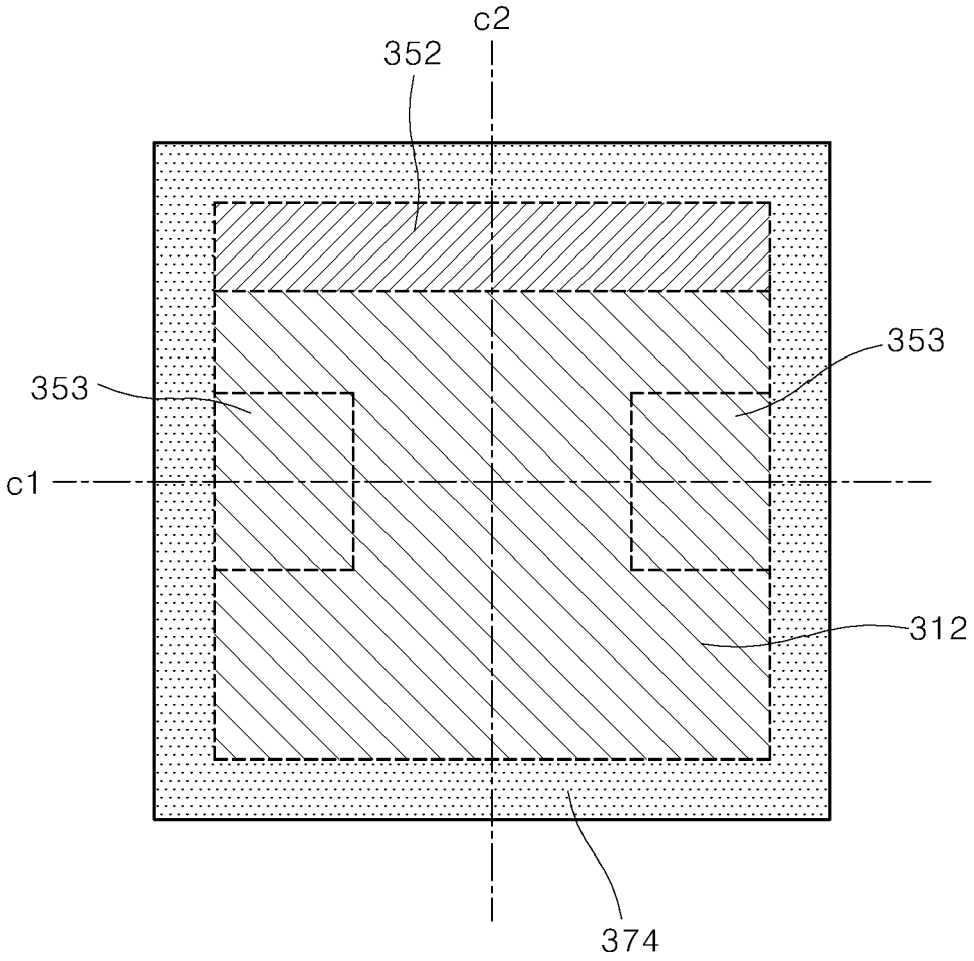

Fig. 18

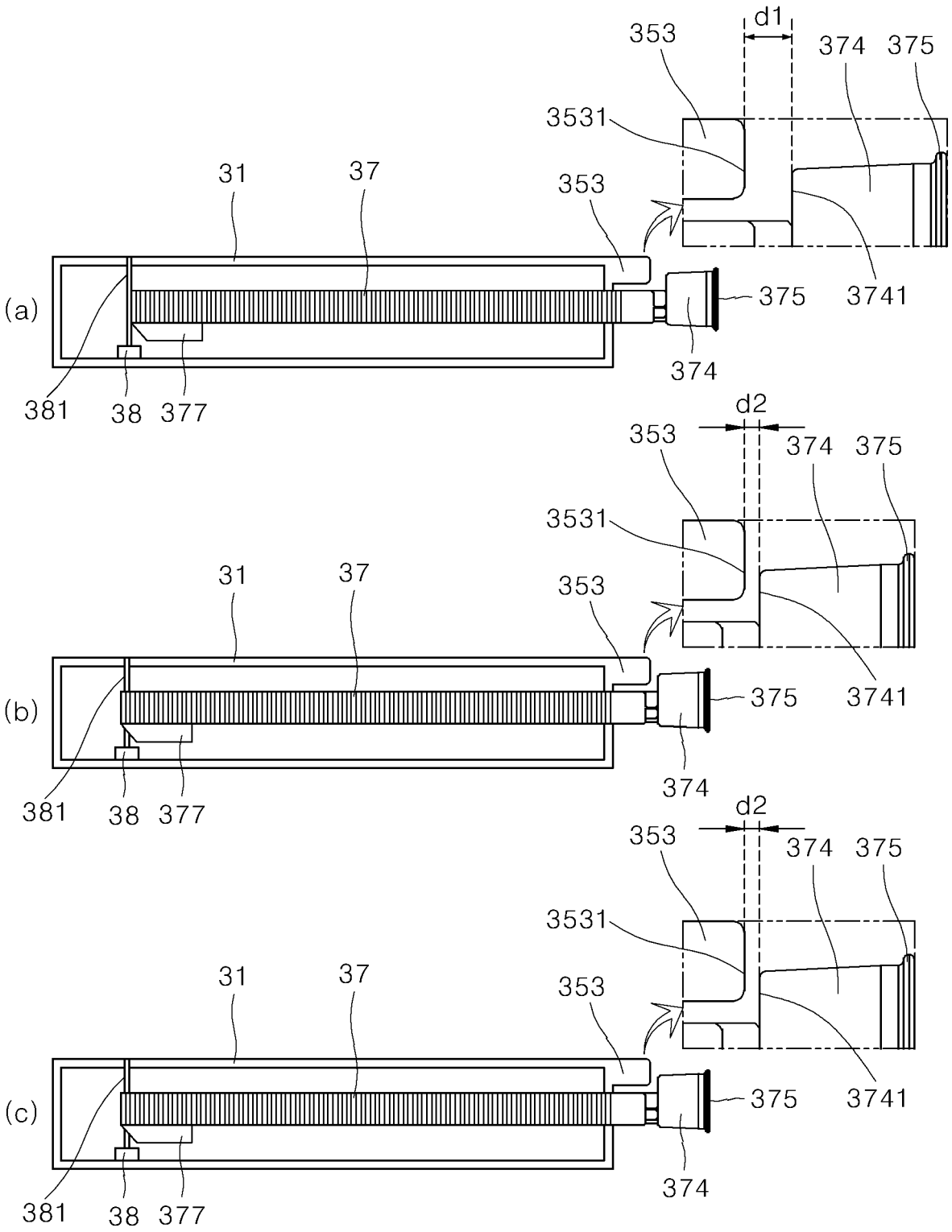
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Fig. 19

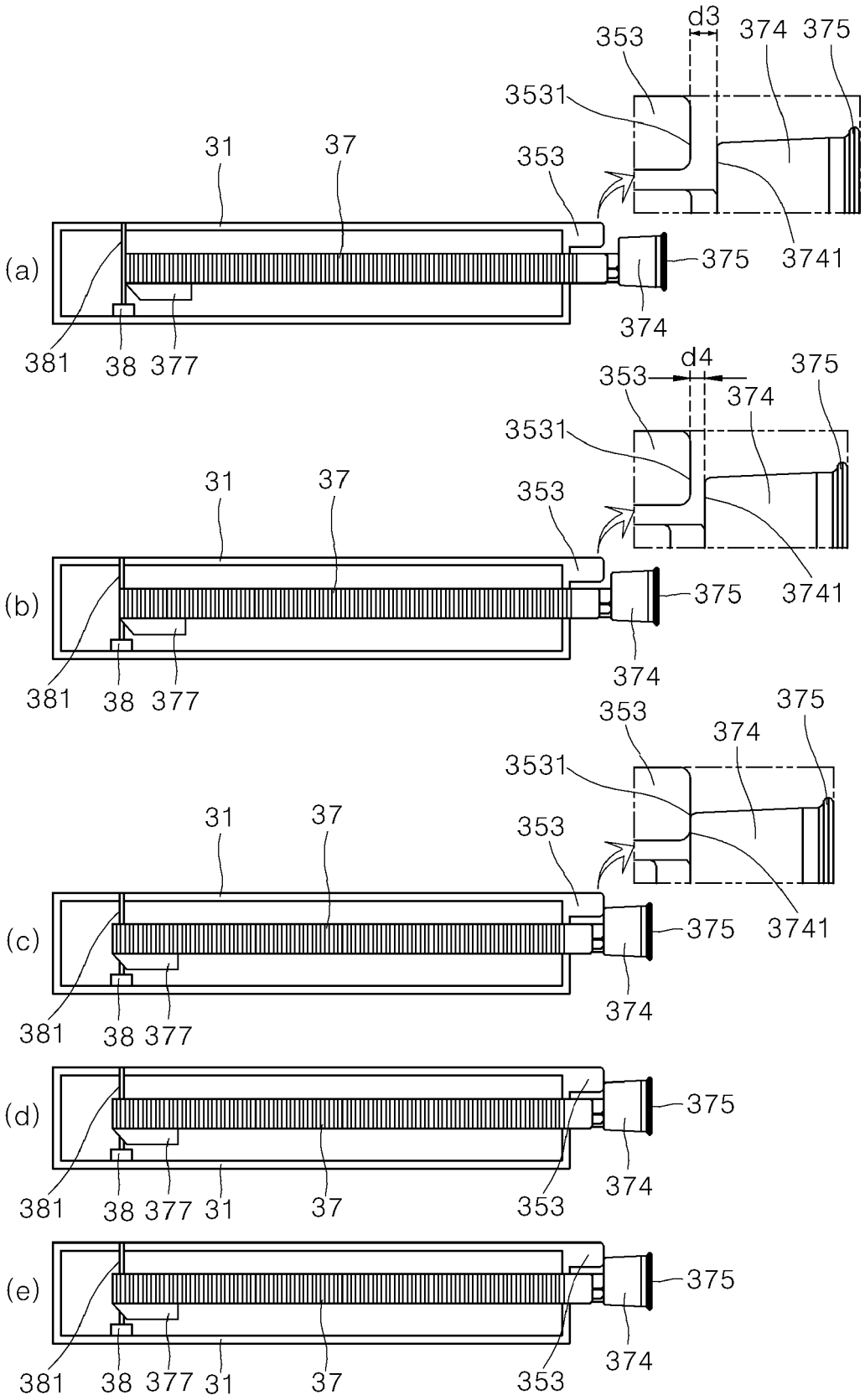
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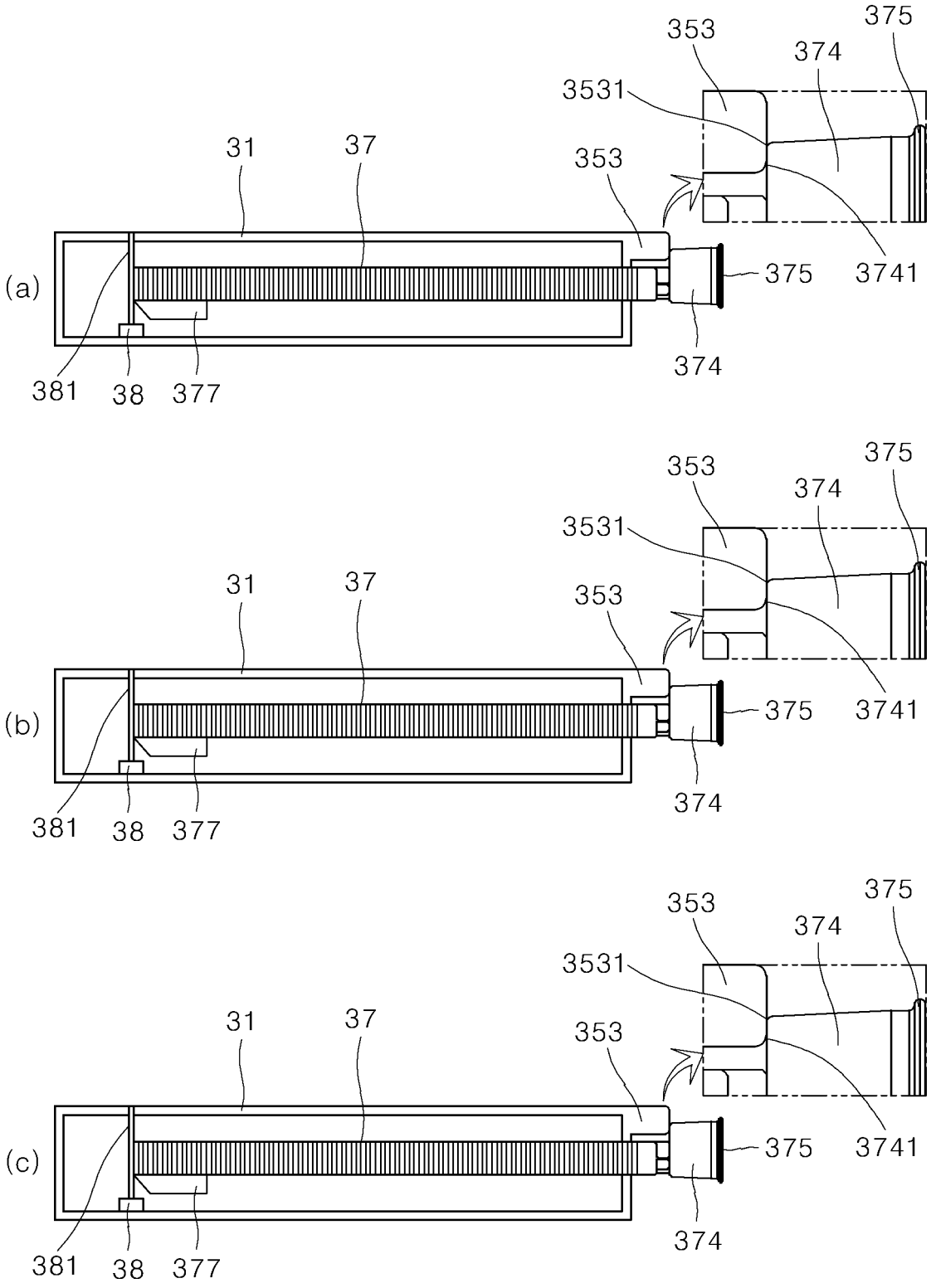
Fig. 20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EUROPEAN SEARCH REPORT

Application Number
EP 23 18 1827

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y A	US 2022/178194 A1 (GUNN TANNER DAVIS [US] ET AL) 9 June 2022 (2022-06-09) * the whole document *	1,5-11,13 2-4,12,14 15	INV. F25D17/04 F25D23/02
Y	US 2008/083243 A1 (LEE DONG HYUN [KR] ET AL) 10 April 2008 (2008-04-10) * the whole document *	2-4	
Y	US 11 029 078 B2 (LG ELECTRONICS INC [KR]) 8 June 2021 (2021-06-08) * the whole document *	12,14	
X	US 5 573 323 A (KIM MYOUNG W [KR] ET AL) 12 November 1996 (1996-11-12) * the whole document *	1,13	
A	US 2019/211603 A1 (SHIN JAEHOON [KR] ET AL) 11 July 2019 (2019-07-11) * the whole document *	10,11	
			TECHNICAL FIELDS SEARCHED (IPC)
A	US 2018/347892 A1 (KIM WOO-SUNG [KR] ET AL) 6 December 2018 (2018-12-06) * the whole document *	10,11	F25D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 November 2023	Kolev, Ivelin

CATEGORY OF CITED DOCUMENTS

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D : document cited in the application
L : document cited for other reasons

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